

INDUSTRIAL & INSTITUTIONAL CONTROL OF INSECTS & VERTEBRATES

Volume III
(2014 version)



NEVADA STATE DEPARTMENT OF AGRICULTURE

www.agri.nv.gov

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STUDY GUIDE FOR THE CONTROL OF INDUSTRIAL & INSTITUTIONAL CONTROL OF INSECTS & VERTEBRATES

Volume III

Preface and Acknowledgments

This manual was prepared as a general study manual for pest control operators to prepare them to meet the written test requirements. The information contained herein is basic and practical, and is not intended to serve as a complete guide but rather to give general information about insect and vertebrate pests commonly found in, or around, industrial and institutional complexes in Nevada. The information and recommendations are based on current data and industry standards.

Information contained herein is not intended to substitute for any pesticide label information, direction or requirement. In addition, information contained herein is furnished with the understanding that no discrimination is intended, and any reference to a commercially known product does NOT imply an endorsement by the Nevada Department of Agriculture. No endorsement, guarantee, warrantee or assumed liability of any kind, expressed or implied, is made with respect to the information contained herein. It is the pest control licensee's responsibility to follow all pesticide label directions and regulations pertaining to the control of pests found in or around industrial and institutional complexes in Nevada.

Due to on going pesticide and regulation changes, the Nevada Department of Agriculture assumes no liability for suggested pesticide use, control techniques, or regulation changes.

For Nevada's most current pest control NAC regulations go to:

<http://www.leg.state.nv.us/NAC/NAC-555.html>

For the most current NRS regulations go to:

<http://www.leg.state.nv.us/NRS/NRS-555.html>

Contributors to this manual included the Nevada Department of Agriculture, Utah Department of Agriculture and Food, Utah State University Extension Service, Colorado Department of Agriculture, and University of Kentucky Cooperative Extension Service.

For a more in-depth understanding of the pest control industry the Department would urge an operator to read pertinent sections of the *Handbook of Pest Control*, A. Mallis, Editorial Director S. Hedges, 2011 (10th edition), and *Truman's Scientific Guide To Pest Management Operations*, G. Bennett, J. Owens, R. Corrigan, editors, 2012 (7th edition). Pest Control Technology (PCT) also publishes several soft cover field guides which can prove invaluable to an applicator in the day to day operations of the business. Several of these PCT field guides are: *Field Guide For The Management Of Structure Infesting Ants*, *Field Guide For The Management Of Urban Spiders*, a two volume edition of *PCT Field Guide For The Management Of Structure Infesting Beetles* and *PCT Field Guide For The Management Of Structure-Infesting Flies*.

Revised 3/2014

POISON CONTROL CENTER

The American Association of Poison Control Centers (AAPCC) supports our nation's 57 Poison Control Call Centers through a single toll-free phone number. All local poison control centers in the United States use this national number although calls are routed through different centers depending on geographic location. Nevada calls are routed through the **Rocky Mountain Poison Control Center** which also services calls from Hawaii and Montana. This national hotline number will let you talk to experts in poisoning.

National Poison Control

1-800-222-1222

NEVADA DEPARTMENT OF AGRICULTURE EXAMINATIONS

- 1) All Pest Control Examinations are monitored and/or video and audio recorded.
- 2) Anyone who cheats on an examination will be excluded from taking any pest control examination for a minimum of six months (NAC 555.340.7).
- 3) No cell phones, pagers or other electronic devices may be taken into the examination area or used at any time during an examination.
- 4) No unapproved study materials, notes or other aids may be taken into the examination area or used during an examination.
- 5) Tests must be paid for prior to examination.
- 6) Examinees should bring a sharp pencil, eraser, and simple non-programmable calculator.
- 7) Any examinee who writes, marks on or otherwise damages an exam booklet will be charged a \$5.00 replacement fee. The exam will not be graded until the fee is paid.

NEVADA DEPARTMENT OF AGRICULTURE EXAMINATION FEES AND SCHEDULING

All Operator examinations must be scheduled and paid for in advance. All fees are **NON-REFUNDABLE** regardless of whether the exam is taken, cancelled, or failed. Exams may be re-scheduled with a minimum of 48 hours notice.

Individuals who “no show” for a *Principal* exam or do not cancel a scheduled *Principal* exam with 48 hours notice, must pre-pay for all future exams.

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BASIC STRATEGIES

INSPECTION

Before any attempt is made to control a pest, a thorough inspection must be performed to gather information that will be used to make pest management decisions. The inspection should include asking the customer questions about the problem, and thoroughly examining the building or site to learn as much as possible about the pest problem. A thorough inspection provides insight about the scope of any infestation and the best methods of treatment and prevention.

During an inspection, look for:

- Sheltered areas and conditions of moisture, heat or darkness that favor infestations.
- Food and water sources that can be used by pests.
- Probable means of pest entry such as infested foods, gaps under entry doors, and poorly sealed window frames.
- Evidence of infestation, such as damage from chewing or tunneling, droppings, cast insect skins, and webs.

DIAGNOSIS

Effective pest control relies on an accurate diagnosis which includes identifying the pest and any environmental factors that contribute to infestation (spilled food, moisture, etc.). Identification of an insect pest is an important first step in effectively controlling it. Often identification must be made from indirect clues such as damage, droppings, or cast skins. Pest control handbooks, field guides, and other references may be excellent resources for identifying some common pests and beneficial insects; however, the scope of these references is usually very limited, and a mistake in identification may lead to improper control tactics that cost time and money and may lead to unnecessary risks to people or the environment. For more accurate identification of a collected insect or other pest, expertise is available from the Nevada Department of Agriculture's State Entomologist and the local University Cooperative Extension Service specialists. Accurately identifying the pest and its damage, recognizing which life stages are present, and understanding the life history of the pest and how it interacts with people are all features of an accurate diagnosis. Proper identification makes it possible to understand much more about the pest and the choices available to control it.

INTEGRATED PEST MANAGEMENT

Information gathered from a thorough inspection and diagnosis of a pest problem is used to prescribe an effective treatment for a particular condition. In many situations, pesticide application may be the best method of control. In other situations, non-toxic methods such as trapping, sealing food and reducing moisture can be used more effectively than pesticides. More often, several types of chemical, mechanical, and environmental methods are used in combination. In pest control, we call this process Integrated Pest Management (IPM), and it is the foundation of successful pest control. IPM is based on the recognition of the fact that the most effective, long-term way to manage pests is by using a combination of methods.

Effective prescriptions can only be made after inspection and diagnosis have been completed. The prescription should include not only what can be done for the customer, but what the customer can do in the way of modifying the conditions that created the pest problem, including such things as better sanitation, moisture control, and exclusion practices. Environmental factors which limit the effectiveness of control (i.e. poor sanitation) should be clearly explained to the customer and steps should be taken to correct the problems.

Habitat adjustments often involve sanitation efforts to remove sources of food or water pests need to survive. Thorough sanitation can largely eliminate many pest problems. Failure to provide effective sanitation can impede or prevent other pest control techniques, such as baits, from working effectively. If good sanitation practices are not being followed by the customer, their importance must be tactfully explained.

Exclusion to prevent infestation or re-infestation should be part of any prescription. Exclusion involves sealing to keep pests out and inspecting new items before bringing them into the area. Keeping doors, windows and vents screened and well sealed, caulking cracks and crevices where utility lines enter or exterior access is provided, and generally blocking any points of entry are essential practices that prevent and eliminate pests without using pesticides.

Pesticides are used effectively when they supplement other control methods. When properly prescribed, pesticides target a specific site that is most often visited or inhabited by the pest. Because of potential human and environmental hazards, selection and proper application of pesticides is a large responsibility. The pesticide chosen and application technique used is often dependent on characteristics of the site, such as proximity to food, accessibility of children or pets to the treated area, ventilation system concerns, etc. Before choosing a pesticide it is essential to read and understand the directions and precautions on the product label. Remember, the pesticide label must include the site where the pesticide is to be applied and the pest which is to be controlled.

EVALUATION

A good pest control program includes a system of ongoing evaluation and regular monitoring for checking the success or failure of a control strategy. Because pest populations vary, and their susceptibility to pesticides may change, periodic inspections to assess the effectiveness of a control strategy are essential to an effective control program. Periodic evaluations determine whether pest numbers are at a minimal level or are increasing, and can be used to determine if past problems have been eliminated or may be chronic, or if new problems are appearing. Consequently, regular follow-up evaluations are necessary to determine whether treatments are successful and to make decisions about future needs and strategies.

INSECTS AND INSECT RELATIVES

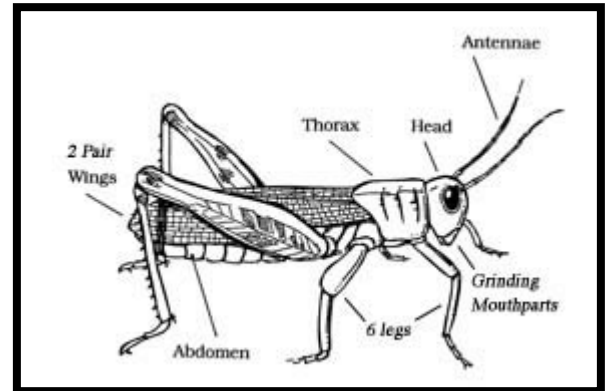
Insects, arachnids, and crustaceans comprise a large group (phylum) of animals called **arthropods** (meaning jointed footed). All arthropods possess the following combination of distinctive characteristics:

- Segmented body
- Jointed appendages
- A skeleton on the outside of the body (**exoskeleton**)
- Growth involving molting

Insects, as a distinct class of arthropods, also possess the following combination of characteristics:

- Three body regions (**head, thorax, abdomen**)
- Three pairs of legs (restricted to the thorax)
- One pair of antennae
- Wings (usually) in the adult stage

Characteristics of four other common arthropod groups (classes) are:



Crustaceans (crayfish, shrimp, sow bugs, pill bugs)

- Five to seven pairs of legs
- Two body regions (**cephalothorax** and abdomen)
- Two pairs of antennae

Arachnids (spiders, ticks, mites, scorpions)

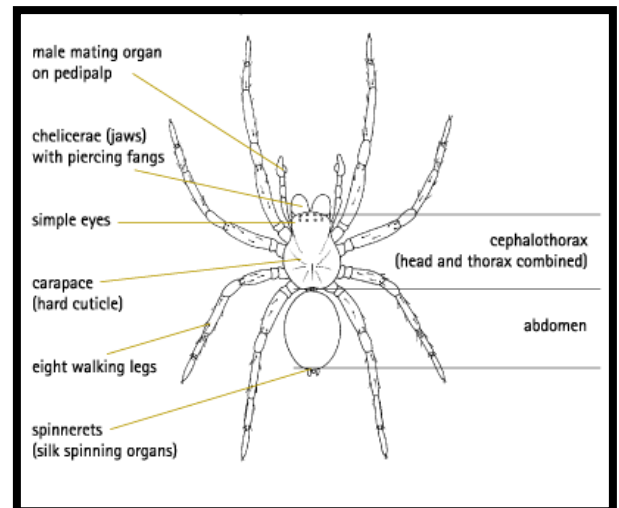
- Four pairs of legs
- Two body regions (cephalothorax, abdomen)
- No antennae

Diplopods (millipedes)

- Elongate, usually rounded bodies
- Many body segments (typically around 50)
- Two pairs of legs on most body segments

Chilopods (centipedes)

- Elongate, flattened bodies
- Fourteen to twenty body segments
- One pair of legs per body segment



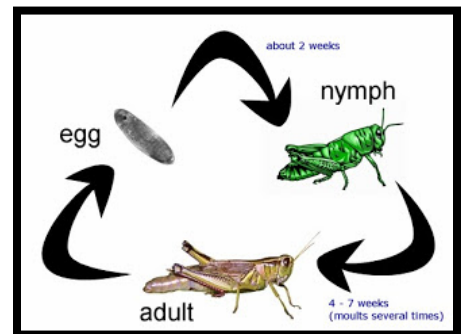
INSECT GROWTH

Most all insects begin development from an egg produced by sexual reproduction between male and female insects. A few species of insects, such as some ants, bees, and aphids, however, can produce eggs without sexual reproduction. In this type of asexual reproduction, the female can produce eggs without the help of male sperm. In the case of aphids, asexually produced eggs may even hatch inside the female. Generally, eggs are laid externally by the female.

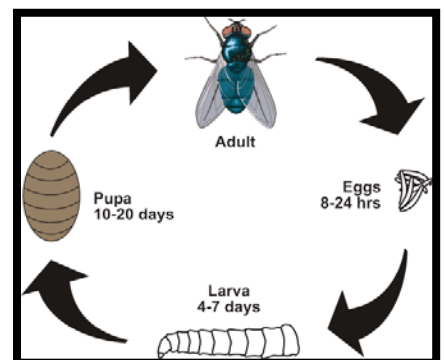
After eggs hatch, insects grow in a series of distinct stages called **instars**. Each instar is separated by a period when the insect sheds (molts) its exoskeleton. Insects may undergo none or many instars until sexual maturity is reached, depending on species and environment. New exoskeletons produced after molting may have a distinctly different appearance and anatomy than molted exoskeletons. A few hours after a molt, the new exoskeleton hardens, and there is no further change in body size until the following molt. Body parts that remain soft, such as the thorax and abdomen of caterpillars, may expand to a limited extent during the course of an instar. All growth ceases following the final molt to the adult stage of the insect. An understanding of instar development clarifies that a small fly will remain a small fly; it is not a "baby" large fly.

A distinct change in form resulting from molting is called metamorphosis. The kinds of change may vary among different insect groups, but two general types of metamorphosis predominate, simple metamorphosis, also referred to as incomplete or gradual, and complete metamorphosis.

Insects undergoing **incomplete metamorphosis** have three basic life forms -- egg, nymph and adult. The nymphs typically pass through three to five instars. Nymphs and adults often live in the same habitat, with the principal changes during metamorphosis being size, body proportions, and the development of wings. Some insects that undergo simple metamorphosis include grasshoppers and crickets, earwigs, the "true" bugs (Hemiptera), aphids, and related insects.



Insects that undergo a **complete metamorphosis** pass through four basic life forms -- egg, larva, pupa and adult. Caterpillars, maggots and grubs are typical examples of larvae. During the larval stage, there may be three to seven instars, during which the larvae usually feed. The pupal stage (cocoon, puparia, chrysalid) is a non-feeding stage. During the pupal stage, the insect changes to the adult form. Adults are usually winged, and they may differ from the larvae in many ways, including type of legs, mouthparts, and feeding habits. Adults of insects undergoing complete metamorphosis are very different from their larvae and may be found in very different habitats. Insects with complete metamorphosis include butterflies and moths, beetles, flies, and lacewings.



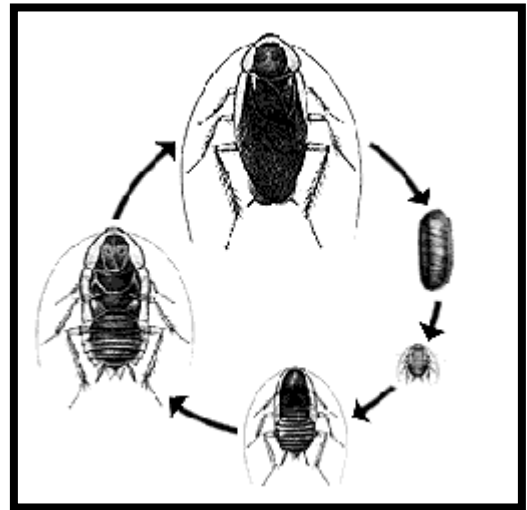
COMMON HOUSEHOLD PEST PROBLEMS IN NEVADA

COCKROACHES (Order: Orthoptera, Families Blattellidae and Blattodeae)

Cockroaches are oval, flattened, fast-moving insects. They may be brown, reddish-brown, tan or black in color. They have chewing mouthparts, long, hairlike, flexible antennae and a broad saddle-like plate (**pronotum**) that partially covers the head. Adult stages of most species have wings, with the front pair being thickened and leathery (**tegmina**) with an inner folded membranous (hind) pair. In some species the males are winged and the females are wingless. Cockroaches go through incomplete metamorphosis, with three basic stages in their life cycle: egg, nymph and adult. The eggs are laid in a bean like egg capsules, called **ootheca**, which may contain several dozen eggs. These egg capsules are often dropped around food sources or glued to surfaces, although some cockroaches carry the capsule during its development.

The immature stages are called nymphs. Several nymphal stages occur, with each separated by a molt. The nymphs generally appear similar to the adult stage, but they lack wings and are smaller. Typically, two to three months pass while they complete their life cycle.

Cockroaches are among the oldest group of insects known, with fossils dating back 200 million years. As a group, the cockroaches have shown exceptional ability to adapt to and survive in a wide range of environments, including human dwellings. Cockroaches are omnivorous, eating almost any animal or vegetable food they discover primarily through a sense of smell. Most cockroaches are capable of developing on a wide range of food, and their flattened body form allows them to move into most areas. Cockroach populations have also developed a high level of resistance to many commonly used insecticides.



Cockroaches can enter buildings and containers of all kinds. Cockroaches can be carried into homes on grocery sacks, in cardboard boxes, food packages, in laundry and in beverage cartons. They also may enter around loose-fitting doors and windows and through utility lines, and they may travel through sewers. Once within a home, cockroaches prefer warm, dark, moist shelters and are often found near kitchens and food-handling areas. Since cockroaches are nocturnal, they are rarely seen during the day. However, if they are seen during the day or when hiding places are disturbed, there is usually a heavy infestation. Other signs of infestation may be dead cockroaches, cast skins, empty egg cases, fecal droppings, fecal stains and a foul odor.

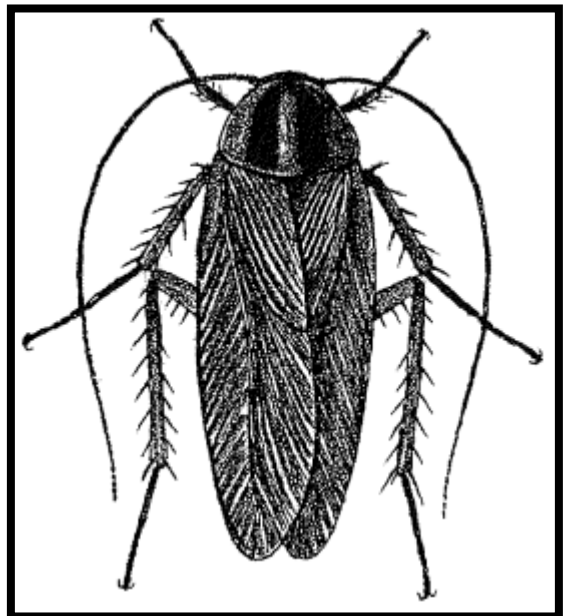
Aside from their importance as a household nuisance, they may soil areas with their salivary secretions and excrement. Large infestations of cockroaches leave an unpleasant

odor. Cockroaches and cockroach parts also produce allergic reactions in some humans. Cockroaches have not been found to be direct carriers of human disease. However, their habits of feeding on filth or disease organisms make them well suited to mechanically contaminate food or utensils. They are suspected of helping to spread diseases such as dysentery, diarrhea, and food poisoning.

Most cockroaches are tropical or subtropical in origin and possess generally harmless habits. However, a few have developed into serious pests, including several species of cockroaches that have been introduced into Nevada. The American, brown-banded, German and Oriental cockroaches are recognized as the most frequent domiciliary cockroaches. Habits of the common pest cockroaches found in Nevada are summarized below:

German Cockroach (*Blattella germanica*)

- German cockroaches are in the family Blattellidae.
- German cockroaches are the most frequently found cockroach species in Nevada.
- German cockroaches are generally considered the most important cockroach species found in Nevada homes, apartments and restaurants.
- German cockroaches are negatively phototrophic (they avoid light) and nocturnal in habit.
- Adults are pale brown to tan and are slightly smaller than one-half inch long.
- Adults have wings and are distinguished by having two dark stripes that run lengthwise along the pronotum, behind the head. Wings are fully developed and cover the abdomen.
- This species has the highest reproductive potential (number of eggs laid and shortest life cycle) of the house-infesting cockroaches.
- Females carry their egg capsule for as long as one month, protruding from their abdomen. One or two days before hatching the ootheca is dropped anywhere. When the ootheca is first visible, it is white, becoming pink within a few hours and light brown to chestnut within a day or two. Females produce about four to eight egg capsules in their lifetime. Each capsule contains 30 to 40 eggs (some up to 50 eggs), which hatch in about 28 days at room temperature. The eggs usually die if the mother is killed before dropping them. Among the domiciliary cockroaches, *B. germanica* is the only species with the ootheca subject to desiccation.

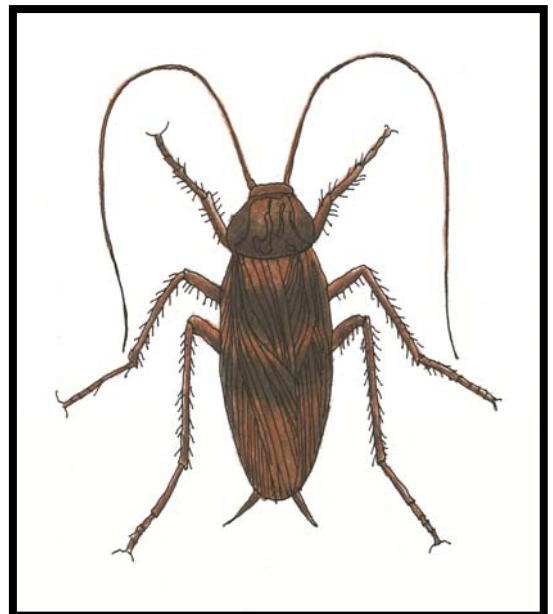


- The female reportedly is not detected by the male except through contact; therefore, synthetic sex attractants probably would not be effective. Their gregarious nature assists mating.
- Nymphs, in concert, exert pressure, splitting the ootheca at the top. They have six or seven instars with the first instar about 3 mm long, dark gray to almost black with a pale brown band on the 2nd and 3rd thoracic segments.
- Completely white nymphs or adults are newly molted. Young nymphs may be eaten by the female if no water is available.
- In the house, this roach is most abundant in the kitchen.
- Females live an average of 250 days. Average development time is 103 days.
- German cockroaches seek secluded and very narrow hiding places (1.6 mm in width or depth), and will generally be found close to moisture and food, such as in kitchens and other food areas, restrooms, and around plumbing fixtures. Surveys should concentrate in cracks and crevices, voids, under table tops, behind sinks, in cabinets, in motor areas of refrigerators, in and around kitchen equipment, and similar sites.
- Infestations found scattered throughout a building (closets, dressers, sofas, behind moldings, picture frames etc.), including non food areas, indicate a very high population due to excessive crowding in their customary harborages.
- In a room, travel is mainly along wall intersections, intersections of floors and walls, walls and ceilings, shelves and walls of the pantry or cabinets.



Brown-banded Cockroach (*Supelia longipalpis*)

- Brown-banded cockroaches are in the family Blattellidae.
- Brown-banded cockroaches are the smallest cockroaches found in Nevada (12 mm), slightly smaller than the German cockroach.
- Brown-banded cockroaches are far less important than German cockroach as a pest.
- Female brown-banded cockroaches vary from light tan to reddish brown to glossy dark brown in color throughout, while the male is a lighter dark brown becoming increasingly lighter posteriorly. The adult stages are marked with two light-colored bands at the base of the wings. The legs of both are a light straw color. Both sexes develop wings with those of the male covering the abdomen while those of the females are shorter and never cover the abdomen. When disturbed the males fly



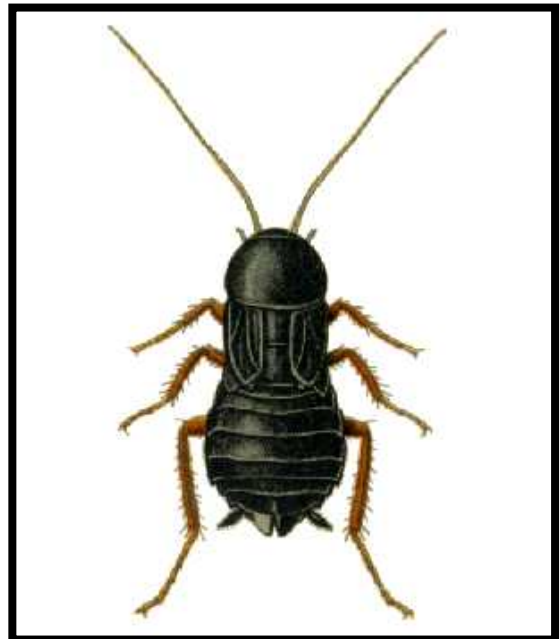
but the females never do.

- Young are basically dark brown with a pale margin on the thorax and a broad pale area on the abdomen.
- Brown-banded cockroaches usually glue their egg capsules (yellowish to reddish brown in color) to surfaces in dark areas such as cabinets, chairs, boxes, drawers, and high areas of a building. Because of this habit, they are easily transported to new buildings. Fertile eggs appear greenish and shortly before hatching the eyes are visible.
- Females produce about 14 capsules (each capsule is 4.0 mm x 2.5 mm and is the smallest of all common domiciliary species) during their lifetime, averaging 18 eggs in each capsule. Eggs hatch in about 50 to 75 days.
- The adult female may typically live about 200 days.
- Brown-banded cockroaches tend to scatter thoroughly through a building. They prefer areas of higher temperature (80°F. or higher). Brown-banded cockroaches tend to occur more often in homes, apartments, hotels and hospitals than in stores or restaurants.



Oriental Cockroach (*Blatta orientalis*)

- Oriental cockroaches are in the family Blattidae.
- Oriental cockroaches are not as important a pest as is the German cockroach.
- Adults are about 30 mm long and dark reddish brown or black in color.
- Wings of the oriental cockroach are short. Females only have small wing pads, while males have wings that only cover about three-fourths of their abdomen, although they do not fly.
- Females drop egg capsules in warm, sheltered areas near a food supply. Each capsule is large, about 10.0 mm x 5.0 mm in size. Each female produces an average of eight egg capsules, each containing about 16 eggs. Under room-temperature conditions, eggs hatch in about 60 days. However, development takes more than a year and may be as long as two years indoors.
- Newly hatched nymphs are about 6.0 mm long and pale brown in color, becoming more reddish with each instar. The nymphs and adults of this species lack cushion-like pads between the claws (**arolium**) of the feet (**tarsi**) and, therefore, cannot climb smooth vertical surfaces.
- Adult females may live about 180 days.

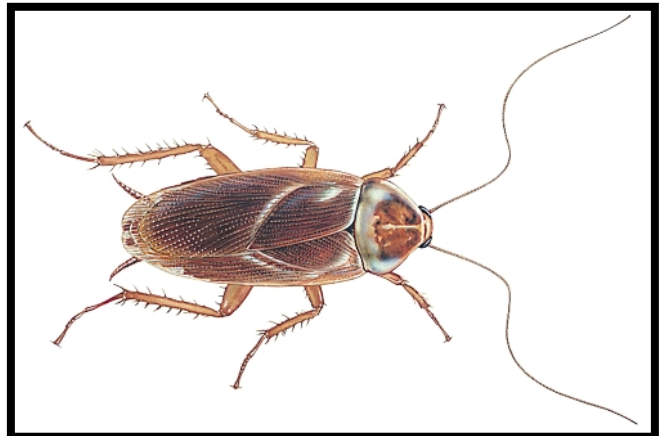


- Oriental cockroaches are usually found around moist, dark sites. Common habitats include floor and storm drains, water-meter boxes, around plumbing fixtures, moist crawl spaces, sewers, and around garbage.
- This species is often called the "water bug."
- Of the domiciliary cockroaches, oriental cockroaches may be found outdoors during the warmer months of the year, as they can withstand lower temperatures than the German cockroach. They thrive in cooler, dryer areas and have ranged farther north. They are often abundant in dense vegetation around structures and especially in dark, damp water meter vaults. This cockroach is probably the most disliked as it travels in sewers and lives on filth.
- Oriental cockroaches are rather sociable, and clusters of them may be found in favorable habitats. They are seldom found high on walls, in high cupboards, or in the upper floors of buildings.



American Cockroach (*Periplaneta americana*)

- American cockroaches are in the family Blattidae.
- American cockroaches are the least important of the domiciliary species.
- Adults are about one and one half inches long or about 4 centimeters making it the largest domiciliary species. The color is reddish-brown throughout except for a pale brown or yellowish band around the forward portion of the thorax (pronotum).
- Wings of the American cockroach are fully developed with those of the male extending four to 8 mm beyond the abdomen.
- Egg capsules are dropped or glued near a food supply. Each capsule is fairly large, about 8.0 mm x 5.0 mm in size, brown in color when deposited but turning black in a day or two. Lateral indentations of the eggs are weakly indicated and for each egg there is a minute opening at its apex. For successful hatching a high relative humidity is required.
- Development is temperature dependant averaging 600 days at room temperature.
- Oothecae are produced generally in April or May; very few are produced in winter. There are probably 13 instars of the nymphs with the first instar consuming its cast skin. They are white, then grayish brown with succeeding instars almost uniformly brown. Wing pads are first noticeable in the 3rd or 4th instar.
- Adults may live an average of 630 days.
- American cockroaches are usually found in damp locations. Common habitats include sewer systems, in basements, in dishwashing rooms and in structures with



inadequate ventilation. In the United States, this species is the predominant cockroach found in city sewer systems and may enter homes and apartments from sewers via plumbing systems.

- Greenhouse infestations may occasionally injure plants through the cutting of stems of seedlings and by removing the epidermis, etc., of larger plants
- American cockroaches discover food primarily through the sense of smell and are omnivorous, being fond of starchy materials, meat products and sweetened or syrupy substances.



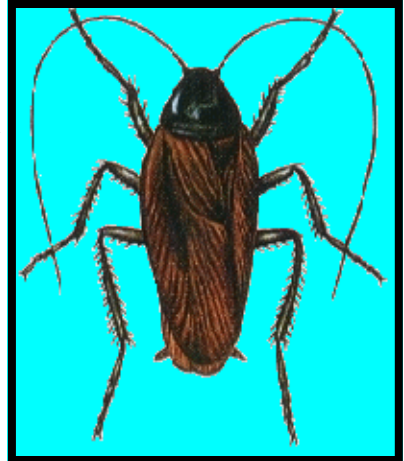
Field Cockroach (*Blattella vaga*)

- Field cockroaches are in the family Blattellidae.
- The field cockroach resembles the German cockroach but is slightly smaller and may be distinguished from it by the blackish-brown colored area of the face from the mouthparts to between the eyes.
- The field cockroach is found in irrigated fields and yards of southern Nevada and sometimes in the desert far from inhabited or cultivated areas.
- Adults have two dark parallel, longitudinal stripes on the pronotum similar to the German cockroach but very dark and more sharply defined.
- The life cycle is similar to the German cockroach but is more likely to be seen during the day as it is not repelled by light. In the evening, it may be seen around streetlights and in lighted display windows.
- Ordinarily, it is found outdoors but in drier seasons it may invade houses in large numbers.
- Field cockroaches feed on decaying vegetation.



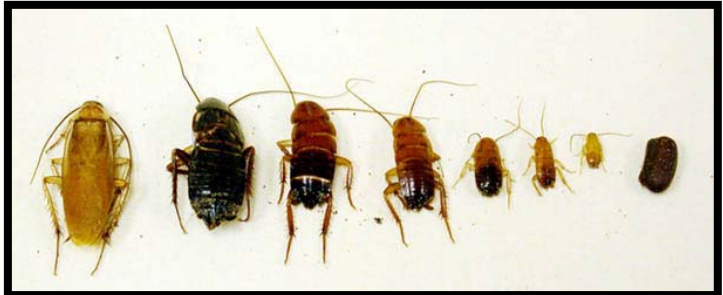
Smoky brown Cockroach (*Periplaneta fuliginosa*)

- Smoky brown cockroaches are in the family Blattidae.
- The smoky brown cockroach is the only uniformly dark colored species of *Periplaneta* in North America and is uniformly shining, brownish black or mahogany in color.
- The smoky brown cockroach is common in the southern states, central Texas eastward and north into Iowa, Indiana and Illinois.
- When found, it is commonly confined to garages, outbuildings, woodpiles and can sometimes be a pest in greenhouses.
- The wings extend beyond the tip of the abdomen and at night it flies to lights and is sometimes attracted to porch lights.
- Smoky brown cockroaches feed on plant material.



Turkestan Cockroach (*Blatta lateralis*)

- The Turkestan cockroach, *Blatta lateralis*, has become an important invasive species throughout the southwestern United States.
- When in competition with Oriental cockroaches they will frequently displace them. In fact, they have rapidly replaced the Oriental cockroach in urban areas of the southwestern United States as the most important domiciliary species.
- The Turkestan cockroach is primarily found outdoors and occasionally indoors. They are usually found in water meter boxes, cracks between blocks of poured concrete, compost piles, leaf litter, and potted plants. They may occasionally be found inhabiting sewer systems.
- The Turkestan cockroach was first reported at Sharpe Army Depot in Lathrop, CA in 1978, and it is now widely distributed throughout California, southern Nevada and other urban centers of the southwest.
- Turkestan cockroaches are relatively new to Nevada and are often mistaken for other cockroach species. Females are often confused with the Oriental cockroach. Females are about 1 inch long with cream-colored markings along the edges behind the head and around the short, rounded wings (females are essentially wingless). Males are often confused with the American cockroach but are slightly smaller with yellowish-tan wings and cream-colored stripes along the edges.
- The nymphs are half black and half dark red.
- The biology of the Turkestan cockroach is very similar to the Oriental cockroach.



Cockroach Control

The control of cockroaches requires a great deal of care and planning by the pest control operator. Several steps and techniques are involved in effective control, and these must be used in a coordinated manner. Cockroach control also usually requires a great deal of cooperation from the client to change environmental conditions that contribute to infestations.

Detection

The site should be thoroughly surveyed to determine the extent of the infestation and to identify the type of treatment that will be required. Fundamental to this survey is determining the cockroach species present. Since different cockroach species have differing habits, this determination will allow treatments to be better targeted. A search should be made of all suspected hiding places. Since cockroaches are rarely active during the day, this can be difficult. "Flushing" sprays of pyrethrins can be used to irritate cockroaches and cause them to move out of their hiding areas.

Sticky traps can also be useful to help to detect cockroach "hot spots." Several different types of traps exist, and some also contain the sex-attractant chemicals used by certain cockroach species. These traps should be placed in areas where cockroach activity is suspected, and they should be checked after a few days. Traps can also be used to help control cockroaches, but they are not an effective substitute for other control practices.

Sanitation

Sanitation is fundamental to cockroach control. Any methods that can be used to deny cockroaches the food, water and shelter they need will greatly aid in control. Cleanliness and good housekeeping are essential. Food should be kept in tightly closed containers and should not be left exposed. This includes spilled materials, garbage, food scraps left in sink areas, and pet foods.

Water is an important need of cockroaches. Dripping faucets, leaking pipes and other sources of moisture should be eliminated. Bottles and cans to be recycled should be stored outdoors, if possible. Sewer openings should be screened.

It is important to remove potential sources of re-infestation. Cracks, crevices, and other openings should be sealed. Pipes should be caulked and sewer drains screened. All materials being moved into the building should be checked for evidence of cockroach infestation.

Chemical Control

Whatever chemical or formulation chosen, applications made near regular hiding places will be most effective because they increase the probability of contact. Chemical controls usually provide only temporary suppression if they are not combined with an integrated pest management approach which includes exclusion practices and vigorous sanitation efforts.

A serious limitation of insecticide use is the development of insecticide resistance by cockroach populations. Many populations of German cockroaches are no longer susceptible to insecticides that formerly were effective. Resistant populations evolve when a large population of pests contain some individuals that have a natural genetic resistance to a specific active ingredient. Repeated application of the insecticide to the population may initially kill most members but allows naturally resistant individuals to thrive and reproduce. The genetically based resistance is conferred to offspring and in this way an entire population of resistant organisms evolves. Furthermore, cockroaches are repelled by several chemicals and will avoid treated surfaces.

Often, where no previous control has occurred, the initial treatment consists of a thorough "cleanup" or "clean-out." During this treatment insecticides (ultra low volume fogs, sprays or dusts) are applied thoroughly throughout the building. Because of this thorough treatment, there is often an immediate reduction in cockroach numbers. However, cockroaches are rarely eliminated by a single treatment since egg capsules are not impacted. Also, some cockroaches may remain hidden in or migrate to untreated areas. Therefore, follow-up treatments are required.

Control chemicals can be oil-based sprays, water-emulsion sprays, dusts, tracking powders or baits. Choice of the type of treatment should be matched to the conditions of the infestation site. Most treatments involve sprays in order to provide a residual effect. These applications leave a toxic residue on the treated surface that cockroaches pick up when moving across it. The length of time that treatments remain effective varies, depending on such factors as the concentration of chemical applied, choice of an insecticide, application surface, and environmental influences. Two to four weeks of residual activity is typical.

Sprays should be applied to cockroach harborages, with emphasis on cracks and crevices or limited to spots where cockroaches hide by day and travel by night. There should be minimal application to exposed surfaces. If exposed surfaces are treated, a low-pressure spray should be used. Runoff or pooling should be avoided by immediately wiping off excess spray. Oil-based sprays should not be applied near open flames, to tile floors, or onto plants. Water-based sprays should not be used near electrical outlets.

Several precautions should always be taken when making insecticide applications for cockroach control. Pets should be removed from the treatment area during application, and all aquariums should be covered. If sprays are to be applied to areas where food, cooking utensils or dishes are stored, these items should be covered or removed before

spraying. Furthermore, applications around these sites must be limited to spots or cracks and crevices, avoiding exposed surfaces. Also, treatments made near air ducts and ventilation systems should be done with extreme care to avoid air contamination.

Dusts and tracking powders can penetrate cockroach hiding areas that sprays may not reach. They are also useful on very rough surfaces or on surfaces that absorb liquid sprays. They may kill the insect by penetrating the insect body or ingestion when the cockroach cleans its antennae and legs. When applied to dry locations, dusts and powders also last longer than residual sprays. Dusts should be applied as thin films because heavy concentrations can repel cockroaches. Some dusts, such as boric acid, may be applied in water, which quickly dries, but to be effective, dusts must remain dry. Dusts are not appropriate for use in areas where they would be unsightly or where they may be unintentionally transported to unsuitable surfaces.

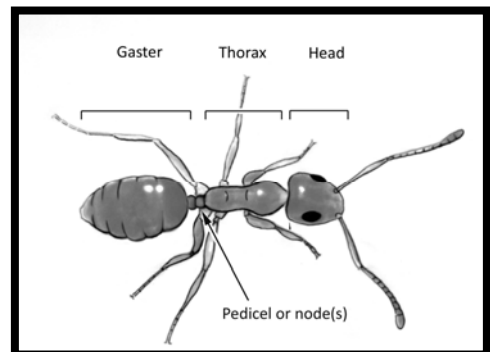
Baits are generally long-lasting and can be applied to areas that can not be treated with sprays or dusts. Baits include an attractant such as peanut butter or syrup in combination with a non-repellent type of insecticide, such as boric acid. Often, baits may be placed inside small containers to help isolate them from pets and humans. To be effective, baits should be used in small amounts placed in many locations. Effectiveness of baits is greatly dependent on the amount of competing food sources available and are minimally effective in areas with poor sanitation.

ANTS (Order: Hymenoptera, Family: Formicidae)

Ants are hymenopteran insects closely related to bees, horntails, sawflies, and wasps. Hymenoptera are insects with two pairs of membranous wings with the forewings much larger than the hind wings. However, in ants, only the reproductive forms may have wings.



Ants, along with honey bees, hornets, yellow jackets and some paper wasps, are social insects that produce colonies comprised of various specialized groups, **castes**, of individuals. Most ants in a colony are known as workers; they are wingless, do most of the food foraging and rearing of young, and defend the colony. Eggs are white or pale yellow in color are produced by the large queens, which have wings until after they have mated. Winged ants may be male or female. Winged males are called **drones**. Drones are the only male ants in the colony and they do have wings. The body of ants consists of a **head**, **thorax** and **abdomen**. Ants are characterized by having a very narrow, pinched "waist" or **petiole**. The narrow portion is called a pedicel or petiole which has one or two segments and bears an upright lobe. The petiole is used in the identification of various ant groups. Ants have antennae that are bent, or elbowed. They are sometimes confused with termites, especially when swarms are produced. However, termites have a broad waist, beaded antennae, and their fore wings and hind wings are similar in size.



Development of ants involves complete metamorphosis. Eggs are very small, 0.5 mm or less. The developing larvae are legless and are fed by the worker ants and pass through several molts before pupation. The pupae do not feed and are immobile, soft and white. The colony most commonly consists of three distinct castes: workers, males and queens. Ant nests are usually produced underground, and colonies can contain tens of thousands of workers.

Usually, mating occurs in flight with the winged males and females swarming during a species-specific mating period. The males die after mating; the mated females lose their wings and seek a habitat to make a chamber. Their nests may be in lawns, bare ground, under stones or wood, in wood, under houses or in walls of houses. The large carpenter ants build nests in wood, usually wood that is partially decayed. Relatively few ants in Nevada form nests indoors; however the pharaoh ant and some carpenter ants are important exceptions.

Different species of ants feed on different types of foods. Most are generalist scavengers eating both plant and animal foods (**omnivores**). Sugary plant foods are preferred by some species; others prefer fatty or protein-rich foods. Some ants are important **carnivorous** predators of spiders and insect pests and some species eat only plant products (**herbivores**).

Ants beneficially consume enormous numbers of dead and decomposing materials. However, their feeding and nesting habits may conflict with human interests. Ants may also aggressively defend resources and habitat by stinging and biting. Problems with ants often occur when they forage for food indoors during the warmer months. In addition, carpenter ants chew on wood and can cause structural damage, and house-infesting species, such as the pharaoh ant, can mechanically transport disease organisms. While there are over 12,000 known ant species in the world, descriptions of some common North American species of ants follows.

Carpenter Ants (*Camponotus* sp.)

Carpenter ants are the largest ants in the United States (6 – 12 mm). Often they are black or dark brown, although some eastern plains species are lighter in color. The most distinct feature of carpenter ants is their habit of excavating nests in wood and piling coarse sawdust at nest openings. Unlike termites, carpenter ants do not eat wood; instead, they scavenge on dead insects, insect honeydew, and other materials and cut galleries into wood to form their nests.



Carpenter ants almost always nest in wood that is soft because of water and decay damage. Their nesting behaviors may result in extensive structural damage. Carpenter ants do not sting, but their jaws can produce a mildly painful pinch.

Because this ant is considered a wood destroying pest, further discussion of carpenter ants can be found in the Nevada Department of Agriculture's *Structural Pest Control: Control of Wood Destroying Pests* manual (Volume IV).

Harvester Ants (*Pogonomyx* sp.)

Lack of plant growth around underground nests in large open areas is a conspicuous feature of harvester ant colonies. The ants are fairly large 6 - 10 mm long and red or dark brown in color. Harvester ants are herbivorous, primarily harvesting and feeding on seeds and characteristically clear the vegetation from the area around primary nest entrances. Harvester ants are important distributors of seeds and soil nutrients in desert ecosystems. They rarely enter homes. Harvester ants



will bite and have a mildly painful sting. Two species are common in Nevada:

- California harvester (*P. californicus*) - 5 - 6 mm long with a light rusty red color.
- Western harvester (*P. occidentalis*) - 10 mm in length with a dark red to reddish brown color.

Both species will bite, hang on and sting. Unlike other ant stingers, the stinger of *P. californicus* detaches easily and remains in the wound. Reaction to the light venom in the sting is usually harmless but may persist for as long as a month in allergic individuals.

Field ants (*Formica* sp.)

There are many species of field ants. These ants are medium-sized, and they may be brown, red, black, or any combination of these colors. Nesting occurs outdoors in low dirt mounds in open fields. Field ants are attracted to sweet foods.

Cornfield ants (*Lasius* sp.)

Nests of cornfield ants occur in fields and around homes. Typically, nesting include brick or stone walls, cracks in the pavement, beneath rocks, and sometimes in openings around foundations. They do not nest in the house, but they often forage inside in search of sweet materials.

Pavement ant (*Tetramorium caespitum*)

Pavement ants can be a frequent nuisance in areas of Nevada where they have become established (Carson City, Clark, Elko and Washoe Counties). They are small (3 - 4 mm in length), hairy blackish-brown ants with pale legs and antennae. There are two nodes on the petiole. The head and thorax are furrowed with parallel lines. As the name might suggest, pavement ants commonly nest under pavement slabs, especially next to lawn areas. Rocks and areas under slab-construction homes are also common nest sites. Foraging in homes most commonly occurs during summer, but nests adjacent to homes can allow foraging to occur year round.

Pavement ants are omnivorous eating dead and live insects, honeydew, meats, grease, young plants and planted seeds. In Nevada they seem to prefer areas where grease or oily substances can be found, and they can be pests of young garden plants.

Pharaoh ant (*Monomorium pharaonis*)

Pharaoh ants are some of the most persistently annoying and hard-to-control nuisance ants in homes, buildings, and hospitals. Pharaoh ants are very small and yellow or pale red. Unlike most other ants, pharaoh ants have adapted well to nesting indoors. Unlike other ant species, colonies of pharaoh ants readily bud (form new colonies without swarming) and fragment to form new colonies throughout a building.



Colonies are difficult to control because they readily split into smaller colonies when disturbed.

Pharaoh ants feed on a wide range of foods that include syrups, jellies, grease, cake, and pet foods. They are especially serious pests in hospitals, since they are known to visit patient wounds.

Thief ant (*Solenopsis molesta*)

The thief ant is a native species that occurs throughout North America. It is one of the smallest ants (1.3 - 1.8 mm long) found within buildings, similar in size to the pharaoh ant. The thief ant is a shiny yellowish to bronze color. However, its habits differ considerably from many other ants found in the region, primarily because it may develop in association with colonies of other ant species which it robs of food and offspring. Because of its small size, a thief ant can move around in the tunnels of other ant species where it steals food and may kill the immature ants. Within homes, thief ants are attracted to the proteins and fats in greasy foods and are sometimes called grease ants. In nature, thief ants are omnivorous foragers and important distributors of seeds with a high fatty content. The robbing of food and brood of other ants has given this ant its common name. Nests can occur in a variety of locations, but they are almost always located outdoors in soil or wood. From these outdoor nests thief ants commonly invade houses. They may nest independently or in the nests of other ants. Nuptial flight is recorded as occurring in late July or early fall.



Acrobat ant (*Cremastogaster* sp.)

Acrobat ants occur throughout most of North America. They are black, brown, reddish or yellow in color, about 3 mm in length, with two nodes on the petiole. Acrobat ants have a sharply-pointed heart-shaped abdomen which they raise in defensive behavior when threatened, giving them their common name. Unlike their name implies, however, acrobat ants are sluggish moving. These ants feed on live and dead insects and are also known to tend aphids, mealy bugs, and treehoppers in order to consume their sugary excrement known as "honeydew". To this extent, they may build "cow sheds" (earthen cylinders) to protect them. Acrobat ants are generally found under stones, in dead tree trunks or stumps. Isolated females may form new colonies. When crushed, an odor described as similar to mammalian excrement is emitted.



Odorous house ant (*Tapinoma sessile*)

The odorous house ant is a native species that occurs throughout North America and is very common in the Western United States. It may be found from sea level to 10,000 feet. It is small (2.4 - 3.5 mm long), soft-bodied, dark reddish brown to black in color. It is similar to, but slightly larger, broader, darker and slower than, the Argentine ant.



Odorous house ants forage on dead insects, sweets, and high protein foods (meat). Nests can occur in a variety of locations, at beaches, woodlands and bogs. They can also be found in wall voids especially near hot water pipes and heaters. Outdoor nests can be found under stones, logs, wood piles, loose bark, plant cavities, insect galls, refuse piles, bird and mammal nests. This ant is considered second only to the Argentine ant as a common household pest. Its movements are very active and rapid along well-travelled trails but when alarmed its movements are erratic and its posterior abdomen (**gaster**) is elevated. In nature, colonies are relatively small but colonies in urban settings may expand to huge numbers as many nests become connected by trails. When a single individual is crushed, a distinct musty odor (a ketone) described as that of “rotten coconuts” is emitted. It is an avid seeker of honeydew and transports aphids and mealy bugs for this purpose. Aphids and mealybugs feeding on shrubs touching a house may function to attract odorous house ants to the building.

Velvety tree ant (*Liometopum luctuosum*)

The velvety tree ant is a glistening ant about 2.5 - 6.0 mm long with a velvety black abdomen, red thorax and brownish black head. The petiole has one node. It occurs in large colonies in hollows or crotches of trees and in stumps. Removal of decayed portions of trees helps to eliminate these colonies. It may be found crawling on trails or up and down trees, especially along streams, foraging for insects and honeydew food resources.

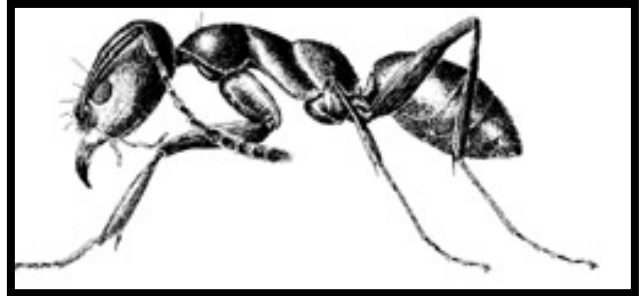


Within homes, velvety tree ant invasions may occur where a limb touches the house. This ant may be seen during daylight hours but reportedly forages for food at dusk or during the night. It tends honeydew-secreting aphids and coccids but is also predacious. In picnic areas, it crawls over food and bites, ejecting a poison into the wound. When crushed a disagreeable odor is produced.

In homes, nests can occur in joints or cracks in wood. The velvety tree ant excavates wood to create and expand a nest chamber; it does not bore into the wood. Pieces of sawdust carried out of the nest indicate where the nest is located. Velvety tree ant trails may extend 200 feet or more from a nest.

Argentine ant (*Linepithema humile*)

The Argentine ant is about 3 mm long, and light to dark brown in color, with one node. The workers are all one size (**monomorphic**). This ant is an invasive species introduced from South America, and has become one of the most common ants in southern Nevada, infesting landscapes and households. It is a strong forager with long, visible trails. Argentine ants prefer sweets, but will feed on a variety of foods. It protects homopterous insects such as aphids and mealy bugs so that it can feed on the honeydew they produce. Its strong preference for nectar and honeydew available in the warmer months makes control with baits more difficult. The Argentine ant is very competitive and often becomes the predominant ant species where it occurs. Argentine ant colonies can become very large and have multiple queens. Colonies can become interconnected, forming “super colonies.” Colonies can also expand by budding. Budding occurs when one or more queens, each accompanied by workers, moves to a new site. Large, interconnected colonies with multiple queens make Argentine ants very difficult to control. Nesting sites are varied and include open ground, under objects such as boards and potted plants, and along walkways and building foundations. Nests can also be found in structural voids.



Fire ants (*Solenopsis sp.*)

The **southern fire ant**, *Solenopsis xyloni*, is native to the southern United States and is a common ant in southern Nevada. It is usually bicolored, with a reddish-brown head and thorax, and a darker brown to almost black abdomen. Workers vary in size (**polymorphic**) and belong to either of two castes; a smaller caste called **minors** and a larger caste called **majors**. Minors are about 1.6 mm and majors about 5.8 mm in length. Characteristics of the genus include two nodes on the petiole, and 10-segmented antennae with a two-segmented **club** (tip). This species has a painful sting, and can be very aggressive. The southern fire ant is an omnivorous feeder, and aggressively forages for many kinds of food, such as grease, live insects, small birds, carcasses, garbage, seeds and other plant parts. It is highly attracted to oily substances. Southern fire ant nests are often found in exposed areas, but also may be found at the base of plants, or at the edge of walkways or structures. Nest mounds are generally inconspicuous in open areas, but can be higher in more protected areas with looser soil. This ant forms foraging trails, and its workers move notably slower than the workers of other species.



The **red imported fire ant**, *Solenopsis invicta*, is not known to be established in Nevada. It is an extremely important public health and agricultural pest in the southern United States. This species is about 1.6 mm (minors) to about 5 mm (majors) in length. It is not as bicolored as the southern fire ant, and is usually more of a solid reddish-brown color. This ant is an important public health pest because of its aggressive nature and painful sting. The sting of this species can cause severe allergic reactions, even death, in some people. It is also an important agricultural, environmental and economic pest, with its habit of forming large mounds and preying on ground-dwelling birds. The geographical range of red imported fire ants is expanding because they are very aggressive and successfully displace other species of ants. Control of this ant in infested areas is difficult and costly.



The red imported fire ant was introduced into the United States from Brazil to Mobile, Alabama in the 1930's. This pest has since spread to much of the southern United States, and more recently into parts of New Mexico and California. Red imported fire ants can be spread to new areas by human practices such as inadvertently transporting ants in shipping containers of potted nursery stock from infested areas.

The red imported fire ant is a **quarantined** pest. Federal and state regulations prohibit the movement of any articles that harbor the pest, such as nursery stock, without proper treatment and certification that the articles are free of imported fire ants. If this ant is found in Nevada, the area of infestation must undergo eradication treatment under the jurisdiction of the Nevada Department of Agriculture. The Department specifies an eradication protocol of pesticide treatments that must be accomplished (see control below).

Bigheaded ant (*Pheidole megacephala*)

The genus *Pheidole* sp. is a large diverse group of ants with two morphologically distinct worker castes, minors and majors. Workers range in size from 1.5 - 4.5 mm, depending on species. Body size of major workers, also called soldiers, may be twice as long as minor workers, and is characterized by a disproportionately large head. Minor workers are much more numerous than soldiers. Body color varies from dark brown to red to light yellow.



P. megacephala is a significant and successful invasive species which has the potential to displace native ant species and whose colonies may dominate large areas through the process of budding. Large interconnected colonies produced by budding may

have multiple queens making eradication and control extremely difficult. New colonies may also be established by swarming of reproductive males and females.

Bigheaded ants produce conspicuous underground nests in disturbed habitats along roadsides and lawns, and around buildings. They rarely nest indoors but may invade buildings when foraging. They feed on both live and dead insects, seeds, and honeydew excreted by insects such as aphids, mealy bugs, white flies, and planthoppers. Populations of honeydew producing insects tend to thrive on plants guarded by bigheaded ants. Although the bigheaded ant does not sting or usually bite unless disturbed, it is considered a threat to native ant species through competitive displacement.

Ghost ant (*Tapinoma melanocephalum*)

Ghost ants are recognizable by their dark head and thorax which contrasts with their pale translucent abdomen and legs. Workers are small, usually 1.5 mm or less, and their light bodies make them appear even smaller and similar in size to Pharaoh ants.



Colonies are moderate to large in size, ranging from a hundred to a few thousand individuals. Eradication is difficult because colonies establish through budding and may have multiple queens. This widespread species is found in humid and moist habitats because it is especially susceptible to desiccation. In the United States they are common household pests in the humid southern states but are limited to indoor infestations in more temperate climates. Food preference is for sweets, and they tend honeydew-producing insects. They also feed on fatty foods and living or dead insects and form trails as they carry food back to their nest. Ghost ants nest outdoors in disturbed areas and under objects. Indoors nesting occurs in cracks, crevices, and wall voids.

General Ant Control

Ants are the most commonly encountered pests around homes and buildings. Effective control relies first on accurate identification of species. Of the many different structure invading species, each has its own characteristics which will influence the method of treatment and control.

Sanitation is an important aspect of any ant control program indoors or out. Crumbs, grease, food scraps, and other foods attractive to foraging workers should be eliminated. Heavy infestations of ants in buildings are rarely found where thorough sanitation is practiced. Sanitation is also important to increase the effectiveness of ant baiting.

Most species of nuisance ants nest outdoors. Band or perimeter treatments with residual sprays applied around foundations and to trails can prevent many ants from foraging indoors. This is usually accomplished by treating the soil surface to a width of two feet from the house plus the exposed surface of the foundation. It is also advisable that perimeter treatments extend into the lawn and include the lower portions of adjacent ornamentals, depending on the label of the pesticide being used. Label directions must always be followed. Perimeter treatments are allowed for Industrial and Institutional applications and are not considered Ornamental and Turf applications, as long as the intent of the treatment is for an Industrial and Institutional pest. **Phytotoxicity** (plant sensitivity to pesticides) should always be a concern when spraying turf or plants, and remember that beneficial insects may be present. Formulations used in ant control are wettable powders, emulsions, dusts, granules and poison baits.

For more permanent control, nests need to be located and attacked; dusts are usually more effective than sprays and granules because they are more readily tracked into the colony. Slow-acting insecticides are the most useful, since they allow the forager time to return to the nest and distribute the toxin by contact with other members in the colony, ultimately killing queens and young.

Ant baiting is another control method that is often very effective in controlling most ants. If the colony cannot be located, baiting may be attempted. Effective bait formulations contain food ingredients on which the ants will feed. The active ingredient kills slowly enough to allow the ant to return to the colony and feed the bait to other members of the colony.

Baits can be successfully used for ant control, but each is dependent on the particular species involved. It may require a pest control technician to try several different bait formulations before discovering a bait that the ants will feed on long enough for the bait to be distributed throughout the entire colony. Several bait formulations are available on the market and include liquid baits, gel baits, and granular baits.

Spot and mound treatments are effective when mounds can be located. This method of treatment is acceptable where ant mounds are found outside in lawns and landscapes. The mounds can be treated using an appropriately labeled water-based residual insecticide. The mound will need to be thoroughly drenched to penetrate throughout the mound and kill all the ants. It is not uncommon that one gallon or more of the insecticide will be required to treat each mound.

For control of ants indoors, several techniques may be needed. Determination of entry points should be made by checking window sills, thresholds, baseboards, cupboards and crevices. Utilizing a properly labeled insecticide, spray the points of entry until the surface is wet and cracks are filled with insecticide. For areas that are inaccessible, dusts or silica aerogel may be applied. For carpeted areas where ants are foraging, the area may be treated by using an appropriately labeled insecticide dust, liquid spray or indoor bait.

Control of some ants, such as carpenter ants, fire ants and pharaoh ants, requires more specialized treatment. Carpenter ant control is discussed in the Nevada Department of Agriculture's *Structural Pest Control: Control of Wood Destroying Pests* manual (Volume IV).

Pharaoh Ant Control

Pharaoh ants are unusually well suited to nesting indoors, and most colonies will be located within buildings rather than outdoors. Pharaoh ants are poorly controlled with residual sprays, since irritating chemicals (including solvents and many cleaners) may cause the nest to bud into separate colonies that disperse throughout the structure.

Slow acting baits have been most effective for pharaoh ant control. Sweet baits, especially mint-apple jelly, are readily accepted by foraging workers. However, pharaoh ants may later become satiated by sweet baits and no longer accept them. Use of fat-based materials in combination with sweets, such as peanut butter and honey, is often effective for a longer period of time than are sweet baits alone.

To improve bait acceptance, sanitation is essential. Failure to restrict other food sources will result in poor bait acceptance. Since the purpose of baiting is to get the ants to feed on the bait and return it to the colony, residual insecticides should not be used in the area of the baiting. It is also important to avoid use of volatile cleaners and solvents, which may repel pharaoh ants. Residual insecticides can be used as a preventive treatment in areas where ants are not present.

Fire Ant Control

The Nevada Department of Agriculture conducts annual surveys of areas of Nevada where red imported fire ants may have been introduced. In many years of survey, the red imported fire ant has been found several times, and has been eradicated by the proper treatment. A treatment approach which results in eradication is aimed at newly introduced colonies. Eradication treatments are not to be confused with “control” methods used in infested states such as Texas and Florida. There is a much greater likelihood of eradicating newly established colonies of fire ants when properly treated. If the colony is allowed to become well established, the likelihood of eradication decreases with time. It is extremely important for homeowners, property managers, and professional pest control operators to recognize the possibility of a red imported fire ant infestation and notify the Nevada Department of Agriculture so that an effective treatment protocol may begin. Other efforts at control may delay proper treatment and possibly enable the colony to become permanently established. Since this species is not adapted to the desert, it requires moisture such as irrigation for survival. Colonies found in Nevada have been discovered in lush, irrigated landscapes or plant nurseries.

Since the appearance of the red imported fire ant and the southern fire ant are similar, samples of aggressive, stinging ants or suspected red imported fire ants should be submitted for positive species identification. The Nevada Department of Agriculture encourages submission of samples of insects for free identification, especially if the red imported fire ant is suspected. Differentiating between red imported and southern fire ants requires a microscope and is difficult without proper training. Information on collecting and submitting samples of ants can be obtained from the Sparks or Las Vegas offices of the Department of Agriculture.

SILVERFISH AND FIREBRATS (Order: Thysanura)

Silverfish and firebrats are flattened insects that are broad near the head and tapered toward the rear of the abdomen. They are wingless and covered with scales, and they have long, slender antennae. Three long, slender appendages from the rear of their body are also very distinctive, giving them their common name, "bristletails."



Silverfish are covered with silvery gray or tannish-gray scales. They prefer areas of moisture and are usually found underneath boxes, boards, and other debris. Firebrats are more mottled in coloration. Firebrats prefer very warm areas and are usually found near heating units.

Both silverfish and firebrats feed on starchy and protein-rich materials. Natural fabrics and rayon, highly refined paper, glue and paste, and books or linens are among the many food items used by these insects. They also may damage items by leaving yellowish stains. These insects are common pests in new homes because of the availability of glues and other building materials left behind during construction and can subsist for months without feeding.

Silverfish and Firebrat Control

Chemical control of silverfish and firebrats is somewhat similar to cockroach control. Hiding areas should be thoroughly treated with sprays or dusts. Attention should be given to wall voids and attics, where these insects are often found. Environmental modifications should also be considered for long-term control. Boxes, furniture, and other items that provide shelter should be moved to deny the insects favored hiding areas. Increased air circulation can help to decrease temperatures around heating pipes, making the site less favorable to firebrats. Some boric acid based baits are commercially available if chemical control is needed for silverfish.

BOOKLICE/BARKLICE/BARKFLIES (Order: Psocoptera)

Booklice, also commonly known as barklice or barkflies, are small, pale-colored insects that are found outdoors feeding on molds under bark, in piled grass clippings, on damp wood, and other similar habitats. Occasionally, they may also enter homes and occur as nuisance-pests. Since booklice require high humidity and feed on molds, almost all household infestations are found in warm, dark, moist areas. Bathrooms are the most common sites of infestations and leaking pipes can also provide suitable conditions. Newer homes may be more likely to be infested because higher-humidity conditions generally persist for a few months after construction. Booklice can become very abundant and annoying. However, they rarely cause much damage. Control of booklice should include eliminating moisture sources by improving ventilation and repairing leaks.



BEETLES: Carpet & Warehouse (Order: Coleoptera, Family: Dermestidae)

Various species of carpet beetles are found throughout Nevada. These beetles are members of a small family known as dermestid beetles, skin beetles, hide beetles and buffalo bugs. Carpet beetles commonly occur outdoors and can invade homes by flying. As a result, almost all homes have some carpet beetles present. Eggs are laid around foods used by the developing larvae. Carpet beetle adults are minute to small, generally oval and convex in shape, with a dense coating of hairs or scales. The head is turned downward with short, clubbed antennae. The short legs are retractable. Carpet beetle larvae are distinctive, light brown in color and having an elongated, tapering shape, and rather bristly.



Carpet beetle larvae often have long hairs protruding from the hind end. Carpet beetles are slow to develop and may require several months or even a year to become full-grown. Adults feed mainly on pollen and nectar, and a few species are predacious on egg cases of mantids and egg masses of lepidopterous insects (butterflies and moths). Carpet beetle larvae are scavengers that feed on a wide range of plant and animal materials.



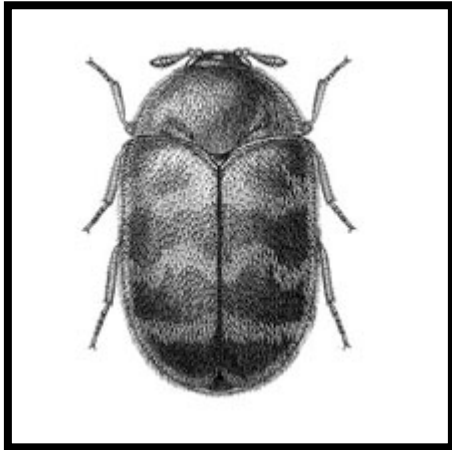
However, they prefer animal-based products, such as wool, hair, feathers, skin, furs and stored grains and other foodstuffs. Household lint or small animals that have died near the home are common materials on which large numbers of carpet beetles may breed. The carpet beetle's name is based on their former importance as a pest of woolen carpets. Carpeting of synthetic fabrics is not susceptible to these beetles. Carpet beetles are most damaging to items such as woolen fabrics, stuffed animals and furs. They are far more common than clothes moths, another major group of fabric pests. Residual populations may breed on debris that collects in or under furniture. Larvae crawl considerable

distances and are often found around the edge of carpets, or in cracks and crevices.

Outdoors, the larvae and adults may be seen in and under dead animals, in hides and horns from cattle, in honeycomb and in nests of birds, rodents, wasps or bees.



Four species are considered the most important fabric pests. These are: the black carpet beetle, *Attagenus megatoma*; the common carpet beetle, *Anthrenus scrophulariae*; the furniture carpet beetle, *Anthrenus flabipes*; and the varied carpet beetle, *Anthrenus verbasci*. Each is described below.

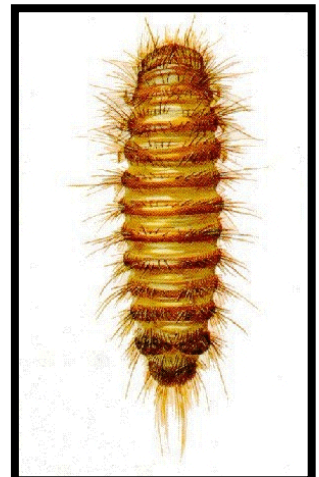


- The black carpet beetle reportedly is the most common species of carpet beetle except in the arid western states. Adults are 2.8 - 5 mm long, shiny black and dark brown with brownish legs. Larvae are 8 mm, carrot-shaped with a hard, smooth and shiny cuticle resembling that of a wireworm. The larvae can eat large holes in fabric but tend to eat the nap, shunning the base threads while on furs they tend to cut the hairs at the base with no injury to the hide but leaving the area bare.
- The common carpet beetle is 3 mm long, gray to

black with a varied pattern of whitish and orange scales on the back and whitish and orange-red scales around the eyes and lower head. This beetle eats slits in carpeting, especially carpeting which is tacked down.

- The furniture carpet beetle is 2 - 3 mm long, spotted yellow, white and black above and white below.
- The varied carpet beetle is 2 - 3 mm long with varied patterns of white, brownish and yellowish scales on the back and fine, long, yellowish scales below. Foods favored by the larvae are dead insects and spiders. It is frequently found in insect collections in museums.

The warehouse beetle, *Trogoderma variabile* is a common pest in the United States and the khapra beetle, *Trogoderma granarium* is one of the world's most destructive pests of stored grain products. For this reason, the U.S. has a quarantine against this particular beetle. The warehouse beetle has been discovered throughout the United States except for a few eastern and southern states. The adult is about 2 mm long and brownish in color. The larvae are about 6 mm long with sharp, pointed hairs (setae) which are irritating, through contact or ingestion, to sensitive persons. This beetle is a major pest of stored foods although the genus is ordinarily considered scavengers in bird, mammal and insect nests. The food preference of the khapra beetle, an important pest of granaries and warehouses, is cereal products and

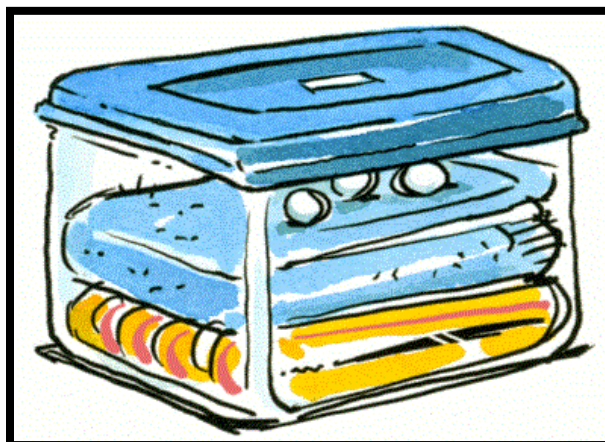


grains: wheat, barley and rice. The younger larvae feed mainly on damaged kernels while the older feed on whole grain or seed. Their activity is usually restricted to the top 12 inches of grain and pupation occurs in the top layer of the food material. A typical infestation is characterized by many larvae and their cast skins. The larvae are very resistant to starvation and as they become older are repelled by light. The larvae are creamy white to yellowish brown with many long hairs and the adult, about 3 mm long, is pale red to brown or black. Flight by the adult has not been observed. All infestations of khapra beetle in the United States and in northern Mexico along the border have been eradicated through fumigation with methyl bromide. Infested maritime shipments (and ships with infested holds) entering U.S. ports are fumigated, refused entry to the U.S. or destroyed.

Infestations of carpet beetles in pantries are much less common than those of flour or saw-toothed grain beetles. Carpet beetles are relatively slow to develop, requiring about a year for a generation on cereal products. However, since the insects are highly mobile, infestations may recur annually.

Carpet Beetle Control

Detection of carpet-beetle breeding areas is the first step toward their management. Materials most likely to be infested should be carefully examined for the presence of the insects or for the shed skins of the larvae. Heavily infested materials should be discarded, if possible. If not, they may be treated in some manner to kill the insects. For small items, deep freezing is possible, since the insects would normally be killed within three to four days of exposure to 0°F temperatures. Fumigation may be necessary for some items. Use of paradichlorobenzene (PDB) moth crystals confined with carpet beetles can kill adult and larval stages in non-food products. Large items, such as furniture, may need to be removed to a fumigation chamber. (A fumigation license is required to use any lethal fumigant.)



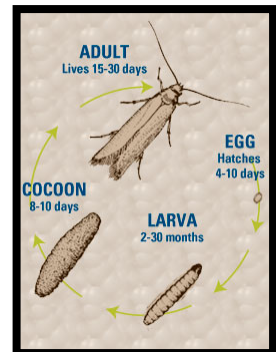
A thorough cleanup of the area is also important for carpet beetle control. Household lint, collections of dead insects around window wells, and other debris can be an important food source for carpet beetles. Very large populations of carpet beetles which occur suddenly, often result where a dead bird or rodent may have become trapped. Sprays may be used to improve control of carpet beetles. However, the "furry" nature of larvae, as well as the natural resistance to insecticides of the black carpet beetle tends to protect these insects, especially against water-base sprays. The use of wetting agents in both oil and water sprays can greatly improve coverage and penetration.

Treatments should be applied by using an appropriately labeled pesticide to areas where carpet beetles tend to concentrate, such as cracks and crevices. If carpeting is to be treated, chemicals should be applied so the penetration is deep enough to reach the base pile but not enough to wet the rubber or synthetic backing. These materials, as well as many kinds of tiles, may be damaged by oil sprays.

CLOTHES MOTHS (Order: Lepidoptera, Family: Tineidae)

Moths in general are members of the order Lepidoptera, which includes butterflies and the skippers. All three members of the order usually have wings, legs and bodies covered with scales, large compound eyes, long antennae, well-developed legs, and mouthparts greatly reduced to an elongated fused tube (**proboscis**) which is coiled when the insect is at rest and extended when sucking up liquid food. Complete metamorphosis occurs in Lepidoptera. The larvae are caterpillars which usually have **prolegs** (short, fleshy projections) used for walking and clinging to plants and other surfaces. Larvae produce a **chrysalis** before the adult stage. The head is usually distinct from the rest of the body.

Moths differ from butterflies in several ways. Moths have tapered, hair-like or feathery antennae while those of butterflies are "clubbed" and never feathery. At rest, the wings of a butterfly are folded up while those of a moth are spread out flat to the sides or over the back. Some adult female moths are wingless or short-winged and are unable to fly. Moths are generally nocturnal. Moth and butterfly pupae (the intermediate stage between larvae and adult) are usually enclosed in silken cocoons and many pupate in the ground.



Populations of clothes moths occasionally infest houses and initiate from the purchase of infested items coming from countries where clothes moths remain a common pest. Adult clothes moths are about 6 mm long and are yellow or buff colored. They are easily distinguished from the other common household moth, the Indian meal moth, which has a distinctive dark banding along the end of the wing.

Larvae of clothes moths develop by feeding on woolen fabrics and furs. Webbing may be produced by the caterpillars as they feed, and one species weaves the silk into a case in which it lives. In a warm building, several generations may be produced during the year. Two clothes moths are discussed below.

- The **webbing clothes moth**, *Tineola biselliella*, is covered with shiny golden scales with a fluffy pompadour of stiff, reddish golden hairs on the head. The compound eyes are black, the antennae darker than the body and the wings without spots. There are conflicting reports in the literature on this moths flying ability. Some reports suggest that they are weak flyers, while others state they can fly 150 to 300 feet. This moth prefers darkness and will fly in darkened corners or at the margins of lighted areas. The egg is large (1 mm), oval, ivory white and fastened with gelatinous material. The female moth dies when all her eggs are laid. The larvae are white, translucent, shiny, greasy-appearing and about 1 mm when hatched. They spin

webbing as they feed creating a temporary silken feeding tube or tunnel. Adults do not feed. Clothes moths infest beef meal, fish meal, pemmican, casein, milk products, clothes, carpets, rugs, felts in pianos, lint from rugs and hairs from pets. They cannot digest cellulose or synthetic fibers that are non protein in origin such as nylon, dynel, dacron, orlon, vicara, acetate or viscose rayon. Natural foods may be pollen, feathers, hair, fur, wool and insect remains.

- The **case-making clothes moth**, *Tinea pellionella*, is somewhat smaller and more brownish than the webbing clothes moth and has three dark spots on the forewings. The hind wings are yellowish brown. The brown headed larva spins a permanent silken case that larvae carry with them as they move. It rarely spins a web on the material on which it is feeding but enlarges the case, one-half at a time, in circumference and length when needed. It closes both ends of the case before pupating. It infests stored tobacco, spices, arrow poison plant, ginger, orris root, poppy capsules, linseed, almonds and other materials.

Clothes Moth Control

Methods for controlling clothes moths include periodic dry cleaning or laundering, proper storage, freezing, heating, fumigating with dry ice, trapping, or insecticide application. Keeping humidity levels low inside buildings creates an unfavorable environment for clothes moth development. Environments lacking tiny cracks and crevices will also have fewer clothes moth problems. Good housekeeping practices are important as well. It is also important to regularly monitor fabrics and closets for clothes moths and their damage so action may be taken when infestations are still small.

Clothes moths often damage improperly stored articles. Stored susceptible items should be clean and pest free and placed in an airtight container. If the container is not air tight, young caterpillars can penetrate the openings and infest the items. Insect repellents containing herbal oils can be placed into the storage container, but little is known about their true effectiveness.

Moth balls, flakes, or crystals containing 1,4-dichlorobenzene (also called paradichlorobenzene or PDB) also are effective for protecting clothes in storage. The use of DDVP (dichlorvos) pest strips can also kill all stages of the insect. Because these materials are toxic, they must be kept away from children and pets. These products have other shortcomings as well. PDB leaves an unpleasant odor on clothes and other cloth objects, and if these products come into contact with plastic buttons, hangers, or garment bags, they can cause the plastic to soften and melt into the fabric.

As these chemicals evaporate they produce vapors that, in sufficient concentration, will slowly kill insects. The vapors build up to the required concentration only in an airtight container. If the container is not airtight, the chemicals only somewhat repel adults, and any larvae already on clothes continue to feed.

The effectiveness of cedar chests and closet floors made of cedar is debatable. Aromatic eastern red cedar, contains oils that can kill small larvae, but it does not affect

larger larvae. After several years, however, cedar loses this quality. Having a tightly constructed chest is more important in the long run than the type of wood used to make it.

Clothes moths can be controlled by heating infested items for at least 30 minutes at temperatures higher than 120°F, enclosing the item in a plastic bag and placing it in a freezer or using dry ice for several days at temperatures lower than 18°F. Before using any of these methods, an applicator must consider if cold or heat will damage the fabric.

Trapping is a relatively easy-to-use technique that helps to detect and reduce clothes moth infestations. Pheromone traps are available to trap both the webbing clothes moth and the casemaking clothes moth. **Pheromones** are specific naturally produced chemicals excreted by an organism which triggers a response from other members of the same species. Female pheromone attractants are used to lure male moths into a trap where they get stuck on the traps sticky substances. Because the pheromone specifically attracts clothes moths, it does not attract other moth species. Pheromone traps are species specific. Pheromone traps for clothes moths are available at pest control supply centers.

Pheromone traps should be placed in closets and other clothes storage areas. Trapping is useful to detect the presence of clothes moths and provides some control. Trapping should be used in conjunction with other control methods such as dry cleaning or laundering, to protect items that may still be exposed to moths.

Spraying infested items with an insecticide is a treatment option for articles that can not be dry cleaned, laundered, heated, frozen, kept in cold storage, or fumigated. The product must be labeled for clothes moths and directions must be exactly followed. Insecticides for clothes moths usually contain pyrethrins, which provide quick knockdown of clothes moths and most can be sprayed directly onto fabrics. Pyrethrin insecticides do not leave persistent toxic residues, which makes them more suitable for clothes moth control than other products.

Insecticide sprays with an oil base should not be used on silk, rayon, or other fabrics that stain easily. Also, they should not be applied around open flames, sparks, or electrical circuits, or on asphalt tile floors. Small, inconspicuous areas on surfaces may be sprayed and tested for staining.

CRICKETS (Order: Orthoptera)

Crickets are a group of insects related to grasshoppers, roaches, mantids, and katydids. They can be identified from their long antennae (as long as their body or longer) and their large back legs, which they use for jumping or hopping. Adult females have a conspicuous sword-like egg-laying device (**ovipositor**) that extends backwards from the tip of the abdomen. Male crickets chirp by rubbing their wings together. Crickets are famous songsters and are usually active at night.

Crickets are common outdoor pests that occasionally invade Nevada homes. They enter buildings through open doors and windows, cracks around poorly fitted windows, foundations, siding, and spaces under doors. Crickets may also move into homes while attracted to evening lights. They feed on a wide variety of foods including fabrics and furs and glue on paper products. Cricket populations are rarely large enough to cause serious damage.

Cricket Control

Crickets are not considered a serious pest inside homes. They are more often a nuisance. Crickets that enter buildings do not usually lay eggs or persist inside. These crickets normally die by autumn or early winter. Reduction in cricket habitats around the foundation (such as plant debris, tall grass and mulch) is the primary control for crickets. Perimeter treatments with insecticides can also reduce cricket movement into homes.

COMMON PESTS OF STORED FOODS

BEETLES (Order: Coleoptera, Families: Cucujidae and Anobiidae)

Flour Beetles (*Tribolium* sp.)

Flour is most commonly infested by either of two closely related beetles, the confused flour beetle or the red flour beetle. Flour beetles do not feed on whole grain kernels; they require the seed coat to be broken.

Adult flour beetles are reddish-brown in color and less than 3 mm long. They are sometimes called "bran bugs," because they are so common in milling operations. Both species of flour beetles have wings, but they rarely fly. Immature stages are pale colored and wormlike. On close inspection, a pair of pointed forks can be seen on the hind body segment. Development of the immature stage typically takes one to two months, and adults lay eggs over a period of five to eight months. Both adult and immature stages feed on flour.



Sawtoothed Grain Beetle (*Oryzaephilus surinamensis*)

The sawtoothed grain beetle belongs to the beetle family Cucujidae and is the most common beetle found infesting coarser cereal products. It can develop in flour, but most infestations occur in processed grain products such as breakfast cereals, oatmeal, corn meal and pasta. Dried fruits and chocolates are occasionally infested. The adult beetle is about 3 mm in length, similar in size to the flour beetles. It is elongate in general body shape, flattened, and distinctively marked with a series of six saw like projections or teeth along the sides of the thorax. It has wings but has never been observed to fly.



Eggs are laid in crevices in its food supply. The larvae are yellowish-white with a dark head and wormlike in shape. Larvae feed on the same foods as the adults. Under optimal conditions, they can complete a generation in less than two months. Adult beetles may live for a year or more and can do considerable damage to grains. They cannot attack sound kernels.

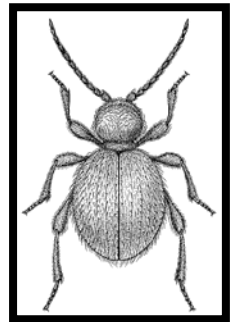
Merchant Grain Beetle (*Oryzaephilus mercator*)

The merchant grain beetle closely resembles the sawtoothed grain beetle and for many years the two were considered synonymous. The merchant grain beetle has larger eyes and a smaller temple area just behind the eyes. Both species readily penetrate processed food packages. The lower the moisture content of dried food, the greater the infestation can be. The merchant grain beetle is found more frequently in foods with higher fat and oil content and is known to fly. Merchant and sawtoothed beetles apparently cannot endure low temperatures in granaries or other grain storage areas and stop breeding in winter unless they occupy a heated building with sufficient moisture.



Spider Beetles (Order: Coleoptera, Family: Anobiidae)

Spider beetles appear similar in shape to a spider. However, the three pairs of legs easily distinguish them from eight legged spiders. Spider beetles are not common stored product pests but may infest a variety of animal or vegetable products in homes, warehouses and grain mills. They are most commonly associated with dried processed foods, although they are scavengers and feathers, wool, dried meat, and other products may be eaten. Eggs of the spider beetles are white and may be conspicuously laid around food products. The larvae are "C" shaped and resemble small white grubs. Pupation of spider beetles often occurs in small cavities that they chew out of wood or other soft materials.



MOTHS (Order: Lepidoptera, Families: Gelechiidae and Pyralidae)

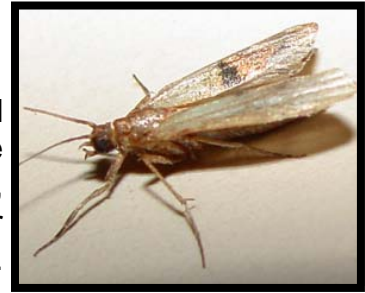
Angoumois Grain Moth (*Sitatroga cerealiella*)

The Angoumois grain moth is considered only second in importance to granary and rice weevils as a pest of stored grain in the United States. The family includes borers, leafminers and leafrollers. The adult moth is buff or yellowish brown and the forewings have two or three to a few dark spots. The eggs are white turning reddish and are laid on heads of wheat and exposed tips of corn in the field and on kernels in storage. The larva is white with a yellowish brown head and about 5 mm long. It feeds inside kernels, weevil fashion, eating the germ and endosperm. There is usually one caterpillar to a kernel of wheat, maybe more than one in a kernel of corn. Because a sorghum kernel is too small for entrance, the larva ties several kernels into a ball and lives within the cluster but outside the kernels. It overwinters as mature larva in stored kernels, field litter and bales of straw. Heavily infested grain in storage has a sickening taste and smell making the grain unpalatable. Combine harvesting has largely eliminated this moth as a pest on wheat. It is active at low temperatures and does much damage where it can survive the winter. It feeds on all whole cereal grains and has been found in hulled chestnuts, red beans and buckwheat in storage.



Indian meal moth (*Plodia interpunctelia*)

The Indian meal moth is an extremely common insect found infesting food products in Nevada homes. Almost any coarse grains (oatmeal, grits, etc.), nuts, seeds, dried pet foods, spices, dried fruits or vegetables are suitable materials for Indian-meal-moth development. However, flour is rarely infested.



The adult stage of the Indian meal moth is about 12 mm long, generally gray in color with bronzy wing tips. The moth is a commonly found flying in homes. Feeding damage is done by the larvae which are usually light-colored, pale yellow to pink, with a dark head. When feeding, the larvae produce webbing mixed with food particles and droppings.



Indian meal moth occurs throughout the United States and is an established insect in most large, permanent storages of susceptible foods. Most household infestations originate from the inadvertent purchase of infested products. During warm months, localized movements of the moths may also occur outdoors, resulting in household infestations. It is rarely possible to establish the original source of a meal moth infestation.

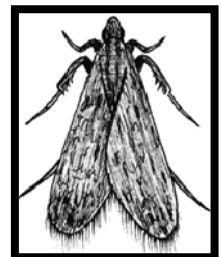
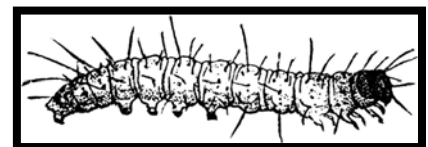
Eggs are laid by the adult moths near suitable foods, such as along cracks or folds of packages. The newly hatched larvae are very small and can penetrate into loosely closed packaging. Upon reaching a suitable food, they begin to feed. Development can be rapid under favorable conditions, and the larvae ultimately reach a length of about 12 mm. After they finish feeding, the larvae will often wander away from the food source to seek a place to pupate.

Adult female moths are capable of laying 200 to 400 eggs during their lifetime of several weeks. The time needed for complete development of the Indian meal moth varies, depending on temperature and food, but it typically takes at least a month to complete.

Mediterranean Flour Moth (*Anagasta kuehnielia*)

The Mediterranean flour moth has pale gray forewings transversely marked with two zigzag or wavy black bands.

The hind wings are a dirty white. At rest, the moth raises its forelegs elevating the forepart of the body in a characteristic posture. The larva is whitish pink and confines itself in a silken tube. It spins silken threads to mat flour particles that may clog machinery. It crawls extensively and may be found anywhere in a house. Mediterranean flour moth pupates in silken cocoon or in cracks and crevices without a cocoon. It infests flour, cereals, bran, biscuits, dog food, nuts, seeds, chocolate, dried fruits and many other stored foods. It is no longer considered an important pest of mills but is still an important pantry pest in homes.



Control of Insects Infesting Stored Foods

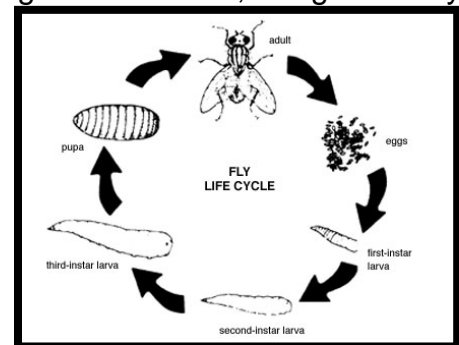
Control of insects infesting stored foods requires a thorough search of all food areas. Flour, nuts, and other dried foods in storage areas are common places to start the inspection. Infestations in cupboards usually involve foods that have not been used for a long time. Commonly overlooked areas include dry pet foods, crafts made of grains, and bird seed. In addition to the presence of larvae, other evidence of infestations includes meal moth webbing and old larval skins left by beetles.

Infested materials should be discarded, if possible. Since the larvae can also feed on spilled foods, the cupboard areas should be thoroughly cleaned. Remaining items that are susceptible should be treated to kill the insects. Deep freezing for several days or heating to 125 to 130°F for a few hours can be effective. All foods that are known to be insect-free should be stored in tight fitting containers to prevent re-infestation.

Insecticide use around food storage areas can help supplement, but not replace, sanitation. If insecticides are used, they must be appropriately labeled for the site and restricted to crack and crevice treatment. If commodity storages are infested, fumigation may be necessary.

FLIES (Order: Diptera)

Flies are members of the order Diptera, which also includes mosquitoes, gnats, midges and leaf miners. Flies are characterized by having a single pair of membranous wings and a pair of knob-like appendages (**halteres**) attached to a greatly enlarged middle part of the thorax. The color of flies is generally somber but some are brightly striped or have a metallic luster.



Several species of flies may enter homes and create serious nuisance problems. Many flies also can be important in the transmission of disease. For example, flies that develop in manure and filth, such as house flies, face flies, and blow flies, are commonly contaminated with disease-causing bacteria. The movement of flies between filth and human food has been associated with several diseases such as cholera, dysentery, and typhoid, and tuberculosis.

Flies undergo complete metamorphosis. The winged adult stage is most commonly observed feeding on liquids that are usually sponged with their mouthparts. Immature stages of flies are pale, legless maggots. After becoming full grown, maggots often wander from the breeding site in search of a place to pupate. Many flies can complete development (egg-larva-pupa-adult) in an extremely short time, as little as seven to 14 days, and many generations are completed during a typical season.

Although flies are most often a nuisance during the warm season, some flies can be problems when they overwinter in buildings. This latter habit is most common with cluster flies and face flies.

Blow Flies (Order: Diptera, Family: Calliphoridae)

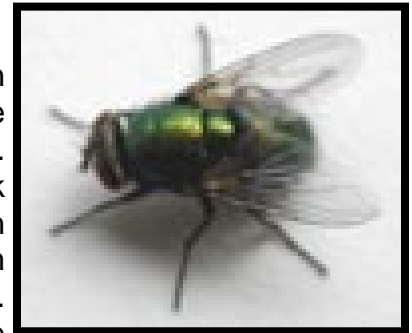
Blowflies, also known as carrion flies, bluebottles, or cluster flies, are a large diverse group of flies which comprise over a thousand different families within the order Diptera. Adult blowflies are metallic green, blue or black flies that are very common in temperate to tropical areas throughout the world including the southern United States.



Blow flies tend to breed on decaying carcasses and animal feces. Garbage is also used as food for maggots. Occasionally, blow fly maggots are found in homes, wandering off the carcass of a dead rodent or bird trapped within the home. Adult blow flies may be attracted to gas leaks and flowers with strong odors of rotting meat.

House Flies (*Musca domestica*)

House flies are the best known and most common flies in human habitats and are found throughout the world. They are believed to have been introduced from the eastern hemisphere. They are generally gray in color. The thorax has four broad, dark longitudinal stripes which are about 4 mm - 6 mm long. Often there is some yellow coloring along the sides, differentiating them from the face flies. At rest, the wings are folded straight back. House flies are intimately associated with humans, and larvae

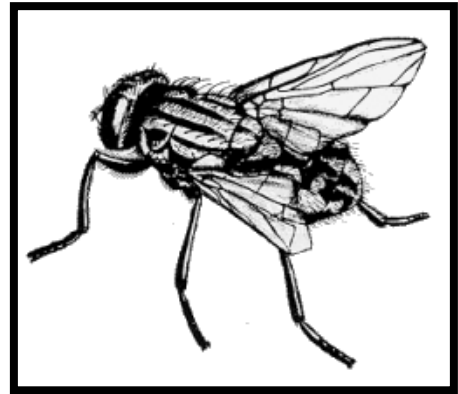


usually develop in man-made sources of food. Food sources include garbage, animal waste, culled fruits and vegetables, and spilled animal feed. Adult flies feed on a wide range of foods using their sponging mouth parts to feed on liquid and solid foods, such as sugar, by regurgitating and liquefying the food. Straw-colored spots on resting sites are regurgitated liquids and dark spots are typically fecal matter. Because of their life habits, house flies can be serious health threats, as they mechanically transmit bacterial and parasitic disease organisms, such as those causing diphtheria, diarrhea, dysentery, cholera, infantile paralysis, and pinworm, hookworm, tapeworm infections. House flies hibernate as adults and enter houses in the fall. During mild winters, house flies may continue to fly and breed continuously as temperatures permit.

Eggs are oval, white and 75 to 100 are deposited on moist substrates including animal manures, garbage and excrement. They hatch in 12 to 24 hours. Larvae are pointed on the front (**anterior**) end and blunt on the hind (**posterior**) end.

Face Flies (*Musca autumnalis*)

Face flies are closely related to house flies and are hard to distinguish from them. The wide separation of the eyes in the male flies and the absence of yellow coloring help identify them. They are also slightly longer and more robust than the house fly. However, laboratory examination is the best method for identification.



Although similar in appearance to house flies, the habits of face flies differ greatly from house flies, and they are often more common than house flies in rural areas where they are common pests of cattle and horses. In the fall, face flies will invade homes and other buildings searching for dark, protected hibernation areas. They pass the winter in the adult stage, often seeking warmth and shelter in upper stories of buildings, such as attics, steeples, and the warmer south and east walls of a structure. They become active in spring, and females lay eggs in fresh cattle manure.

The life cycle from egg to adult is similar to the house fly. Adult flies mate in early spring. Females lay their eggs, and the second adult generation appears approximately three to four weeks later. Adult populations reach maximum numbers three to four months later. Adult flies mainly feed on the secretions from the eyes, nose, and mouth of cattle and horses. They have been implicated in the transmission of pinkeye disease.

Cluster Flies (*Pollenia rudis*)

Cluster flies include bottle flies which are found throughout the world and are widely distributed throughout the United States.

Cluster flies are one of the most annoying flies found within homes during cool seasons. They can resemble the house fly but are darker and larger with an overall length of almost 12 mm. The thorax is coated with bristles and short, golden, crinkly hairs. The abdomen is checkered black and silvery. At rest, the wings overlap, unlike the house fly.



They may also be a serious nuisance in buildings, often concentrating in upper stories. When cluster flies are indoors, they are semi-dormant and fly awkwardly.

Habits of cluster flies are very different from the habits of other common flies. Immature stages develop as parasites in earthworms. Eggs are laid in soil near earthworm burrows. The maggots enter and feed within the earthworms for about 13 days then leave the host to pupate in the soil and emerge two weeks later as adults. Cluster flies do not feed on garbage and animal manure and are not a health hazard because they do not lay eggs on human food. In late summer and fall, cluster flies seek overwintering shelter. Late in the afternoon, they often fly to buildings and rest on sun exposed areas. As the sun sets, the flies creep upwards, ultimately moving to upper stories of buildings. They then seek out openings into the buildings. They may accumulate in attics, closets, reverse side of wall hanging pictures or other dark inaccessible places.

Fruit Flies (Families: Tephritidae and Drosophilidae)

Fruit flies (family Drosophilidae) and peacock flies (family Tephritidae) are among the smallest flies found in homes, about 3 mm in length. Fruit flies are usually a light-brown color with beautiful patterns on body and wings and may have bright red eyes. Most often, they are found hovering around overly ripe fruit or around fermenting organic matter, such as leftover beer or soft drinks remaining in opened containers. Ovipositing females raise and lower their wings slowly as they rest or walk on healthy fruits.



The larvae tunnel into fruits, berries, husks of nuts, leaves, stems and other parts of living plants. Fruit flies are serious agricultural pests capable of wreaking havoc on fruit crops. Household insecticides approved for eliminating the adult flies may provide temporary relief, but eradication requires eliminating the source of the infestation, typically fermenting organic matter.

Common Fruit Fly (*Drosophila melanogaster*)

The common fruit fly is also known as the vinegar fly. It is found mostly around rotting fruit feeding primarily on organisms associated with decay. The adult is yellowish with dark cross bands on the abdomen. It is about 3 mm long with a lifespan of about 30 days. The female can lay about 500 eggs, about five at a time. Eggs are pearly white eggs and have respiratory "horns" at their anterior end. The horns extend above the surface of the



moist media on which the eggs are laid. Larvae are cream colored or transparent, about 7 mm in length and may develop into adults in as little as seven days. Being prolific, easy to rear and with a short life cycle, they have been used extensively in genetic research. Radiation induced mutations of flies led to the sterile male technique of insect control which is a method of biological control where a large number of sterile male insects are released into a population. The sterile males compete with wild males for breeding females and population size is diminished as a result.

Fly Control

Sanitation practices that remove breeding areas are fundamental to the control of filth breeding flies, such as house flies and blow flies. Garbage should be regularly removed or covered. Spilled animal feed and manure should be cleaned up. Face flies (that typically develop in pasture lands) and cluster flies (earthworm parasites) are often hard to control with breeding area management.

Screening and other exclusion techniques can be very important in the management of indoor fly problems. All openings into homes should be caulked or covered to prevent flies from entering. Efforts to exclude flies must be done before they enter. For example, cluster flies are rarely observed indoors until winter and spring months, but they typically enter during late August and September.

Use of insecticides for fly control should only be considered as supplemental to other controls. Insecticide resistant flies are widespread, and many fly populations are now poorly controlled with insecticides. Spot treatments of insecticides and fly baits applied to areas of high fly activity are most efficient. For example, insecticide impregnated resin strips may be used inside garbage cans. Flies that tend to rest in dark corners can be controlled by applications to these areas. Cluster flies are controlled by treatments applied to upper stories of building exteriors immediately before the flies move indoors to over winter.

Mechanical fly traps are also available and can supplement other controls. Flypaper and electrocution light traps can kill flies, but these should only be considered for sites where exclusion and sanitation efforts have reduced the fly populations to low numbers. Various food-based traps are also offered for sale and can supplement other controls.

FUNGUS GNATS (Order: Diptera)

Fungus gnats are small, dark-colored flies that are most often observed collecting around windows, usually during fall and winter. Fungus gnats commonly occur outdoors, where they breed in mushrooms and decaying plant materials. Adults are about 4mm long. Indoors, fungus gnats infest potting mixes used for house plants. High-organic matter plant mixtures or use of organic fertilizers, such as fish emulsion, can encourage fungus-gnat development. Over-watering, a common problem during fall and winter, also encourages fungus gnats by increasing fungus development.

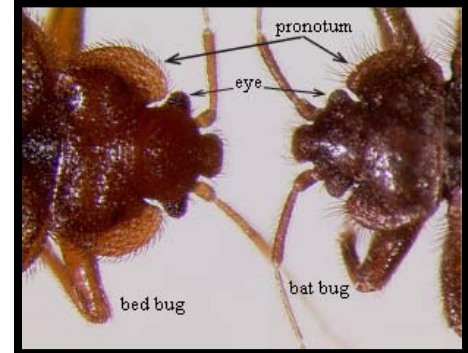


Fungus gnats are harmless to house plants and humans and are primarily a nuisance problem. Attention to correcting conditions of the breeding area (moist potting soil) is the most effective means of controlling infestations.

BITING AND STINGING INSECTS

BEDBUGS (*Cimex lectularius*) and **BAT BUGS** (*Oeciacus vicarius* and *Cimex* sp.)

The common bedbug and its relatives form a small group of parasitic bloodsucking insects in the family Cimicidae. Cimids also include swallow bugs (*Oeciacus vicarius*), a parasite of cliff swallows and barn swallows, and poultry bugs (*Haematosiphon inodorus*) associated with chickens and other poultry. Bat bugs are rare in Nevada. Cimids are specialized in their choice of host but may change prey when their preferred host is unavailable.



Bat bugs and bedbugs are characterized by a short, broad head, broadly attached to an oval body. The body, as a whole, is broad and flat, enabling the bugs to crawl between narrow crevices. The adults are 6 - 8 mm long, brown and wingless. After taking a blood meal, bedbugs change enough in size, shape and color to make them look like an entirely different insect.

The adult female deposits eggs in cracks, crevices, behind woodwork, and in cryptic locations on or near fecal spots. Eggs hatch in 6 - 17 days, about 10 days on average, and newly hatched nymphs will feed when food is available. Environmental factors and food availability will cause variation in developmental rates. Complete development of bedbugs and bat bugs averages 1½ months. Adults can live for a year or more without feeding, and females can lay up to 400 eggs in their lifetime. The bite of these bugs is usually painless because the bug initially administers an anesthetic and anticoagulant, but saliva injected during the bite often causes severe itching and a large inflamed area resembling a welt. Most bedbugs will feed from 3 to 10 minutes at a time. Peak feeding activity is typically between 2:00 a.m. and 3:00 a.m., however, bedbugs will adapt to the sleeping patterns of their hosts. When not feeding, adult bedbugs hide in tiny cracks and crevices in furniture and fabrics near their host's sleeping surfaces.

Individuals vary widely in sensitivity to bed bug bites. Bed bug bites can be distinguished from flea bites by the absence of a red halo surrounding the bite and the presence of a red central area within the inflamed area. The sequential feeding pattern of bed bugs produces a cluster or row of red bumps on their host. Individual responses to the bite are highly variable. Some develop an immediate intensive itching but others may have a delayed response.

Bedbugs spread from one location to the next mainly on infested furniture and bedding, suitcases and other items frequently moved between sleeping and living areas. Bedbugs may also migrate from infested homes by way of water pipes, gutters, through windows, along walls, but generally rely on passive transport by their host to spread. Migrations often occur if a house is vacated and their food supply is cut off. A typical bedbug

will travel between 5 and 20 feet to feed on a host, but can easily travel up to 100 feet if necessary.

Populations of bat bugs usually develop on nesting bats, birds, or small mammals before invading living areas through cracks and crevices. Typically, bat bug infestations originate from animal populations established in attics.

Swallow bugs breed freely all summer in swallow nests built under overhanging structures and cavities in natural sites and human habitations. When migrating swallows desert their nests after the breeding season, the swallow bugs scatter and can invade human dwellings and feed on humans. Management of swallows and their nests must comply with federal and state regulations which protect these birds and their nest sites.

Poultry bugs (*Haematosiphon inodorus*) may become very abundant in crowded, confined chicken coops. Like bed and swallow bugs, they hide during the day in cracks and crevices and feed on their roosting hosts at night. In addition to causing anemia, weight problems and poor laying in their preferred host, backyard chicken shelters provide opportunity for bug migration and inadvertent transport of poultry bugs into to human dwellings.

In homes, problems with poultry bugs, swallow bugs and bat bugs can be severe for a short period (days or weeks) but populations slowly decline because survival is poor without their natural animal hosts.

As an infestation increases, bat bugs and bedbugs will infest other areas of the home, such as in tufts and seams of mattresses and bed covers, under loose wallpaper, in areas behind baseboards, around window casings, beneath floorboards, and in any other suitable crack or crevice. Indicators of an infestation may also include blood stains on walls and bed linens, excrement spots, and cast skins from immature stages. A odor resembling the smell of fresh red raspberries is often associated with severe bedbug infestations but not with bat bugs.

Bedbug and Bat Bug Control

Where bat bugs are a problem, the original site of the infestation (bat roosting areas) should be treated. Using an appropriately labeled total release aerosol in attics to supplement the spraying of residual insecticides is helpful. Controls should be concentrated on living areas below the attic by treating cracks and crevices with a properly labeled insecticide for indoor applications. Areas around light fixtures and any other place that bat bugs may use to migrate from the attic should be treated. Bats should be removed and their entry points sealed. This last step should be coordinated with insecticide treatments since an increased movement of bat bugs into the living area may occur after the bats have been removed.

Inspection: A thorough inspection before and after control is an essential part of a successful bat bug and bedbug control program. Follow-up inspections must be done after each treatment to determine their effectiveness and to find any overlooked or new hiding places. Several treatments followed by inspections may need to be done. Bedbugs are very flat and find shelter in tiny cracks and crevices. Any place offering darkness and protection (such as areas behind baseboards, under loose rugs or wallpaper, and in/on box springs and mattresses) should be inspected. A thorough examination of folds in chairs, beds and couches should also be a part of a bedbug inspection, as bedbugs are not limited to infesting beds. The most common practice for finding bedbugs is simply a close visual inspection of their preferred hiding places. Glue boards placed next to baseboards, under bed frames, and other frequented areas may also be a useful means of detection.

Canines are increasingly used by the pest management industry to assist with bedbug detection. A study conducted by entomologists at the University of Florida concluded that well-trained dogs can discriminate live bed bugs and viable bed bug eggs from dead bed bugs and cast skins, with 95% accuracy and a 3% false positive rate on bedbug feces. Dogs were 98% accurate in locating live bed bugs in hotel rooms. However, these impressive results depend on properly trained dogs and handlers. Chances of false positive findings increase when training of dogs or their handlers decrease. Clearly, dogs can be used to locate live bed bugs but proper and ongoing training of the dog and handler team is an unregulated variable that is critical to effectiveness.

As demand increases, innovation and development of bedbug inspection and detection devices continues to grow. An internet search will reveal all sorts of these devices. Devices range from simple physical barriers placed under furniture legs, to very elaborate CO₂, heat and odor producing devices designed to attract and trap bedbugs. The U.S. EPA, however, does not register, provide efficacy data, or test the claims of pest control devices. Professionals and consumers must perform their own due diligence when purchasing such items.

Treatment Options: Currently, there are only a limited number of products labeled for indoor use to control bedbugs. Unfortunately, due to the global resurgence of bedbugs and increasing use of pyrethroid insecticides to control them, bedbug populations are beginning to show signs of pyrethroid resistance. To avoid this increasing resistance problem, applicators should periodically switch between pyrethroid and non-pyrethroid insecticides. Regardless of type of chemical used, products must be registered for indoor application and must have bedbugs listed on their label as a controlled pest. An applicator might also consider adding a synergist to enhance insecticide effectiveness.

- Fumigation is the most drastic, hazardous and expensive chemical treatment method for eliminating bedbugs. However, it is the most effective method of killing all life stages of bedbugs. FUMIGATION IS NOT ALLOWED WITH A NEVADA **C2** CATEGORY PEST CONTROL LICENSE. A NEVADA **C4** CATEGORY LICENSE IS REQUIRED TO PERFORM FUMIGATIONS. Fumigation is mentioned here only as an alternative chemical treatment. Fumigation of an entire structure should only be

considered in extreme infestation cases.

- An alternative to fumigants are insecticide products that produce penetrating vapors such as Vapona and DDVP. Penetrating vapors are being successfully used inside sealable plastic bags to treat shoes, art work, computers, electronics, printers, radios, books and other physical objects with unexposed surface areas within them.
- Freezing devices that apply CO₂ directly onto exposed bedbugs and eggs will kill them instantly but has no residual effect. Bedbugs insulated by fabric or deep inside cracks and crevices may not be killed. Care needs to be exercised as some finished surfaces may become damaged by liquid CO₂.
- Dry heat exposure of 120 - 130°F for as little as 20 minutes will usually kill all life stages of bedbugs. A conventional household clothes dryer typically attains this temperature range and works well for disinfecting clothing and other articles. Also, non-clothes dryer articles can be heat treated by placing them in sealed plastic bags and setting them in direct sunlight. Care must be taken to ensure the core temperature of the heat treated articles reach at least 120°F for at least 20 minutes. This may take hours to accomplish depending on the time of year and ambient air temperature, or if the bagged items are dense or well-insulated.
- Steam (120°F) applied directly to bedbugs will kill any life stage. As with dry heat, insects deeply imbedded or insulated from exposure will not be affected.
- Monitors can not only help determine the presence of bedbugs they can also be used to evaluate the effectiveness of treatments. Monitors range from simple pitfall and sticky interceptor traps, to more elaborate traps which include CO₂ or heat lures that mimic a living host.
- Vacuuming, mattress encasements, chemically treated fabrics, structural heating, heat treatment lights are all viable treatment options.

Bedbugs are cryptic in nature. They crawl into tiny spots to hide. One-hundred percent elimination may be difficult in some situations and will require a program of re-inspection and re-treatment as necessary.

Insecticides should contact the bedbug to achieve control. Do not rely on residual residue deposits for control. It should be mentioned that dust formulations of pesticides provide more residual control than dried liquid deposits. Alternative methods like freezing, heat treatments, steaming and vacuuming are useful but leave no residue for further affect. Fumigation is very effective, but highly hazardous and can be expensive. An applicator may have to resort to several methods to achieve control.

Appendix D at the end of this manual is a University of Kentucky, Cooperative Extension Service Fact Sheet (ENTFACT - 636) on Bedbugs. It is included to provide a more in depth understanding of bedbugs, their habits, biology and control. Some examination questions may come from this fact sheet.

BEDBUG QUICK FACTS



Figure 1. Bed bug on Human.

- Bedbugs are oval bodied.
- They are brownish in color.
- Their shape is flattened.
- They feed solely on blood of animals.
- Bed bugs do not fly, but can move rapidly.
- Eggs are tiny and whitish and are hard to see.
- Eggs are sticky when laid and stick to surfaces.
- Females lay up to 5 eggs per day and up to hundreds during a lifetime.
- Newly hatched nymphs are straw colored and no bigger than a pinhead.
- A blood meal is needed between each successive molt.

- Nymphs can survive for months without feeding and adults can survive more than a year without feeding.
- The common bedbug prefers humans, but it will also bite other warm-blooded animals, including dogs, cats, birds and rodents.
- They are mainly active at night.
- They prefer to hide close to where people sleep.
- bedbugs like to hide in tiny crevices, especially those associated with mattresses, box-springs, bed frames and headboard.
- Congregate in habitual hiding places.



Figure 3. Bed bug feeding on human.

- Hiding places are marked by excrement which causes dark spotting and staining, and by eggs, eggshells and brownish colored molted skins.
- Reddish blood smears on bed sheets or mattresses occur when engorged bedbugs are crushed.
- Usually bite people at night while they are sleeping.
- Feed by piercing the skin with elongated beak.



Figure 2. Bed bug size comparison (Bed bug on a U.S. penny).



Figure 4. Bed bug and bed bug stains on bedding.



Figure 5. Bed bugs on a mattress.

- Immediately after feeding, they crawl off to a hiding place to digest meal.
- Bite symptoms vary between individuals. The CDC believes that disease transmission from bedbugs is unlikely.
- Conventional insect repellents do not deter them.
- They are efficient hitchhikers and are easily transported.
- They are often transported on used beds, furniture, books, luggage, clothing, etc.

- The level of cleanliness has little to do with infestations.
- The presence of bats and birds as contributing to the presence of similar bedbug species that may bite people. Nesting/roosting areas should be treated.
- To find them, a thorough inspection of the bed, frame, headboard and box spring is essential.
- Beds must be dismantled and mattress seams, frame, etc. inspected, including removal of gauze dust cover on bottom of box spring so box spring can be thoroughly inspected.
- For larger infestations, chairs, sofas, night stands, dressers, etc., should also be inspected.
- Hiding places made of wood are preferred over those made of plastic or metal.

Hiding places also include the junctures where carpets meet walls, walls meet ceilings, cracks in molding, behind wall mounted pictures, mirrors, switch plates, outlets, loose wallpaper, inside closets, etc.



Figure 6. Hiding spaces



Figure 7. Treatment



Figure 8. Inspection

- Control can be difficult. Customer cooperation and access for inspection and treatment is crucial.
- Rooms and apartments above, below, and next to the infested area must also be inspected.

- Infested sheets, blankets, clothing, toys, backpacks, shoes and similar items can be treated by placing them in a dryer at medium to high heat for at least 20 minutes.
- Vacuuming by itself is limited in its control, but can help dislodge eggs when the end of the suction wand is scraped along infested areas.
- When used correctly, steamers and rapid freezing equipment kill on contact, but afford no residual protection and may not reach inside the box spring or mattress.
- Infested items which are to be discarded must be bagged or wrapped to prevent eggs and bugs from dislodging when removed from infested rooms.
- Proper treatment may take hours and follow-up visits are usually required.
- Heavily infested beds should be discarded.
- Bed encasements are helpful, but will not prevent bugs from crawling onto the bed and biting people.
- Fumigation can be used as a control.
- Used furnishings, especially beds and couches, and secondhand items should be examined closely before being brought into the home.
- Items that have been discarded or left by the curbside should be avoided.
- Travelers should check their beds and elevate suitcases off the floor and onto a table or other hard surface.
- Upon returning home, travelers should wash and/or dry their clothes immediately.
- Infested suitcases should be treated or discarded.



Figure 10. Adult bed bugs, eggs, larva, and fecal droppings are shown exposed on this bed strap.

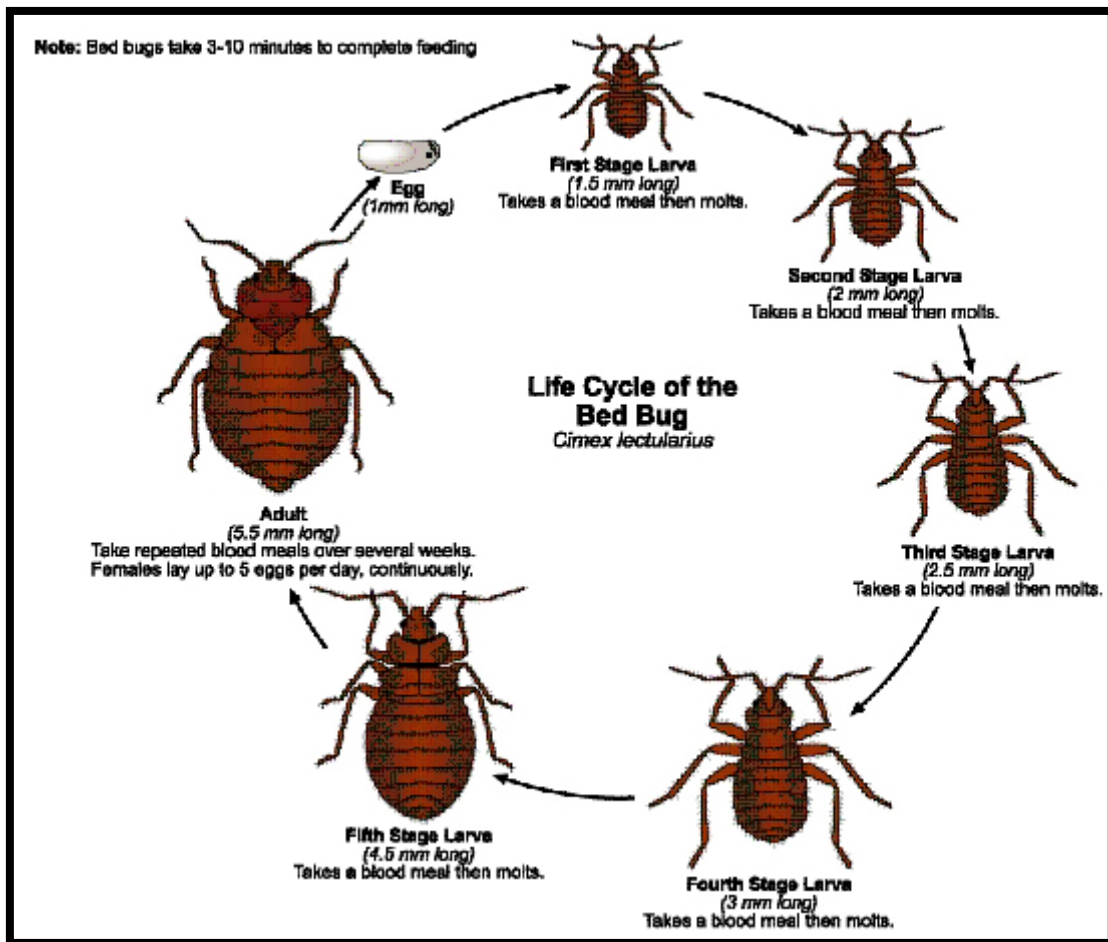


Figure 9. Adult males are slightly larger than the females. The males most notable feature is a spine-like external organ that seems to have evolved specifically for reproduction.



Figure 11. Defacing or destroying infested furniture is a good way to prevent spreading bed bugs from one property to another.

BEDBUG LIFE CYCLE



TICKS (Order: Acari, Families: Argasidae and Ixodidae)

Ticks are members of the order Acari which includes mites. Most are terrestrial and have no antennae or wings. The head, thorax and abdomen of ticks and mites are fused.

Tick stages are egg, larvae, nymph and adult. Tick nymphs and adults have four pairs of walking legs; larvae (or "seed ticks") have three pairs. Both sexes suck blood and engorgement (full of blood) must occur before larvae and nymphs can molt and before fertilization can be achieved by the adults. Tick stages are egg, larvae, nymph and adult. There is one nymphal stage in the hard ticks (Family: Ixodidae) while there may be several in the soft ticks (Family: Argasidae).

The anterior (forward) part of the female hard tick is covered by a hard plate or shield as is the entire back of the male. The mouthparts of the hard ticks are visible from above while those of the soft are not. Hard ticks are scarce in forests but may be abundant in shrubs along trails and paths. The genera *Dermacentor* spp. and *Rhipicephalus sanguineus*, are hard ticks, also known as wood ticks, which include the American dog tick, the Rocky Mountain wood tick, and the brown dog tick.

Hard Ticks

American Dog Tick (*Dermacentor variabilis*)

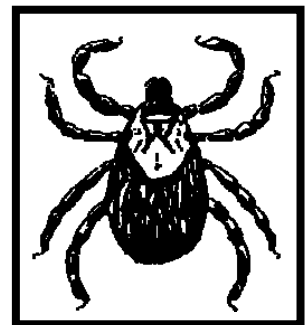
The American dog tick occurs along the Pacific Coast and east of the Rockies. The shield on the back is dark brown with a variable pattern of white. The female lays 4,000 - 6,500 elliptical, yellowish-brown eggs and then dies. The larvae have three pairs of legs, red markings near the eyes, and no white markings on the shield. They are yellow when unfed and slate gray to black when fed.



The nymphs also have no white markings on the shield, have red markings near the eyes and are light yellowish brown when unfed and a slate gray when engorged. Both larvae and nymphs may survive starvation for a year or more. It is a vector of Rocky Mountain spotted fever and tularemia and a common cause of tick paralysis.

Rocky Mountain Wood Tick (*Dermacentor andersoni*)

The Rocky Mountain wood tick occurs in the Rocky Mountain states, Nevada, eastern Oregon and Washington, and parts of California east of the Sierra and Cascade mountains. This tick is superficially identical to the American dog tick. The larvae and nymphs feed on small animals, especially ground squirrels and other small rodents. The adults feed on large animals and man. Hosts reported include man, cattle, sheep, horses, dogs, rabbits, squirrels, raccoons, opossum, coyote, badgers and skunks. Nymphs and adults overwinter in grass



and leaves on the ground. With the first warm days they climb up on brush to catch on to passing animals. They feed from about mid-March to mid-July. This tick is a vector of Rocky Mountain spotted fever.

Brown Dog Tick (*Rhipicephalus sanguineus*)

Another hard tick is the brown dog tick. Unlike the more common wood ticks (*Dermacentor* spp.) that are commonly encountered in hiking, the brown dog tick is capable of reproducing and completing its entire life-cycle indoors. Almost invariably, dogs or rodents must be present on which the ticks feed and reproduce. Humans are rarely bitten by this species.



The brown dog tick is a subtropical and tropical tick that cannot overwinter outdoors in Nevada. Most infestations originate by direct contact with infested dogs or during warmer months, when dogs travel through areas previously frequented by an infested dog. Kennels are also a source of brown dog tick proliferation.

The eggs of the brown dog tick occur within a large mass, usually numbering several hundred eggs. Eggs hatch in about two weeks, and the minute, light brown, six-legged seed ticks move about to find dogs or rodents on which to feed. After feeding on the blood of the host animal for a few days, the young ticks drop off and hide in cracks or similar protected areas, usually near where the dog commonly rests. They then shed their skin (molt), this time appearing as a slightly larger eight-legged form. Another feeding cycle is then completed, and the third, adult stage appears.

Adult brown dog ticks typically feed between the toes, near the ears, or around the anus of the host. During this final blood feeding, the ticks may remain attached for one to five weeks. Numerous ticks can reduce vitality and cause irritability in the animal. After becoming fully engorged, they drop from the dog. At this time, the ticks may be almost 12 mm in size and bloated, grey-blue or olive in color. Full-grown adult ticks are about 3 mm long, flat, uniformly reddish-brown with tiny pits scattered over the back and often show a strong tendency to climb and are often found climbing walls or hidden in cracks of ceilings and kennel roofs.

The entire life cycle of the brown dog tick may be completed in as little as two months under favorable conditions. When temperatures are cool or the ticks are unable to find a host for feeding, the life cycle may extend to as long as a year.

Hard Tick Control

When outdoors, clothing should be tightened at extremities and/or treated with an approved repellent type pesticide. As engorged ticks do not travel far after dropping off the host, an approved insecticidal spray in a swath of 10 - 20 feet along paths, roadsides, edges of lawns and gardens should be of benefit. Any grass more than six inches tall gives ticks considerable protection from sun and dryness. Mowing dislodges and disperses the masses of seed ticks and most then desiccate. Indoors, primarily for brown dog ticks, an appropriate pesticide with long residual is desirable as the eggs lay protected in cracks and behind baseboards and moldings. Treating all areas accessible to the dog is necessary, and severe infestations may require re-treating one or two weeks later.

Hard tick control can be a long, difficult project. If the animal is to remain in the infested area, some careful use of pesticides will be required to kill ticks on the animal and in locations where the ticks hide. Several products are registered for use as pet shampoos, sprays or dips to kill ticks present on the animal. It is usually desirable to get the help of a veterinarian for prescription of materials used on pets since some breeds are especially susceptible to certain pesticide products. Pesticides used on dogs almost invariably mention that they are not to be used on puppies, convalescing or sick dogs, and nursing mother dogs.

Attention must also be given to the areas used by ticks when molting or laying eggs. Often, these areas found near where the dog usually rests. Directed pesticide applications to these areas with residual sprays can be effective for this use. Removal of dogs from infested homes will eventually cause infestations to die out. However, ticks can survive for six to eight months without feeding, and re-infestations are possible anytime during this period, if susceptible host animals are present.

Soft Ticks

Fowl ticks (*Argas* spp.)

Fowl ticks are considered soft ticks in the family Argasidae. These ticks have no hard plate or shield on the back. Until recently, the fowl tick was considered as one species, *Argas persicus*; now it is believed to be a complex of three or four species. The adult tick is flat, sub-oval, light red to dark brown in color, leathery, hairless, with more or less distinct cuticular discs around the margin of the body. The mouth parts are of the piercing-sucking type. The eggs are shiny, reddish-brown and of a spherical shape. The larvae are pinhead size, six-legged and active. Larvae, unlike other stages, remain attached to the host for four to nine days. Adults and nymphs feed one to two hours at night and secrete themselves after feeding. Larvae may survive without food for several months while nymphs and adults may survive up to three years or more. Hosts include all domestic poultry, quail, turkey, dove, vulture, golden-crowned sparrow, owls and



humans if they live close to infested abandoned roosting or nesting sites of birds. Heavy feeding by the ticks result in anemia, poor appearance, reduced or stopped egg production, stunted growth of young chickens and even death of chicks.

Ear Tick or Spinose Ear Tick (*Otobius negnini*)

The ear tick or spinose ear tick occurs throughout the western United States. Its broadly rounded body is conspicuously constricted in the middle, is reddish-brown to black, with the surface minutely roughened with stiff, short, bristle like spines. All stages are eyeless. Severe pain is produced by the bite. This tick feeds in the ears of horses, cattle, and sheep. It has also been taken from the ears of humans.



Soft Tick Control

General management procedure to avoid introduction of soft ticks is advised as the best control. Spraying poultry and/or livestock housing with a properly labeled residual pesticide may be the best method to treat for this tick because the tick drops off the bird soon after feeding. Before considering any treatment options consult fish and wildlife officials to ensure the bird species which may be affected by the treatment is not protected. Before treating, remove nests and roosts from walls for thorough spray coverage. Spray walls, ceilings, roosts, and nests. Coarse, high pressure sprays (up to 300 psi) are recommended.

LYME DISEASE / TICK-BORNE RELAPSING FEVER

Lyme disease is of particular concern in many parts of the United States where deer ticks, the primary carriers of the disease, are common. In the eastern United States up to 80% of the deer tick population carry the disease. In the coastal and foothill areas of California 10%-15% of the deer tick population may carry the disease. Few cases of Lyme disease have ever been reported in Nevada due primarily to the fact that deer ticks are uncommon in Nevada. Lyme disease cases in Nevada most likely occur when the victim is bitten and infected in another state then returns to Nevada after which time the symptoms develop.

Tick-Borne Relapsing Fever: For information, see Appendix A of this manual.

FLEAS (Order: Siphonaptera)

Pets such as dogs and cats, and wildlife, especially ground-dwelling rodents, can occasionally develop seriously annoying infestations of fleas. Fortunately, problems in Nevada are less frequent than in more humid areas of the country and are usually of short duration.



However, a more serious concern in various parts of the world, including Nevada and most of the United States, is the ability of fleas to transmit bubonic plague. Humans and other mammals get plague from a bacterium transmitted by rodent fleas.

Flea bites to humans appear as itchy, red spots usually surrounded by a red halo. Bites often occur in clusters, especially at the edges of tight fitting clothing. Some individuals are extremely sensitive to flea bites, while others are fairly immune. Humans are not a favored host of fleas, and most bites occur when the fleas are starved, such as following a long absence of a pet.

Adult fleas are small (2-3 mm long), reddish-brown, flattened insects. They are wingless but can jump. The adult stage feeds on blood.

Flea eggs are usually laid around areas used often by pets. The eggs hatch, and a wormlike larval stage follows. It feeds on organic matter such as hair, skin flakes, or blood excreted by adult fleas. Several months are required for the larvae to complete development, with low humidity prolonging development.

Flea Control

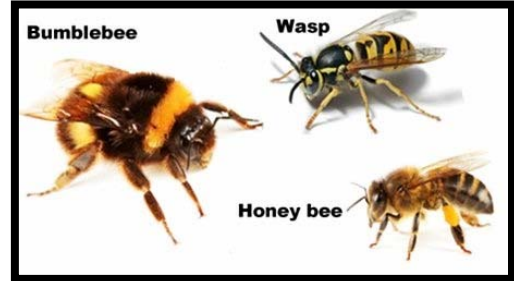
Flea-control measures should be directed at all stages of the flea's life cycle. Control of the eggs and larvae include washing pet blankets and bedding, and thoroughly cleaning any areas where pet hair accumulates. Larval control can further involve application of insecticides to cracks and crevices around where the pet lives. Among the more effective chemicals are newer insecticides that inhibit flea growth (insect growth regulators).

Adult fleas on pets can be controlled by use of medicated shampoos, flea powders, and flea-and-tick collars. Owners should only buy products that are labeled for use on the species of pet to be treated and, as is the case with all insecticide and chemical products, label directions must be carefully followed. Insecticide resistant strains of fleas may also evolve that may not be easily controlled.

In areas where wild rodents harbor fleas that may carry the plague disease organism, control involves dusting of rodent burrows. Rodents such as ground squirrels and rock squirrels that have died suddenly may indicate plague outbreaks. Suspected plague incidents should be reported to your local county health department or to the State Health Department.

WASPS AND BEES (Order: Hymenoptera)

Several species of wasps and bees occur in Nevada. Most are highly beneficial. Bees, such as the honeybee and leafcutter bee, are essential for the pollination of many crops and native plants. Most wasps are predators of pest insects, feeding insects to their developing young. Problems with wasps and bees occur when nests are located near high-traffic areas or in buildings. Also, late-summer foraging by yellow jacket wasps can be a serious nuisance in areas where food (particularly meat) is served outdoors. Also, wasps may enter homes and buildings during fall in search of overwintering shelter.



Social Wasps (Family: Vespidae)

Social wasps include yellow jackets, hornets, umbrella (paper) wasps and wasps in the genus *Mischocyttarus*. All belong to the family Vespidae. Vespidae wasps are medium to large and usually black and yellow or black and white with four wings, two forward wings and two hind wings. At rest, the wings are folded along the length of the body. Adults have well-developed upper jaws (**mandibles**) for capturing and chewing insects and a tongue for sucking nectar, fruit and other juices. There are three casts: queens, workers (sterile females) and males (drones). The queen lays unfertilized eggs which produce male wasps or fertilized eggs which produce female wasps. Old queens, males and workers die at the end of the summer. The young queens, which have mated, overwinter in protected areas, including under the bark of trees or in homes or other cracks and crevices. In the spring, the young queens build a nest and lay fertilized eggs which develop into workers. As the season progresses, more worker wasps are present to help with colony development and the nest rapidly increases in size. By late summer, each colony may have hundreds of wasps. At this time, the colony starts to break up, and many of the queens leave.



Most nuisance problems around peoples' homes involve social wasps, including yellow jackets. These insects annually build new nests made of paper. Yellow jacket nests may be underground, in wall voids or aerial. Aerial nests consist of several combs which are completely covered with "paper." Western yellow jacket (*Vespula pennsylvanica* and *V. arenaria*) nests are often placed on buildings especially under eaves. Bald-face hornets make large aerial nests in trees, especially maple trees. Umbrella wasps or paper wasps in the genus *Polistes* sp., build a single comb layer umbrella shaped nest with cells exposed. Following several hard frosts, the nests are abandoned and not reused.

Social wasps feed their young protein-rich foods, mainly insects. Late in the season, food preferences switch to include more sugary materials, and wasps are attracted to soft drinks, syrup, and other materials. During this period, they can be extremely annoying. Almost all "bee" stings actually involve social wasps such as yellow jackets.

Mud dauber wasps, family Sphecidae, have petiolate abdomens which characteristically have long and slender petioles. They are also known as thread-waisted wasps. They overwinter in the pupal stage. Nests are made of cylindrical cells of mud or clay built side by side and plastered over to make a relatively smooth and uniform outer surface. Nests may be attached under bridges, against structures, under eaves, and in open sheds, barns or garages.

Wasp Control

Destruction of wasp colonies is fairly easy if the nest can be located. Insecticide dusts are usually most effective for ground nesting yellow jackets, since they are more readily tracked into the colony. If a liquid insecticide is used, it should be poured into the openings of the subterranean nests. Aerial nests are best controlled with use of directed sprays forced into the opening and then over the entire nest. Often it is best to combine a fast acting "knockdown" insecticide, such as pyrethrin or resmethrin, with a more persistent insecticide. Note: pyrethrins are not fast acting on yellow jackets, but resmethrin (a pyrethroid) is fast acting.

Colonies are often not completely killed for at least a week after application, since developing wasps in rearing cells continue to emerge for several days. It is safest to control wasps during the coolest period when their activity is the lowest, usually in the very early morning. When nests cannot be found, a properly labeled protein or fruit juice poison bait may be effective against some wasps. Wasp traps may also be effective against some wasp species.

Light-colored protective clothing is recommended to avoid stings. If a wasp nest is a minor nuisance, problems may be resolved without treatment, since colonies die off at the end of each season. Abandoned aerial nests can be cleaned up by knocking them down and throwing them away.

Solitary Wasps

Several wasps do not produce a social colony; instead they individually rear their young in mud nests or underground tunnels. These are hunting wasps that collect spiders, cicadas, caterpillars, and other prey for their young. Many are highly beneficial. Although the solitary wasps sometimes appear rather fearsome, they rarely sting, and their sting is less painful than the sting of social wasps. If necessary, colonies of mud-nesting species can be controlled simply by pulling down nests. Residual insecticide sprays can also prevent wasps from nesting.



Honeybees

Unlike the social wasps, honeybees form semipermanent colonies. Nests are constructed of wax, and some colonies are maintained by beekeepers. Honeybees feed on nectar and pollen, which they feed their young and use to produce honey and beeswax. Honeybees also may collect water to cool the hive and plant sap to help seal cracks.



Periodically, overcrowded honeybee colonies form swarms that leave the hive, or escape from beekeepers and become feral. The swarms rest temporarily on a tree or shrub while scout bees search for a nesting cavity. Although the swarms are very striking, the bees are usually docile at this time. Most beekeepers are willing to collect honeybees in a swarm. Problems with honeybees occur when swarming bees find a building wall opening and construct nests in buildings. These nests can become very large over several years, thereby complicating their removal. Although colonies can be relatively easily killed with insecticides, the wax, honey, and other hive debris remains behind. The old colony can attract rodents and can melt under high temperatures which may attract a host of other pests. As a result, the remains of the old colony must be removed, which may require the removal of walls, chimneys, etc.

Africanized Honeybees:

The sting of an Africanized honeybee (AHB) is no more dangerous than the sting of a familiar European honeybee. The Africanized variety (sometimes called “killer bee”) is simply the result of experimental crossbreeding an African variety with the familiar European honeybee (EHB), an experiment that turned out to have been very ill-advised.

The two varieties differ significantly in behavior, but not in appearance. From appearance alone, it is virtually impossible to tell which is which. However, when it feels threatened, which happens easily and quickly, an AHB swarm attacks in far larger numbers than EHB, inflicting hundreds or thousands of stings. An AHB swarm chases the object of the attack (in most cases a human or animal) much farther. Such a large number of stings may be fatal, especially if prompt medical aid is not provided. Even if the stings are not fatal, if not treated, the AHB toxins can cause kidney failure and death within days.

Not only are AHBs stimulated into action much more easily than the familiar EHB, they remain stimulated much longer. Approaching a hive or even making loud noises, as with a lawnmower or edger, at a distance of up to hundreds of feet may draw an attack. This aggressive behavior has complicated the removal and control process.

Africanized honeybees migrated to the U.S. from South America via Mexico. They entered the United States through Texas in 1990 and arrived in Nevada in 1998. Africanized honeybees are now established and considered the predominate strain of feral honeybees in Southern Nevada. Currently, the range of Africanized honeybees in Nevada includes all of

Clark County; Lincoln County south of latitude 38° north; and in Nye County south of latitude 37° north. All of this area is under an “INTERIOR QUARANTINE AGAINST AFRICANIZED HONEYBEES” which provides some restriction on bee keeping activities.

Managed and feral bees (including honeybees) are mostly unregulated. However, specific city and county codes may address commercial beekeeping, hobby apiaries, etc. within the incorporated and unincorporated political subdivisions. NAC 554.805 to NAC 554.825 regulates the keeping of honeybees within the above described quarantine area. For this discussion feral AHBs and feral colonies of honeybees are not protected under current laws and regulations and can be removed and eradicated. All bee eradication services are regulated under pest control laws (NRS and NAC chapter 555). Nevada Law (NRS 552.0852) defines “disease” in bees and apiaries. Africanization of a colony of honeybees, whether feral or managed, is a diseased honeybee colony.

Feral honeybees within the established interior quarantine zone are considered Africanized. The Department has determined that these unmanaged feral swarms and feral colonies of honeybees to be a public nuisance which may be destroyed through pest control services. The Nevada Pest Control Association has set up a 24 hour recorded bee information “hotline” for the public. The phone number is 702-385-5853.

However, diseased bees (including Africanization) in managed colonies can be dealt with by contacting the quarantine officer in the Nevada Department of Agriculture. The quarantine officer will follow the diseased bee abatement process outlined in NRS 552 and NRS 554.



Africanized honey bee (left) and a European honey bee (right).

Ground-Nesting Bees

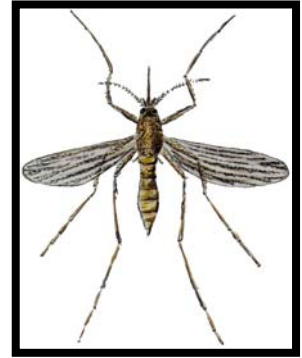
In several areas of the state, occasional problems occur with ground nesting bees. These are solitary bees that individually rear their young within underground cells. Sites with a sunny exposure and proper soil type and cover are highly preferred. Hundreds of bees may nest near each other at such a site.

Solitary bees are not aggressive and rarely sting. They are best controlled by changing the characteristics of the nesting site. Planting grass, sod, covering with straw, other organic materials or incorporating different soils may do this. When nesting conditions become unsatisfactory the bees move elsewhere.



MOSQUITOES (Order: Diptera, Family: Culicidae)

Due to the development of an Aquatic (C5) license category, the mosquito section has been removed and placed in the Aquatic study guide. Mosquito abatement activities involving the control of the aquatic life forms requires a C5 (Aquatic) license. Some general information about mosquitoes follows.



Mosquitoes are small, delicate insects, mostly 3 - 6 mm in length, with globular heads, laterally compressed thoraxes and slender long legs. The abdomen is long and cylindrical. The single pair of wings is long and narrow with six longitudinal veins. At rest, the wings lie flat on the back. Mosquitoes differ from most other flies in that they have scales on their wings, body, appendages, and parts of the head. Their mouth parts are modified into a piercing-sucking beak consisting of long blade-like stylets and a sucking tube. Antennae have 15 segments.

Adulticiding is the term used to describe the chemical control of adult mosquitoes. Adulticiding is only a temporary solution. The only effective control for mosquitoes is modifying or eliminating breeding sites. In some cases outdoor foggers will keep mosquitoes away for several hours, but once the chemical dissipates, the mosquitoes return. Spraying hiding spots around homes, thickets or shrubs along the perimeter of a home can help reduce the population of adult mosquitoes that rest in these areas; however, use of these insecticide treatments will provide only temporary reduction in mosquito populations.

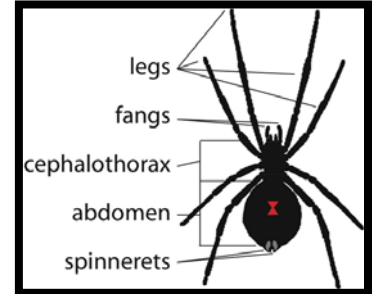
Mosquito larvae are aquatic. They have well developed heads, swollen unsegmented thoraxes and abdomens with eight segments. They breathe through **siphons (spiracles)** located at the rear end of the body which extend through the surface film of water. Tufts of bristles arise from many of the body segments. The larvae ingest some dissolved substances but feed primarily on particulate matter ranging in size from bacteria to clearly visible pieces floating in the water surface film, suspended in the water or clinging to submerged surfaces and other microorganisms. The larva of a few species are predaceous on other mosquito larvae.



It is important that mosquitoes are controlled because many of the species are vectors of human illnesses (Western Equine Encephalitis, Malaria, West Nile Virus, etc.).

SPIDERS (Class: Arachnida)

Spiders are a group of arthropods that have eight legs. Spiders are not insects. Spiders and insects are in different groups within the phylum Arthropoda. Spiders are grouped into a separate class, the arachnid, which also includes mites and ticks. Spiders are characterized by having eight legs and two distinct body regions (**cephalothorax** and abdomen).



Spiders feed on insects and other small arthropods. Their activities are highly beneficial since they help control many pest species in yards and in and around homes. Unfortunately, there is a widespread and largely unfounded general fear of spiders by most people. Fear also exists because a few poisonous species occur in Nevada, such as the black widow and desert brown spider.

Spiders begin life as eggs laid in egg sacs that are bound by silk. These egg sacs may be guarded or even carried by the female. The young spiders (**spiderlings**) emerge from the eggs and scatter. Many spiders disperse by "ballooning." This occurs when spiders produce silken threads that are caught by the wind. Although they do not have wings, ballooning spiderlings have been known to be carried hundreds of miles on wind currents. The developing spiders feed and grow over a period of several months. During this period, they molt several times before becoming full grown. Many common spiders have one generation per year and usually become full grown in late summer. However, mating and egg laying can occur almost any time of the year, depending on the species.

All spiders can produce silk. Many of the more conspicuous species use silk to help build webs used to capture prey. Other spiders do not produce a web, instead they hunt their prey. Hunting, or ambush spiders use their silk only for building egg sacs or hideaways. Spiders eat live prey. Victims are killed by venom that the spider injects through its fangs.

Spiders may survive for months without food. Most species of spiders found in homes are attracted to water sources. Water pipes, floor drains, plumbing fixtures and air conditioners are common areas where spiders may be found in a home. Some spiders prefer warm, dry, undisturbed sites and can be found in sub-floor air vents or upper corners of rooms. Spiders found indoors often hide in cracks, darkened areas, or silken retreats they have built.

Movement of spiders into homes greatly accelerates after cool weather arrives in early fall. Also, male spiders of most species are often highly mobile and range widely while searching for mates. Many male spiders fail to survive for long in homes, but periodically they can be very numerous.

Spider Bites

Although all spiders bite and produce venom, few pose any health threat. The venom of most spiders is not very toxic to humans, and many smaller spider's bites cannot break the skin. Also, spiders are not usually aggressive and only bite when accidentally handled or trapped. Two poisonous species of spiders do occur in Nevada, the black widow and the desert brown spider.

Common Nevada Spiders

Wolf spiders (Family: Lycosidae)

Wolf spiders are fairly large hunting spiders that often cause alarm because of their appearance. Most are gray or brown and fast moving. Many species exist, and they vary largely in size from 1- 35 mm long. However, one genus of wolf spiders, the giant burrowing spider, may be 37 mm long. Wolf spiders most commonly enter homes late in the season. They hide in cracks and do not produce webbing. Larger species can produce a mildly painful bite, but symptoms do not last long.



Jumping spiders (Family: Salticidae)

Jumping spiders are the largest family in the spider order. They are brightly colored, active spiders. Their bodies are often densely covered with colored hairs, and some may appear iridescent. Their stout body and large eyes make them easy to identify. They are relatively small in size and average less than 13 mm in length. They are active during the day and may jump or move sideways with ease. They rarely reproduce in homes, and most occur as invaders after frosts.

Orb weavers (Family: Araneidae)

Orb weavers produce characteristic large webs that have threads radiating from a central point. Some orb weavers are quite large. The bodies of some females, excluding legs, can range up to 20 mm. They rarely enter homes, but they attract attention because of their conspicuous size and web.

Cobweb spiders (Family: Theridiidae)

Cobweb spiders are very common in homes, and many are well-adapted to survival indoors if enough prey is present. These are small to medium-sized spiders that typically are found hanging upside down from irregular webs in corners of rooms and other darkened areas. When prey is tangled in the web, they throw anchoring silk strands over it. They do not completely wrap the prey, as do the orb weavers. Although most cobweb spiders are harmless, black widows also belong to this family of spiders.

Black Widow (Family: Theridiidae Genus: Latrodectus)

The black widow is a common spider in all parts of Nevada. There are 30 different species of Black Widow worldwide and five species occur in North America. Black widows produce a loose web and prefer to inhabit dark, undisturbed areas. Typical locations of black-widow nests include locations such as shrubbery, around log piles, in crawl spaces, under porches, in garages, and around piled debris.



Essentially all bites occur from the female, as she is guarding her egg sack. The body of the full-grown female is about 12 mm long and shiny black or dark brown. It has a spherical abdomen. Most black widows also have orange-red markings on the underside of the abdomen, sometimes appearing as an hourglass. However, these markings may be reduced and even absent among many black widows. The venom of the black widow spider is a nerve poison that produces distinctive symptoms. Often the original bite is not very painful, but it may be followed by a burning sensation, local swelling and redness. Pain may become intense in one to three hours and last up to 48 hours. Cramping of the legs, arms, abdomen and chest may follow.

Black-widow bites should receive prompt medical attention. Although fatalities are very rare, symptoms are very painful. Antiserums are available, and injections of calcium gluconate can help to relieve symptoms. Whenever possible, the spider should be brought to the doctor to confirm the diagnosis and help with proper treatment.

Funnel-weavers (Family: Agelenidae)

Funnel-weavers are medium-sized spiders with a body size, excluding legs, of up to 17 mm in length. This family includes Hobo Spiders. Their funnel webs are easily seen on lawns in late summer. Funnel-weavers may also inhabit corners of cellars or outbuildings. Egg sacs are often laid in a cocoon that remains attached to the web.

Hobo Spider (Family: Agelenidae, Species: *Tegenaria agrestis*)

The hobo spider is believed to occur in White Pine and Elko Counties, however. However, confirmation of the spiders existence is yet to be determined. The hobo spider is of importance because of its ability to cause necrotic spider bites similar to those of the brown recluse spider. Necrosis is the scientific term for dead or dying tissue. Spider bites that become necrotic have been reported in Nevada for many years and are usually blamed on the brown recluse spider. Currently there are no known established populations of brown recluse spiders in Nevada.



Hobo spiders build funnel or tube shaped webs. It is a long-legged and swift running spider with a brown cephalothorax and brown legs. The abdomen has a distinctive pattern of yellowish markings on a grayish background, although this pattern may be hard to see without a microscope.



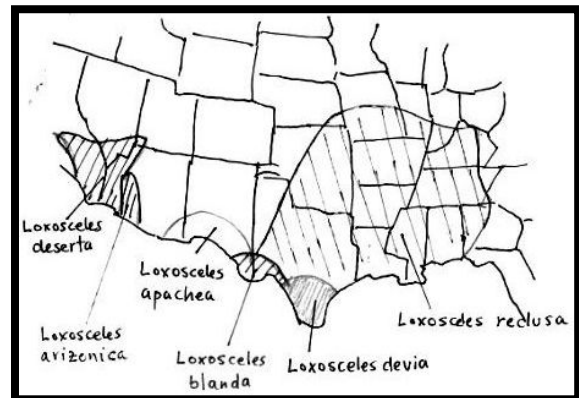
The complete life cycle of the hobo spider lasts for two years. They prefer habitats that have holes or cracks to support their funnel like webs. They are poor climbers and are rarely seen above ground level.

Hobo spiders are most commonly encountered from June through September, when males wander in search of females. Complaints of bites usually occur during this period of activity. Females tend to stay in their webs and do not wander. Males generally have more toxic bites than females and bites of immature spiders are more serious than those of adults. There are no confirmed cases of hobo spider bites causing necrosis

Control methods for the hobo spider are most effective if a combination of control methods are used which include habitat elimination, exclusion, avoidance of risk, and chemical control.

Desert Brown Spider (*Loxosceles deserta*)

The desert brown spider may be confused with the brown recluse, both by size, coloration, and symptoms of their bites. The desert brown spider is a native of the southwest region of the United States. In Nevada it occurs as far north as the northern Clark County line. In contrast, the brown recluse occurs in the south central United States. The brown recluse has been identified from other areas, but few established populations have been recorded. Although bites from brown recluse spiders have been reported in Nevada, only one specimen (found in a piano from Texas) has ever been identified. No established populations of brown recluse spiders have ever been found in Nevada.



Identification: The desert brown spider has a medium sized body from 7 - 14 mm in diameter. They are yellow-tan to light brown in color. The most distinguishing characteristic is their six eyes, arranged in three pairs across the front of the head. These spiders also have a brown violin-shaped marking on the head extending from the eyes back between the legs. The visibility of this marking varies among individual



spiders. For positive identifications, samples may be submitted either to a Nevada Department of Agriculture office or Cooperative Extension office.

Biology / Behavior: The desert brown spider prefers to be outside. This spider is usually found under litter, boards, and other debris in the desert. It is occasionally found in quiet protected areas in buildings, garages, and sink drains. The desert brown spider prefers locations that remain undisturbed for long periods of time such as houses that have not been lived in recently. Like most spiders, the desert brown spider is non-aggressive and only bites when trapped or inadvertently threatened. If given an opportunity to escape, the spider will usually do so. Bites can occur when putting on clothing in which the spider is hiding, cleaning out storage sheds and closets, or stepping on a wandering spider at night with bare feet.

Avoidance / Control: The following actions will help prevent contact with the desert brown spider:

- Clothing and bedding before use (especially if it has been stored for a long time);
- Gloves should be worn when working in areas where the spider may be found;
- Collections of papers, unused boxes, boards, litter, etc. should be eliminated;
- Areas behind and beneath furniture should be cleaned;
- Spiders, webs, egg cases should be removed from living and storage areas;
- When necessary, appropriate pesticides may be used.

Spider bites: Reactions to spider bites vary greatly among bitten individuals and with the species of spider. The typical desert brown spider bite may not be felt at the time of the bite. Generally, 3 - 4 hours after the bite, the area around the bite becomes swollen, red, and painful. In the following days and weeks, a blister may appear and the area may eventually become necrotic. This tissue sloughing may require medical attention. If any spider bite progresses past the blister stage or if there is a more rapid reaction, a physician should be contacted. Keeping any bite sites clean and sterile is important while healing takes place. It should be noted that the bites from many spiders can cause similar reactions and the same precautions should be taken.

Sun Spiders/Wind Scorpions (Order: Solifugae)

Sun spiders (solpugids or wind scorpions) are a group of arachnids distinct from the true spiders. Sun spiders are yellowish-brown and larger than most spiders. They are most easily identified by their very long pair of pedipalps (segmented appendages attached to the cephalothorax; structures most people refer to as claws or pincers) on the sides of the head, which superficially appear as a fifth pair of legs. Sun spiders also have a pair of greatly enlarged jaws.



Sun spiders are common throughout Nevada. They are active hunters of other arthropods and usually feed at night, hiding under rocks and debris during the day.

Occasionally, sun spiders enter homes. Because of their large size and aggressive appearance, they typically cause alarm. However, they seldom bite, unless handled or crushed inadvertently. The bite can be painful, but the pain is not very persistent. Sun spiders have no venom. Sun spider movements into homes can be discouraged by keeping shelter materials (rocks, debris, etc.) away from the foundation. Foundation perimeter applications of insecticides can further improve control. However, sun spider abundance in homes is usually very low, with most incidents involving isolated sun spiders.

CENTIPEDES (Class: Chilopoda)

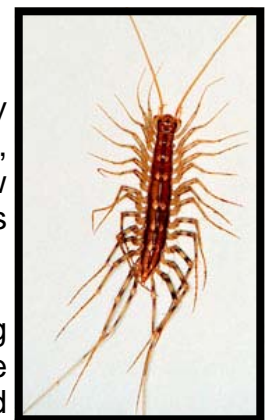
Centipedes are arthropods that are distinguished by having a single pair of legs per body segment. They are generally flattened and elongate in form. Centipedes are quite fast moving predators of insects and other arthropods.



Most Nevada centipedes rarely invade homes, mostly staying outdoors under cover during the day. Occasionally, individuals of the large (four to six inches long) desert centipede (*Scolopendra heros*) are found indoors and cause alarm. However, like most centipedes, the giant desert centipede has shy habits and avoids light. All centipedes possess poison gnathopods (large hollow appendages located on the first body segment), but the venom is not sufficiently toxic to be lethal to adults or small children. Although centipedes can produce a painful bite, this is extremely uncommon and only occurs when they are accidentally crushed or handled. The effect of the bite is similar to a wasp sting. Persons bitten will have swelling and tenderness for several weeks. Household invasions of centipedes are usually self limiting since they do not reproduce or survive long in most homes.

House Centipede (Family: Scutigeraidae, Genus: *Scutigera* spp.)

House centipedes are the only centipedes that may successfully live in damp areas of houses. Legs of the house centipede are very long, and it can crawl and climb fast. House centipedes survive in low numbers in many homes as long as live prey (insects, spiders, etc.) is available in the home.



Centipede movements into homes can be reduced by removing sheltering debris from around homes and by use of perimeter insecticide application around building foundation. Because venom is administered through their legs, technically centipedes sting rather than bite their prey. House centipedes venom is not considered dangerous to humans.

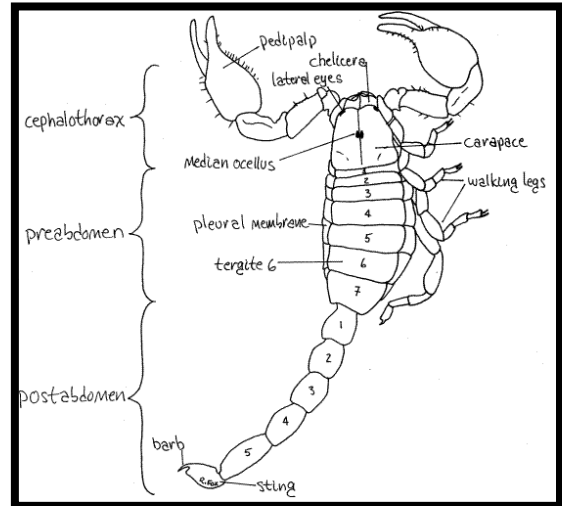
SCORPIONS: (Order: Scorpiones)

Scorpions are a distinctive and well-recognized group of arachnids. They are most easily distinguished by their lobster like appearance, but especially by their fleshy tail that terminates in a bulbous sack and prominent stinger. The larger front pincers (modified mouthparts) are used to capture and hold prey while feeding. The stinger is used to subdue prey and for defense.

Scorpions are common throughout Nevada. Approximately 23 species of scorpions are known to occur in Nevada, usually with more than one species living in close proximity to one another. Only one Nevada species is considered seriously poisonous, the bark scorpion (*Centruroides exilicauda*). The bark scorpion only occurs in extreme southeastern Clark County in the Virgin Mountains near Mesquite and Gold Butte and is also well established in areas of the Las Vegas valley. All other species have venom and can sting when provoked or trapped, but reaction to the sting is usually mild. Most desert scorpions are commonly encountered by people working around rocks or debris, which are hiding areas for scorpions during the day. Entrance into homes usually occurs in newly developed areas less than three years old. Migrations into homes often follow heavy summer rains. *Centruroides exilicauda*, however, has been caught inside (on walls and behind pictures) and outside Las Vegas houses throughout most of the year. Outdoors they have been collected from palm trees, outer walls of buildings and concrete block walls. Another peculiar habit of bark scorpions is their tendency to climb and seek cover in cracks and crevices of houses and under tree bark (especially palm tree bark), hence its name - bark scorpion. *Centruroides exilicauda* is often found fair distances above the ground. Most other scorpion species in Nevada are ground dwellers.

Scorpions can produce a painful sting when handled or disturbed. Again, most Nevada species are not highly poisonous, with the exception of the bark scorpion *Centruroides exilicauda*. If stung by *Centruroides exilicauda*, you may exhibit a variety of symptoms. Stings are usually immediately painful. The limb or area around the sting may exhibit numbness, weakness and even paralysis. Other symptoms are hyperactivity, anxiety, profuse salivation, dizziness, respiratory distress and even convulsions. The sting site does not swell and become discolored as it does with other species of scorpion. If a person has been stung by a bark scorpion, a physician should be contacted. However, most treatments can be done at home with the use of a mild analgesics and cold compresses for discomfort. Children two years old and younger are especially sensitive and often require hospitalization.

Scorpions live two to five years. They do not lay eggs. The female bears live young seven to 12 months after mating. A female may produce 14 to as many as 100 young, which are carried on her back until they have molted. After molting, immature scorpions leave the mother. They mature in about one year.



Scorpions are nocturnal. At night they defend their territory, feed and mate. Scorpions have poor eyesight. They do not stalk their prey; instead, they lie in wait for ambush. Insects, spiders, millipedes, other scorpions, and small vertebrates are common scorpion prey. Only a small portion of scorpions may be out on any one night.

Scorpion Control

During dry weather, scorpions are attracted to moisture. Because of this habit, they may be trapped by spreading wet burlap bags or newspapers and collected during the day. Scorpions can be discouraged from areas around homes by removing potential cover, such as stones, lumber, and other debris. Sealing entrances into homes can also exclude scorpions. When exposed to ultraviolet light (UV or black light), scorpions fluoresce a light yellow green color. When they fluoresce they may be easily spotted for capture, physical killed or sprayed with an insecticide from several yards away.

Outdoor applications of residual insecticides can increase scorpion control. Applications should be directed to harborages, such as stone piles. It is not necessary to treat lawns. Exterior foundation treatments can also help provide additional control.



DELUSIONAL PARASITOSIS

Victims of **Delusional Parasitosis**, also known as Ekbom's syndrome, have a delusional belief that they are infested by parasites. Although delusional parasitosis is a relatively uncommon disorder, sufferers are most often encountered by pest management professionals, doctors, and dermatologists because individuals experiencing this form of psychosis are convinced that their problem is an insect infestation. Sufferers adamantly maintain a delusional belief they are infested with tiny parasites, insects or other organisms crawling under their skin, flying out of their bodies, and infesting their environment. They typically report that parasites exist under their skin, around or inside body openings, in the stomach or bowels and may believe that the parasites infest their home, surroundings, or clothing, when in fact no evidence of such pests exist. Individuals often bring small particles such as, dust, skin flakes and other material to doctors for inspection. Because victims are convinced that the cause of their problem is real insects or other tiny organisms, they fail to seek psychiatric treatment or accept results of investigations which do not find any evidence of parasites. People suffering from this condition may self-mutilate, or harm themselves by scratching to the point where they cause skin treatments or pesticides.

Note: The NDOA Entomologist can not accept or inspect body tissue or bodily fluids for insect identification.

DOMESTIC (COMMENSAL) RODENTS

Domestic (commensal) rodents have coexisted with humans for centuries. They have eaten human food and wastes and have shared human living quarters. They have become human's chief vertebrate pests because of their great reproductive capacity and their ability to thrive in a wide variety of environmental conditions. In addition to eating human food, domestic rodents contaminate foods, destroy structures, cause fires by gnawing, transmit diseases and harbor parasites of medical and veterinary importance.

The problems caused by rats are many. Various species of rats damage a variety of crops such as citrus, sugarcane and rice to name a few. Burrowing activities can undermine foundations. Their gnawing damages a variety of things and can cause electrical fires when insulation is chewed (a problem in older homes especially). A single rat may consume 20 to 40 pounds of food per year. Depending on activity level, rats consume approximately 10 percent of their total body weight daily. In addition to the food they consume, rats damage a much greater quantity of material by contaminating it with hair, feces and urine.

Some human diseases that rodents directly or indirectly transmit are:

- Plague (*Yersinia pestis*): Plague is a bacterial disease transmitted to humans by rat fleas as well as other fleas.
- Murine typhus fever (*Rickettsia mooseri*): This form of typhus is transmitted to humans by infected feces of rat fleas. The bacterial disease organism enters the bloodstream through broken skin.
- Leptospirosis (*Leptospira spp.*): This bacterial infection is usually transmitted to humans by contact of water contaminated with rat urine with breaks in the skin or ingestion of urine contaminated feed and water.
- Rat bite fever (*Streptobacillus moniliformis*): This bacterial infection is contracted by rat bites.
- Trichinosis (*Trichinella spp.*): This parasitic infection is caused by a nematode worm that is transmitted to humans by ingestion of infected rat feces. Parasitic larvae and adult worms form cysts in muscle tissue.
- Salmonellosis (*Salmonella spp.*): This bacterial disease can be transmitted to humans by contact with contaminated rat feces and urine, usually on food.
- Rickettsialpox: This chickenpox type of bacterial disease is transmitted to humans by the bite of infected house mouse mites.
- Lymphocytic choriomeningitis: This infectious disease is caused by a virus (Choriomeningitis Virus, or LCMV) which is transmitted to humans by contact with contaminated feces and respiratory droplets of mice.

The main domestic rodents found in Nevada are the house mouse, white-footed mouse (deer mouse) and the roof rat. The Norway rat may be found in isolated regions within Nevada, but is not commonly encountered. These four rodents, as well as others, are discussed below.

RATS (Order: Rodentia, Family: Muroidea)

Norway Rat (*Rattus norvegicus*)

The Norway rat is the least common domestic rat in Nevada. It has coarse hair, close-set ears, and a blunt muzzle. The tail is shorter than the combined length of the head and body. The fur is variable in color, gray brown on the back and gray white on the belly. Adults weigh from 7 to 20 ounces and are 7 to 10 inches in length. Tail length is from 5 to 9 inches for a total (head to tail) length of 12 to 19 inches. Feces are capsule shaped and about three-fourths inch long.



Norway rats can be found in warehouses, farm buildings, houses, sewers, rubbish, dumps, woodpiles, and building foundations. They are good climbers. On their hind legs, they can reach a height of 18 inches, and they can jump 24 inches vertically. Rats are good swimmers and may stay afloat for 72 hours. The Norway rat has relatively poor vision but keen senses of smell, touch, taste and hearing. The sense of touch is enhanced by long whiskers on the snout. Domestic rats and mice run close to walls where these sensory hairs touch to give the animals information about their surroundings. The home range is often 100 to 200 feet.

Norway rats and other domestic rodents are mainly nocturnal, but they may go about in undisturbed places during the day. They feed on virtually anything edible. Norway rats are unable to vomit. Unlike some members of the rat family Muroidea, Norway rats must drink water to survive.

Roof Rat or Black Rat (*Rattus rattus*)

Roof rats are smaller and more graceful than Norway rats. In Nevada roof rats are primarily found in the Las Vegas area. Nationally, the roof rat is confined along the southern and western coastal areas of the country. Roof rats have large, membranous ears and a sharply pointed muzzle. Their tail is usually longer than their head and body combined. The adult head-and-body length is between 6 and 8½ inches, while the tail ranges between 7 and 10 inches in length for a total (head to tail) length of 11 to 18 inches.



The adult roof rat weighs from 4 to 12 ounces. The feces differ from those of the Norway rat in that they are about one half inch long and are spindle shaped.

House mice and young rats are similar in appearance. They can be differentiated by the relative size of their feet and heads. A young rat has a larger head and larger feet in proportion to its body size, than does a house mouse.

Reproduction

Norway and Roof rats generally live less than one year in the wild. The gestation period for these rats is 21 to 23 days. A litter usually has between 6 and 12 young. A female will wean an average of 20 young in her lifetime. Young are weaned when they are about five weeks old and become reproductively mature at three months of age.

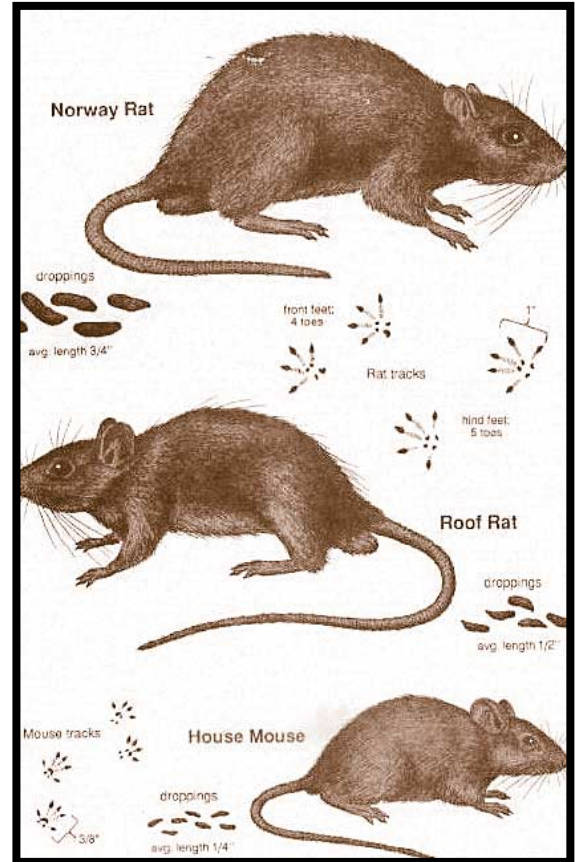
Norway rats usually build nests in underground burrows or close to ground level. Roof rats tend to build their nests above ground in attics, trees or vegetation.

Breeding peaks in spring and fall with little occurring during cold winter or hot summer periods. In warm or tropical climates breeding is uniform all year. Rats are polygamous and young initially mate with adults.

Desert Woodrat (*Neotoma spp.*)

There are two species of wood rats, also called pack rats, in Nevada. The desert woodrat (*Neotoma lepida*) is found throughout most of Nevada in desert habitats. The bushy-tailed woodrat (*Neotoma cinerea*) is found in mountainous areas throughout the state. In some areas, the species may overlap. Woodrats are about the size of Norway rats with large eyes and large hair-covered ears. Desert woodrats are yellowish brown to grayish brown above and gray below. They may have streaks of black on their back. Their tail is bi-colored, dark on top and white below and their feet are white. Their total length is 8 to 15 inches, and tail length is 4 to 7 inches. The bushy-tailed wood rat, as its name implies, has a long bushy tail that distinguishes it from the desert woodrat.

Desert woodrats are primarily nocturnal. When not out and about feeding they occupy a nest site built of debris on the ground, in rock piles or cliffs, or in thick vegetation. They often use existing burrows for their nest sites. They gather sticks and other debris and carefully pile it over the burrow entrance, seemingly to hide it. This is indicative of packrats and woodrats. Desert woodrats have a strong tendency to carry objects, including other animal dung, to their nests and thus can create fairly large piles of debris at the nest site.

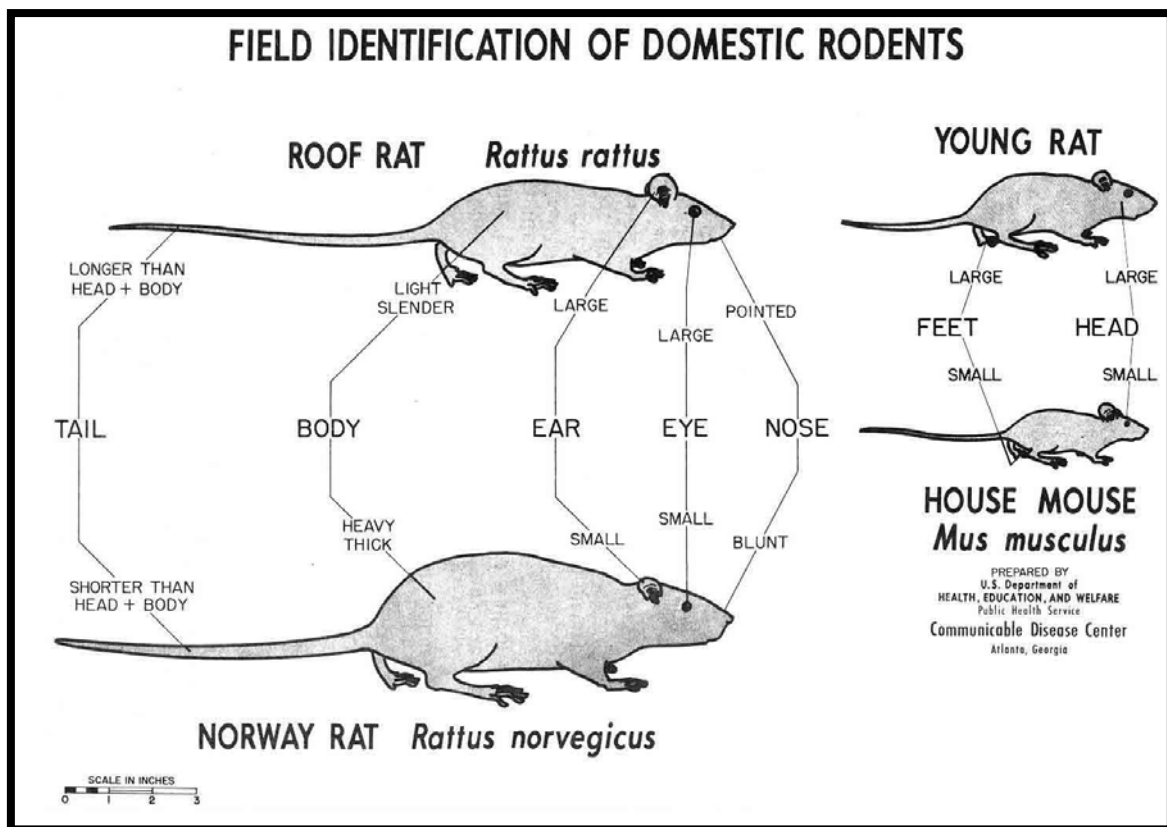


Desert woodrats feed on desert vegetation (including leaves of mesquite in southern Nevada) and on juniper trees (at higher elevations in Nevada). They will also eat available cacti, creosote bush, thistle, and ephreda. In more urban settings, desert woodrats will eat other green vegetation, seeds, fruits, acorns, and garden vegetables.

Wood rats are good climbers and can enter houses from trees or other overhanging vegetation. They are usually found in rural areas, mountain or desert cabins and so forth. They build nests of sticks frequently in attics or walls. They are noisy, nocturnal animals and one in the attic sounds like a dozen!

A female desert woodrats gestation period is 30 to 36 days. A female can have 4 or more litters per year. Litter size varies from 2-3 young, but may number 1-5. Young are weaned in 21-34 days (depending on litter size) and reach sexual maturity in 2-3 months.

Wood rats are easy to trap and can be taken with rat traps or live traps. Dried fruits make good baits. If trapping does not work, anticoagulant baits can be effective rodenticides.



Cotton Rat (*Sigmodon hispidus*)

The hispid cotton rat may occasionally be a problem pest in southern Nevada. Cotton rats build a network of surface runways, shallow tunnels, and burrows similar to those of meadow mice but larger in width (2 to 3 inches).



Zinc phosphide grain is an effective rodenticide in controlling them in these situations. Grains, chopped carrots and potatoes make good baits. Anticoagulant baits are also effective but repeated feedings are necessary. Removing grassy cover and weeds reduces their protective cover lessening the chance of re-infestation.

MICE (Order: Rodentia, Family: Muridae)

The amount of damage done by mice is difficult, if not impossible, to determine. They are so extensive that they are "almost everywhere". It is not uncommon to find mice droppings, urine or nibbled on books and papers, in a desk drawer or trunk in an attic. They contaminate foodstuffs to a much greater extent than rats. A mouse eats about 4 lbs. of food per year and contaminates much more than that. Their gnawing of electrical wires causes an unknown number of fires.

House Mouse (*Mus musculus*)

The most common commensal rodent is the house mouse. This mouse resembles the roof rat in that both rodents have large ears, pointed muzzles, and slender bodies. However, the house mouse is a great deal smaller. The tail has little hair, and is about as long as the head and body combined. An adult mouse can be distinguished from a young rat of the same size, because the head and feet of the mouse are distinctly smaller in proportion to its body size. Adults weigh one-half to 1 ounce and are 2½ to 3½ inches long in head-and-body length. The tail measures between 3 and 4 inches long for a total (head to tail) length of 5 to 8 inches. The feces are one eighth to one fourth inch long and are rod shaped.



Although house mice are commonly found living in human structures, they are also well adapted to living outdoors. They are common inhabitants of grassy fields and cultivated grain crops. These wild populations often move into buildings when weather becomes severe. The house mouse has poor vision and is color-blind. However, it has keen senses of smell, taste, hearing and touch.

Mice use their sense of smell to find food items and recognize other individual mice. More research is needed on the value of repellent and attractant odors in

controlling mice pests, but taste appears able to override most odor effects. House mice have acute hearing. They readily respond to unusual noises as a means of detecting and escaping danger. However, house mice become accustomed to repetitive, ordinary noises, and, as a result, their activities may be more visible than those of rats.

An important sensory factor is touch. Mice use their long, sensitive whiskers on their nose and above their eyes as tactile sensors. The whiskers and guard hairs enable mice to travel easily in the dark, along runways close to walls. House mice feed on a wide range of foods, although cereals seem preferred to other items. In particular, the germ of grains is favored by most mice. As supplemental diet items, mice often show preference for foods high in fat and protein, such as lard, butter, nuts, and dried meats. House mice are sporadic feeders. Small amounts of food are often taken many times at many places.

Mice have two main feeding periods, at dusk and dawn. Because of their small size and high metabolism, mice must feed several times during a 24-hour period. This means that they will be active day and night. Their range is normally 10 to 30 feet from the nest. Their nest is lined with soft materials such as cotton or paper. Nests may be built in walls, cabinets, upholstered furniture, or other convenient spaces. Their urine and droppings mark trails for others. Mice are poor swimmers.

White-footed Mice (*Peromyscus spp.*)

There are five very similar looking species of white-footed mice in Nevada. They are widespread though rarely seen since they are nocturnal. Similar looking to the house mouse, the native white-footed mouse occasionally invades buildings next to fields or woodlands. White-footed mice are about the same size or slightly larger than house mice. White-footed mice can be differentiated from house mice by their distinctly, bi-colored tail (upper half tan to gray, lower half white). White-footed mice characteristically have large ears and eyes and a relatively long tail. White-footed mice are largely seed-eaters and may damage newly seeded gardens and flower beds. New gardens can be protected by covering them with ¼ inch wire mesh screen or something smaller.

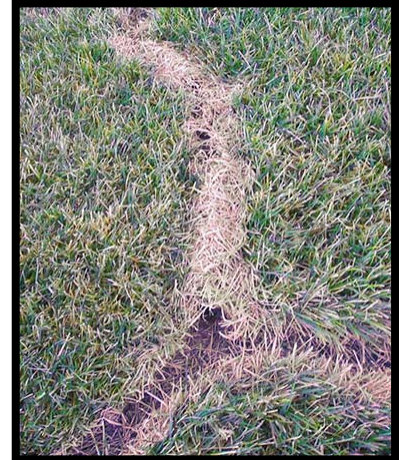


The deer mouse (*P. maniculatus*) is a host of the Hantavirus. Other *Peromyscus* species in Nevada probably host the virus to some extent. Other rodent species may occasionally carry the disease for short periods. Hantavirus is a viral illness transmitted from saliva, feces or urine of infected animals. Once these waste products dry, the virus can become airborne. Though not easily transmitted, infection is usually caused from inhalation of the virus. Hantavirus is described as a severe respiratory illness that results in death for about 30 percent of its victims.

Use extreme caution or avoid activities associated with exposure to deer mouse droppings and urine. (Due to the potential severity of Hantavirus infection, this manual does not include control techniques or suggestions for its control.)

Meadow voles or meadow mice (*Microtus spp.*)

There are two native species of meadow mice or voles in Nevada. They are stocky animals gray brown to blackish in color with longer hair than deer mice or house mice. The tail is comparatively short averaging $\frac{1}{3}$ to $\frac{2}{5}$ of the total body length of 5" to 9". They are most active in daytime and are active all year long. They prefer areas with dense grass cover. They damage turf and grass through their intricate system of surface runways and burrow openings. These tunnels and openings are 1" to 2" wide. Meadow mice can be controlled with anticoagulant or zinc phosphide baits. Rolled barley or oat groats make good bait materials. If approved by the label directions, bait can be broadcast when large numbers of meadow mice are present. Teaspoon amounts can be placed in runways when small numbers are present. Wooden mouse traps placed in runways are also effective in controlling small numbers of voles. Peanut butter mixed with dry cereal is usually a good bait.



Elimination of tall grasses and dense low growing vegetation reduces the attractiveness of an area to meadow mice. Meadow mice are excellent swimmers and cannot be controlled by flooding.

Occasionally meadow mice invade homes and can be trapped using snap traps with enlarged bait pans. They are not serious household pests, probably entering by mistake rather than design. One quarter inch mesh screen or metal barriers at least 12" high and extending 6" underground will exclude meadow mice from areas.



Reproduction

House mice, white-footed mice and meadow voles have similar, though not identical, reproductive characteristics. Mice have life spans of about six months to two years in the wild. Their gestation periods are around 21 days. Litter size averages three to six and a female may have several litters per year. Young are weaned at around three weeks of age. Sexual maturity occurs at 5-6 weeks for voles; 7-8 weeks for white-footed mice and 6-10 weeks for house mice. Breeding is essentially year around when house mice live indoors. Breeding peaks in spring and fall when they live outdoors.

Determining Rodent Presence

Rodent activity is seldom directly observed. Indirect evidence of rodent presence includes:

- **Sounds** -- Gnawing, clawing, climbing in the attic, and various squeaks are commonly associated with house mice and rats.
- **Droppings** -- Droppings are left along runways, near shelters, and in other places that rodents frequent. Droppings of mice are smaller and usually harder than those produced by rats. However, insects and other rodents may produce similar droppings.
- **Urine** -- House mice urinate at intervals along well-used runways. Occasionally, they also will form small mounds (urinating pillars) that consist of a combination of grease, urine and dirt. Wet and dry rodent urine stains will fluoresce under ultraviolet (black) light.
- **Smudge marks** -- Dirt and oil from the fur of the rodent may sometimes leave smudge marks on well traveled pipes and beams. Smudge marks left by rats are much more conspicuous than those produced by house mice.
- **Gnawing marks** -- Wood chips about the consistency of coarse sawdust are produced by the gnawing of house mice. Most gnawing occurs around baseboards, doors, windows and frames, and kitchen cabinets. Recent gnawing on wood is light in color, darkening with age. The size of the tooth marks left in the wood can help distinguish between rats or mice.
- **Pet excitement** -- Pawing and excitement of cats and dogs can indicate the presence of rodents. Pets respond most commonly when the premise has been recently invaded.
- **Odors** -- Rodents produce characteristic odors. With experience, the musky scent of house mice can be differentiated from odors produced by rats.

Estimating Rodent Populations

There is no easy or certain way of estimating rodent numbers. The techniques used most often are: "reading" of signs; actual observations of rodent activity; and census of feeding activity. After considerable experience, a rodent control worker can usually detect the presence of rodents, even in fairly low numbers.

Rat signs can provide a very rough estimate of density. After a thorough search for rat signs in attics, basements, around foundations, and behind stored materials, use the following guidelines:

- **Rat-free or low infestation** -- No sign. Probably invaded by rats only recently, or the habitat won't support many.
- **Medium population** -- Old droppings and gnawing common, one or more rats seen by flashlight at night. No rats reported observed during the day. There are probably ten rats or more in each general area where one rat is seen at night.

- **High population** -- Fresh droppings, tracks, and gnaw marks. Three or more rats are seen at night. Rats are seen in daylight.

Physical Capabilities of Common Commensal Rodents

Rats: Rats have keen sense of smell, touch and hearing. Their sense of balance is excellent. Their eyesight is poor. It is surprising where and how rats get into buildings. The following list illustrates some things they are capable of and should be remembered when trying to rat-proof a building or area. Rats can:

- Gain entrance through any opening that is larger than one-half inch square.
- Climb both horizontal and vertical wires.
- Climb the inside of vertical pipes that are 1½ to four inches in diameter.
- Climb the outside of vertical pipes and conduits up to three inches in diameter.
- Crawl horizontally on any type of pipe or conduit.
- Jump vertically as much as 36 inches.
- Jump horizontally 48 inches on a flat surface.
- Jump horizontally at least eight feet from an elevation of 15 feet.
- Drop 50 feet without being seriously injured.
- Burrow vertically in earth to a depth of four feet.
- Climb brick or other rough exterior walls that offer footholds.
- Climb vines, shrubs and trees or travel along telephone or power lines.
- Swim as far as one-half mile in open water, dive through water plumbing, and travel in sewer lines.
- Gnaw through a wide variety of materials, including lead sheeting, sun-dried adobe brick, cinder block, and aluminum sheeting.

Mice: Mice have keen sense of smell, taste, touch and hearing. Their eyesight is poor and sense of balance is excellent. Mice are capable of getting into “impossible” places. The following list shows some things they are capable of and should be kept in mind when mouse proofing a building or area. Mice can:

- Gain entrance through openings slightly larger than one-fourth inch in diameter.
- Jump 12 inches from a flat surface.
- Jump against a wall or vertical surface and use it as a springboard to gain additional height.
- Jump from a height of eight feet without injury.
- Run up almost any rough vertical surface, including brick walls, wood, weathered sheet metal, wire mesh and cables.
- Run horizontally along insulated electrical wires and small ropes.
- Travel upside down along one-fourth-inch hardware mesh.
- Swim capably, if they need to. House mice do not tend to dive below the water surface, as do rats.

RODENT CONTROL

Rodent control may involve the use of several control measures, including: sanitation, removal of harborages, rodent-proofing, use of toxicants and traps, and other methods. Sanitation is essential in a successful rodent-control program. The elimination of shelter, food and water can mean the difference between success and failure in controlling rodents. Good housekeeping practices are important. A program of routine cleaning should be set up and followed. Obscure areas such as corners, shelves, under cabinets, work tables, and equipment shouldn't be overlooked. Eliminate rubbish piles. Keep refuse in rat proof containers until it is removed.

Rodents need a safe place to hide. Inspect buildings to identify potential harborages. Rodent proof areas such as stairways, cabinets, lockers, machinery, double walls, false ceilings and floors, boxed-in pipes and conduits may be needed. These sites serve as shelter, nesting and breeding sites.

Rodent damage to stored materials can be greatly reduced if good storage practices are followed. In commercial storage areas, products should be on pallets at least eight inches off the floor, 18 inches from adjacent walls, not stacked more than six feet wide, and separated by an aisle at least 12 inches wide.

Practices which reduce harborage areas, permit inspection and cleaning, and allow for utilization of appropriate control measures are important measures to minimize rodent populations. Outside, grass, weeds, and other vegetation near buildings should be closely cut, stored lumber, rock piles, rubbish, and old equipment should be eliminated, and old rat holes and burrows should be filled with earth. Any stored items should be at least 18 inches off the ground, away from walls and fences.

Rodent-proofing involves the removal of all possible entrances into buildings. Exclusion practices are often difficult because of the habits and behaviors of rodents. Rats and mice can enter through extremely small openings. Openings over $\frac{1}{4}$ - $\frac{1}{2}$ inch are big enough for mice and rats, respectively. Rats can enter buildings through drains and toilets. Both rats and mice are capable of gnawing through wood, fiberboard, and many plastics. Exclusion or rodent proofing is hard, but it can be achieved through modification of existing buildings or in the design of new buildings. In pest control work, it is not always possible to do extensive rodent proofing; however, you should see that some is done so your control program will have a chance to succeed.

The bottoms and edges of doors that do not fit closely can be built up with wood so there is no opening greater than a $\frac{1}{4}$ inch, and covered with a metal cuff. Openings around pipes, windows, holes in walls, foundation vents, and ventilating fans can be covered with screening or hardware cloth (19 gauge or heavier), sheet metal (26 gauge or heavier), 24 gauge or heavier $\frac{1}{4}$ inch mesh perforated metal or 28 gauge or heavier $\frac{1}{4}$ inch mesh or smaller expanded metal. Holes in masonry walls should be cemented shut. It is impossible to list every situation or place that needs rodent proofing. You will need to

rely on your ability to observe every possible entry route into the building.

Rodent competition

There is some competition between the various commensal rodents. Spatial separation between rats and mice has been reported in grain stacks, with house mice feeding in the lower areas and rats in upper portions. The smaller size of house mice gives them access to places that are not available to rats. Upon direct confrontation, rats may kill mice.

Pest-control operators have observed that when a building is freed of rats, house mice often move in or increase in numbers. This may be due to reduced competition, but it often results from mice being able to enter and colonize areas that have been made rat proof, since potential mouse infestations may follow rat control activities. This should be anticipated by the pest control operator. House mice are highly competitive with deer mice. Where house mice are present, deer mice will rarely be found.

Control Methods

When using a rodenticide a number of precautions should be followed. First of all, **READ, UNDERSTAND and FOLLOW all product label directions.** All toxicants are hazardous, to some degree, and should not be accessible to children and non-target animals. Dead animals should be disposed of when possible for sanitary reasons, to reduce secondary poisoning possibilities and for public relations.

In Nevada pesticides must be registered before they can be used. Because of this, the products available change somewhat from year to year. Thus, while a particular pesticide may be manufactured, it may not be currently registered in Nevada. If in doubt about whether a product is currently registered, contact the nearest Nevada State Department of Agriculture Office.

Rodenticides

Both acute single-dose (**second-generation anticoagulant** or **non-anticoagulant**) and chronic multiple-dose (**first-generation anticoagulant**) rodenticides are available for rat and mouse control. Although a wide variety of finished baits are available, some persons trained in rodent control prefer to mix their own baits with rodenticide concentrates.

When possible, finished baits and tracking powders should be used because they do not require that the applicator handle the concentrate, a more hazardous material. Rodenticides are used in many situations because they provide economical control with a minimum of time needed. Rodenticide safety precautions are covered in a separate section starting on page 86.

Pre-baiting

Mice and rats are cautious feeders and may reject new foods or eat only small amounts of new foods for the first several days. Acceptance of toxic baits can be increased by conditioning rats to feed on a nontoxic version of the same food a "pre-bait."

Pre-baiting is highly recommended before using an acute single-dose toxicant. After the untreated baits are eaten regularly, treated baits are substituted. Pre-baiting may be necessary for two to five days to achieve maximum benefits. The amount of pre-bait eaten helps determine the amount of toxic bait needed. All uneaten pre-bait should be removed before toxic bait is applied.

If acceptance of pre-bait is poor, toxic bait should not be applied. Poor acceptance may be corrected by changing bait material or its placement.

Single-dose rodenticides

Single-dose rodenticides, whether second-generation anticoagulant or non-anticoagulant rodenticides will give a quick knockdown of rat and mouse populations, and they may be preferred where rats and mice are abundant or where it is challenging to get rats and mice to accept a bait for several days in succession because of competing food items. When rats or mice consume a sub-lethal amount of an acute toxicant such as zinc phosphide, "bait shyness" or "poison shyness" may result. Because of this bait-rejection problem, single-dose poisons should not be used more than twice a year at a given location, and preferably only once.

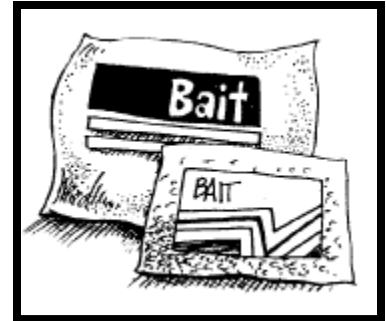
Multiple-dose rodenticides

Multiple-dose anticoagulant rodenticides classified as first-generation anticoagulants are generally considered much safer than single-dose rodenticides. Bait shyness does not occur when properly formulated anticoagulant baits are used. With the exception of second generation anticoagulants, such as Brodifacoum, anticoagulants cause death to mice and rats after they are fed on for several days. Second generation rodenticides can cause death after a single feeding, however, death does not occur for several days.

When multiple-dose anticoagulant rodenticides are used, they must be made available to rats and mice continuously for at least two weeks or until all signs of feeding cease.

Bait selection and placement

Anticoagulant baits are available in several types. Grain baits in meal or pelleted forms are often available packaged in small plastic, cellophane or paper packets. These "place packs" keep baits fresh and make it easy to place baits into burrows, walls or other locations inaccessible to people, children and pets. Rats and mice will readily gnaw into these bags to get at acceptable bait.



Anticoagulant baits that have been formulated into paraffin blocks are available from various manufacturers. These blocks are especially useful in sewers or where moisture may cause loose-grain baits to spoil. Acceptance of paraffin-block baits by rats and mice is usually less than acceptance of loose grain baits. Sodium salts of anticoagulants are available to be mixed with water. Since rats require water daily, they can be drawn to water stations in some situations. Although mice require little water to survive, where moisture is scarce, water baits can be an effective supplement to other control measures.

Bait stations (boxes) protect rodenticides from weather and provide a safeguard to people, pets, and other animals. Bait stations should have at least two openings about 2½ inches in diameter for rats or one inch in diameter for mice. Bait boxes should be large enough to hold several rats or mice at once, depending on the problem rodent species. Bait boxes must be tamper proof or must be permanently affixed to a location. They should be placed next to a wall with openings close to the wall, or in places where rats or mice are active and non-target animals and people cannot get to the bait.



Rats usually feed in one place, so relatively few bait stations may be needed if correctly located. On the other hand, mice feed in many places and won't travel great distances. Many bait stations may be needed for mice. They should be spaced no farther than 10feet apart, and preferably closer when home ranges are small (as little as 3 feet). Baits or traps need to be placed where mice are living, such as in wall spaces, on pallets of feed, etc. **ALL BAIT BOXES MUST BE CLEARLY MARKED ON THE OUTSIDE WITH THE FOLLOWING INFORMATION (NAC 555.460):**

- a. The name, address and telephone number of the pest control business that performed the pest control;
- b. The name of the rodenticide;
- c. The EPA registration number of the rodenticide;
- c. The name and percentage of the active ingredient of the rodenticide; and
- d. The precautionary word and symbol for the rodenticide that is used by the manufacturer of the rodenticide on the product label.

All bait station locations should be recorded to facilitate inspections. At each inspection, the surface of granular baits should be smoothed so that new signs of feeding will show readily. Paraffin bait blocks should be examined for signs of rodent gnawing, and moldy, wet, caked or insect-infected baits should be replaced with fresh bait. Recordkeeping of activity indicating where baits have been disturbed, dead rodents found, and droppings or tracks observed assists control efforts. By regulation, upon termination of a service using rodenticides in bait stations, all bait stations (boxes) must be removed from the property by the pest control business.

Recent research has shown that “mimic” substances, incorporated into pre-bait, may initially cause lower consumption of pre-bait but ultimately will increase acceptance of the final bait. A mimic substance is one that is similar in taste and odor to the toxic but is not toxic. Quinine would probably be a good mimic for the bitter taste of strychnine and garlic a mimic of the garlic-like smell of zinc phosphide.

Dying the color of bait is recommended for several reasons:

- The bait will not be mistaken as a food or feed item.
- The dye aids in the proper mixing of ingredients. A uniform color indicated complete mixing.
- Dyed bait may be less attractive to birds at least initially (green is the best color in this respect).
- Baits be color coded for easy identification as to toxicant, strength, etc.

Dyes used should not be repellent in nature and should be tested first. Use just enough dye to provide the desired color.

Resistance to rodenticides

Generally, rodent populations are comprised of individuals that vary in susceptibility to specific rodenticides. These differences in individual responses to rodenticides are due to inherent genetic differences among individuals. The inherent differences are not caused by exposure to a rodenticide but are already be present in any population of genetically variable individuals. When resistant individuals already present in the population survive a rodenticide treatment, they are likely to reproduce and pass their genetically based resistance traits to their offspring. Repeated frequent applications of the same rodenticide acts as a selective pressure on the population favoring the survival of resistant individuals while eliminating susceptible individuals and minimizing their reproduction. Eventually, if no other rodenticides with different modes of action or if no other control measures are used, the population evolves in response to the selection of resistant individuals.

As a result of the differential survival of resistant and less-resistant individuals, the population becomes comprised of an increasing proportion of resistant individuals; less resistant individuals died and left fewer offspring while genetically resistant individuals survived to reproduce. The population becomes comprised of an increasing proportion of genetically resistant offspring. The development of an increasing number of resistant

individuals becomes a serious problem as the population changes in response to frequent exposure to a selection pressure such as the repeated use of a specific rodenticide to which the original populations was susceptible. The result is a population of resistant individuals and a total lack of control over the population when the rodenticide is used.

Where rodent control efforts are regularly applied, periodic shifting of active ingredients is advisable. Because individuals with inherent multiple resistance to different types of rodenticides are expected to be less common, the selection intensity on the population increases and the evolution of resistant populations diminishes. Repeated and frequent use of a specific rodenticide as the only rodent control measure should be avoided. Effective and practical approaches to rodent population control apply the concepts of integrated pest management including the use of mechanical traps, enclosures, removal of breeding sites and food and water resources.

Rodenticide safety precautions

Rodenticides are important products for controlling mice, rats and other rodents that pose threats to public health, critical habitats, native plants and animals, crops, and food supplies. However, these products also present human and environmental safety concerns. Consider all rodenticides dangerous, and place baits where only rodents can get them. On May 28, 2008, EPA issued a “Final Risk Mitigation Decision” for ten rodenticides

(<http://www.epa.gov/pesticides/reregistration/rodenticides/finalriskdecision.htm>). This final rule protects children and wildlife, restricts “over-the counter” sales of residential use rodenticides, while maintaining their availability for agricultural production and pest control operators.

Exposures to Children - Rodenticides are an important tool for public health pest control, including controlling mice and rats around the home; however, the use of these products has been associated with accidental exposures to thousands of children each year. To minimize children's exposure to rodenticide products used in homes, EPA requires that all “consumer size”, “over-the-counter” rodenticide bait products available for retail sale, be sold only with second-generation anticoagulants and with a bait station or pre-loaded in a bait station. First and second-generation anticoagulants and non-anticoagulant products are only available to professional users, pest control operators and for agriculture producers.

Risks to Wildlife - Rodenticides pose significant risks to non-target wildlife including birds, such as hawks and owls, and mammals, including raccoons, squirrels, skunks, deer, coyotes, foxes, mountain lions, and bobcats. Rodenticides applied as bait products pose risks to wildlife from primary exposure (direct consumption of rodenticide bait) and secondary exposure (predators or scavengers consuming prey with rodenticides present in body tissues). In the U.S., wildlife poisonings have involved federally listed threatened and endangered species, for example the San Joaquin Kit Fox and Northern Spotted Owl, in addition to the Bald Eagle, which is protected under the Bald and Golden Eagle Act.

To reduce wildlife exposures and ecological risks, EPA requires sales and distribution and packaging restrictions for products containing four of the ten rodenticides that pose the greatest risk to wildlife (the second-generation anticoagulants – brodifacoum, bromadiolone, difenacoum, and difethialone) to prevent purchases by the general public.

Differences Among the Rodenticides - EPA's decision reduces rodenticide exposures to children and wildlife, while still allowing residential users, livestock producers, and professional applicators access to a variety of effective and affordable rodent control products. The ten rodenticide active ingredients covered by this action are divided into three categories:

(1) First-Generation Anticoagulants:

- Warfarin
- Chlorophacinone
- Diphacinone

(2) Second-Generation Anticoagulants:

- Brodifacoum
- Bromadiolone
- Difenacoum
- Difethialone

(3) Non-anticoagulants:

- Bromethalin
- Cholecalciferol
- Zinc phosphide

First-generation anticoagulants include chemicals such as warfarin which interfere with blood clotting. Death can result from excessive bleeding after ingestion of the lethal dose; however, first generation anticoagulants generally require higher concentrations and consecutive intake in order to accumulate the lethal dose than second generation anticoagulants. Second-generation anticoagulants such as brodifacoum are generally much more toxic than first-generation anticoagulants. They are applied at lower dosages and lethal after a single dose. Non-anticoagulant rodenticides include a variety of poisonous chemicals which are fatal through various means of metabolic disruption. Bromethalin is a nerve toxicant that causes respiratory distress. Cholecalciferol is vitamin D3, which in small dosages is needed for good health in most mammals, but in massive doses is toxic, especially to rodents. Zinc phosphide causes liberation of toxic phosphine gas in the stomach.

Second-generation anticoagulants are especially hazardous for several reasons. They are highly toxic, and they persist a long time in body tissues. Second-generation anticoagulants are designed to be toxic in a single feeding, but since time-to-death is several days, rodents can feed multiple times before death, leading to carcasses containing residues that may be many times the lethal dose. Predators or scavengers that feed on poisoned rodents may consume enough to suffer harm.

Label directions on all rodenticide products must be vigilantly followed. All dead rats and mice must be collected after a poisoning program to avoid secondary poisoning effects and carcasses handled with tongs or rubber gloves. Large numbers of rats and mice should be disposed of by incineration or burial. Small numbers of carcasses can be placed in sealed plastic bags and disposed of with other refuse.

Summary of Rodenticide Restrictions

“Consumer Size” Products (products containing \leq 1 pound of bait)

- Products marketed for general public use may not contain brodifacoum, difethialone, bromadiolone, or difenacoum (second-generation anticoagulants).
- Loose bait forms such as pellets are prohibited (i.e. tear open boxes and toss packs only).
- Each retail unit must include a bait station.
- Bait refills may be sold with bait stations in a single retail unit.
- All outdoor above ground use must be in a bait station and applied within 50 feet of buildings.

First Generation Anticoagulant and Non-Anticoagulant Products for Professional Applicators (Agricultural and PCO)

- Products must contain at least four pounds of bait.
- Bait stations are required for all outdoor, above-ground placements of first-generation anticoagulant and non-anticoagulant products.
- Bait stations are required indoors if exposure to children, pets, or non-target animals is possible.
- Distribution to, and sales in, “consumer” stores, including grocery stores, drug stores, hardware stores, club stores is prohibited.
- Outdoor applications are limited by label restrictions.

Second-Generation Anticoagulant Products for Use Around Agricultural Buildings

- Products must contain at least eight pounds of bait.
- Bait stations are required for all outdoor, above-ground placements of second-generation anticoagulant products.
- Bait stations are required indoors if exposure to children, pets, or non-target animals is possible.
- Distribution to, and sales in, “consumer” stores, including grocery stores, drug stores, hardware stores, club stores is prohibited.
- Outdoor applications are limited by label restrictions.

Second-Generation Anticoagulant Products for Professional Applicators

- Products must contain at least 16 pounds of bait.
- Bait stations are required for all outdoor, above-ground placements of second-generation anticoagulants.
- Bait stations are required indoors if exposure to children, pets, or non-target animals is possible.

- Distribution to, and sales in, “consumer” stores including grocery stores, drug stores, hardware stores, club stores is prohibited.
- Outdoor applications are limited by label restrictions.

Tracking powders

Tracking powders are toxicants in dust formulations that are placed in rodent runways, near their harborages, or in their burrows. The dust is picked up on their feet, and rodents swallow the tracking powder when they groom themselves. Tracking powders can be useful when baits are not accepted or when there is a surplus of food.

Tracking powders should not be used where rodents or air currents may carry them onto human food surfaces or food-preparation areas. Bait stations may be used in these situations. Tracking powders can be applied with a shaker on runways, with a dust pump in burrows, or with a duster in wall voids.

Fumigants

Fumigants are often used to control rodents in their burrows in outdoor situations, and sometimes in rail cars and on ships. The operation can be expensive if the structure has to be enclosed in a tarp tent. Fumigants are highly toxic and they must not be used in any situation that might expose the occupants of a building to the vapors. Because of the hazards involved with fumigants, only people licensed for fumigation pest control (category C4) can use fumigants in any situation involving, burrows, buildings or other enclosed structures.

Traps

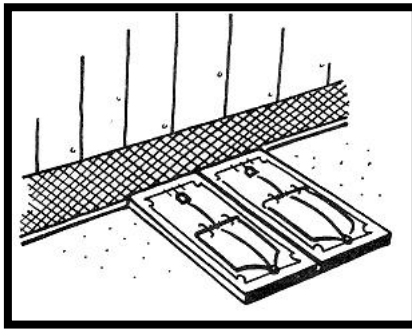
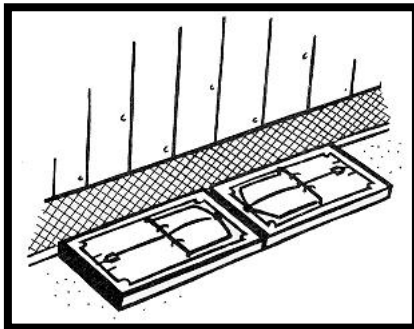
Trapping can be an effective method of controlling rats and mice, but it requires more skill and labor than most other methods. Trapping is recommended where poisons seem inadvisable, and it is the preferred method to try first in homes, garages, and other small structures where there may be only a few rodents present. Trapping has several advantages:

- It does not rely on inherently hazardous rodenticides.
- It permits the user to view effectiveness.
- It facilitates disposal of rodent carcasses, thereby eliminating odor problems, which may occur when poisoning is done within buildings.

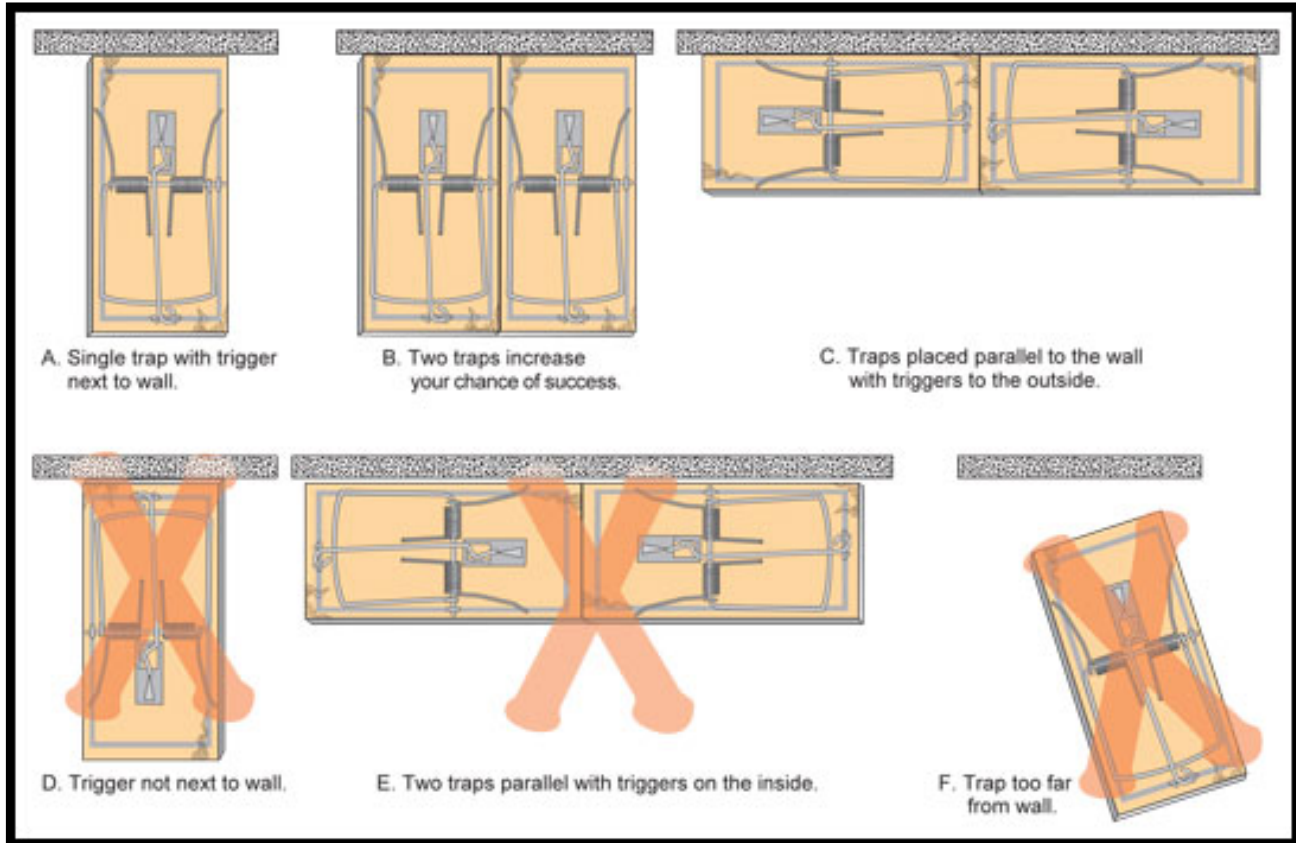


Snap-traps are generally more effective than cage traps. Simple, inexpensive, wood-based snap-traps are readily available. Traps baited with peanut butter, chocolate candy, dried fruit, or a small piece of bacon tied securely to the trigger is typically attractive to rats. For mice, bacon, nuts, hard sugar-candy, gumdrops, or peanut butter are attractive baits. Leaving traps unset until the bait has been taken at least once reduces the chance of rats or mice becoming trap-shy.

Traps should be placed close to walls, behind objects in dark corners, and in other places where rat and mouse activity has been seen. Placement should occur where rats and mice following their natural course of travel (usually close to a wall) will pass directly over the trigger. Traps can be set on ledges or on top of pallets of stored materials if rodents are active in such locations. An area may be lightly dusted with talcum powder to determine whether rodents are present. If rodents are present, their tracks will be visible in the dust. All areas of escape should be covered with traps and the number of placed traps recorded and mapped to assist with efficient follow-up.



Enough traps should be used to make the campaign short and decisive. Since mice seldom venture far from their shelter and food supply, traps should be placed from three to ten feet apart in areas where mouse activity is noted and within 20 feet of one another for rat control.



Glue boards

Glue boards are an alternative to snap traps. Glue boards catch and hold mice and rats. As they trying to cross a glue board they get caught in the sticky substance, much the same way flypaper catches flies. Like traps, glue boards need to be placed along walls where mice and rats travel. They should not be placed where children, pets, or wildlife can contact them. Glue boards lose their effectiveness in dusty areas, and temperature extremes may affect the tackiness of the adhesive.



Frightening sounds and electronic devices

Although rats and mice are easily frightened by strange and unfamiliar noises, they quickly become accustomed to regularly repeated sounds and are often found living in noisy grain mills and factories. Ultrasonic sounds, those above the range of human hearing, have very limited use in rodent control because they are directional and do not penetrate behind objects. Also, they lose their intensity with distance. There is little evidence that sounds of any type will drive established mice or rats from buildings. Several types of electromagnetic devices are marketed with claims of repelling rodents effectively or causing them to behave abnormally. Scientific tests of many such devices suggest that they failed to control rodents as claimed by their advertising.

OTHER VERTEBRATES

Yellow-Bellied Marmot (*Marmota flaviventris*)

The yellow-bellied marmot, or rock chuck, is found in the northern half of Nevada. Yellow-bellied marmots are usually found close to piles of rocks and boulders in which they find protection and dig burrows. They are active spring through early summer and estivate (summer hibernation) or hibernate the rest of the year. Typically, they spend more than half of their approximate 15 year life span hibernating in their burrows. Their burrowing activities can undermine foundations but are usually constructed on slopes or cliffs. Although they scavenge and forage above ground near their burrows and feed on leaves and other plant materials as well as occasional insects, about 80% of their life is spent within their burrows. They may become pests when they forage or burrow in gardens, horticultural areas, and landscapes.



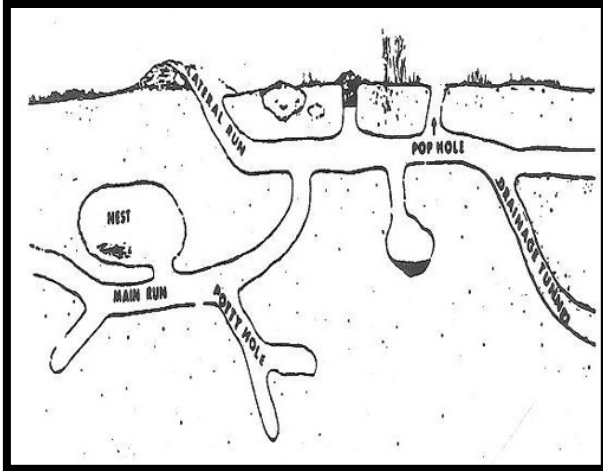
They can be live-trapped with baits such as cabbage, apples and carrots. Where large numbers occur, gas cartridges inserted into a burrow are sometimes effective and may require less time than trapping. Burrows that are in rocks cannot usually be sealed well enough for gas cartridges to be effective. Shooting in the morning is also effective where it is permitted.

Pocket Gophers (*Thomomys spp.*)

Pocket gophers are found throughout Nevada. There are four species in Nevada. Pocket gophers are stocky animals with very small eyes and ears and short strong forelegs with long claws. Their eyesight and hearing are poor and senses of smell and touch very good. Pocket gophers spend most of their lives underground and have evolved quite well for this purpose. They are excellent burrowers and dig extensive tunnel systems usually from



four to 24 inches below the surface of the ground. The name pocket gopher comes from their fur lined cheek pouches that they use to carry food. They eat underground parts of plants and to some extent aboveground parts also. Their burrowing activities and destruction of plants make them a pest in gardens, lawns and certain agricultural crops.

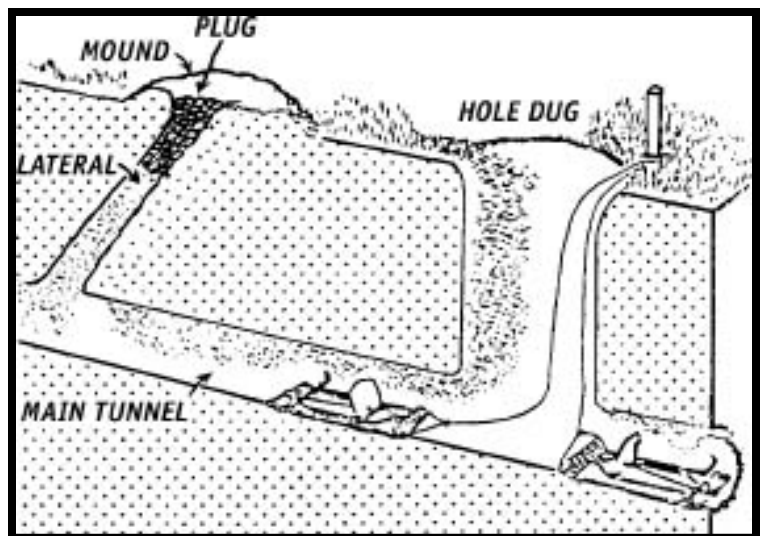


The mounds of a pocket gopher are similar looking to those of a mole; however, there are differences that aid in correct identification. Moles push soil to the surface forming volcano - like mounds that are conical in shape. The hole, which is plugged, travels up through the center of the cone. Additionally, shallow tunnels between mounds raise the soil slightly at the surface. Pocket gophers do not have raised tunnels and their mounds are not cone shaped. Frequently pocket gopher mounds are somewhat U-shaped with the tunnel descending from the open end of the U.

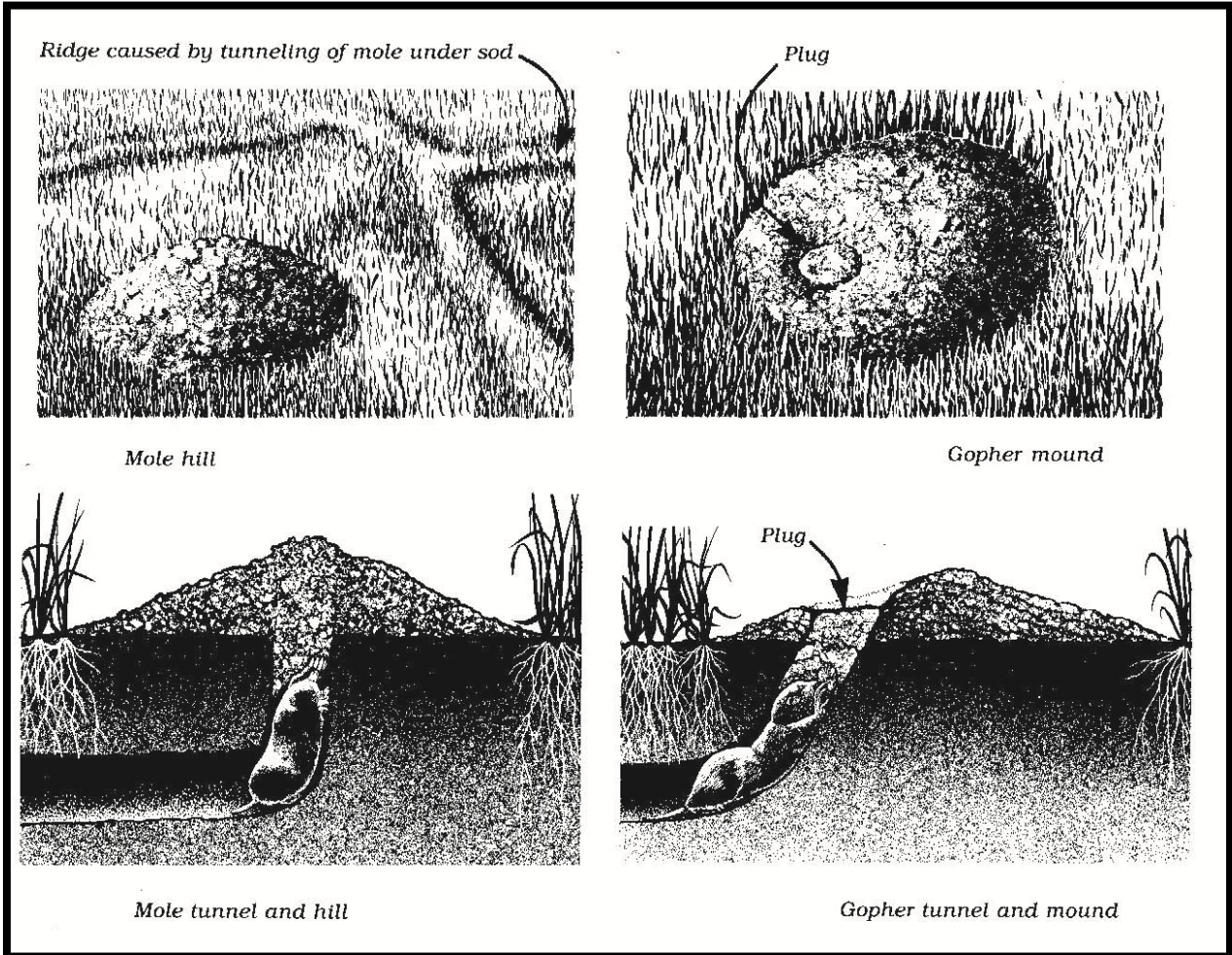
The most common method of gopher control in home garden & lawn situations is trapping. There are several gopher traps on the market. The best place to set gopher traps is a main runway. Traps should be set in pairs with the end the gopher enters facing toward the burrow, not the other trap.

Toxic baits provide the most efficient method of pocket gopher control where large numbers of pocket gophers are present. Bait is placed in one of the pocket gophers' tunnels where it is available to the gopher yet unavailable to other animals. The fastest way to put bait in a tunnel is to find the tunnel with a probe. Probes can be purchased or made from a variety of materials (broom handles, pipes, etc.).

When the probe contacts a runway it will drop suddenly until it hits the runway floor then withdraw the probe. Using a registered pesticide bait, and place the appropriate amount (per label) down the hole. Then **COVER** or **PLUG** the hole. Most registered pocket gopher baits are grain based baits. Vegetable baits (carrots, parsnips, etc.) are also effective, especially if the pocket gophers have become shy of grain baits. Gas cartridges, which emit toxic fumes and smoke, are at times effective against pocket

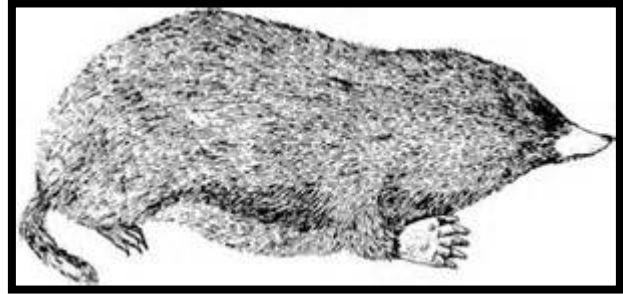


gopher. Gas cartridges are not effective in large burrow systems, because pocket gophers may plug their tunnels when they detect the gas. Whatever pesticide you decide to use, follow the label directions when baiting and disposing of dead gophers.



Broad-footed Mole (*Scapanus latimanus*)

The broad-footed mole is found along the western edge of Nevada. Moles are not rodents and belong to a different order of mammals (Insectivora). Their diet consists of earthworms and other soil invertebrates.



Moles damage lawns and gardens by their tunneling activities. Trapping is the most common method of mole control. There are several types of mole traps on the market. They work best when set on the mole's main runways that run deeper than the shallow feeding tunnels. To find a main runway probe between two mounds until one is found. Alternately press down the ridges of shallow runways and then set the trap on those that are consistently pushed up again by the mole. An indirect control method is to apply an insecticide to the soil thereby depriving the mole of its food supply causing it to leave the area.

Ground Squirrels (*Spermophilus* spp.)

There are seven species of ground squirrels in Nevada. Ground squirrels excavate underground burrow systems for their homes. Though some species are good climbers and damage fruit or nut trees they do not nest in trees or in upper stories of buildings.



They are active in daytime, hibernate to varying degrees during winter and estivate (summer hibernation) to varying degrees during summer. Ground squirrels breed soon after they emerge from hibernation in spring. Young emerge after a 28 day gestation period plus an additional few weeks when they are in the burrow. There is only one litter born each year.

Ground squirrels or their ectoparasites (external parasites) have been implicated in a number of diseases transmissible to man. Plague (*Yersinia pestis*), a bacterial disease, is probably the most common. Other diseases include: tularemia, relapsing fever, spotted fever and Colorado tick fever. Plague is usually contacted in areas where ground squirrels are abundant and relatively tame due to people feeding them (campgrounds, rural homes, parks, etc.).

Burrowing activities of ground squirrels can damage foundations, roads, etc. and cause erosion problems. Their fondness for a variety of foods can wreak havoc on gardens, fruit trees, ornamental plants and agricultural crops.

Ground Squirrel Control

Trapping is an effective method of ground squirrel control. Several companies manufacture live traps for squirrels. Traps should be set near burrow entrances and in areas where ground squirrels travel. There are several bait materials that have been effective. These include: nut meats, rolled oats and peanut butter, apples and cabbage. A bait preference test may be necessary to find accepted baits. Traps should be set in early morning before ground squirrels become active. Protective cover should be placed over traps in the summer and traps checked every few hours to keep captured squirrels from dying of overheating.

Drowning the animals in the trap or placing the trap in a trash can (or similar container) with dry ice are effective methods of killing trapped animals. At times people object to killing trapped squirrels. In these situations trapped squirrels should be transported several miles away to an area where they will not become a problem for someone else or return to the original area.

Gas cartridges and fumigants (phosphine gas) are also effective in controlling ground squirrels. They are placed in burrow systems and the burrow entrances tightly sealed to keep gas from escaping. Label directions for gas cartridges and phosphine gas, are considerably different. A restricted fumigation license (C4 restricted to burrowing rodents) is required for the use of phosphine gases.

The acute active ingredient in phosphine gases, zinc phosphide, is currently registered by EPA for ground squirrel control. It is generally mixed within a grain or pelleted bait. A concentrate enables applicators to formulate baits using a variety of bait material. Zinc phosphide is not always highly effective, due to poor acceptance and/or to bait shyness. Bait acceptance can be improved if pre-baiting is conducted. Vegetable baits such as chopped cabbage may also increase acceptance. Bait shyness occurs when sub-lethal doses are consumed at the initial feeding.

Slower-acting, chronic, anticoagulant (diphacinone or chlorophacinone) baits may also be available for ground squirrel control, but are more expensive to purchase and require more bait because multiple feedings are necessary to produce death. With the use of the chronic anticoagulant baits, however, bait shyness is not produced, thus providing more latitude than zinc phosphide in the timing of bait programs.

Strychnine paste concentrate has been registered in Nevada. It is usually mixed with chopped cabbage and must be placed at least 8" into the ground squirrels burrow. **Above ground use of strychnine is prohibited.**

Rattlesnakes (*Crotalus* spp.)

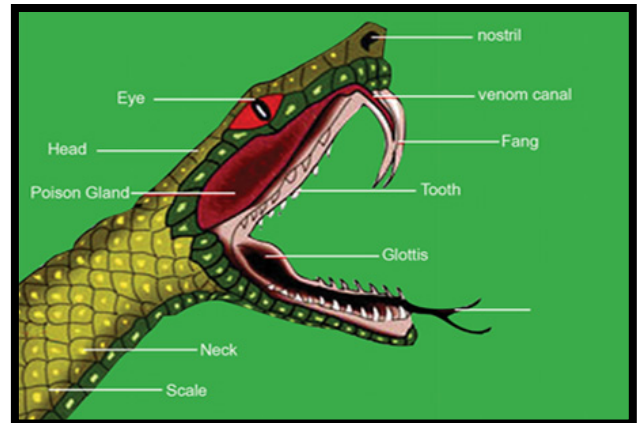
Rattlesnakes are the only poisonous snakes in Nevada. Like all snakes, rattlesnakes are cold blooded. They are inactive in very hot or cold temperatures.



Rattlesnakes have hollow fangs through which they inject venom that destroys blood cells and affects heart action. Young rattlesnakes should be considered dangerous also. Their venom, while small in quantity, is more powerful than the venom of adult snakes.

There are several characteristics that enable correct identification of rattlesnakes.

- Rattles present on tail (if not lost)
- Head somewhat triangular in shape and wider than the neck
- Stout body
- Vertical, elliptical pupils rather than horizontal pupils
- Often large diamond, blotchy or chevron markings
- Large, hollow, movable fangs



Snake control is often requested around the home. Snake proofing houses and yards will prevent entry. Fences to exclude snakes should be of ¼ inch mesh hardware cloth 3 feet high. The bottom of the fence should be buried a few inches and fence posts should be on the inside of the fence. Slanting the fence outward 30° keeps it free of vegetation and debris.

Jackrabbits (*Lepus* spp.)

There are two species of jackrabbits in Nevada, the blacktail jackrabbit (*L. californicus*) and the whitetail jackrabbit (*L. townsendii*). The black-tailed jackrabbit is found throughout the state and the white-tailed jackrabbit is found primarily in northeastern Nevada and in the northern Sierra mountains.

Jackrabbits feed at night and usually remain hidden in the shelter of vegetation during the day. They do not have burrows instead they use shallow depressions in the ground called "forms."



Jackrabbit populations are cyclic, building to a peak over several years then unpredictably "crashing" to low levels in a matter of weeks. Tularemia, a bacterial disease, is probably the cause of these declines though plague may also be a factor at times.

Jackrabbits become a problem especially in rural and developed areas when they eat ornamental, garden and agricultural plantings. This damage (as might be expected) can be especially severe during population "peaks."

The best method of protecting small areas from jackrabbits is to fence them out. A rabbit-proof fence should be made of 1 yard wide, 1.5 inches mesh or smaller woven wire. The bottom 6 inches should be buried and slanted outward.

Commercial rabbit repellents may be available as powders and sprays and are usually available at home hardware stores. The repellent's label and any manufacturer's guidelines must be followed as they may have specific sites of application. Some home recipe repellents may afford various degrees of protection over short periods, and may be used by homeowners. Repellents with sulfur type odors have generally been shown to be the most effective for herbivores. Research, however, has not been conducted for all brands and on every species. It should be remembered that repellents are variably effective, short term solutions.

Live trapping jackrabbits, using a box-type trap, is not recommended since they are often reluctant to enter a trap or dark enclosure.

Bird Pests

The **domestic pigeon** or rock dove (*Columbia livia*) becomes a problem primarily through the effects of its roosting and nesting on buildings.

Diseases such as salmonellosis, histoplasmosis, cryptococcosis, encephalitis and toxoplasmosis can be transmitted to humans through pigeons, their ectoparasites or their droppings. Pigeon droppings can accelerate the deterioration of structures and ruin their appearance also.



Frightening pigeons from an area is rarely successful since they are very territorial. Scaring devices may work for a short time but flocks acclimate to these types of deterrents.

Sticky repellents applied to areas where pigeons roost or nest may drive them away, however, repellents may stain buildings and are usually short term measures. Sticky repellents are less effective at high temperatures and in locations with high sun exposure.

Trapping may be effective in removing pigeons. Pre-baiting in and around the traps with the trap doors open may be required to get pigeons into the traps. Live pigeons should be put in the traps to decoy other birds (white or bright colored birds make better decoys). Bait materials include whole corn, popcorn, sunflower seeds, bread, peanuts and oat groats. Water should be kept in the traps at all times. State legislation requires all trapped animals be provided with food and water and maintained humanly within traps.

Several nontoxic chemical repellents (polybutenes) are commercially available for repelling pigeons from roosting or loafing areas. Some repellents available are 4 The Birds™, Hotfoot™, Tanglefoot™, Roost No More™, and Bird-Proof™. These products come in a variety of formulations such as, liquids, aerosols, nondrying films and pastes. They all produce a sticky surface that pigeons dislike. These repellents may be effective for up to two years if kept free of dirt and dust.

Avitrol® is classified as a “chemical frightening agent” (or a flock repelling product) which can be used to frighten pigeons. Avitrol® is a chemical toxin and a Restricted Use Pesticide which typically kills birds or other animals which may consume it. Avitrol® uses a whole-corn bait formulated with 4-aminopyridine. Birds and other animals that consume sufficient amounts of the treated bait usually die. The dying birds exhibit convulsions purported to function as a “distress behavior” and promoted to frighten other birds in the flock away. Secondary poisoning is unlikely to occur with Avitrol® unless the stomach and gullet containing undigested product is consumed by foraging scavengers.

Another toxicant is Rid-A-Bird™ perch. Rid-A-Bird™ perch contains fenthion, a Restricted-Use Pesticide, which is registered for pigeon control. The application of the fenthion is through a perch that contains a hollow tube that holds about 1 ounce of the toxicant within a wick. When the bird lands on the perch, the toxicant is absorbed through the feet in a short period of time. Death takes place within 72 hours of exposure. Fenthion may present a secondary hazard to non target birds, small carnivores and scavengers. Any non target animal, including humans that contact the perch could absorb a fatal amount of fenthion.

Exclusion and modifying roosting and nesting areas with exclosures, spikes, netting and other mechanical hardware are the most permanent and effective methods of preventing pigeons from roosting and nesting in areas where they are a nuisance. Because pigeons are ubiquitous, flying, commensal organisms which cover large territories, effective long-term control programs should focus on exclusion rather than poisoning.

House sparrows or **English sparrows** (*Passer domesticus*) were brought to the United States from Europe and are now common throughout the nation. They become pests in urban situations when their nests and droppings contaminate and deface buildings, walks, etc. They can also be very noisy.



Frightening devices (shell crackers, fireworks, etc.) when persistently used will dislodge them from roosting areas but rarely from their nests.

Sticky repellents are effective but may be very difficult to apply since sparrows can nest and roost in small inaccessible places. Products with sharp metal projections such as Nixalite® and Cat Claw® may prevent the birds from roosting comfortably in an area.

Trapping and exclusion may be the most widely used and successful methods in attempting to reduce house sparrow populations in small areas. The procedures used for house sparrows are basically the same for pigeons. Baits include chicken scratch, milo, wheat and bread crumbs. However, sparrows are notoriously trap-shy. Therefore, trapping will not remove an entire sparrow flock. Also, sparrows from neighboring flocks will repopulate available habitats where flocks have been diminished or eliminated by baiting and poisoning.

Avitrol® Corn Chops is registered Restricted-Use Pesticide for house sparrow control and may be effective in temporarily reducing the size of a flock from an area. Rid-A-Bird™ perches containing fenthion, a Restricted-Use Pesticide, is also registered for house sparrow control. Protecting non-target and protected species is an additional major concern when using any products.

Occasionally **woodpeckers** and **flickers** become pests when they drum on roofs, etc. of houses or peck out nest holes on structures. Mechanical barriers such as nylon netting or chicken wire are effective in screening them from an area. Frightening devices or sticky repellents rarely work since woodpeckers and flickers will likely move a short distance away and try again.

Trapping with a wooden rat trap is an effective means of control. Traps should be secured to the building near where the bird is working with the trigger side down. Suet or nut-meats make good baits. A permit is required; contact USDA Wildlife Services.

Bird control is perhaps the most difficult vertebrate pest control area. Quite often clear solutions without drawbacks do not exist. A pest control operator has to evaluate each problem individually working within an integrated pest management approach which considers multiple techniques depending on context and goals. Flexibility and individual evaluation of each problem are important requirements for successful bird control.



Woodpescker



Sapsucker



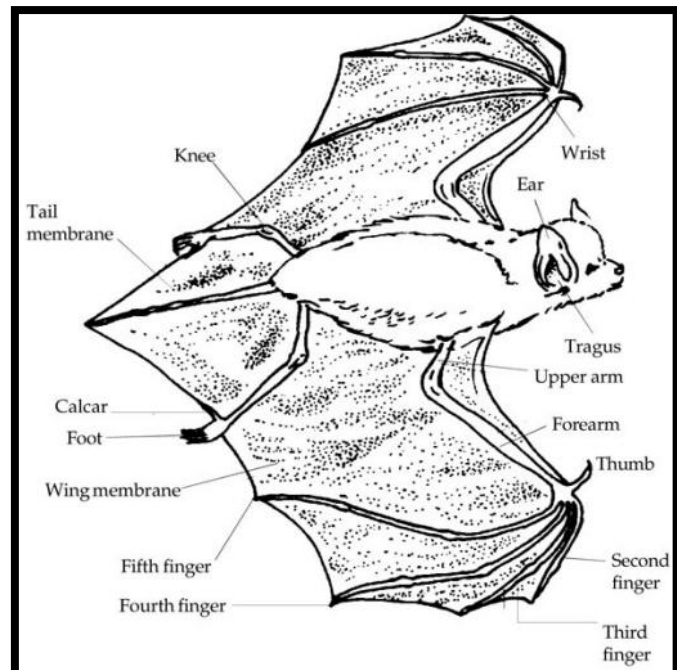
Flicker

Bats (Order: Chiroptera)

The Endangered Species Act of 1973 and the Fish and Wildlife Coordination Act of 1956 protect the six federally listed endangered bat species. None of the six species have been reported in Nevada. However, there are 23 species of bats in Nevada of which 9 have been classified as **“Protected, threatened and sensitive mammals” (NAC 503.030)**. State laws provide protection to the bats, and federal laws safeguard their habitats on public and private lands.

Bats are nocturnal, insect-feeding, or fruit or nectar-feeding mammals. They are highly beneficial, since they feed on large numbers of pest insects such as mosquitoes and cutworm moths and are also important pollinators.

Problems with bats can occur when roosting areas are found in buildings. Roosting sites may cause offensive odors and distracting noises. There are also some potential health problems associated with bats. Bats are a reservoir for rabies in Nevada. Brown bats are also reservoirs of encephalitis, which may be transmitted to humans or horses by mosquitoes. Histoplasmosis is a fungus disease that can be contracted by inhalation of spores that develop on bat manure. Bats also are hosts of bat bugs, which may move into living areas and bite humans. Bats breed in autumn, before hibernation and usually have one or two young per litter. Young are born from May to July. Young bats may cling to their mother for some time after birth. Bats are comparatively long-lived for small mammals. No nests are built. Most bats are colonial, living together in roosting areas.



Symptoms of rabies in bats include uncoordinated fluttering on the ground or aggressive behavior. Bats displaying these symptoms should not be handled. Bat bites and scratches should be treated by a physician immediately and the bat saved for examination.

Bat Control

Toxicants –There are no registered toxicants or fumigants for bat control.

Since nine of the 23 bat species in Nevada have legal status and are protected, only exclusionary methods and repellents will be discussed in detail.

Exclusion - Illumination of roosting areas may be an effective repellent. One-hundred to 150 watt floodlights can be strung throughout the attic area. Air drafts can be created by the use of fans. Fans lower the roost temperature and increase the thermoregulatory burden on the bats making the roost less desirable.



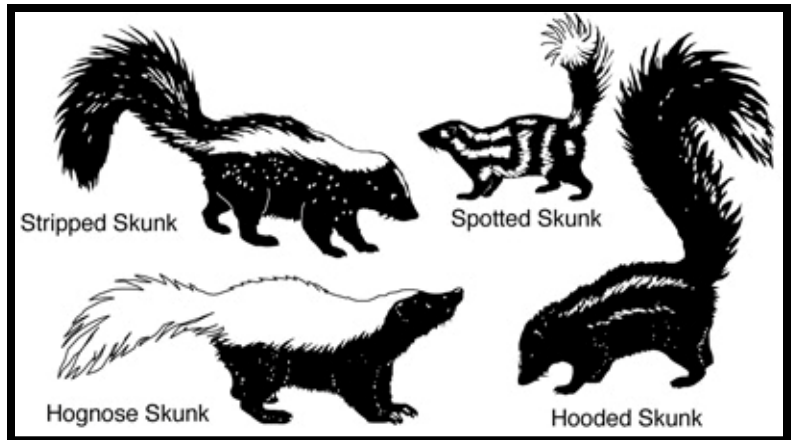
Exclusions should be constructed after bats have left the roost, usually around dusk. Openings must be caulked, built over, or closed with ¼ inch hardware cloth, sheet metal or wood to exclude bats. Small species of bats can enter a crack one cm in size. Since bats may be attracted by the odors left by the departed bats, a thorough cleanup should also take place. During this cleanup, respiratory protection should be used to prevent inhalation of infectious organisms such as histoplasmosis spores.

Repellents – Naphthalene crystals and flakes (mothballs) are the only repellents registered by EPA for indoor bat control and are to be applied in attics or between walls. Dosages of up to five pounds per 1,000 cubic feet may be needed to repel bats. However, bats will return when the odor dissipates, and exclusionary measures need to be taken when the bats leave the area. Prolonged exposure to naphthalene vapors may be hazardous to human health.

Bat bugs are often associated with bat roosting areas. When bats are eliminated, bat bugs may migrate to human living areas, where they can be a serious problem. Where bat bugs are present, bat management should also include bat bug controls.

Skunks (Order: Carnivora, Family: Mephitidae)

There are two species of skunks in Nevada, the **striped skunk** (*Mephitis mephitis*) and the **spotted skunk** (*Spirogale gracilis*). Both are distributed throughout the state. Skunks are nocturnal, reclusive animals in the weasel family. They have omnivorous feeding habits, their diet including insects, grubs, snakes, fruit, vegetation, small rodents, bird eggs, and garbage. Although their feeding habits are often innocuous or even beneficial, the sulfurous musk they produce in self-defense makes them undesirable around living areas. Skunks may also damage lawn areas while digging for white grubs. Damage can be mistaken for meadow mice damage since at first glance the holes may not appear shallow and are similar in size to meadow mouse burrow openings. They are common in suburban areas. Occasionally, skunks may carry rabies.



Striped skunks are similar in size to house cats, weighing four to 10 pounds. Their bodies are black, except for a white stripe on the forehead, with a wide area at the nape of the neck that divides into a "V" and runs along the back.

Spotted skunks are a small species, weighing only about 0.8 to 2.2 pounds. Spotted skunks are black, with white spots on the forehead and under each ear. They have four to six broken stripes on the back and sides and a white-tipped tail. Spotted skunks are known to climb trees. They need to be handled with extra care, since they are more excitable than the striped skunk and produce a stronger scent.

Skunks may be active all year. They may sleep for several days during very cold weather, but they do not hibernate. Skunks usually breed once a year, in February or March. Young are born in early May, and litter sizes range from two to 10. Kits are not capable of spraying musk until about 45 days after birth.

Skunks usually use an underground den, in which they spend the daylight hours. Dens are seldom occupied by single individuals; most are occupied by a female and her current brood. Most problems with skunks occur when dens are found under buildings and decks. They usually enter buildings by digging or through foundation openings.

Skunk Control

In Nevada, spotted and striped skunks are classified as an “unprotected mammal” (NAC 503.035) and may be legally killed. However, the best control of skunks is by removing and relocating or exclusion. If killing of a damage-causing skunk is the only option available, NRS 503.470, states that a hunting license or permit is not required to hunt unprotected mammals, including coyotes, **skunks** and weasels. However, the Nevada Department of Wildlife (NDOW) regulations further state killing fur-bearing mammals by any legal method, or unprotected mammals by trapping, or selling raw furs for profit requires a trapping license.

Repellents – There are no registered repellents for skunk control. Although numerous “home remedies” are touted, none are known to be effective. Licensed Pest Control Applicators operators may only use registered pesticides (including repellents) in the course of pest control.

Toxicants – There are no registered toxicants for skunk control in the Industrial and Institutional licensed category.

Exclusion -- Skunks may be prevented from taking refuge under buildings and porches by blocking or sealing any potential ground-level openings with wood, wire mesh, sheet metal, concrete or other suitable material. Female skunks in particular sometimes burrow under concrete slabs to establish dens to bear young. Burrowing may be prevented by burying wire mesh along the slab 1½ to 2 feet deep. If a skunk has already settled under a building or slab, and trapping has not been effective, the animal maybe tracked and excluded by blocking all openings except one and placing tracking material such as sand, lime, or kitchen flour around the remaining opening. Periodic inspection after dark will indicate when the animal is outside the den and an enclosure maybe installed to seal the opening. The following day the den should be inspected for any remaining skunks. Young skunks may be present during May and June, and sealing the opening then would result in starvation and odor. If possible, it is best to allow the young to grow and abandon the den, typically by summer, then re-sealing the opening.

If a skunk:

- has entered a garage or basement, doors should be left open so the animal can wander out on its own after dark.
- is raiding bee hives for honey and larvae, bee hives should be placed on elevated stands and sheet metal tacked on stand legs to prevent skunks from climbing. Skunks normally do not climb.
- has been trapped in a basement window well or depression wait until evening, then place a board (must have some grip) into the well at a shallow angle so the skunk can climb out.

Trapping -- Fully-enclosed cage-type traps are effective and reduce the potential for spraying. Wooden box or cage-type traps can also be used. Skunks may be captured in cage traps baited with fish-flavored cat food, sardines, eggs, or peanut butter. Peanut butter, over-ripe bananas, jelly, or marshmallows are preferred baits where cats and raccoons might also be caught. The trap should be placed near the den entrance and the sides of the trap covered with a tarp to reduce the chance of the skunk discharging its musk. When moving the trap, it should be approached quietly, deliberately, and avoid sudden movements to minimize the potential for spraying.

In general, capturing skunks with leg-hold traps, as opposed to live traps, followed by shooting, is effective and legal. Before trapping skunks in leg-hold traps, check with the NDOW on leg-hold trap requirements specified in chapters 503 of the Nevada Revised Statutes and Nevada Administrative Code. Use of leg hold traps require special skill and experience and usually cause the animal to spray. Restrictions apply; current NDOW regulations should be consulted. Leg-hold traps should not be used in areas where pets and other-non target animals might be trapped. NDOW has restrictions on trap placement other than on private property.

Odor control -- Neutroleum alpha is the best chemical to help eliminate skunk-musk odors on pets, people, clothing, or residential areas that have been sprayed. Neutroleum alpha is contained in some commercial odor-control products. Diluted solutions of ammonia, chlorine bleach, tomato juice or vinegar may help to eliminate odors from clothing and possessions.

Skunks transmit rabies to humans more than any other species of wild animal. However, rabies is rarely found in skunks in Nevada. Skunks that exhibit unusual behavior should be watched carefully. Symptoms of rabies in skunks include: wandering around listlessly in the daytime, no fear of humans and aggressive behavior.

Appendix A

Tick-Borne Relapsing Fever

Jim Gibbons
Governor

STATE OF NEVADA

TONY LESPERANCE
Director



Sparks Office
2150 Frazer Ave.
Sparks, Nevada 89431-5566
(775) 688-1166
Fax (775) 688-2533

Elko Office
4780 E. Idaho St
Elko, Nevada 89801-4672
(775) 738-8076
Fax (775) 738-2639

DEPARTMENT OF AGRICULTURE

405 S. 21st Street

Sparks, Nevada 89431

Telephone (775) 353-3600 Fax (775) 353-3601

Las Vegas Office
2300 McLeod Street
Las Vegas, NV 89104-4314
(702) 486-4690
Fax (702) 486-4695

Winnemucca Office
1200 E. Winnemucca Blvd.
Winnemucca, NV 89445-2999
(775) 623-6502
Fax (775) 625-1200

May, 18, 2005
Revised November 4, 2009

MEMORANDUM

IMPORTANT

Re: Tick-Borne Disease Information Bulletin
To: ALL LICENSED PEST CONTROL COMPANIES OPERATING IN NEVADA
From: Lee Lawrence-Agriculturist IV, & Jeff Knight-Entomologist

Attached to this Memorandum is: 1) an informational bulletin entitled "Tips for the Control of the Soft Tick *Ornithodoros hermsi*" which discusses the control of "soft ticks", and 2) a CDC brochure entitled "Tick-Borne Relapsing Fever - What is it and How to Prevent it".

The informational bulletin was developed by the Washoe County District Health Department's Vector-Borne Disease Program in an effort to inform the public about the tick which is known to vector the disease Tick-Born Relapsing Fever. Effects of the disease can be serious. Not all rodents carry the tick. As indicated in the information bulletin, rodent control inside structures at higher elevations (e.g. Mt. Charleston, Lake Tahoe and much of Northern Nevada), needs to include the removal of nesting materials and the ticks themselves. Removing only the rodents can actually increase the risk of people being bitten by the ticks as they seek out new mammal hosts upon which to feed.

Please read the information bulletin and CDC brochure carefully. If you have any questions you may contact the Washoe County District Health Department's Vector-Borne Diseases Program at (775) 785-4599, or the Nevada Department of Agriculture at (775) 353-3671 or (775) 353-3716.

Attached --

TIPS FOR THE CONTROL OF THE SOFT TICK *Ornithodoros hermsi*



(*Ornithodoros* sp. by CDC)

BIOLOGY

O. hermsi is a member of the family Argasidae, commonly known as “soft ticks”. In contrast with the hard ticks, its mouthparts cannot be seen when viewed from above. They are mainly found mainly in the mountains and foothills, between 3000 and 9000 feet elevation. Soft ticks live in dark, cool places such as rodent nests within snags, and decayed tree stumps and shaded woodpiles outside of buildings. During the winter rodents may move into buildings, especially those that are unoccupied and build nests within the walls and beneath floorboards. Soft ticks usually feed on small animals such as chipmunks, squirrels or mice. If the rodents become scarce or are excluded from the nest, they will take a blood meal from other warm-blooded animals including humans. Unlike hard ticks, they usually feed at night. Their bite is painless and feeding is accomplished in 15 to 30 minutes. Most people are unaware that they have been bitten. Soft ticks can survive without a blood meal for over 20 years. These ticks are also the vector of Tick-Borne Relapsing Fever, a disease of relapsing episodes of fever caused by spiral shaped bacteria (spirochetes). The spirochetes in infected ticks can remain infectious for over 10 years.

CONTROL

- It is important that the control of rodents in buildings where soft ticks are likely include removal of rodent nest materials and ticks from walls, ceiling and floors. Eliminating or excluding rodents without tick control can actually increase the risk of people being exposed to tick bites as hungry ticks will seek out other mammals upon which to feed when rodents are not available.
- Application of appropriate acaracidal pesticide (e.g., pyrethrins and permethrins). More than one treatment is often necessary to rid a building of soft ticks.
- Rodent-proof buildings to prevent re-entry of rodents.

For further information:

In Nevada contact: Washoe Co. Dist. Health Dept., Vector-Borne Diseases Program at (775) 785-4599
Nevada Dept. of Agriculture, (775) 353-3600

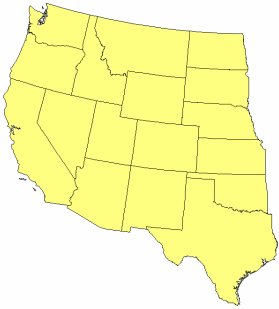
Sources: CDC-DVBID
DHS-VBDS
The Ticks of California by Furman, D. and E. Loomis

WHAT IS TICK-BORNE RELAPSING FEVER (TBRF)?

Relapsing Fever is a disease of relapsing episodes of fever caused by a spiral-shaped bacteria (spirochetes).

WHO CAN GET TBRF?

STATES WHERE TBRF OCCURS



Anybody of any age can develop relapsing fever. The disease occurs in the Western United States and is relatively uncommon. Most people become infected while vacationing in cabins in rural, wooded, mountainous areas. A few people have developed relapsing fever after being in caves.



HOW DOES SOMEONE GET TBRF?

In the United States, people get relapsing fever through the bite of an infected soft tick. These ticks, *Ornithodoros*, usually feed on small animals such as squirrels, mice, chipmunks, or rabbits. The ticks live in rodent nests under flooring and between walls. If these rodents are scarce, the ticks will take a meal from other warm-blooded animals including humans.

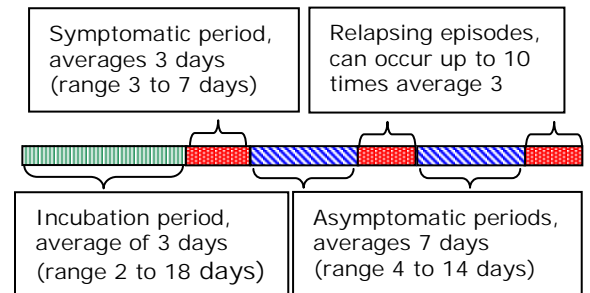


Soft ticks, unlike hard ticks, usually feed at night. Their bite is painless, and they feed between 15 and 30 minutes before they drop off. Most people are unaware that they have been bitten.

Relapsing fever can not be transmitted from person to person except in the case of pregnant women, who sometimes transmit the infection to their fetus.

WHAT ARE THE SYMPTOMS?

Symptoms usually develop within 7 days after being bitten. They include a sudden high fever with chills, sweats, headache, and body aches. Other possible symptoms include nausea, vomiting, loss of appetite (anorexia), dry cough, inability to tolerate bright lights (photophobia), rash, neck pain, eye pain, confusion and dizziness.



HOW IS TBRF DIAGNOSED AND TREATED?

When a person has fever it is often possible to see the spirochetes in a sample of the person's blood. Antibody tests are also available, but these are not useful in the early stages of the disease.

Although symptoms usually resolve on their own, treating relapsing fever with antibiotics will make the symptoms subside much more quickly.

If you think you may have relapsing fever consult a medical professional for further testing and treatment.

HOW CAN I PREVENT GETTING TBRF?

The best protection against relapsing fever is knowing where and how people get it and avoiding that exposure.

To prevent infection:

- Avoid sleeping in rodent infected buildings
- Use insect repellent containing DEET
- Rodent-proof buildings in areas where the disease is known to occur
- Identify and remove any rodent nesting material from walls, ceiling and floors
- In combination with removing the rodent material, fumigate the building with preparations containing pyrethrins and permethrins. More than one treatment is often needed to rid the building of the soft-ticks.

For more information contact either the CDC at 800-311-3435 or your local or state health department

Department of Health & Human Services
Centers for Disease Control and Prevention (CDC)
Division of Vector-Borne Infectious Diseases
PO Box 2087
Fort Collins, CO 80522-2087

TICK-BORNE RELAPSING FEVER



WHAT IS IT AND HOW TO PREVENT IT

Appendix B

Pigeon Control for the Homeowner Handbook



- Install electric shock bird control systems to prevent perching and roosting.
- Use pigeon traps to remove the birds.

The following website has additional information for the home owner regarding pigeon control:

www.wildlifedamage.unl.edu/handbook/handbook/birds/bird_e87.pdf

Hire a Professional

There are a number of licensed pest control operators available in the Reno/Sparks area who do pigeon control. Some are willing to trap and humanely euthanize the birds.



For more information contact:

Vector-Borne Diseases Program
 1001 East Ninth Street
 P.O. Box 11130
 Reno, NV 89520
 (775) 785-4599



Pigeon Control for the Homeowner



**District Health Department
Vector-Borne Diseases Program**



Background

The pigeons found in North America are feral offspring of captive pigeons brought to this continent by European immigrants. They continue to thrive in urban centers where they are highly dependent on humans to provide them with food and sites for roosting and nesting.

Unfortunately the damage done by feral pigeons is estimated at about a billion dollars annually (D. Pimentel and L. Lach 1999). Pigeon droppings deface and accelerate the deterioration of buildings and increase the cost of maintenance. In 1977 the Biggest Little City in the World neon sign in downtown Reno ignited due to a methane explosion from decaying pigeon droppings costing \$10,000 to repair (W.J. Weber 1979).

While there are many human pathogens associated with pigeon droppings, the incidence of human disease from pigeons remains extremely low. For this reason, the Health Department Vector-Borne Diseases Program does not become involved with the control of this species. Because of the significant damage caused by feral pigeons, the Program tries to educate the public about methods to discourage them. The recommendations include:

Eliminate food sources that attract pigeons

Don't leave pet dishes with uneaten food outside. Garbage containing food matter should be kept in a container with a tight-fitting lid.

Bird feeders can be a major attractor for pigeons. Some

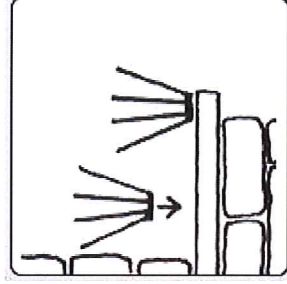
ways to feed wild birds without attracting pigeons follow:

- Buy quality bird seed such as sunflower seeds, thistle seed, and nuts. Don't use bird seed mixed with fillers like millet and corn. Cheap bird seed mixes might just as well be labeled "pigeon food."
- Use feeders that pigeons can't perch on. Tube feeders, perchless bowl-style feeders and feeders enclosed in wire cages are good. If pigeons manage to use the perches, shorten them.
- Rake up any bird seed that falls on the ground daily.
- Keep pigeons out of fallen seed by building a frame with 2" by 2" lumber about 12 inches high, large enough to cover the ground where seed falls under feeders; then cover the frame with chicken wire. Small birds will pass easily through to eat fallen seed.



Exclude Pigeons from Perching and Nesting Sites

- Block pigeon access from openings in buildings using wood, metal, glass, plastic or nylon netting, or ¼ inch rust-proof wire mesh.
 - Shape and fasten wooden, stone, or metal to form a 45 degree angle on ledges that discourages resting and nesting.
 - Install sharp objects such as spikes designed to attach to flat structural features to deter pigeons from landing. (See diagram at left.)



Appendix C

University of Kentucky Cooperative Extension Service – Fact Sheet

Bed Bugs

BED BUGS

By Michael F. Potter, Professor & Urban Entomologist

Most householders of this generation have never seen a bed bug. Until recently, they also were a rarity among pest control professionals. Bed bug infestations were common in the United States before World War II. But with improvements in hygiene, and especially the widespread use of DDT during the 1940s and '50s, the bugs all but vanished. The pests remained fairly prevalent, however, in other regions of the world including Asia, Africa, and Eastern Europe. In recent years, bed bugs have also made a comeback in the U.S. They are increasingly being encountered in homes, apartments, hotels, motels, health care facilities, dormitories, shelters, schools, and modes of transport. Other places where bed bugs sometimes appear include movie theaters, laundries/dry cleaners, furniture rental outlets and office buildings. Immigration and international travel have undoubtedly contributed to the resurgence of bed bugs in the U.S. Changes in modern pest control practice — and less effective bed bug pesticides — are other factors suspected for the recurrence.

DESCRIPTION AND HABITS.



Adult bed bug feeding on human

Bed bugs are small, brownish, flattened insects that feed solely on the blood of animals. The common bed bug, *Cimex lectularius*, is the species most adapted to living with humans. It has done so since ancient times. Bed bugs are mentioned in medieval European texts and in classical Greek

writings back to the time of Aristotle. Other bed bug species prefer to feed on wild hosts, especially bats and birds.

Adult bed bugs are about 3/16-inch long and reddish-brown, with oval, flattened bodies. They are sometimes mistaken for ticks or cockroaches. The immatures (nymphs) resemble the adults, but are smaller and lighter in color. Bed bugs do not fly, but can move rapidly over floors, walls, ceilings and other surfaces. Female bed bugs lay their eggs in secluded areas, depositing 1, 2 or more eggs per day and hundreds during a lifetime. The eggs are tiny, whitish, and hard to see on most surfaces without magnification (individual eggs are about the size of a dust speck). When first laid, the eggs are sticky, causing them to adhere to surfaces. Newly hatched nymphs are straw-colored and no bigger than a pinhead. As they grow, they molt (shed their skin) five times before reaching maturity. A blood meal is needed between each successive molt. Under favorable

conditions (70-80°F), the bugs can complete development in as little as a month, producing three or more generations per year. Cooler temperatures or limited access to blood extends the development time. Bed bugs are resilient. Nymphs can survive months without feeding and the adults for more than a year. Infestations therefore are unlikely to diminish by leaving premises unoccupied. Although *C. lectularius* prefers feeding on humans, it will also bite other warm-blooded animals, including dogs, cats, birds and rodents.



Dark spots of bed bug excrement on a mattress

Bed bugs are active mainly at night. During the daytime, they prefer to hide close to where people sleep. Their flattened bodies enable them to fit into tiny crevices — especially those associated with mattresses, box

springs, bed frames and headboards. Bed bugs do not have nests like ants or bees, but do tend to congregate in habitual hiding places. Characteristically, these areas are marked by dark spotting and staining, which is the dried excrement of the bugs. Also present will be eggs and eggshells, the brownish molted skins of maturing nymphs and the bugs themselves. Another telltale though less frequent sign is rusty or reddish blood smears on bed sheets or mattresses from crushing an engorged bed bug. Heavy infestations



may have a “buggy” smell, but the odor is seldom apparent and should not be relied upon for detection.

Bed bugs prefer to hide close to where they feed. However, if necessary, they will crawl several feet to obtain a blood meal. Initial infestations tend to be around beds, but the bugs eventually may become scattered throughout the bedroom, occupying any crevice or protected location. They also may spread to adjacent rooms or apartments.

BITES & CONCERNS.

Bed bugs usually bite people at night while they are sleeping. They feed by piercing the skin with an elongated beak through which they withdraw blood. Engorgement takes about three to 10 minutes, yet the person seldom knows they are being bitten. Bed bugs normally do not reside on people like head or body lice — immediately after feeding they crawl off and reside elsewhere to digest their meal. Symptoms after being bitten vary with the individual. Many develop an itchy red welt or localized swelling within a day or so of the bite. Others have little or no reaction, and in some people the reaction is delayed. Unlike flea bites that occur mainly around the ankles, bed bugs feed on any skin exposed while sleeping (face, neck, shoulders, back, arms, legs, etc.). The welts and itching are often wrongly attributed to other causes, such as mosquitoes. For these reasons, infestations may go a long time unnoticed, and can become quite large before being detected. The likelihood of bed bugs increases if the affected individual has been traveling, or had acquired used beds or furnishings before symptoms started to appear. Bed bugs also are suspect if you wake up with itchy bites you did not have when you went to sleep. Conversely, it is important to recognize that not all bites or bite-like reactions are due to bed bugs. Confirmation requires finding and identifying the bugs themselves, which often requires the help of a professional. (Other possible sources of irritation are discussed in University of Kentucky entomology fact sheet ENT-58; *Invisible Itches: Insect and Non-Insect Causes*).

A common concern with bed bugs is whether they transmit diseases. Although bed bugs can harbor pathogens in and on their bodies, transmission to humans is considered unlikely. Their medical significance is chiefly limited to the itching and inflammation from their bites. Antihistamines and corticosteroids may be prescribed to reduce allergic reactions, and antiseptic or antibiotic ointments to prevent infection. Though not known to carry diseases, bed bugs can severely reduce quality of life by causing discomfort, sleeplessness, anxiety, and embarrassment.

Conventional insect repellents, like those used to deter ticks and mosquitoes, do not appear to be effective against bed bugs. Attempting to avoid being bitten by applying insect repellent at bedtime is not recommended. Sleeping with the lights on is not likely to deter hungry bed bugs either.

HOW INFESTATIONS BEGIN.

It often seems that bed bugs arise from nowhere. The bugs are efficient hitchhikers and are usually transported in on

luggage, clothing, beds, furniture, and other items. This is a particular problem for hotels, motels and apartments, where turnover of occupants is constant. Bed bugs are small, cryptic and agile, escaping detection after crawling into suitcases, boxes and belongings. The eggs are especially tiny and are usually overlooked. Acquiring secondhand beds, couches and furniture is another way that the bugs are transported into previously non-infested dwellings. Bed bugs also can be carried in on a person’s clothing or shoes, resulting in an infestation.

Once bed bugs are introduced, they often spread throughout a building. The bugs can travel from room to room or floor to floor either by crawling or via a person. Unlike cockroaches that feed on filth, the level of cleanliness has little to do with most bed bug infestations. Pristine homes, hotels and apartments have plenty of hiding places and an abundance of warm-blooded hosts. Thus, they are almost as vulnerable to infestation as are places of squalor.

When bed bug-like insects are found, it’s important to consider whether bats, swallows, chimney swifts, pigeons or other wild hosts are involved. Although similar in appearance, species of bed bugs that normally feed on bats and birds can be differentiated from those that prefer humans. Entomologists and knowledgeable pest control firms can make this determination.



Bed bugs often congregate along seams of mattresses and box springs. Blackish spots are excrement.

WHERE THEY HIDE.

Bed bugs can live in almost any crevice or protected location. The most common place to find them is the bed. Bed bugs often hide within seams, tufts and crevices of the mattress, box spring, bed frame and headboard. A thorough inspection requires dismantling the bed, and standing the components on edge so that upper and lower surfaces can be examined. Things to look for are the bugs themselves, and the light-brown, molted skins of the nymphs. Dark spots of dried bed bug excrement are often present along mattress seams or wherever the bugs have resided. Box springs afford many places for bed bugs to hide, especially underneath where the fabric is stapled to the wooden frame. Oftentimes the underlying gauze dust cover must be removed to gain access for inspection and possible treatment. Successful treatment of mattresses and box

springs is difficult, however, and infested ones may need to be discarded or encased in a protective cover. Cracks and crevices of bed frames should be examined, especially if the frame is wood. (Bed bugs have an affinity for wood and fabric more so than metal or plastic). Headboards secured to walls should also be removed and inspected. In hotels and motels, the area behind the headboard is often the first place that the bugs become established. Bed bugs also hide among items stored under beds.



Bed bugs are frequently found on the undersides of box springs.

During the early stages of a bed bug problem, the pests tend to congregate mostly in beds and other sleeping areas. As infestations grow larger, they tend to move beyond beds into other locations making control more difficult. Upholstered chairs and sofas should be examined above and beneath, especially seams, tufts, skirts and crevices. Sofas can be major bed bug hotspots, especially when used for sleeping. Like beds, they can be difficult to treat and may need to be discarded. Nightstands and dressers should be emptied and examined inside and out, then tipped over to inspect the woodwork underneath. Oftentimes the bugs will be hiding in cracks, corners, and recesses. Other common places to find bed bugs include: along and under the edge of wall-to-wall carpeting (especially behind beds and furniture); cracks in wood molding; ceiling-wall junctures; behind wall-mounted picture frames, mirrors, switch plates and outlets; under loose wallpaper; amongst clothing and clutter stored in closets; and inside clocks, phones, televisions and smoke detectors.

Bed bugs tend to congregate in certain areas, but it is common to find a single bug or some eggs scattered here and there. Persistence and a bright flashlight are requisites for success. A thorough inspection and treatment may take up to several hours. Some companies are beginning to use canines for detecting hard-to-find infestations. When properly trained, the dogs can be very effective. However at this time very few companies are using them due to the expense of training and maintaining such animals.

CONTROLLING INFESTATIONS.

Bed bugs are challenging pests to control. Since they can hide in so many places, treatments must be thorough and elimination is not always a certainty. In most cases, it will



Bed Bugs hidden beside a recessed screw under a nightstand.

be prudent to enlist the services of a professional. Experienced pest control firms know where to look for bed bugs, and have an assortment of management tools at their disposal.

Owners and occupants have an important role and will need to assist the professional. Affording access for inspection and treatment is crucial, and excess clutter will have to be removed. Belongings strewn about rooms afford many places for bed bugs to hide, and impedes inspection and treatment. Some pest control firms want furniture moved away from walls and mattresses and box springs stood on edge before they arrive; others prefer to inspect first and move these items themselves. Since bed bugs can disperse throughout a building, it often will be necessary to inspect adjoining rooms and apartments.

Treatment Procedures.



Inspections and treatments must be very thorough

Infested and infestation-prone bedding and garments will need to be bagged and laundered (120°F minimum) since these items cannot be treated with insecticides. Another effective and efficient option is to place clothing, toys, shoes, backpacks, etc., in a clothes dryer set at medium to high heat for 10 to 20 minutes. This will kill all bed bug life stages and can be done alone or in conjunction with laundering. According to textile experts at the Drycleaning & Laundry Institute (Laurel, MD), most garments designated as 'dry-clean only' (e.g., cotton, wool, silk, linen, rayon, nylon, poly blends) will not be harmed provided they are dry before being placed in a clothes dryer at moderate (less than 160°F) settings. While dry cleaning procedures also kill bed bugs, there is risk of infesting the establishment when buggy items are de-bagged, tagged and sorted.

Items which cannot be put in a washer or dryer can sometimes be de-infested by wrapping in plastic and placing them outdoors in a hot, sunny location, closed vehicle, etc. for at least a day. If this method is attempted, packing fewer items per bag makes it harder for the bugs to find cooler places to hide. Monitoring with a thermometer is prudent, with a target internal temperature of at least 120°F. Bed bugs also will succumb to cold temperatures below 32°F, but the freezing temperatures must be maintained for several days. Consequently, throughout much of the country, heating tends to be a faster, more reliable option than chilling. Attempts to rid an entire dwelling of bed bugs by raising or lowering the thermostat will be unsuccessful, although some companies are having success using supplemental heaters.



Bed bugs often reside along baseboards. Photo show eggs, nymphs, and adults beneath carpet edge.

General housecleaning measures, such as vacuuming floors and surfaces, seldom reaches the places where bed bugs hide. Targeted vacuuming of infested harborages, however, can help remove some of the bugs before treatment with insecticides. Bed bugs and especially the eggs can be difficult to dislodge. Optimum results will be achieved by moving and scraping the end of the suction wand along infested areas such as seams and fabric folds of beds and sofas, and the perimeter edge of wall-to-wall carpets. Afterward, dispose of the vacuum contents in a sealed trash bag. Some pest control firms also employ commercial steamers or rapid freezing equipment to treat areas where bed bugs are found or suspected. Used correctly, they kill both bugs and eggs on contact. Neither method, however, affords residual protection against bed bugs which may have been missed.

At times it may be necessary to throw out infested items, especially beds and upholstered furniture. Knowledgeable pest control firms are able to advise clients on what can stay and what should go. When infested items are discarded, bagging or wrapping them prevents dislodgement of bugs en route to the Dumpster®.

While the aforementioned measures are helpful, insecticides are important for bed bug elimination. Professionals treat using a variety of low-odor sprays, dusts and aerosols. Baits designed to control ants and

cockroaches are ineffective. Application entails treating all areas where the bugs are discovered or tend to crawl or hide. This may take hours of effort and follow-up visits are usually required.

Some bed bug species are parasites of bats or birds, and may bite people if the wild hosts are no longer available. If bat bugs or bird bugs are involved, roosting and nesting sites should be the primary focus of treatment and the animals excluded from the building.

Do I Have to Throw Out the Bed? Eliminating bed bugs from beds can be challenging. If there are holes or tears in the fabric, the bugs and eggs may be inside, as well as outside. There also are restrictions on how beds can be treated with pesticides. For these reasons, companies sometimes recommend that beds be discarded, especially when heavily infested or in poor condition. Another option is to encase both the mattress and box spring in a protective cover like those used for allergy relief. Encasements specifically designed to help protect against bed bugs are available through retail outlets or pest control firms. Once the cover is installed and zipped shut, any bugs which happen to be inside are entombed and eventually will die. Encasements also help protect newly purchased beds, and make it easier to spot and destroy any bugs residing on the outer surface during subsequent examination. Encasements will not, however, keep bed bugs from crawling onto a bed and biting a sleeping person.

Some companies treat seams, tufts, and crevices of bed components with insecticides, but they usually will not spray the entire mattress surface. They also should not spray bed sheets, blankets or clothing, which should be laundered. Vacuuming and steaming further help to eliminate bugs and eggs from beds, but afford no residual protection and may not kill bed bugs hidden inside the box spring or mattress. Fumigation is another way to de-infest beds and hard-to-treat items, but the procedure is not always available. In extreme cases, entire buildings have been fumigated for bed bugs. The service can be quite costly though, and involves covering the building in a tarp and injecting a lethal gas. Some companies also de-infest such items with specialized heating equipment.

PREVENTING INFESTATIONS. As difficult as it can be to eradicate bed bugs, it makes great sense to take precautions to avoid them in the first place. Householders should be vigilant when acquiring used furnishings, especially beds and couches. Curbside items should be avoided, and secondhand articles should be examined closely before being brought into the home, and perhaps laundered or placed in a dryer. Avoiding problems with bed bugs is most challenging in apartments, hotels and other places where there are ongoing opportunities for the bugs to be introduced. Preventative inspection by tenants, housekeeping staff, or pest control firms is the best way to uncover infestations in their initial stages when they are easiest to control.



Discarded beds and couches might be infested and should be left alone.

Concerned travelers may want to get in the habit of checking their bed for signs of bed bugs, a common practice in the past. This would entail examining the bed sheets and upper and lower seams of the mattress and box spring, especially along the head of the bed. Some professionals also suggest removal and examination behind the headboard, a frequent hiding place for the bugs in hotel rooms. Headboards are heavy and cumbersome, however, and untrained persons should not attempt removal themselves. If bed bugs are discovered, travelers can request another room, preferably in another area of the building. Vigilant travelers may also want to elevate suitcases off the floor on a luggage stand, tabletop or other hard surface. Should travelers experience itchy welts suggestive of bed bug bites during their stay, it would be prudent upon returning home (before unpacking) to place all clothing in disposable plastic bags and directly into the washer and/or dryer. Inspecting or vacuuming luggage upon arrival home is less useful since it's hard to spot bed bugs inside a suitcase. The suitcase itself can either be treated or discarded.

The incidence of bed bugs in the United States is increasing to the point where vigilance by all is a prudent practice. Familiarity can help to avoid infestation, or at least prompt earlier intervention by a professional.

Revised August, 2008