Species Composition, Distribution, Biology and Control of Flies of Veterinary Importance in Ethiopia

Compiled by
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This manual is targeted for veterinary professional working on the subject to create better understanding on external parasites of domestic animals in Ethiopia and equip with essential knowledge and skills on identification and control.
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National Animal Health Diagnostic and Investigation Center
Foreword

This technical manual entitled "Species composition, Distribution, Biology and control of flies of Veterinary importance in Ethiopia" is prepared with the objective of assisting professionals understand flies and related diseases, identify and control those flies having veterinary importance in animals agriculture in Ethiopia so that health and productivity of domestic animals would be improved. Flies of veterinary importance play a very destructive role in terms of depressing the productivity of cattle, sheep, goats and other domestic animals. They also seriously damage cattle hides and sheep and goat skins resulting in the rejection or downgrading of the hides and skins. Export earnings from this important commodity are, therefore, drastically reduced. The effects of wound producing flies on the skin and hide of ruminants can be reduced through prevention and treatment. In order to achieve this, basic knowledge on the biology, taxonomy, distribution and type of control methods to be used is very useful. The information in the manual is useful as a reference in the control of flies of veterinary importance by the producers, development (extension) agents (DAs), small holder farmers and pastoralists and field veterinarians. At this juncture, I would like to thank all those involved in the preparation and review of this technical manual.
Introduction

External parasitism results in poor quality sheep and goat products especially skins and lost income to producers. Common external parasites include ticks, lice, keds and mites, some of which feed on blood causing blood-loss anemia, especially in young animals resulting in unthriftiness and poor-performance of livestock. A regular program of treatment and prevention of veterinary important flies should be an important part of a flock health program. The benefits of an effective fly control program include increased comfort for animals, improved performance, and higher quality of products. This technical bulletin assesses the damage caused by biting and non-biting diseases carriers and vector flies and also the prevention, control and treatment measures to minimize the effects of these flies on livestock production and productivity.

Anatomy of insects

The body of most insects is divided in three different parts: head, thorax (meaning breast) and abdomen (meaning belly).

The head has complex eyes, a pair of antennae and various mouthparts. Based on mode of feeding, mouthparts of flies are adapted for piercing (e.g. biting, blood-sucking flies, fleas, mosquitoes, etc.), sucking (many other flies, butterflies, etc.) or chewing (e.g. crickets, wasps, etc.). The two antennae are movable sense organs usually in the front of the head, mainly olfactory or to detect movements.

The thorax has 3 segments, each one with a pair of legs. The wings are inserted in the first and the second segments. Some insects have two pair of wings (e.g. wasps, bees, butterflies, etc.), other insects have only one pair of wings (e.g. house flies, stable flies), and others don't have wings at all (e.g. lice, cockroaches, etc.).
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The abdomen has a variable number of segments, but neither legs nor wings but contains the reproductive organs, as well as parts of the digestive and excretory systems.

The body of insects is covered by a hard "skin" or shell called the exoskeleton or outer skeleton. It protects the body organs against mechanical pressure, desiccation and external pathogens, and offers attachment sites for the muscles. The exoskeleton is formed of various structures, one of which is the cuticle that contains chitin. Chitin is a special molecule responsible for the hardness of the cuticle that is specific for arthropods.

Insects are highly complex organisms despite their small size. They have digestive, nervous, excretory and respiratory systems. Instead of blood they have hemo-lymph that fills the main body cavity (called hemocoel) between the organs.

Biology of insects: metamorphosis and life cycle

All insects have a so-called indirect development in which they undergo a process called metamorphosis (a word of Greek origin meaning "form change") through which process they change their form several times along their developmental stages such as egg, larva, nymph or pupa, and adult (also called imago).

Some insects undergo a complete metamorphosis (they are called holometabolic), e.g. flies, beetles, butterflies, etc. Adult females lay eggs from which small larvae hatch that look like small worms and crawl around to find food. Larvae grow through a series of moults until they become mature (so-called stage-III larvae). Such mature larvae stop crawling and become pupae (the chrysalid of butterflies) that don't move. Inside the pupa the adult is formed that hatches out after several days. Adults don't moult and they don't grow anymore, among other reasons because the rigid exoskeleton makes it impossible.

Other insects undergo an incomplete metamorphosis (they are called hemimetabolic), e.g. cockroaches, lice, crickets, etc. Larvae don't look like small worms, but like small adults. These larvae moult several times and increase their size until they become nymphs. They don't go through the pupal stage. The nymphs moult lastly to become adults without going through the pupal stage. Nymphs look like smaller adults too, but they cannot reproduce.

Metamorphosis is regulated through two major hormones, ecdysone and juvenile hormone. Depending on the species, the whole life cycle may take less than a week to more than a year to be completed. Within each species, the duration of the life cycle strongly depends on environmental factors such as temperature and humidity as well as on the availability of food. Duration of the life cycle is a very important factor to be considered when establishing strategies for controlling a given parasite.

In some insect species the whole life cycle is completed on the host (e.g. lice). In many other species only adults or larvae are parasitic while the other stages live free in the environment (e.g. in the vegetation, in manure, in the soil, etc.) and do not cause any harm to their hosts. Biting flies, fleas,
mosquitoes cause damage to their hosts only as adults. Screwworms, flystrike, warble flies cause damage to their hosts only as larvae.

It is important to understand the life cycle of the parasites, because control measures consisting e.g. in applying insecticides on the host will affect more, less or not at all the stages in the environment that will continue attacking the host or producing infective stages.

Biology of insects: metamorphosis and life cycle

Types of insects that parasitize livestock and pets

Insects that are parasitic of livestock, dogs and pets belong mainly to the following groups of insects:

- **Diptera** (one pair of wings): flies, mosquitoes, gnats, midges, warble flies, screw worms, blow flies, sheep ked, etc.
- **Hemiptera** (two pairs of wings): bed bugs
- **Phthiraptera** (no wings): most lice
- **Siphonaptera** (no wings): fleas

Ticks and mites are not insects but **acari** (or **acarina**), although they too belong to the **arthropods**.

Harm to livestock (domestic animals) caused by parasitic insects

Many parasitic adult insects are blood sucking, i.e. they feed on the blood of their hosts which is their main food and absolutely necessary for them to survive and/or to produce eggs. This is the case for
biting flies, mosquitoes, midges, fleas, etc. Other parasitic adult insects do not suck blood (e.g. face flies lice) but feed on fluids in humid parts of the body (eyes, nose, mouth, udders, genital organs) or feed on skin or feather debris.

Larvae of some parasitic insects cause the so-called myiasis. The larvae feed on the host’s tissues, either from outside (e.g. screw worms and blow fly larvae) or feed themselves into the host’s body and migrate more or less inside while feeding (e.g. warble flies and botflies).

Harm to livestock or pets may come from painful biting and itching due to inflammation at the biting site or to allergic reactions (especially in pets) that cause scratching. Intense scratching may produce loss of hair, wool or feathers as well as skin wounds that can be infected with bacteria or other microorganisms, or attract other parasites (typically screwworms and other flies). Blood loss due to heavy infestations may also cause anemia and negatively affect livestock performance. Uncontrolled screw worms and blow fly larvae may literally devour their prays from the outside within days. Other myiasis caused by warble and bot flies may occasionally damage essential organs or just debilitate the hosts’ organism. Such harm often leads to substantial economic losses in livestock production. A very important harm of parasitic insects is disease transmission, since many parasitic insects are vectors of (i.e. they carry and transmit) microorganisms such as bacteria and viruses that are pathogenic for livestock or pets.

- In cattle, damaging insects with substantial economic impact are horn flies (worldwide, mainly range cattle), stable flies (worldwide, mainly for feedlots and dairy), tse-tse flies (in Africa), screw worms (Africa, Central and South America, Asia), Dermatobia hominis and lice (worldwide). Houseflies may be a significant problem in the dairy industry worldwide.
- In sheep, the most damaging insects with substantial economic impact are sheep keds and mites (mainly in Ethiopia) and lice (worldwide).
- In pigs, lice, stable flies and houseflies occur worldwide although damage is usually not as substantial as on cattle and sheep.
- In poultry, lice and houseflies can have a significant impact in productivity.
- In dogs and cats, the most harmful insects are fleas, lice, and mosquitoes that carry various diseases.

Flies affect livestock by causing discomfort, resulting in reduced production and transmitting infectious diseases and parasites.

Flies can be divided into:

A. Biting flies
Biology and Control of Flies

B. Nuisance flies
C. Flies where larval stages result in damage causing myiasis

Flies have a predilection for certain places on the body of their host

Biting flies

1) Horn flies
2) Stable flies
3) Tsetse flies
4) Horse flies
5) Sheep ked flies
   - Deer flies
   - Pangoniae
   - Haematopota

Nuisance flies

1) House flies
2) Face flies
3) Sheep head fly

Myiasis

Myiasis is the result of fly larvae infestations on animals that feed on dead and living tissue and secretions. The following are responsible for myiasis:

1) Screwworms
2) Warble flies or cattle grubs
3) Old world flesh fly
4) Blow flies
5) Sheep nasal bot flies

Stomoxys calcitrans

Identification

The stable fly, *Stomoxys calcitrans*, is 1/4-inch long with a pale spot behind the head, indistinct stripes on the thorax, and seven dark spots on the abdomen. The stable fly is similar in size and appearance to both the house fly and the face fly. Two important differences are the stable fly's biting habit and its
Biting mouthparts that stick out like a bayonet from the front of the head. An easy field identification tip is the stable fly's behavior of biting cattle (or people) on the lower legs. Since they inflict a very painful bite, stamping of the feet is a sign that stable flies are present and feeding.
Wing of *Stomoxys calcitrans*

Parts of the proboscis of *Stomoxys calcitrans*
Anterior end of a fly netted at a dairy

Stomoxys calcitrans

aristae

blood-sucking proboscis

eye

Upper view Stomoxys calcitrans

Side view Stomoxys calcitrans
Biology and Control of Flies

Head of a Stable Fly

Stomoxys calcitrans

Ventral part Stomoxys calcitrans

Stable Fly (Front Side Shot)

Engorged Stomoxys calcitrans

Stomoxys niger bilineatus

Stomoxys niger niger

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Morphology:

- Size is 5.5-7.5 mm. Color variable from light to dark grey.
- Poor longitudinal stripes on the thorax.
- Color of abdomen is grey, light or dark marking.
- Complex mouth part is present which is adopted for sponging.
- Mouth part is composed of Labrum, Labium, Maxilla, Mandibles and Hypopharynx. Maxilla and Mandibles are rudimentary.
- During feeding, mouth part is prominent.
- A pair of wings having veins is present. Veins are very helpful in differentiating different species of flies.
- Presence of sticky hair on pad like structures is the most important morphological feature which lies at the end of claw leg. Germs stick with this hair.

Biology, Habits and Life Cycle

Stable flies have piercing-sucking mouthparts used to puncture the skin and obtain blood. The flies perch with their heads pointed downward while feeding. Both male and female stable flies feed on blood. Each fly feeds several times per day, taking only a drop or two of blood at a time. Adult flies are common near barns, animal pens, and shade trees. They often bite while cattle are in the shade around a building or under a tree.

Female stable flies lay their eggs inside barns in such decaying organic matter as wet straw or manure-straw mixtures. Stable fly larvae also develop in other wet, decaying plant material such as spilled feed, silage, and grass clippings. Development from egg to adult requires about 3 weeks during warm weather and up to 9 weeks when temperatures are cooler. Stable flies overwinter as larvae or pupae in piles of larval breeding material.
Life Cycle of stable fly, *Stomoxys calcitrans*.

The lifecycle of the Stable fly is 4 weeks or more.

Although the stable fly has historically been a pest only of cattle housed in barns, it is becoming a pasture pest in operations where large hay bales are used. In such situations, larval development takes place in decaying hay at the base of improperly stored bales.
Economic Threshold

1) Stable flies are monitored by counting the flies on all four legs of about 15 animals. When the average number exceeds the treatment threshold of 10 flies per animal, control measures should be implemented. Stable fly feeding can cause a decline in production due to the animals' fatigue from trying to dislodge the flies. Heavy infestations of more than 50 flies per animal can reduce weight gain by 25 percent and milk production by 40 to 60 percent.

2) Hides can be substantially spoiled due to the numerous piercings of the skin during feeding.

3) Stable flies are vectors of serious livestock diseases such as various types of trypanosomiasis (Trypanosoma vivax and T. evansi), anthrax, brucellosis, African horse sickness and fowl pox. They seem to be able to mechanically transmit anaplasmosis, as well as a number of other livestock viral and bacterial diseases such as foot-and-mouth disease.

4) In addition, bite wounds can be sites for secondary infection. Stable flies feed mainly on the legs of cattle and horses. Since these pests leave an animal immediately after feeding they may go unnoticed unless heavy outbreaks occur.

They are inactive at night, roosting on fences, buildings, trees, and bushes.

Management Strategies

Integrated pest management for stable flies combines cultural manure management methods with the use of traps and biological control agents.

Cultural Control

Management of livestock waste is the first step in pest management. Since the stable fly can complete its life cycle in as little as 21 days, removal of wet manure at least weekly is necessary to break the breeding cycle. The manure can be spread to dry or added to a liquid manure pit. If a pit is used, be certain not to allow manure to accumulate above the water line, since this provides ideal conditions for fly development.

Wet straw should never be allowed to pile up in or near buildings. Moreover, since straw is one of the best fly breeding materials, it is not recommended as bedding. Coarse sawdust or shredded paper make excellent bedding materials and do not breed flies. Likewise, spilled feed should not be allowed to accumulate but should be cleaned up every 2 to 3 days.

Mechanical Control

Traps for adult flies can be useful in stable fly control programs if enough traps are used, they are placed correctly, and they are used both indoors and outdoors. Outdoors, stable flies are attracted to vertical white panels not more than 30 inches above the ground. Once attracted to the trap by a carbon dioxide producing bait, the flies can be trapped with sticky adhesive or killed with an electrocuting grid.
trap should be installed for every 20 to 30 feet of perimeter of fly breeding area. Recommended placement areas include near building entrances, in alleyways, beneath trees, and around animal sleeping areas and manure piles. Indoor fly traps of the ultraviolet light type kill flies with an electrocuting grid or trap them inside an inverted cone. One trap should be used for every 30 feet of wall.

**Biological Control**

The use of biological control agents in fly management programs is still at a relatively early stage. At present, parasitic wasps are the most widely used biological control agents for stable flies. A highly recommended parasitic wasp for livestock operations in the northeast is the species *Muscidafurax raptor*. Other species commonly sold through farm magazines have proven ineffective in some cases.

In addition to the parasites that occur naturally in a manure ecosystem, populations can be augmented by periodic releases of wasps purchased from a commercial insectaria. Because stable fly populations develop twice as fast as parasite populations, without supplemental releases there is a lag time of several weeks between numbers of flies and numbers of parasites. An early-season augmentative parasite release program can greatly increase the population of parasites. A parasite release program should begin in mid- to late May and continue through August. Research suggests that weekly releases of 200 parasites per cow can provide effective control. Parasitic wasps should not be used as the sole method of control. Their use should be combined with a program of manure management and trapping. If it becomes necessary to include the use of insecticides into a management program, only products that are not harmful to the parasites, such as baits and pyrethrin space sprays should be used.

**Control at Breeding Sites**

The most practical and economical method for reducing stable fly populations is the elimination or proper management of breeding sources. It is important to remember that flies cannot develop in dry materials.

**Stable flies breed in the following premises:**

1) Green Chop or Silage - The stable fly maggot thrives in decaying plant material, such as old silage in and around feed troughs and trench silos. Silage probably has a greater potential for producing stable flies than almost any other material found on today's farms.

2) Stable flies often become abundant around feedlots, dairy cattle loafing areas, and horse stables. They prefer sunny, outdoor conditions, although a few will enter buildings and breed there.

3) They are often found breeding in outdoor silage, decayed hay and piled manure mixed with bedding. Stable flies will also be found breeding indoors in dairy calf pens and outside in calf hutches where straw bedding is used.

4) Sometimes, stable flies are found inside in poultry manure containing spilled feed. However, the fly is primarily an outdoor pest, where it feeds actively on livestock.
5) It takes about 2–5 minutes for a fly to feed to engorgement. The feeding flies are most often found on the lower parts of animals, especially on the lower half of the legs. They will attack humans as readily as livestock.

6) Crop Residues - Unwanted crop residues, discarded in piles during harvest are frequently very important sources of fly breeding. This material should be spread thinly for quick drying.

7) Hay and Grain - Accumulations of hay where animals are fed in the fields decay rapidly when exposed to the elements and may produce flies in tremendous numbers. To prevent this source of fly breeding, cattle should be fed at a different place in the field each time so that accumulations of old hay do not occur. Spilled grain around feed troughs or storage bins likewise may provide the stable fly with a moist, favorable breeding medium and should be cleaned up immediately.

8) Animal Manures - When handled properly manure need not breed stable flies at all. It should not be allowed to accumulate for more than a week before spreading thinly on the fields, where quick drying eliminates stable fly breeding.

9) Stables - Proper care and management of waste feed and manure can greatly reduce or eliminate fly populations in these areas. Animals pens or kraals should be cleaned of droppings daily and the manure spread thinly (not more than 1-2 inches deep). The choice of bedding is also very important. Hay or straw absorbs urine and decomposes rapidly and unless it is changed every few days will produce flies by the thousands.

10) Other Sources - Any pile of moist, decaying organic matter should be considered a potential source of stable flies that can cause serious damage to farm animals.

Horn Fly Biology and Management
Of the many species of insects that feed on the blood of cattle, the horn fly, *Haematobia irritans*, is the most common fly pest. Other animals such as sheep, goats, horses, mules and dogs are also bothered. The horn fly's feeding activity causes anemia due to loss of blood, reduced weight gain, and a general weakening of the animals.

**Identification**

Horn flies are 3/16-inch long and dark gray in color. They resemble house flies but are half as large and have blood-sucking mouthparts. An easy way to identify horn flies in the field is by their habit of clustering around the horn bases or on the shoulders and backs of cattle. The flies often move to the animal's belly on extremely hot days or during rain storms. They will fly up in a swarm when disturbed but immediately return to the animal.
Both male and female horn flies are blood feeders. The flies feed in a head-downward position, holding their wings at a 45-degree angle to their bodies. Each fly feeds intermittently, 10 to 40 times a day for 10 to 25 minutes at a time. Such continual feeding causes the cattle considerable pain and aggravation.

**Biology, Habits and Life Cycle**

The image shows the life cycle of the horn fly, with stages including egg laying, larval development, and adult emergence.

**Haematobia irritans**

The life cycle of the horn fly is 3 weeks or more.

Adult horn flies spend their entire lives on cattle. Females leave only to lay their eggs in manure that is less than two minutes old. Their requirement of such fresh manure results in interesting egg-laying behavior. Adult flies remain on a host, even while not feeding. When the host defecates, gravid female flies quickly move to the fecal pat to lay their eggs. Hatching occurs within 24 hours and the resulting larvae move into the pat for food and protection. Several molts later, the larvae pupate in about 4 days and, provided the climate is favorable, adults emerge 6 days after that. (Horn flies may overwinter as pupae under unfavorable conditions).

Egg laying usually occurs in the early morning where each female fly lays up to 500 small, reddish brown eggs in clumps on grass and other vegetation under the manure. The eggs hatch in a few hours and maggots mature in 10 to 14 days. Horn fly maggots develop best in grass-type manure from cattle that are on pasture and poorly on the manure from cattle on concentrated feed.

Mature horn fly maggots transform to the pupal stage in or below the manure. Upon emergence from the pupal stage, the adult flies immediately seek out cattle to begin feeding.
Biology and Control of Flies

Damage

Horn flies are bloodsuckers and cause painful bites which can predispose them to screwworm attack and/or secondary bacterial infection. When in large numbers, cattle feed poorly due to the annoying biting behavior, leading to reduced milk and meat productivity. Addition, *Haematobia irritans* serve as intermediate hosts for the filariid nematode, *Stephanofilaria stilesi*, which itself produces a mild dermatitis to the midventral abdomen.

Economic Threshold

Horn flies are monitored by counting the number of flies on the heads, backs, and shoulders of at least 15 cattle. An average of more than 50 flies per side or 100 flies per animal is considered the "treatment threshold," or the number above which control measures may be required. The "economic injury level" is given as 200 flies per animal, since many experts estimate that fewer than this will not result in measurable economic loss.

In cases of heavy infestation, weight gain may be reduced by up to 0.5 pound per day. In one study, heifers not infested with horn flies gained an average of 20 pounds more than infested heifers over a 79-day test period. Loss from horn fly feeding is also apparent in lactating cows, where horn flies can reduce milk production by 10 to 20 percent.

Management Strategies

Because the horn fly breeds in fresh manure, such cultural control methods as cleanup of barnyard manure through manure management, used effectively against the house fly and the stable fly, are not practical.

Also, biological control methods that have been successful against other fly pests have not been developed for control of the horn fly. But, because horn flies stay on the animal all of the time, they are relatively easy to control with ear tags, dust bags, oilers, or nonchemical walk-through traps.

Biological Control

Biological control of the horn fly is limited at present to organisms that occur naturally in the field. The horn fly's immature stages (eggs, maggots, and pupae) are attacked by predaceous mites, predaceous beetles, and parasitic wasps. Methods of capitalizing on the presence of these naturally occurring biological control agents to augment pest management programs are presently unknown. The parasitic wasps released in management programs for the house fly and the stable fly are ineffective against horn flies.
Biology and Control of Flies

Dung beetles can limit horn fly populations by removing and burying the manure before the fly completes its development. In the United States, however, dung beetle populations have not increased in proportion to the increase in livestock production and the corresponding increase in dung pats. It is possible that the widespread use of certain dewormers and systemic insecticides in manure may be responsible. In recent years, several species of exotic dung-burying beetles have been introduced by USDA in efforts to implement biological control of dung-breeding flies. Unfortunately, the program has not yet reached the stage where individual producers are able to obtain and use dung beetles for horn fly control.

Mechanical Control

A walk-through fly trap, first proposed in the 1930s, is the most promising tool for on chemical horn fly control. The trap is placed where cattle must pass through it to obtain water or to access salt. The trap works on the inverted-cone principle, whereby insects are funneled in through a large opening and subsequently are unable to find an escape route through a small opening. As cattle enter the trap, strips of canvas brush along their backs and dislodge the flies. The flies are attracted to light, move toward the screened sides of the trap, and are unable to escape. Research indicates that use of such a trap can provide a 50 percent reduction in the number of horn flies in a herd.

Black Flies or Buffalo Gnats

Description

Adult black flies are small insects that measure 2 to 5 mm in length, and possess a shiny thorax which is strongly convex, giving them a humpbacked, gnat-like appearance. Color ranges from black to various shades of gray or yellow. Adults also have broad clear wings without hairs or scales, heavy veins near the anterior wing margin, a short 11 segmented antennae, and large round eyes (no simple eyes).
Biology and Control of Flies

Host

Simuliidae is a small family of blood sucking flies commonly known as black flies or buffalo gnats. Even though they may appear to be identical, they often live in different habitats and do not interbreed. Black flies have not been studied in Ethiopia, but it appears we should have perhaps a dozen species. Most of these are in the genus *Simulium*.

Symptoms

Humans as well as domestic animals may be viciously attacked. The extreme pain, itching, and the resultant local swellings, together with occasional severe complications, indicate the presence of an active allergen. In some individuals, the face, arms, and other exposed parts may be greatly swollen as a result of the bites; in others, effects other than blood loss may scarcely be noticeable. Livestock and poultry are sometimes killed by large numbers of black flies. Death seems, in most cases, to be the consequence of a toxemia caused by the bites or the result of an anaphylactic shock; although debility resulting from blood loss and suffocation brought about by inhalation of the flies is apparently a contributing cause. In addition, certain species are known to transmit leucocytozoon, microfilaria, and trypanosome infections in poultry.

Life Cycle

Egg laying habits vary with the species, but all lay their eggs in running water. Some lay in masses on plants trailing in the water, others drop the eggs singly into streams, while others lay their eggs in long strings. Each female will lay from 150-450 eggs. The eggs are white to orange when laid and darken before hatching. Hatching in species with several generations per year can take from 4 to 30 days depending on species and temperature. Species with one generation per year often enter diapause in the egg stage, so hatching can take as long as 7 months.

Larvae occur only in running water. Some species are found in clear mountain streams, some in temporary streams, some in rivers, and some only around springs or reservoir outlets. Some species breed successfully in irrigation ditches. Larvae are usually brown, gray, or black in color with a light brown head. They are somewhat club shaped and have a prominent pair of mouth brushes with which they gather food. They feed on small organisms and detritus found in the water. Larvae attach to stones, vegetation, and other objects by means of a sucker-like disc at the end of the abdomen. The larval period may be as short as 2 weeks in late spring or may extend from October into early spring in species that overwinter as larvae, but larval development only occurs when there is running water or sufficient movement to accelerate oxygenation of the water.

Pupation takes place on rocks or other objects in the water. Each larva spins a basket-shaped cocoon open at the downstream end in which to change to an adult. The pupal period lasts only 2-6 days in some species and up to 3 or 4 weeks in others.
Biology and Control of Flies

When the adult emerges, it floats to the surface in a bubble of air and quickly flies away. Mating occurs in swarms in many species but on the ground near the emergence site in others. Both males and females feed on nectar and the females of most species also require a blood meal for development of the eggs. Some species feed mostly on birds while others prefer to feed on mammals.

Adults are often found several miles from the nearest known breeding area. They are commonly reported to move 7-15 miles and wind-aided migration of 90-150 miles have been reported in some cases.

Eggs
- Laid in a mass of 200-500 eggs
- Laid in or on with flowing water
- Direct hatching occurs in 4-30 days
- Eggs of some species may diapause

Adult
- (5-15 mm long)
- Males and females emerge in late spring-early summer
- Males and females feed on nectar and male males die
- Females feed on blood and develop an egg mass

Larvae
- (Last stage >5-15 mm long)
- Develop in flowing water
- 4-9 larval stages usually 7
- Larval period 1 month to 6 months

Pupa
- (5-15 mm long)
- Pupal stage completed in 4-7 days

Damage

Black flies have preferences for a wide range of individual host species. Adult females feed on the blood of humans, cattle, horses, sheep, goats, poultry, other livestock and wild mammals and birds. Each black fly species may prefer one type of host over another. The black fly common name sometimes indicates host specificity, for example the turkey gnat. Black flies are daytime biters preferring low wind conditions. They are not restricted to shaded or humid sites, and usually do not go indoors. They are attracted to hosts from a distance by smell, heat, and by sight. The female flies swarm around and crawl on the host preferring the head, hair, and ears as well as any skin that is exposed or that they can crawl over. They feed on the host every 48-72 hours,女士 usually feeding once to twice a week. Discomfort and irritation are caused by the bites and may persist up to 24 hours. In some individuals, the reaction is severe and can cause an allergic reaction and anaphylactic shock, which is a life-threatening medical emergency. The severity of the reaction can vary from person to person.
onto. *S. slossonae* is primarily a bird feeder and probably preys on wild turkeys to some extent. It is the primary vector of the protozoan blood parasite, *Leucocytozoon*. This parasite is restricted only to birds, especially turkeys. *S. slossonae* will feed on domestic turkeys as well as chickens and other poultry.

Female black flies are blood feeders whose bites can itch and persist for several days. The flies bite by cutting into the skin and feeding on the pool of blood that forms in the hole they make. Anticoagulants injected into the feeding site by black flies can cause mild to severe allergic reactions in sensitive individuals. Strong reactions include fever, nausea and allergic dermatitis. Large black fly populations and strong bite reactions can be life threatening and have been reported to kill domestic animals. Black fly bites are very painful because of the hole that is cut in the skin, the anticoagulants and other materials that are injected, and the immunological differences between insect and hosts' tissues.

**Face Fly, *Musca autumnalis***

Although the face fly, *Musca autumnalis*, is nonbiting, it is nonetheless a troublesome pest of cattle. The face fly’s feeding activities, normally on secretions of the animal’s eye and nose, often result in both annoyance to the animal and transmission of disease.

**Identification**

Face flies are 3/8-inch long, slightly larger than the house fly. A female face fly is slightly darker than a female house fly, but is otherwise almost identical. The male face fly’s abdomen is orange with a black band down the center. The puparium or pupal case of the face fly is unusual in that it is white. An easy field identification characteristic is that face flies congregate in clusters of 20 to 100 on the faces of cattle.
Biology and Control of Flies

Musca autumnalis

Biology, Habits and Life Cycle

Only the female face fly is a pest of livestock. Males spend their time perched on vegetation, awaiting mates. The males feed on plant nectar and on the liquid secretions of dung. Females feed on protein contained in eye secretions, nasal secretions, and saliva, not on blood. They feed only during the daytime, resting on fence posts or vegetation at night.

While the fly is feeding, the roughness of its sponging mouthparts irritates the cow's eye and increases tear production. Face fly feeding can transmit bacteria to the eye, increasing the likelihood of bovine pinkeye and Thelazia eye worms.

The lifecycle for the face fly is about 14-21 days long.

In addition to feeding on facial secretions, face flies are sometimes facultative blood feeders. This means that although they don't bite cattle to obtain blood, they will feed on blood that oozes from scratches and other mechanical wounds. The female face fly lays her eggs only in recently deposited (less than 15 minutes old) manure from grass-fed cattle. They do not lay eggs in manure piles around barns or in the trampled manure associated with feedlots.
Face fly larvae, or maggots, develop under the crust of the manure pat. When they reach maturity, they move into the soil next to the manure to complete their transformation to the pupal stage. The flies emerge as adults about a week later. Development from egg to adult requires from two to three weeks. The face fly is active from early spring through late autumn. Although face flies prefer bright sunlight and do not enter buildings during the summer, in the fall adult face flies often seek out hibernation places inside structures.

**Economic Threshold**

The treatment threshold for face flies is five flies per animal. A population of 12 to 14 flies per animal will result in a decrease in grazing by about one hour per day. Twenty to 200 flies per animal is considered a heavy population. Heavy face fly populations can cause cattle to stop feeding and move into a shady location to escape the flies, resulting in reduced animal production. Dairy cattle will cluster together to reduce face fly attack, thereby increasing heat stress and reducing milk production. The face-fly (*Musca autumnalis*) is considered to be the major transmitter of infectious keratoconjunctivitis (bovine enzootic keratitis, pinkeye), a disease of cattle caused by *Moraxella bovis*.

**Deer Flies, *Chrysops* species**

**Identification**

Deer flies are moderate-sized biting flies with a pattern in the wing. They are larger than a house fly but smaller than most horse flies. Most common species are gray or light brown, sometimes with patterned bodies and wings with large colored eyes. They can bite human, pets, and livestock. Deer flies are day biters, produce a painful bite, and frequently draw blood in the process.

Deer flies are similar to horse flies but smaller in size ranging from 12-25mm in length. Deer flies are black with yellow-green markings on the thorax and abdomen. Their eyes are bright green or gold with patterns and their wings have a distinctive brownish-black pattern.
Head of a Deer Fly (*Chrysops relictus*), a bloodsucking insect with piercing mouthparts and iridescent compound eyes

**Description**

Adult *chryspos spp* are medium to large (up to 2.5 cm in length) biting flies. They are generally dark in color, but some may have stripes or patches of color on the abdomen or thorax, while others may appear greenish or nearly white. They have large heads and compound eyes which project beyond the thorax on both sides. Their antennae are relatively short and stout with three segments and no arista. Mouthparts of female flies are blade-like and used for piercing. By contrast, the male flies have no mandibles and therefore cannot feed on blood. Instead, they feed on plant juices. *Tetanus* is larger and darker than...
Chrisoms. Usually, the two genera can be distinguished by the coloration of their wings; Tetanus flies have clear or brownish wings, while most species of Chrisoms have spots or a dark band running through the middle of their wings.

Life Cycle

Eggs: are laid in masses ranging from 100 to 1000 eggs. Eggs are laid in layers on a vertical surface such as overhanging foliage, projecting rocks, sticks and aquatic vegetation. Aquatic vegetation is most preferred. A shiny or chalky secretion, which aids in water protection, often covers eggs. The vertical
surfaces on which the eggs are deposited are always directly over water and wet ground favorable to the
development of larvae. The female will not deposit egg masses on vegetation that is too dense. Eggs are
initially a creamy white color but soon darken to gray and black. Eggs are cylindrical in shape and
measure from 1 to 2.5 mm in length. Eggs hatch in five to seven days, depending upon ambient weather
conditions, and the larvae fall to the moist soil and water below.

Larvae: use a hatching spine to break out of the egg case. The larvae are aquatic, semi-aquatic or
terrestrial. Chrysops spp. Are termed "hydrations" and are found in areas with high water content.

Tetanus species prefer dryer substrates and are "hemi-hydrations". The larvae taper at each end and are
usually whitish in color, but also can be brownish or green depending on the species. Black bands are
found around each segment of the body in many species. The larva breathes through a tracheal siphon
located at their posterior end. The larva has a small head and 11 to 12 additional segments. Larvae pass
through six to nine stadia. The time spent in the larval stage can last from a few months to a year. The
larvae of Chrysops feed upon organic matter in the soil. Tabanus spp. feed upon insect larvae,
crustaceans, and earthworms. Even though the Tabanus species are considered to be carnivorous and
cannibalistic, reports of as many as 120 larvae per square yard have been found. The larva moves into
the upper 2.5 to 5.0 cm of the soil, where it is drier, when it is ready to pupate. Within two days after
moving to the surface the pupal stage is reached.

Pupa: are brown colored, rounded anteriorily, tapering posteriorily, and have leg and wing cases
attached to the body. There is a row of spines encircling each abdominal segment. A pupal "aster"
consisting of six pointed projections is located at the apex of the abdomen. The pupal stage generally
lasts from two to three weeks.
Adult: fly emerges from the pupal case via a slit located along the thorax of the case. In most species the males emerge before the females. After emergence of both sexes, the flies mate. Mating starts with the male pursuing the female. Mating is initiated in the air and completed on the ground. The female then deposit an egg mass and is ready to seek a host. Adult Tabanidae are large flies with broad bodies and bulging eyes. The males are easily differentiated from female flies because eyes are contiguous in the males and widely separated in the females. The antennae are three segmented. The thorax and abdomen are covered with fine hairs. Deer flies range in length from 7 to 10 mm while horse flies are from 10 to 25 mm. The deer flies are yellow to black, have stripes on the abdomen, and possess mottled wings with dark patches. Yellow flies are yellowish with the same body shape of deer flies, but have dark purple to black eyes marked with fluorescent green lines. Horse flies are black to dark brown with green or black eyes. Adult deer flies have apical spurs on the hind tibiae that are not present in horse flies.
Eyes and wing of Deer flies

- styliate antennae
- head hemispherical

Tabanidae
Adult female deer fly, *Chrysops pikei* Whitney

*Chrysops caecutiens* Female

*Chrysops caecutiens*

*Chrysops viduatus*

*Chrysops viduatus*

*Chrysops cf. flavidus - Chrysops ♀*
Biology and Control of Flies

deer fly - *Chrysops ater*

Biting fly - *Chrysops excitans* - ♀

Deer Fly - *Chrysops cincticornis* - ♀

Deer Fly - *Chrysops frigidus* - ♀

*Chrysops indus* - ♀

*Chrysops fulvistigma* - ♀
Biology and Control of Flies

Deer Fly - *Chrysops geminatus* - ♂

*Chrysops discalis*

Deer Fly - *Chrysops shermani* - ♀

*Chrysops dimmocki*

*Chrysops fuliginosus* - ♀

*Chrysops flavidus* - ♀
Deer Fly - *Chrysops macquarti* - ♀

*Chrysops caecutiens* - ♀

*Chrysops vittatus* - ♀

Deer Fly - *Chrysops cincticornis* - ♀

*Chrysops caecutiens*: mâle

*Chrysops caecutiens*: female
Chrysops relictus, male

Deer Fly - Chrysops aberrans - ♀

Chrysops viduatus female

Chrysops atar

Chrysops callidus
Biology and Control of Flies

Chrysops indus
Chrysops pikei
Chrysops calvus
Chrysops niger
Chrysops reicherti
Chrysops sackeni
Larvae are large maggots usually in slow moving water where they feed on organic matter. Adult flies can be found around lakes and ponds. However, they are also a pest of livestock in rangeland where the adults like to roost in cedar trees.
They lay eggs on grasses and other aquatic vegetation around the edge of small ponds and other permanent standing water. The larvae develop within the mud and plant matter around the edge of the pond, feeding on decaying organic matter and small invertebrates.

Deer flies have a one year life cycle. Adults are present for two to three weeks. They rest on shrubbery or tall grass when not mating and feeding.

The summarized life cycle of deer flies begins with the emergence of adults from late spring into summer, depending on the species. Upon becoming active, adults of both sexes feed on energy-rich sugars in nectar, plant sap, or honey dew produced by sap-sucking insects such as aphids and scale insects. Mating of the few species of that has been observed takes place in flight. Females of some species are capable of developing an initial batch of eggs without taking a blood meal (autogeny); otherwise, blood is required for the development of eggs. Females search for a place to lay a single mass of eggs consisting of 100-800 eggs, depending on the species. Egg masses of most species that have been studied are laid on the underside of leaves or along the stems of emergent vegetation growing in wetlands. Hatching occurs in approximately 2-3 days and newly emerged larvae drop down into water or saturated soil in which they feed and develop.
Biology and Control of Flies

The sites in which deer fly larvae develop are aquatic habitats, including marshes, ponds, and streams. Developmental sites of horse fly larvae are more varied. Larvae of most species are found in freshwater and saltwater marshes, some in streams, some in moist forest soils, and a few in moist decomposing wood.

The larval stages of deer flies range in number from 6-13, depending on the species. The last larval stage passes through winter in the site in which it developed and molts into a pupa the following spring. Most species complete one generation per year. However, small species of deer flies can complete 2-3 generations per year to complete larval development.

Damage

Deer flies lie in wait in shady areas under bushes and trees for a host to happen by. Sight is the main host finding mechanism, but carbon dioxide and odor also play a role. Moving objects, especially if dark colored, are most prone to attack. Attacks occur during daylight hours with a peak beginning at sunrise and lasting three hours. A second peak is two hours before sunset and commences shortly after. Attack frequency is low on overcast days or at temperatures below 22 and above 32 °C. On livestock, biting occurs on the abdomen, legs, and neck. These tabanids inflict deep wounds that cause a flow of blood. The mandibles and maxillae penetrate the skin in a scissor-like action. Anticoagulants in the saliva are pumped into the wound and the blood is ingested through the sponging labella. Pathogens may be transmitted from flies that are disturbed while feeding on one animal and begin feeding on another. It is known that deer flies can mechanically vector Tularemia and Loa loa. Fly attacks result in lowered gains and low milk production in livestock animals. It is not uncommon to see as many as 100 flies feeding on an animal at one time. Twenty to thirty flies feeding for six hours are capable of taking 100 cc of blood.

Control

There are no chemical controls for deer fly larvae, which develop in mud around edges of ponds and small streams. However, breeding can be suppressed by removing vegetation around pond edges to inhibit egg laying. To control adults, direct insecticides application at shrubbery and other resting sites is recommended.

Deer flies may also be trapped. The "Manitoba trap" uses a dark, heat absorbing body to attract these insects, which then are directed into a cone where they are trapped. A typical design for such a trap includes a dark painted beach ball or similar object suspended under a cone. The addition of small amounts of carbon dioxide around the trap can further increase the attractiveness of the trap.
House Fly Biology and Management

House flies are well-known cosmopolitan pests of both farm and homestead. Not only are they a nuisance, but they also can transport disease-causing microorganisms. Thus, large populations of flies are a potential threat to the health of animal and man.

Identification

The adult house fly, *Musca domestica*, is 1/4-inch long and light gray, with four dark lengthwise stripes on the thorax, pale yellow sides on the abdomen, and reddish eyes. House fly maggots are 3/8-inch long, creamy white, and spindle-shaped.

In anterior view, the head is dominated by two large compound eyes, purple-brown in color, which occupy each side of the head. The surface of each eye is divided into about 4,000 facets, each an irregular hexagonal shape. Each facet is a visual unit so that the fly perceives a mosaic of a scene.

At the top of the head (vertex), between the compound eyes, are three simple eyes (ocelli), arranged in a triangle. Lower on the head between the eyes is the one pair of antennae partially set in a depression.

The area above the bases of the antennae and below the ocelli is very narrow in male flies and relatively wide in females. Therefore, in males the compound eyes appear to be set close together (holoptic) while in females they appear to be set far apart (dichoptic).

The antennae are important sensory structures used to detect air movement and odors.
Among the olfactory receptors are sensilla located in several pits which lie ventrally on the basal one-third of the third segment of the antenna.

The antenna is three-segmented with a branched arista projecting dorsally from the third segment.

(wing vein 4 bends upward to join costa near vein 3)
Musca domestica.
Biology, Habits, and Life Cycle

The house fly is a non-biting fly belonging to a group of flies known as filth flies. This name comes from the female flies' habit of laying their eggs in various types of moist, decaying organic materials. House flies prefer to breed in either manure or garbage. Each female fly lays up to 500 eggs in several batches of about 150 each over a three to four day period. House fly maggots feed on and develop in the material where the eggs are laid. When the maggots are full grown, they crawl to a drier region of the breeding material and transform to the pupal stage.

Female housefly mates about 36 hours after emerging from the pup and must feed after copulating for egg development. Egg laying (oviposition) begins four to 20 days after mating.

The housefly has a complete metamorphosis with distinct egg, larva or maggot, pupal and adult stages. The house fly overwinters in either the larval or pupal stage under manure piles or in other protected locations. Warm summer conditions are generally optimum for the development of the house fly, and it can complete its life cycle in as little as seven to ten days and as many as 10 to 12 generations may occur in one summer. Each female lays batches of 100-150 eggs over a 3-4 day period. If temperatures are high, eggs may hatch within 7.5 hours, otherwise it may take 1-2 days for them to hatch. The eggs hatch into maggots and feed on the organic material in which they find themselves. The larvae go through
three moults before they stop feeding and burrow for protection in dry surrounding areas, where they pupate.

Adults mate within one or two days following emergence from their pupal cases. The entire life cycle can be completed in as little as a week, though more commonly the life cycle takes up to three weeks for completion.

During the warmer months the life span of the house fly is 2 1/2 weeks but during the cooler months they overwinter in protected locations in the larval or pupal stage.

**Egg:** the white eggs, about 1.2 mm in length, are laid singly but pile up in small masses. Each female fly can lay up to 500 eggs in several batches of about 75 to 150 eggs, each over a three to four day period. The number of eggs produced is a function of female size, which is principally a result of larval nutrition.

**Larva:** the mature larva is 3 to 9 mm long, typical creamy whitish in color, cylindrical but tapering toward the head. The head contains one pair of dark hooks. The posterior spiracles are slightly raised and the spiracular openings are sinuous slits which are completely surrounded by an oval black border. The legless maggots emerge from the eggs in warm weather within eight to 20 hours, and they immediately feed on and develop in the material where the eggs were laid. The full-grown maggots have a greasy, cream-colored appearance and are 8 to 12 mm long. The larvae go through three instars. When the maggots are full-grown, they crawl up to 50 feet to a dried, cool place near breeding material and transform to the pupal stage. High manure moisture favors the survival of house fly larvae.

**Pupa:** the pupae are dark brown and 8 mm long. The pupal stage is passed in a pupal case formed from the last larval skin which varies in color from yellow, red, brown, to black as the pupa ages. The emerging fly escapes from the pupal case through the use of an alternately swelling and shrinking sac, called the ptilinum, on the front of its head which it uses like a pneumatic hammer.

**Adult:** the adult house fly is 6 to 7 mm long, with the female usually larger than the male. The eyes are reddish and the mouth parts are sponging. The thorax bears four narrow black stripes and there is a sharp upward bend in the fourth longitudinal wing vein. The abdomen is gray or yellowish with dark midline and irregular dark markings on the sides. The underside of the male is yellowish. The sexes can be readily separated by noting the space between the eyes, which in females is almost twice as broad as in males.

Adults suck liquids containing sweet or decaying substances. Larvae feed on moist food rich in organic matter. Although they are attracted to a variety of food material, house flies have mouth parts which allow them to ingest only liquid materials. Solid materials are liquified by means of regurgitated saliva.

The house fly overwinters in either the larval or pupal stage under manure piles or in other protected locations. The life cycle from egg to adult requires as little as seven to 10 days. House flies are active in
the Northeast from May through October with the largest populations occurring during July, August, and September.

The lifecycle of the house fly is about 10-14 days long.

**Economic Threshold**

House flies are monitored with baited traps, sticky ribbons, or spot cards. Spot cards are 3-inch by 5-inch white index cards attached to fly resting surfaces. Cards have some advantages over the other monitoring methods in that they are nontoxic, inexpensive, and can be filed away for a permanent record of fly activity. A minimum of five cards should be placed in each animal facility and left in place for seven days. A count of 100 or more fecal or vomit spots per card per week indicates a high level of fly activity and a need for control.

**Pathogenesis**

1) It causes restlessness to livestock and human beings.
2) Flies are mechanical vectors of all kinds of pathogens and contaminants: virus, bacteria and other microbes. More than 100 diseases and contaminants have been reported to be potentially transmitted by houseflies, e.g. *Salmonella*, anthrax, mastitis, conjunctivitis, cholera, botulism, tuberculosis, Newcastle disease, *Giardia*, etc. Houseflies can also transmit viable eggs of various parasitic worms (e.g. *Ascaris* spp).
3) *Habronema* (parasite) and *Relletenia* (worm) eggs are also transmitted by flies.
4) *Parafilaria bovicola* is also transmitted by these flies.
5) *Mosca autumnalis* feed on lacrimal and nasal secretions and are responsible for transmission of eye worm (*thelazia*) which causes Pink eye disease.
Being a "mechanical vector" the microbes do not spend part of their life cycle inside the fly’s organism, as it happens with many other microorganisms. Houseflies simply transport them from one place to another one sticking to their mouthparts or their legs.

Houseflies can be a serious issue for livestock operations that have become too close to newly developed peri-urban residential areas. Legal suits due to fly nuisance can have a significant economic impact for producers.

Management Strategies

Integrated pest management for house flies combines cultural manure management methods with the use of traps and biological control agents.

Cultural Control

House fly management begins with removing the maggots’ food source. Management of livestock waste is therefore the first step in a pest management program. Since the house fly can complete its life cycle in as little as seven days, removal of wet manure at least twice a week is necessary to break the breeding cycle. The manure can be spread to dry or added to a liquid manure pit. If a pit is used, care should be taken not to allow any manure to accumulate above the water line as this provides ideal conditions for fly development.

Wet straw should not be allowed to pile up in or near buildings. Since straw is one of the best fly breeding materials, it is not recommended as bedding. Coarse sawdust or shredded paper make suitable bedding materials and do not breed flies. Spilled feed should not be allowed accumulate but should be cleaned up every two to three days.

Mechanical Control

Traps for adult flies can be useful in house fly control programs if enough traps are used, if they are placed correctly, and if they are used both indoors and outdoors. House flies are attracted to white surfaces and to bait that give off odors. Thus, cone- or pyramid-shaped traps covered with white freezer paper and coated with sticky adhesive are usually effective. Such traps can be baited with a mixture of molasses, water, grain, and milk. Outdoors, one trap should be installed for every 20 to 30 feet of perimeter of fly breeding area. Recommended placement areas include near building entrances, in alleyways, beneath trees, and around animal sleeping areas and manure piles. Indoors, ultraviolet light traps collect the flies inside an inverted cone or kill them with an electrocuting grid. One trap should be installed for every 30 feet of wall inside buildings.
Biology and Control of Flies

Biological Control

The use of biological control agents in fly management programs is still at a relatively early stage. At present, parasitic wasps are the most widely used biological control agents for house flies. A highly recommended parasitic wasp for livestock operations in the northeast is the species *Muscidafurax raptor*. Other species commonly sold through farm magazines have proven ineffective in some cases.

In addition to the parasites that occur naturally in a manure ecosystem, populations can be supplemented by periodic releases of wasps purchased from a commercial insectary. House fly populations develop twice as fast as parasite populations. Therefore, without supplemental parasite releases there is a lag time of several weeks between numbers of flies and numbers of parasites.

An early-season augmentative parasite release program can greatly increase the population of parasites. Such a release program should begin in mid- to late May and continue through August. Research indicates that weekly releases of 200 parasites per cow can provide effective control. The cost of the parasites normally is more than offset by savings in traditional insecticides. Since each farm is different, however, the actual number of parasites used may require adjustment to be both effective and affordable.

Parasitic wasps should not be used as the sole method of control. Their use should be combined with a program of manure management and trapping. If it becomes necessary to include the use of insecticides into a management program, only products that are not harmful to the parasites, such as baits and pyrethrin space sprays, should be used.

Tsetse Flies

Tsetse flies, found in Africa (latitude 5°N to 20°S) are important blood-feeding flies of medical and veterinary importance due to their capability of transmitting trypanosomes to man and animals. They are generally considered one of the greatest factors affecting the course of economic and social development in Africa.

Tsetse flies are narrow bodied, yellow to dark brown, and 6-13.5 mm long. When resting, their wings are held over the back in a scissor-like configuration. The thorax has a dull greenish color with inconspicuous spots or stripes. The abdomen is light to dark brown.

General Aspects

Taxonomy

Tsetse flies compose a family of their own, Glossinidae, which is placed within the Hippoboscoidea due to the morphological and reproductive similarities of tsetse flies to keds and other hippoboscid flies.
Biology and Control of Flies

(McAlpine, 1989). Glossinidae includes the single genus *Glossina* with 23 species, 6 of which are further divided into 14 subspecies (Gouteux, 1987; Potts, 1973). *Glossina* ("tongue fly", in reference to the prominent proboscis) species are arranged in three subgenera – *Austenina*, *Nemorhina*, and *Glossina* – that correspond roughly with groups of species found in different ecological settings. The subgenera often are cited by their group names: the *fusca* group (*Austenina*), the *palpalis* group (*Nemorhina*), and the *morsitans* group (*Glossina*).

**Distribution**

Tsetse flies occur in the tropical and subtropical regions of sub-Saharan Africa, approximately 15° N to 26° S. Species in the *fusca* group are most often found in forested habitats, such as rain, swamp and mangrove forests (forests cover most of the western and central African distribution areas of the *palpalis* group). Species in the *palpalis* group occur among vegetation around lakes and along rivers and streams (primarily along watercourses in western and central Africa). The *morsitans* group, with the exception of the forest-dwelling *Glossina austeni*, occurs in open country and is most often found in dry thickets, scrub vegetation, and areas of savanna woodland (primarily central and southeastern distribution).

**Veterinary and Medical Importance**

For centuries tsetse flies have had a great impact on human health in Africa, due to their function as transmitters of trypanosomes causing extreme human suffering in form of African sleeping sickness. Furthermore their position as vectors of tsetse-borne *trypanosomosis* in both domestic and wild animals is a major impact in preventing the development of commercial domestic animal production over about one-third of the African continent. Domestic animal disease continues to inhibit agricultural productivity and economic development (Krinsky, 2002).

**General Morphology**

Tsetse flies are narrow bodied, yellow to dark brown (tan or brown flies), and 6-14 mm long excluding the proboscis. Members of the *fusca* group are the largest (9.5-14 mm). The *palpalis* and the *morsitans* group species are small to medium in size (6.5-11 mm). Tsetse adults are characterized by several distinctive morphological features. These include the shape of the proboscis, the position and branching of the fringe on the arista of their antenna, and the wing venation and folding pattern. When not feeding, the proboscis extends directly forward between the palps in front of the head. For further details on morphology see e.g., Krinsky (2002).
Feeding Behavior

Adults of both sexes feed exclusively on blood.

Activity Dynamics

Although tsetse feed mostly in daylight, feeding does occur at night. Tsetse adults are most active in the morning and in the late afternoon. They rarely fly more than 30 min a day and are known to disperse up to about 1 km/day. Most of the time is spent resting on vegetation. Tsetse flies are more prone to start feeding on calm animals. They fully engorge within about 1-10 min.

The transmission of the different trypanosomes (T. brucei and T. congolense in dogs) is occurring during feeding of the tsetse flies.

Host Spectrum

Host preferences vary among tsetse species. Members of the palpalis group feed mainly on reptiles, bushbuck, oxen, and occasionally smaller mammals and humans visiting the watering spots. Members of the morsitans feed mostly on the mammals of the savanna. The one forest-dwelling species in the savanna group (G. austeni), feeds exclusively on suids. The fusca group feeds on a variety of host species, including bushbuck, buffalo, other cattle etc. Humans are not the preferred host of any of these fly species.
Tsetse transmitted trypanosomes can circulate in a number of different species of livestock

External Anatomy of Glossina

The word anatomy means the structure of the body, in this case, of the tsetse fly.

Cuticle

Like all other insects, the tsetse fly has a tough outer covering or cuticle. The whole of the body is covered with cuticle, even the eyes. Most parts are hard, but some areas remain flexible, especially the base of the wing, the joints on things and where the mouth parts join on to the head; these parts can therefore be moved easily. The cuticle on the underside (ventral side) of the abdomen in the tsetse fly is elastic, so that it can stretch when the abdomen takes up the large blood meal. Movements of the legs are controlled by muscles attached to the inside of the cuticle of the legs; rapid movement of the wings for flying is controlled by very large muscles in the thorax.
External Appearance

The tsetse flies are nearly always some shade of brown or grey-brown; sometimes there is a slight pink or sandy-red tinge. Several species are very dark. The body usually has darker and lighter patches, making the insect difficult to see when it is settled on bark, rock or soil. At rest, the tsetse normally appears quite slim because the wings are placed one over the other on the back (Figure 1.3) not projecting outwards at an angle to the body as in house flies or most blowflies. Immediately after a blood meal the tsetse abdomen is large, rounded and red.

The body is made up of three main parts: the head, the thorax (to which are attached the wings and legs) and the abdomen. These parts will now be described in greater detail.

Morphology

- Adult flies are long, narrow and yellow to dark brown in color.
- Size is 6-15mm and mouth is projecting forward.
- Wings held over the abdomen like a pair of close scissors when at rest.
- Mouth parts are composed of U-shaped Labium with rasp labella which lie at the terminal region of Labium and upper sharp labrum.
- B/W Labium and Labrum, Hypopharynx is present which carries salivary duct and delivers anticoagulant to Host tissue.
- In the center of the wings, there lies hatchet or cleaver.

Fig. 1.1 Diagram of Glossina, dorsal view, with wings spread out.
The end of the female abdomen does not have large obvious structures corresponding to the male hypopygium and hecters. But there is a small hole (vulva) through which the larva emerges. This hole may have a few small plates around it; the number and arrangement of these plates can, in some cases, help an expert to identify the species.
Difference between the posterior end of the abdomen in male and female Glossina, ventral view.

Side view of male abdomen of Glossina, to show structures uncovered when the hypopygium opens up.
Four characteristics definitively separate adult tsetse from other kinds of flies:

- **Proboscis**: Tsetses have a distinct *proboscis*, a long thin structure attached to the bottom of the head and pointing forward.

- **Hatchet cell**: The discal medial cell of the wing has a characteristic hatchet shape resembling a meat cleaver.

- **Branched arista hairs**: The antennae have arista with hairs which are themselves *branched*.
Biology and Control of Flies

Description of the more important species in Ethiopia

Glossina pallidipes (Size 8.5 – 11 mm)

i. Last two tarsal segments of the hind leg dark coloured.
ii. All tarsal segments of the front leg pale.
iii. Fringe of long hairs on the antennal 3rd segment, visible with x10 hand lens.
iv. Third antennal segment less than 4 times as long as wide.
v. Forward projection at end of third antennal segment long and pointed.
vi. In the female, median scutellar bristles long.
 vii. Superior claspers of male pointed; median lobes do not project.

A key vector of nagana in East Africa

Glossina morsitans (Size 7.75 – 10 mm)

i. On the front leg, the tarsal segment next to the last dark coloured.
ii. No long fringe of hairs on the antennal 3rd segment visible with x10 hand lens.
iii. Third antennal segment more than 4 times as long as wide.
iv. Forward projection at end of third antennal segment not as long or pointed as in G. pallidipes.
v. In the female, median scutellar bristles short.
vi. Superior claspers of the male with a wavy edge, not sharply pointed; median lobes project between the superior claspers.
Glossina palpalis (Size 8 – 11 mm)

i. Most, or all, of the tarsal segments of the hind leg dark.
ii. General colour of the abdomen very dark on the dorsal side.
iii. Superior claspers of the male sharply clawed; claspers joined by membrane.
iv. Inferior claspers of the male having a long thin ‘neck’ and a small ‘head’.
Tsetse Fly (Glossina palpalis)

**Glossina fuscipes** (Size 8–11 mm)

- Most, or all, of the tarsal segments of the hind leg dark.
- General colour of the abdomen very dark on the dorsal side.
- Superior claspers of the male sharply clawed; claspers joined by membrane.
- Inferior claspers of the male having a long thin ‘neck’ and a small ‘head’.

**Glossina tachinoides** (Size 6.5 – 9 mm)

- Most, or all, of the tarsal segment of the hind leg dark.
- Abdomen with dark bands separated by yellowish areas, but some very dark specimens resembling G. palpalis may be found.
- Superior claspers of the male sharply clawed; claspers joined by membrane.
- Inferior claspers of the male having a short wide ‘neck’ and a wide, lobed ‘head’.
Glossina longipennis (Size 11.5 – 13.5mm)

i. General colour pale brown, sometimes with a pink colour to the thorax.
ii. Thorax with four dark spots arranged in a rectangle.
iii. Underside of thecal bulb pale, with a darker apex.
Glossina morsitans centralis

Tsetse Reproduction

Tsetse reproduction is different from most other insects. Female tsetse flies only mate once. A single copulation renders a female fly fertile for her lifetime, during which she can produce as many as 12 larvae. She produces 1 larva at a time, retaining it within her uterus; after ~10 days, the larva is deposited on loose, sandy soil, where it digs in and begins pupation within 60-90 min. This pupation period averages ~35 days, after which the adult emerges. This contrasts with most other flies and insects which usually lay hundreds or thousands of eggs. Their slow rate of reproduction means that tsetse populations can be eradicated by killing just 2-3% of the female population per day and it also means that tsetse rarely if ever become resistant to insecticides.

Both sexes are avid blood feeders and the different species of tsetse seem to prefer feeding on the blood of different types of animals such as cattle, pigs and people themselves act as ideal substitutes for these wild hosts.
Mating of tsetse flies (*Glossina morsitans morsitans*) - The female has a full blood meal in her abdomen.

Female tsetse fly (*Glossina morsitans morsitans*) giving birth to a fully developed larva
Female tsetse fly (*Glossina morsitans morsitans*) giving birth... a final push with her legs and it is out.

Tsetse fly (*Glossina morsitans morsitans*) larva
Tsetse fly (*Glossina morsitans morsitans*) pupae - the colour develops with age. It takes a couple of hours to attain its mature dark purple colour.

Newly emerged male tsetse fly (*Glossina morsitans morsitans*) with fully extended ptilinum

**Tsetse flies** (*Glossina*) belt in Ethiopia
According to Langridge (1976) the tsetse flies in Ethiopia are confined to the southern and western regions between longitude 33° and 38° E and latitude 5° and 12° N. They infest areas which together amount to 97,855 km². Tsetse infested areas lie in the lowlands and also in the river valleys of Abay (Blue Nile), Baro, Akobo, Didessa, Ghibe and Omo (Figure 1). The infested area extends from the southern part of the Rift Valley, around the south-western corner of the country and along the western lowlands and escarpments to the Blue Nile. Restricting a further eastward spread is the cold limit imposed by highlands that rise to the height above which tsetse cannot survive, or the semi-desert condition along the southern border east of the Rift Valley. Elsewhere there have been advances of tsetse, including extension of the upper altitude limit of the fly from about 1,600 to 2,000 meters above sea level in certain areas, although whether flies caught at the highest altitudes are representative of self-sustaining population is uncertain. Tsetse fronts in many places are unstable and tsetse-animal interface is constantly moving. Consequently new areas are being invaded and settled communities are being continually evicted by the advancing tsetse.

Such hot spots include the areas in Upper Didessa Valley, the northern and north eastern edges of Lake Abaya in the Rift Valley, the upper reaches of the Omo-Ghibe and its tributaries. To date five species of Glossina (G. m. submorstanis, G. pallidipes, G. tachinoides, G. f. fuscipes and G. longipennis) have been recorded from Ethiopia but only four are widespread and significant economic importance. These are Glossina m. submorstanis and G. tachinoides, which have a west to east distribution across Africa south of the Sahara desert, and G. pallidipes and G. f. fuscipes which often occur together in East Africa, although the former extends far to the south whereas the latter has essentially central African distribution. Out of the nine regions of Ethiopia five (Amhara, Beneshangul-Gumus, Gambella, Oromiya and SNNPR) are infested with more than one species of tsetse flies (Table 1).
Tsetse infested river basins

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

Tsetse infested river basins of Ethiopia
Table 1: Tsetse infested regions and river basins of Ethiopia

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

Vector control

Previous control techniques included vegetation clearing, ground and aerial insecticide spraying and selective game destruction. These methods have been discouraged due to the high costs involved in addition to being environmentally un-friendly (FAO, 1992). The development of insecticide impregnated, odour baited traps (Dransfield et al., 1990) and targets (Vale et al., 1988) and insecticide-treated cattle as pour-on (Shereni, 1990) which attract and kill tsetse offer the prospect of cheaper alternatives with less damage to the environment (Jordan, 1988). In Zimbabwe, Kenya, Ethiopia, Rwanda and Burkina Faso, insecticide-treated targets have been used for control of both G. pallidipes and G. morsitans (FAO, 1992). Work carried out in Kenya indicated that the populations of G. pallidipes and G. longipennis were reduced by 99.9% while using insecticide-impregnated targets (Dransfield et al., 1990). In Zimbabwe, Vale et al. (1988) indicated that use of targets consisting of a black cloth and netting baited with Octanol, acetone and coated with deltamethrin, reduced G. pallidipes and G. m. morsitans populations by 99.9%. In conclusion he indicated that targets offer a simple and ecologically clean method of controlling tsetse and preventing re-invasion. In Ethiopia, these techniques have been tried and are still in use in the different tsetse infested areas.

Apart from this, operation is underway to eradicate tsetse flies from an area of 25,000 km² in the in Southern Rift Valley Ethiopia Tsetse Eradication Project (STEP) area using the Sterile Insect technique (SIT). The use of insecticide impregnated target and application on of pour-on on cattle in the area has
suppressed the tsetse population from 4.1 to 0.9 fly/trap/day. As a result the prevalence of bovine trypanosomosis has dropped from 27 to 6% in two years time (Getachew Abebe et al. 2004).

**Parasite control**

**Chemotherapy/Chemoprophylaxis**

Chemotherapy and chemoprophylaxis are presently the major methods of control of trypanosomosis in livestock. Diminazene, homidium and isometamidium are primarily used for treatment and prophylaxis of trypanosomosis in cattle, sheep and goats. Quinapyramine, suramin and melarsomine are primarily used as therapeutic agents for infections with *T. evansi*, although quinapyramine is also used for prophylactic purposes (Table 4). These latter three compounds are therefore, generally restricted to use in camels, equines and buffaloes (Peregrine, 1994). All the three compounds have been available for at least 45 years. After the introduction of isometamedium in 1961 (Berg et al. 1961) the development of new trypanocidal drugs has made little progress. Recently, however, quinapyramin sulphate (Antrycide) has been reintroduced because of the need especially, to control camel trypanosomosis. The incidence of resistance to these drugs is apparently increasing (Peregrine, 1994) and the main means of controlling the disease is therefore under threat.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Trade name</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diminazene aceturate</td>
<td>Berenil (Intervet)</td>
<td>Cattle, buffalo</td>
</tr>
<tr>
<td>Homidium chloride</td>
<td>Ethidium “C” (Boots)</td>
<td>Cattle, horses</td>
</tr>
<tr>
<td>Homidium bromide</td>
<td>Ethidium bromide (Boots)</td>
<td>Cattle, horses</td>
</tr>
<tr>
<td>Isometamidium chloride</td>
<td>Samotin (Merial)</td>
<td>Cattle/horses/camel/dogs</td>
</tr>
<tr>
<td></td>
<td>Trypamidium (Merial)</td>
<td></td>
</tr>
<tr>
<td>Suramin</td>
<td>Naganol (production stopped)</td>
<td>Cattle/horses/buffalo/camel/dogs</td>
</tr>
<tr>
<td>Quinapyramine sulphate</td>
<td>Antrycide (ACCI)</td>
<td>Pigs/camels/buffalo/horses</td>
</tr>
<tr>
<td>Cymelarsan</td>
<td>Mel Cy (Merial)</td>
<td>Camels</td>
</tr>
</tbody>
</table>

The alternative tsetse control measures include method such as aerial and ground spraying with insecticides and deployment of targets, traps and screens. A particular concern with large-scale insecticide application is the pollution it may cause, as most insecticides are harmful to aquatic and terrestrial animals. If live bait animals are used without any other form of tsetse control, difficulties arise with persistence of flies in areas where the treated animals do not go.
Biology and Control of Flies

In case of sterile male technique, the effect on the population only becomes apparent after a period and a substantial fly suppression has to precede the application of SIT. Traps and screens may be stolen for cloth they contain and during rainy season the rapidly growing vegetation may camouflage the trap or screen, which thus loses its visual activities for the flies (Uilenberg, 1998). Trypanotolerant cattle that stand up to challenge in a particular region may suffer from disease when introduced into another area, and so far, all attempts at developing a vaccine against trypanosomosis have failed (Uilenberg, 1998).

In general, all of the available methods have advantages and disadvantages and the various techniques act in a complementary way; an advantage of one may off set a disadvantage of another. The economic and feasibilities of employing various control methods must be compared for any given tsetse infested area. In Ethiopia, reducing the risk of trypanosomosis by employing more effective control methods may well increase both livestock and crop production. The use of vector and parasite control in an integrated package has effectively reduced the burden of tsetse and trypanosomosis in cattle in the Ghibe (Leak et al. 1995) and Didessa valleys (Feyesa Regassa, 2004).

The NGU trap is a simple, safe and economical cloth trap for the capture of biting flies (tsetse flies, horse flies, deer flies, stable flies). It was developed at ICIPE in Kenya.
The Nzi trap is a simple, safe and economical cloth trap for the capture of biting flies (tsetse flies, horse flies, deer flies, stable flies). It was developed at ICIPE in Kenya.
Conclusion

Tsetse and Trypanosomosis have kept farmers and poor livestock keepers out of areas that have very high potential for agricultural development. The problem caused by tsetse and trypanosomosis is not only that of disease but also a significant negative impact on natural resource conservation and sustainable utilization. Increasing gap between population growth and food production creates an increasing pressure for utilization of new land and diversification of food resources. In Ethiopia, the emergence of multiple drug resistance has seriously hampered the control of animal trypanosomosis. The resistance trait is known to be stable for a long time and such stocks can spread to wider areas through animal movement and/or the spread of tsetse populations. Tsetse transmitted animal trypanosomosis is, therefore, one of the most significant and costly diseases in Ethiopia hindering the effort made for food self-sufficiency. It is, therefore, important to remove the burden of tsetse and trypanosomosis and make the infested areas of Ethiopia accessible for wise and sustainable land resource utilization.

**Sheep Ked (Melophagus ovinus) (Linnaeus)**

![Sheep Ked (Melophagus ovinus) (Linnaeus)](image)

**Description**

**Adult** — the adult sheep ked or sheep tick is a wingless, blood-sucking fly that is 5 to 7 mm in length. It is reddish-brown in color with the head short and sunken into the thorax and a sac-like body that is leathery and spiny.

**Egg** — eggs are retained within the body of the female.

**Larva** — the larvae are fully grown and sticky when extruded by the female and stick in the wool.

**Pupa** — sheep ked pupae are chestnut brown and are stuck in the wool on the belly, shoulders, and thighs.
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Biology

**Distribution** -- sheep keds are found throughout the United States and other areas of the world in which sheep are raised.

**Hosts** -- sheep are the only known host animals of the sheep ked.

**Damage** -- primarily, damage is to lambs. High ked populations cause unthriftness and emaciation.

Since the sheep ked is a blood sucking insect, naturally it causes irritation to the host, resulting in many different damages that are economical losses.

In young lambs the sheep ked may cause anemia and retard weight gain. Since the sheep ked sucks the blood from its host it causes irritation to the sheep's hide causing it to rub resulting in loss and damage of the wool. When the sheep ked bites and scratches the sheep, it makes firm, hard nodules that develop on the top layer of the skin called "cockle", which reduces the value of the hide, because of the decline in the tinsel of the leather.

![Skin damage due to sheep keds](image)

Because of the decline in the sheep's immune system due to the feeding of the ked, the wool production suffers as well. The ked feces also stain the sheep's wool making it very difficult to wash out; therefore the best way to get rid of the feces is to shear the wool. Also, when the ked and its pupae are found in the harvested wool, it gives the wool a "dirty classification" resulting in a decrease in value there as well.

The physical appearance of the sheep also decline due to the heavy infestation of sheep ked making the sheep itch causing them to have a dirty and ratty appearance. Reduction in carcass weight and decline
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in clean dry weight of wool are among the few cases resulting in economic loss as a result of sheep ked in Ethiopia.

Life History -- The entire life cycle of the ked is spent on sheep. Adult keds survive only 2 to 8 days when off the host. Eggs are retained within the body of the female. The female ked extrudes one mature larva every 7 to 8 days. The larva immediately pupates. Pupae can be found commonly on the belly, shoulders, and thighs throughout the year. The total life cycle may take from 3 to 6 weeks, depending on temperature. The adults live 3 to 4 months and bear 10 to 12 larvae in this time.

Sheep ked Control

Control is best achieved by application of chemical insecticides immediately after shearing. About half of the adults and most of the pupae are removed with the fleece. Better coverage with insecticides is possible on newly shorn animals.

Oestrus ovis, Linnaeus, Sheep bot fly

Family Oestridae. Genus Oestrus (Nasal Bot Flies)

- Larvae of these flies spend most of their time in the nasal passage of sheep & Goat. So called nasal bots
- Adult flies are having short life span (1 week) whereas larvae having 1 year or more of life span.

Morphology adult

- Adult flies are 1cm in size and of grey color.
- Small dark spots are present on the abdomen with a covering of short brown hair.
- Size of Larvae is 3cm and color is yellowish white. Larva is tapering anteriorly with prominent step posteriorly.
- Body is segmented having dark transverse bands dorsally (each segment).
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Adult fly netted near several sheep
*Oestrus ovis*

Note lack of mouth parts

Note bee-like appearance. This pinned specimen lacks two of its six legs.

sheep nasal botfly (*Oestrus ovis*)
Necropsy finding: Sinus cavity of a sheep
Description

**Adult** -- The sheep nose botfly is a hairy, yellowish, bee-like fly about the size of a common horse fly. Adults are 12-14 mm in length but are rarely seen.

**Egg** -- Within female fly.

**Larva** -- When fully grown, larvae are 20 to 30 mm long.

**Pupa** -- Pupae are found in the soil.

The sheep nose botfly, *Oestrus ovis*, is a cosmopolitan parasite that, in its larval stages, inhabits the nasal passages and sinuses of sheep and goats. It is one of the most widely distributed sheep parasites in Africa in general and Ethiopia in particular.

The adult fly is grayish brown and ~12 mm long. The female deposits larvae in and about the nostrils of sheep without alighting. These small, clear-white larvae (initially <2 mm long) migrate into the nasal cavity; many spend at least some time in the paranasal sinuses. As the larvae (bots) mature, they become cream-colored, then darken, and finally show a dark or black band on the dorsal surface of each segment. The larval period, which is usually shortest in young animals, varies from 1-10 mo. When mature, the larvae leave the nasal passages, drop to the ground, burrow down a few inches, and pupate. The pupal period lasts 3-9 wk, depending on the environmental conditions, after which the fly emerges from the pupal case and pushes its way to the surface. Mating soon occurs, and the female begins to deposit larvae.

**Life History** -- The adult female fly is active during summer and early fall. Eggs are retained in the body until they hatch. Flies deposit as many as 500 larvae in the nostrils of sheep. The larvae then move up the nasal passages to the nasal and frontal sinuses. The larvae remain in the sinuses for 8 to 10 months and then are sneezed out of the nostrils. The larvae pupate in the soil with the pupal period lasting 3 or more weeks, depending on temperature. Adults then emerge from the pupae and may live as long as 28 days.
Clinical Findings

Once the larvae begin to move about in the nasal passages, a profuse discharge occurs, at first clear and mucoid, but later mucopurulent and frequently tinged with fine streaks of blood emanating from minute hemorrhages produced by the hooks and spines of the larvae. Continuing activity of the larvae, particularly if they are numerous, causes a thickening of the nasal mucosa that, together with the mucopurulent discharge, impairs respiration. Paroxysms of sneezing accompany migrations of the larger larvae. Larvae present in the sinuses are sometimes unable to escape; they die and may gradually become calcified or lead to a septic sinusitis. The purulent inflammation produced in the sinuses occasionally may spread to the brain with fatal results. However, the principal effects are annoyance, with a resulting reduction in grazing time and loss of condition. Usually only 4-15 larvae are found, although ≥80 may be present.

To avoid the fly’s attempts at larval deposition, a sheep may run from place to place, keeping its nose close to the ground, and sneeze and stamp its feet or shake its head. Commonly, especially during the warmer hours of the day when the flies are most active, small groups of sheep gather and face the center of a circle, heads down and close together.
Pathogenic effects

- Itching and Irritation
- Rubbing the nostrils against hard objects
- Nasal discharge which later on becomes mucopurulent
- In coordination, convulsions
- Also called false gid (signs resembling *coenurus cerebralis*)
- Cause swelling of eyes in human called as keratoconjunctivitis and inflammation of lips called stomatitis
- Loss of weight

Effects of nasal botflies on sheep

Sheep exhibit distinctive behaviour when botflies are active, during the warmest parts of the day in warm-to-hot periods of the year. When the flies are attempting to deposit their larvae, just inside sheep’s nostrils, the sheep show typical disturbed behaviour. They snort and stamp their front feet, run in short bursts with their noses almost on the ground, and bury their noses into the fleeces of other sheep or into the soil. Sheep may congregate in shaded places where the flies are less active.

The signs shown by affected sheep vary, possibly depending on the number and stage of development of the larvae. Sheep may show no signs at all, or may have a watery or thick discharge from one or both nostrils; sometimes containing flecks of blood which may cause difficulty in breathing and may sneeze or cough.

This pursuit can cause animals to become stressed, which hampers production. Bot larvae tunnel through the nasal passages and feed on mucosal secretions, thus making animals vulnerable to bacterial infections. Mature larvae crawl or are sneezed out of the nasal cavities in the following spring and pupate in the soil. Bot fly infestations may kill older sheep.

Monitoring

Look for fly activity around the face and avoidance behavior in sheep during the summer. The highest bot infestation levels occur in November and December. Bot fly larvae cause excess, sometimes bloody, nasal discharge; sneezing; inflammation; grating of the teeth; and labored breathing. Loss of appetite may cause weight loss or reduced weight gain.
Treatment:

- **Refoxanide, Ranide**.... 1ml/25kg BW subcutaneously
- **Nitroxynil, Trodex**.... 1ml/20kg BW subcutaneously
- **Ivermectin**.............. 1ml/50kg BW subcutaneously, is highly effective against all stages of the larvae

Control

- Regular use of insecticidal drugs should be followed
- **Cultural/Mechanical Control**: Sheep nose bot flies cannot travel far, so change pastures frequently

Tabanid flies (Common Name- Horse Fly)

Horse flies, *Tabanus* species;

Tabanidae, DIPTERA

Description

**Adult** -- Horse flies are moderate to large flies (14 to 19 mm long); their wings are clear and their thorax grayish-brown. Deer flies are small to medium flies (10 to 13 mm long). Their wings are tinted smokey gray-brown or have dark patterns, and their thorax is greenish-yellow with dark stripes.
Diagram showing the short, indistinctly segmented antenna of flies of the Family Tabanidae and Suborder Brachycera. Their wings have a roughly hexagonal discal cell and a branching third vein. The veins in the wings allow an entomologist to identify the fly to genus.
Head region of Tabanid fly
Mouthparts of a horse fly. The fly feeds by using its lacerating mouthparts to produce a pool of blood on the skin of its host. The blood is then lapped up by the labium.

**Biology**

Egg -- The narrow eggs are cylindrical and 1 to 3 mm long, initially white but turn brown to black in a few hours. An egg mass consists of 200 to 500 eggs cemented together by a waterproof secretion.
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Larva -- Mature larvae are approximately 10 to 19 mm long and up to 3 mm wide. Deer fly larvae tend to be smaller than horse fly larvae. Both types are white, brownish or greenish in color. Spindle-shaped, the larvae taper to a point at both ends. The head is small, cylindrical and retractable.

Pupa -- Pupae measure about 15 mm in length and are white at first but turn light brown in a few hours. They are rounded anteriorly and tapered posteriorly with a double row of spines on segments 2 through 7.

Distribution

Horse and deer flies are found worldwide. More than 40 species occur in North Carolina, but only about a dozen are common. These biting flies are often encountered along hiking trails, narrow lanes and roads and at the edges of woodlands. They are numerous and annoying along the coast and near their breeding and natural feeding sites such as flood plains of swamps, streams and rivers and around ponds, salt marshes, and beaches.

Feeding Habits

Female tabanid flies are active and persistent blood-sucking pests of cattle, horses, deer, other warm-blooded animals, and at times, man. Females also consume nectar. Birds are usually not attacked by these flies. Male tabanid flies do not feed on blood. Males consume nectar and plant sugars. Horse fly larvae are predaceous on small invertebrates and consume organic matter. The food habits of deer fly larvae are not known.

Damage

Tabanids lie in wait in shady areas under bushes and trees for a host to happen by. Sight is the main host finding mechanism, but carbon dioxide and odor also play a role. Moving objects, especially if dark colored, are most prone to attack. Attacks occur during daylight hours with a peak beginning at sunrise and lasting three hours. A second peak is two hours before sunset and commences shortly after. Attack frequency is low on overcast days or at temperatures below 22 and above 32 °C.

On livestock, biting occurs on the abdomen, legs, and neck. Tabanids inflict deep wounds that cause a flow of blood. The mandibles and maxillae penetrate the skin in a scissor-like action. Anticoagulants in the saliva are pumped into the wound and the blood is ingested through the sponging labella. Pathogens may be transmitted from flies that are disturbed while feeding on one animal and begin feeding on another.

It is known that horse flies transmit Anaplasmosis, anthrax, tularemia of cattle and several other diseases are known to be spread by these vicious bloodsuckers. In addition to causing great annoyance in some recreational and work areas, horse and deer flies are suspected vectors of important livestock diseases.
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hog cholera virus of swine and equine infectious anemia virus of horses (EIA) and other viral and bacterial diseases.

Fly attacks result in lowered gains and low milk production in livestock animals. It is not uncommon to see as many as 100 flies feeding on an animal at one time. Twenty to thirty flies feeding for six hours are capable of taking 100 cc of blood.

Life History

Female horse flies and deer flies inflict painful bites on man and animals as they seek a blood meal. Males do not bite. These flies are aquatic or semi-aquatic in breeding habits. Eggs are laid in clusters on objects, such as plant stems and leaves, near the water. In about one week, eggs hatch and the young larvae soon crawl or drop into water or wet soil. The larvae undergo 4 to 9 molts and sometimes require a month to a year or more to fully develop. When mature, they move to dry areas near the surface of the soil to pupate for 2 to 4 weeks. Most flies emerge sometime from May through August.

Summarized life cycle of horse flies
Some species of horse flies have two generations per year in coastal Georgia. Most species of horse flies and deer flies have a 1-year life cycle. In some cases, however, 2 or 3 years may be necessary to complete development. In other cases, a full generation and a partial second are produced within a single year.

Similar to all flies, horse flies develop from egg to adult via a process of "complete metamorphosis." This means the last larval stage passes through a non-feeding pupal stage, from which the adult eventually emerges.

Upon becoming active, adults of both sexes feed on energy-rich sugars in nectar, plant sap, or honey dew produced by sap-sucking insects such as aphids and scale insects. Mating of the few species of that has been observed takes place in flight. Females of some species are capable of developing an initial batch of eggs without taking a blood meal (autogeny); otherwise blood is required for the development of eggs. Females search for a place to lay a single mass of eggs consisting of 100-800 eggs, depending on the species. Egg masses of most species that have been studied are laid on the underside of leaves or along the stems of emergent vegetation growing in wetlands. Hatching occurs in approximately 2-3 days, and newly emerged larvae drop down into water or saturated soil in which they feed and develop.

Larvae of most species are found in freshwater and saltwater marshes, some in streams, some in moist forest soils, and a few in moist decomposing wood. Larvae of all species of horse flies that have been studied are predators. They feed primarily on other soft-bodied animals such as insect larvae and worms, but larvae of some large species of horse flies feed on small vertebrates, including tadpoles, frogs, and toads. Horse fly larvae appear to possess a toxin in their saliva that is involved in subduing their prey.

The larval stages of horse flies range in number from 6-13, depending on the species. The last larval stage passes through winter in the site in which it developed and molts into a pupa the following spring. Most species complete one generation per year. However, very large species of horse flies require 2-3 years in which to complete larval development.

**Control**

Horse flies and deer flies have a few reported parasites and predators, but these natural enemies are relatively ineffective as control agents. Chemical control of horse flies and deer flies is difficult. Some repellents give temporary relief.

Large-scale pesticide applications to control adult horse flies and deer flies have only been moderately successful. Treatment of salt marshes to control larvae is impractical because of the large areas which larvae inhabit. Box traps for horse flies apparently help reduce horse fly populations in small areas such as home yards and campgrounds, particularly if high vegetation on the perimeter limits fly infiltration to relatively narrow fly-ways or fly-paths. Box traps have 4 shiny black sides, 16 x 32 inches, suspended by legs 24 inches from the soil. The top of the box trap is a 32 x 32 inch metal screen (birds destroy plastic screen). At the bottom, 2 rectangular 32 x 20 inch screens are fastened on opposite sides and
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Canted upward so that a 0.053 inch slot is left for the flies to crawl into the trap. The attractiveness of such a trap is enhanced by suspending under the trap and 4 to 6 inches above the soil a 14- to 16-inch ball painted shiny black. Vegetation should be kept low around the trap.

Biological Control

There are no effective biological control programs for controlling tabanids. There are native beneficial insects that target tabanids. Eggs are parasitized by such Hymenoptera families as Trichogrammatidae, Scelionidae and Chalcididae. Diapriidae and Pteromalidae (Hymenoptera) and Bombyliidae and Tachinidae (Diptera) parasitize the larvae and pupa. Tabanid adults are used as provisions for nest building wasps. Cattle egrets and killdeer are also tabanid feeders.

Management

Currently there are no adequate means for managing populations. Traps are sometimes effective in control of small areas such as yards, camping sights, and swimming pools. Trapping of nuisance flies has reduced their numbers on the Atlantic Coast of the United States. Traps have been effective when used around cattle that are confined to manageable areas.
Philoliche elongate

Tabanus abactor

horse fly, Tabanus proximus

Tabanus mularis

Tabanus equalis
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*Tabanus stygius*

*Tabanus trimaculatus*

*Tabanus sulcifrons*

*Tabanus subsimilis*

*Tabanus fulvulus*

*Tabanus gladiator*
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Tabanus melanocerus

Tabanus nigrescens

Huge fly - Tabanus atratus

Tabanus imitans

Tabanus molestus

Tabanus catenatus
Haematopota

Horse Fly > Haematopota

Description

Horse fly is sometimes called Cleg Flies that feed on nectar and sometimes pollen. Females usually also feed on blood which aids in egg development. Males lack the necessary mouthparts for blood feeding. Most horse flies feed on mammal blood, but some species are known to feed on birds, amphibians or reptiles. The females' primary sense for locating prey is sight, and they have large compound eyes that serve this purpose well. The flies usually lay waiting in shady areas for prey to happen by. They are attracted to large, dark objects, and to certain animal odors and carbon dioxide. They are also attracted by motion, their eyes being well adapted to its detection. The eyes of horse flies are generally brightly colored, and this coloration is one of the means entomologists use to identify them to species, though the colors rarely persist after death.

The bite from a larger specimen can be quite painful, especially considering the light, agile, and airborne nature of the fly. Unlike insects which surreptitiously puncture the skin with needle-like organs, horse flies have mandibles like tiny serrated scimitars, which they use to rip and/or slice flesh apart. This causes the blood to seep out as the horsefly licks it up. They may even carve a chunk completely out of the victim, to be digested at its leisure. When attacking humans they usually prefer the buttocks, legs, and feet, though they have been known to attack arms as well. The horsefly's modus operandi is less secretive than that of its mosquito counterparts, although it still aims to escape before pain signals reach their mark's sphere of awareness. Moreover, the pain of a horsefly bite may mean that the victim is more concerned with assessing and repairing the wound, than finding and swatting the interloper.

Haematopota horse flies are most active in hot weather, mostly in summer and autumn during the daylight hours. Most species also prefer a wet environment, which makes it easier for them to breed. Eggs are generally laid on stones close to water or on plant stems or leaves. On hatching, the larvae fall into water or moist earth, feeding voraciously on invertebrates, such as snails and earthworms, and small vertebrates.
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Haematopota wings

Antenna styline of *Haematopota pluvialis*

*Haematopota crassicornis*

*Haematopota pluvialis*

*Haematopota bigoti*

*Haematopota rara*
Hydrotaea irritans (Head Fly)

*Hydrotaea irritans* is the only important species, commonly known as Head fly. Head flies are non-obligatory and non-biting flies which are important vectors of many diseases.
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Morphology

Size is 5.5-7.5 mm.

- Thorax is having longitudinal stripes.
- Abdomen color is olive green.
- **Yellow, orange** coloration at the base of the wing
- Mouth parts are adapted for **sponging** and composed of Labella (labium), labrum, maxilla, mandibles and hypopharynx.
- Labium is having sharp **teethes**. Maxilla and mandibles are rudimentary.
- Hypopharynx carries salivary duct delivers anticoagulant to host tissues.

Life Cycle

- Adult flies are active during midsummer. These flies prefer to live in still conditions. These live in **woodland and plantation**.
- Adult lay eggs on decaying organic matter or rotting material.
- Egg hatch and larva develop. Maturation of larva takes place during **autumn** season.
- Larva undergoes hibernation. With the onset of **spring season**, larva become active and pupa develop.
- With the onset of **summer**, adult emerges from pupa.
- There is only **one generation** in a year.
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Pathogenic Effects

- Flies are abundant around the base of the horn in the form of the clusters.
- As these flies feed on lachrymal secretions, wound secretions.
- Labella is adapted for sponging and having sharp teeth which create wound due to rasping effect of teeth. This condition sometimes cause extension of wound and resemble blow flies myiasis. This also led to secondary bacterial infections.
- Flies are also abundant on ventral potion of abdomen and udder.
- Flies cause summer mastitis by transmitting Streptococcus disgalactie and corynebacterium pyogenes.

Treatment & Control:

- All of the drugs used in genus musca apply here too.
- Sings of toxicity include shivering, sweating, salivation, and diarrhea. Antidote is atropine sulfate.
- Medicated water should not fall on ear, eyes, nose and mouth. So, use muzzle when injecting.
- Use of flies' repellant (sporon, spoton)
- Use ear tags, nose rings and tail bands impregnated with insecticides.
- Provide good hygienic conditions.
- Proper drainage of marshy areas is very important.

Chrysomyia bezziana: Cattle screw–worm fly

Also Callitroga hominivorax (synonym: Callitroga macellaria (synonym: Cochliomyia macellaria): Cattle screwworm

General Description: Adult flies are 10 to 15mm long with bluish–green bodies. The thorax has three longitudinal stripes, and the face and eyes are brown. Mature larvae are 10 to 15mm long with bands of spines around body segments.
Larvae of Cattle screw-worm

Damage to hides due to Cattle screw-worm

Life Cycle: Female flies deposit eggs at the edges of wounds on the host. Larvae hatch in 10 to 12 hours and mature in 3 to 6 days before dropping from the host to pupate in the ground. Pupae become adults in 3 to 7 days.

Location: Larvae inhabit skin around wounds of any size.

Geographical Distribution: Callitroga hominivorax – Southern Mexico, Central America and South America, generally in warmer areas; Callitroga macellaris / North and South America, from Canada to southern Argentina; Chrysomyia bezziana / Africa, southern Asia.

Significance: Severe disease is common in screwworm fly areas. Death occurs frequently, causing serious economic losses.

Effect on Host: Screwworm myiasis begins in wounds as minor as tick bites. Larvae digest tissue as they migrate, expanding the lesion. Secondary bacterial infections are common and may cause death. Wounds have a putrid odour, and foul smelling liquid oozes out. Affected animals often isolate themselves from the herd and seek protection in shade and bushes.

Diagnostic Information: Identification of adult flies and larvae is the only diagnostic method.

Control: Adult screwworm flies mate only once during their lives. In 1958, 20 billion sterilised male flies were released in the southern United States to compete in breeding with normal males. This program eliminated screwworm in the United States within 2 years. Other control measures are limited in effectiveness, and include treating wounds with insecticides. Some macrocyclic lactones such as ivermectin have reliable, long term protection against larvae and screw worm; and as such the
prophylactic use of ivermectin has been adopted as a key component of the national strategy designed to eradicate an incursion into Australia of the old world screw-worm.

*Dermatobia hominis*: tropical warble fly

**General Description:** Adult females are about 12mm long and have no mouth parts for feeding. The thorax is dark blue and the short, broad abdomen is brilliant blue.

The larvae of the fly *Dermatobia hominis* attacks, especially cattle, sheep but to a lesser degree pigs and dogs. Horses and people are exceptionally rare. The larvae are burrowed under the skin, causing a case typical of myiasis, Furunculoid, identified with name of Dermatobiosis or tropical cutaneous myiasis.

The weather more appropriate for the development of the larvae is the temperate climate. Environmental factors such as temperature, 17 to 28 °C, high humidity, rainfall of 2,000 mm and sandy soils, conducive for its development. Weeds and shrubs are the best shelter for the production of larvae. The areas of highest incidence are those which are located between 600 and 1800 meters above sea level but it is
possible to find also between 450 to 2000 meters above sea level. The larvae present 2 to 3 generations per year; the time of the highest levels of infestation is at the end of the rains.

Life Cycle

Adult flies attach mosquitoes and deposit eggs on these transport hosts. A period of 6 days on the transport host is required for larval development within the eggs. Hatching can then occur when the mosquitoes land on animals to feed. The larvae penetrate the skin of the host animal through the mosquito bite. Larvae grow under the animal’s skin and produce a painful swelling with a hole through which the larvae breathe. Mature larvae are about 25mm long after completing their development, some 5 to 10 weeks after entry. They leave the host and pupate in the ground for 5 to 10 weeks before emerging as adults. Blood sucking flies or ticks may also serve as transport hosts. Life cycle takes about 4 months.
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The female uses other insects more light (mosquitoes, ticks) to deposit and put their eggs in the abdomen through a sticky substance, then, appear a very small larvae, which are taken up and transported to cattle. The eggs are elongated shape, are white and have the appearance of a bunch of bananas. The incubation lasts from 4 to 6 days. The carriers with great ability to fly and agile, they give greater possibility of a short incubation period. When the flies not find vectors to deposit eggs, they put them on the leaves of weeds or shrubs. When the larva is formed, emerge only if the conditions to invade the host. Of the contrary it may take up to 15 days in hopes of the host (veal).

The larvae that abandon to vector fall out to the skin the animal and moving very short, to begin the drilling of the skin. Each larva bores its own entry, choosing areas of the skin intact, where they get their food from living cells. After 1 week you can see a slight swelling at the site of the puncture. Under the skin the larvae molt 2 times pass for 3 larval stages, with duration of 36 to 56 days.

Once the parasite completes its life cycle within the animal, leaves, fall to the floor and then they are buried, this state is called: The pupal stage, the larva spent to penetrate the earth, until about 5 cm., is 8 to 65 minutes. The pupa stage lasts from 32 to 43 days. A higher temperature reduces the period (20 days at 30°C).

The fly *Dermatobia hominis* is big, sturdy, showy, bright blue, covered with tiny hairs; with brown head and yellow eyes. The thorax is shiny, metallic blue and brown wings and the female to-male ration is 3:1. The life of the adult fly is approximately 9 days.

Female Dermatobia doesn’t rest on the cattle at any time. There are two major groups of insect vectors, namely the blood-sucking (mosquitoes, biting flies), which not selected their victims, carry a small number of eggs, are agile and quick on the cattle; and those who feed on animal secretions and lymph (flies), which carry large amounts of egg.

The larva has natural enemies to abandon the cattle for the pupal stage; can be attacked by flies, fungi and some bacteria.
Effect on Host

*Dermatobia hominis* larvae cause large painful swellings in subcutaneous tissue of the host. There are breathing holes through the skin, and these expose the underlying tissue to the air and possible invasion by other parasites and disease-producing organisms.

The larvae mature under the skin generated reaction in the cattle and each larva is surrounded by a gelatinous material formed by a cyst. For its high degree of morbidity can cause in the calves, inflammation of the eyes (ophthalmia) and inflammation of the eyelids (blepharitis). In cows in production, the larvae uncomfortable to animal, disrupting food and rumination, with a decrease in milk production, weight loss, bad appearance and susceptibility to other diseases.
Large swellings in subcutaneous tissue of the shoulder area of a cow.

Lesions of *Dermatobia hominis* larvae on the back of a cow

Wound of adult bovine infested by *D. hominis* larva
Damage to processed hides in the tannery due to Dermatobia

**Diagnostic Information:** Painful swellings in the subcutaneous tissue, each underlying a skin hole, suggest bot infestation. Diagnosis can be made by removal and examination of the larvae.
Control: Dips, washes or pour-on chemical agents. Ivermectin and Doramectin are effective drugs in the control of *Dermatobia hominis*. The treatment involves cleansing and healing of wounds and the use of antibiotics and vitamins to animal.

*Hypoderma bovis, H. lineatum*: Ox warbles or cattle grubs; heel or bomb flies

**General Description**

Adults are hairy flies without functioning mouth parts. Thus they do not feed. The abdomen has three bands of hairs, light yellow hairs toward the front, dark hairs in the middle and orange-yellow hairs at the rear. The name "bomb flies" comes from the adults' habit of diving at the cattle. *H. bovis* is 15mm long. *H. lineatum* is 13mm. The larvae or grubs are large with a segmented surface tapering at both ends.
Male, *Hypoderma bovis*

- *Hypoderma bovis* - adult fly
- *Hypoderma* - larvae leaving through breathing hole
- *Hypoderma eggs attached to hair*
- *Hypoderma* - pupa on grass

The ox warble fly *Hypoderma bovis*
Life Cycle

Adult flies are most active on warm days of summer months, attacking cattle to deposit eggs, 1 mm long, on hairs of the leg, sometimes on the body. Females may lay 100 eggs on one animal. Tiny larvae hatch in about 4 days and crawl down the hair and penetrate the skin. Once in the skin the larvae migrate through the subcutaneous tissue toward the back of the animal, growing as they move. *Hypoderma bovis* larvae usually go directly toward the back and are 27 to 28 mm long when they reach it. Larvae of *H. lineatum* travel to the wall of the esophagus and rest there through autumn before continuing on to the back, reaching a size of 25 mm. Swellings about 3 cm in diameter form around the larvae, which perforate the skin in order to breathe. This stage lasts about 1 month. In spring the larvae leave through the holes, drop to the ground, and burrow into soil to pupate. Flies emerge 34 to 36 days later. Life cycle generally spans 1 year.

Female flies attach their eggs (up to 500) to hairs around the hocks and on the lower parts of the body. (In California, these flies begin laying eggs in April.) 1st-stage larvae hatch within a few days, burrow into the skin and begin their migration towards their winter "resting sites", i.e. the epidural fat in the spinal canal. After a period of several months and a molt, the L2s migrate to the subcutaneous tissue of the back where they molt to L3s. These can be palpated as distinct swellings ("warbles"). After 5-11 wks the mature larvae emerge through the skin and drop to the ground. In California, *H. bovis* occurs in February to April. The grubs will be gone from the back by April or May. The mature larvae pupate in the soil, and adults emerge in 1-3 mos.
Hypoderma bovis on the back of cattle

Damage to leather due to larval stages. This piece of leather is unusable and thus represents an economic loss to the tanners and the national economy.

Location: Adult flies lay eggs on hairs of legs and occasionally the body. Larvae live in the subcutaneous tissue of the back.
Geographical Distribution: Many countries of the northern hemisphere.

Significance

Migrating larvae cause much damage to skin and underlying flesh. Affected areas of the carcass must be discarded at slaughter. Annual losses in the U.S. are $200 to $400 million. Adult flies cause sufficient annoyance to cattle to decrease feeding, and cause weight loss. Cattle attempt to escape fly attacks by running to shade or water. Stampedes may result from the activity of only a few flies. Poor quality hides due to grub damage cause serious economic loss.

Effect on Host

Enzymes are released by the larvae to break down tissue and ease their movement as they migrate to the back. The tissue through which larvae travel becomes greenish-yellow. Allergic reactions to larvae may occur if they die under the skin naturally or if killed during attempts to remove them manually. The larvae emerge through breathing holes in the skin, leaving a large hole which makes the hide worthless. The disease is referred to a cutaneous myiasis.

Diagnostic Information

Eggs may be found on hair of the animal’s legs. Larvae in cysts or lumps under the skin indicate ox warble infestation.

Control

Insecticides are used to kill migrating larvae, but infections and allergic reactions may occur when the larvae die. Systemic use of some chemical agents (eg. ivermectin) has been effective when applied after a frost, when flies have died.

Blow Flies

Blow flies (Fig. 1) are non-biting flies found throughout the world. They feed and lay their eggs mostly on decomposing animal remains. Because of this, they often come in contact with human and animal pathogens. So it is important to suppress blow fly populations to reduce the risk of spreading disease.
Description

Blow flies are metallic flies about 1/4 inch long. Based on their appearance, they can be separated into two groups, green bottle flies and blue bottle flies. Green bottle flies are metallic green but sometimes have a bronze tint. They are active during warm months of the year. Blue bottle flies are metallic blue to black or purple and are active during cooler months of the year. Both groups of blow flies can be found in urban or rural settings.

Life Cycle

Life cycle of blow fly has four stages of development. A single blow fly can lay up to 2,000 eggs during its life. Eggs are deposited on decomposing animal remains and usually hatch in about 12 hours. The resulting larvae (Fig. 2) feed on the decomposing remains. When the temperature is about 80 degrees F, larval development takes 11 to 20 days. Larvae pass through three larval instars during that time. During the last stage, larvae leave the food source and form pupae (cocoons). Blow fly pupae are football-shaped. Pupation lasts 6 to 12 days.
Control

Blow flies can be suppressed with cultural and chemical control methods. Using both methods is most effective and least expensive.

Cultural control

means changing the environment so that blow flies are no longer able to develop. The best cultural control method is to properly dispose of any decomposing animal remains where blow flies might lay eggs. Dead animals such as birds, cats, dogs and opossums should be buried at least 12 inches deep or placed in garbage bags that are tightly tied. Removing all food residues and cleaning garbage cans weekly will also make the cans less attractive to blow flies. Keep windows screened and doors closed to keep flies from entering a home. Stores and other businesses can place exhaust systems above their doors to reduce fly access, and install doors that open and close mechanically. Sticky traps and ultraviolet light traps placed around homes and businesses will reduce blow fly populations.

Chemical control

is effective with insecticides that contain pyrethrins. Insecticide sprays labeled for home use can be purchased at grocery and hardware stores. Fly baits, such as QuickBayt® and Golden Malrin®, are not recommended for controlling blow flies. These baits usually are sugar-based and contain a compound that attracts only adult house flies. Always read and follow the directions listed on the insecticide label.

Hippobosca flies

*Hippobosca variegata*  *Hippobosca equine*
Biology and Control of Flies

Hippobosca camelina –
This is the "camel fly"

Ornithomya avicularia

Cattle louse fly (Hippobosca rufipes),

Adult Hippobosca dipteran fly, blood feeding ectoparasite of livestock animals.

Tabanids - subfamily Pangoniinae

Family: Hippoboscidae (louse flies)

1. about 100 species
2. look much like ticks, however, only 6 legs
3. wings have been lost by females of most species, whereas males have usually retained wings; some where both sexes have wings
4. both males and females feed on blood
5. larvae retained in female and larvae ingest secretions from inside female somewhat similar to the tsetses; larvae are born and ready to pupate
Mosquitoes/Culicidae

There are more than 3,500 known species of mosquitoes worldwide and, while they are mainly a nuisance for both animals and humans, they are of major significance as vectors of several important pathogenic organisms.

Adult mosquitoes have three basic body parts:

- **Head** - This is where all the sensors are, along with the biting apparatus the proboscis (only females have the proboscis, for biting). The head has two compound eyes, antennae to sense chemicals and a mouth part called the palpus.
- **Thorax** - This segment is where the two wings and six legs attach. It contains the flight muscles, compound heart, some nerve cell ganglia and trachioles.
- **Abdomen** - This segment contains the excretory and digestive organs.

Mosquitoes can fly about 1 to 1.5 miles per hour (1.6-2.4 kph).
Mosquito Bites

Females drink blood and the nectar of plants; the males only sip plant nectar. When a female bite, she also injects an anticoagulant (anti-clotting chemical) into the prey to keep the victim's blood flowing. She finds her victims by sight and smell, and also by detecting their warmth. Not all mosquito species bite humans.

Disease Carrier

The mosquito is often a carrier of human diseases, such as malaria, encephalitis, yellow fever, dengue fever, and many others. Mosquito is also carrier of many viral, bacterial and protozoal livestock diseases such as Rift valley fever, the dog heartworm etc. The females, who drink blood, can carry disease from one animal to another as they feed.

Anatomy

Like all insects, the mosquito has a body divided into three parts (head, thorax, and abdomen), a hard exoskeleton, and six long, jointed legs. Mosquitoes also have a pair of veined wings. They have a straw-like proboscis and can only eat liquids.

Life Cycle

The complete life-cycle of a mosquito takes about a month. After drinking blood, adult females lay a raft of 40 to 400 tiny white eggs in standing water or very slow-moving water. Within a week, the eggs hatch into larvae (sometimes called wrigglers) that breathe air through tubes which they poke above the surface of the water. Larvae eat bits of floating organic matter and each other.

Larvae molt four times as they grow; after the fourth molt, they are called pupae (also called tumblers). Pupae also live near the surface of the water, breathing through two horn-like tubes (called siphons) on their back. Pupae do not eat. An adult emerges from a pupa when the skin splits after a few days. The adult lives for only a few weeks.
The mosquito goes through four separate and distinct stages of its life cycle and they are as follows: Egg, Larva, pupa, and adult. Each of these stages can be easily recognized by their special appearance. There are four common groups of mosquitoes living in the Bay Area. They are *Aedes*, *Anopheles*, *Culex*, and *Culiseta*.

**Egg**: Eggs are laid one at a time and they float on the surface of the water. In the case of *Culex* and *Culiseta* species, the eggs are stuck together in rafts of a hundred or more eggs. *Anopheles* and *Aedes* species do not make egg rafts but lay their eggs separately. *Culex*, *Culiseta*, and *Anopheles* lay their eggs on water while *Aedes* lay their eggs on damp soil that will be flooded by water. Most eggs hatch into larvae within 48 hours.

**Larva**: The larva (larvae - plural) lives in the water and come to the surface to breathe. They shed their skin four times growing larger after each molting. Most larvae have siphon tubes for breathing and hang from the water surface. *Anopheles* larvae do not have a siphon and they lay parallel to the water surface. The larva feed on micro-organisms and organic matter in the water. On the fourth molt the larva changes into a pupa.

**Pupa**: The pupal stage is a resting, non-feeding stage. This is the time the mosquito turns into an adult. It takes about two days before the adult is fully developed. When development is complete, the pupal skin splits and the mosquito emerges as an adult.
Adult: The newly emerged adult rests on the surface of the water for a short time to allow itself to dry and all its parts to harden. Also, the wings have to spread out and dry properly before it can fly.

The life-cycles of *Anopheles*, *Aedes* and *Culex* mosquitoes*
With live mosquitoes, anopheline and culicine adults can be differentiated by observing their resting postures. Anophelines rest at an angle of between 50° and 90° to the surface whereas culicines rest more or less parallel to the surface.
Heads of male and female anopheline and culicine mosquitoes
Aedes, Anopheles and Culex larvae. An indication of the genera of mosquito larvae can be made from the length of the siphon. Anopheles has very short siphons (see below also), while Culex tend to have the longest siphons.

Aedes, Culex larvae and pupa. Both Aedes and Culex larvae hang down from the water surface at an angle. Compare this with Anopheles larvae.
This mosquito belongs to the genus *Culex*. Note the distinguishing features of the *Culex* mosquitoes: cross veins on narrow wings, blunt abdomen, short palpus, and no prespiracular or postspiracular setae.
Adult Anopheles mosquitoes

Morphological differentiating characters of Anopheles mosquito
Adult *Aedes aegypti* mosquitoes

Morphological differentiating characters of *Aedes* mosquito

National Animal Health Diagnostic and Investigation Center
Endemic (on left) and epidemic (on right) life cycles of Rift Valley fever involving close association between heavy rainfall conditions, vector Aedes and Culex mosquitoes, domestic animals, and humans. The epidemic cycle is precipitated by excessive heavy rainfall associated with the El Niño/Southern Oscillation (ENSO) climatic phenomena. The three Xs depicted in epidemic cycle represent critical pathways, which can be interrupted by targeted and specific mosquito control activities.

**General note on RVF**

**The Vector**

RVFV is an exceptional virus in that it can be vectored by many, and quite varied, arthropods depending on the specific geographic location. For example, several species of mosquito, sandflies and ticks are all capable of transmitting RVFV between hosts. Nevertheless, mosquitoes are far and away the primary and most important vector for this virus. Mosquito vectors are central to the enzootic, epizootic, and epidemic ecology of the virus. In most of the geographic areas where RVFV is present, *Aedes* mosquitoes are the dominant mosquito vectors for enzootic transmission among animals, and for sporadic transmission among humans. These are the virus maintenance vectors. *Aedes mcintoshi* is the most important of these maintenance vectors.
On the other hand, when specific features of the landscape emerge, *Culex* mosquitoes serve as important amplifying vectors, which transition virus circulation and transmission in animals from enzootic conditions to epizootic conditions, and subsequently also increase the risk for human epidemics. These dynamic landscape features of mosquito and disease ecology will be discussed in greater detail below.

**Prevention and control of mosquitoes on livestock**

Large area control of mosquitoes is always a complex task usually taken over by public authorities (governments, municipalities, etc.) and is not a topic in this site. Farmers and producers can contribute to solve at least part of the problem with a few simple measures that reduce the suitability of water ponds in their properties for mosquito breeding, reducing the surrounding vegetation, building ponds with steep borders that reduce the areas with shallow waters, eliminating floating vegetable material, etc. Some larvicides are approved for treating such ponds in certain countries.

Since a number of species can complete their development in small water amounts in old tires, drains, garbage bins, cans, etc., eliminating such breeding places will also reduce the mosquito population.

For confined poultry or pig operations, it is highly recommended to install metal or plastic screens on doors, windows and other openings so that they can substantially reduce the exposure of the animals to mosquitoes. Such screens can also be impregnated with classical insecticides (e.g. pyrethroids or...
organophosphates) that can usually be used for fumigation in case of massive outbreaks of mosquitoes as well.

On-animal chemical treatment for mosquito control is usually not a good practice because protection will last only a few days and will have almost no effect on the mosquito population. If absolutely needed, pour-ons should be more effective than spraying or dipping. Insecticide-impregnated ear-tags do not usually protect against mosquitoes, or only marginally. Endectocides such as ivermectin provide no control of mosquitoes, neither as injectables, nor as drenches, slow-release boluses or pour-ons.

To protect dogs and cats against mosquitoes best results are obtained with certain collars impregnated with pyrethroids. Spot-ons, shampoos, soaps, sprays and the like are mostly useless against mosquitoes: if ever, protection may only last for a few hours or days.

Mosquitoes can also breed in urban environments wherever small amounts of water remain for a few days: flowerpots of any size, some plants that can retain water (e.g. at the base of the leaves), ponds, fountains, drains, gutters, old tires, cans and tins, plastic bags, watering troughs, swimming pools, holes in trunks, etc. Eliminating these sites or keeping them dry will diminish the number of mosquitoes in your surrounding area.

Most research on chemical or natural repellents has been carried out precisely to protect against mosquitoes. There are effective repellents for humans and pets (e.g. DEET), but protection won't last longer than 4 to 8 hours. Such repellents are completely inadequate for whatever livestock operation, among other reasons for their high cost.

**Culicoides midges**

Culicoides midges are minute to tiny flies that can be severe biting pests of humans, pets, livestock, and wildlife. Their blood-sucking habits also raise concerns about possible involvement in the transmission of disease agents. They have a much greater impact on livestock animals, both as biting pests and vectors of disease agents.

Culicoides midges are flies (Order Diptera) in the family Ceratopogonidae, which includes over 4,000 species in 78 genera worldwide. The genera of greatest importance to livestock health in Ethiopia are Culicoides. Very little information exists regarding biting midges in Ethiopia, but distribution data reveal that several species occur in the country.

Culicoides midges belong to the order Diptera (2 winged flies), genus Culicoides. Culicoides are significant to livestock production as they are able to transmit diseases such as Bluetongue to cattle and sheep and African horse sickness virus to equines.
Biology and Control of Flies

Culicoides of veterinary importance

Vector for viruses that cause the following diseases

1) Bluetongue
2) African Horse Sickness
3) Epizootic Hemorrhagic disease
4) Bovine ephemeral fever

Culicoides and bluetongue

The African species Culicoides imicola has been determined as the main vector of bluetongue virus (BTV) outbreaks in Africa.

Culicoides obsoletus, vector of bluetongue virus

Culicoides imicola is the main vector of BTV outbreaks in Africa

Blood fed female Culicoides obsoletus (approximately 1.5 mm in length) ...

Adult biting midge, Culicoides sonorensis
Female and male Biting Midge - *Culicoides villosipennis*

*Culicoides imicola*, vector of African horse sickness

**Culicoides midges - Morphology**

*Culicoides species* are very small insects, usually seen flying in large swarms at dawn or dusk.

In the image below the size of a midge is compared with a mosquito and fly.
Due to their small size, they generally do not fly in windy conditions however they are easily spread by light winds.

Culicoides midges are about 1mm in length and have short legs. The wings contain stains and are folded over the back at rest. The female midges require blood meals for egg production and have biting mouthparts.

**Culicoides midges - Behavioural Patterns**

These tiny insects fly in swarms during the twilight hours of dusk and dawn when conditions are still and warm. Some species can enter animal housing.

**Trophic habits**

Both male and female midges feed on sugar sources (lice, flower nectar, plant juice). Only the females are blood sucking, blood meals are required for the development and maturation of eggs. Females feed on all warm blooded vertebrates but prefer domestic animals. Females suck blood every 3 to 5 days. During their lifespan, females can feed more than three times. Peak feeding times are during the peak flying times of dusk and dawn.
The female midges prefer biting on the underbelly and legs, especially in the area around the coronary bands of the claws.

**Culicoides midges - Lifecycle**

In most Culicoides species the lifecycle is poorly understood. During summer the development from egg to adult takes a couple of weeks. Some larvae and pupae are overwinter in protected breeding places and continue development in warmer weather.

**Bluetongue infections**

The epidemiology of bluetongue infection is closely related to the biology of the vector. It is, therefore, a seasonal disease generally observed in late summer and early autumn. Virus transmission begins in the early spring with the onset of insect flight activity and continues until the first hard frosts.

**Biology of the midge**

Culicoides species are holometabolic (undergo complete metamorphosis). The adult midges usually live for about 20 days, depending on ambient conditions they can live for more than 90 days. The adults fly and copulate in swarms.

The female midges require blood meals for the maturation of their eggs. Between 100 and 200 eggs are usually laid in areas with a specific humidity and abundant organic material. Development from egg to adult usually takes about 15 days but can be up to up to 7 months during the overwintering period.
Diagram representing the lifecycle of *Culicoides* spp.
Figure 2. Biting midge life cycle. (Illustration by: Scott Charlesworth, Purdue University, based in part on National Animal Health Diagnostic and Investigation Center)
Females typically require a blood meal for development of eggs, but those of a few species are capable of producing an initial batch of eggs without feeding. Eggs are laid in a mass on various moist surfaces and hatch in 2-7 days. There are four larval stages (Figure 2), with larval development completed in about two weeks to a year or more, depending on temperature and food supply. The pupal stage typically is formed in the same site as the last larval stage, and adults emerge in 2-3 days. Adults can live for two to seven weeks. Laboratory and field studies suggest that biting midges may complete two or more generations per calendar year. Last stage larvae over-winter and pupate the following spring to early summer.

Biting midge larvae develop in a variety of semi-aquatic or aquatic habitats, depending on the species. For example, larvae of some species of Culicoides are truly aquatic, developing both in streams and ponds, but those of most species are found in organically rich, semi-aquatic sites such as marshes, bogs, tree holes, and saturated rotting wood. Larvae of Culicoides species that are biting pests of livestock develop in saturated soil of wastewater ponds and seepage from watering troughs, both typically enriched with livestock manure.

Habitat

The midges breed in moist conditions in a variety of habitats, particularly damp, muddy areas and in faecal and plant matter. Modification of these areas by removing organic matter and draining muddy areas, form an important part of the control strategy for Culicoides.

Can biting midges be controlled?

Control of biting midge larvae and adults is very difficult. The only species that can be controlled in the larval stages is C. sonorensis, a species associated with livestock production. Larval development is disrupted by modifying the bank structure of the wastewater ponds, the periodic altering of water levels, and the reduction of leakage from watering troughs. Suppressing adult biting midges with insecticides has enjoyed limited success, and only under certain conditions. For example, temporary relief has followed aerial application of insecticides during evening hours, when biting midges are most active.
References


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Cutwa MM, O'Meara GF. An identification guide to the common mosquitoes of Florida. http://farm.ifas.ufl.edu/kev/ (19 October 2011)


