

SECTION 3
CHAPTER
14

TICKS, MITES, BEDBUGS, AND LICE

LEARNING OBJECTIVES

After completely studying this chapter, you should

- Be able to identify common biting pests.
- Understand the life cycles, habits, and habitats of biting pests.
- Know which biting pests transmit diseases.
- Know what precautions to take to prevent disease transmission.
- Know integrated pest management options for biting pests.
- Know what to do in the case of imaginary pest infestations.

An organism that lives in or on another organism and obtains nourishment during all or part of its life from it, without directly causing its death, is generally known as a *parasite*. The organism from which the food is obtained is known as the *host* of the parasite. Many of the biting pests discussed in this chapter will feed directly on humans or other warm-blooded animals. These parasitic pests are blood feeders. Some may carry disease-causing organisms such as bacteria or viruses from one host to another. When parasitic organisms perform this function, they are known as *vectors*. Ticks, especially, are known to be vectors of some serious human diseases.

In many of the pest situations discussed in this chapter, pesticide application will not be necessary. Habitat

alteration is often all that is needed to manage biting pests. It is important that pest control technicians understand the habits, life cycles, and disease-vectoring capabilities of biting pests so that clients receive the proper advice. For example, knowing when to advise a client to seek medical attention is crucial. Furthermore, fear of parasitism and/or unfavorable environmental conditions can lead to imaginary pest infestations. This chapter discusses how pest control technicians should approach these situations. Clients' fears and concerns should not be discounted. A thorough investigation should be conducted to determine whether the pest infestation is real or imaginary.

TICKS AND MITES

Ticks and mites are in the arachnid order Acarina. Many new mite species are found and described every year. They have sack-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 and ticks have only a single (one part), oval body with legs attached to its sides.

Ticks and mites have four stages in their life cycle: egg, larva, nymph and adult. All first-stage tick and mite larvae have only six legs; both later stages, nymphs and adults, have eight.

TICKS

Ticks, the largest mites, feed only on the blood of 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).

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 hosts.

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, campers, 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 and the adult drops off to find another host. Most ticks, however, have three hosts—one for each stage.

Life Cycle

Seed Ticks. Normally, thousands of tiny larvae hatch from a batch of eggs and crawl randomly in the surrounding area. Fortunate ones attach to a small mammal or lizard. These larval 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.

Nymph. 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.

Adult. The adult 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. According to one report, a soft tick lived for 11 years without feeding!

If heat 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 into the fur (or feathers) to a place where it can engorge.

Attachment and Feeding

Adult female hard ticks will feed from several days to more than a week. Anyone who removes an engorged tick gains, at least, a grudging respect for the parasitic tenacity of this pest. Since ticks cannot 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.

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 feeding attachment begins. The central holdfast organ, covered with recurved teeth or ridges, is inserted, and blood sucking begins. Secretions from the tick's salivary glands are 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 feeding ceases and the secretions stop.

The strength of the holdfast organ helps the tick resist scratching. The organ's importance increases as feeding proceeds because as the female tick engorges, she cannot hold onto 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 of the host, lays eggs, then dies.

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

BROWN DOG TICK (*Rhipicephalus sanguineus*)

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 host is dogs. 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.

Adult ticks are about $\frac{1}{8}$ 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 becomes a dark blue gray because of her blood-stretched abdomen.

The female can deposit up to 4,000 eggs. When the eggs hatch, larvae outdoors climb vegetation; when they are inside, they climb 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.

After each engorgement, the tick drops and crawls 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 can be produced each year, depending on the availability of hosts and the temperature.

Infestation. Homes and yards can be infested by the visit of an infested dog that drops mated, engorged female ticks. Other dogs can become infested when they are taken to an infested kennel or a home where ticks 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 indoors late that fall. In fall, winter, and spring, tick infestations indoors are likely to be brown dog ticks.



Figure 14.1. Brown dog tick, *Rhipicephalus sanguineus*, male and female.

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. Its sleeping areas will probably have the most severe infestations.

Control and Management of Brown Dog Ticks

Inspection

- Look in rooms where dogs sleep—under the edges of rugs, under furniture; in cracks around baseboards, windows, and doorframes; in dog boxes.

Habitat Alteration and Pesticide Application

Advise clients to:

- Check pets regularly for ticks.
- Treat pets using pesticidal dips, washes, or dusts. *Do not let small children play with dogs that have been recently treated.*
- Wash dog bedding frequently.
- Evaluate flea and tick collars. Effectiveness is variable.
- Keep grass cut short around buildings and fences. Mow on both sides of fences.
- Keep stray dogs out of the yard.

Pest control technicians:

Inside:

- Use crack and crevice pesticide applications where ticks hide.
- Treat under the edges of rugs; under furniture; in cracks around baseboards, windows, and doorframes; in dog boxes.
- *Do not allow pets or children in the sprayed area until it is dry.*
- Fogging for ticks is useless.

Outside:

- Spray or dust kennels and resting areas using pesticides labeled for that treatment.
- *Do not allow pets or children in the sprayed area until it is dry.*

Follow-up

It is important that clients know that dogs should be protected even after treatment because eggs can take 30 days to hatch. Take time to assure clients that brown dog ticks do not bite humans and will therefore *not transmit a disease*. The fear of Lyme disease can drive a desire for overkill. Explain that the brown dog tick does not spread Lyme disease.

TICKS AND DISEASES

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). All technicians 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 diseased ticks because of:

- Reversion of farmland to scrub vegetation.
- Continuous incorporation of rural land into urban population centers.
- 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 are not susceptible to classical agricultural pesticide cover applications.

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

- They are persistent bloodsuckers—they attach and hold on.
- Long feeding periods allow time for infection and extend the distribution time.
- Many species have a wide host range. Initially, ticks feed on small hosts, later on larger hosts. Most can take three different hosts. They primarily find mammals but accept birds and reptiles.
- They have a tremendous reproduction potential and lay several thousand eggs.
- Eggs of some disease-carrying ticks also carry disease.
- They have few natural enemies. Only two species of wasps parasitize hard ticks.

LYME DISEASE

Lyme disease is caused by a spirochete (a spiral-shaped bacterium). 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 to 12 hours after feeding begins, if the tick is located and removed within that time, no infection will occur.*

Usually, within 7 days (from 3 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 cronicum 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.

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 to 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 to 10 percent of the cases, heart block may occur.

Dogs can also acquire Lyme disease when they forage in tick habitat. In fact, diagnosis of the disease in dogs in an area is a harbinger of human cases to follow. Symptoms in dogs include sluggishness and lameness.

Responses to Lyme Disease: Education

This serious disease can be expected to increase. Technicians should clearly instruct their clients that there are no easy or effective control measures that state or federal agencies can perform.

- Children are at highest risk. They encounter infected ticks in camps and parks, on hikes, or at play in areas where deer and mice abound. Children are not as sensitive to finding ticks on themselves as adults are.
- The second risk group consists of adults whose occupations place them in tick habitat: farmers, outdoor maintenance workers, park and forestry personnel, and military personnel.
- Members of the general public who hike, camp, participate in outdoor recreational sports, or live in areas of preferred tick and host habitat are the third risk group.
- Hunters, depending on the amount of time spent outdoors, fit into either of the last two groups.

ROCKY MOUNTAIN SPOTTED FEVER (RMSF)

RMSF is caused by a rickettsia, 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.

At least four to six hours elapse after the American dog tick begins feeding before disease transmission begins. If ticks are removed during this noninfective 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 to 106 degrees 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.

TICKS THAT CARRY DISEASE

Deer ticks, or *Ixodes* spp. 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 scapularis*, is the carrier (called a vector) of Lyme disease in the eastern and midwestern United States. 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 Lyme disease transmission is not yet known.

The American dog tick, *Dermacentor variabilis* is the eastern, central United States, and Pacific coast vector of Rocky Mountain spotted fever. The Rocky Mountain wood tick, *Dermacentor andersoni*, which closely resembles *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 two species of *Dermacentor*.



Figure 14.2. Disease-carrying ticks—deer, lone star, and American dog.

DEER TICKS (*Ixodes scapularis*)

The deer tick is unlike the larger lone star tick and the American dog tick (see Figure 14.2). 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 $\frac{1}{8}$ inch, 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. Adult tick females that have overwintered lay eggs in the spring. Tiny 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.

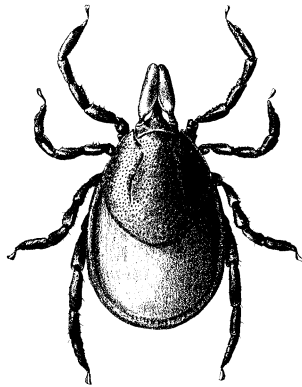
Nymphs. Nymphs are ready to feed in May and June. The body of the nymph is tan with black legs and a black shield (scutum) near its front. Nymphs climb vegetation and attach to passing animals such as dogs, cats, horses, cattle, raccoons, opossums, migrating birds, and humans, as well as mice.

Nymphs live in what is classically called the “white-footed mouse habitat,” where larvae fed the previous late 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 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. Nymphs usually molt into the adult stage in late summer.

They sometimes overwinter and molt in the spring.

Adults. The body of the adult female is brick red with black legs; she has a black shield (scutum) in the front. The male is entirely dark and smaller than the female.

Adults feed on deer, which are unaffected by Lyme disease. Where these deer move while hosts of egg-laying females determines the distribution pattern of the next generation. Adults feed in late fall or spring. Deer ticks also bite on warm days in winter. Hosts of the western blacklegged tick are dogs, cats, sheep, horses, cattle, and deer.



AMERICAN DOG TICK (*Dermacentor variabilis*)

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.

Only the adults, which are slightly over $\frac{1}{8}$ inch long, are found on 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 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 possible transmission of RMSF, any tick attachment should be noted and the victim observed for symptoms.



Figure 14.3. American dog tick, *Dermacentor variabilis*, male and female.

LONE STAR TICK (*Amblyomma americanum*)

The lone star tick lives in the southeastern quarter of the United States from Texas to Missouri and east to New Jersey. It attacks birds and both wild and domestic mammals, including humans.

Females are brown with a white spot in their center (the lone star). Males are mottled brown without a white spot. Both sexes have pigmented eyes at the front lateral edges of the scutum. Females are prolific, often producing more than 6,000 eggs.

Though it is rare to find larval ticks on humans, all three stages of the lone star tick will attack people. When the solid brown larval tick infests humans, it is usually the result of an unwitting person sitting or lying 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 larvae wander but do not attach. They can be showered off.

Lone star ticks are associated with cattle and deer, so human risk increases around large cattle and deer herds. When found on humans, the ticks certainly should be removed and noted, in case RMSF symptoms develop.

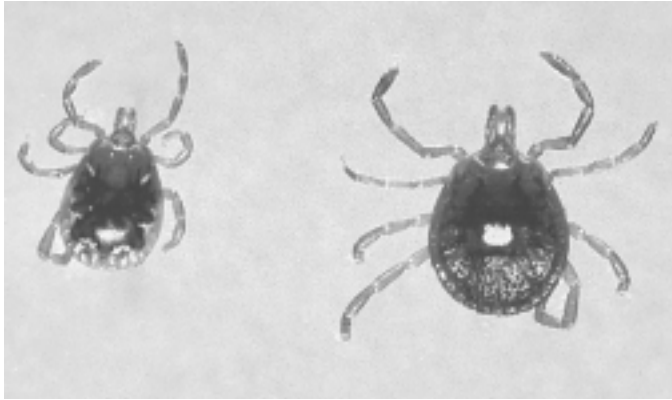


Figure 14.4. Lone star tick, *Amblyomma americanum*, male and female.

CONTROL AND MANAGEMENT OF DISEASE-CARRYING TICKS

Where pest management services are provided to an area such as a neighborhood, camp, park, 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.*

Inspection

- Drag a flannel rectangle, 2 by 3 feet, 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. Small pieces of dry ice (CO₂) placed in the middle of cloth squares have also been successful in attracting 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 on disease prevalence in hunters and hunting dogs.

Habitat Alteration

Talk with game conservation personnel about game management practices and game habitat modification. Make recommendations.

- 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.

- Reduce the rodent habitat to reduce hosts for larval and nymphal ticks.
- Open up woodland edges to provide observation perches for hawks (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.
- Widen paths in camps and parks to keep walkers away from plants from which ticks can make contact with humans.
- Keep vegetation short to eliminate rodent habitat in areas where people congregate.
- Advise that uncontrolled areas with high tick density be kept off-limits to the public.

Pesticide Application

A novel control measure using *permethrin-treated cotton balls in cardboard cylinders* has been reported to reduce tick populations. The white-footed mice use the pesticide-treated cotton as nesting material. The pesticide does not harm the mice but kills their tick parasites. This device must be placed early enough to catch larvae and nymphs and must be placed close enough to reach all the female mice.

Pesticide sprays are most effective when applied to the sides of paths.

- Spray low vegetation including low shrubs thoroughly.
- Mow around weedy fences that provide cover for rodents moving in from nearby woodland edges. Spray at their base.
- Use herbicides to control weeds where mowing is impossible. Remember, broad application of pesticides to mowed grass does not reduce tick populations because white-footed mice do not infest lawns.
- Dust rodent runs or burrows in areas where human traffic cannot be controlled and where there is a danger of disease transmission.

To control ticks on pets:

- Use insecticidal dips, washes, or dusts that can be obtained at pet counters or from veterinarians. Dogs should be protected if they roam in tick habitat.
- Encourage regulating all uncontrolled or ownerless dogs
- Use of flea and tick collars has variable results.
- Cats do not appear to be at risk from Lyme disease nor are they hosts for RMSF vectors.

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 (children and outdoor workers and recreators) are vital.*

Precautions for At-risk Group Members

- Wear long pants tucked in socks while working or hiking in tick habitat.
- Use insect repellents on clothes and skin. Do not use formulations with over 20 to 30 percent active ingredient on skin.
- Use permethrin formulations that are labeled for use as a repellent on clothes. They withstand washing and remain effective.
- Sulfur powder dusted on socks repels chiggers. It also may be effective against ticks.
- Schedule regular body inspections for ticks at noon and at 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 disease carriers.
- Only adult American dog ticks can infest both people and dogs.

Tick Removal

Regular inspection, location, and early removal of ticks prevents disease transmission.

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.

If they do not release in a few minutes, *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 symptoms onset.

If the tick is identified as a deer tick, see a physician. If it is an RMSF carrier, look for symptoms within a week after exposure. If they occur, notify a physician.

MITES

Mites are more diverse than spiders. More than 30,000 species of mites have been identified. They are found all over the world, from deserts to rain forests, mountain-tops to tundra, saltwater ocean floors to freshwater lakes. They suck plant juices and animal blood, make tumors (galls) in plants, and transmit diseases. Relatively few mites are parasites on humans or other animals.

Mouthparts are attached at the very front end of a mite's body. These mouthparts consist of a group of small appendages that sometimes looks like a head, but the brain actually is located behind the mouthparts and eyes. The mouthparts of mites form a tube that ingests plant or animal juices. Very short appendages on each 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 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 purposes: some sense touch; others pick up odors; not uncommonly, some hairs have light-sensing cells that allow the mite to distinguish light from dark.

HUMAN ITCH OR SCABIES MITE (*Sarcoptes scabiei*)

Pest management technicians are sometimes asked to treat homes where scabies mite infestations have occurred. Pesticides 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.

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 contact only. 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. Pesticide ointments or creams prescribed by physicians are applied from the neck down to every member of the family. Bedding and underwear is laundered. *No pesticide application to rooms or objects is indicated under any circumstances.*

HOUSE DUST MITES (*Dermataphagoides* spp.)

Though these microscopic mites are found in the United States, they are much more prevalent in England, where humidity is very high.

House dust mites sometimes cause allergic reactions. Cast skins and body parts of house dust mites accumulate with other dust and small household allergenic disintegrated matter. Vacuum intensely. A new and effective management method is to spray carpet with tannic acid solutions obtained from carpet cleaning suppliers.

BIRD MITES

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.

Several populations of arthropods occupy bird nests. 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 small ecosystem.

Applicators will find predatory species that feed on mites: beetles that feed on feathers, textile pests that infest woolens, and beetles and mites that feed on fungi. This community of organisms is supported by the blood, feathers, down, and moist droppings of the birds.

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).

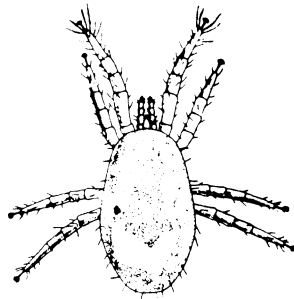
In the middle Atlantic states, bird mites become problems when fledgling starlings leave the nest in late May and early June. Suspected bird mite infestations at other times of the year more often than not turn out to be caused by other problems.

CONTROL AND MANAGEMENT OF MITES

Inspection

Always collect mites for identification.

- Use a small watercolor brush to pick them up.
- Store them in alcohol.
- 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 mites can enter buildings.

Habitat Alteration

In this case, habitat alteration also refers to the host birds' habitat.

- Remove nests.
- Screen or net nest areas.
- Install inclined ramps to prevent nest attachment.
- Prevent nesting.
- Caulk entrance points into structures.

Technicians should always protect the eyes and respiratory system from dust of the nest, bird droppings, and fungal spores when cleaning roost areas. Wear rubber gloves to keep mites from crawling on hands and arms.

Pesticide Application

Use pesticides labeled for mite control. Without food and with pesticide applications, mite activity should cease within one day. Activity for extended periods means that nests and entrances have been missed (or the pest was misidentified).

- Apply pesticides indoors to cracks and crevices in the area of mite activity.
- Apply sprays or dusts in the cracks that might communicate with the nest area.
- Outside, spray or dust pesticides at the nest area to kill wandering mites.
- Poultry mites, the same species or a close relative of bird mites, can be problems. These mite infestations are treated in poultry houses or coops.
- Obtain and follow recommendations from university or county Extension Service agents.

Follow-up

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.

BEDBUGS

The term "bug" is slang for insect. Used technically, however, it refers to the thousands of species of the order Hemiptera, "true bugs," which includes bedbugs. Most species of true bugs feed on plants; many feed on animals, other insects in particular; some are aquatic. Feeding is accomplished when the bugs pierce tissues with slender thread-like stylets (located in a "beak" on the front of the insect's head) and suck up liquids. Bedbugs are indeed true bugs that suck blood.

COMMON BEDBUG (*Cimex lectularius*)

This wingless bedbug, a notable blood-sucking parasite of humans throughout written history, has moved with us all over the world. The bedbug's adaptation to humans is so complete their bites are nearly painless. In the United States, bedbugs have been one of the most important pests. They were disliked more than cockroaches, but DDT so effectively controlled bedbugs in the late 1940s that they are of minor importance today.

Bedbugs are dark reddish brown, oval and very flat. Adults are almost $\frac{1}{4}$ inch long and become mature in about four weeks when host blood is available and temperature, humidity, and harborage are favorable. If hosts are scarce, bedbugs can survive for a year without feeding.

Hosts include many species of vertebrates besides humans, including poultry, rodents, dogs, and cats. They infest shelters along hiking trails and cabins of summer camps and parks. The surprise occurrence of bedbugs in urban homes often can be traced to these recreation facilities.

Eggs. Eggs are deposited several times each day in protected places near the host's sleeping area; several hundred might be deposited. Hatching occurs in one to two weeks, depending on temperature—the warmer the weather, the shorter the incubation time.

Nymphs. Nymphs, tiny and colorless at first, go through five molts, taking a blood meal between molts. This nymphal period can last from several weeks under favorable conditions to as long as a year when hosts are unavailable and temperatures are low.

Adults. Undergoing gradual metamorphosis, the bedbugs mate soon after becoming adults. Adult bedbugs prefer humans as hosts. Though they have been known to harbor several human diseases, *there has been no record of disease transmission.*

Harborage

Under normal conditions, bedbugs feed at night. Flat bodies allow them to hide in cracks in beds, bedside furniture, dressers, wallboards, door and window frames, behind pictures, under loose wallpaper, and in rooms near host sleeping areas.



Figure 14.5. Bedbug, *Cimex lectularius*.

CONTROL AND MANAGEMENT OF BEDBUGS

Inspection

The bedroom is usually the center of infestation. All dark cracks and crevices are potential harborage.

- Inspect camping sleeping equipment.
- Inspect outdoor animal sheds and coops, even if not recently occupied.

Habitat Alteration

Because bedbugs have alternative hosts besides humans (e.g., rodents, some birds, etc.), excluding these animals is very important. Though it is difficult, infested woodland cabins must be vermin-proofed.

Inside

- Tighten, caulk, and screen routes of entry.
- Store mattresses in protected areas.
- To prevent mouse nesting, do not fold mattresses on cots when they are not in use.
- Open protective harborage inside, such as wall voids, or tighten it up completely.
- Open cabinets. This discourages rodent nesting.
- Make crawlspaces accessible to predators and light.

Outside

- Move woodpiles away from the structure.
- Keep weeds and shrubs away from the foundation.
- Eliminate garbage.

Pesticide Application

There is no tolerable number of bedbugs in occupied structures. Camps and hiking shelters should be treated only when there is evidence of an active bedbug infestation. Rodents found inside should be trapped or baited. Several general application pesticides labeled for bedbugs are available.

- Dust or spray desiccating dusts or labeled insecticides, etc.
- Use crack and crevice application methods to treat harborage thoroughly.
- Treat furniture joints.
- Ensure that treated tufted mattresses or depressed seams dry and are covered with bedding before they are used.
- Leave time for drift or droplets to settle before bedtime.
- Do not use space treatments or fogs. They are not effective.
- Check state regulations. Some laws allow the use of appropriately labeled residual pesticides for cracks and crevices. This reduces the need for repeated applications.

Follow-up

If treated infestations recur, evaluate to determine whether some harborage was missed or if the structure is being reinfested; revise the management plan. Monitor structures where periodic reinfestation occurs. Remember, camps used only seasonally should have a pest management plan too. Keep good records on pesticide use and application methods. Educate clients and maintain communication. Emphasize that bedbugs do not transmit diseases. Remove rodent baits when recreational buildings are occupied.

Two species of bedbugs can be found in bat colonies. Called "**bat bugs**," these bugs are very similar in appearance to the common bedbug. They do not build up in structures as intensely as the common bedbug. Their host is the bat, but bat bugs wander when hosts leave during migrations. They are also disturbed by reconstruction and bat-proofing. An occasional bat bug appears in rooms usually just below attics. Locate infested bat nesting sites and dust after the bats and detritus have been removed.

Endangered Species

Be aware of endangered species of bats and other animals when treating bedbug infestations. Outside, treat rodent burrows only.

HUMAN LICE

There are three species of human lice: **head lice**, **body lice**, and **crab** or **pubic lice**. They all suck human blood and are not found on birds, dogs, cats, farm animals, or other hosts. The lice discussed here all belong to the insect order Anoplura.

Historically, the disease typhus, transmitted by body lice, was common where people were confined together and could not wash or delouse their clothing. This disease became epidemic within confined populations such as cities under siege or armies limited to trenches or on the move and unable to delouse their clothes. Typhus is a fatal disease and was so pervasive that it, more than wounds of war, determined who was victorious and who was defeated in wartime.

Widespread louse epidemics ceased being a problem when DDT dust became available during World War II. Although body lice became resistant to DDT when it was intensively and repeatedly used, other synthetic pesticides were found to work as well. Typhus epidemics are not caused by either head louse or crab louse infestations.

With the elimination of the large infestations, modern societies are puzzled and alarmed when small, persistent louse outbreaks occur. Common examples of small infestations are head louse infestations among elementary school-aged children, body louse infestations on people who are unable to care for themselves, and pubic louse infestations resulting from sexual intercourse with an infested partner.

Informed pest control technicians can be very helpful as consultants on louse infestations and can provide a great service by discouraging pesticidal use other than

for hair treatment. Leaving directions on lousicide choices with parents, school medical personnel, physicians, or the infested individual strengthens the clients' confidence in the technician's technical understanding and discourages the application or spraying of pesticides.

HEAD LICE (*Pediculus capitus*)

Adult head lice are gray and about $\frac{1}{8}$ inch long. Hatching occurs about one week after attachment. Lice go through a gradual metamorphosis so the tiny nymphs resemble the adults. They grow to maturity in about 10 days. Adult lice mate and the female can lay about 100 eggs but often falls short of that in her life of only several weeks.

In the United States, lice live in the head hair of children of elementary school age (only rarely on adolescents or adults). They scuttle about on the scalp between hairs with much more speed than might be expected of a small, soft, wingless insect with slender, hair-grasping claws on the ends of blunt legs.

Close adaptation locks head lice into the human scalp in several ways. First, louse claws grasp human hair so firmly that they do not fall or wander out of it. Second, head lice suck blood by grasping the scalp with tiny hooks that surround their mouth and painlessly pierce the skin with slender stylets. Head lice feed several times a day but do not become engorged. Most importantly, head lice neatly glue their eggs (called nits) to the hair shaft, always within $\frac{1}{4}$ inch of the scalp. The tiny, pearl-like eggs stick alongside the hair so tightly that they can be dislodged only by being torn from the neat sleeve of biological glue by fingernails or a fine-toothed comb. Nits found farther than $\frac{1}{4}$ inch away from the scalp will have already hatched. What is found is the empty shell that remains attached.

How head lice spread is not well known, but lice do not roam from child to child. Neither do they wander onto coat collars or hats because they are so restricted to human hair and the scalp surface temperature of around 80 degrees F or a little more. Temperature preference and perhaps humidity are so critical that lice die at elevated temperatures and from excess perspiration. Conversely, at lower surface temperatures (about 50 degrees F), lice become torpid and do not move or feed. A reasonable speculation is that head louse nymphs hatch from nits on hair snatched by brushes and knit hats. The tiny nymphs then move toward the warmth of the next head covered by the cap or brushed by the brush. This normally limits *transmission to siblings that have their hair brushed with a "family brush" or to children who use knit hats and brushes of friends*. Louse infestations are often discovered by school teachers who are watching for the signs of itching heads, but classroom neighbors are not as likely to be infested as are brothers and sisters or close friends that sleep over and share brushes. Head lice have been shown by surveys in several large eastern cities to infest the heads of Caucasian and Oriental children but they very seldom infest those of black children.

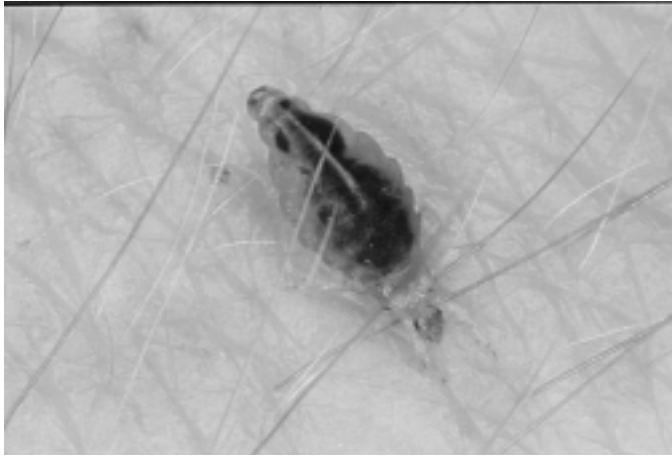


Figure 14.6. Head louse, *Pediculus capitis*.

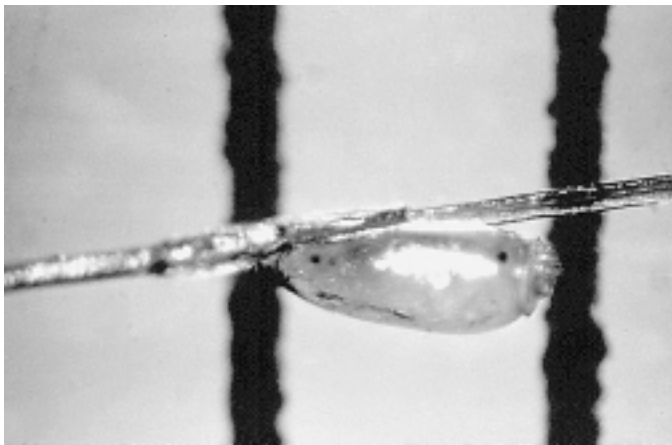


Figure 14.7. Head louse egg (nit).

Control of Head Lice

Several over-the-counter and prescription preparations are used to eliminate louse infestations. They are all equally effective when used according to label directions. Prescription preparations are applied only once and have a high probability of killing the eggs as well as live lice. The preparations from drugstores need to be used twice. The first application kills all of the live lice. Viable nits hatch in 6 to 10 days and the second application kills that population. These lousicides are applied to wet hair and after a short waiting period they are shampooed out. Advise clients to:

- Treat *all members of the family who are infested* at the same time.
- Wash bedding, hairbrushes, and knit caps in hot water to be sure any nits on fallen hairs are killed.
- Vacuum all surfaces where children lie or play (including stuffed toys). In day-care centers and kindergartens, napping mats should be wiped or vacuumed.
- Clean rugs or simply quarantine them for 10 days after vacuuming.
- Remember, do not apply pesticides to rooms, toys, or furniture surfaces.

Decisions on the formulation of lousicide, treatment of head infections from extensive infestations, and so forth, are decisions to be made by parents and physicians.

Reported louse infestations of adolescents and adults should be investigated by a physician. If live lice are not seen, the nits should be examined through a microscope to assure that they are not symptoms of scalp conditions.

BODY LICE (*Pediculus humanus*)

Head and body lice are indistinguishable in appearance and life cycle, but their behavior is very different. Both suck blood, but body lice engorge themselves, feeding to the point that their abdomens become purple and distended. Body lice are easily reared on rabbit blood after a period of assimilation but head lice can be successfully reared only on humans. Body lice harbor on clothes, hiding along seams and moving to the body to engorge. They do not deposit their eggs on body hair or head hair but on clothing. Body louse epidemics are controlled on humans by emergency applications of pesticides (dusts usually), but control is maintained by cleaning and washing clothes.

For these reasons body lice, historically the most common human louse, are now rare in the United States. Infestations appear on those who cannot take care of themselves, such as homeless individuals who do not remove clothes for cleaning and older, incapacitated individuals. Infested clothing passed from one individual to another is a common method of transmission.

Control of Body Lice

Some general application pesticide formulations are labeled for spraying but are of little value.

- Clean or wash clothing, bedding, etc., with hot water and detergents to kill lice.
- Bathe to detach and kill moving lice on the body.
- Use detergents and disinfectants to clean bed frames, bedside furniture, ambulances, and ambulance and hospital equipment.
- Counsel clients carefully to control emotionally charged situations and prevent louse reinfestations.



Figure 14.8. Head/body louse, *Pediculus* spp.

CRAB OR PUBIC LICE (*Phthirus pubis*)

Adult crab lice are only a little over half the size of body or head lice. Their last two pairs of legs terminate in hooked mitts that resemble crab claws. These lice are confined to coarse pubic hair and sometimes eyelashes. Pubic lice move very little in the pubic region and produce few eggs. The most common method of transmission is by sexual intercourse. When infested pubic hair detaches, lice can hatch on underwear, in beds, or on toilet fixtures. If their immediate environment is above 50 degrees F, a pair of pubic lice could infest another person.

Control of Pubic Lice

Accurate, calm communications are invaluable in explaining pubic louse infestations and making recommendations for their control.

- Use pubic louse preparations.
- Wash bedding and underwear.
- Use detergents or disinfectants in toilets.
- Vacuum.

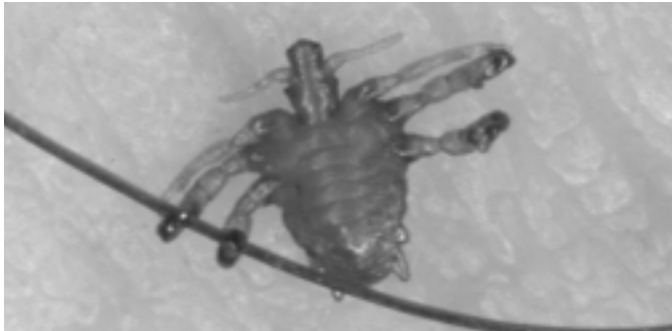


Figure 14.9. Crab louse, *Phthirus pubis*.

IMAGINARY PEST INFESTATIONS

Imagination is the ability to form a mental image to experience something that is not present. Everyone experiences an occasional itch that feels like crawling insects. A look confirms that either an insect is present or the mental image was not real. These unreal feelings can be troubling. Concern that the cause of an itch cannot be seen and may be a microscopic parasite can be overwhelming. This idea affects some people so strongly that it inhibits their ability to function. Imaginary insect-related problems can be separated into three groupings: entomophobia; contagious hysteria; and delusions of parasitism.

ENTOMOPHOBIA

Taken alone, entomophobia can be defined as an admitted fear of insects. This does not mean a fear of imaginary insects, but an exaggerated, illogical, unexplained fear of actual insects. A fear of insects occurs to a minor extent with a majority of people. In an extreme form, when the fear inhibits normal functioning, help from counseling professionals is needed. Group treatment has been found to be very successful.

Entomophobes rarely are problems for pest control technicians. However, their excessive desire for preventive pesticide applications may be encountered when clients attempt to coerce technicians to use pesticides unwisely. Such pressure should be resisted. Technicians should remain firm and apply controls only as professionally indicated by pest infestations. The term “entomophobia” is used sometimes generically to include all imaginary insect-related categories.

CONTAGIOUS HYSTERIA

As the name implies, imaginary pest infestations sometimes upset a group of people. This hysteria can be passed along or accepted by others. Contagious hysteria often occurs in an office workforce. Factors usually connected with the hysteria include:

- Crowded conditions.
- Overtime work.
- Excessively detailed or boring tasks.
- Changing climate.
- Changing seasons.
- Paper handling.
- Perceived unfairness of working conditions caused by physical arrangements in the workspace.

Classically, a few individuals, including a leader or spokesperson, begin feeling bites and discover rashes and other skin eruptions. These individuals identify certain portions of rooms where the pests are common and demand control. Supervisors usually do not believe there is a pest problem because they are usually unaffected by the contributing conditions, but they may be recruited as pressure for results mounts.

Inspection

- Look for pest infestations such as mites infesting stored products or populations of psocids and fruit flies that may cause entomophobia.
- Inspect for fiberglass filaments and for insect parts that could cause allergies.
- Do not allow obvious miscellaneous insects to become important for the sake of coming up with an answer.
- Carefully inspect the entire work area—the non-targeted part as well as the identified part.
- Listen to workers explaining their situation fully. Arrange for management not to refute or ridicule their statements. Not having a hearing entrenches feelings of unjust treatment. Ask if the pests are ever seen biting; ask to see the pests.
- Leave alcohol vials, tweezers, and a small brush so pests can be collected when seen later.
- Notice the differences between the pest-affected and non-affected parts of the workplace.

- Check air-conditioning, air filtering, workspace furniture, amount of window space, carpeting, type of work, proximity to duplicating equipment, and availability of refreshments, and compare the two areas. Where there is an apparent discrimination, bring it to the attention of the supervisors. Different conditions influence worker feelings.

Problems with contagious hysteria usually erupt during periods of seasonal change. Changing climate results in changing humidity and the need for the body to acclimatize to different atmospheric conditions.

- Notice static electricity around duplicating machines, and check the relative humidity of the office air. Low humidity dries skin and increases electrical static. This results in skin sensitivity, causes paper fibers to jump, and electricity discharges that snap and sting as well as cause hair to move on the skin, giving the impression of crawling insects.
- Periods of changing clothing styles—e.g., winter to spring, summer to fall—find people more restive. Changing climate and changes between heating and air cooling result in dry or humid air.

Habitat Alteration

Responses to the problem are needed. By the time responses are carried out, the condition often is rectified. Discuss observations with management. Suggest patience. Request physical changes in the environment.

- Inquire whether a physician has prescribed a pesticidal lotion. If this has happened, and it often does, strongly recommend that the lotion use be discontinued if no skin eruptions are seen, and substitute a non-pesticidal lotion.
- Inquire about the possibility of fiberglass insulation.
- Recommend that the workers at the center of the affected area be dispersed, that desks and furniture in that area be wiped down with disinfectants, and that intensive vacuuming or carpet cleaning be done. Leave the area empty for a time, if possible.
- Balance air cooling or heating. Bring relative humidity to 65 percent.

Pesticide Application

Unless there is real evidence of pest problems, NEVER apply pesticides. Do not make false statements relating to control of non-existent pests. Legitimate pesticide application in label-approved sites should produce clear results that can be seen. Otherwise, it will be viewed as a control failure and lost credibility will result.

Follow-up

Monitor the area periodically with sticky traps. Explain what the captured objects on the sticky surfaces are (e.g. small flies, dust, lint, cockroaches, etc.), and whether or not they are important. Identify any specimens or objects workers have collected in the alcohol vials. Use hand lens or microscopes, and let the workers view the specimens. After taking the steps outlined above, often simply demonstrating to clients that you are on the job and that you are competent and informed about pest management will be an adequate solution.

DELUSORY PARASITOSIS

A condition in which an individual has delusions of parasitism is an extremely emotional and sensitive situation. An inspection of the problem environment and an examination of specimens alleged to be the pest or parasites affirm or contradict the occurrence of an infestation to the technician but rarely to the client.

Often people affected by these delusions will have been referred from one or several physician(s) to a dermatologist, to a psychiatrist, to entomologists, to health departments, to pest control companies ad infinitum. The amount of time that must be expended by each consultant soon becomes excessive, and the patient experiences repeated rejections of one type or another—not to mention strain due to expenditure of time and money.

In any of these situations, it is possible that the complainant has a medically treatable condition. There have been cases in which drug abuse or conflicting drug prescriptions for patients being treated for several health problems elicited such manifestations. The fact is, there is little that can be done by anyone but a medical diagnostician with experience in the cause of delusions.

Always be honest in answering questions. Do not agree to see pests that are not there. NEVER apply pesticides in these situations. Remember, communicate with the client that only pest management technicians should apply pesticides only when active pest infestations have been identified and evaluated.

SUMMARY

The pests discussed in this chapter are not as commonly encountered as other pests found in or around structures. When infestations are found or suspected, however, they elicit fear—fear of being parasitized as well as a fear of the unknown. Calm, authoritative, and well communicated advice is very important for pest management technicians to use in situations involving biting pests.

Review Questions

Chapter 14: Ticks, Mites, Bedbugs, and Lice

Write the answers to the following questions and then check your answers with those in Appendix A in the back of this manual.

- Ticks:
 - Are the largest mites.
 - Feed on the juices of plants.
 - Adults have six legs.
 - Feed on blood.
 - A & D
- Match the correct stage of tick development to each characteristic.
 - Larva ___ Has six legs.
 - Nymph ___ After feeding several days, drops off the host to lay eggs.
 - Adult ___ After feeding several days, drops off the host to molt.
 ___ Referred to as "seed ticks."
- Which is NOT true about ticks?
 - Feeding attachment is often unnoticed by the host.
 - May live for several months without feeding.
 - Will try to crawl to the highest point on their host.
 - Most ticks have only one host for each stage of development.
 - Developing ticks usually find a larger host than they had during the previous stage.
- Once a tick begins secreting saliva and feeding off of a host, it can detach itself easily.
 - True
 - False
- Brown dog ticks may not feed for more than six months while they wait for a host.
 - True
 - False
- Which tick(s) are responsible for the spread of Lyme disease?
 - Deer tick
 - Brown dog tick
 - American dog tick
 - Lone star tick
 - C & D
- Which tick(s) are responsible for the spread of RMSF?
 - Deer tick
 - Brown dog tick
 - American dog tick
 - Lone star tick
 - C & D
- Ninety percent of human Lyme disease cases are the result of feeding by nymphal ticks.
 - True
 - False
- Match the following to the appropriate description:
 - Deer tick
 - Brown dog tick
 - American dog tick
 - Lone star tick
 - Two-year life cycle; utilize three different hosts; adults the size of a sesame seed
 - Complete life cycle in 3 months; lays up to 6,500 eggs in late summer
 - All three stages will attack man
 - There is an increased risk of humans contracting the disease they vector around large cattle and deer herds.
 - Do not transmit disease to humans.
 - Associated with white-footed mouse habitat; peak infection symptoms occur in July.
 - Females are brown with a white spot in the center.
 - Adults slightly over $\frac{1}{8}$ inch long are found on dogs and humans.
- The critical time period for removing a tick before transmission of Lyme disease is:
 - 10 to 12 hours.
 - 24 hours.
 - Three days.
 - One week.

18. What advice would you give a client whose dog is infested with brown dog ticks?
19. What advice would you give a client who needs to remove a feeding tick?
20. List inspection procedures for disease-carrying tick populations.
21. List some pest management techniques for reducing disease-carrying tick populations.
22. How can permethrin-treated cotton balls placed in cardboard cylinders help reduce disease-carrying tick populations?
23. List some precautions for people who spend a lot of time outdoors to protect themselves from ticks.

24. Pesticides can be used in homes to control scabies mites.
- True
 - False
25. A scabies mite found parasitizing a dog may also parasitize a human.
- True
 - False
26. Burrowing by scabies mite females is noticed instantly by victims.
- True
 - False
- 27-32. Match the following to the appropriate description:
- Scabies mites
 - House dust mites
 - Bird mites
- _____ 27. Lay eggs under the skin surface.
- _____ 28. Crack and crevice pesticide applications can be used to control.
- _____ 29. Cast skins and body parts may cause allergic reactions.
- _____ 30. Control by vacuuming intensely.
- _____ 31. Control by removing their hosts' habitat.
- _____ 32. Control by spraying carpet with tannic acid solutions.
33. Bedbug nymphs feed on the host's blood between molts.
- True
 - False
34. Bedbugs are known to transmit diseases to humans.
- True
 - False
35. List some pest management techniques for controlling bedbugs.
36. Typhus is transmitted by:
- Body lice.
 - Bed bugs.
 - Ticks.
 - Crab lice.
 - Head lice.
37. What procedures should be used when head lice are discovered in schools?

38-42. Match the following to the appropriate description:

- A. Head lice
- B. Crab lice
- C. Body lice
- D. All of the above

- _____ 38. Wash bedding to control.
- _____ 39. Deposit eggs on clothing.
- _____ 40. Transmitted by sexual intercourse.
- _____ 41. Found in coarse pubic hair and some times eyelashes.
- _____ 42. Females lay about 100 eggs that hatch every 6 to 10 days.

43-46. Match the following to the appropriate description:

- A. Entomophobia
- B. Contagious hysteria
- C. Delusory parasitosis

- _____ 43. Imaginary pest infestation by an individual.
- _____ 44. Exaggerated fear of real pests.
- _____ 45. Imaginary pest infestation by a group of people.
- _____ 46. Increasing relative humidity to 65 percent may help.

47. When investigating a possible case of contagious hysteria, you should:

- A. Assure clients that their fears are not real.
- B. Apply pesticides to calm fears.
- C. Inspect for possible allergens.
- D. Investigate problems with heating and air cooling.
- E. C & D