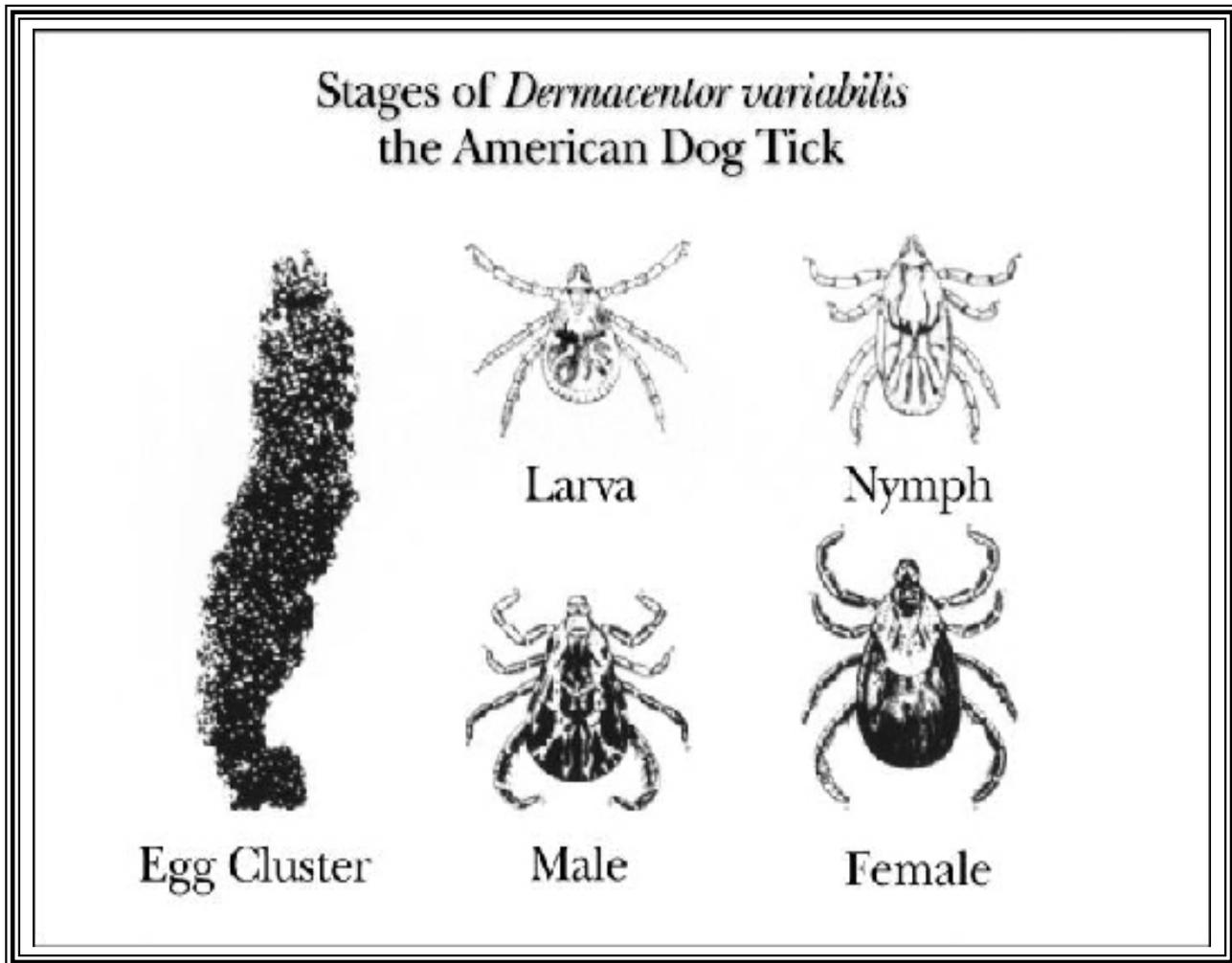


CHAPTER 20
THE BEST CONTROL FOR
TICKS, MITES, MOLD AND FUNGI

Developmental Stages of the American Dog Tick

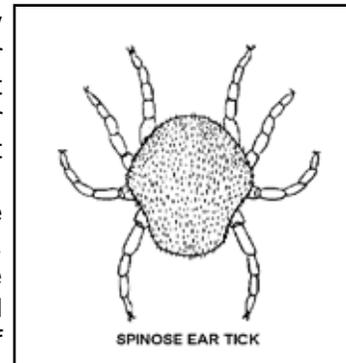


Ticks are bloodsucking parasites that are often found in tall grass and brush. There are more than 850 species of ticks worldwide, at least 100 can and do transmit more than 65 diseases. For photographs and Quick Time movies of several tick species click on the tick image gallery at: <http://www.ent.iastate.edu/imagegal/ticks/>. Many tick-borne diseases often go undiagnosed because they mimic Lyme disease and its flu-like symptoms. They include: babesiosis, Rocky Mountain spotted fever, Colorado tick fever, tularemia and ehrlichiosis. It is very likely that a person can be bitten once and become infected with more than one agent. Ticks are literally living cesspools that suck blood and diseases from a variety of animals before they finally die. The tick's mouthparts are designed for sucking blood and holding on to the host at the same time. Most ticks prefer to feed on animals, but when they are hungry and you walk by, watch out. The two common ticks in the U.S.A. are the Lone Star Tick and the American Dog Tick. An estimated 1% of tick populations can carry Colorado tick fever or Rocky Mountain spotted fever (primarily in the western and eastern U. S.) Ticks can be found in the woods, lawns, meadows, shrubs, weeds, caves, homes and cabins. Wear medicated body powder or food-grade DE mixed in menthol or diluted geranium oil and/or Safe Solutions Insect Repellent to try to repel them. **Ticks are extremely hard to control, even with pesticides and/or enzyme cleaners. Try using Safe Solutions Insect Repellent and/or their Pet Wash and/or Enzyme Cleaners (1 oz. per quart water); you can, if you wish, add a "kicker" of: 1 tablespoon table salt or borax or food-grade DE and 1 tablespoon 3% hydrogen peroxide in 1 quart water. Repeat as needed.**

TICKS
CLASS - Arachnida
ORDER - Acarina
SUBORDER - Ixodides

PEST OVERVIEW

Ticks are not insects; they belong to the class Arachnida, which also includes mites, spiders and scorpions. Ticks differ from insects in that they have one body region, eight legs and no antennae. Ticks are the largest members of the order Acarina and are virtually the only members of that order you can see without magnification. The order Acarina (ticks and mites) to which they belong differ from other arachnids in that their bodies are not conspicuously segmented, but the abdomen and cephalothorax are fused into one body region. They can not fly, run, hop or jump; they can only slowly climb up and perch on an object until some host passes by; then they either climb on or fall on to the unfortunate creature. They feed entirely on blood of vertebrates with barbed, piercing organs; they take a firm grip on the skin and suck blood for anywhere from 15 minutes to several days - they keep on drinking until they are full. There are about 80 species of ticks in the U.S.A., but only a dozen have important health concerns. **They are difficult to control! Try a pair of free-range Guinea fowl.**



Ticks are further divided into two families: hard ticks in the family Ixodidae, and soft ticks in the family Argasidae. Hard ticks have a hard, smooth shield on their backs and are tapered at the front with an apparent head; they are the ticks most readily recognized by most people. Female hard ticks feed once and lay as many as 10,000 eggs or more. Soft ticks lack the shield-like plate on their upper surface, have a tough, leathery, pitted skin and no distinguishable head and look like animated pieces of bark or debris. Some soft tick females can feed several times and lay 20 - 50 eggs after each meal. Both groups can swell to considerable size after a blood meal. Ticks have 4 stages in their life cycle: egg, larva, nymph and adult.

Examine all of your pets' and livestock's heads, especially around their ears and necks daily for engorged ticks. Remember, many ticks are about the size of a period before they feed. Some tick bites appear as a right red spot surrounded by a purple ring. Try rolling a masking tape roller (or duct tape) over the bodies and necks of your pets to capture ticks when they come back inside. Keep vegetation, weeds and brush mowed and closely trimmed. Avoid infested areas. Remember ticks cannot burrow through clothing, so always wear protective long-sleeved shirts and trousers when visiting infested areas; tuck your pant legs into your socks. Closely inspect for ticks on your own or others skin or clothing every few hours. Their favorite places to attach to people are on the legs, thighs and groin, in armpits, along the hairline and in or behind ears. Don't be modest when inspecting for ticks. Remember the ticks may be very small, so look for new "freckles". Vacuum baseboards and other cracks and crevices thoroughly to remove and destroy adults, eggs and immatures. Put salt in the bag to help desiccate them. The best way to remove an attached tick from people or pets is to firmly grasp the tick with a pair of tweezers or forceps as close to the head as possible and gently but firmly pull the tick straight off. Do not heat or pinch the tick with your gloved fingers, tweezers or forceps as this may inject the contents of the tick into the wound. Apply an antiseptic to the bite. Save the tick in a small vial of alcohol so it can be identified. Ticks are of great medical importance because of their ability to act as vectors of five major groups of organisms which cause disease in humans (bacteria, viruses, rickettsiae, spirochaetes and protozoans). Ticks can also cause a condition known as tick paralysis. **Seek immediate medical attention.**

Ticks are extremely dangerous external parasites of warmblooded animals, birds, reptiles, amphibians and man. Their bites are not only annoying and occasionally painful, but may result in localized skin inflammation, secondary infection and possible introduction of disease-causing microorganisms or pathogens. Some ticks are venomous and produce very painful bites and some ticks cause tick paralysis and lameness in people and animals. Both males and females feed on blood. Male ticks generally die shortly after mating. Ticks that feed on humans take no more than three blood meals in their lifetime.

Because tick movements and bites are seldom felt, you must carefully and frequently examine for ticks on your own body and clothing. Early tick removal is important since many disease organisms are not transferred

until the tick has fed for 2 - 8 hours. **More than 65 disease-causing pathogens are now known to be transmitted by ticks, making this group of parasites one of the most dangerous from the perspective of human and domestic animal health.** When a tick feeds it takes up whole blood, extracts the water about 70% - 75% and injects the water back into the host. So, a single tick bite can inject the host with multiple pathogens.

In addition to transmitting disease-causing pathogens, some ticks can cause a form of paralysis in man and other animals that results from the materials the tick injects into the host as part of its saliva when it feeds.

Because ticks are relatively slow, bloodsucking feeders, they can ingest more pathogenic organisms from one infested host (such as ground squirrels or any other mammal) that serve as reservoirs for any disease organism) than can any of the more rapid blood feeders, e.g., mosquitoes and fleas. Because they use different hosts for blood meals in their various stages of growth, ticks can and do spread these terrible disease organisms from one host group to another.

Remember, ticks attach firmly to a host and may go unnoticed for long periods of time as they continue to feed. Ticks have few natural enemies, are relatively long-lived and have high reproductive rates. Some ticks, such as the deer tick and western black-legged tick that carry the Lyme arthritis disease pathogen are so small they are very hard to see before they fill themselves with your blood. **Ticks can detect host heat or odors, exhaled carbon dioxide, vibrations and shadows of a passing vertebrate host.**

ACARINA GENERAL CLASS DESCRIPTION

More than 30,000 species of mites have been identified. Mites are placed in the arachnid order Acarina. Many new mite species (which includes ticks), are found and described every year. They have sac-like bodies, rather than segmented bodies like scorpions. Unlike spiders which have a combined head and thorax where the legs attach and an abdomen that is connected behind, mites have only a single (one part), oval body with legs attached to its sides. All first stage mite larvae have only six legs; both later stages, nymphs and adults, have eight. Most are the size of sesame seed. **Menthol kills or repels many mites and ticks.**

Mites are more diverse than spiders; mites are found all over the world from deserts to rain forests, mountain tops to tundra, salt water ocean floors to freshwater lakes. They suck plant juices and animal and bird and reptile blood, make tumors (galls) in plants, and transmit diseases.

Mouthparts are attached at the very front end of a mite's body. These mouthparts consist of a group of small appendages that sometimes look like a head but the brain actually is located behind the mouthparts and eyes. The mouthparts of mites form a tube that ingest plant or animal juices. Very short appendages on either side of the mouthparts guide other mouthparts as they are inserted into food tissues. As the mite sucks, digestive juices gush out of the front of the body, mix with the food juices in the mouth, and are sucked back through the mouth tube. The mite's genital opening is found underneath and between the attachments of the first two pairs of legs.

Mites walk by using body muscles to press blood into individual legs. The movement of blood extends into individual legs. The movement of blood extends a leg out or forward. Little muscles in each leg segment, then pull the segment back, and the mite moves forward. Many mites use their first pair of legs like antennae, feeling in front as they walk along. Leg hairs have diverse purpose: some sense touch; others pick up odors; not uncommonly, some hairs have light-sensing cells which allow the mite to distinguish light from dark.

TICKS

Ticks are the largest and most conspicuous members of the order Acarina, which also includes mites; ticks feed only on the blood of vertebrates, e.g., mammals, birds, reptiles and amphibians. Ticks differ from other mites; ticks are larger and have recurved teeth or ridges on the central mouthparts (called the holdfast organ). **Ticks do not have wings and they can not jump and they can not run, hop, fly or even move quickly.**

They also have a sensory pit on each of the first pair of legs. This pit detects stimuli such as heat and carbon dioxide. Ticks also detect light and dark as well as shapes, shadows and vibrations - all stimuli that help them find their vertebrate hosts. Ticks are noted for crawling under clothing, hiding under fringes of hair and attaching to the skin. **Some species of ticks have the uncanny ability to detect people up to 18 feet away.**

There are two types of ticks: soft and hard. Soft ticks feed on hosts that return periodically to a nest, shelter, cave, coop and so forth. Hard ticks are found on pets, cattle, wildlife and people. In the United States, all campers, soldiers, hikers and hunters are sometimes hosts for hard ticks; worldwide, there are over 650 species in this group.

Some ticks live their life on one host; other species spend only their larval and nymphal stages on one host, then the adult drops off to find another host. Most ticks, however, have three hosts - one for each stage in their life cycle.

Ticks are considered the most important vectors of disease agents affecting livestock. In the U.S.A., ticks are the causal agents of more human cases of vector-borne diseases than any other group of arthropods.

TICK LIFE CYCLE - Four stages: egg, larvae, nymph and adult

Seed Ticks - A fully engorged female tick can deposit (100 - 18,000) eggs on the ground. Normally, thousands of tiny 6-legged larvae hatch from the batch of eggs and crawl randomly up grasses, weeds, twigs or low vegetation or walking over the ground to await or search for a host in the surrounding area; fortunate ones attach to a small mammal, bird or lizard. These ticks, called seed ticks, suck blood. Being small, their feeding (or engorgement) time lasts only hours or a day or so. While feeding, the host wanders and seed ticks are distributed away from the site of the initial encounter. When the engorged seed ticks drop off, they are still usually in or near an animal run. After eating its blood meal the larva or seed tick molts (shed its skin) and becomes an 8-legged nymph.

Nymph - They are small: between 1/25 to 1/6 inch long and very hard to see. After molting the engorged nymph climbs grass leaves or a plant stem. Ticks climb progressively higher as they develop; different stages reach different layers of vegetation. Because of this, developing ticks usually find a larger host than they had during the previous stage. After several days feeding, the engorged nymph drops off its host and molts again. Look for a tiny dark speck that does not brush off.

Adult - The adult slowly climbs vegetation, stretches its front pair of legs and waits for vibrations or a shadow announcing a nearby host. Ticks sometimes wait for months or more than a year for a suitable host to pass by. According to one report, a soft tick lived for eleven years without feeding! Copulation usually takes place on the host while the female is feeding. Ticks do not even need to drink. Tick saliva contains over 400 proteins that interfere with blood clotting, increase blood flow at the wound and help destroy the host's immune response.

If heat or vibration or odor or shadow or carbon dioxide is detected, e.g., from a feeding mouse, the tick will seek it out. As the host passes by, claws located at the tips of the tick's legs grab hold of the host; the tick moves in the fur (or feathers) to a place where it can engorge itself on its host's blood. Make a carbon dioxide trap described in this manual. **Limit the vegetation and you limit the infestations.**

Attachment and Feeding - Adult female hard ticks will feed from several days to more than a week. (Anyone who has removed an engorged tick gains, at least, a grudging respect for the parasitic tenacity of this pest.) Since ticks cannot run, fly or jump and do not crawl up high shrubs or trees, they grasp human hosts from a point relatively close to the ground: on the shoe, ankle or lower leg and crawl upwards until constricted by tight clothing or until they reach the head. On wild mammals or pets, they often move until they reach the highest point on the host - the head or ears. **They are extremely hard to control chemically.** Safe Solutions Enzyme Cleaner with Peppermint used as a shampoo or spray, kills them in 2 minutes.

The tick's ability to creep undetected is matched only by its ability to attach for feeding without the notice of the host; stealth keeps ticks from being scratched off by the host before they can attach.

The tick slides its pair of slender teeth painlessly into the host's skin and so the feeding attachment begins. The central holdfast organ, covered with recurved teeth or ridges, is then inserted. Blood sucking begins. Secretions from the tick's salivary glands are then painlessly injected into the wound; these secretions form around the holdfast organ and glue it in place. At this point, the tick cannot voluntarily detach until its feeding ceases and the secretions stop. If you are in a known tick area, please purchase and use a device to remove ticks. The strength of the holdfast organ helps the tick resist being scratched or pulled off. The organ's importance increases

as feeding proceeds; as the female tick engorges, she cannot hold on the host with her legs alone.

Female feeding may take from several days to a week or more - or in the case of human hosts, until the tick is discovered. When feeding is complete, the engorged female drops off the host, lays eggs and then dies. The Colombians feed their dogs brown sugar (from sugar cane) to stop ticks from feeding on their pets.

Male ticks are on the host primarily to mate. They do not enlarge greatly or feed much on the host. In fact, they sometimes pierce and feed on the engorged females. (In one species, this is the only way males feed.)

INTELLIGENT PEST MANAGEMENT® AND CONTROL OF TICKS

Inspection (Be very thorough.)

- Deer ticks are as tiny as a freckle and hard to spot- dog ticks maybe about as large as a match head. Both like to burrow in along the hairline - so carefully look and feel along the back of your neck, around your ears and forehead and those of your pets and children, especially in the hair.
- Look in rooms where dogs sleep, under the edge of rugs, under furniture, in cracks around baseboards, window and door frames, in dog boxes.
- Ticks prefer still, damp, shady areas, so turn on the lights and dehumidifier and fans.

Habitat Alteration and Control (They prefer shady areas.)

Advise occupants to:

- Forget modesty: Thoroughly and carefully inspect pets, children and one another regularly (at least once a day) for ticks. Try lightly using Safe Solutions Insect Repellent, neem oil, food-grade diatomaceous earth in your pet's fur or menthol on their fur as a repellent.
- Wash dog bedding frequently with Safe Solutions Pet Wash or their enzyme cleaner with sodium borate.
- Keep grass cut short around buildings and paths and vegetation trimmed. Screen and caulk. Keeping grass cut under 3" in height lowers the humidity at ground level making it difficult for ticks to survive desiccation and their predators.
- Keep stray dogs and wildlife out of the yard. Fence your yard. Remove all underbrush and shrubs.
- As a last resort have a veterinarian treat pets using pesticidal dips, washes or dusts. **Do not let small children play with dogs that have been recently treated.** Try bathing pets with Safe Solutions Pet Wash or their enzyme cleaner with peppermint or even menthol or with food-grade DE first.

Inside:

- Caulk/seal all tiny spaces, crack and crevices where ticks hide. Don't forget to check behind mop boards, moldings, frames and baseboards, in furniture and carpets and rugs and inside window pulley openings. Lightly dust with food-grade DE, boric acid, table salt, baking soda, talcum powder, medicated body powder or powdered sulphur or Comet®. Spray Not Nice to Bugs® or diluted enzyme cleaners as needed.
- Vacuum daily under the edge of rugs, under furniture, in cracks around baseboards, window and door frames, in dog boxes. Try spraying and/or cleaning with 1 oz. diluted Safe Solutions, Inc. enzyme cleaners per quart water and/or peppermint soaps or menthol soaps and/or 1 tablespoon of borax or salt and 1 tablespoon of 3% hydrogen peroxide (**Caution: This mix will cause discoloration of certain fabrics, paints, colors, etc.**) or routinely steam clean the entire area.
- Routinely launder your pet's bedding with diluted Safe Solutions, Inc. enzyme cleaner and borax and groom your pets. Then lightly dust with Safe Solutions Food-grade DE.
- Fogging for ticks with volatile pesticide poisons is useless and dangerous.

Outside:

- Keep grass, weeds, shrubs and brush cut short and severely trimmed or cultivated wherever you walk or play.
- Practice proper sanitation. Remove clutter and debris.
- Avoid tick infested areas and/or wear appropriate clothing.

- Seal all cracks, crevices and other openings into your home or buildings. Remove leaf litter and debris.
- Make tick flags, drags and/or traps; keep grass and brush trimmed and routinely sprayed with diluted enzyme cleaner using a hose-end sprayer, or lightly dusted with powdered lime or medicated body powder and/or sulphur. Remember, the shaded areas usually produce the most ticks.
- Raise and allow Guinea hens roam free for them to search out and destroy ticks.
- Read and utilize this Master IPM Planning Manual.

Follow-up - It is important that everyone know that dogs should be protected or inspected daily even after treatment since eggs can take 30 days to hatch. **Take time to assure occupants that brown dog ticks do not normally bite humans and will, therefore, not transmit a disease.** The fear of Lyme disease can create hysteria and a desire for overkill; explain that the brown dog tick does not spread Lyme disease.

TICKS AND DISEASES

Both the argasid and the ixodid ticks are vectors of over 30 diseases to people, pets, cattle, sheep, goats and other livestock. Many domestic and wild animals are killed by tick-borne diseases, e.g., fowl spirochaetosis, Texas tick fever, relapsing fever, piroplasmiasis and anaplasmosis. Many other animals are so weakened they succumb to other diseases. *Argus persicus*, the “blue bug”, causes nervousness, weight loss, lowered egg production, and even death in poultry due to blood loss. Several species of hard ticks are significant human disease vectors (or carriers) and are responsible for the spread and increase of Lyme disease and the persistence of Rocky Mountain Spotted Fever (RMSF). For this reason, you should be familiar with Lyme disease and the *Ixodes* ticks that transmit it. The large urban population in the United States is becoming increasingly at risk from tick-borne diseases. Humans are closer to disease-carrying ticks due to:

- reversion of cultivated farmland to scrub vegetation (soil banks),
- continuous incorporation of rural land into urban population centers, and
- frequent travel to rural areas for recreation and vacations.

Wildlife populations, hosts for tick-borne disease, are increasing in both rural and urban areas. As well, urban tick populations do not lend themselves to classical agricultural pesticide poison applications.

There are many reasons why ticks are successful parasites and successful at transmitting diseases:

- They are persistent blood suckers; they attach and hold on until they finish feeding.
- Long feeding periods give time for the transfer of infections and extend the distribution time.
- Many tick species have a wide host range. Ticks feed initially on small hosts; later on larger hosts. Most can take three different hosts; they primarily find mammals, but will accept birds, amphibians and reptiles.
- They have a tremendous reproduction potential and lay several thousand eggs.
- Eggs of some disease-carrying ticks can also carry the disease.
- They have natural enemies. Two species of wasps are known to parasitize hard ticks; spiders, nematodes, fungi, birds, e.g., Guinea fowl, and fire ants will eat them. **No single control method will eliminate every tick.**

TBE - Tick-borne Encephalitis (TBE) can lead to meningitis and, in serious cases, results in paralysis and death; it is now epidemic in 27 countries across mainland Europe, an increase of 11 in 2006. TBE infected ticks are typically found in forest and rural areas of endemic countries, especially where people participate in outdoor activities, e.g., walking, hiking, trekking, climbing, cycling and/or camping.

Lyme Disease - It takes an infected tick between 36 and 48 hours of attachment to transmit Lyme disease to humans. First named in 1977, Lyme disease is an arthropod-borne zoonosis, initiated by a spirochete (a spiral-shaped bacteria called *Borrelia burgdorferi*) vectored and maintained by a hard tick, *Ixodes dammini* (Spielman, Clifford, Piesman & Corwin) in the Northwestern U. S. and by other tick species, e.g., black-legged (deer) tick, *Ixodes scapularis* in the Eastern and Midwestern states and by the western black-legged tick, *Ixodes pacificus* in the western states. Other tick species may also be involved in transmission of additional other *Borrelia* species. In other areas. In addition to ticks *B. burgdorferi* spirochetes have been found in 6 species of deerflies and horseflies (Tabanidae) and 3 species of *Aedes* mosquitoes. Symptoms vary and may mimic

other diseases; many cases go undiagnosed. The first indication of a potential infection may be the discovery of an attached tick. Disease transmission does not occur for an estimated 10 - 12 hours after feeding begins; if the tick is located and removed within that time, no infection is likely to occur. There are different strains of the spirochete, especially in the Southern states. First diagnosed in 1976 in Lyme, Conn. In 1998 there were almost 18,000 reported U. S. cases.

Lyme disease is now found on nearly every continent in temperate zones as well as in some colder zones. At this time it is not found in tropical areas. Lyme disease, or borreliosis, is an emerging infectious disease caused by at least three species of bacteria belonging to the genus *Borrelia*. [1] *Borrelia burgdorferi* is the predominant cause of Lyme disease in the United States, whereas *Borrelia afzelii* and *Borrelia garinii* are implicated in most European cases.

Usually within seven days (from three to 32 days) after disease transmission, a rash appears (in 60 to 75 percent of all cases). The rash looks like a red, expanding ring with a clear center; this center often is the site of the bite. The rash may burn or itch. Technically, this rash is called erythema chronicum migrans (ECM); it is not uncommon to find ECM at multiple sites. It disappears within three weeks but can recur. Other skin symptoms may be hives, redness of cheeks under eyes and swelling of eyelids with reddening of the whites of the eyes. Flu-like symptoms may accompany the skin symptoms, e.g., high fever, headache, stiff neck, fatigue, sore throat and swollen glands, it can be treated with antibiotics.

A second set of symptoms occurs in untreated patients four to six weeks after transmission. Over half of untreated victims experience an arthritis of the large joints (primarily the knees, elbows and wrists) intermittently or chronically. A few (10 - 27 percent) experience neurological effects including severe headache, stiff neck, facial paralysis, weakness and, possibly, pain of the chest or extremities; these symptoms may persist for weeks. In 6 - 10 percent of the cases, heart blockage may occur. In 1995, the U. S. had about 11,700 confirmed cases of Lyme Disease in 43 states and the District of Columbia. In 1996, there were 16,461 cases nationally, with 90% of them in the Northeast. Ninety per cent of all cases of human exposure is from the black-legged tick nymph. Approximately seventy per cent of all human cases of Lyme disease originate in people's back yards. The highest density of ticks will be within 3 feet of the wood edge of your yard. They also live down in the duff of the forest floor where the white-footed mice live.

Dogs can also acquire Lyme disease. They forage in tick habitat and become infected. In fact, diagnosis of the disease in dogs in the area is a harbinger of human cases to follow. Symptoms in dogs include sluggishness and lameness. Usually the disease is contracted from May through August.

Robert Lane, an insect biologist from the University of California at Berkeley, said in April 1998 that ticks with Lyme disease can be cleansed of the infection when they feed on the blood of the common fence lizard.

Responses to Lyme Disease: Education

This serious disease can be expected to increase. You should clearly instruct your children and any visitors or occupants of an area that there are no easy or effective control measures that school districts, local, state or federal agencies can perform.

- Children are at highest risk; they encounter infected ticks in camps, parks, on hikes, or at play in areas where deer and mice abound. Children are not as concerned or sensitive to finding ticks on themselves as adults.
- The second risk group are adults whose occupations place them in tick habitat: farmers, outdoor maintenance workers, park and forestry personnel and military personnel.
- The general public who hikes, camps, participates in outdoor recreational sports, or lives in areas of preferred tick and host habitat is the third risk group.
- Hunters, depending on the season and the amount of time spent out of doors, fit into either of the last two groups.
- If you are trapping white mice wear gloves when handling sprung traps and/or mice carcasses. Dispose of all dead mice in sealed plastic bags.
- When land is cultivated the deer population is decimated and ticks all but disappear.

AIDS - Glenn Gordon noted that ticks in Africa are suspected of carrying and transferring HIV.

Rocky Mountain Spotted Fever (RMSF) or American Tick Typhus

RMSF is caused by a rickettsia (*Rickettsia rickettsii*), a disease organism related to bacteria. It is an acute infectious disease characterized by pain in muscles and joints, fever and spotty, red skin eruptions. It is normally transmitted by two species of ixoid (hard) ticks that function both as reservoirs and vectors of RMSF. Even with treatment, 3% to 5% of those who become ill with this disease will die from the infection. The incidence of infested American Dog or Rocky Mountain Wood Ticks (both of which are Ixodid [hard] ticks) carrying the organism *Rickettsia rickettsii* is normally between 1% - 3% of the tick population. Male ticks can pass the organism to females in their sperm. Infected female ticks can pass the organism to their eggs. Infected larvae or nymphs can pass the organism to their next stage up into adults as they molt.

At least four to six hours elapse after the American dog tick begins feeding before disease transmission begins. If ticks are removed during this non-infective period, infection will not occur. A rash on wrists and ankles, the most characteristic and consistent symptom of RMSF, occurs on the second to fifth day after infection. Often aching in the lower back and headaches around the head and eyes will also occur. Victims feel very tired and can run fevers of 104° - 106° F. Less obvious symptoms may not be noticed. Laboratory blood tests can be done to assist diagnosis in questionable cases. Early treatment using antibiotics is most successful.

HGE or human granulocytic ehrlichiosis is also carried by deer ticks as a bacteria that attacks victim's white blood cells like a virus, causing the immune system to weaken, which makes people more susceptible to other illnesses.

Tick Paralysis is caused by materials from the salivary glands of some species of tick. The paralysis is most severe when the ticks are attached to the head or over the spine. The ticks most responsible for tick paralysis are the Rocky Mountain wood tick, American dog tick, Canadian wood tick and European castor bean tick.

Some Ticks that Carry Disease - Deer ticks, or *Ixodes*, carry Lyme disease. This genus of ticks contains the greatest number of species of the hard ticks and they transmit diseases around the world. The northern deer tick, *Ixodes dammini*, is the carrier (called a vector) of Lyme disease in the eastern United States. Its counterpart in the South is called the Blacklegged Tick. In the West, the common vector is *I. pacificus*. There are many other *Ixodes* in the United States, and what part they will play in the transmission of Lyme disease is not yet known.

The American Dog Tick, *Dermacentor variabilis* (Say) is the Eastern, Central United States, and Pacific coast vector of Rocky Mountain Spotted Fever. The Rocky Mountain wood tick, *Dermacentor andersoni*, which closely resembled *D. variabilis*, is found in the Rocky Mountain States, Nevada, eastern California, Oregon and Washington. This tick was the original vector of Rocky Mountain Spotted Fever. When settlers reached the west, their dogs contracted RMSF from the wood tick and transmitted it to the American dog tick. The American dog tick then became the principal vector of the disease and has carried it around the world.

The Lone Star tick, *Amblyomma americanum*, ranges in the southeastern quarter of the United States from Texas to northern Missouri and east to New Jersey. The Lone Star tick can transmit Rocky Mountain Spotted Fever, but it is not as important an RMSF vector as the previous two species of *Dermacentor*.

GENERAL DESCRIPTION

ORDER - Acarina.

FAMILIES - Ixodidae. (Hard Ticks) and Argasidae. (Soft Ticks)

TYPE OF METAMORPHOSIS - Complete.

LIFE CYCLE

Egg - Laid in any protected place on the ground.

Larva (seed ticks) - Resembles nymph, but only has only six legs.

Nymph - The nymph resembles the adult, but is smaller and has eight legs, but no genital opening. The order Acarina (ticks and mites) to which they belong differ from other arachnids in that their bodies are not conspicuously segmented, but the abdomen and cephalothorax are fused into one body region. One stage in hard ticks and up to 8 stages in soft ticks.

Adult - Adult bodies are flattened and have eight legs. The mouthparts of hard ticks project forward and can be seen from above. The mouthparts of soft ticks are not visible from above. The soft ticks lack a scutum or shield-like plate and their skin appears wrinkled or pitted and leathery.

PREFERRED HABITATS - All of the following described tick species are attracted to carbon dioxide and generally prefer low light intensity, high relative humidity, and protection from constant breezes. Temperature and humidity are the two most important environmental factors affecting survival.

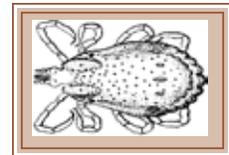
TYPE MOUTHPARTS - Piercing and sucking. Hard ticks feed on blood only once per stage. Soft ticks feed periodically in all stages.

DISEASE ASPECTS - Ticks are external parasites that feed on vertebrates, e.g., man, other mammals, birds, reptiles and amphibians. Some of the pathogens they carry from host to host as vectors of disease are bacteria, viruses, rickettsiae, round worms and protozoans. Various species are capable of causing paralysis or are capable of transmitting Lyme disease, Rocky Mountain spotted fever, yellow fever, relapsing fever, ehrlichiosis, babesiosis, Texas fever, fowl fever, yaws, tularemia, salmonella, anthrax, malaria, encephalitis, typhus, etc.. **If bitten, seek medical attention immediately!** Cats are suspected of carrying ticks into homes, and when cats groom themselves - live ticks drop off.

SPECIFIC EXAMPLES

BROWN DOG TICK

Rhipicephalus sanguineus (Latreille)



The brown dog tick is the most urban of the pest ticks in the United States. It has been introduced around the world on dogs and other animals, but in the United States its only known host is the dog. In the southern United States, the brown dog tick lives outdoors year round, but in most of the country it cannot live outdoors in winter and must overwinter in a heated building. So clean and wash or shampoo thoroughly with Safe Solutions, Inc. enzyme cleaners (enough to make a lather) or their Pet Wash; you can add a "kicker", if you wish, consisting of 1 tablespoon salt or borax and 1 tablespoon 3% hydrogen peroxide per quart hot water (120° F.) - remember, even plain soap burns the eyes.

Adult ticks are about 1/8 inch long and uniformly dark red-brown, differing from the other pest ticks that have a red-and-black or white-and-brown color variation. The engorged female (1/2" long and 1/4" wide) becomes a dark blue-gray to olive in color because of her blood-stretched abdomen. **Most calls for tick control occur in late summer or early fall.**

Anywhere from a few hundred to 5,000 eggs can be deposited by the female tick. When the eggs hatch, tick larvae outdoors climb up vegetation; inside, up walls and furniture. The larvae, nymphs and adults return to the dog to feed; they do not bite humans. If they do not find a host, they can easily wait more than six months without feeding. (Larvae can wait 8 months. Adults can wait 18 months, but must feed before mating.)

After each feeding engorgement, all stages of this tick drop off and crawl to a crack where it molts. (After a generation or two, ticks can be found at all stages hiding, molting or seeking a host.) One to four generations of ticks can be produced each year, depending on the availability of hosts and the temperature.

Infestation - Buildings and yards can be tick infested by the visit of an infested dog who drops mated, engorged female ticks. Other dogs can become infested when they are taken to an infested kennel or a home where ticks can successfully attach.

When outside, dogs encounter ticks that live outside. When the dog spends more time indoors in late summer or fall, female ticks will drop off indoors, lay eggs, and their larvae will emerge late that fall - indoors.

In fall, winter and spring, tick infestations indoors are likely to be brown dog ticks. Therefore, all stages of this tick are found hiding behind trim, baseboards, moldings, in furniture, etc. Be sure to properly dust all of these areas - try medicated body powder or boric acid or food-grade DE or spray and mop with ½ cup borax per gallon of hot water.

Ticks at each developmental stage drop from the host and seek cracks to hide in and molt. Brown dog ticks usually drop off when the dog is sleeping; these areas will most likely have the most severe infestations - steam clean and **caulk, caulk, caulk**. Routinely clean with diluted Safe Solutions Enzyme Cleaner with peppermint and sodium borate and/or with borax and food-grade DE daily until control is obtained.

DESCRIPTION - Named from its overall reddish brown color and its preferred dog host. They have a somewhat elongated, tear drop-shaped body with an unornamented shield on the back.

Adults - The 1/16" - 1/8" male and female are different in appearance. The female, prior to feeding is about 1/16" long and when engorged with blood, is about 1/3" - 1/2" long and bluish-gray or olive in color. The male has tiny pits scattered over its back. Before feeding they are flattened dorsoventrally (top to bottom) but after feeding can enlarge up to a 1/2" "berry". It rarely attacks man. They can live extended periods (over 500 days) without a blood meal.

Larva (seed tick) - Larva are about 1/40" long with three pairs of legs. Pale yellow in color before feeding. When feeding they attach themselves to their host, feed 3 - 6 days, fall off and molt into the nymph stage.

Nymph - It is about 1/25" to 1/6" long and reddish-brown to dark gray in color. The nymph has four pairs of legs. This stage lasts about one month.

Egg - Very small and laid in masses of 1000 to 5000 dark brown eggs, which normally hatch in 10 days to 2 months. Usually found in cracks and crevices near wall hangings, ceilings or roofs.

Note - There are other species of ticks, such as the Relapsing Fever Tick, (*Ornithodoros hermsi*) (Wheeler), Pigeon Tick (*Argas reflexus*) (F), Fowl Tick (*Argas persicus*) (Oken), American Dog Tick (*Dermacentor variabilis*) (Say), Ground Hog Tick (*Ixodes cooki*) (Packard), Rocky Mountain Spotted Fever Tick (*Dermacentor andersoni*) (Stiles), and the Lone Star Tick (*Amblyomma americanum*) (Linnaeus). They all have the same type metamorphosis, but their life cycles differ basically in length. All wood ticks, e.g., the Rocky Mountain Spotted Fever Tick, American Dog Tick and Lone Star Tick become a nuisance in yards and around structures, but are not usually found in buildings.

LENGTH OF LIFE CYCLE - Varies among species, e.g., the brown dog tick, lives from 2 - 7 months, other species from 2 - 4 years.

HABITAT - Most species of ticks live in fields, woods, shrubs and in and around lawns. They are often carried indoors by pets. Only the Brown Dog Tick, however, is capable of living entirely indoors. They all prefer low light intensity, high relative humidity, and protection from constant breezes - **so turn up the lights, plug in your dehumidifier and fans!** Lightly dust with food-grade DE, Comet®, talcum or medicated body powder.

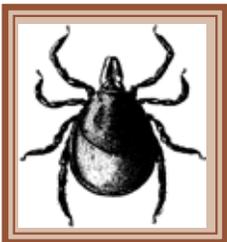
NATURE OF INJURY - Although brown dog ticks can transmit diseases, e.g., Lyme disease, canine piroplasmiasis, tick paralysis, tularemia, human babesiosis, powassan encephalitis, Q Fever, relapsing fevers and Rocky Mountain Spotted Fever, they mainly annoy by biting. These bites cause red welts that itch when scratched may lead to bacterial infections. If sufficient in number they can sap the strength of victims, particularly animals. As stated previously, ticks are vectors of many pathogens and disease organisms.

HARBORAGE POINTS - Brown dog tick adults, larva and/or nymphs may all be found feeding anywhere on a dog, but typically in the hair on the back or on or in the ears or between the toes. They attach themselves firmly and gorge on blood for 3 - 6 days then drop off and find a place to hide. They are also found in lawns, shrubs, fields and woods. Within the home, ticks may be found in dirt and debris, behind baseboards, wall hangings, curtains, upholstered furniture, moldings, door and window trim and in floor cracks. Bedding of pets is another common harborage point. After feeding they typically move upward. **These ticks do not do well outside but they are the only ticks that prefer warm, dry conditions inside.**

BROWN DOG TICK CONTROL - Fence the yard to keep out stray animals. Thoroughly clean the building; remove all debris, wash all bedding, physically remove as many ticks as possible; (if there is an imminent health hazard), blow absorptive (desiccating) dusts into the wall voids; caulk all visible cracks and crevices; vacuum daily all furniture, behind all wall hangings and all cracks and crevices for at least 3 weeks. Remember, ticks do not travel very far from where they drop off their host. Ticks are usually carried into a building by rodents, pets or wild animals. Have any infested pets treated by your veterinarian. Check animals' sleeping quarters frequently and thoroughly, destroy all infested bedding. If possible, deny any of our wild or domestic furry friends access to all public buildings, especially schools at least during the warm seasons. **Clean, wash and spray with diluted Safe Solutions, Inc. enzyme cleaner with peppermint; if you wish, add a "kicker" consisting of 1 tablespoon of borax/salt and 1 tablespoon of 3% hydrogen peroxide. Be careful; this mix will cause discoloration.**

Brown dog ticks may be found anywhere in the upper or lower portions of a room. Curtains, ceiling moldings, picture frames, and upholstered furniture backs, baseboards, pet bedding, floor cracks, etc. are all normal harborage or hiding points. **Routinely vacuum and clean with diluted Safe Solutions, Inc. enzyme cleaner with peppermint; if you wish, you can add a "kicker" consisting of 1 tablespoon of borax or food-grade DE and 1 tablespoon of 3% hydrogen peroxide in hot (120° F.) water until control is obtained. Be careful; this mix will cause discolorations or stains.**

Only if the ticks are determined to present an imminent health hazard to humans, should any spot treatments be made with "registered" pesticide poison dusts, aerosols and/or liquid "registered" pesticide poisons in typical harborage points including the cracks and crevices mentioned above. If entire carpets require treatment only a least-toxic spray material such as pyrethrin, insecticidal soap, d-limonene or linalool should be used. The yard may also require the same spray treatment, particularly in the south or where infested pets live outdoors. Ticks may accumulate behind certain types of exterior siding and, when present, these areas should also be treated. Where liquids must be used outdoors it is very important to thoroughly soak grass, grass clippings and mulch. **Be careful to follow the label directions.** Porches and crawl areas may also have to be treated with pesticide poison sprays and/or pyrethrin aerosols, but try routinely flooding or spraying the area with diluted enzyme cleaners and 3% hydrogen peroxide and food-grade DE first. Ticks are sometimes discouraged from biting people who daily ingest garlic and nutritional yeast. They may be repelled by the smell of menthol or oregano or rose geranium essential oil and irritated by talcum powder, baking soda and/or Comet®. Do not forget to routinely shampoo pets with Safe Solutions Pet Wash or their enzyme cleaners and/or salt and/or food-grade DE in those areas where the brown dog tick is present. **Fence all yards to prevent any stray animals from reinfesting the area with new brown dog ticks.**



DEER/BEAR TICK

***Ixodes dammini* (Spielman, Clifford, Piesman & Corwin)**

Before 1979 - this tick was previously described as *Ixodes scapularis*

The deer tick is found in eastern North America including the New England, mid-Atlantic, and southeastern states and the Midwestern states of Minnesota and Wisconsin. It has also been observed in Michigan, Iowa, Illinois, and Indiana. Deer ticks prefer heavily-forested or dense brushy areas and edge vegetation, but not open areas. Larvae and nymphs feed primarily on small mammals (especially the white-footed mouse, other rodents, and insectivores), and also on birds, dogs, deer and humans. Nymphs aggressively bite humans. Adults feed primarily on deer, but also attach themselves to large mammals (foxes, raccoons, opossums, dogs) and humans. They are blind.

Females lay up to 3,000 eggs in soil and litter. Eggs take about one month to hatch. Larvae engorge for 2 - 3 days during the summer, detach, over winter on the ground, and molt in the early fall. Adult females engorge for 7-21 days, detach, oviposit the following spring, and die. The life cycle may range from 2 - 4 years and is regulated by host abundance and physiological mechanisms. Larvae are active from July through September, nymphs from May through August, and adults in the fall, winter, and early spring (October-May).

Distribution is associated with high humidity and mild mean winter temperatures. However, it is not restricted by winter temperatures as areas of tick activity occur in Minnesota and Wisconsin. The requirement for high humidity restricts this tick from spreading to arid areas and high mountains where desiccation is a limiting factor (Lane et al. 1991). **So properly install and maintain fans, air conditioners and/or dehumidifiers.** Lightly dust with talcum powder, baking soda, medicated body powder, food-grade DE or Comet® or Bon Ami®.

The deer tick is the major vector of Lyme disease in the northeastern and Midwestern United States. It is incriminated as the vector of human babesiosis in the northeastern United States.

The deer/bear tick is unlike the larger Lone Star Tick, American Dog Tick and Rocky Mountain Spotted Fever Tick. Larvae are no larger than the period at the end of this sentence. Nymphs are close in size to the adult - a little less than 1/6", or the size of the head of a pin. Adult deer ticks are the size of a sesame seed. Deer ticks have a two-year life cycle and utilize three different hosts.

Eggs and Larvae - Eggs of the deer tick are laid in the spring by overwintering females. Tiny tick larvae hatch and feed on white-footed mice and other mice in the late summer. Larvae can feed on humans but will not transmit Lyme disease. Larvae overwinter, and in the following spring, they molt into the nymphal stage.

Nymphs - Tick nymphs are ready to feed in May and June. The body of the tick nymph is tan with black legs and a black shield (scutum) near its front. Nymphs climb up vegetation and attach to passing animals such as dogs, cats, horses, cattle, raccoons, opossums, migrating birds and humans as well as mice. Nymphs live in what is classically called the "white-footed mouse habitat", where larvae fed the previous summer. This habitat is best described as woodlands: bushy, low shrub woodland edge regions and grassy areas that border woodlands. This is also deer habitat. The mice travel in trails and nest almost anywhere they can find a sheltered depression. Nymphal tick activity usually coincides with human outdoor activity, and peak human infection symptoms occur in early July. Ninety percent of the human Lyme disease cases are the result of nymphal tick feeding. The remainder is due to adult activity. Tick nymphs usually molt into the adult stage in late summer; they sometimes overwinter and molt in spring.

Adults - The body of the adult tick female is brick red with black legs; she has a black shield (scutum) in the front. The male tick is entirely dark and smaller than the female. Adult ticks feed on deer which are unaffected by the Lyme disease. Where these deer move as hosts of egg-laying females they carry, determines the distribution pattern of the next generation. Adult ticks feed in late fall or spring. Deer ticks also bite on warm days in winter. Hosts of the western black legged tick are dogs, cats, sheep, horses, cattle and deer. Another tick-borne illness in the Midwest is a flu-like illness called *Human granulocytic ehrlichiosis* or HGE which is fatal about 5% of the time.

Deer Note: Researchers removed deer from large areas called deer enclosures and found fewer ticks at the nymph stage, which is when they can transmit tick-borne encephalitis (TBE) virus and other diseases, but when they removed the deer from smaller areas, they found more nymphs. **If you remove deer from a small area you may create a TBE hot spot and actually promote tick growth.**

CLASS/ORDER/FAMILY - Arachnida/Acari/Ixodidae

METAMORPHOSIS - Simple/Gradual

DESCRIPTION - Deer ticks get their common name because the preferred (adult) host is the white-tailed deer; in the Midwest, it is also called the bear tick. This tick is of medical importance because it is the primary vector of Lyme disease; about 8,000 cases of which are reported each year. Deer ticks are found primarily in the northeastern and Midwestern states in the United States.

Unengorged female ticks are about 1/8" long, male smaller (about 1/16"). Also flattened dorsoventrally (top to bottom), orange-brown in color except for the legs, mouthparts and scutum (dorsal shield just behind mouthparts) which are dark reddish brown, but abdomen darker when engorged; male body reddish brown in color overall. First instar larvae about 1/32" long, with 6 legs; second instar nymphs about 1/16" long, with 8 legs.

LENGTH OF LIFE CYCLE - Although the entire tick life cycle can be completed in 2 years in nature, it may be extended to 4 years if vertebrate hosts are scarce. They have been adapting in Vermont; veterinarians noted on 1/19/07 that they have seen ticks on dogs during January even when it is below zero and freezing outside.

NATURE OF INJURY - Principle vector of Lyme disease.

HARBORAGE POINTS - Adult ticks feed during the winter primarily on the white-tailed deer or hibernating bear. Here they mate, with the male dying shortly after mating and the female remaining on the host until spring when she drops off and deposits about 3,000 eggs. The larvae feed only once on small mammals, e.g. mice,

chipmunks, voles, etc. Nymphs usually feed once during the summer on larger mammals, squirrels, skunks, dogs, opossums, humans, birds, raccoons, etc. Then the adults feed on deer or bear and occasionally on man. Lyme disease is caused by the spirochete *Borrelia burgdorferi* or a bacteria that looks like a corkscrew. Its primary reservoir is the white-footed mouse which is the preferred host of the larval steps of this tick and thus infests all subsequent stages and hosts. These ticks climb up grass and branches to wait for a passing host and move very little laterally. **That is why the best and safest control is simply cultivating or cutting the grass and removing or trimming the branches and vegetation in the yard or trail and allow Guinea fowl to eat them.** The favorite feeding areas on humans is at the back of the neck at the base of the skull. It is believed that the tick has to be attached for 6 - 8 hours or longer before the Lyme disease can be transmitted. **In any event seek medical attention immediately if you find a tick attached to your person, your child or your pet.**



AMERICAN DOG TICK *Dermacentor variabilis* (Say)



The American dog tick larvae and nymphs attack small mammals and the adults attack larger mammals - dogs, horses and humans. Larval and nymphal stages prefer small rodents, especially *Microtus*, the short-tailed voles called meadow mice.

This is the tick species most likely to be found both on humans and dogs in the eastern United States and parts of the Midwest and West. It is a fairly large tick, average about 1/4" long before feeding, and its egg-shaped body is dark brown with a mottled white shield on the back. It is the primary vector for Rocky Mountain spotted fever in the eastern U. S. and can also transmit Tularemia and cause tick paralysis.

The American dog tick is found throughout the United States except in parts of the Rocky Mountain region. It also occurs in parts of Canada and Mexico. Its habitat includes wooded areas, abandoned fields, medium height grasses and shrubs between wetlands and woods, and sunny or open areas around woods. Larvae and nymphs feed primarily on small mammals (especially rodents), while the adults feed mainly on dogs, but will readily bite humans. **Wash dogs with Safe Solutions Pet Wash or 1 oz. undiluted Safe Solutions, Inc. enzyme cleaner and 1 tablespoon of salt or food-grade DE and 1 tablespoon of 3% hydrogen peroxide per quart of heated (120° F.) water.**

The female tick lays 4,000-6,500 yellow-brown, ellipsoidal eggs over a 14 - 32 day period and then dies. The eggs usually hatch in 36 - 57 days. Larvae usually engorge for 3 - 5 days, nymphs for 3 - 11 days, and adult females for 5 - 13 days. Unfed larvae can live up to 15 months, nymphs 20 months, and adults can live 2 to 3 years. The process can only take 3 months or less under ideal conditions. Mating takes place on the host (Goddard 1989, Metcalf and Flint, 1962). Adult ticks are active from mid-April to early September and larvae from late March through July. High light intensity and low relative humidity stimulate questing behavior (Newhouse 1983). **So turn up the lights and use fans and dehumidifiers.** Lightly dust with talcum powder, baking soda, medicated body powder, food-grade DE or Comet®.

Only the adult ticks, which are slightly over 1/8" long, are found on passing animals, e.g., dogs and humans. The adult female is brown with a pearly-light anterior dorsal shield. Males are brown-backed with pearly streaks. Both sexes have eyes, or unpigmented light receiving areas, at the edges of the shield.

With a favorable food supply, American dog ticks can complete their entire life cycle in three months with the female laying up to 6,500 eggs in late summer. Warm springs promote early adult and larval activity and egg laying.

Adult ticks usually contact people on the lower extremities and crawl upwards until they are stopped by constricting clothing such as belts or underclothing. Loose clothing worn by children allows ticks to proceed as far as the head hair. (This is probably the basis for the false idea that ticks drop out of trees.) Because of the possible communication of RMSF through this American Dog Tick and/or the Rocky Mountain Wood Tick, any

tick attachment should be noted by a physician and the victim observed for symptoms.

LONE STAR TICK a.k.a. Speckback
***Amblyomma americanum* (Linnaeus)**

The Lone Star name comes from the white spot that is clearly visible on its dark shield. It is fairly large (about 1/3" long). These ticks carry and therefore can transmit Rocky Mountain spotted fever, Lyme disease and tularemia.

The Lone Star Tick lives in Northern Mexico, in the southeastern quarter of the United States from Texas to Missouri, north to Iowa and east to New Jersey. The immatures and adults attack and feed on ground-feeding birds and both wild and domestic animals, including man.



Female ticks are brown with a white spot in their center (the Lone Star); male ticks are mottled brown without a white spot. Both sexes have pigmented eyes at the front lateral edges of the scutum. Female ticks are prolific, often producing more than 8,000 eggs. These ticks are found in wooded areas especially where there is dense underbrush but also in scrub, meadow margins, hedge rows, cane breaks and marginal vegetation along rivers and streams.

While it is rare to find larval ticks on humans, all three stages of the Lone Star Tick will attack man. When the solid brown larval tick infests humans, it is usually the result of an unwitting person sitting or laying on an aggregation of larvae; frequently, the infestation amounts to many - perhaps hundreds of ticks. These infestations of larval ticks are easily noticed and easily removed. Usually the tick larvae wander but do not attach; they can simply be showered off.

Each female produces 3,000-8,000 eggs, which are deposited under leaf and soil litter in middle to late spring. Incubation may take 30 days or longer, depending on temperature. The newly hatched six-legged immatures, also known as larvae or seed ticks, feed for 3 - 7 days on a host. After full engorgement the larvae drop from the host into vegetation and shed their skins 9 - 27 days later. The eight-legged immatures that emerge are called nymphs. These attach to a second host and feed for up to 38 days; the nymphs then detach and rest for 13 - 46 days before they shed their skins to become adults. Adults attach to a third host, feed for 6 - 24 days, and detach. Oviposition occurs 7-16 days after the last blood meal. Larvae may survive for 2 - 9 months, and nymphs and adults for 4 - 15 months each; the life cycle may take up to 2 years to complete. Lone Star tick nymphs can move very quickly and may cover a person's legs or arms in less than five minutes. This is a good behavioral characteristic to note to aid in identification of this tick species.

Lone Star tick adults and nymphs are both active from early spring through midsummer, while larvae are active mainly from late summer to early fall. Low humidities and high daytime temperatures restrict the occurrence and activity of these ticks (Goddard 1989), **so use dehumidifiers, desiccants and fans.**

Lone Star Ticks are associated with cattle and deer; therefore, there is increased human risk around large cattle and deer herds. When found on humans, the ticks certainly should be removed and saved in case RMSF symptoms develop. **We advise everyone who has been bitten by any tick to seek immediate medical attention.**

ROCKY MOUNTAIN WOOD TICK, ROCKY MOUNTAIN SPOTTED FEVER TICK
***Dermacentor andersoni* (Stiles)**

Both the American Dog Tick and this tick can pass on tick paralysis caused by a neurotoxin in both ticks' salivary gland. Most tick paralysis cases occur from April to June when adult dermacenter ticks emerge from hibernation and actively seek hosts. In Australia tick paralysis is caused by *Ixodes holocyclus*. Both botulism and tick paralysis can mimic the Guillain-Barre syndrome. At the first sign of weakness beginning in the lower limbs (unsteady gait), search for embedded ticks. This tick is similar in size and appearance to the American dog tick but is slightly paler in color, with ornate markings on the back and shield. This tick is found from the western counties of Nebraska and the Black Hills of South Dakota to the Cascade and Sierra Nevada Mountains, and from northern Arizona and northern New Mexico in the United States to British Columbia, Alberta, and Saskatchewan in Canada. Their habitat is primarily fields and forested areas. This tick species is especially prevalent where

there are is brushy vegetation that encourages the small mammal hosts of immature ticks and sufficient forage to attract the large hosts of the adults. Immatures feed mainly on small mammals such as ground squirrels and chipmunks, and adults on cattle, sheep, deer, humans, and other large mammals.

Rocky Mountain female ticks lay about 4,000 eggs in plant debris on the soil or in crevices in construction materials, usually in masses of hundreds at one location. Unfed tick larvae may live for 1 - 4 months, nymphs for 10 months, and adults for more than 12 months. Adults and nymphs can be found from March to midsummer. Larvae are active throughout the summer and are associated with cool soil temperatures, shallow soil, abundant leaf litter, and high relative humidity. This tick specie is the primary vector of Rocky Mountain spotted fever in the Rocky Mountain states and is also known to transmit Colorado tick fever and Tularemia. It also carries tick paralysis in the United States and Canada.

WESTERN BLACK-LEGGED (DEER) TICK

***Ixodes pacificus* (Cooley and Kohls)**

This pinhead-sized tick is found in the western United States and is the primary vector of Lyme disease there. It is teardrop-shaped, and the adult (unfed) female is reddish-brown with black legs and about 1/10" long. The male is smaller and brownish-black. **Keep mice and other hosts away from your property.**

EASTERN BLACK-LEGGED (DEER) TICK

***Ixodes scapularis* (Say)**

It is also referred to as the deer tick and is another primary vector of Lyme disease. It is most numerous along deer trails and is attracted to the deer's urine and glandular secretions. Deer do not carry the disease; the immature ticks feed on rodents that do. **Keep mice and other hosts away from your property.**

GROUNDHOG TICK

***Ixodes cookei* (Packard)**

Found in the New England States where it will attack man and groundhogs. Primary vector of Powassan (POW) encephalitis.

GULF COAST TICK

***Amblyomma maculatum* (Koch)**

Is very similar to the Lone Star tick with basis capituli triangular dorsally, first pair of legs (coxa) with single spur and next to last tarsol segment of the other three legs with two stout spurs near the distal end. Male ticks become active in early summer and attach to cattle 4 - 6 weeks in advance of the female ticks. They feed primarily on the ears of their hosts. The larvae and nymphs feed on small rodents and ground-dwelling birds. These ticks can vector a protozoan that causes canine hepatozoonosis. Mating takes place on the host for 10 - 12 days; then the engorged female drops off and lays her eggs.

EXAMPLES OF SOFT TICKS

FAMILY - ARGASIDAE

COMMON FOWL TICK

***Argas radiatus* (Raillet)**

Found in poultry houses in the South and Southwest. It is also called "the blue bug and/or chicken tick". It attacks man and chickens. A closely related tick, *Argas sanchezi*, is found in the Southwest. Caulk, caulk.



RELAPSING FEVER TICKS

***Ornithodoros* spp.)**

These ticks are the vectors of relapsing fever, which has created serious health problems at the Grand Canyon. The relapsing-fever tick, *Ornithodoros hermsi* (Wheeler, Hermes &



Meyer), is sand-colored before feeding, but turns grayish-blue after it feeds. The adult female is about 1/4" long. *Ornithodoros turicata* (Dugés), *O. Parkeri* (Cooley) and *O. tulaje* (Guerin- Meneville) all are part of this group.

Another important tick-borne disease is endemic relapsing fever. This disease is limited to the western states and is caused by a spirochate carried by certain ticks in the genus *Ornithodoros*. These are found on tree squirrels (*Sciurus spp.*) and western chipmunks (*Eutamiasl spp.*). The disease can also be transmitted directly to the tick's offspring. These ticks usually live three to five years. People/campers are at increased risk of contracting endemic relapsing fever when they sleep in dwellings that have become inhabited with infected squirrels or chipmunks. As with sylvatic plague, the rodents vacate the building or are killed by the humans who use the buildings. The ticks which remain behind feed on the people using the buildings. Implementation of rodent exclusion efforts will reduce the incidence of ticks.

Many species of argasid ticks of the genus *ornithodoros* are considered venomous. Their bites are not only painful, but produce hard, raised wheals which may itch for days. One of the worst of these ticks is *Ornithodoros coriaceus* of the southwestern United States.

Note: Routinely remove bird nests to reduce soft tick numbers; routinely spray with diluted Safe Solutions, Inc. enzyme cleaner and borax or sodium borate and seal all cracks and crevices.

INTELLIGENT PEST MANAGEMENT® TICK CONTROL NOTES/TECHNIQUES:

A typical lawn is not considered good tick habitat, especially for deer ticks. Deer ticks are very susceptible to desiccation, and the typical well-mowed lawn, receiving lots of direct sunlight, is not conducive to maintaining high tick populations. The American dog tick, however, is more hardy and able to survive well in lawns and fields. None the less, most control efforts should be focused on the edge of your lawn, especially if its adjacent to wooded areas or other habitats harboring tick populations. Generally, ticks are not a serious indoor pest. Most all tick species cannot live very long inside, as it is too dry for them. Ticks require a habitat with a very high humidity (>80%). Therefore, they may enter your house on your pets or on your clothing, but they aren't likely to become established. A good exception is the brown dog tick, *Rhipicephalus sanguineus*.

1. Most ticks can only slowly climb to the top of grass, medium height vegetation and/or low brush to await a passing host, so cultivate the land or at least keep your grass and brush cut low especially around walks, paths, fences, sheds, trees, shrubs, play areas and other potentially dangerous locations; remove weeds, woodpiles and other debris which are attractive to mice as nesting areas, and any leaf litter which is attractive to ticks, especially the nymphs; keep garbage can lids on tightly to discourage opossums, raccoons and skunks from coming into the yard to raid your garbage cans for food because these animals also can carry or harbor the ticks which transmit the Lyme disease pathogen; discourage feeding birds because the seeds will attract white-footed mice, the major reservoir host for the Lyme disease pathogen; install a chimney screen to keep squirrels, raccoons, birds and other vertebrates out of your building and install/maintain a fence to keep stray animals out of your yard. Simply cleaning up leaf litter and putting down wood chip barriers at the lawn perimeters can reduce nymphal abundance by 42 to 88 per cent. Keeping the grass short in tick infested areas increases tick dessication during hot weather. Allow free-range Guinea hens to forage for the ticks. Seal all cracks and crevices. Dust with Safe Solutions Food-grade DE as needed.

2. Personal protection consists of: wearing hats, long sleeved pants and shirts and tuck shirts into light colored pants and pants into socks or boots when going into any infested or suspect areas; check people for ticks when they come back into the house because it can take up to 4 hours, possibly longer, for ticks to start feeding; wear light colored clothing which makes spotting ticks easier as they crawl up the outside of your clothing. Remember to stay on clear paths and avoid brushing or touching any trail edges, brush and grassy areas; pets (especially cats) which go outdoors may increase the chance of your encounter with these ticks, so have your vet routinely check your pet's blood to determine if they are carrying the Lyme disease spirochete. As a last resort use a chemical repellent. The only poison that used to be 100% repellent to ticks that carry Lyme disease pathogens and other disease organisms was permethrin (Permanone), a synthetic pyrethroid insecticide poison that immobilizes or kills ticks shortly after they touch clothing sprayed with it, but this is also very dangerous to people and pets. Try Azadirachtine or better yet neem oil and/or menthol or sulphur powder. **It is extremely difficult to kill all of the ticks with any one thing, e.g., enzymes, food-grade DE, pesticides, soap, etc.!**

But people who raise Guinea hens that can freely roam and forage for food seldom find any ticks or snakes, rodents or even any insects in their yards or gardens. Guinea fowl are also known to eat every Japanese beetle they find. Caution: Guinea hens will also sit in front of a bee hive and eat every one that comes out .



3. MONITORING AND SURVEYING FOR TICKS

Periodic surveys of potential or known tick habitats during warm months can reveal the presence of low-level tick infestations. This permits tick management procedures to prevent or retard further population increase. Monitoring techniques that have proven effective (Gladney 1978) are as follows.

Examination of personnel for attached ticks. A volunteer wearing protective clothing walks through each sample site and then is inspected. Ticks attached to or walking on the collector's clothing and skin are collected in 70% ethanol for later identification and counting. Careful inspection is necessary to prevent the attachment of unnoticed ticks and possible disease transmission to the volunteer. Collections can be standardized in relation to time, distance, or area units covered during sampling.

Dragging/flagging. Done by dragging a white cloth over relatively open ground or "flagging" low-level vegetation (i.e., moving the cloth in a waving motion over and through vegetation) in densely brushy ground. Ticks that are lining up, waiting or questing for passing hosts cling to the cloth and can be removed for identification and counting. The "drag" consists of a 1 sq. yd. piece of white crib bedding or corduroy material hemmed on all edges, weighed at one end, and attached to a wooden pole at the opposite end. A rope attached to the two ends of the pole allows the collection device to be dragged along the ground. Alternatively, the pole can be gripped at one end so that the cloth hangs vertically downwards, and the device used to flag vegetation. Dragging or flagging depends upon the degree of contact between the cloth and ground or vegetation surface. The selection of sampling sites may have significant effects on the success of the sampling effort. Sampling sites should reflect favored tick habitats for best success. Sampling should be done under conditions that favor tick presence and activity (e.g., when vegetation is not wet and when ambient temperature is above 50° F).

Habitat change is very important in tick control. Always remember that clutter, tall vegetation and moisture will severely inhibit your IPM tick control efforts.

Trapping small animal hosts. Small mammal hosts such as rodents and insectivores can be livetrapped at selected sampling sites, with traps set out in grids or line transects. Trapped animals are anesthetized and searched thoroughly for attached ticks, which are removed using fine forceps. Removed ticks can be stored in 70% ethanol pending identification and counting. The animal host is released at the site of capture after recovery from anesthesia. Gloves should be worn throughout all animal and tick handling operations. A veterinarian or qualified technician should be consulted on the proper usage of anesthetics administered to trapped animals. Remember this method will kill at least some of the animal host "volunteers".

Avoidance. Simply avoid all areas where ticks are common, e.g., woody or overgrown areas.

Dry-ice collection traps. This has been proven to be the most efficient method of tick collection. It is nondestructive to host animals, does not require a human as an "attractant", and gives more reproducible results than dragging. However, the traps need to be kept in the field for several hours (preferably over night) for best results. Dry ice is available at some ice cream and beverage stores, but you should call first. The basic principle is to use carbon dioxide vaporizing from the dry ice to attract ticks onto a white cloth panel on which they are easily visible and can be removed periodically (if the traps are set out for a limited time under periodic monitoring), or onto a platform lined with double-sided sticky tape on which they get trapped (if the traps are set out overnight). See also #6 that follows.

Sampling sites for monitoring ticks should be selected in areas favoring ticks or are likely to receive human visitation, A conscientious monitoring program is the basis of an effective integrated pest management. Regular surveys should be done at all sites where ticks have been seen.

4. If the ticks are determined to be an imminent health hazard, you can increase areas of open lawn with grass 3" or less in height and/or you can dust the area with powdered sulphur, Safe Solutions Food-grade DE, lime,

talcum powder or ground up chalk or calcium carbonate (Comet® or Bon Ami®), or you can, as a last resort, spot treat the areas where the ticks show up on the drag with an appropriate labeled pesticide poison, e.g., wettable powder and/or microencapsulated formulations work best, but first try routinely drenching the area with diluted Safe Solutions Enzyme Cleaner with Peppermint using a hose-end sprayer and, if necessary, sodium borate. **Remember, sodium borate and/or borax also can kill plants.**

5. You can also treat cotton balls with a residual pyrethroid or boric acid or sodium borate and place them inside open cylinders. The cotton balls will be gathered by mice as a nesting material and when ticks come in contact with it, they will, hopefully, die. First try soaking infested areas with diluted Safe Solutions Enzyme Cleaner with Peppermint and 3% hydrogen peroxide. Sodium borate or boric acid or Equal® may kill the mice.

6. You can also make a dry ice or carbon dioxide tick trap for the control of ticks.

- Find a box or a covered ice bucket or any other Styrofoam container measuring at least 6" x 6" x 12".
- Cut at least four 3/4" holes in the sides near the bottom. This will allow the dry ice to vaporize outward and attract ticks to your trap.
- Place a 2 lb. piece of dry ice (CO₂) into the trap. It will last about three hours, depending on the temperature. The majority of ticks in a 75 sq. ft. area around the trap will be captured within the first three hours.
- Place the dry ice-filled container over a 1 sq. yd. section of cloth, tarp or flannel or a similar-sized section plywood with either a masking tape or sticky fly paper strip barrier at the edges. The tapes or strips can be stapled to the board plywood sticky-side-up, or you can simply fold it in half so it will adhere by itself to the plywood.
- If you use material, carefully inspect both sides of it for ticks one to three hours after the trapping begins. If you use plywood and masking tape, remove the tape to which ticks have adhered and replace it as often as necessary during the three-hour trapping period.
- Remove the ticks from the strip or tape with a tweezers or forceps. Place the ticks in soapy water or rubbing alcohol. Flush away the liquid with the ticks. See also #3.

7. Control exterior rodents with a glue boards baited with a Cheerio or similar bait and/or traps carefully placed inside a PVC pipe or similar protective device. See Rodent Control.

8. Biological Control - Several species of ants are known to feed on ticks. Recently, releases of the parasitic wasp *Hunterellus hookeri* have been made on several island on the New England coast. This wasp attacks *Ixodes dammini* and has been recovered from some of the release sites. Ticks have many natural predators in the environment. As mentioned, several wasp species will parasitize ticks, one species in particular (*Ixodiphagus hookeri*) has been studied quite extensively. The female wasp lays her eggs inside an engorged nymph. After the wasp eggs hatch, the larvae feed on the tick's internal tissues and then emerge, killing the tick in the process. Many species of spiders and ants will also eat ticks if they can find them. Also, there are a variety of fungi and nematodes that also feed on and kill ticks while they are molting in the soil. Some of these organisms (in particular the fungus, *Metarhizium anisopliae*) are beginning to be intensely studied for their pathogenic effects. Birds will certainly eat ticks that they encounter during foraging. The most notable is the helmeted Guinea fowl, *Numida meleagris*. Studies have shown that these birds will readily forage on ticks (engorged and nonengorged).

9. Mechanical Controls

- Increase areas of open lawn and sunlight penetration.
- Keep your lawn mowed to a height of 3 inches or less. This lowers the humidity at ground level, making it difficult for ticks to survive.
- Get rid of brush, weeds, leaf litter, and other debris. This vegetation can attract ticks and their hosts.
- Animal proof your house and yard.
- If your yard borders a wooded area, rake up leaf litter and cut down underbrush for several feet into the woods.
- Eliminate densely planted beds near your house.
- Keep picnic tables, lawn furniture, and children's play areas as far away as possible from woods, shrubs, and undergrowth.
- Use wood chips or gravel to create a barrier between wooded areas where ticks are common and your lawn.
- Vaccines - They stimulate the production of an antibody that damages tick gut cells and kills the

- ticks or stops reproduction.
- Install a pair of free-range Guinea fowl.

10. Dress Appropriately

- It is also important to dress appropriately when entering areas that are infested with ticks. Wearing lighter colors will help you to easily spot ticks that may be on you.
- You should also wear clothes that fit tightly around your wrists, ankles, and waist.
- Tuck your shirt into your pants, and your pants in your socks. Use a rubber band or tape the area to seal where the socks and pants meet so that ticks can't get under clothing.
- Wear a hat and long-sleeved shirt.
- Also, ticks often wait on tall grass and vegetation along trails, so try to stay in the middle of trails to avoid brushing up against the vegetation.

LYME DISEASE - There is about 1 chance in 100 of getting lyme disease from a tick bite. The disease causes debilitating arthritic, heart and neural problems in dogs and man. Symptoms were first described in Europe over 100 years ago. The disease was named in 1975 by a Physician studying the disease symptoms in children living around old Lyme, Connecticut. The symptoms are usually divided into 3 stages.

Initial Symptoms - Spreading rash, fever, flue-like symptoms, aches, inflammation of a single joint, particularly the knee, nerve pain particularly radiating down the back of the legs or nerve paralysis of the face. Try serrepatase.

Stage 1: Expanding rash (*Erythema migrans* or EM rashes)

- (a) 3 - 30 days after bite.
- (b) Ringlike/bull's-eyelike appearance to rash. (Clear at the center with concentric circles around it.)
- (c) One or more rash sites.
- (d) May or may not have flu symptoms, e.g., chills, fever, body aches during the warmer months..
- (e) May come and go or persist.

Stage 2: Complications or disorders of the heart or nervous system.

- (a) Heart. Varying degrees of blockage of the heart muscle. Check the pulse or EKG.
- (b) Nervous system. Meningitis, encephalitis, facial paralysis.
- (c) "Bell's palsy", other conditions involving peripheral nerves.
- (d) Migratory pain in joints, tendons, muscles and bones, often without joint swelling or redness.

Stage 3: Months to years after disease onset.

- (a) Arthritis that appears and disappears intermittently for several years.
- (b) Enlarged knee joints.
- (c) Erosion of cartilage and bone.

TREATMENT NOTES: If you find a tick, it needs to be removed right away:

<http://www.cdc.gov/ncidod/dvrd/rmsf/prevention.htm>

1. Once bitten by a deer tick possessing the spirochete, it may not produce antibodies in the victim for up to 6 weeks. **Therefore, it is difficult to verify that one has been infected with Lyme disease quickly.**
2. Oral medications for Lyme disease can destroy the spirochetes in the blood and give an antibody reading that the person is "cured". However, the spirochete may still persist in the brain and reappear in the person 5 - 10 years later. Therefore, intravenous treatment is advised over oral medications by some physicians considered experts in this area, especially for persons showing Stage 2 and Stage 3 symptoms.
3. Firmly attached ticks must be carefully removed so that the tick's head and mouthparts do not break off and remain in the skin. You can brush off an unattached tick with your bare hands, but you should not use bare fingers to remove an attached tick since this exposes you to possible disease. The following steps are recommended by most medical authorities.

Note: Often ticks can be removed with duct tape or cellophane tape or lint removal rollers if the ticks have not been attached for extended periods.

- a. **Protect your hands with a tissue or gloves.** Always try to remove the tick alive with a forceps or tweezers with its mouthparts intact. Hasty removal of an attached tick can break off its mouthparts. Mouthparts left in the skin may cause a secondary infection. **It is best to remove the tick using only an approved tick remover kit, tweezers or disposable gloves or, at a minimum, use a paper towel or tissue to protect your hands.** Caution: If you try to relax tick mouthparts for easy removal, e.g., touch the tick with a dollop of menthol shaving cream or a few drops of camphor or use “relaxers” like turpentine, fingernail polish, cleaning fluid, petroleum jelly, alcohol, chloroform, ether, gasoline, kerosene or mentholated vapor rub; may actually cause the tick to salivate while still in your skin which can increase the danger of contracting a disease. A burning cigar or cigarette may actually hurt you more than the bite by irritating the skin, making the tick harder to remove intact and most are poisonous especially in the blood. The best method is to then grasp the tick firmly with a blunt, curved tweezers or forceps as close to the head as possible and remove it with a slow, steady, gentle pull. Then destroy and save the tick. Avoid touching the tick with your bare hands. If an infected tick is crushed between the fingernails the organisms responsible for various diseases may enter you through a cut or abrasion. At a minimum you will inject the contents of the tick into the patient’s wound.
- b. **Caution:** Do not twist the tick. Pull it out slowly and steadily. Tick mouthparts have harpoon-like barbs; they do not screw into the skin. Avoid crushing the tick during its extraction. The tick’s body fluids, which potentially include Lyme spirochetes or other disease organisms, e.g., Rocky Mountain spotted fever, can enter your body or the patient’s body through the punctured skin or mucous membranes. Spray the attached tick and/or area with 2 oz. of enzyme cleaner per quart hot water and 1 tablespoon food-grade DE or borax or salt or boric acid or sodium borate and 1 tablespoon of 3% hydrogen peroxide. **Note: Sodium borate, boric acid, salt and/or borax can also kill plants.**
- c. In order to **save the tick for identification**, drop it into a small vial of rubbing alcohol, or you can simply drown it in soapy water or crush it with the tweezers (but never with your bare hand).
- d. **Carefully clean the site of the tick bite with an antiseptic.** If the head of the tick is left embedded in the skin, try to remove the remaining parts with the tweezers or forceps. Removal helps prevent an infection in the wound. If you cannot remove the mouthparts, apply an antiseptic and monitor the site regularly for complications. **Seek medical attention immediately.**

Epidemiological Notes

1. Epidemiologists have isolated an unidentified type of spirochete from ticks collected in southeastern Missouri which appears to be different from *Borrelia burgdorferi*.
2. Initial studies show that infection by this “new/different” spirochete can result in the expanding rash (EM), but that it is less often followed by multiple skin lesions than with Lyme disease.
3. Therefore, more than one species of tick may be the vector of Lyme disease.

INTELLIGENT PEST MANAGEMENT® TICK SUMMARY - DO NOT USE ONLY ONE (ALTERNATIVE) CONTROL!

Where pest management services are being provided to an area such as a neighborhood, camp, park, school, hospital, zoo, government installation or similar facility, it is important to know what kinds of ticks are present, where they are most numerous, what the disease potential in the area is, and what the host and reservoir populations are. **Pest management programs are critical for effective management of tick species that transmit Lyme disease or Rocky Mountain Spotted Fever.**

Outside Inspection - Most ticks which bite humans are found in moist, humid, bushy areas.

- Drag a flannel rectangle, 2' x 3', using a rope on a board at the front and a strip of wood at the back for weight. All stages of ticks attach to the flannel. Collect them and take them to a University Extension Service office for identification. An office is located in each county in the United States. Small pieces of dry ice (CO₂) placed in the middle of cloth squares or in traps have also been successful in attracting or trapping ticks.
- Visit deer checking stations during hunting season; trap mice and count ticks. If governmental agencies

or regional health associations are interested, they will test collected live ticks to ascertain their level of infection.

- Consult local veterinarians; they are the first to see Lyme disease cases in an area; positive disease diagnosis in dogs is a clear signal that human cases will follow.
- Interview game conservation agents to learn host (mice, deer) prevalence. They also have information concerning disease prevalence in hunters and hunting dogs.

HABITAT MANAGEMENT AND/OR ALTERATION - TICKS HATE SUNLIGHT!

Wherever possible, people and pets should be directed towards areas that are tick free or provide unfavorable habitat for ticks. Regular inspections should be performed to determine when tick IPM management needs to be initiated. The basic principles of management include isolation of susceptible domestic animals from known tick populations and rotation of pasture or run areas to reduce tick populations or routine flooding the area with diluted Safe Solutions Enzyme Cleaner with Peppermint in a hose-end sprayer and, if necessary, dust lightly with food-grade DE. **Note: Sodium borate and borax will also kill plants. Remove leaf litter and debris.**

Removal of shrubs, weeds, brush, trees, or tall grass can be particularly helpful. Dense shrub and tree cover and tall grass provide harborage for both ticks and their animal hosts. Removal of excess brush and shrubbery and clearing the canopy trees so that 50% to 80% of a management area is exposed to direct sunlight at any time are recommended IPM control practices for walkways, parks, and landscaped grounds (Hair and Howell 1968). Grass should be kept below 6' in height to allow the penetration of sunlight and soil ventilation. Such techniques result in higher soil temperatures, lower humidities, and lower soil moisture content, all of which create higher tick mortality. (And it makes it easier for predators to find them.) In one study, such techniques resulted in 75% to 90% natural control of different tick life stages of the Lone Star tick (Mount 1981). Mowing vegetation with a bush-hog rotary mower reduced adult deer tick populations by 70% in another study (Wilson 1986). Spray diluted Safe Solutions Enzyme Cleaner with Peppermint using a hose-end sprayer. **Avoid tick infested areas, especially from May to August.**

Controlled burning of habitat may also help reduce tick numbers. For example, burning tick-infested areas on Great Island, Massachusetts, reduced deer tick populations by 38% six months after the burn (Wilson 1986). However, the long-term implications of burning are unclear. Burning typically improves deer browse in the area; thus increased deer abundance may result in the movement of ticks back into the area. Try reducing the vegetation with boiling water, propane flammers or with steam sprayed with high pressure equipment and safety gear. **Clean up bird seed, fruit, wood piles, vegetables, debris, etc. that create rodent problems.**

Barrier - A 2' - 5' edging of woodchips, gravel, decorative stones or ground-up tires can help prevent ticks from entering your yard.

Sunlight - Areas that receive lots of direct sunlight are not conducive to high tick populations.

Research has shown that high deer populations can lead to increased Lone Star and Deer tick populations since there will be more hosts from which a blood meal can be obtained. Reducing the deer population may be a feasible tick management strategy. This reduction has been experimentally demonstrated in Massachusetts (Wilson et al. 1988), although the decline in tick numbers may not correspond directly to the reduction in deer population. Managing deer populations by hunting, fencing, or environmental modification should be considered seriously before tick infestations become severe and should be done within state and local guidelines. Efforts at deer management should be done in coordination with state natural resources and wildlife department personnel. **Fence them out of your property and/or raise free-range Guinea fowl to eat all of the ticks.**

Under unusually high tick population or parent pressure it may be necessary to treat indoor areas. The major IPM methods of non-chemical indoor tick management include regular inspection, elimination of animal (especially rodent) harborage areas, use of food and waste-handling procedures that minimize animal entry and harborage, and animal-proofing buildings. This includes sealing all holes in foundations and walls, and screening (with heavy gauge metal screen) above-ground windows, vents, and other openings through which animals may enter. A 18" perimeter border of gravel or limestone may prevent movement of ticks from grass areas into buildings. Cracks and crevices around the base of buildings should be sealed with caulk.

Recommended IPM practices include frequent examination of clothing (preferably by another individual) and the body (after showering), destruction of collected ticks, and wearing protective clothing (e.g., coveralls with trouser cuffs taped to shoes, high-top shoes, socks pulled over trouser cuffs, long-sleeved shirts or jackets, or mesh jackets). Clothing should be light-colored so ticks may be seen easily.

Periodic surveys of potential or known habitats can reveal the presence of low-level tick infestations, thus indicating the need for application of management practices to prevent or retard further population increase.

Vegetation management is another excellent tick IPM control option. It produces the same benefits as mechanical management of vegetation; i.e., reduced harborage for animal hosts of ticks, reduced soil humidity, and increased soil temperature, all of which are detrimental to tick survival. Management of vegetation by herbicidal and mechanical methods may not always produce comparable results; Hoch, et al. (1971) found that herbicidal treatment of woodlots was not as effective as mechanical vegetation clearing in reducing the population of Lone Star ticks - Just another reason not to use volatile herbicide poisons. Plow (under) or cut short the grasses to increase tick desiccation.

Natural tick repellants - Extracts from plants were tested by researchers from the Centers for Disease Control in Colorado - the most effective extract against tick nymphs was from the heartwood of the Alaskan Yellow Cedar, *Chamaecyparis nootkatensis*, the most effective extract against tick larvae was from the heartwood of Eastern Red Cedar, *Juniperus virginiana*. Both of these oils are readily available as a by-product of lumber production and should give the same control of ticks as permethrin, diazinon or other volatile synthetic pesticide poisons. We would also suggest the use of Safe Solutions Enzyme Cleaner with Peppermint, menthol, myrrh, garlic, Safe Solutions food-grade DE or avocado, basil, mint, rosemary, rose geranium, cedar or citrus oil emulsions to repel and/or kill ticks. Put a glob of liquid soap on a cotton ball and put on the tick; it will come out on its own in 20 - 30 seconds.

In 2006, Agricultural Research Service (ARS) scientists in Oxford, Miss., isolated compounds from a shrub called American beautyberry (*Callicarpa americana*) that enable its crushed leaves to repel mosquitoes.

This work, led by chemist Charles Cantrell at the ARS Natural Products Utilization Research Unit in Oxford, was inspired by a tip another ARS scientist—botanist Charles Bryson in Stoneville, Miss.—got long ago from his grandfather: that American beautyberry was used in northeastern Mississippi to protect people and farm-work animals from biting bugs.

Now ARS scientists in Beltsville, Md., have shown that two beautyberry compounds—callicarpenal and intermedeol—may effectively repel blacklegged ticks as well.

Blacklegged ticks are the principal carrier of bacteria that in humans cause Lyme disease, an affliction known for its fevers, headaches and bull's-eye rash. Left untreated, this disease can cause severe and chronic illness.

ARS entomologists John Carroll, in the Animal Parasitic Diseases Laboratory, Beltsville, and Jerome Klun, in the Chemicals Affecting Insect Behavior Laboratory, also in Beltsville, tested the compounds by administering them to cloth strips wrapped around a person's finger in dosages at which the commercial repellent DEET repels ticks. The treated strips repelled more than 95 percent of blacklegged tick nymphs.

Callicarpenal did especially well in a separate duration test, repelling all the blacklegged ticks tested for three hours after application, and 53 percent after four hours. The researchers also tested the natural compounds against nymphs of Lone Star ticks, which transmit potentially serious human diseases known as ehrlichioses.

The two compounds, as well as DEET, were considerably more potent against blacklegged ticks than against lone star ticks. An experimental repellent developed by ARS and known as SS220 was most effective against the Lone Star ticks.

In addition, some grass species, e.g., *Stylosanthes*, spp. produce viscous fluids that poison and kill ticks. Some African plant extracts are capable of reducing tick feeding, molting, fecundity and viability of the eggs. Some pasture grasses possess hairs (trichomes) that retard ticks from climbing on them.

INDOORS

Normally ticks are not a serious indoor pest as it is usually to dry for them inside, but, if they are inside, all tick life stages can be found in cracks and crevices in any infested building. Sites such as crevices, baseboards, trimming, furniture, ceilings, floors/carpets, walls behind pictures, bookshelves, and drapes should all be routinely and thoroughly vacuumed (especially cracks and crevices near dog runs) and then spot-treated with dusts (e.g., food-grade DE, talcum powder and/or medicated body powder) and then caulked or patched as needed. Chimneys, crawl spaces and porches should be screened. Crack and crevice treatments should be done with residual dusts or silica gel or food grade diatomaceous earth. This is the most effective way to use non-volatile pesticides in a building. Fumigation does not work well in buildings because ticks can readily re-enter through doorways or windows. Properly install fans and dehumidifiers and increase the light intensity, caulk all cracks and crevices and routinely clean with diluted Safe Solutions, Inc. enzyme cleaners and borax or Mop Up® and 3% hydrogen peroxide. **Be careful; this mixture will cause discoloration.**

Talk with game conservation personnel about game management practices and game habitat modification. Make recommendations. **Remember, ticks like the shade; treat or avoid these areas especially.**

- Regularly mow the grass; keep it short.
- Inspect yourself, your family and pets whenever you enter the building. It is good idea to brush your cat and/or dog daily, especially during tick season. Modesty has no place during this inspection.
- Lower the relative humidity with dehumidifiers, increase the light intensity and install oscillating fans - all of which ticks hate and try to avoid. Lightly dust with baking soda or medicated body powder or talcum powder or Comet® or Safe Solutions Food-grade DE or draw a line with their Chalk De-Fence. Routinely mop with diluted or Safe Solutions Enzyme Cleaner and borax or install double-sided carpet tape.
- Encourage hunting or other game management practices to reduce the deer population in infested areas. (Previously restricted areas may need to be opened to hunting.) Cultivate the land.
- Reduce the rodent habitat to reduce hosts for larval and nymphal ticks.
- Open up woodland edges to provide observation perches for hawks and owls (mouse predators) and reduce edge browse for deer.
- Protect owls and hawks from hunters.
- Advocate cleaning up corn left in the edge rows of fields and grain spills around storage bins and roads to reduce wild vertebrate populations.
- Widen paths in camps and parks to keep walkers away from plants from which ticks can make contact with humans. Mow regularly and remove brush and debris and all dark, humid places.
- Keep vegetation mowed or cut short to eliminate rodent habitat in areas where people congregate.
- Advise that uncontrolled areas with high tick density be kept mowed and off limits to the public. Try spraying or cleaning with Safe Solutions Enzyme Cleaner with Peppermint and salt or myrrh extracts or red cedar oil and/or rose geranium oil or borax or Mop-Up® (sodium borate) bi-weekly. Use tick drags to monitor on a regular basis.
- Spray the ground with *Steinernema carpocapsae* (SC) or *Heterohabditis bactererphora* (Hb). SC will penetrate any body opening; Hb will also penetrate the body. Doing flea control with these products also reduces tick populations. Ants, birds, spiders, beetles, mites and even some mice naturally control tick populations. Seal any small cracks and crevices in your home/building.
- Fungi (*Metahizum anisopliae* and/or *Beauveria bassiana*) can be used to control some tick populations.
- Place double-sided carpet tape or duct tape (sticky-side up) around the edges of the rooms.

Note: Molasses Grass, *Melinis minutiflora* (Beauv.) - a well known pasture, hay and foddergrass in various tropical countries, e.g., Kenya, has a foul odor at certain stages, dried grass is free of this odor. Odor of fresh grass repels insects, snakes and ticks. In Tanganyika the bruised leaves are rubbed on animals as an insect repellent and the grass is used for nesting hens to control insect vermin. The whole plant is insecticidal and has been cultivated in Central Africa and Brazil for this purpose. In Brazil an infusion of this plant is used to control diarrhea.

SYNTHETIC PESTICIDE CONTROL AS A LAST RESORT - Remember, ticks have an uncanny ability to detect and avoid volatile pesticide poisons.

A novel control measure you may use as a last resort incorporates the use of very small amounts of **permethrin-treated cotton balls in cardboard cylinders** to reduce tick populations. The white-footed mice use the pesticide treated cotton as nesting material. The pesticide does not usually harm the mice but can sometimes control their tick parasites. This device, marketed as Damminix, must be placed close enough to reach all the female mice. Boric acid dusts would work even longer, but may kill the mice.

**** Control is most effective when you pay attention and mow/remove brush on both sides of paths.**

- Mow around weedy fences that provide cover for rodents moving in from nearby woodland edges. Heat treatments with propane torches will destroy the weeds as will spraying with herbicidal soap or undiluted ammonia or a urea or muriate of potash mix; do this where mowing is impossible. (Remember, broad application of volatile, synthetic pesticide poisons to mowed grass is not only dangerous but entirely useless, because it does not even reduce tick populations due to the fact that white-footed mice do not infest lawns and most ticks are already resistant to these toxins.)
- Keep brush cleared or burned along frequently traveled areas and lightly dusted with food-grade DE.
- As a last resort, you can dust rodent runs or burrows in areas where human traffic cannot be controlled and where there is a danger of disease transmission.

TO CONTROL/REPEL TICKS ON PETS:

- Feed your pets garlic on a daily basis and inspect at least daily. Wash routinely with Safe Solutions Enzyme Cleaner with Peppermint. Your veterinarian may prescribe and/or use insecticidal dips, washes or dusts which may be obtained at pet counters or from veterinarians. Do not touch treated pets. An alternative is to wash your pet with Safe Solutions Pet Wash and salt or borax, or with salt water and peppermint soap and/or undiluted Safe Solutions Enzyme Cleaner with Peppermint or use an herbal rinse - put 2 pounds of fresh or dried rosemary in a ½ pint of boiling water, steep for 20 - 25 minutes, strain, allow to cool and rinse your pet with the cooled liquid - do not towel off, simply allow to air dry or use a hair dryer. Be sure your pets are dry before letting them outside. Try using menthol or putting a few drops of rose geranium, lemon oil, lavender oil, rosemary oil, geranium oil, peppermint oil or oil of oregano as a personal and/or pet tick repellent or use Safe Solutions Insect Repellent on a pet's flea collar or use fresh leaves of mountain mint. Carefully rub food-grade diatomaceous earth into their fur per label directions. Add a tablespoon of apple cider vinegar to your dog's water.
- Check the area where your pets sleep and wash their bedding in hot water with borax regularly.
- Advise that all uncontrolled or ownerless dogs be regulated.
- Use of flea and tick collars not only have variable results but also can be dangerous.
- Cats do not appear to be at risk from Lyme disease nor are they hosts for RMSF vectors.
- Keep pets within your own mowed areas. Mow regularly and remove brush and debris.
- Apply 10 drops of rose geranium oil (or bay, pennyroyal, eucalyptus, myrrh) mixed in 1 tablespoon of vegetable oil. Check a small area first to see if you and/or your pet are sensitive. Keep out of the eyes.
- Boil 6 lemon halves; put lemons and water in blender and then strain this solution with a teaspoon of dish soap into a spray bottle and spray the cooled mix directly on the ticks and/or your pets.

FOLLOW UP - Continued monitoring and record-keeping is important. Tick counts should be reviewed annually to evaluate and adjust the pest management program. **Educational programs and materials for at risk groups are vital.** Caution: Remember, Safe Solutions Food-grade DE basically repels ticks. The Author has covered them in powder and it takes days for them to desiccate and die.

Precautions for At-Risk Group Members

- Avoid wooded or grassy areas, especially if they are inhabited with deer or rodents.
- Do not sit on the ground or logs in bushy areas.
- Wear light-colored clothing to enable you to easily spot ticks. Carefully put a few drops of rose geranium oil on your shoes, cap and coat; **avoid any eye contact.**
- Wear buttoned, long sleeved shirts inside long pants and tuck pants in socks while working or hiking in tick habitat. As you enter your home, put your clothing directly into the washer. **Remember, the heat of a clothes dryer for 60 minutes will kill ticks.**
- Use insect repellents on clothes and skin. Never use any formulations with over 20% - 30% active ingredient on skin. Try rose geranium oil, menthol or oil of oregano first if you are not sensitive to these fragrances.

- You can use permethrin formulations that are labeled for use as a repellent on clothes; they withstand washing and remain effective but are extremely dangerous in our opinion.
- Sulfur powder dusted on socks repels chiggers. It also may be effective against ticks, but may give some people an allergic reaction. Try menthol or neem oil as a tick repellent. The USDA is trying an extract of the resin of *Commiphora erythrae* for possible use as non-toxic tick repellent. The oil is currently used in Africa as a perfume and insect repellent. Try lightly dusting with food-grade DE.

Schedule regular and completely thorough body and clothing inspections for ticks at noon and bedtime:

- Nymphal deer ticks are small, but they can be seen with close inspection. Larval deer ticks cannot be spotted easily, but they are not normally disease carriers.
- Only adult American dog ticks infest people or dogs.

TICK REMOVAL - Remove them as quickly as possible.

Regular inspection, location and early removal of ticks prevents disease transmission. Veterinarians have told me that after washing a dog with a small amount of Safe Solutions Enzyme Cleaner with Peppermint or their Pet Wash all ticks were dead in 2 minutes. To remove feeding ticks **dab them with alcohol**. If feeding has just started, and mouthparts are not cemented in, ticks sometimes pull their mouthparts out. Try covering them with a dollop of menthol shaving cream or Vicks Vaporub. Note: Menthol is a monoterpenoid compound that is the only registered acaricide for tracheal mite control in the U. S. Ticks and mites are in the same order - Acarina - so it is not surprising menthol works on ticks too. **Generally it is advised not to apply any substance to a feeding tick as this may agitate the tick and cause the tick to regurgitate infected fluids into the wound. It is generally best to take tweezers, grasp the tick at the skin level and pull steadily** until the tick is removed. Grasping the tick by the back end, or heating it, can force disease organisms into the wound. Place the tick in alcohol or otherwise keep it for identification. **If the mouthparts are left in the skin, they will not transmit the disease, but the wound should be treated with an antiseptic to prevent secondary infection.** Note the date of removal to calculate the time of the symptoms onset. If the tick is identified as a deer tick, see a physician. If it is a RMSF carrier, look for symptoms within a week after exposure; if they occur, notify a physician. Ticks are sometimes discouraged from biting people who daily ingest garlic and nutritional yeast. Try spraying or applying menthol (Vicks) on people and pets to repel or remove ticks. Carefully sprinkle talcum powder or medicated body powders or food-grade DE around infested areas - be careful - the dusts can be irritating. Mop with diluted Safe Solutions, Inc. enzyme cleaner and/or peppermint soap with borax or food-grade DE; **keep little children and pets off the borax laundered floor.** We are working on an encapsulated pyrethrin spray/chalk and a new sodium borate enzyme product that holds a great deal of promise. **Any sign of illness or rashes and you should immediately see your health care professional.**

CLOTHING: Washing clothing in warm or cold water will only kill 10% of the blacklegged tick nymphs, even with agitation and sudsing; hot water will kill about 30%. Ticks can be under fresh water for hours and not drown. An hour of high heat in a dryer will kill them all. Safe Solutions Enzyme Cleaner will also kill them if you make them wet enough.

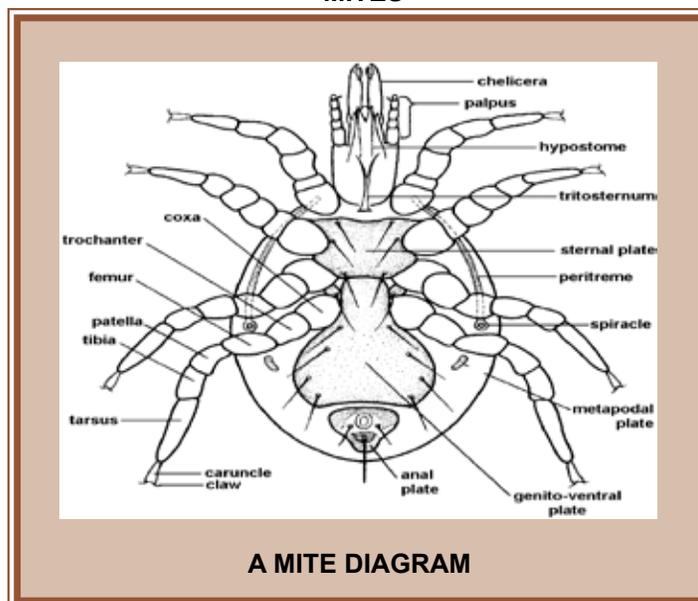
Note: The Author has been told that when removing large ticks from snakes, it is often necessary to use very hot forceps to convince ticks to back out. Using unheated forceps often leaves the mouthparts in place where they can cause infections. Safe Solutions Enzyme Cleaner with Peppermint at a rate of 1 oz. per quart water will kill most ticks in 2 minutes.

A comparison of tick removal products:

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=3453335&dopt=Abstract

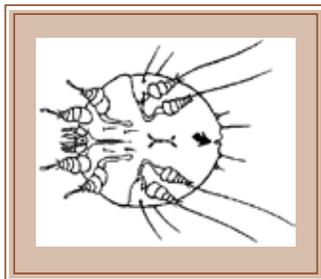
For alternative control products: <http://www.safesolutionsinc.com>

MITES



HUMAN ITCH MITE OR SCABIE MITE

Sarcoptes scabiei var. hominis (DeGeer)



You may be asked to treat buildings where scabies mite infestations have occurred. Volatile, pesticide poisons should not be applied. Scabies mites are parasites of humans, dogs, pigs, horses and sheep; the species of one host does not parasitize other hosts. Mites only live on the host.

Scabies mites are microscopic. The only way to be certain of an infestation is to have skin scrapings made and inspected under a microscope. However, physicians with experience can usually make accurate diagnoses without laboratory procedures.

Infestation - Scabies are transmitted by direct personal contact only e.g. sexual contact. Crowded conditions, particularly where children sleep together, spread scabies infestations most quickly. A scabies mite infestation begins when a fertilized female cuts into the skin and burrows in the upper layer of skin. She lays eggs in the burrows. Larvae hatch in the burrows and come to the surface to molt. Two nymphal stages and the adult stage are spent on the skin surface; only fertilized females burrow beneath the skin surface.

Favored places of infestation include the skin between fingers, at the bend of elbows and knees and under breasts. Though the idea of mite burrowing, even if it is only in the epidermis, might bring on itching, these sensations do not develop for a month after the initial infestation; it takes two or three generations with subsequent secretions and excretions to bring about sensitivity to burrowing.

Treatment - Treatment is relatively simple. See Human Lice and Scabies chapter; remember, bedding and underwear must be routinely laundered in borax and dried on hot cycles, or isolated for a week; mites cannot survive without a blood source for more than 5 - 7 days. Because of their sensitivity to heat, try using a sauna. We also recommend treatment with Lice R Gone® or eucalyptus oil, peanut oil, olive oil, or Safe Solutions Enzyme Cleaner with Peppermint. An old home remedy for dog scabies (mange) was to cover the whole dog with used motor oil (fresh oil will not work), but this is dangerous. **No volatile pesticide application to rooms or objects is indicated under any circumstances.** Remember, Norwegian scabies are resistant to lindane and lindane was banned as an agriculture insecticide because it was too toxic. Elimite (5% permethrin) Dermal Cream also has 1 mg (0.1%) formaldehyde. NTP, IARC and OSHA all list formaldehyde as a suspect carcinogen. The Elimite® package insert notes the first named inactive ingredient is butylated hydroxytoluene (BHT) which Sigma notes as: "Limited test results suggest that BHT might be a carcinogenic or tumorigenic agent." Try washing clothing and personally soaking with diluted Safe Solutions Enzyme Cleaner with Peppermint or

their Lice R Gone® and eucalyptus, peanut or olive oil and/or borax in a bath tub and then rinsing thoroughly. **See Chapter 16 - Human Lice and Scabies.**

HOUSE DUST MITES

***Dermatophagoides* spp**

Class- Arachnida

Order- Acarina

Family- Pyroglyphidae

Metamorphosis - Simple or Gradual

The term “house dust mites” has been applied to a large number of sightless, eight-legged, microscopic arachnids called mites (smaller than a speck of salt) found in dwellings associated with dust. About 80% of dust in a building is us; each one of us sheds several million cells daily or about the weight of a paper clip. A family of four could fill a quart container in a month! Dust mites breathe through their skin and have a hypopial stage that makes them virtually immune to synthetic insecticide poisons and fumigants during this deep dormancy stage of life. They love warm, humid settings and feed on skin scales and dander shed by humans and animals. Hundreds can be found in one pinch of dust. Household dust is a microscopic blend of sloughed skin cells, sneezed viruses, soil, furniture and clothing fibers, pet dander, carpeting pieces, soil, mold, bacteria, insect fragments, etc. **The average U. S. home collects 40 pounds of dust per year, which is home to at least 15 species of mites that live about 45 days and one ounce can contain over 42,000 individuals. Their feces and dead bodies are allergens.**

ECONOMIC IMPORTANCE. 35 million people in the U. S. suffer from dust mite allergy symptoms. In England, 1/3 of all cereal foods inspected had dust mite contaminations. Because of the medical implications, house dust and the fauna of mites associated with house dust have been tested for the source of the house dust allergen. The highest house dust allergen activity was found in dust samples stored at 85% RH. Mite allergens are mainly present in feces of house dust mites and may become airborne and inhaled by patients giving rise to asthma, rhinitis, or atopic dermatitis. Mite cultures contain so much allergen that a millionth of one per cent is still reactive to allergic people per Judith A. Mollet of Virginia Tech. This is suburbia’s most common allergen. The second most common allergen is the pet cat whose dander, hair and saliva are all allergens. In the Northeast the cockroach is the most important allergen. Even the most spotless buildings house millions of dust mites. **It is estimated that humans shed about 400,000 particles of skin a minute or 10 million scales of dead skin every day!**

DISTRIBUTION: Nearly cosmopolitan, associated with house dust, bedding, carpets, furniture and bird nests. **The National Institute of Environmental Health Sciences noted 5/9/00 at the American Lung Association/ American Thoracic Society Conference in Toronto that in an estimated 23% of American housing the bedding carries levels of dust mite allergens high enough to trigger asthma attacks; that number represents about 22 million homes. Their survey also found that certain proteins from dust mites are thick enough to cause allergies in more than 45% of all U. S. households.**

HOSTS: Mammals, particularly man, and in bird nests and occasionally in bee hives.

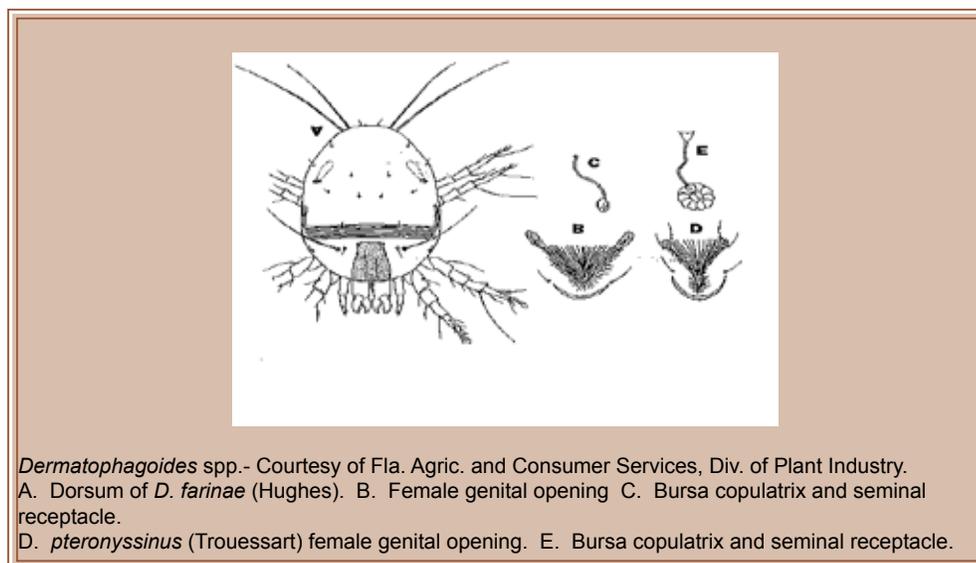
DESCRIPTION: A sightless, microscopic (some are 1/1000 the size of the head of a pin) creature that lives in carpeting, drapes, bedding, upholstered furniture and stuffed toys. They prefer temperatures in the 68° - 84° F. range. Both male and female adult house dust mites are globular in shape, creamy white and have a striated cuticle. The female measures approximately 420 microns in length and 320 microns in width. The male is approximately 420 microns long and 245 microns wide. (About the size of a sharp pencil dot. They look like miniature hairy dinosaurs, complete with armor plates and pincers.) A pair of suckers on the ventral posterior idiosoma of the male is used to grasp the female during copulation. Males are more sclerotized with enlarged legs I and III. The male aedeagus is located between the apodemes of leg IV. The female has a well defined genital opening (B) anterior to the bursa copulatrix located near the anus (Suggers, 1987) They feed on dead skin cells. Most adults are about 1/100” to 1/64” long with soft, oval, somewhat flattened bodies. **They are very dependent on temperature, moisture and an adequate food supply.** Male dust mites are so sensitive to dehydration they huddle together to increase the humidity. While these microscopic mites, which are relatives of spiders that feed on our dead (moldy) skin, are found in the United States, they are much more prevalent in England where humidity is very high (over 50%), so use a dehumidifier and a fan with an activated charcoal filter. You provide their food in the form of dead skin cells that fall off your body each day. As Heywood Banks,

the singing comedian, has written in a song, "Those dust mites smack their bony lips and eat that skin like taco chips. It's a rain of manna from the sky." **Dust mites are easily controlled when they are exposed to direct sunlight so hang your wash out on a clothesline or steam clean all items.**

House dust mites often cause allergic reactions. Dust mite feces contain at least 15 proteins that also act as allergens. These mites and/or their droppings may cause allergic reactions to 500 million people worldwide and be responsible for triggering reactions in 50% to 80% of asthmatics! The dust mite can reingest the dung as many as three times. Wrapped in a special film, the droppings incorporate enzymes that continue to digest the dung even after it has been excreted. The University of Virginia estimates hospital emergency rooms see over 200,000 asthmatics a year with allergic reactions to dust mites. Female house dust mites can deposit 50 eggs in her 36 day (average) life span. Each mite can deposit 20 fecal pellets a day. So you can see how they can totally overwhelm your area very quickly with allergens that are normally "recycled" every time you vacuum or dust. Few eggs hatch at temperatures below 60° F. or above 95° F. For more information call 1-800-7-ASTHMA, Asthma and Allergy Foundation of America, <http://www.aafa.org> and Allergy Control Products, Inc., 1-800-422-DUST, <http://www.allergycontrol.com>.

There are several species worldwide including the House Dust Mite, *Euroglyphus maynei*, the American House Dust Mite, *Dermatophagoides farinae* (Hughes) and the European House Dust Mite *Dermatophagoides pteronyssinus* (Trouessart). Cast skins, fluids, feces and body parts of house dust mites accumulate with other dust and small household allergenic disintegrated matter. Vacuum with a Hepa filter intensely. A new and effective control method is to spray carpet with tannic acid solutions obtained from carpet cleaning suppliers. We prefer that you mop and routinely clean/dust and/or use a rinse-and-vac with diluted enzyme cleaner. Allergens are not normally removed by temperature or humidity changes.

LIFE STAGES AND BIOLOGY: The life cycle of 2 mite species *D. farinae* (Hughes) and *D. pteronyssinus* (Trouessart) include egg, active larvae, resting larva (pharate tritonymph), active tritonymph, resting tritonymph (pharate adult), and active adult. Between 19-30 days are needed to complete a life cycle depending upon the temperature and humidity (Furumizo, 1973). Mated females live about 2 months. A male may attach itself to a tritonymph female and mate when she reaches the adult stage. *D. farinae* lays eggs over a 30-day period, producing about an egg a day, while *D. pteronyssinus* lays about 80 eggs over a 45 day period. There is a general agreement that house mites in the home feed on shed skin of man. The average individual sheds 0.5 to 1.0 gram of skin daily. Each dust mite can excrete 20 fecal pellets in a day, or an amount of excrement equal to 200 times its own weight in a lifetime. Dust mite numbers are highest in the summer. Spieksma et al. (1971) reported that the mites were **very** sensitive to relative humidity and at 60% or lower the mite population stops growing and dies out, **so properly install a dehumidifier, air conditioner and fans.**



American house dust mites, *Dermatophagoides farinae* (Hughes), were marked by adding a 4% solution of Sudan Red 7B, a microbiological stain, to mite rearing media. Marked mites were released onto a downstairs

couch in a two-story residence. Two children sat on the couch for about 3 hours after which their clothes were examined for stained mites. Various parts of the house and family vehicle were vacuum sampled, and dust samples examined for presence of marked mites. Results of 2 trials showed the presence of stained mites on children's clothes, upstairs in the residence, as well as in the family vehicle. Clothing is shown to be a significant factor in the dispersal of American dust mites. Even if concentrated in a small area (one couch) mites were able to disperse throughout the house, and into a family vehicle, within a matter of weeks. Mollet, J. A. and W. H. Robinson. 1996.

Intelligent Pest Management® Non-toxic Dust Mite Control:

1. **Practice proper sanitation and avoid using humidifiers. Reduce the relative humidity with dehumidifiers or air conditioners. The one thing that dust mites never do is drink; they suck moisture from the air, so dry conditions will kill them.** Remove (if possible) any dander, dead skin and/or dust and/or dust catching materials, e.g., books, magazines, clutter, stuffed animals, rugs, textiles, furs, feathers, woolens, drapes, carpets, etc. and/or enclose mattresses, pillows and box springs in plastic or zippered allergen-impermeable encasings designed to block dust mites and spray all surfaces with diluted Safe Solutions, Inc. Enzyme Cleaner with Peppermint (1 oz. per qt. water) as needed. Install allergen trapping filters in air conditioning/heating systems. Keep all clothing in closets with the doors closed. Keep windows closed in the spring. **Clean the air with HEPA air filtration or electrostatic air filters.** Tannic acid neutralizes the allergens in dust mite and animal dander; so dust problem areas with tannic acid powder.
2. Avoid sleeping with or keeping pets - especially cats and dogs or wash them often with Safe Solutions Pet Wash. **It is best to keep your pets outside;** if you can not, HEPA vacuum carpets, rugs, floors, mattresses, pillows, drapes, etc. daily and wash your hands after petting your pet. Dander stays around long after the pet has gone. Clean and disinfect with ultraviolet light. Cover the mattress properly.
3. Keep windows and doors closed and as weather-tight as much as possible to avoid the entry of pollen and insects. Clean window coverings every two weeks or replace with shades or mini-blinds.
4. Keep food products in glass containers and control all insect pests.
5. Reduce the relative humidity below 60%; repair all plumbing/moisture problems; install a dehumidifier and/or air filtration system. **Hot air vents should be covered with HEPA filters.**
6. **Avoid wet mopping and dusting unless you use diluted or Safe Solutions, Inc. Enzyme Cleaners and borax.** Then use diluted enzyme cleaner in a rinse-and-vac or spray diluted enzyme cleaners, but vacuum very thoroughly with a rinse-and-vac, water vacuum or Li'l Hummer with a HEPA filter at least once a week - **go very slowly** and allow the vacuum to actually suck up all materials; dust furniture and shelves before you vacuum. Carefully and slowly vacuum beds, pillows, drapes, carpet, upholstered furniture, floors, etc. **Steam clean everything but make sure everything is dry. Don't allow smoking in the building.**
7. Shampoo or steam clean or dry clean (off premises and air out thoroughly before returning) or better yet, simply put in to the sun all non-washable carpets at least one a year.
8. **Weekly washing** sheets, pillows, rugs and carpets in Safe Solutions, Inc. enzyme cleaners, soapy water or borax at least 122° F. for 5 - 8 minutes will kill all mites. Use silk or tightly woven linen sheets and pillow cases or, better yet, a mattress cover from Safe Solutions; dust mites can not pass through them.
9. **Direct sunlight** also kills mites and bedding is the prime harborage for dust mites, with stuffed furniture a close second. So put furniture, bedding, drapes, clothing, etc. out in the sun and/or line dry your washing. Replace heavy drapes with washable shades, mini-blinds or lightweight curtains.
10. Put plush toys in a plastic bag, tie the bag and freeze for 24 hours. Repeat as needed, e.g., once a week or wash them weekly. **It is best to only purchase washable stuffed toys and wash them weekly with enzyme cleaner in water (100° - 120° F.).**
11. To help control dust and dust mite allergens take a (square box) window fan, using duct tape attach two (charcoal) furnace filters (cut to size) to the fan grills on both the intake and exhaust sides. Turn on the fan to filter the air. **Activated charcoal will increase the filtration results** and help remove odors and some toxic gases. Change filters as needed. You can also use a high-efficiency HEPA air cleaner.
12. Over 25% of the mass of an old pillow might be dust and dust mites - so get a new one every 6 months. **Remove carpeting and drapes if needed.**

Least-toxic Control:

13. Routinely steam clean and clean the mattress with Hygienitech (<http://www.hygienitech.com>) and/or mop and clean with diluted Safe Solutions, Inc. enzyme cleaner or peppermint soap or alcohol. Then, if you still have any allergic reactions, as a last resort, you may have to try to clean with borax or Mop Up® (sodium borate) or a cleaning solution called Allerite® which penetrates carpet fibers and when vacuumed up dislodges all allergen-bearing mite feces. Houses severely infested with dust mites might require four vacuumings with Allerite® over a two-month period to reduce mite allergens to tolerable levels (less than two micrograms of allergen per gram of dust). Tannic acid can be used to control dust mites.
14. Clean any mold in the basement, bathrooms, kitchen, etc. with ultraviolet light, diluted bleach or borax or, better yet, with diluted Safe Solutions, Inc. enzyme cleaners and/or borax or sodium borate.
15. **As a last resort**, if none of the above options work on your dust mites, there are two insect growth regulators, Altosid® and Altonar®, the mosquito repellent diethyl-m-toluamide (DEET), and the herbal mixture Paragerm®, which contains solol, thymol, terpineol, citrus fruit natural essence, natural essence of *Syringa* and *Nardus* spp. plants, two halogenized phenyl alcohols and light liquid paraffin. The herbal product, hopefully, will not affect asthmatics or those with allergies. Always remember most pesticide poisons have little effect on dust mites. **You should instead try diluted Safe Solutions Enzyme Cleaner with Peppermint with borax or sodium borate or use a steam cleaner or ultraviolet light first.**

NOTE: HEPA filters, negative ion plates and other filters help remove small dust particles from the ambient air.

MORE METHODS TO MANAGE DUST MITE ALLERGIES - Caution: Children's bedrooms may be hazardous to their health. Kids occupy them a third or more of each day, and while there, come in close, long-term contact with bedding, carpeting and other fibers. While these furnishings can be comforting touches, they also contain most allergy sufferers' biggest enemies: dust mites. Microscopic arachnids, these 8-legged spider-like scavengers thrive in humid and warm conditions, shedding particles that trigger symptoms even after the insects cease to exist. Remove the fuzzies - wool blankets and non-washable stuffed toys. Install medical-grade air cleaners, use dustless vacuums and obtain other less costly aids that keep allergies at bay. Humans shed about 1/5 oz. on dead skin (dander) every week. About 80% of the "dust" seen "floating" in a sunbeam is actually shed skin flakes. Dust mites eat dead skin flakes both animal and human that have fungus growing on them. Enzymes and borax or sodium borate and ozone air conditioners kill the fungus and eliminate their food source. **Safe Solutions, Inc. Enzyme Cleaners and/or their ultraviolet light helps remove dust mites their eggs, and/or the fungus *Aspergillus repens* which predigests human skin flakes into a form the mites can eat.**

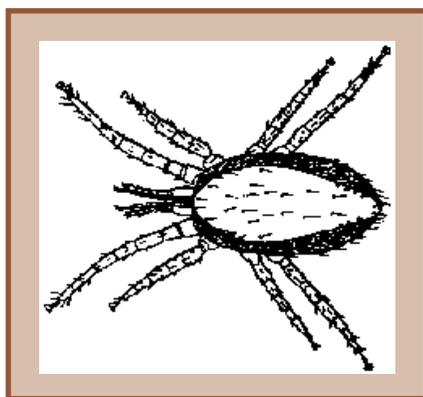
The first hurdle to overcome: The bed. That's because a mattress is the resort capital of the dust mite's world. A double bed mattress can hold millions of mites; you feed them with you and your provide them with about 1 pint of moisture vapor each night through your breathing and perspiration. After 10 years it is said the weight of a mattress is now half dust mite population and half mattress! Pillows and blankets are popular too. Mattresses and box springs should be encased in zippered, dust-proof covers or silk sheets and pillow cases. Sleep movement (people toss and turn up to 60 times each night) kicks up allergens, which are then breathed in and/or can remain suspended in the air for up to 24 hours. Washing bed linens in hot water is crucial. Water below 120° F. prevents accidental scalding, but it must be 130° F. or you must use borax and/or enzyme cleaner in cooler water to kill dust mites. For hotter water without scalds, get an "instant flow" device that supplies hot water at a specific point of use, such as a washer. Because bunks, canopies and upholstered headboards attract dust, avoid them, and don't allow a bed to be placed on the floor as it fosters dampness because bedding can't breathe, and dampness means moisture - an ideal condition for mites. Try leaving an electric blanket turned on high during the day to dry the humidity and kill the dust mites in the mattress. **Wash blankets in hot water and Safe Solutions, Inc. Enzyme Cleaner and borax every two weeks. Avoid blankets made of wool or down. Use silk products.**

The next place to concentrate on is the floor. Mites claim it as private stomping grounds too. The University of Virginia maintains that carpets are likely to have 100 times more allergens than wood floors. Besides hardwood, tile and vinyl are good flooring alternatives. You will still need to remove traces of dust on them and on wood-work, however, by cleaning with water and enzymes, then wax or oil regularly. Even using a damp cloth with diluted Safe Solutions, Inc. Enzyme Cleaner or diluted alcohol every day helps. Small rugs and throws, if they are washable - and laundered often in borax - are all right. Low pile carpet usually is not as troublesome to an

allergy sufferer as high shag. A vacuum with a high-efficiency particular air (HEPA) filter will capture particles without spewing exhaust dust, as a standard vacuum's paper filters does. A HEPA filter eliminates 99% of dust. There are chemical carpet products that reduce or destroy allergens - A moist powder is sold in all states but California. A tannic acid spray is acceptable there. A central or portable air purifier with a HEPA or electrostatic filter will remove particles and some dust mites - Keep in mind it is only effective on airborne irritants.

A refrigerated air conditioning system which, if ducts are professionally cleaned routinely, can prevent hot and humid conditions that stimulate mite growth. Central heating ducts demand similar maintenance and synthetic filters to prevent dirt particles. Keep indoor relative humidity below 50% by using a dehumidifier, especially during humid seasons. Pets: Animal dander, saliva and other irritants, including dust that their fur collects, may cause allergic reactions, so keep them out of bedrooms or use an air filter. Windows: Choose washable curtains or roller shades over draperies or blinds. When you clean, move all furniture to the center of the room so you can reach all of the corners and, with a damp cloth, wipe all of the moldings, light fixtures, shelves and door and window tops. Clean wood or linoleum floors daily with a specially treated dust cloth and mop cover. Don't use dusters, dust mops, bag-equipped vacuum cleaners or brooms - these utensils merely rearrange the dust or provide breeding grounds for additional dust mite/allergen growth.

Medical-grade air filters circulate and effectively clean up to 300 cu. ft. of air per minute. Inexpensive table top models generally are ineffective. 30 drops of tea tree oil in your sprayer, washing machine or rinse-and-vac will kill mold and dust mites. The distinct tea tree odor disappears when dry. Air out for 1 - 2 hours before re-entry. Repeat as needed. Metabolic gases emitted from molds and fungi growing inside buildings may be a significant source of volatile organic compounds (VOC's) that can cause indoor air quality problems known collectively as the "sick building syndrome". Spray or wash with Safe Solutions, Inc. enzyme cleaners or peppermint soaps. Tape an activated charcoal filter on both sides of a window fan - turn on and filter mites/dust from the air. Change filters as needed. Install and properly maintain dehumidifiers and/or air conditioning. Lower the relative humidity below 50% and control this pest. Remove all dust and dead skins routinely and thoroughly.



BIRD MITES - Urban pest problems ranging from imaginary itches to pubic lice have been diagnosed as bird mites. Several species of mites bite and suck blood from birds. Smaller than a period, these rapidly moving mites are difficult to find. They may be very light-colored, red or dark, depending on their last blood meal. Their bites resemble small skin pricks. Hungry mites are not reluctant to bite, injecting saliva that causes intense itching. They bite any part of the body but human blood will not support an infestation.

Bird nests are occupied by several populations of arthropods; they make up their own community with physical and biological supporting factors. For this reason, bird mite control is a simple example of integrated pest management. Management is required of this entire, but small, ecosystem.

Try routinely cleaning or spraying with diluted Safe Solutions, Inc. Enzyme Cleaners; use a hose-end sprayer.

You may find predatory species that feed on mites: beetles that feed on feathers, textile pests that infest woolens, and beetles and mites that feed on fungus. This community of organisms is supported by the blood, feathers, down and moist droppings of the birds. Lightly dust with Safe Solutions Food-grade DE.

When the young birds fledge (grow flight feathers and leave the nest), the food supply stops and the arthropod community leaves in search of other harborage. Often, bird mite migration can be tied to a particular bird species (usually one of the pest birds that nest on structures.) The tropical fowl mite, *Ornithonyssus bursa*, or the Northern fowl mite, *Ornithonyssus sylviarum*.

In the middle Atlantic states, bird mites become problems when fledgling starlings leave the nest the last weeks of May and the first weeks of June. Suspected bird mite infestations at other times of the year, more often than not, turn out to be caused by other problems.

Inspection - Always collect mites for identification.

- Use a small watercolor or make-up brush to pick them up.
- Store them in alcohol. Note: often mite activity is close to their point of entry into a structure. When this is the case:
- Look for bird nests on the outside of the structure on ledges, air conditioners, etc.
- Identify ways they can enter buildings.

Habitat Alteration - In this case habitat alteration also refers to the host birds habitat. **See Chapter 35.**

- Remove nests (if legal). If not, lightly dust with food-grade DE.
- Screen or net nest areas. Install string or fish line 2" above all landing areas.
- Install inclined ramps to prevent nest attachment.
- Prevent further nesting with screens, spikes, repellents, string, etc. See Bird Control chapter.
- Caulk mite entrance points into structures; then lightly dust with talcum or medicated body powder or Safe Solutions Food-grade DE.
- **Routinely clean or spray with diluted Safe Solutions, Inc. enzyme cleaners and/or borax or sodium borate. Lightly dust with food-grade DE.**

You should always protect your eyes and respiratory system from dust of the nest, bird droppings, and fungal spores when cleaning roost areas. Wear rubber gloves with duct tape "collars" sticky-side out on the cuffs. to keep mites from crawling on your hands and arms.

Control - Without food, mite activity should **usually** cease within a few days. Activity for extended periods means that nests and entrances have been missed (or the pest misidentified).

- Thoroughly steam clean or vacuum and then caulk/seal all cracks and crevices especially in the area of mite activity.
- Vacuum with a HEPA filter or steam clean any areas or cracks that might communicate with the nest area.
- Practice proper exclusion, sanitation and habitat reduction. Spray surfaces, nesting areas, sills, etc. with diluted peppermint soap and/or enzyme cleaners or natural soaps and/or borax as often as necessary.
- Mix ½ c. buttermilk, 3½ c. wheat flour and 5 gal. water. Spray to control all mites on plants.

Poultry mites, the same species or close relative of bird mites, can be problems. These mite infestations are treated in poultry houses or coops. The chicken mite, *Dermanyssus gallinae*.

- Mist/clean with diluted enzyme cleaner with peppermint and sodium borate and/or lightly dust with Safe Solutions Food-grade DE.
- Obtain and follow recommendations from University County Agricultural Extension Service agents. First try cleaning with borax with enzyme cleaners or peppermint soap sprays before applying **any** volatile, "registered," synthetic pesticide poisons.

Follow-up - Routinely spray/clean with diluted Safe Solutions Enzyme Cleaner with Peppermint (1 - 2 oz. per 1 gal. water). Record nest sites and control methods; if later infestations appear, new nests can be identified. Note the dates when identified bird mite infestations are reported. Keep records for several years; pinpoint times and seasons when these pests can be expected. Conduct annual monitoring of nesting sites before birds fledge. **Think before you spray or use any volatile, "registered," synthetic pesticide poison!**

Note: If you do not have a HEPA filter, vacuuming will low them all over the room.

Oil of Oregano - Oil of oregano kills mites and mold.

MOLD - FUNGI

Allergies can cost up to \$2 billion yearly in medical costs, prescriptions and decreased productivity - up to 10 million work days are missed each year and every day allergies keep 10,000 kids out of school! The number of allergy sufferers has soared in the last 20 years as more and more contaminants fill the air, water and food. High

levels of mold and/or fungi, e.g., *Aspergillus versicolor* can create many health problems, especially if a person has allergies; symptoms can be itching, eye irritation, vomiting, diarrhea, breathing problems, a sore throat, runny nose, headaches, congestion, and even life-threatening collapse from anaphylaxis. Sometimes volatile organic compounds (VOC's) are created and residents can really get sick. At every school where we have had them mist the area and clean the ducts with diluted enzyme cleaner at 1 oz. per quart and mop with and clean all surfaces and ducts with 1 oz. per gal. water and/or rinse-and-vac with 2 oz. per gal. water, we have controlled the allergy symptoms for at least 30 days with only Safe Solutions, Inc. enzyme cleaners. Routine cleaning with enzyme cleaners and Mop Up® or borax or baking soda should quickly control or eliminate any and all fungi and mold problems, especially if you repair all leaking roofs, walls, plumbing and other moisture problems. Dry out basements and bathrooms/showers - prime breeding areas for fungal spores. Don't use humidifiers, or if you must, only use them with diluted enzyme cleaners. Properly install and maintain dehumidifiers. Circulate air in bathrooms with exhaust fans. Install and maintain (activated charcoal) filters in all ducts in central air conditioning and heating systems. Treat all wet wood and/or cellulose materials you want to save with TIM-BOR® per label directions and mop all floors, etc. with Mop Up® per label directions or, if you do not have access to these products, use ½ c. of borax or even baking soda per gal. hot water; **be careful not to put any boron product where it can be ingested by man, plant, fowl or animal.** To quickly bring the allergic reactions down, simply mist the room with diluted (1 oz. per gal. water) Safe Solutions, Inc. Enzyme Cleaner with Peppermint (Use a mask and goggles.) and then install the activated charcoal filters on both sides of a box window fan; then turn the fan on and filter the air...or you can buy a high-efficiency air cleaner. Replace the filters as needed. Clean routinely with diluted Safe Solutions, Inc. enzyme cleaners with sodium borate and peppermint. Borax and/or sodium borate when sprayed at a rate of one pound per gallon of hot water will permanently control wood destroying insects, mold and fungal infestations on unfinished wood surfaces. Sodium borate or borax will also control mold and fungus on other surfaces, but the control will have to be repeated as needed. You will find the mold odors will completely disappear. You can carefully spray, mop, paint or fog sodium borate to control mold generated voc's. (See Decay Fungi, Chapter 36.)

Smoke Odors: Diluted ½ c. per gallon water, washing soda will remove smoke and soot. Caution: It will also peel wax off floors, so be careful and wear gloves. This mix also will kill insects. Safe Solutions Enzyme Cleaner with Peppermint also removes many odors, including skunk and smoke.

**Great men are they who see that spiritual is stronger than any material force,
that thoughts rule the world. — Emerson**

**A man's best friends are his 10 fingers and
you will always find a helping hand at the bottom of your arm. — My Mom**

Think before you spray any volatile, synthetic pesticide poison. — S.L.T.



**Hold fast to dreams - for if dreams die,
Life is a broken-winged bird that can not fly.
Hold fast to dreams - for when dreams go,
Life is a barren field frozen in the snow.
Stand up for what is right -
Even if you have to stand alone.
— Langston Hughes**

**This we know.
All things are connected
like the blood which unites one family.
All things are connected.
Whatever befalls the earth,
befalls the Sons of the earth.
Man did not weave the web of life;
he is merely a strand in it.
Whatever he does to the web,
he does to himself.
— Chief Seattle, 1854**



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