

CHAPTER 10

Vertebrate Pests

Learning Objectives

- ✓ List physical characteristics of rats and select those unique to each species.
- ✓ Identify the habits and habitat that are characteristic of the house mouse.
- ✓ Describe monitoring procedures used in vertebrate pest control.
- ✓ Discuss use of rodenticides.
- ✓ Describe the impact of other vertebrates on household and structural resources.
- ✓ Identify nonchemical and chemical control alternatives for management of problem bird species.
- ✓ Identify methods for dealing with nuisance bats.

A number of animals can occur in close proximity to people, and this trend will probably increase over the next several years. As housing development continues to move out from population centers, more people are being brought into habitats that were once ideal for animals. This development may destroy or drive out some animals; however, other species are adapting to the changes and are thriving. Rats, mice, squirrels, deer, opossums, raccoons, skunks, bats, numerous bird species, snakes, and lizards can be found around structures.

Squirrels or raccoons will occasionally enter buildings (attics), and raccoons may get into crawl spaces. Usually they are looking for nesting sites. Over time, odors can develop from the nests, or fleas and other parasites may enter the living space of the building. Deer can damage ornamental or vegetable plants, and snakes may present potential health problems if they are a poisonous species. Rats and mice have adapted to living with people; they destroy or contaminate food and fabrics, cause structural damage, and are carriers of transmissible disease organisms.

Bats and birds do not live intimately with people, but many species use buildings for roosts or nests. They produce smelly and unsightly urine and droppings, are noisy, build messy nests, and may have several insect and mite pests living on their bodies or in their nests. There is also concern that bats can be infected with rabies. Birds may be capable of harboring or contributing to several different diseases, such as histoplasmosis.

Managing vertebrate pests requires special skills because these animals are larger and more intelligent than invertebrates. Vertebrates may learn to recognize and avoid some control attempts; therefore, an integrated and persistent approach is needed. It is necessary to understand their habits and food preferences to monitor and manage population levels effectively and economically; otherwise, control attempts may fail or even increase the problem.

RATS AND MICE

Rodents

Rats and mice, as a group, are known as “commensal rodents.” The word commensal is defined as “living together,” and over time, these animals have adapted to living with humans. Rodents can chew through wood and other materials to get to food sources. They are good climbers and can squeeze through small openings. Rat and mouse populations can expand rapidly and then consume or contaminate large quantities of stored food. They contaminate stored products and storage facilities with their urine, feces, and hair. They also damage cloth, plastic, and paper bags or cardboard boxes used to package stored products. Rodents within a storage facility may also chew on electrical wiring and cause serious fire hazards or equipment malfunction.

Rats and mice forage for food mostly at night, and this keeps them from coming into direct contact with humans. These rodents have poor vision but a highly developed sense of smell, taste, hearing, and touch. When foraging, rats tend to be nervous and become even more so if they detect changes within their territory. Mice are the exact opposite. They are very inquisitive and immediately investigate changes they find within their territories.

NORWAY RAT—*Rattus norvegicus*

Norway and roof rats are the principal rat species that may be in buildings. The two species can be distinguished by certain physical characteristics, including relative size of body and tail, shape of nose, and size of ears and eyes (Figure 10-1). The Norway rat, also known as the brown rat, house rat, wharf rat, and sewer rat, is the larger of the two rat species commonly found in buildings. Adults weigh between 12 to 16 ounces; their average length ranges between 7½ and 10 inches, excluding their tail. Tail length is less than head and body length, and ranges between 6 and 8½ inches. Norway rats have coarse brown fur with scattered

black hairs. The underside of the body is usually gray but may also be shades of yellowish white. The almost hairless tail is colored dark brown above, lighter below. This species has small, closely set ears, a blunt muzzle, and small eyes.

Norway rats become sexually mature at 3 to 5 months of age. They live for an average of 9 to 12 months in the wild, although their life span in captivity may be much longer. Females produce 4 to 7 litters of 8 to 12 young each.

Outdoors, Norway rats usually nest in the ground. They construct their burrows under cement slabs, in lumber piles, garbage and rubbish heaps, along stream banks, road embankments, or in other suitable locations. Nests are often no more than 6 to 8 inches below the surface and may be connected to bolt holes (separate exits used for escape when the main tunnel is blocked or endangered). From outdoor nests, Norway rats forage for food, entering buildings at night but returning outside before dawn. During cold or rainy weather, Norway rats move into buildings in search of shelter, warmth, and food. Indoors, they nest in secluded areas such as wall voids, behind appliances, beneath floors, and in drawers and closets where they will not be disturbed. When food and shelter requirements are adequate, these rats remain inside throughout their lives. Conversely, rats may migrate outdoors and even away from the building as weather improves. In some cases, the rat might colonize sewer systems and use this system to move between buildings, especially in larger cities.

Norway rats generally feed on any type of food, but they prefer greasy meat and other animal products, as well as fruits, grains and vegetables. When starved, they eat other items such as soiled or stained clothing, snails, cockroaches and other insects, soap, and animal feces. Rats must have a source of "free water" and may obtain water from leaking pipes or faucets, condensation, pet dishes, sinks, and toilet bowls. Norway rats have been known to gnaw holes in plastic and metal pipes to get water.

ROOF RAT—*Rattus rattus*

Roof rats, also known as black, fruit, or citrus rats, are smaller than Norway rats but have a tail longer than the combined length of the head and body. In adults, head and body length ranges from 6 to 8½ inches and tail length is from 7 to 10 inches. Body weight ranges between 6 to 12 ounces. Tail color is uniform on both sides rather than being lighter on the underside. There are several color variations in roof rats, ranging from mottled gray with white underbelly, to solid gray, to solid black with a gray underbelly. Roof rats have a pointed muzzle and large prominent ears. Eyes are larger and more pronounced than those of Norway rats. They become sexually mature at 3 to 5 months of age. Females can produce up to six litters having six to eight young per litter. The average life span is 9 to 12 months. Roof rats prefer to eat vegetable matter, including fruits, nuts, grains, and vegetables. Under stress, however, they eat a much wider variety of food.

This species will nest in ground burrows, but because of its excellent ability to climb, it prefers to nest in vines, hollow trees, and other types of dense foliage. Occasionally, they are found in sewers. In buildings, they nest in wall voids, attics, rafters, and other secluded and elevated locations. They can swim and squeeze through openings as small as ½-inch in diameter, making them difficult to exclude from buildings.

HOUSE MICE—*Mus musculus*

The house mouse (Figure 10-2) occurs throughout the United States. Although they are building pests, they also live outdoors. An adult house mouse is about 3½ inches long with a tail about the same length. They are usually dusky gray but may range from light brown to dark gray and have a lighter underbelly. House mice have large distinct ears. Adults weigh between ½ and 1 ounce. They reach sexual maturity within 35 days after birth. Gestation takes 18 to 21

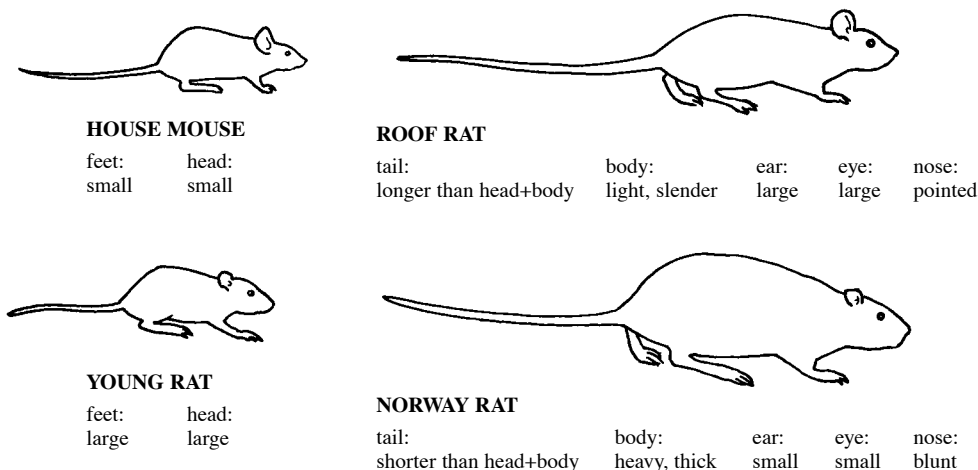


Figure 10-1. The Norway rat and roof rat can be identified by certain physical characteristics including relative body size, shape of nose, size of ears and eyes, and length of tail.

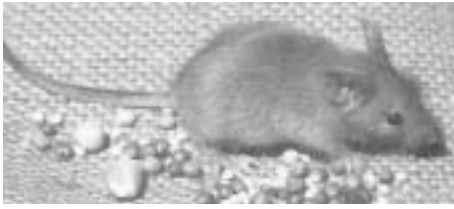


Figure 10-2. House mouse—*Mus musculus*.

days, and mature females can produce a litter every 50 days, with an average of 6 young per litter. After about 15 months of age, females stop having litters. Both males and females may live several years.

House mice cause structural damage to buildings by gnawing and nesting. They can damage attic and wall insulation and may chew through electrical wiring. If they build nests in large appliances, they may destroy insulation and wiring. Through feeding and nesting, house mice ruin items stored in warehouses, storerooms, attics, basements, and garages, and they can also seriously damage museum collections.

House mice eat most human food items. They consume meat, grains, cereals, seeds, fruits, and vegetables. A single mouse is capable of eating up to 8 pounds of food per year, although it destroys much more than this through fecal and urine contamination or partial eating. Mice also damage food packaging materials and containers. They can go for long periods without water, although in locations where water is scarce, they are attracted to fruits and other foods with high water content. They require more water when they eat high protein food.

House mice climb well, are good swimmers, and can jump more than 12 inches. They are capable of crawling through openings as small as ¼ inch wide. They run easily along horizontal pipes, wires, beams, and other objects. House mice adjust rapidly to changes in their environment, explore new objects, and try new food within a few hours after it is put out. They usually range an average of only 10 to 12 feet from their nest for food and water. At a maximum, their travel is usually within a range of 30 feet, although they sometimes travel farther.

General Management Guidelines for Rats and Mice

The management of rats and mice is similar. However, it is important to identify the species so that control efforts can be tailored to its particular habits. For more successful management, use several approaches including sanitation, exclusion, mechanical, and chemical control.

Successful rodent control may be followed by an outbreak of secondary pests such as rat fleas or mites. Be sure to look for possible secondary pest problems and be prepared to use control measures for these pests while conducting a rodent control program.

Because rodents may be diseased or infested with parasites such as fleas or mites, wear gloves when handling and disposing of carcasses. Place carcasses in sealable plastic bags and dispose of them by burning or burying. Keep children and pets away from living or dead rodents.

Detecting and Monitoring. Rat and mouse infestations can be detected by their feces and urine color and odor. Other identifying characteristics are holes and gnaw marks on structural portions of the building, and trails and greasy markings along runways. The size and shape of fecal pellets can be used to separate commensal rodent species; however, pellet shape is more characteristic than size, as younger rats produce smaller pellets than adults. The urine has a distinctive odor and a blacklight (ultraviolet light source) can be used to see urine droplets. The urine fluoresces in the presence of the blacklight, producing a distinct color. Any or all of these characteristics can be used to locate centers of rodent activity. Use these signs to help determine how the rodents are getting into the building and how they are moving about the premises once inside. Search for areas where nests are located. For rats, stuff paper wadding into burrow entrances and check them in 24 hours to see if wadding has been removed or chewed, indicating active burrows. Determine the type of food available to the rats or mice and where and how they are getting it. Look for water sources.

If possible, evaluate the extent of damage and economic loss caused by the rats or mice so that you can estimate the degree of effort and amount of money that should be spent to eliminate the infestation. From this information, begin to develop a control strategy. Prepare a sketch of the floor plan of the building, indicate entry points, feeding areas, water supplies, runs, and nest sites. Begin by focusing control efforts in areas of greatest and most recent activity.



Figure 10-3. The shape of fecal pellets can be helpful in identifying the species of rodent infesting a building. Left to right: roof rat, Norway rat, and house mouse droppings.

Exclusion. The most important control method for rodents is rodent proofing. To exclude rodents from storage areas, seal openings with heavy gauge sheet metal, heavy wire screen with a mesh of ¼ inch or less, or concrete with heavy wire screening embedded in it. Attach metal plates to the bottoms of doors to reduce the gap to ¼ inch or less and prevent rodents from entering. Modify foundations of buildings with concrete or metal barriers to stop rodents from digging their way in. Eliminate dead spaces inside the

storage area, if possible, to restrict areas where rodents may hide. Dead spaces include double walls, false ceilings, enclosed staircases, boxed plumbing, and voids under cabinets. Be careful not to seal rodents into wall spaces or attics as they will die without food or water, causing odor and fly problems.

Sanitation. Sanitation is important in preventing rodent buildup. Spilled grains and other food items around the periphery of a building attract rodents and encourage them to nest nearby. Be sure all spills are cleaned up quickly and placed in rodent proof containers or promptly destroyed. Sanitation must also include keeping all storage areas and adjacent spaces well-lighted, clean, and orderly.

Eliminate weeds, shrubs, and vines that provide shelter and hiding places for rodents. Rodent activity can be more quickly spotted in clean, orderly areas, enabling early control.

Habitat Modification. Modify the environment inside and around the outside of the building to discourage rodents. For instance, wrap rat guards (bands of thin sheet metal at least 18 inches wide) around the trunks of all trees adjacent to the building to keep rats from climbing them. Trim or remove dense foliage and ivy in contact with the building and place 18-inch sections of plastic shower curtain rod covers around electrical and telephone wires coming to the building. Eliminate sources of excess food and water. Clean areas daily where food is prepared or served. Store leftover food or food scraps in rodent-proof containers. Establish policies for good housekeeping in other areas of the building to eliminate nests and materials that can be used for nesting. Outdoors, keep shrubbery and grass well trimmed. Get rid of weeds and dense foliage that can provide nesting sites. Remove trash heaps and other stored materials that can provide nesting sites. Keep all garbage containers tightly covered, and place hardware cloth over the drain holes of large trash bins such as dumpsters.

Trapping. If possible, use mechanical or sticky traps to control rodents inside a building. The different types of traps available for rat and mouse control include snap traps, glue boards, and live traps. Because they are nontoxic, traps are one of the safest methods of eliminating rats and mice, and they may produce results more quickly than other control methods. Dead animals caught in traps can be located and disposed of more easily than those that are killed by poisons. Some individual animals learn to avoid traps and become trap shy.

To be most effective, traps should be placed along normal runways with triggers of spring traps placed adjacent to walls or other objects in the line of travel. If traps are used in areas where they are accessible to children or pets, put them in large bait boxes or similar containers. Trapping requires more time than chemical control methods because traps must be checked and serviced frequently.

Snap Traps. Snap traps are illustrated in Figure 10-4. In many cases, snap traps provide an effective, humane

method of controlling rodents without the need for rodenticides. They are useful in situations where there is a chance that poisoned animals might go into wall voids or other inaccessible areas to die. Other criteria for the use of snap traps include: (1) only a few animals are present, (2) people are opposed to the use of toxicants, and (3) there is time available for a successful trapping program.

To increase their effectiveness, put snap traps where rats or mice are most likely to encounter them, such as along or near known travel routes on floors, shelves, and walls. Lay a board against the wall to create a runway. Always use many traps to increase chances of catching rodents. Place two traps end to end to prevent rodents from jumping over and eluding them. Locate traps in areas inaccessible to children or pets. Also, do not place traps where they might be tripped accidentally. In homes and offices, place traps out of sight so animals caught will not be visible. Check traps daily to remove captured animals.

Rodent odors from previous catches will not repel other rodents and may even enhance the effectiveness of spring or live traps. Petroleum oils repel rodents, however; so never use these as a lubricant or rust prevention. If rust is a problem, cover metal surfaces with vegetable oil, lard, or other animal fat.

To reduce trap shyness (more of a problem with rats), bait the traps for several days without setting them until bait is taken regularly; then set the spring mechanism. Bait snap traps with an attractive food or nesting material. Foods attractive to rodents include peanut butter, sardines, bacon, sausage, whole peanuts, chocolate candy, marshmallows, cheese, dry rolled oats (for mice) and dog or cat kibbles. Many people have discovered other materials that work well in their situations. When unsure of which bait to use, try several different types at first, then continue baiting with the one that seems to work best. Tie bait securely to the trigger mechanism so it cannot be removed without springing the trap. Baits that cannot be tied, such as peanut butter, have the disadvantage of being easily removed from the trap without setting it off. Therefore, place only small amounts on the trigger plate. The rodent must work harder to remove the bait, so its chances of being caught are increased. Replace old or stale bait frequently to prevent baited traps from losing their effectiveness.

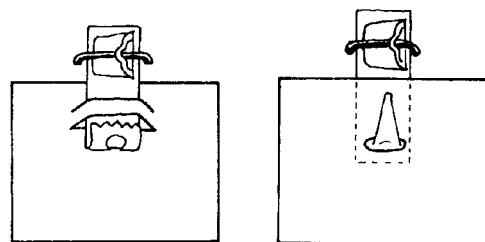


Figure 10-4. Snap traps can be more effective and can be used without bait if the trigger pedal is enlarged with a piece of heavy cardboard. Traps can also be purchased with an enlarged trigger pedal.

Baits used in traps may attract ants or cockroaches. If these are a problem, use nonbaited traps or bait them with nesting materials. For example, use a small securely attached cotton ball because mice collect cotton fibers for their nests. Traps are also available with trigger pedals infused with a mouse-attracting scent that does not attract insects.

When using nonbaited traps, enlarge the trigger mechanism with a piece of thin cardboard as illustrated in Figure 10-4. This type of trap is available commercially. Place nonbaited traps directly in rodent pathways, close to walls or other vertical surfaces; position the trigger side toward the wall. Also, nail nonbaited traps to beams and other overhead passageways. Be sure the trigger side is positioned in the line of travel.

Trapping rodents is most successful during the first 3 or 4 days after traps have been placed, after which, rodent catches usually drop off. Once the initial trapping period has passed, use a nontoxic tracking powder to see where remaining rodent activity is taking place and concentrate trap placement in those areas.

Glue Boards. Use glue boards in the same manner as snap traps to catch mice and rats (Figure 10-5). Glue boards, also called sticky traps, are disposable cardboard or plastic units having one or more surfaces thickly coated with a sticky paste. Put glue boards in runways and tape them around pipes or other objects traversed by rodents. Once an animal is caught, dispose of both the trap and pest. Submerging the trap in water or placing it in a freezer may kill live rodents.

Glue board management is necessary for effective rodent control. Keep them away from children or pets. Use vegetable oil to clean glue from fingers and mineral spirits to clean surfaces. Glue boards do not work well in wet or dusty locations where sticky surfaces become coated with dust and debris. If these conditions exist, place glue boards in protected bait boxes and use nonpoisonous bait to attract rodents.

Check glue board traps daily. Do not reuse traps once a rodent has been caught as some of the sticky substance will be lost and the trap is not as effective. Because they are large



Figure 10-5. Glue boards, also known as sticky traps, are used for trapping mice, rats, and insects such as cockroaches.

er and stronger, rats are more difficult to capture on glue boards; therefore, it is necessary to secure traps to a surface with tape or tacks to keep rats from dragging them away.

Live Traps. Live traps can be used to capture rats and mice, as well as birds, skunks, opossums, and other small animals. Live traps are the only types that can be used for PROTECTED WILDLIFE SPECIES. Live trapping requires time and patience. Use a nontoxic food as bait such as grains, fruits, meat, and other items. To increase trapping success, keep traps that are not set supplied with fresh bait for several days with the doors wired open. Set the trap-closing mechanism after food is taken regularly. An animal that has escaped from a trap will probably not go into one again, so do a careful, thorough job of trapping the first time. Place live traps in areas where children or pets will not disturb them and where the traps will not capture wildlife that is not targeted. Check traps at least daily to make sure that bait is available and the trap is still set.

Several styles of live traps are available for catching mice. A simple plastic one has a door that snaps shut as the mouse enters to get the bait. A more complicated mechanical live trap for mice is powered by a spring-wound mechanism. When a mouse enters the baited or unbaited trap, it trips a lever causing it to be flipped into a holding chamber. Another multiple-catch live trap uses a tipping runway leading into the holding compartment. These last two traps hold several mice and do not have to be reset each time one is caught. Live traps must be checked daily.

Rodenticides. Rodenticides are divided into three groups based on their mode of action or application method. These groups are (1) multiple-dose and single-dose anticoagulants, (2) acute single-dose non-anticoagulant toxicants, and (3) fumigants. Anticoagulants and acute toxicants may be applied as tracking powders, food baits, or liquid baits. Bait shyness and resistance problems may be associated with careless use of rodenticides, so keep bait fresh; use it selectively, and only when nonchemical methods are unsuitable. Rodenticides must be carefully placed to ensure that target rodents walk through or consume the toxic material. For instance, placement is different for control of roof rats (in rafters, etc.) than for Norway rats (on the ground) because these two species prefer to nest and feed in different environments.

An understanding of the rodent's habits is required for successful rodenticide use. Rats, for example, are wary of new items in their environment and may take several days before investigating or tasting introduced bait. Mice, on the other hand, usually investigate new items within a few hours. A disadvantage of poisons is that rodents may die in inaccessible places, causing odor and fly problems.

Baits. Poisonous baits are effective ways of controlling rodents in a confined area. Use them especially if access to other sources of food or water can be reduced or eliminated. Sometimes the attractiveness of rodent baits can

be enhanced by combining them with sugar, molasses, corn syrup, or similar sweetener, or with peanut butter or animal fat. This may attract ants, however, and makes the baits more attractive to nontarget animals. Most current baits available are ready to use.

KEEP BAIT OUT OF THE REACH OF CHILDREN OR PETS. Rodenticides are one of the leading causes of dog poisonings. These materials may also attract ants, stored-product pests, or other insects. Some baits are available as bait blocks, which can be attached to walls or structures in areas where rodents are most active. Most bait blocks incorporate paraffin or other waxy materials to keep them fresh and help protect them against moisture. Dogs may chew on paraffin blocks, so put them in out-of-reach places or in tamper-resistant bait stations.

Baits in the form of grains or pellets should be placed in bait stations so the toxic material will not be scattered. Put bait stations along known travel routes and near nests. Record the location of each bait station within a treated area so that each can be properly maintained and so all stations will be removed when the baiting program is over. Be sure bait stations are marked to indicate that they contain poisonous bait; also attach a label that includes the signal word, chemical name, and the name and telephone number of the person responsible for the bait station. The words “KEEP OUT-OF-THE-REACH OF CHILDREN” should be clearly printed on the bait station.

Prebaiting for several days with untreated bait may be useful as a monitoring technique and may help to determine how much toxic bait to use in a bait station. Once the untreated bait is consumed regularly, switch to bait with a toxicant. In this way, rodents should become accustomed to the bait stations as a food source. Whether using treated or untreated bait, check the stations frequently to be sure there is an ample supply of fresh bait. If bait is not being taken from some stations but is from others, consider relocating those with no activity. If little or no bait is removed from all the bait stations, the bait may not be suitable, or there may be another food source that is more attractive.

Bait stations may also be located in the wrong places. First, if possible, eliminate all competing food sources. Be sure bait stations are positioned near nests or known travel routes. If bait acceptance is still poor, switch to another type or brand of bait. Liquid baits can be very effective in situations where it is impossible to remove competing food sources but where water is limited. Liquid baits are used in chick-watering fountains. Be sure they are out of the reach of children, pets, and wildlife. You can add sweetened, powdered fruit drink to the water to increase attractiveness. Should this fail, use other methods of control such as toxic tracking powder and trapping.

Tracking powder is used to treat rodent burrows and inaccessible voids used by rodents. Use of a dust mask is advisable since you should not inhale the airborne powder. **NOTE: ONCE TOXIC TRACKING POWDER IS**

APPLIED, IT IS HARD TO RECOVER OR CLEAN UP IF THIS BECOMES NECESSARY.

Fumigants. Most fumigants used for rodent control are injected or released into the burrows of the pest or are used in food-storage areas such as grain silos. A disadvantage of fumigation is that dead rodents trapped in inaccessible sites may result in serious odor and fly problems. Fumigation requires that the treated area be evacuated and sealed so that the airborne concentration of toxicant can reach a lethal level. The toxicant concentration must be held at this level for a specific period of time as described on the label. Afterward, the area must be thoroughly ventilated before it is safe to enter.

BATS

Bats are highly beneficial wild mammals. They are not flying rodents but belong to a unique order of mammals called the Chiroptera (i.e., chiro - hand, ptera - wing). Bats are more closely related to primates (monkeys and humans) than they are to rodents. There are two families and 18 species of bats in the eastern United States, and most feed on night-flying insects. Each bat eats about its weight in food every night. This means that even a small colony, numbering several hundred individuals, consumes hundreds of pounds of insects every week. These insectivorous bats have tiny sharp teeth for chewing insects. Bats cannot use their teeth to gnaw wood or wires, as can rodents with their chisel-like incisors.

During the day, bats rest in dark secluded roosts, such as caves, hollow trees, under bridges, crevices, and the attics of buildings. In winter when insects are scarce; some bats migrate, while others hibernate in caves, trees, or buildings. Most bat species have only one baby per year. Therefore, it takes bat populations a long time to recover from human acts of destruction. Bats are long-lived animals. The little brown bat from the northern states is known to live up to 30 years. Bats in Mississippi can probably live 10 to 12 years, and they are creatures of habit. Once a roost has been established, they will frequent the same roost year after year.

Bats can become infected with the rabies virus, as can dogs, cats, raccoons, and skunks. Use care when dealing with bats. However, unlike the other animals, bats infected with rabies do not generally become enraged and attack people or other animals. They usually become paralyzed and die quietly. The infection rate for house-dwelling bats is very low, ranging from one per 2,000 (0.05 percent) in southeastern bat populations to four per 1,130 (0.35 percent) in Brazilian free-tailed bat populations.

Despite their importance as insect predators, bats can be a nuisance when they choose to live in houses, buildings, or other structures used by people. Common problems are listed below:

- noise
- smell

- accumulations of feces (guano) and urine
- staining and spotting of surfaces
- attraction of other pests such as flies or cockroaches
- general fear of these mammals by the public, requiring that they be excluded from a structure

Table 10-1. Distribution and natural history of bats in Mississippi.

Common Name	Species	Distribution	Summer Habitat	Winter Habitat	Notes
Southeaster Bat	<i>Myotis austroriparius</i>	Entire State	Caves, trees, buildings	Caves	Common building inhabitant
Gray Bat	<i>Myotis grisescens</i>	Extreme NE Mississippi	Caves	Caves	Endangered species
Northern Long-Eared Bat	<i>Myotis septentrionalis</i>	Northeast Mississippi	Hollow trees, buildings	Caves	Rare in Mississippi
Indiana Bat	<i>Myotis sodalis</i>	Northeast Mississippi	Hollow trees, under loose bark	Cave	Endangered species, rare in Mississippi
Little Brown Bat	<i>Myotis lucifugus</i>	Entire State	Hollow trees, buildings	Caves	Rare in Mississippi
Eastern Pipistrelle	<i>Pipistrellus subflavus</i>	Entire State	Trees	Caves	Rarely enter houses
Big Brown Bat	<i>Eptesicus fuscus</i>	Entire State	Buildings/under bridges	Caves, attics	
Red Bat	<i>Lasiurus borealis</i>	Entire State	Trees	Trees	Tree Bat
Seminole Bat	<i>Lasiurus seminolus</i>	South to North Central	Tree foliage, Spanish moss	Tree foliage Spanish moss	Tree Bat
Hoary Bat	<i>Lasiurus cinereus</i>	Entire State except for Coast			
Northern Yellow Bat	<i>Lasiurus intermedius</i>	Entire State	Trees, palms, Spanish moss	Trees, palms Spanish moss	Tree Bat
Silver-Haired Bat	<i>Lasionycteris noctivagans</i>	Entire State except for Coast	Trees	Trees	
Evening Bat	<i>Nycticeius humeralis</i>	Entire State	Buildings, hollow trees	Hollow trees	Common building inhabitant
Rafinesque's Big-Eared Bat	<i>Plecotus rafinesquii</i>	Entire State	Abandoned buildings, trees	Same as summer	
Brazilian Free-Tailed Bat	<i>Tadarida brasiliensis</i>	Entire State	Buildings, bridges	Same as summer	Common building inhabitant

The information in this table was checked for accuracy by Dean Stewart, Extension Wildlife Specialist, Mississippi State University.

General Management Guidelines for Bats

Removing Single Bats from a Building. Single bats occasionally enter buildings accidentally. This usually occurs in the spring or fall when bats move between winter roosts and maternity roosts, or in the late summer when young bats have just learned to fly. Young bats can become confused, get lost, and turn up inside buildings where they do not belong. In most cases, all that is required is to open a door or window so the bat can escape. If that is not possible, as in most air-conditioned buildings, you can capture a bat by covering it with an empty coffee can while it is resting. Then gently slide a piece of cardboard or heavy paper between the can and the surface on which the bat is resting, trapping it inside. Small groups of bats, fewer than 10, can also be removed in this way. If a bat is resting quietly, it may be possible to pick it up while wearing heavy leather gloves. Never touch a bat with bare hands; it will bite to defend itself, as would any wild animal. Do not try to catch a flying bat; this is almost impossible and usually results in injuring the animal. After the bat is captured, take it outside, away from children and pets, and let it fly away, or place it high on the side of a tree or wall to fly away on its own. A torpid (cold and sleepy) bat will need to “warm up” before it can fly.

If anyone is bitten, cleanse the wound thoroughly with soap and water and call the county health department for information and instructions. Try to collect the bat so it can be tested for rabies. **Never pick up a bat found lying on the ground. Keep children and pets away from it and, if necessary, move it to an inaccessible spot with a shovel or similar implement. Call the county animal control officer to have the bat removed.**

Confirming the Presence of Bats in a Building. The presence of a bat colony in a building is often confirmed by seeing bats emerge from various openings at dusk. Squeaking and rustling noises coming from ceilings and walls may indicate a bat colony is present. The sounds may also come from mice or flying squirrels. Nesting chimney swifts, which are small insect-eating birds, usually make chirping noises inside chimneys. An opening, which can be as narrow as ¼ inch, with a dirty stain below it, may be the exit hole for bats. Stains come from urine, feces, and body oils that are deposited around the opening as bats enter or leave the roost. Droppings on sidewalks, ledges, patios, or underneath rafters in an attic or barn may indicate bats are present. Bat droppings, which are brown or black and resemble instant rice grains in size and shape, are composed entirely of insect parts. Mouse droppings are similar in size and shape but do not crumble between your fingers to reveal bits of insects. Gecko (lizard) droppings are similar to bat droppings, but the pieces of insects are larger, less chewed up, and have a small white ball of uric acid on one end. Cockroach droppings are usually smaller.

Bat Proofing. As with most nuisance animal situations, preventing a problem is much easier and cheaper than correcting it. To prevent bats from establishing themselves in a building, all attic and soffit vents should be screened with ¼-inch hardware cloth or screen. Good ventilation of attics discourages bats from roosting and discourages infestations of large peridomestic cockroaches. In Spanish tile roofs, cover vent holes with screen that is held in place with silicon rubber chalk. Seal gaps in siding, spaces under warped fascia boards, spaces between house and chimney, and loose flashing and moldings to exclude bats and other invading household pests.

Excluding a Bat Colony. When bats do become established in a building where they are not wanted, the best and most permanent solution is exclusion. The following steps should accomplish exclusion:

1. Observe the building at dusk from all angles on three or four consecutive evenings to identify the entrance and exit openings that the bats are using.

2. Seal and bat proof all other openings that bats do not use but might use in the future. Some species of bats can enter through a crack or crevice that is only ¼ inch wide. Sealing materials can include caulking, wood, sheet metal, plaster, cement, ¼-inch hardware cloth, or window screen.

3. Plan to do the exclusions in the spring or fall. Bats give birth in the summer. Exclusions must not be attempted when baby bats are present as they do not fly with their mothers until they are almost full-grown. Baby bats trapped in the roost by exclusion will die of thirst or starvation and create a serious odor and fly problem. In Mississippi, exclusions should not be attempted from April through August. Wait until the young are flying to exclude the colony. Avoid exclusions in cold weather because bats usually do not fly when temperatures are below 45 °F.

4. Exclude unwanted bats by placing one-way devices on each of the colony's exit points. These devices can be as simple as a plastic “sleeve” (Figure 10-6). Once the bats exit through this, it collapses behind them. They cannot climb or crawl on the smooth plastic. Bat netting works the same way. The top of the netting is attached securely to a wall, beam, or other solid surface above the roost opening and extends over it. The bottom of the netting is secured at spots along the bottom edge. The netting can be secured with duct tape, staples, Velcro tabs, or silicon rubber chalking. The bats exit the roost, crawl out the bottom of the netting and escape, but they are not able to find the roost opening when they return for feeding because the netting covers the hole. Professional bat exclusion specialists have developed a variety of exclusion devices for special situations. Experienced professionals should exclude colonies in large structures or in high dangerous places. Returning bats may fly around the roost openings but will disperse within a day or so.

5. Once excluded, a large bat colony may leave behind external parasites such as bat bugs, soft ticks, or mites. Most bat parasites are host specific and will not bite people. Once

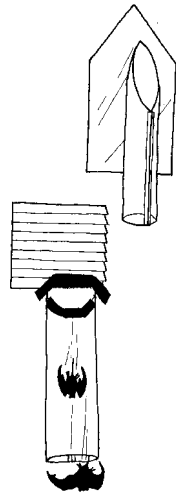


Figure 10-6. Plastic sleeve used as one-way device to exclude bats.

the bats have been excluded, the application of a desiccant or insecticide dust throughout the roosting site will kill parasites. This is a good precaution to prevent their spread while they look for other hosts. Bat guano dries to form a crumbly, powdery substance that can grow a fungus called *Histoplasma capsulatum*. Spores from this fungus become airborne when the guano is disturbed. Inhaled spores develop into yeast-like infection in the lungs. This produces a systemic disease called histoplasmosis, the effects of which can range from flu-like symptoms (in most people) to serious lung abscesses and lesions resembling tuberculosis (in a minority of others). When working in an area where bat guano is present, wear protective clothing and a cartridge respirator (capable of filtering particles as small as 0.3 microns) to avoid breathing guano dust. Before removing accumulated guano, spray it with water to hold down the dust.

6. Permanently seal roost openings when you are sure that all of the bats have left the roost. Leave the excluder in place for at least 3 days in warm weather, longer in cool or cold weather.

Other Methods of Bat Exclusion. Bright lights can be used to discourage bats from roosting in large structures that are difficult to seal, such as warehouses, barns, or similar buildings. Fiberglass insulation also discourages bats from roosting; this is probably because of the irritating nature of this material. Ultrasonic sound emitters for control of bats are expensive (\$20 to \$70) and there is no scientific evidence to indicate that they actually work.

Bat Houses. Since bats are beneficial, many people want to keep them in the neighborhood but exclude them from a building. This can be done by putting up one or more commercially available bat houses. Bat houses are similar to birdhouses in size and shape. However, they do not have a

circular entry hole; bats enter and exit from the bottom of the house, which is left open. Bats will not leave a building to move into a bat house. However, if a colony is excluded, bats may move into the closest new accommodations. A bat house should be placed high on the east side of a tree or building (10 to 15 feet) as far in advance of the exclusion as possible. There should be no branches directly below the bat house to obstruct the entry or exit of bats. Plans for a bat house are available from Bat Conservation International, P. O. Box 162603, Austin, Texas 78716-2603.

BIRDS

STARLINGS—*Sturnus vulgaris*

PIGEONS—*Columba livia*

HOUSE SPARROW—*Passer domesticus*

People spend millions of dollars each year on “birding” equipment, including various types of seed used for feed, bird feeders, binoculars, and clothing. They enjoy watching birds that come to the feeders or going out on bird-watching trips to identify different species. In some of the larger cities, birds may be the only contact people have with “a wild animal,” and they often do not want to hear that birds, regardless of the species, are causing a problem. Birds can present problems, however! They use eaves, roof ledges, statues, abandoned buildings, and similar areas as resting sites or for nest building. Over time, “droppings” and old nest material begin to accumulate. This accumulated material can create an odor problem or be a breeding site for microorganisms. The manure leads to the deterioration of statues or other building material. If birds gain access to warehouses, the accumulation of manure and feathers can lead to product contamination.

The most important way to prevent bird damage is to exclude them from the area where their presence is creating a problem. Exclusion devices might include the placement of plastic strips in large entrances that must be kept open for a period of time. These barriers enable people and vehicles to pass through freely but keep birds out. In all storage facilities, seal cracks and openings that are large enough for birds to enter. Close off vents and other high-level openings with wire screen that has a mesh of $\frac{1}{4}$ inch or smaller. Remove or modify ledges that serve as roosting sites, or install nets or other barriers to keep birds from using these areas. If birds are using a grove of trees as a nesting site, a noise/pyrotechnic approach might be instituted. This is usually done around roosts in the early fall and is mostly done by wildlife officials.

Maintain good sanitation around storage areas. Clean up grains or other items spilled during loading, transfer, and handling. Be sure that conveyors, railings, ledges and other parts of the storage facility are kept clean and free of food residues. Dispose of spoiled or contaminated products in covered containers, and remove these promptly from the area.

Avicides may be formulated as alarm materials, or they may cause the death of the pest bird. If avicides are used, place them in locations where there is no risk of contaminating any stored food products or attracting songbirds. Whenever possible, use materials that repel pest birds rather than killing them.

Repelling or poisoning pest birds requires considerable experience and expertise. Permits may be required from federal or state wildlife management groups to trap some species. Extreme care is required to prevent injury of protected nontarget species. In some cases, a trapping program may be used, but this usually works better with small isolated populations.

Birds are major predators of forest and agricultural insects. Because of their beauty and enjoyment value, the public wants birds protected. State and federal law and international treaty protect all native bird species. Some local communities have additional ordinances that protect all birds, both native and exotic species.

Although few birds actually cause problems, they can become nuisances when their activities conflict with human needs. The most common problem involves birds nesting in or on buildings. Their feeding, roosting, and flocking behaviors can also cause problems in specific situations. Such situations include the following:

- English sparrows and starlings defecating on materials stored in a warehouse to the extent that the receiving store refuses to accept the materials.
- Pigeons nesting, loafing, and defecating on buildings; chimney swifts nesting inside chimneys.
- Flocks of blackbirds, grackles, or ring-billed gulls living in parking lots and parks and becoming a nuisance.
- Birds eating commercial fruits, such as blueberries.
- Fish-eating birds in fish hatcheries or commercial production ponds.
- Ducks and geese defecating on parking lots and side walks near ponds, lakes, and canals.
- Birds striking aircraft or being sucked into jet engines at airports, damaging planes, and potentially causing accidents during takeoffs and landings.

General Management Guidelines for Birds

Identification. The first step in solving a bird problem is identification. This is very important because most birds are protected by law. Color identification field guides to birds are available at your public library or local bookstore.

Type and Extent of Problem. If birds are nesting in buildings, how are they entering the structure? If they are roosting on ledges, which ledges and what portion of the surfaces? Where are the food and water sources that support the nuisance population?

Exclusion. Close off openings with bird netting, screen, hardware cloth, wood, or sheet metal to eliminate entrances and nesting cavities. Special chimney caps are available to keep birds and other wildlife out of the flue. Large openings to warehouses and other buildings can be excluded using air curtains, a wall of air blown downward in front of the door, or heavy plastic strips covering the doorway. Protect fruit plants by covering them with plastic bird netting. In some situations, it is not possible to exclude birds because the area is too large or not suited to exclusion. Porcupine wire (Nixalite[®], CatClaw[®], etc.), electrified wires (AviAway[®]), and tactile roost repellents (sticky substances, usually polybutenes) are often used to keep birds from nesting or loafing on ledges, pipes, and ductwork. These materials will remain effective as long as they are clean and free of debris.

Flight Interrupters. These are used to deter large birds such as gulls, wading birds, and waterfowl from large areas such as over ponds or in large open buildings. Flight interrupters are sections of fine cable or heavy monofilament line strung to interfere with normal flight. The birds hit the lines while trying to land, take off, or fly through an area, and this makes flying difficult. While some birds will avoid the area, others learn to avoid the lines. Therefore, flight interrupter lines must be moved frequently for continued effectiveness.

Frightening Devices. The following items are of limited use because birds grow accustomed to them quickly, and noisy devices disturb people as well as birds:

- propane cannons (automatic gas exploders)
- electronic alarms
- recorded distress calls
- flashing lights
- pyrotechnic devices (fireworks, shellcrackers, whistle bombs, etc.)
- kites
- balloons
- artificial snakes
- models of hawks or owls

These devices are better suited to agricultural situations than urban settings. The greater the unpredictability and irregularity of the sound, the more effective these devices become. Therefore, use multiple devices with different timing intervals for maximum effectiveness. Ultrasonic devices have been used because they operate above the normal hearing range of human beings. Again, birds quickly get used to the sound and ignore it. Also, high frequency sounds bounce, creating sound shadows where the birds can escape the sound.

A variety of bird live traps are manufactured for English sparrows, starlings, and pigeons. Two types of entrances are used: funnel type and bob type. The funnel

type traps use the same concept as a minnow trap; it is easy to find their way in, but difficult to find their way out. The bob type trap uses vertically hanging rods, called bobs, that can be easily pushed in to let the bird into the trap but cannot be pushed out. Prebaiting is important for the success of either type of trap. Funnel trap locations are baited for several days before setting out the trap. Prebaiting of bob traps involves securing the bobs out of the way and placing bait inside the trap for up to a week before setting the trap by releasing the bobs. Some birds, especially cavity nesting birds like English sparrows and starlings, can learn how to escape from funnel traps. These educated birds frequently enter traps to feed and then exit them as easily as a person goes out a door. Live traps will never remove all nuisance birds if used alone.

Avicides. Avicides are bird poisons. The only avicide currently registered for use is 4-aminopyridine, Avitrol®. This material is toxic to all vertebrates and has rapid knock-down when used on birds. Poisoned birds often give distress calls, which scare other members of the nuisance flock away, thus limiting the number of nuisance birds that are killed while relieving the nuisance situation. Pigeons do not produce these distress calls, and this material should be considered strictly as an avicide in pigeon control.

Birds and Public Health

Birds may act as hosts for ectoparasites that can also attack people. These ectoparasites include bed bugs, soft ticks, mites, and some species of fleas, such as the stick-tight flea. Lice are very species specific, and bird lice will not live on humans or mammalian pets. Ectoparasites that leave birds or bird nests must be treated with a product labeled for these pests.

The accumulation of bird droppings may provide a medium for the growth of fungi harmful to human health. The fungus *Cryptococcus neoformans* grows in pigeon droppings, and the yeast-like cells that can infect people are inhaled with the dust when the droppings are disturbed. Cryptococcal infections may result in respiratory symptoms or no symptoms at all. Most cases go undiagnosed because no serious complications develop. However, if cryptococcal meningitis (an inflammation of the membranes covering the brain) develops, it can be fatal if not diagnosed and treated. Before cleaning up pigeon roosts, the guano, or accumulated feces, should be sprayed with an alkaline disinfecting solution. *Cryptococcus neoformans* is sensitive to alkali, so disinfecting solutions should contain sodium hydroxide (lye) or ammonium hydroxide (ammonia).

The fungus *Histoplasma capsulatum* is often associated with guano-enriched soil under bird roosts that are 3 or more years old. Although the fungus grows well in guano, it does not produce the infectious spores under the acid conditions found in fresh guano. Fresh guano contains large amounts of uric acid, the white “urine” in bird feces. The soil under roost trees used annually by flocks of breeding or

migrating birds are the most common sources of *Histoplasma* spores. This fungus is uncommon in pigeon roosts. Histoplasmosis usually produces no symptoms or only mild flu-like respiratory symptoms. Once infected, most people are immune from further histoplasmosis infections. People with weak immune systems may develop pneumonia with lung damage, blindness, or systemic involvement of the spleen and other organs. Droppings can only be decontaminated with a formalin solution, but the formaldehyde fumes are a greater health risk than the possibility of histoplasmosis, and its use is not recommended unless necessary.

When cleaning up bird guano, workers should wear a high efficiency particulate air (HEPA) filter that removes particles as small as 0.3 microns (μm) or supplied air respirator with full faceplate, disposable coveralls, rubber gloves, boots, and hat for adequate protection.

NUISANCE VERTEBRATE CONTROL LAWS

Frequently, pest control companies receive requests for help with “nuisance” wildlife problems either from current customers or one-time-only customers. These types of calls are often considered a nuisance because they can be time consuming. Response to nuisance wildlife calls should be considered a service to create good will and loyalty with current customers or an opportunity to develop relationships with potential new customers for other services.

Mammals

The roof rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), nine-banded armadillo (*Dasypus novemcinctus*), and coyote (*Canis latrans*) are not protected in Mississippi. Registered rodenticides may only be used to control house mice, roof rats, and Norway rats, if used according to label instructions.

All other mammals are protected as either native game or native nongame wildlife. Native mammals that are causing damage (except deer, bear, threatened or endangered species) may be taken by a property owner only in the immediate area where the damage is occurring. Only property owners, tenants, family members, and employees may kill nuisance wildlife without a permit. Pest control operators in Mississippi should check with the Mississippi Department of Wildlife, Fisheries and Parks, Division of Wildlife and Fisheries, P.O. Box 451, Jackson, Mississippi, if it is necessary to remove nuisance wildlife and if there is any doubt about the legality of the procedure. There are six district offices (Table 10-1) that might also provide information, as well as the USDA, APHIS Animal Damage Control Offices at Mississippi State University.

Two common native mammals that are often considered pests in lawns and golf courses are the southeastern pocket gopher (*Geomys pinetis*) and the eastern mole (*Scalopus*

Table 10-2. Mississippi Department of Wildlife, Fisheries and Parks, and Division of Wildlife and Fisheries District Offices and USDA, APHIS Animal Damage Control

District	Address	Location	Telephone
One	745 Rex Drive	Tupelo, 38801	1-800-670-9611
Two	253 Eureka	Batesville, 38606	1-800-670-9612
Three	4377 Highway 61	Merigold, 38759	1-800-670-9613
Four	P. O. Box 470	Newton, 39345	1-800-670-9614
Five	304 S. 2nd Street	Brookhaven, 39601	1-800-670-9615
Six	1318 W. Pine St.	Hattiesburg, 39401	1-800-670-9616
USDA, APHIS Animal Damage	Box 9690	Mississippi State, 39762	601-325-3014

aquaticus). The pocket gopher is a tan, subterranean rodent that makes large regularly spaced mounds and should not be confused with the protected gopher tortoise.

The most common species of nuisance wildlife in suburban environments are raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), gray squirrels (*Sciurus carolinensis*), and southern flying squirrels (*Glaucomys volans*). They are usually only a problem when they move into an attic or crawl space. Live trapping is usually the preferred method of control, followed by permanent exclusion. Raccoons are very difficult to trap.

Two species of bats in Mississippi (the Indiana bat and the gray bat, which generally do not occur in buildings) are classified as endangered species by the U.S. Fish and Wildlife Service. If good cause is shown (damage to property or to protect human health) endangered species may be removed, captured or destroyed, but a permit must be issued for this activity. **NO POISONS OR FUMIGANTS ARE LEGAL OR REGISTERED FOR CONTROL OF BATS IN MISSISSIPPI.** Poisoning a bat colony exposes people, especially children and pets to large numbers of dead and dying bats, thus increasing the chance of someone being bitten by picking up a sick animal. Exclusion is the only recommended permanent solution to an unwanted bat colony in a building and does not require a nuisance animal permit.

The repellent, naphthalene, is the only material registered for bat control in Mississippi. However, the effectiveness of the product has not been demonstrated, and even if some degree of repellency is obtained, its use is not a permanent solution. Naphthalene evaporates, and as soon as this occurs, the bats will return unless roost openings have been sealed. There is also the odor and expense of placing several pounds of naphthalene in a building where people live. If people are sensitive to the odor of mothballs, avoid using naphthalene. If naphthalene is used to repel bats from a structure, a nuisance animal permit is recommended to

protect the user legally in the event that bats are accidentally killed.

It is illegal to release exotic, nonnative species of wildlife into the wild in Mississippi. This might include such things as parrots, parakeets, white mice, ferrets, gerbils, hamsters, or exotic fish species.

Reptiles and Amphibians

It is illegal to use toxic materials such as gasoline or fumigants to flush reptiles from their dens or to kill them. No toxicants are registered for control of reptiles or amphibians. Exotic species are not protected and may be captured or killed without a permit. Native species of amphibians and reptiles are protected from wanton destruction and are generally beneficial.

Native snakes that are not listed as threatened or endangered, but are a nuisance because they frighten people, may be captured and relocated using various trapping methods. Some frogs and turtles may be harvested for food with a fishing license. Current lists of endangered and threatened species and state species checklists are available from the Mississippi Department of Wildlife, Fisheries, and Parks. Nuisance American alligators (*Alligator mississippiensis*) may only be captured and removed or killed by licensed trappers, members of MDWF&P or USDA animal control officials.

Birds

English or house sparrows (*Passer domesticus*), starlings (*Sturnus vulgaris*), rock doves or domestic pigeons (*Columba livia*), and the Muscovy duck (*Cairina moschata*) are unprotected exotic birds. They may be shot, live trapped, snared, or captured by hand without a permit or license. Local ordinances usually prohibit the discharge of firearms and may protect all species of birds from being killed or harassed. Check your local ordinances.

The red winged blackbird (*Agelaius phoeniceus*), rusty and Brewer's blackbirds (*Euphagus spp.*), grackles (*Quiscalus spp.*), brown-headed cowbirds (*Molothrus ater*), and crows (*Corvus spp.*) may be taken by a property owner without a permit when they are in the act of damaging or about to damage ornamental trees, agricultural crops, wildlife, livestock, or are concentrated to be a threat to human health. These birds are protected when not causing damage. When crows are not causing damage, they may only be taken during the legal crow-hunting seasons, at which time a hunting license is required. If pest-control operators or others are hired by a property owner to remove these bird species that are causing a nuisance, they should check with local wildlife officials for any regulations which might govern this activity.

All other species of birds are protected under THE MIGRATORY BIRD TREATY ACT, 16 U.S.C. 703-711. These protected birds include all other species of wild birds not previously mentioned. When protected birds become a nuisance, permits from the the United States Fish and Wildlife Service are required before attempting to take these birds or their nests. Situations that fall in this category include the following: chimney swifts nesting inside chimneys, bar swallows nesting inside buildings, Carolina wrens nesting inside buildings and mailboxes, woodpeckers pecking on or nesting in buildings, vultures roosting on buildings, least terns nesting on roofs, and gulls flocking around garbage dumps, airports, warehouses, and parking lots.

