American Association of Equine Practitioners

External Parasite and Vector Control Guidelines

AAEP External Parasite and Vector Control Guidelines

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INTRODUCTION

Commonly used strategies for external parasite control in horses have not changed significantly in recent years. This document is intended to provide practitioners with current information regarding the control of Ticks, Flies, Lice, Mites and Mosquitos as well as pertinent information on the life cycles, biology and basic terminology used when discussing these parasites. Where appropriate, we have included brief information regarding the diseases for which a specific parasite may serve as the vector.

It is important to keep in mind that the information contained within these guidelines are suggestions; there are many variations of these suggested programs that will still meet the same goals and follow the same principles.

There are a number of product treatment charts included in this information. It should be noted that only those products which are approved for use in horses have been included.

TICKS

Glossary/Terminology

Tick Anatomy Terms

***Basis capituli*:** portion of the tick anatomy that attaches the head to the body of the tick

Cuticle: outer covering of the tick

Festoons: distinguishing characteristic of some hard ticks; small rectangular areas separated by grooves along the posterior edge of the scutum in both male and female ticks

Hypostome: barbed structure located between the palps which anchors the tick to the host during feeding

Palps: paired, leg-like sensory structures protruding from the basis capituli at the head of the tick that allow the tick to detect an approaching host

Scutum: hardened dorsal plate or shield on the back of a tick

Tick Lifecycle Terms

1-host tick: tick species capable of completing all three life cycle stages of larvae, nymph, and adult on the same host

3-host tick: tick species that requires feeding on three different hosts to complete its life cycle, one host for each of the three life cycle stages of larvae, nymph, and adult.

Engorged: Enlargement or distention of a tick following a blood meal

Larvae: immature stage of the tick life cycle following molt from an egg

Molting: shedding of the cuticle

Nymph: immature stage of tick life cycle following molt from a larvae

Categories

Tick species can be generally categorized into two different family groups: hard ticks (Ixodids) and soft ticks (Argasids). Hard ticks have a scutum and are more commonly seen, including the Ixodes, Dermacentor, Amblyomma, and Rhipicecphalus ticks, just to name a few. Soft ticks do not have a scutum and are less prevalent with Otobius species being the most frequently seen soft ticks on cattle and horses.

Lifecycle/Biology

Distribution and activity of each species of ticks in the U.S. is both geographical and seasonal.

While most tick species in the U.S. are active in moderate climates from the spring through the fall, some tick species in warmer parts of the country can be active year round. Additionally, one tick in particular, *Dermacentor albipictus*, is active primarily in the winter throughout the continental U.S.

There are four stages in the life cycle of the tick: the egg, the 6-legged larvae or seed tick, the 8-legged nymph, and the adult (male and female). Transition from one stage to the next is made by one or more moltings (shedding of the cuticle). After hatching from eggs, ticks must ingest a blood meal from a host during each successive life stage to survive. Many tick species have a 3-host life cycle and some have a 1-host life cycle.

In ticks with a 3-host life cycle, development of the tick from larvae to nymph to adult requires feeding on a different host at each stage (i.e. 3 different host species are needed to mature to adult stage). The larva and nymphs of these ticks usually feed on a variety of host species, such as birds and small mammals, while the adult stages often feed on larger mammals such as cattle, horses, and deer. Three-host ticks typically can complete their life cycle in one to two years.

Ticks with a 1-host life cycle will attach to a specific host in the larval stage and will molt into the nymph and adult stages all on the same host. One-host ticks can complete their life cycle in a few months to a year.

3-host tick life cycle: http://tickapp.tamu.edu/images/three-host%20lifecycle.jpg

1-host tick life cycle: http://tickapp.tamu.edu/images/One-host%20tick%20lifecycle.jpg

Identification

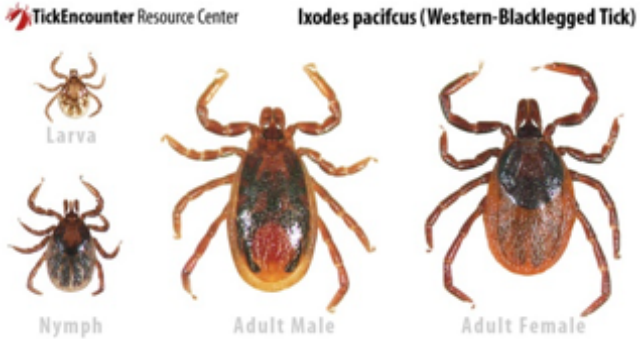
Identification of tick species requires visual examination of specific morphology of the tick either with the unaided eye or under a magnifying lens. Factors to consider during evaluation include lifecycle stage of the specimen, whether the tick is male or female, and characteristics of key anatomical features such as scutum, festoons, basis capituli, and palps. Additionally, consideration of the common geographic distribution of certain tick species can aid the evaluator in correct species identification. The following link can be used to explore the distribution maps of common ticks in the U.S.: http://www.cdc.gov/ticks/geographic_distribution.html

When examining the tick for identification, it is recommended that you first determine the correct life stage of the specimen (egg, larvae, nymph or adult). If the specimen is an adult, you should next determine whether the tick is male or female. Female ticks tend to be larger than males and the scutum, or hard shell, extends over the male's entire back, but extends only one-third of the way down the female's back. Finally, evaluate the colors and morphology of the scutum and palps (mouth parts) to identify the distinctive species of tick. If you are unable to determine the species or want confirmation of your field identification, consider submission of the specimen to a laboratory with a qualified entomologist. Additional guidance for tick submission to a laboratory is included in the "Clinical Signs and Diagnosis" section.

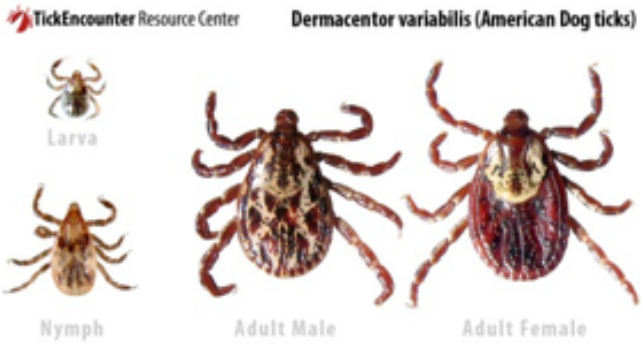
The following is a list of common tick species in the U.S. with links to pictures of the tick at various lifecycle stages:

Ixodes scapularis (Deer Tick or Blacklegged Tick)
http://www.tickencounter.org/tick_identification/deer_tick#top

Ixodes pacificus (Western Blacklegged Tick)
http://www.tickencounter.org/tick_identification/westernblacklegged_tick#top

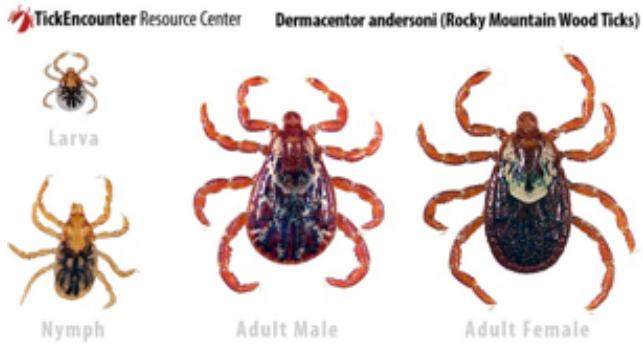


Dermacentor variabilis (American Dog Tick)
http://www.tickencounter.org/tick_identification/dog_tick#top

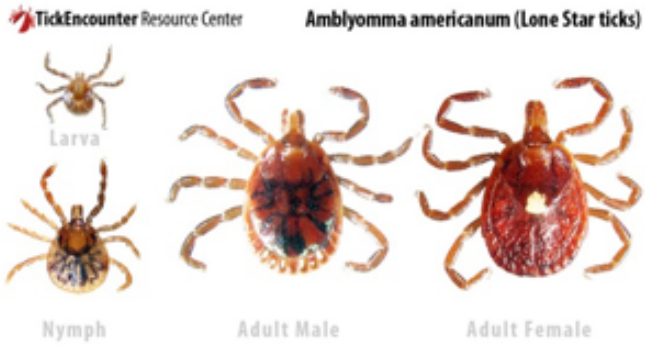


Dermacentor albipictus (Winter Tick)
http://extension.unh.edu/resources/files/Resource001955_Rep2885.pdf

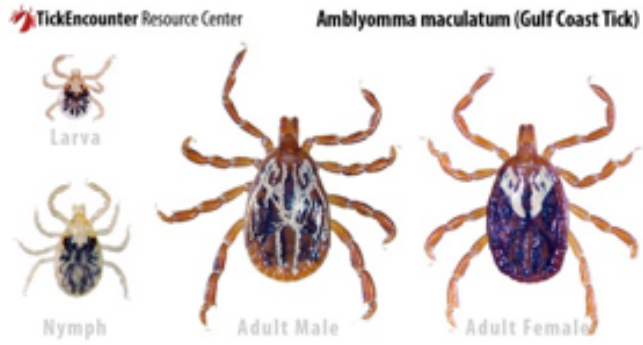
Dermacentor andersoni (Rocky Mountain Wood Tick)
http://www.tickencounter.org/tick_identification/rocky_mountain_wood_tick#top



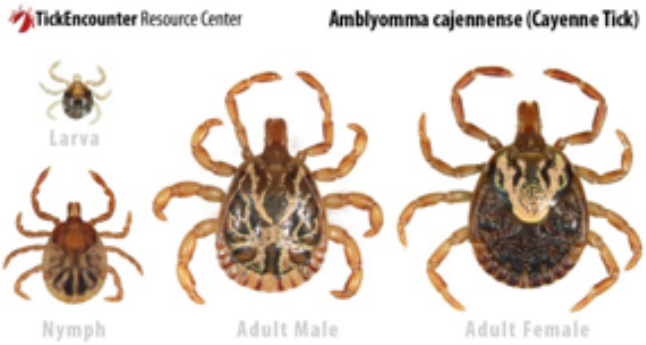
Amblyomma americanum (Lone Star Tick)
http://www.tickencounter.org/tick_identification/lone_star_tick#top



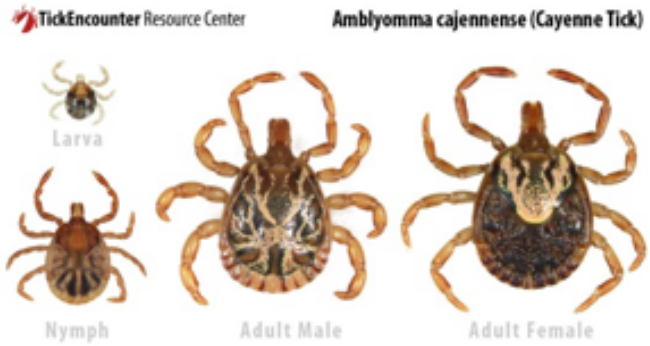
Amblyomma maculatum (Gulf Coast Tick)
http://www.tickencounter.org/tick_identification/gulf_coast_tick#top



Amblyomma cajennense (Cayenne Tick)
http://www.tickencounter.org/tick_identification/cayenee_tick#top



Rhipicephalus sanguineus (Brown Dog Tick)
http://www.tickencounter.org/tick_identification/brown_dog_tick#top



Otobius megnini (Spinous Ear Tick)
http://www.forestryimages.org/browse/detail.cfm?imgnum=1418002

Clinical Signs and Diagnosis

Examination of horses for the presence of ticks involved both visualization and careful palpation over all parts of the horse with specific focus on locations in which certain tick species prefer to attach. This combination of visualization and palpation in the examination for ticks is termed "scratching" for ticks. Scratching for ticks is a systematic procedure.

Taking into account the safety of the examiner and the horse, attempts should be made to thoroughly examine the following anatomical locations:

- Beginning at the horse's head, examine the false nostrils visually and palpate with a forefinger;
- Slowly palpate the ears beginning around the base of each ear, moving to the caudal side of the pinna, and then around to the rostral side of the pinna of each ear sliding a finger down toward the ear canal as far as the horse will allow. (Note: some ear ticks may attach further down the ear canal than is reasonable to palpate, so consider performing an otoscopic exam on horses that have clinical signs of tick-borne disease, especially tick paralysis)
- Move to the forelock of the mane and with thumb opposed to fingers, palpate the forelock and continue palpating down the mane from the forelock to the withers.
- Examine and palpate the submandibular/intermandibular space with fingers of the flattened hand feeling for any unevenness of the skin.
- Examine and palpate with a flattened hand down each side of the neck and to the center of the chest between the forelegs
- Examine visually and palpate the axilla of one side.
- Examine and palpate the posterior fetlock to the coronet of the front foot.
- Examine and palpate along the midline from the center of the chest caudally to the abdomen
- Visually examine the udder/scrotum area on one side.
- Examine visually and palpate the tail, perineum, and between the hindquarters including the inner thigh of each side.
- Examine and palpate the posterior fetlock to the coronet of the back foot
- Examine the udder/scrotum of the other side.
- Examine and palpate the posterior fetlock to the coronet of the other back foot.
- Examine and palpate the posterior fetlock to the coronet of the other front foot.
- Examine visually and palpate the axilla of the other side.

If ticks are found in the process of scratching, they should be removed carefully so as not to break off the capitulum. This is especially important in ticks with long mouthparts such as Ixodes and Ambloyomma species. Forceps may be useful to grasp the tick near the head end as close to the skin of the host as possible and gently pull upward with steady, even pressure. If the mouthparts break off, remove them separately with the forceps. After removing the tick, thoroughly clean the bite area with iodine/betadine scrub and isopropyl alcohol or soap and water.

Ticks can also be collected from the environment (grass and other vegetation) by dragging a light colored flannel cloth over the area. This is termed "dragging" for ticks. The drag is made by attaching one end of the flannel cloth (30" x 60") to a piece of wood, such as a broomstick, to which a strong cord is attached for a towline. Other more sophisticated tick traps, such as those that use CO2 to attract ticks to a bait station, can also be used.

Once collected, ticks can be placed in a blood collection tube or screw cap vial and preserved in 70% isopropyl alcohol. In this condition, they can be submitted to a laboratory for specific identification or confirmation of your field identification.

Associated Diseases/Conditions

Although a number of tick species present in the U.S. may be found on horses, few tick species are known at this time to transmit clinically relevant disease in the horse. It should be noted that ticks infected with relevant pathogens do not usually transmit those pathogens immediately and often must feed for a period of time before transmission of the pathogen occurs. Additionally, some ticks may transmit a pathogen, but at a volume lower than that necessary to cause clinical disease. The following table summarizes the most common tick-borne diseases in horses:

Table 1. Tick-borne diseases of horses.

Disease	Pathogen(s)	Known Tick Vectors	Links to detailed information
Lyme Disease (Lyme Borreliosis)	Borrelia burgdorferi	Ixodes spp.	http://www.merckmanuals.com/vet/generalized_conditions/lyme_borreliosis/overview_of_lyme_borreliosis.html
Equine Piroplasmosis	Theileria equi, Babesia caballi	Dermacentor variabilis, Ambloyomma cajennense, Boophilus sp.	http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/animalhealth?1dmy&urile=wcm%3apath%3a%2Faphis_content_library%2Fsa_our_focus%2Fsa_animal_health%2Fsa_animal_disease_information%2Fsa_equine_health%2Fsa_piroplasmosis%2Fct_equine_piroplasmosis
Equine Granulocytic Anaplasmosis (formerly Equine Granulocytic Ehrlichiosis)	Anaplasma phagocytophilum (formerly Ehrlichia equi)	Ixodes pacificus	http://www.merckmanuals.com/vet/generalized_conditions/equine_granulocytic_ehrlichiosis/overview_of_equine_granulocytic_ehrlichiosis.html
Tick paralysis		D. variabilis and D. andersoni most common causes, however D. albipictus, I. scapularis, A. americanus, A. maculatum, R. sanguineus, and O. megnini have also been implicated	http://www.merckmanuals.com/vet/nervous_system/tick_paralysis/overview_of_tick_paralysis.html

While the diseases in the table above comprise the most commonly known tick-borne diseases encountered in horses, it should be noted that infection or co-infection with other as yet undefined or unknown tick-borne pathogens is possible. In human medicine, awareness is increasing that co-infection of people with multiple tick-borne pathogens is more common than previously thought. Given the 3-host tick patterns of most tick species, it is possible for them to be infected with multiple pathogens obtained from multiple hosts. For example, people confirmed as infected with Lyme disease have also been found to be co-infected with Babesia microti and Mycoplasma spp. It seems reasonable that these same types of co-infections, as yet undefined in horses, should be considered in clinical and diagnostic evaluation of horses suspected of harboring a tick-borne disease.

Specific Control and Treatment Measures

Treatment options for ticks on horses mostly include several choices of topical acaricide applied directly to the horse. Alternatively, orally administered ivermectin is effective against ticks on horses, however the tick must first take a blood meal from the treated horse to be affected by the drug. For tick species that may be capable of transmitting disease within a short period of time after feeding has begun, using oral ivermectin as the sole option for tick control may not mitigate tick-borne disease transmission and additional treatment modalities should be used in conjunction with this method.

It should be noted that Amitraz should NOT be used on horses as it is an alpha 2 adrenergic agonist which can cause toxic effects in the horse including a sedative effect and dose-dependent decrease in locomotor control and activity.

Table 2: Acaricides for treatment of the horse.

Active ingredient	Formulations	Application	Important Notes
• Pyrethrins • Synthetic pyrethroids (permethrin, cypermethrin, resmethrin)	Ready-use-spray	Spray over body; spot treat legs, tail, mane, ears	
	Aerosol spray	Spray directly onto ticks, spot treat on/in ears	
	Emulsifiable concentrate spray	Spot treat back, legs, mane, tail, ears	
	Pour-on	Follow label directions	Safe to use on lactating mares
	Wipe-on	Use mitt to apply	Not for use on foals less than 3 months
	Spot-on	Follow label directions	Safe for foals older than 3 months
	Dip (hand soak or sponge)	Wet to skin; drip dry; avoid face	
	Impregnated garment (blankets, leg wraps)	Apply leg wrap/blanket to appropriate location	
	Back rubber	Horses will use freely	Keep applicator charged
Zeta-cypermethrin	Dusting powder	Follow label directions	
Coumaphos	Emulsifiable concentrate spray	Wet to skin, drip dry	Requires special license; organophosphate precautions for application; do not use on horses intended for slaughter

Notes: Fipronil is effective against ticks and is available as a ready-to-use spray, but is NOT labeled for use on horses. Amitraz can have toxic effects in the horse and is contraindicated for any purpose.

Table 3. Acaricides for treatment of the environment, premises, pastures.

Active Ingredient	Formulation	Application	Important Notes
Pyrethrin	Dusting powder	Apply to cracks and crevices in barns and stalls	
	Emulsifiable concentrate spray	Apply in and around barns	
Permethrin	Aerosol spray	Barn floors, cracks and crevices	
	Emulsifiable spray concentrate	Paddocks and dry lots	
	Ready-to-use spray	Spot treatment of barns and stables	
Cypermethrin	Emulsifiable spray concentrate	Apply to perimeters of barns and outbuildings	
	Wettable spray powder		
Commercial grade pyrethroids (for use on land/crops)	Emulsifiable spray concentrate	For use on pastures and pens; Follow label directions	Restricted use pesticide; requires personal protective clothing/measures

Insecticide active ingredients labeled for topical application to control ticks and ear ticks*

Active ingredients and concentrations	Application options	Precautions
Coumaphos 6.15%	Spray	Cholinesterase inhibitor
Cypermethrin 0.075%	Dust	
Cypermethrin 0.15% + Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% diflubenzuron IGR	Spray, wipe or Pour-on	Do not use pour-on application on foals
Permethrin 7.4% to 10%*	Pour-on, paste or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%*	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old

References:

Strickland RK, Gerrish RR, Hourrigan JL, Schubert GO. Agriculture Handbook No. 485: Ticks of Veterinary Importance. United States Department of Agriculture, Animal and Plant Health Inspection Service. Reprinted May 1976.

University of Rhode Island Tick Encounter Resource Center: http://www.tickencounter.org. Accessed October 3, 2013.

The Tick App for Texas and the Southern Region: http://tickapp.tamu.edu/. Accessed November 10, 2013.

University of New Hampshire Cooperative Extension. The Winter Tick (Dermacentor albipictus): http://extension.unh.edu/resources/files/Resource001955_Rep2885.pdf. Accessed December 18, 2013.

USDA-APHIS-Veterinary Services. Standard Operating Procedure for Importation of Horses: World Equestrian Games. Examination for Ectoparasites on Import: 2010.

The Merck Manual for Veterinary Professionals online: http://www.merckmanuals.com/vet/index.html. Accessed December 18, 2013.

USDA-APHIS-Veterinary Services website: http://www.aphis.usda.gov/index.shtml. Accessed December 18, 2013.

FLIES

Glossary/Terminology

Fly Anatomical Terms

Head: Most anterior portion of the adult fly where shape and color can determine genus or species, sex, etc.

Mouthparts: Used for feeding; mostly sponging, but several forms of piercing mouthparts used for blood feeding.

Palps: Paired, leg-like sensory structures protruding from the area around the mouth parts.

Cuticle: The outer covering or skin of the fly, supple and lightly chitinized in the egg and larval stages, flexible and highly chitinized in the puparium and adult stages.

Thorax: Second of the three major anatomical divisions of the adult fly body. The place where the wings, halteres and legs are attached to the body. Stripes or coloration on the dorsal surface can be used for identification purposes.

Wings: Flies have only one pair, unlike most (but not all) other insects, which have two pair. Key aspects of wing color or venation can be used for identification.

Halteres: Found only in flies, these were formerly the second pair of wings. They have been reduced to club-like organs used for stability and guidance.

Abdomen: Third and most posterior of the three major anatomical divisions of the adult fly body. Appendage free, but shape and color can be used for identification.

Fly Life Cycle Terms

Eggs: Life cycles for most nuisance flies begin with eggs deposited within a substrate by the female flies.

Instar: One of the larval developmental stages, e.g., 1st instar, 2nd instar, or 3rd instar.

Larvae: Generally 3 larval instars in Muscidae and Calliphoridae, and from 6 to 13 in the Tabanidae (horse flies). The newly hatched larvae are in the first instar, and the last instar larvae molt to the pupal stage.

Pupa: Stage where metamorphosis to the adult stage occurs.

Posterior Spiracles: Chitinized openings where air enters the posterior portion of the body of fly larvae. Also visible on the puparium. Characteristic to species in many cases.

Puparium: Chitinized shell which encases a fly pupa.

Molting: Shedding of the cuticle during changes in stage or instar.

Eclose: To emerge, particularly as an adult from the puparium, but sometimes used to indicate hatching from the egg.

Imago: Synonymous with adult.

Categories

Nuisance Flies

Diptera, the flies, is one of the largest Orders of insects, and fortunately most of them are considered to be beneficial. The few nuisance species can be easily confused because of the variety of sizes, shapes and color patterns. Three families having pestiferous species associated with horses worldwide are the Muscidae (house flies, stable flies, horn flies and face flies), Calliphoridae (the blow flies or bottle flies) and the Tabanidae (yellow flies, deer flies and horse flies). The conformations of most

of the pertinent Muscidae and Calliphoridae are similar to that of the house fly, with the Muscidae having generally dull, non-shiny coloration, and the Calliphoridae having metallic coloration. Exceptions exist. The Tabanidae have completely different conformations, with a variety of sizes and colors. They may or may not appear to be shiny because of their waxy surface coating, but they are not metallic. The eye colors of many tabanids are quite striking while the insects are alive, but fade to a dark gray or black after death. The female tabanids and both sexes of the stable fly are obligate blood feeders.

The flies discussed herein are all very strong fliers and can move relatively long distances in short periods. House flies and stable flies can fly 5 mph with no wind assistance. The flight speed of the other flies mentioned above has been difficult to document, but based on the size of the insects, they are probably capable of similar speeds. The mobility of these insects makes management difficult because the flies seen on the horses may be arriving from off-the-farm locations.

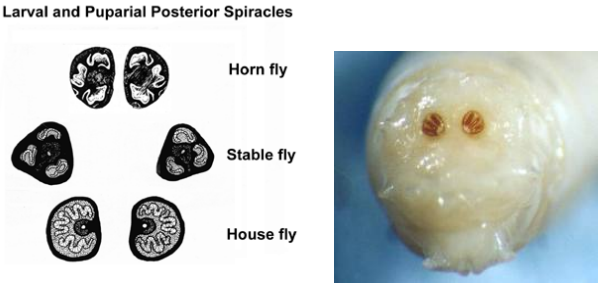
The few pertinent anatomical terms listed below may be encountered when reading technical articles. Definitions of other terms can be found on line.

Life Cycle

Members of the three families are found in essentially all parts of the US. The exception is the face fly, which does not penetrate into the hotter southern states. Fly activity is seasonal depending on temperature ranges suitable for adult survival and moisture levels in larval habitats. In the southern tier of states, house flies, stable flies, and horn flies can be present from almost January through December. Northern penetration during cooler months depends on annual temperature variation. The Muscidae and Calliphoridae have relatively short life cycles (6.5 days from egg to adult for house fly) and can produce many generations per year. By contrast, the Tabanidae usually have only one generation per year. Adults of some tabanids emerge over long periods of time and are visible in the environment for many months. Other species have shorter, more defined periods when adults emerge and these can be missed or overlooked. In some locations, the sheer volume of adult tabanids present in the environment simultaneously can cause problems for horses and humans alike.

Identification and Behavior of Immature Stages

Larvae: Most of the flies seen around horses will be in the adult stage. However, maggots or larvae will sometimes be seen if there is suitable habitat in stalls or manure wagons and such. Larvae are ectotherms and control their internal temperature by finding desirable temperature ranges in their developmental media. The larvae most often found in horse manure will be house flies. These larvae are slender and white and tend to be found in groups. Larvae in compacted hay or feed in paddocks are usually stable flies. These larvae are also slender and white, but they are usually found individually in the habitat. Larvae in garbage or organic wastes might be blow flies. These are larger, cream-colored larvae and are usually found grouped in large numbers. As soon as they are exposed to light, house fly and stable fly larvae attempt to burrow down into the habitat. This is not true for all blow flies, which tend to



Blow fly posterior spiracles

www.nadsdiptera.org Taphonomy wikispaces.com

ignore the light. These larvae can be identified by the shape of their posterior spiracles.

Horn fly and face fly females lay their eggs only in fresh cattle manure as soon as it hits the ground and larvae develop only in undisturbed

Third-instar house fly larva and young to older puparia

manure pats. Thus, these flies are produced by pastured animals, not confined animals where the manure is usually trampled into the ground. Tabanids lay their eggs in swampy, environmentally sensitive areas, and the immature stages are rarely if ever seen around livestock facilities.

Pupae: As stated above, the pupal stage where metamorphosis to the adult stage occurs. In the flies we are discussing, the actual pupa is inside of a protective puparium. However, the puparium with the pupa inside is commonly referred to as the pupa. The puparium is the last larval skin, and all of the characteristics remain. Thus, puparia can be identified by looking at the posterior spiracles. The most common puparia encountered around horses are from house flies, stable flies and possibly blow flies. Pupae are white when they first form and then turn darker with age.

Identification and Behavior of Adult Stages

Adult flies are also ectotherms and thermoregulate to maintain a desirable internal temperature range. On hot days adult flies will rest in cooler, shady areas and on cold days they will rest in the sun. Internal temperature required for flight is generally between 60 and 65° F. Mortality increases above 90° F. After adult flies emerge from their pupae and harden off, their size does not change. Adult fly size is within a range, not a single definitive size. This makes identification difficult at first, which is why knowledge of behavior is important. Taxonomic keys for Musca and Calliphorids can be helpful (http://www.cdc.gov/nceh/ehs/Docs/Pictorial_Keys/Flies.pdf) but identification of Tabanidae to species can be an impossible and unnecessary task. See simplified key below.

Muscidae: House flies, face flies, stable flies and horn flies can be difficult to distinguish for the uninitiated and house flies and face flies can be difficult for experts to distinguish. Links to additional information are given below, but many additional links can be found on the net.

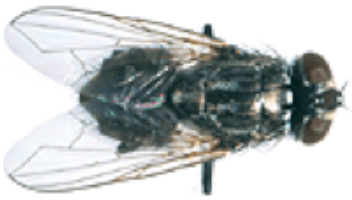
House flies – House flies, *Musca domestica*, L., are indicative of unsanitary conditions. When on the horse, house flies can be dispersed over the body, usually imbibing moisture on the hair. In extremely dry conditions, they may cluster on the face beneath the eyes in a manner characteristic of face flies. This is usually a temporary phenomenon. House flies tend rest on surfaces and leave spots which indicate preferred resting locations. House flies will enter barns, stalls within barns and tack and feed storage rooms. Adults will feed on and lay eggs in just about any moist organic materials. Large populations of house flies can be a nuisance to the horse and move to nearby residences and business where they can become a legal problem if the source can be determined. Established flight range is 20 miles. See link for photos and more information:

http://entnemdept.ufl.edu/creatures/urban/flies/house_fly.HTM

Stable flies – Stable flies, *Stomoxys calcitrans*, L., feed on the lower legs of the horse and are only on the horse long enough to feed. Because of their painful bite, their feeding is often interrupted by defensive actions of the horse. Therefore individual flies may attempt to feed several times on several animals before they take a complete blood meal. This interrupted feeding makes for a good vector, but so far stable flies have not been shown to be very successful vectors. After feeding, stable flies rest on nearby structures, e.g., fences, to digest their meal. Stable flies do not tend to enter barns, but this is not always the case. They are only attracted to host animals for feeding and to decomposing hay, straw or feed for laying eggs. Large numbers of feeding stable flies can make it difficult to ride a horse. Stable flies can fly 5 mph and the established flight range at this time is 135 miles with weather systems. See the link for photos and more information:

http://edis.ifas.ufl.edu/ig133

Face flies – As the name implies, face flies, *Musca autumnalis*, De Geer, are found on the face of the animal around the eyes. Face flies can rasp the conjunctiva near the medial canthus and cause increased eye secretions. They also feed on nasal discharges. Face flies are difficult to control and can be difficult to distinguish from house flies. Unlike house flies, face flies tend to be pasture pests and do not usually frequent barns and paddock areas. See link for photos and more information: http://vet.entomology.cals.cornell.edu/arthropod-identification/horse-recommendations/face-flies



Horn flies – *Haematobia irritans*, L., flies are actually a pest of cattle and have gradually adapted to using the horse as an alternate host. They can live on horse blood, but the larvae are unable to develop in horse manure. Horn flies on a horse have dispersed from nearby pastured cattle. The established flight range is 3 miles, but they will probably travel much further. The horn fly has established a very close relationship with the host and rarely leaves the host except, when the host is a cow, to lay eggs in freshly dropped cattle manure. Flies will move from one horse to another when horses are closely grouped. Male and female horn flies are obligate blood feeders and irritate the horse by intermittent feeding during the day. During cooler mornings and evenings, horn flies will be on the neck, withers and back. During warmer periods they will move to the shade in the vicinity of the ventral midline. These flies are much smaller than the other muscoid flies discussed here and their habit of staying on the host make them easy to identify. See link for photos and more information:
http://entnemdept.ufl.edu/creatures/livestock/flies/horn_fly.htm

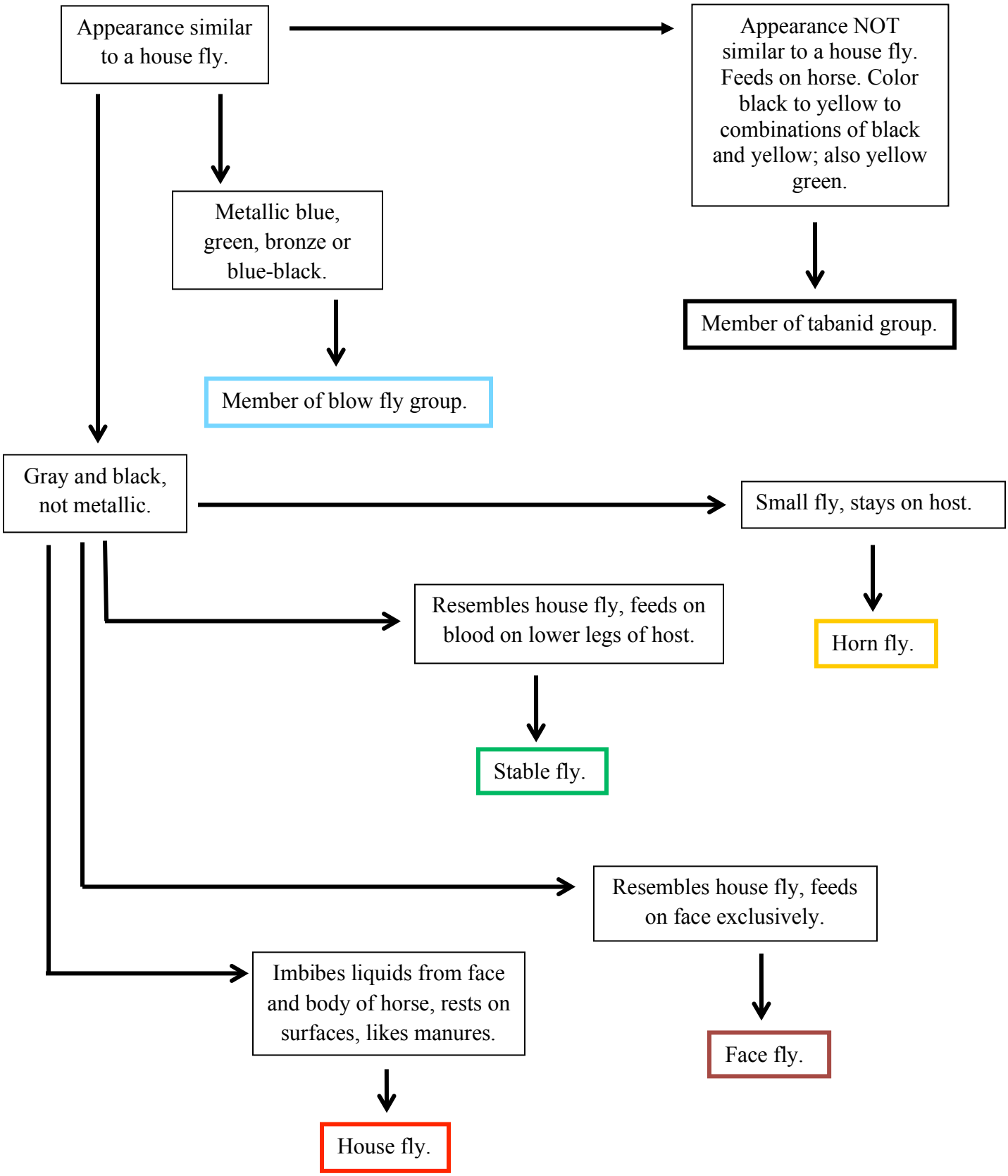
Calliphoridae: There are numerous blow fly species in the US. Essentially all are house fly size or larger, and are metallic blue, green, bronze or blue-black. No other nuisance fly has this metallic look. Blow flies are attracted to and feed on dead flesh, food waste and other organic materials for the most part. They are present around road kills. Blow flies on an equine facility would indicate improper handling of garbage or a dead animal or other fly production source nearby, e.g., a dump. They are not usually interested in the horses unless they have untreated open sores, or there is afterbirth left after foaling. Blow flies are ever present in the environment and they will appear out of nowhere when a food source is produced. These flies are present all year round, but are more prevalent during the cooler months. Blow flies will enter barns and stalls. They do not tend to rest on horses. These flies can probably also fly at 5 mph and a flight range has not been established. See link for photos and more information: http://entnemdept.ufl.edu/creatures/livestock/flies/lucilia_sericata.htm.

Tabanidae: This is a complicated group because of the sizes and colors and behaviors and feeding activities, and because of the names given to the flies by the general public who commonly come in contact with these flies. Some states have more than 100 species. Horse owners will talk about these flies using the common names, like greenheads, yellow flies, deer flies and horse flies. Other names may be used depending on location. In general, despite the names or the species, they are essentially impossible to control. Some of the new repellent wipes will provide limited periods of relief. In most locations, these flies are most numerous in late spring to early summer, e.g., April to May. These flies do not look like any of the flies discussed above. They can sometimes be seen resting on fences or buildings or on vehicles, but most often they immediately attack the horse. Females are obligate blood feeders, but males feed on nectar. Feeding can take place on all parts of the body and flies make persistent feeding attempts until replete. Because these flies inject an anticoagulant when feeding, sometime blood will drip from feeding sites after the flies leave. This is not a common situation in the US. These flies are fast fliers but flight ranges are unknown. See link for more information and photos:

http://en.wikipedia.org/wiki/Horse-fly

http://entnemdept.ifas.ufl.edu/creatures/livestock/deer_fly.htm

Quick identification key



Flies as Vectors

The flies in this section can transmit various organisms, but transmission of most of the important pathogens of horses is done best by mosquitoes. Below is a summary of organisms transmitted by the Muscidae, Calliphoridae, and Tabanidae.

House fly: Capable of mechanical transfer of almost any pathogen it comes in contact with. Most significant recent finding is the fly's ability to harbor and transmit the coliform O157:H7.

Stable fly: Shown in the laboratory to transmit many pathogens, but is not very successful in the field. Is a developmental vector for the nematode, *Habronema microstoma*, to horses in the US and many parts of the world. Can mechanically transmit equine infectious anemia.

Face fly: Stimulate tear production, which is the result of damage done to ocular tissue from their feeding activity. Can transmit pathogens that cause keratoconjunctivitis, and the eyeworm, *Thelazia lacrymalis*, in horses.

Horn fly: Feeding can cause seasonal midline dermatitis. Intermediate host for the filarid nematode, *Stephanofilaria stilesi*.

Calliphoridae: Similar to house fly, but since these flies rarely contact a live animal, they are not a threat.

Tabanidae: Have been shown to mechanically transmit a number of pathogens, including the ones causing equine infectious anemia and ringworm (*Microsporum gypseum*).

Control and Treatment Measures

Although fly management may not be the reason a practitioner is present at an equine facility, fly management questions are often asked. It is important to know which flies can be managed through the various methods. Farnam (Central Life Sciences) continues to maintain the most complete line of equine care products. However, other companies do exist and a variety of good product choices are available. Products can be found in feed stores and on line. Some links are provided for examples of product types. For pesticides, always follow label instructions. Green or natural on the label do not always mean effective. Natural repellents can be effective, but duration may be shorter than conventional repellents.

Feed-through additives for fly management are only potentially effective if flies are breeding in the manure from the horses on site being fed the additives. Face flies, horn flies and tabanids do not breed in horse manure. House flies and stable flies *can* breed in horse manure. Proper manure management can minimize this problem. Frustration occurs when flies are still present despite all of the best efforts to eliminate them. Many times this is because the flies on site have dispersed in from someplace else. This can be true for all of the flies discussed herein.

Insecticide resistance is a big problem in fly control and the affected flies are mainly the house flies and horn flies. Continued use of the same pesticide and use of long-term residual pesticides on surfaces or on animals are major causes. Most pesticides on the market are pyrethroids. If other chemical classes cannot be found for use, at least suggest rotation among pyrethroids.

Basic management methods for each nuisance fly are:

House fly – Sanitation, because of the possibility of on-site breeding, trapping, granular baits, and repellent wipes on animals. Surface residual sprays not recommended because of insecticide resistance.

Stable fly – Sanitation, because of the possibility of on-site breeding, trapping, repellent wipes on animals. Granular baits, which are sugar based, are not effective against stable flies, which are blood feeders.

Face fly – Use protective masks and on-the-animal pesticides and repellents.

Horn fly – On-the-animal pesticides and repellents are the only choices.

Tabanids – Very little management can be done. Available traps can be cumbersome to use, but effective psychological tools (http://horse-journal.com/article/horse-pal-remains-top-fly-trap-choice-16152). There are some repellent wipes that provide short-term relief, but pesticides are not effective. Sometimes fly populations will be lower in open pastures away from woods and marshy areas.

Sanitation implies removing stall and paddock litter and disposing of it properly. Stacking to reduce surface area is best. On facilities with small numbers of horses, covering stacks with plastic film can help reduce fly breeding. If hay is fed in paddocks, do not allow hay to be trampled into the substrate near the feeder. When enough hay accumulates, flies can develop in the hay right beneath the horses' feet. Depending on soil type, flies in substrates like hay can be found from several inches to several feet beneath the soil surface.

Traps for house flies rely on attractants with specific, but foul odors, e.g. Farnam Terminator trap (http://www.amazon.com/FARNAM-Home-Garden-3001920-Terminator/dp/B00061MSJ4) and bait, but traps for stable flies rely on reflectance of sun light, e.g., the KnightStick Trap (http://www.bugjammer.com/) and the Olson Sticky Trap (http://www.olson-products.com/Insect-Control-Pg--2.html). Place traps where flies are numerous. For stable flies, place traps as close to the animals as possible.

Granular baits for house flies

http://www.gemplers.com/product/147985/QuickBayt-Fly-Bait-5-lb-Pail-Granules) (http://farnamhorse.com/product.php?mainkey=200005&pid=100881&key=300002; can be effective for fly management in localized areas where flies tend to congregate, e.g. in dead air spaces in feed storage rooms. Follow label instructions and always place baits in shallow containers, such as paper plates. Keep out of the reach of pets. **Bait strips,** such as the Quik Strike Fly Abatement Strips (http://www.amazon.com/Farnam-Garden-Starbar-Strike-Abatement/dp/B000BWPBPG) can be effective for long periods. Affix this device to walls about 3 feet above the floor in dead air spaces where house flies tend to congregate.

To combat any flies that enter barns, **fans** provide effective, pesticide-free protection. Flies avoid the fans because they cannot control their flight.

Ultraviolet light traps (zappers) may be helpful inside of barns. Do not place them outside or operate them after dark because they will attract and kill mostly non-target insects.

Insecticide active ingredients labeled for topical application to control house fly

Active ingredients and concentrations	Application options	Precautions
Cypermethrin 0.15% + Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.20% + 0.13% Prallethrin	Spray	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% Diflubenzuron	Pour-on, Spray, or Wipe	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old
Pyrethrins 0.10% to 0.40%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. House flies are attracted to mucous discharges and wounds.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Insecticide active ingredients labeled in premise sprays to control house flies around barn and stable areas

Space spray or fogger for quick knockdown

Active ingredients	Insecticide Group Number*	Precautions and concentrations
Permethrin 10% to 40%	3	Spray when animals are absent Do not contaminate feed or water
Pyrethrins 0.10%	3	Spray when animals are absent Do not contaminate feed or water

Residual surface sprays to fly resting sites

Active ingredients	Insecticide Group Number*	Precautions and concentrations
Cyfluthrin 11.8%	3	Do not contaminate feed or water
Cyhalothrin 5.9 to 9.7%	3	Do not contaminate feed or water
Permethrin 7.4% to 40%	3	Do not contaminate feed or water
Spinosad 44.20%	5	Do not contaminate feed or water
Tetrachlorvinphos 50%	1	Do not contaminate feed or water

*Active ingredients classified in the same Insecticide Group number have the same mode of action or target site in a pest. Continued use of insecticides belonging to the same group can lead to resistance in the pest population. Rotation among groups will reduce the chance for resistance problems.

Use higher label application rates of active ingredient for longer duration of control.

Use space spray or fogger applications for rapid knockdown of high fly populations.

Insecticide active ingredients in baits labeled to control house flies

Active ingredients and concentrations	Insecticide Group Number*	Precautions
Dineotfuran 0.50%	4	
Imidacloprid 0.5% to 10%	4	
Methomly 1.0%	1	Do not apply where animals have access.

*Active ingredients classified in the same Insecticide Group number have the same mode of action or target site in a pest. Continued use of insecticides belonging to the same group can lead to resistance in the pest population. Rotation among groups will reduce the chance for resistance problems.

Insecticide active ingredients labeled to control house fly larvae by feed-thru application

Active ingredients and concentrations	Insecticide Group Number*	Precautions
Cyromazine 2.12%	17	
Diflubenzuron 0.24%	15	

*Active ingredients classified in the same Insecticide Group number have the same mode of action or target site in a pest. Continued use of insecticides belonging to the same group can lead to resistance in the pest population. Rotation among groups will reduce the chance for resistance problems.
Stable flies and house flies breed in many sites in addition to animal manure.

Insecticide active ingredients labeled to control house fly larvae in manure and spilled feed

Active ingredients and concentrations	Insecticide Group Number*	Precautions
Tetrachlorvinphos 50%	1	

*Active ingredients classified in the same Insecticide Group number have the same mode of action or target site in a pest. Continued use of insecticides belonging to the same group can lead to resistance in the pest population. Rotation among groups will reduce the chance for resistance problems.

Apply to active fly breeding sites.

Traps: A variety of house fly traps are available. The traps do provide an effective means of monitoring fly populations, which is helpful in managing a control program, but may not result in a noticeable reduction in fly populations.

Sticky ribbons and spot cards also provide means of monitoring and documenting fly populations.

Non chemical control:
A variety of beneficial insects are attracted to horse manure where they feed on immature stages of flies. Commercial firms also supply tiny parasitoid wasps that can be effective in augmenting natural control. It is important to have a high level of sanitation to minimize potential breeding sites so that the natural enemies have a reasonable chance to succeed.

Insecticide active ingredients labeled for topical application to control horse flies and deer flies

Active ingredients and concentrations	Application options	Precautions
Cypermethrin 0.15% + Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.50% + Pyrethrins 0.5%	Spray or wipe	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% Diflubenzuron	Pour-on, Spray, or Wipe	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on, or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe.	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old
Pyrethrins 0.10% to 0.25%	Spray or wipe	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. Treat head, neck, shoulders, flanks, legs, and rump.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

Source reduction: The larvae of most horse fly and deer fly species develop in moist semi-aquatic or aquatic areas that cannot be treated with insecticides.

Non-chemical control: Commercially available traps such as the Epps Biting Fly Trap, Greenhead / Horse Fly Trap, and Horse Pal Fly Trap can capture large numbers of flies if placed effectively. Plans for do-it-yourself traps are available on line. For example, http://extension.missouri.edu/p/G7013 . Any flies captured in traps will not attack horses. This may suppress numbers but in areas with large breeding sites but control may not be satisfactory.

Protective fly sheets may be useful in protecting pastured horses from horse and deer flies.

Open barns and sheds provide shelters where horses can escape attack during the day.

Insecticide active ingredients labeled for topical application to control horn fly

Active ingredients and concentrations	Application options	Precautions
Coumaphos 6.15%	Spray	Cholinesterase inhibitor
Cypermethrin 0.075%	Dust	
Cypermethrin 0.15% +Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.25%	Dust	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% diflubenzuron IGR	Spray, wipe or Pour-on	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old
Pyrethrins 0.10% to 0.20%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. Apply to back, sides, and underbelly.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

Source reduction: Horn flies only breed in fresh cow manure so they are a problem for animals pastured near cattle.

Non-chemical control:
Protective fly sheets may be useful in protecting pastured horses from horse and deer flies.

Open barns and sheds provide shelters where horses can escape attack.

Insecticide active ingredients labeled for topical application to control face flies

Active ingredients and concentrations	Application options	Precautions
Cypermethrin 0.075%	Dust	
Cypermethrin 0.15% +Pyrethrins 0.20%	Spray or wipe	
Permethrin 0.5%	Spray	
Permethrin 0.25%	Dust	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.20% + 0.13% Prallethrin	Spray	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% Diflubenzuron	Pour-on, Spray, or Wipe	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old
Pyrethrins 0.10% to 0.4%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. Apply to face and around eyes, being careful not to get product in the eyes. Face flies also may feed at wounds.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

Source reduction: Face flies only breed in fresh cow manure so they are a problem for animals pastured near cattle.

Fly masks can provide protection against aggravation by face flies.

Insecticide active ingredients labeled for topical application to control biting/ non-biting gnats (Black flies, No-see-ums, eye gnats, etc.)

Active ingredients and concentrations	Application options	Precautions
Cypermethrin 0.075%	Dust	
Cypermethrin 0.15% +Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.50%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.20% + 0.13% Prallethrin	Spray	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 0.9% + Tetramethrin 0.25% + Cypermethrin (0.10%)	Spray or wipe-on	Do not use on foals under 3 months old
Permethrin 5% + 5% Diflubenzuron	Pour-on, Spray, or Wipe	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on, paste or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old Suppression only
Pyrethrins 0.10% to 0.20%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. Black flies - wipe the inside of the ears, under chin, throat and midline of belly. Biting midges (Culicoides – nosee-ums) feed on back, sides and the underbelly, which is difficult to protect with insecticides or repellents. Eye gnats - apply to face and around eyes, being careful not to get product in the eyes.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

Source reduction: Black flies breed in flowing water of streams and rivers. Biting gnats develop in moist semi-aquatic or aquatic areas including treeholes, seepage areas, and other sites that are unknown or so diffuse that it is impractical to eliminate or treat them.

Black flies generally feed during daylight and are most problematic in the spring. Providing shelter or keeping horses up when populations of these flies are high may be a practical way of providing protection.

Ear nets can be used to protect against ear feeding by black flies.

Protective fly sheets may be useful in protecting pastured horses from biting gnats.

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Mites

Glossary/Terminology

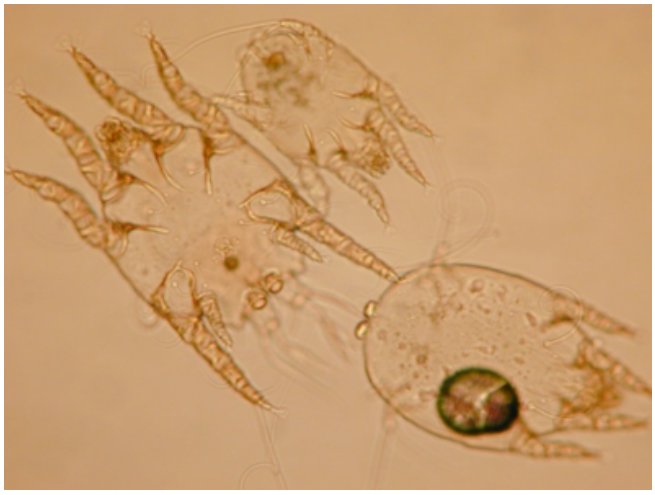
Chelicerae: piercing mouthparts
Coxae: basal segments of the leg that articulate with or are fused to the body wall.
Pedicel (stalk): thin extension off the end of the appendages/legs.
Setae: hair-like, cuticular process composed of hollow shaft found on the surface of the legs and body.
Tarsal suckers: an attachment organ found on the distil segments of the legs, typically on the end of the pedicel.

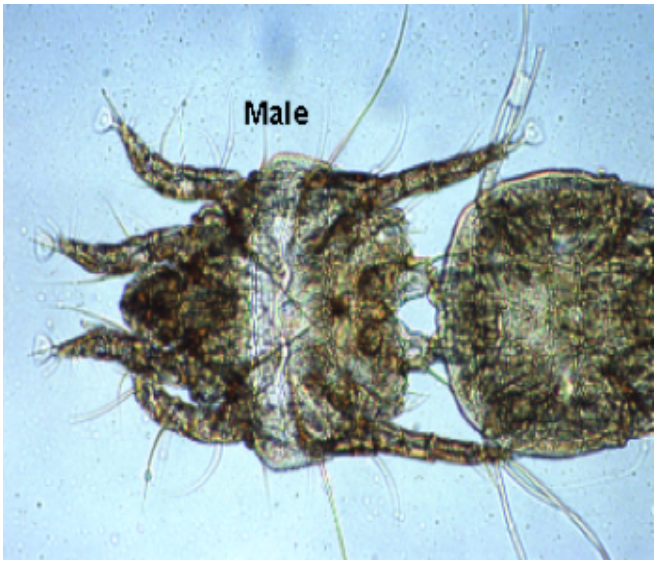
All mites including those of equines are phylum Arthropoda, class Arachnida, subclass Acari, order Acariformes. The suborder Sarcoptiformes or Astigmata contains the family Psoroptidae of which the genera *Chorioptes* and *Psoroptes* are equine parasites.

Categories

Chorioptes (equi) bovis

The genus has now been lumped into a single species although various populations of the mite are associated with specific areas of the body of specific host species. *Chorioptes* is the cause of leg mange of horses and is usually found in feathered area of fetlock on draft horses.





Oval body, coxae 1 and 2 separate from coxae 3 and 4 with tarsal suckers present on short stalks. All stages occur on host: adult → egg → larva → nymph; Egg to egg 3 weeks. The mite can survive off the horse for as long as 69 days in a suitable environment. It is more prevalent in cooler areas and during winter.

The mites feed on skin, do not burrow. The infestation is associated with foot stamping and "greasy heel." The hypersensivity of individual horses to the infestation varies considerably so that some horses will be adversely affected by comparatively few mites where as others will serve as a source of reinfestation.

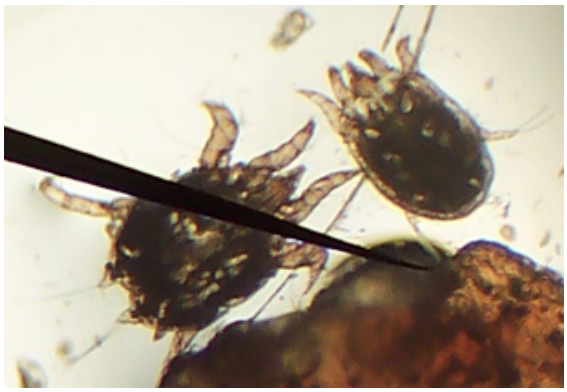
Psoroptes (equi) ovis

The genus has now been lumped into a single species although various populations of the mite are associated with specific areas of the body of specific host species.

Psoroptes is identified by the tarsal suckers on long jointed stalks; the body is oval with at least 3 pair of legs extending past body margins. The tarsal suckers are on long jointed stalks with the female suckers on legs 1,2 and 4, and long setae on leg 3. The male tarsal suckers are seen on legs 1, 2, and 3. All stages occur on host: adult → egg → larva → nymph with the

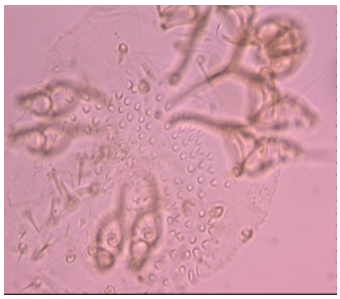
life cycle (egg to egg) 11 days with increased egg production in winter. Mites may survive off host for 15 20 days provided cool moist conditions.

Psoroptes (cuniculi) ovis is commonly found in ears of horses, goats and rabbits. There are extensive crusty scab formations in ear canal. In horses ears you may see white specks moving in brown exudate on the surface of the ear. Horses may have head sensitivity with swelling that becomes malodorous at base of ears.



Psoroptes (equi) ovis may be found under the mane, base of tail, axillae or between hind legs. It is a rare parasite and probably does not occur in North America. It is associated with pruritus and may be found by skin scraping.

Sarcoptes scabiei sarcoptic mange, scabies, scab is a member of the family Sarcoptoidea and is shared among a number of mammalian host species. *Sarcoptes* are round mites that live under keratin layers in epidermis. Coxae 1 and 2 are separate from coxae 3 and 4. On a dorsal view only legs 1 and 2 extending beyond body margin with long unsegmented bell stalks are seen. Legs 3 and 4 are short and stubby; do not extend beyond lateral margin of body. There are triangular scales on dorsum and a terminal anus.



Life Cycle/Biology

All life stages occur on host: adult → egg → larva → nymph; Egg to egg 3 weeks. They are more prevalent in cooler areas and during winter. The mites may survive off host for 15 20 days provided cool moist conditions. Populations of *Sarcoptes* are indistinguishable among those found on various hosts. They can colonize a different species of host causing pruritus but they cannot successfully breed on a host different from the one they are adapted to. Separate strains or races of *Sarcoptes* occur in dogs, man, horses, cattle, camels, llamas, swine, rabbits, foxes, sheep and goats.

Sarcoptes are tunneling mites and cause intense burning pruritus so the animal constantly rubs and scratches. The skin becomes thickened, dried and wrinkled. Scab formation occurs in infested areas due to self-mutilation from scratching and serum oozing from damaged skin and there is extensive alopecia. In the horse there is dry mange on sides, back, and shoulders and the mite may illicit pruritic response in handlers, "cavalryman's itch."

The suborder Trombidformes or Prostigmata includes the family Demodicidae of which the genus *Demodex* spp. is well known in veterinary medicine but rarely encountered in equids.

Demodex are elongate cigar shaped mites with short stubby legs grouped toward anterior that live in hair follicles and sebaceous glands. They are common symbionts of many hosts so that disease is rare, but infection common. Demodectic mite species are host specific.

Two species of *Demodex* have been described in horses, *Demodex equi* on the body and *D. caballi* the eyes and muzzle. Both are extremely rare but can be associated with alopecia or formation of nodules where the mites are located. Sufficient numbers of mites so they can be found are often associated with long term corticosteroid treatment or other conditions affecting the horse's immune system.

Trombiculidae is the family of mites commonly known as Chiggers. Chiggers are the larva of trombiculid mites over 40 genera found within the continental United States. Most are yellow to red in color (red bugs), have 3 pair of legs, often body and legs have many setae (hairy).

The salivary enzymes cause local dermatitis in man and other animals. Chiggers only feed for hours but the pruritus persists for days. Hypersensitive areas are easily invaded by secondary bacterial or fungal agents the nymphs and adults are free-living. They are most commonly active in early spring or fall. Harvest mite or red bug season varies geographically. The mites are easy to kill but damage already done pruritus with possibly papules may be seen. Usually the mites will have moved on by the time a skin scraping is done.

The Trombidiformes superfamily Pyemotoidea contains the genus *Pyemotes* (Straw or Forage Itch Mites). These mites usually feed on insects in hay, straw and grain and can opportunistically infest horse and handlers skin. Papules and wheals appear on the face and neck if horses are fed from a hay rack, and on the muzzle and legs if fed from the ground. Human infestation occurs where the feedstuff was carried.

Pruritus is variable and can be controlled with glucocorticoids. These mites are not truly parasitic but will attempt to get a meal when the opportunity presents itself. The salivary and excretory products of many arthropods contain common antigens and individual animals may become sensitized by one arthropod then show signs of allergy when encountering other species.

Diagnosis, Identification and Clinical Signs

Most mite infections are characterized by pruritus with hair loss in the affected area. The skin may also become thickened with papual eruptions. The skin may also become excoriated with serum oozing. Crusting may develop.

The skin lesions are due to the direct effects of the mites as well as trauma from the intense pruritus and resultant rubbing or scratching by the host.

Perform skin scrapings of the affected areas. Use low power objectives (10 to 30X) on microscope to identify mites.

Associated Diseases/Conditions

There are no known infectious diseases transmitted by mites in horses.

Treatment

Never use Amitraz on horses!

Psoroptes: Treatment with macrocyclic lactones such ivermectin or eprinomectin should be quite effective against this mange mite and the widespread use of these drugs as anthelmintics has probably done much to lower the incidence of infestation.

Chorioptes: Both topical and injectable acaracides such as ivermectin, pour-on moxidectin, sprays with coumaphos or permethrin and topical products containing fipronil, usually used in small animals, have been used to treat horses.

However because the mites are surface feeders the systemic drugs are only partially effective in removing the mites from the host. Removing hair and skin debris in the infested area by clipping and shampooing may enhance the effectiveness of treatment. The fact that many horses do not show any signs of infestation and the mites or eggs can be transferred by grooming equipment makes it difficult to control unless all of the horses in the vicinity are treated.

Sarcoptes: Organophosphate insecticides or lime-sulfur solution can be used. These may require spraying, sponging, or dipping. Multiple treatments are recommended repeated at 12- to 14-day intervals at least 3–4 times. Oral administration of ivermectin or moxidectin at 200 µg/kg can also be used. Several treatments are required 2–3 wk apart. It is sometimes required that these treatments be used concurrently. It is also important to treat all the animals in direct contact.

Corticosteroids may be helpful to relieve signs and repellants help in protecting further infestation.

Never use Amitraz on horses!

Insecticide active ingredients labeled for topical application to control mites

Active ingredients and concentrations	Application options	Precautions
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Pyrethrins 0.20%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. Chorioptic mites cause leg mange of horses and usually are found in feathered area of fetlock on draft horses. *Psoroptes (cuniculi) ovis* is commonly found in ears of horses. *Sarcoptes* mites are tunneling mites and cause intense burning pruritus; there is dry mange on sides, back, and shoulders.

Removing all crusts, scales, and other skin debris before the application will increase the efficacy of control measures.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

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Lice

Glossary/Terminology

Nits: lice eggs
Nymph: immature form of life cycle following hatch from egg
Pediculosis: infestation of animals or humans by biting or sucking lice.

Categories

Lice are members of the Phylum Arthropoda, Class Insecta, and Orders Anoplura (sucking Lice) and Mallophaga (chewing biting lice). Horses, donkeys, mules and other equids may be parasitized by an Anopluran or sucking louse, *Haematopinus asini*, and a mallophagan louse, *Werneckiella (Damalinia, Bovicola) equi*. These species of lice are capable of parasitizing the skin and/or subcutaneous tissues of horses.

Lifecycle/Biology

As a sucking lice, *Haematopinus asini* feeds on tissue, fluids, and blood from horses, whereas Bovicola *(Werneckiella) equi* ingests skin and the occasional blood meal from horses.

Lice undergo a life cycle referred to as a simple metamorphosis, consisting of the egg (nit), larvae (nymph), and an adult stage. All stages of the louse lifecycle may be found among the body hair coat of the infested horse. Lice are typically host specific insects, and thus, horse lice are permanent ectoparasites of horses. The entire lifecycle of the horse lice species are spent on the horse (or other equids).

The eggs are oval, pale, and translucent. Adult females oviposit their eggs or nits on hairs, near the skin, using a 'glue-like' substance as a means of attachment. A female will deposit 1 egg/day and will usually live 30-35 days. Eggs hatch in 5 to 20 days, into small, pale nymphs, which are the same general body configurations – head, thorax, and abdomen. Sucking lice nymphs begin taking blood meals immediately, reaching maturity in 2-4 wks. Lice breed in a horse's thick hair coat, and can be found throughout the year, but the total population numbers tend to diminish during the spring to summer months. Transmission of lice is by direct contact between horses, via infested brushes, blankets and other tack.

Geographical

Both *Haematopinus asini* and Bovicola *(Werneckiella) equi* have a worldwide distribution. In temperate parts of the world, populations of horse lice are characteristically greatest during the winter or early spring with a decline in the summer.

Identification

Adult lice are dorsal-ventrally flattened insects, a configuration that allows them to position themselves under the hair coat. As insects, the typical louse possesses a body with three distinct divisions: the head, the thorax, and the abdomen. Sucking and chewing/biting lice can be differentiated by a comparison between the widest part of the head (minus the antennae) with the widest part of the thorax. Sucking lice possess a head which is narrower than the widest part of the thorax, whereas chewing lice will have a head that is wider than the widest part of the their thorax.

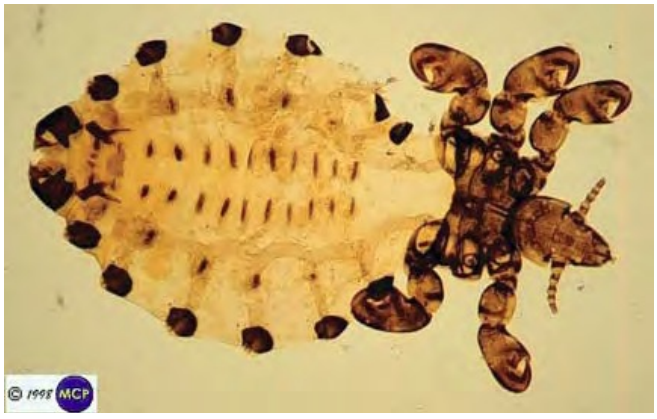
The sucking louse, *Haematopinus asini* is approximately 3-5 mm long, grey to yellow-brown in color, with a thorax which is about half the width of it's the abdomen. The head of *H. asini* is narrowed anteriorly, and less than one-third of it's abdominal width. Since it is a sucking louse, this louse possesses distinct piercing mouth parts. *H asini is* often found on the head, mane and tail, and tend to move slowly. This specie may be observed with its mouthparts embedded in the skin.

The chewing louse, *Werneckiella equi*, is

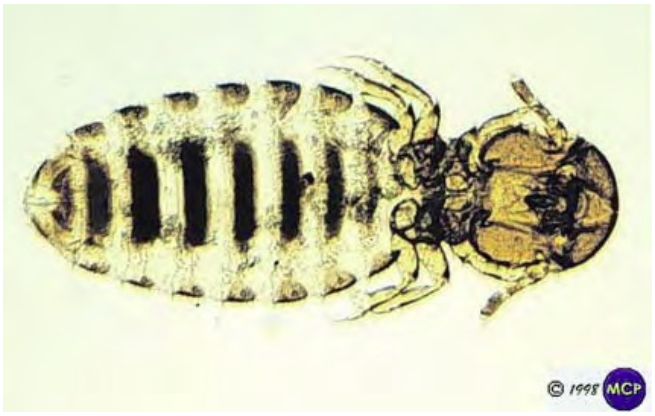
approximately 1-2mm long, flat with broad, rounded head. This louse has an arc, anterior to the antennae, a ventral chewing mandible, and thin legs. These chewing lice also are brown in color, and have yellow abdomens with contrasting dark bands. *W. equi* lice are usually found on the back and flanks, are more mobile and tend to move faster than *Hematopinus asini*. However, when heavy infestations occur, lice can be found everywhere on the body.

Extension bulletin with photos of equine lice, page 9
http://www.uaex.edu/publications/pdf/MP484.pdf

Sucking louse, *Haematopinus* sp. (Marcelo de Campos Pereira, http://www.icb.usp.br/~marcelcp/**)**



Horse biting louse, *Bovicola equi* (Denny). (Marcelo de Campos Pereira, http://www.icb.usp.br/~marcelcp/**)**



Lice overview with photos.
http://www.merckvetmanual.com/mvm/integumentary_system/lice/lice_in_horses_and_donkeys.html

Lice nits on a horse

Clinical Signs & Diagnosis

Lice infestations are more common in sick, debilitated, possibly under conditioned, immunosuppressed animals. Pediculosis in horses is characterized by pruritus (scratching, rubbing, biting, etc), skin irritation, unthrifty appearance, a rough 'unkept' hair coat, and possibly a loss of body condition. In severe infestations, hair loss and skin scarification are often seen, and in the case of sucking lice, anemia may be present. Although both types of lice can be found anywhere on the horse, the chewing lice are more common on the head, mane, tail base, and shoulders; whereas the sucking lice are more commonly found in shorter haired regions of the horse (eg. head, neck, back, and inner thigh). Lice infestations and subsequent clinical signs are more common in late winter and early spring. Horses with thick hair coats appear to be more commonly infested. Some heavily infested horses may exhibit a nervous behavior which is associated with the constant irritation of feeding lice.

A diagnosis can be made based the presence of lice on the horse and possibly clinical signs. Use of a pen light and magnifying glass may be helpful, in a well lighted environment, the hair

around affected areas of the horse can be carefully parted, and the layers of the hair coat and skin carefully examined. Fast moving chewing lice are more easily observed, while sucking lice tend to move more slowly. Louse eggs can also be detected as small white eggs 'cemented' to the hair shafts. The mane, forelock, lower neck and base of tail are common sites of infestations and clinical signs.

Associated Disease/Condition

There is no documented transfer of infectious disease by lice in the horse.

Specific Control and Treatment Measures

Infested horses should be thoroughly washed with a shampoo that contains an approved insecticide (permethrins , coumaphos, dichlorvos, etc), insuring adequate skin contact to all affected areas. The use of a shampoo containing 1% selenium sulphide, just prior to the application of the insecticide containing shampoo, may help remove dead skin and scale, and allow for better insecticide contact. Selenium sulfide shampoos may also have a direct antiparasitic action. To maximize the effectiveness of lice control, the shampooing/cleaning should be repeated in two weeks in order to kill any nits that hatch after the first treatment. If shampooing is impractical, wetable powders or dusts containing insecticides (eg. carbaryl, coumaphos, fenthion, pyrethroids synergized with piperonyl butoxoide, rotenone, etc) can be used. Regardless of the method used (washing or dusting) the horse should be completely covered and the treatment should come in contact with the lice near or on the skin. The treatments may also be delivered by spraying, but care should be taken to insure sufficient skin contact. Gloves, and other protective gear should be worn in order to minimize human skin, eye, etc contact with the lice killing chemicals. The person treating the horse should also make every attempt to avoid the horse's eyes, mucosa of the mouth, nostrils, prepuce and vulva when applying insecticides or other chemicals. When using organophosphates such as coumaphos, you may be required to obtain a special application license—depending upon the formulation and the specific requirements of your state. These products should not be used on horses intended for slaughter.

The routine use of a macrocyclic lactone de worming products (ivermectin, moxidectin) may also aid in the control of sucking lice. A possible treatment protocol may include the use of deworming product, particularly if the horses are concurrently parasitized with susceptible nematodes. It is preferable that all product labels be carefully read, the instructions followed and only approved lice control products be used. Where possible, the extra label use of any insecticide, or other pharmaceutical should be avoided.

All fomites (eg.,tack, brushes, saddles, etc) should be treated with an effective insecticide. Blankets used on infested horses should also be washed in hot water, carefully rinsed, then dried at the hottest possible clothes dryer setting.

Insecticide active ingredients labeled for topical application to control lice (biting and chewing)

Active ingredients and concentrations	Application options	Precautions
Coumaphos 6.15%	Spray	Cholinesterase inhibitor Dilute before using (Follow all label precautions when using these product)
Cypermethrin 0.15% + Pyrethrins 0.20%	Spray or wipe	
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.20%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.20% + 0.13% Prallethrin	Spray	
Permethrin 0.25%	Dust	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 5% + 5% diflubenzuron IGR	Spray, wipe or Pour-on	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe Dilute before use	
Pyrethrins 0.10%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness. Clean and treat grooming equipment with insecticide after use.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed. The sucking louse is numerous in the mane, base of the tail, on the fetlocks, and upper and inner thighs. The chewing louse is commonly found on the forehead, neck, and dorso-lateral trunk. However, both can occur over larger areas in cases of heavy infestation.

Insecticides kill adults and nymphs (immature stages) but not the eggs (nits). A second treatment applied 14 to 21 days after the first is necessary to control the infestation.

Carefully examine newly acquired animals for lice. Those found to be infested or coming from a premise with a history of infestation should be isolated and treated before introduction to the herd.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe the horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Instruct clients to notify you if signs of sensitivity to treatment are observed.

Available insecticide products containing active ingredients for topical application to control lice

Brand name	AI 1	AI 2	Synergist
Bite Free Biting Fly Repellent	Cypermethrin 0.15%	Pyrethrins 0.20%	Piperonyl butoxide 1.60%
Endure Roll-on for Horses	Cypermethrin 0.15%	Pyrethrins 0.20%	Piperonyl butoxide 1.60%
Endure Sweat-Resistent Fly Spray	Cypermethrin 0.15%	Pyrethrins 0.20%	Piperonyl butoxide 1.6%
Tri-Tec 14	Cypermethrin 0.15%	Pyrethrins 0.20%	Piperonyl butoxide 1.6%
Absorbine Ultrashield Sport	Cypermethrin 1.0%		
Ambush Insecticide and Repellent	Permethrin 0.10%	Pyrethrins 0.05%	Piperonyl butoxide 0.5%
Bronco Equine Fly Spray Plus Citronella Scent	Permethrin 0.10%	Pyrethrins 0.05%	Piperonyl butoxide 0.5%
Flysect Super-7 Repellent Spray	Permethrin 0.20%	Pyrethrins 0.20%	Piperonyl butoxide 0.50%
Absorbine Dura Guard Insecticide & Repellent	Permethrin 0.20%	Pyrethrins 0.10%	
Mosquito Halt Repellent Spray For Horses	Permethrin 0.20%	Prallethrin 0.13%	Piperonyl butoxide 0.50%
Absorbine Ultrashield EX Insecticide & Repellent	Permethrin 0.5%	Pyrethrins 0.10%	Piperonyl butoxide 1.0%
Bio-Groom Repel-35 Insect Spray	Permethrin 0.5%		
Cut-Heal Zonk it!35	Permethrin 0.5%		
Gordon's Horse & Pony Spray	Permethrin 0.50%	Pyrethrins 0.5%	Piperonyl butoxide 0.5%
Absorbine Ultrashield Red	Permethrin 0.9%	Tetramethrin 0.25%	Pyrethrins 0.025% PBO 1.0% Cypermethrin 0.10%
Equicare Flysect Super-C Repellent Concentrate	Permethrin 1.0%	Pyrethrins 0.50%	Piperonyl butoxide 1.85%
Brute Pour-On Insecticide	Permethrin 10%		
Permectrin II	Permethrin 10%		
Atroban 11%EC	Permethrin 11%		
Gardstar 40% EC Livestock And Premise Insecticide	Permethrin 40%		

Available insecticide products containing active ingredients for topical application to control lice (continued)

Brand name	AI 1	AI 2	Synergist
Equi-Spot Spot-On Fly Control For Horses	Permethrin 45%		
FlyRid Plus Spot-On Fly Control For Horses	Permethrin 45%		
Celebration Spot-On	Permethrin 45%		
Freedom Spot-On 45	Permethrin 45%		
Prozap War Paint Insecticidal Paste	Permethrin 7%		
Permectrin CDS	Permethrin 7.4%	Piperonyl butoxide 7.4%	
Bronco Gold Equine Fly Spray	Pyrethrins 0.10%	Piperonyl butoxide 1.0%	
Equicare Flysect Citronella Spray	Pyrethrins 0.10%	Piperonyl butoxide 1.0%	
Equisect Fly Repellent	Pyrethrins 0.10%	Piperonyl butoxide 1.0%	
Pyranha Wipe n Spray for Horses	Pyrethrins 0.10%	Piperonyl butoxide 1.0%	
Prozap Aqueous Fly Spray	Pyrethrins 0.10%	Piperonyl butoxide 1.0%	
Wipe Fly Protectant	Pyrethrins 0.20%	Piperonyl butoxide 0.5%	
Equine Spray n Wipe	Pyrethrins 0.25%	Piperonyl butoxide 2.5%	

Extension bulletin with list of equine lice control products, pg 3.
http://msuextension.org/publications/AgandNaturalResources/MT201002AG.pdf

Extension bulletin with products for external parasite control in horses, lice is found on page 9.
http://alabamahorsecouncil.org/wp/wp-content/uploads/2011/10/ANR-0464-Managing-Pests.pdf

Prevention and Environmental Control Options

Infested horses should be kept separate form non infested horses. Tack and other grooming equipment should never be used on infested and non-infested horses. In the case of an extensive louse infestation within a stable or other horse facility, all horse handling or grooming equipment should be thoroughly cleaned, and Sevin dust or a pyrethroid spray or powder should be applied on the floors of infested areas. Good grooming practices are also an important part of early detection and control. Careful attention to adequate nutritional intake and body condition score, internal parasite control, overall health particularly in geriatric or other at risk horses (chronic illness, thin, poordoers) may aid in the prevention and or treatment.

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Mosquitoes

Glossary/Terminology

There are more than 3,000 species of mosquitoes, but the members of three bear primary responsibility for the spread of diseases that can cause deaths worldwide each year. Anopheles mosquitoes are the only species known to carry malaria. They also transmit filariasis (also called elephantiasis) and encephalitis. Culex mosquitoes carry encephalitis, filariasis, and the West Nile virus, and Aedes mosquitoes, of which the voracious Asian tiger is a member, carry yellow fever, dengue, and encephalitis. Approximately 150 species of mosquitoes are found in the United States and their irritating bites and nearly ubiquitous presence can ruin a late afternoon ride or a trail ride through the woods.

Mosquitoes transmit disease in a variety of ways. In some instances, parasites attach themselves to the gut of a female mosquito and enter a host as she feeds and in others a virus enters the mosquito as it feeds and is transmitted via the mosquito's saliva to a subsequent victim. While mosquitos feed on humans, they usually prefer horses, cattle, or birds, which is why we need to understand their life cycles to help protect our horses.

All mosquitoes must have water in which to complete their life cycle. This water can range in quality from melted snow water to sewage effluent and it can be in any container imaginable. The type of water in which the mosquito larvae is found can be an aid to the identification of which species it may be. Adult mosquitoes show a very distinct preference for the types of sources in which to lay their eggs. They lay their eggs in such places such as tree holes that periodically hold water, tide water pools in salt marshes, sewage effluent ponds, irrigated pastures or rain water ponds. Each species has unique environmental requirements for the maintenance of its life cycle.

Mosquitoes use exhaled carbon dioxide, body odors, temperature and movement to home in on their victims. Only female mosquitoes have the mouth parts necessary for sucking blood. When biting with their proboscis, they stab two tubes into the skin: one to inject an enzyme that inhibits blood clotting; the other to suck blood into their bodies. They use the blood not for their own nourishment but as a source of protein for their eggs. For food, both males and females eat nectar and other plant sugars. Some mosquitoes prefer to feed on only one type of animal or they can feed on a variety of animals. In addition to horses, mosquitoes feed on man, other domesticated animals and wild animals, all types of birds, and snakes, lizards, frogs, and toads.

The flight habits of mosquitoes depend on the species. Most domestic species remain fairly close to their point of origin, but there are some species that migrate far from their breeding place. The flight range for females is usually longer than that of males. Many times wind is a factor in the dispersal or migration of mosquitoes. Most mosquitoes stay within a mile or two of their source. However, some have been recorded as far as 75 miles from their breeding source.

The length of life of the adult mosquito depends on several factors: temperature, humidity, sex of the mosquito and time of year. Most males live for about a week and females live about a month depending on the above factors.

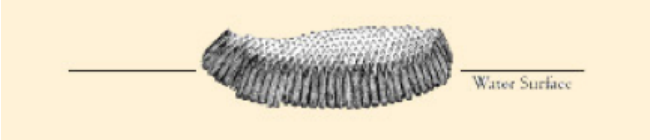
Lifecycle/Biology

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.

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.

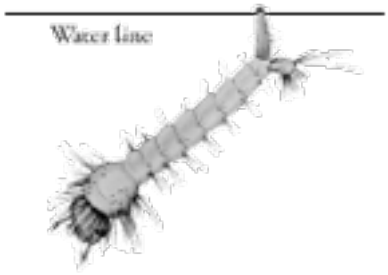
Mosquito Egg Raft



Culex mosquitoes lay their eggs on the surface of fresh or stagnant water, usually at night. The water may be in tin cans, barrels, horse troughs, ornamental ponds, swimming pools, puddles, creeks, ditches, or marshy areas. The female will lay her eggs one at a time, sticking them together to form a raft of 200- 300 eggs. A raft of eggs looks like a speck of soot floating on the water and is about 1/4 inch long and 1/8 inch wide. Tiny larvae emerge from the eggs within 24 hours. Mosquitoes prefer water sheltered from the wind by grass and weeds. A mosquito may lay a raft of eggs every third night during its life span.

Anopheles mosquitoes lay their eggs singly on the water, not in rafts. Aedes mosquitoes lay their eggs singly on damp soil. These eggs will hatch only when flooded with water (salt water high tides, irrigated pastures, treeholes, flooded stream bottoms, etc.).

Larva: Mosquito larvae live in the water and come to the surface to breathe. They shed their skin four times growing larger after each molting. The stages between molts are called instars. At the 4th instar, the larva reaches a length of almost 1/2 inch. 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.



Mosquito Larva

Mosquito larvae are commonly called "wigglers" or "wrigglers" and they must live in water from 7 to 14 days depending on water temperature.

Larvae must come to the surface at frequent intervals to obtain oxygen through their siphon. The larva eats algae and small organisms which live in the water.

Pupa: The pupal stage is a resting, non-feeding stage. At this stage of life the pupa are called "tumblers", and they must live in water from 1 to 4 days, depending upon species and temperature. The pupa is lighter than water and therefore floats at the surface. It takes oxygen through two breathing tubes called "trumpets". When it is disturbed it dives in a jerking, tumbling motion and then floats back to the surface. This is the time the mosquito turns into an adult. When development is complete, the pupal skin splits and the adult mosquito emerges to the surface of the water where it rests until its body can dry and harden.

Mosquito Pupa

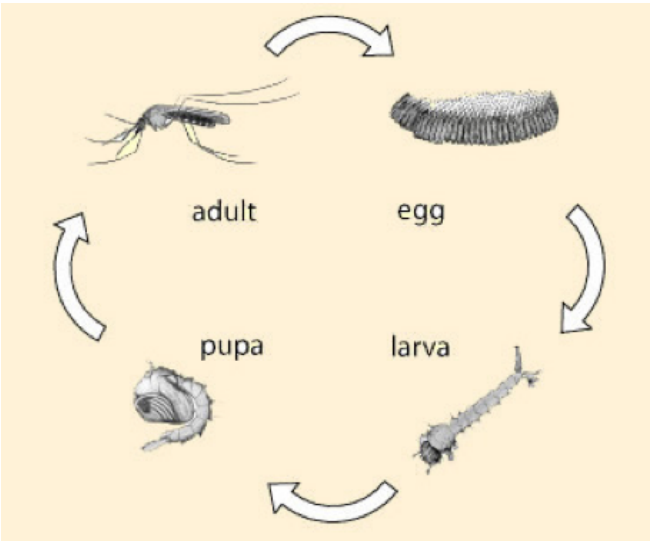
Mosquito Adult

Aedes mosquitoes are painful and persistent biters, attacking during daylight hours (not at night). They do not enter dwellings, and they prefer to bite mammals. They are strong fliers and are known to fly many miles from their breeding sources.

Culex mosquitoes are painful and persistent biters also, but prefer to attack at dusk and after dark, and readily enter dwellings for blood meals. Domestic and wild birds are preferred over horses. *Culex tarsalis* is known to transmit encephalitis (sleeping sickness) to man and horses. This genus is generally a weak flier and does not move far from their breeding ground, although they have been known to fly up to two miles. *Culex* species usually live only a few weeks during the warm summer months. However, the females that emerge in late summer search for sheltered areas where they "hibernate" until spring. Warm weather brings them back out in search of water on which to lay eggs.

Culiseta mosquitoes are moderately aggressive biters, attacking in the evening hours or in shade during the day.

Mosquito Life Cycle



Associated disease/condition

Mosquito borne viruses	Transmission	Vector	Equine Amplifiers	Equine Mortality %	Equine Morbidity/year
WEE	Birds	Culex tarsalis	No	3-5o	0-5
EEE	Birds	Aedes and Coquillecttidia	1 out of 20	70-90	120
VEE	Rodents	Culex	Unknown	Rare	Unknown
SLE	Birds	Culex	No	None	None
JE	Birds	Culex	No	Rare	Unknown
WNV	Birds, Horses, Alligators	Aedes, Culex, Anopholes	No	30	~200

Information on Arboviral Encephalitides

Arthropod-borne viruses or arboviruses are maintained in nature through biological transmission between susceptible vertebrate hosts by blood feeding arthropods (mosquitoes, psychodids, ceratopogonids, and ticks). Vertebrate infection occurs when the infected arthropod takes a blood meal. Togaviridae are small, lipid- and protein-enveloped RNA viruses. Arboviruses of the genera *Alphavirus* and *Flavivirus* have been associated with encephalitis in horses. The *Alphavirus* species tend to be more infectious and more often associated with epidemics compared with the *Flavivirus* species.

Arboviral encephalitides have a global distribution, but the main virus agents of encephalitis in the United States are eastern equine encephalitis (EEE), western equine encephalitis (WEE), and St. Louis encephalitis (SLE), all of which are transmitted by mosquitoes. Most cases of arboviral encephalitis occur from June through September, when arthropods are most active. In milder parts of the country, where arthropods are active late into the year, cases can occur into the winter months.

All arboviral encephalitides are zoonotic, being maintained in complex life cycles involving a nonhuman primary vertebrate host and a primary arthropod vector. Humans and domestic animals can develop clinical illness but usually are "dead-end" hosts because they do not produce significant viremia, and do not contribute to the transmission cycle. Many arboviruses that cause encephalitis have a variety of different vertebrate hosts and some are transmitted by more than one vector. Maintenance of the viruses in nature may be facilitated by vertical transmission.

Eastern Equine Encephalitis is caused by a virus transmitted to humans and equines by the bite of an infected mosquito. EEE virus is an *Alphavirus* that was first identified in the 1930's and currently occurs in focal locations along the eastern seaboard, the Gulf Coast and some inland Midwestern locations of the United States. Equine epizootics can be a common occurrence during the summer and fall.

EEE virus can produce severe disease in horses, some birds such as pheasants, quail, ostriches and emus, and even puppies. Because horses are outdoors and attract hordes of biting mosquitoes, they are at high risk of contracting EEE when the virus is present in mosquitoes. Human cases are usually preceded by those in horses and exceeded in numbers by horse cases which may be used as a surveillance tool.

EEE virus occurs in natural cycles involving birds and *Culiseta melanura* and *Aedes* spp., in some swampy areas nearly every year during the warm months. Where the virus resides, or how it survives in the winter, is unknown. It may be introduced by migratory birds in the

spring or it may remain dormant in some yet undiscovered part of its life cycle. With the onset of spring, the virus reappears in the birds (native bird species do not seem to be affected by the virus) and mosquitoes of the swamp. In this usual cycle of transmission, virus does not escape from these areas because the mosquito involved prefers to feed upon birds and does not usually bite humans or other mammals.

For reasons not fully understood, the virus may escape from enzootic foci in swamp areas in birds or bridge vectors such as *Coquilletidia perturbans* and *Aedes sollicitans*. These species feed on both birds and mammals and can transmit the virus to humans, horses, and other hosts. Other mosquito species such as *Aedes vexans* and *Culex nigripalpus* can also transmit EEE virus.

Western Equine Encephalitis was first isolated in California in 1930 from the brain of a horse with encephalitis, and remains a cause of encephalitis in horses and humans in North America, mainly in western parts of the USA and Canada. In the western United States, the enzootic cycle of WEE involves passerine birds, in which the infection is unapparent, and culicine mosquitoes, principally *Culex tarsalis*, a species that is associated with irrigated agriculture and stream drainages. The virus has also been isolated from a variety of mammal species. Other important mosquito vector species include *Aedes melanimon* in California, *Aedes dorsalis* in Utah and New Mexico and *Aedes campestris* in New Mexico. WEE virus was isolated from field collected larvae of *Aedes dorsalis*, providing evidence that vertical transmission may play an important role in the maintenance cycle.

Expansion of irrigated agriculture in the North Platte River Valley during the past several decades has created habitats and conditions favorable for increases in populations of granivorous birds such as the house sparrow and mosquitoes such as *Culex tarsalis*, *Aedes dorsalis* and *Aedes melanimon*. All of these species may play a role in WEE virus transmission in irrigated areas.

Venezuelan Equine Encephalitis (VEE) like EEE and WEE, is an alphavirus and causes encephalitis in horses and humans and is an important veterinary and public health problem in Central and South America. Occasionally, large regional epizootics and epidemics can occur resulting in thousands of equine and human infections. Epizootic strains of VEE virus can infect and be transmitted by a large number of mosquito species. The natural reservoir host for the epizootic strains is not known. A large epizootic that began in South America in 1969 reached Texas in 1971. It was estimated that over 200,000 horses died in that outbreak, which was controlled by a massive vaccination program using an experimental live attenuated VEE vaccine.

Enzootic strains of VEE virus have a wide geographic distribution in the Americas. These viruses are maintained in cycles involving forest dwelling rodents and mosquito vectors, mainly *Culex* species.

An equine vaccine is available for EEE, WEE and VEE. Arboviral encephalitis in horses is best prevented by ensuring that horses are immunized appropriately and steps are taken to reduce the population of infected mosquitoes.

West Nile Encephalitis (WNV) is a flavivirus belonging taxonomically to the Japanese encephalitis serocomplex that includes the closely related St. Louis encephalitis (SLE) virus. WNV has the most widespread geographical distribution and the largest vector and host range of all mosquito-borne flaviviruses. WNV was first isolated in the West Nile Province of Uganda in 1937. The first recorded epidemics occurred in Israel during 1951-1954 and in 1957. Epidemics have been reported in Europe in the Rhone delta of France in 1962 and in Romania in 1996.

An outbreak of arboviral encephalitis in New York City and neighboring counties in New York state in late August and September

1999, was initially attributed to SLE virus based on positive serologic findings in cerebrospinal fluid and serum samples using a virus-specific IgM-capture ELISA. The outbreak was subsequently confirmed as caused by West Nile virus based on the identification of virus in human, avian, and mosquito samples. SLE and WNV are antigenically related, and cross reactions are observed in most serologic tests. The limitations of serologic assays emphasize the importance of isolating the virus from entomologic, clinical, or veterinary material.

Although it is not known when and how WNV was introduced into North America, international travel of infected persons to New York or transport by imported infected birds may have played a role. WNV can infect a wide range of vertebrates; in humans it usually produces either asymptomatic infection or mild febrile disease, but can cause severe and fatal infection in a small percentage of patients. Migratory birds may play an important role in the natural transmission cycles and spread. Like SLE virus, WNV is transmitted principally by *Culex* species mosquitoes, but also can be transmitted by *Aedes*, *Anopheles*, and other species. The predominance of urban *Culex pipiens* mosquitoes trapped during this outbreak suggests an important role for this species (Weissenböck et al 2010).

Widespread use of equine WNV vaccines decreases the incidence of equine WNV disease.

St. Louis Encephalitis virus is the leading cause of epidemic flaviviral encephalitis in the United States. During the summer season, SLE virus is maintained in a mosquito-bird-mosquito cycle, with periodic amplification by peridomestic birds and *Culex* mosquitoes. The principal vector is in the Midwest is *Culex pipiens* and *Culex tarsalis*. Infected wild birds and mammals do not exhibit clinical signs (Reisen 2003). Experimental inoculation in horses produces viremia but no clinical signs

Japanese Encephalitis (JE) virus is a flavivirus, related to St. Louis encephalitis and is widespread throughout Asia. Worldwide, it is the most important cause of arboviral encephalitis with over 45,000 human cases reported annually. The virus is maintained in a cycle involving culicine mosquitoes and wading waterbirds such as egrets. The virus is transmitted to man primarily by *Culex tritaeniorhynchus* and *Culex pipiens*, which breed in rice fields. Pigs are the main amplifying hosts of JE in peridomestic environments. In most cases JE is a disease of humans and they are the source for horses. When JE was still widespread in Japan, epizootics of encephalitis in horses tended to coincide with human epidemics, but nowadays equine disease has become rare (Halstead and Jacobson, 2003). Clinical signs of the disease in horses vary widely in presentation and severity. Mild signs are pyrexia, depression and icterus for a few days. In most cases complete recovery occurs in 5-10 days.

Diagnosis

The usual method of diagnosing viral infections is by complement fixation, hemagglutination inhibition and cross serum neutralization assays. A combination of these techniques increases the likelihood of a positive diagnosis. A four-fold increase in antibody titer in convalescent sera commonly is recommended for a diagnosis. However, viral antibodies are commonly present within 24 hours after the initial viremia and their presence often precedes clinical encephalitis. Therefore an initial sample taken when encephalitic signs are present may be after the titers have peaked and a second sample may actually have a decreased titer compared to the first one. Viral cultures are unlikely to be of use except in the case of acute VEE.

Specific Control & Treatment Measures

Owners should use insecticides and repellents when possible and practical and eliminate standing water. Selection of mosquito control methods depends on what needs to be achieved; but, in most situations, the preferred method

to achieve maximum results over a wide area is aerial spraying. In many states aerial spraying may be available in certain locations as a means to control nuisance mosquitoes. Such resources can be redirected to areas of virus activity. When aerial spraying is not routinely used, such services are usually contracted for a given time period.

Pesticides for adult mosquito control can be applied from hand-held application devices or from trucks or aircraft. Hand-held or truck-based applications are useful to manage relatively small areas, but are limited in their capacity to treat large areas quickly during an outbreak. In addition, gaps in coverage may occur during truck-based applications due to limitations of the road infrastructure. Aerial application of mosquito control adulticides is required when large areas must be treated quickly, and can be particularly valuable because controlling WNV vectors such as *Cx. quinquefasciatus* or *Cx. pipiens* often requires multiple, closely spaced treatments (Andis et al. 1987). Both truck and aerially-applied pesticides for adult mosquito control are applied using ultra-low-volume (ULV) technology in which a very small volume of pesticide is applied per acre in an aerosol of minute droplets designed to contain sufficient pesticide to kill mosquitoes that are contacted by the droplets. Information describing ULV spray technology and the factors affecting effectiveness of ground and aerially-applied ULV pesticides is reviewed in Bonds 2012.

Key active ingredients

Control of adult mosquitoes is attempted by the use of pesticides registered by the environmental protection agency as adulticides. These compounds are applied either by aircraft of truck-mounted sprayers. Two organophosphates are in use, Malathion and Naled. In addition to these compounds pyrethroids are widely used for controlling various insects. Pyrethroids are synthetic chemical insecticides that act in a similar manner to pyrethrins, which are derived from chrysanthemum flowers. Permethrin, resmethrin, and d-phenothrin are synthetic pyrethroids commonly used in mosquito control programs to kill adult mosquitoes. More information regarding their use and methods of distribution are available at http://www2.epa.gov/mosquitocontrol/controlling-adult-mosquitoes

Environmental control options

Integrated Vector Management

Mosquito abatement programs successfully employ integrated pest management (IPM) principles to reduce mosquito abundance, providing important community services to protect quality of life and public health (Rose 2001). Prevention and control of zoonotic arboviral diseases is accomplished most effectively through a comprehensive, integrated vector management (IVM) program applying the principles of IPM. IVM is based on an understanding of the underlying biology of the arbovirus transmission system, and utilizes regular monitoring of vector mosquito populations and viral encephalitic activity levels to determine if, when, and where interventions are needed to keep mosquito numbers below levels which produce risk of human disease, and to respond appropriately to reduce risk when it exceeds acceptable levels.

Change the water in water troughs is changed at least twice a week to discourage mosquito breeding. Have secure screens on windows and doors to keep mosquitoes out.

Get rid of mosquito breeding sites by emptying standing water from flower pots, buckets, barrels and other containers. Drill holes in tire swings so water drains out and keep children's wading pools empty and on their sides when they aren't being used.

Insecticide active ingredients labeled for topical application to control mosquitoes

Active ingredients and concentrations	Application options	Precautions
Cypermethrin 0.075%	Dust	
Cypermethrin 0.15% + Pyrethrins 0.20%	Spray or wipe	
Cypermethrin 1%	Spray or wipe	Do not use on foals under 3 weeks old
Permethrin 0.5%	Spray	
Permethrin 0.10% to 0.50% + Pyrethrins 0.05% to 0.50%	Spray, spot spray or wipe	Do not use on foals under 3 months old
Permethrin 0.20% + 0.13% Prallethrin	Spray	
Permethrin 0.90% + Tetramethrin 0.25% + Cypermethrin 0.10%	Spray or wipe	Do not use on foals under 3 months old
Permethrin 1.0% + 0.50% Pyrethrins	Spray or wipe	Do not use on foals under 3 months old
Permethrin 0.9% + Tetramethrin 0.25% + Cypermethrin (0.10%)	Spray or wipe-on	Do not use on foals under 3 months old
Permethrin 5% + 5% Diflubenzuron	Pour-on, Spray, or Wipe	Do not use pour-on application on foals
Permethrin 7.4% to 10%	Pour-on, paste or wipe	Do not use on foals under 3 months old Do not ride within 24 hours of use
Permethrin 10% to 40%	Spray or wipe	Dilute before use
Permethrin 45%	Spot-on	Do not use on foals under 3 months old Suppression only
Pyrethrins 0.10% to 0.20%	Spray or wipe-on	

Check the product label for treatments intervals, application rates, and precautions prior to application.

Brush animals before treatment to remove dirt and dust which can reduce insecticide effectiveness.

Be familiar with pest feeding sites and thoroughly treat areas where the pests feed.

Select Ready-To-Use products with higher percentages of active ingredient for longer duration of protection or for more effective protection when pest pressure is high.

Some animals may be sensitive to ingredients any product, especially if the concentration of active ingredients is high. Reactions may include skin sensitivity, itchiness, rash and hair discoloration or hair loss at the application site. Bathe your horse with a mild, non-insecticidal shampoo and rinse with large amounts of water if you see signs of sensitivity. Contact your veterinarian immediately if the signs persist.

Insecticide active ingredients labeled for application mosquitoes breeding sites to control larvae

Active ingredients and concentrations	Application options	Precautions
Bacillus thuringiensis israelensis(Bti) toxin 10.31%	Standing water where mosquitoes breed,	Do not treat drinking water including animal watering troughs.
(S)- Methoprene 8.62%	Standing water where mosquitoes breed,	Do not apply to water that may drain into public waterways, such as streams or lakes including animal watering troughs.

Mosquito control alternatives

Remove or drain sites where water can collect and stand long enough to serve as a breeding site.

If practical, stock mosquito fish, such as *Gambusia affinis* or *G. holbrooki*, in ponds and standing water that cannot be drained or treated.

Mechanical aerators can create wave action that discourages mosquito breeding and helps to increase oxygen content that to a level that allows fish to survive.

Non-Toxic Pheromone Mosquito Trap uses an egg pheromone to entice gravid mosquitoes to lay their eggs in the container. It attracts species that prefer stagnant water in artificial containers and are vectors of encephalitis virus. The mosquitoes can enter the trap but cannot escape.

Mosquito proof barns and stables by installing window and doors screens, using air screens or fans to keep mosquitoes from entering. Replace incandescent lights with fixtures that are less attractive, such as fluorescent.

Protective fly sheets may be useful in protecting pastured horses from mosquitoes, when practical.

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