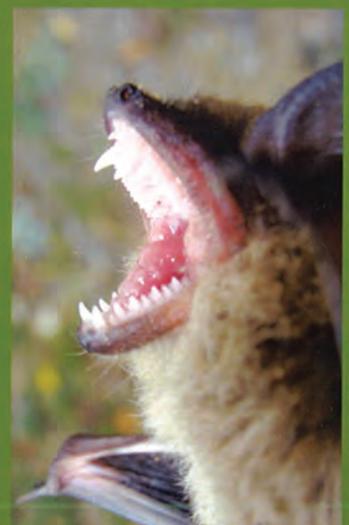


# Wildlife Damage Management for Nebraska Master Gardeners

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National Wildlife Control Training Program

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## Disclaimer

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Wildlife damage management (WDM) involves risks, including bodily injury. Readers are advised to review the safety information provided in this manual.

Not all information included within this manual may be applicable or allowable under existing state or local laws and regulations. For example, some control methods mentioned may not be legal in your location. Use this manual for informative and training purposes only. Periodically, regulations will change, so it is up to you to be aware of these changes. Some wildlife species are regulated by the federal government (e.g., migratory birds), and all applicable federal permits must be obtained before conducting control work when necessary.

Always use repellents and toxicants in accordance with labels approved by the US Environmental Protection Agency (EPA) and your local and state regulations. Mention of any products, trademarks, or brand names does not constitute endorsement, nor does omission constitute criticism.

Wildlife damage management is controversial. Readers are encouraged to be discreet and always act with the highest ethical values when performing WDM.

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# Overview

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Wildlife has an important role in the environment and adds beauty to our world. Unfortunately, wildlife can damage property, be a nuisance, and pose threats to human health and safety. The purpose of this manual is to provide the basic information needed to help people resolve conflicts with wildlife.

*Wildlife Damage Management for Nebraska Master Gardeners* is designed to help Master Gardener volunteers manage wildlife problems by proposing solutions based on the principles of integrated pest management (IPM). Golf course managers, landscape managers, and homeowners may find the information useful as well.

This manual covers the basic knowledge needed to effectively deal with a variety of wildlife issues. It focuses on techniques appropriate for Master Gardener volunteers and homeowners. For the most part, only methods suitable for nonprofessionals dealing with human-wildlife conflicts have been included. Anyone who needs to resolve conflicts with wildlife can implement the fundamental principles of wildlife damage management (WDM), using IPM for birds and mammals.

Safety practices should be followed. You will need knowledge of the biology, habitats, signs, and damage caused by various species. This manual includes information on species that commonly cause human-wildlife conflicts in Nebraska.

Animal-handling and control techniques must be learned, practiced, and mastered. If an animal must be killed or euthanized, it should be done as humanely as possible. Whether the conflict with wildlife is simple or complex, your response should follow the highest ethical standards. Federal, state, and local laws and regulations must be obeyed.

A high level of skill and knowledge often is necessary to effectively and safely manage some species. If the damage situation is complex, safety issues exist, or you have concerns about your ability to handle a wildlife problem with appropriate care and diligence, do not hesitate to contact a professional Wildlife Control Operator (WCO). Nebraska requires professional certification for the use of regulated toxicants. To find a WCO in your area, check your local yellow pages or the Internet. We recommend that clients interview the WCOs thoroughly before hiring to ensure that the solutions they suggest are sound and meet with your expectations. In addition, the Nebraska Game and Parks Commission (402.471.0641) or the USDA-APHIS-Wildlife Services (402.434.2340) may be able to assist.

Those who want to learn advanced control methods used by WCOs can purchase a copy of the *National Wildlife Control Training Program (NWCTP)*, from which this Master Gardener manual was adapted (<http://NWCTP.com>). The *NWCTP* was developed to provide consistent educational standards for wildlife control professionals. The *NWCTP* addresses situations and methods that require a high level of expertise, such as disease threats, dangerous equipment, lethal controls, and problems involving legal issues and permits.

The authors welcome comments and suggestions from readers. Our goal is to provide a manual that helps people resolve conflicts with wildlife in a responsible and effective way. Send your comments and suggestions for improvements to [svantassel2@unl.edu](mailto:svantassel2@unl.edu).

*Wildlife Damage Management for Nebraska Master Gardeners* was developed with support and funding from the US Department of Agriculture-Integrated Pest Management Program.

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# Introduction

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This manual provides methods for managing wildlife damage, based on research, for a variety of different species using the latest techniques within a framework of Integrated Pest Management (IPM). We offer strategies for a variety of situations and believe this manual has the following advantages:

1. suitable for any state in North America,
2. recognizes the diversity of activities and complex decisions involved with managing problem wildlife,
3. organized so that readers can find information quickly, and
4. encourages feedback from readers with the goal of improving the manual.

Several important topics are addressed, such as management techniques, safety, wildlife diseases, animal biology, legal issues, and euthanasia. We have adapted this manual to an online format so individuals can read the information at their own convenience via the Internet at <http://WildlifeControlTraining.com>. This manual focuses on all aspects of wildlife damage management (WDM) that are essential for Master Gardeners and other non-licensed people who wish to resolve human-wildlife conflicts.

Prevention of damage is something many people can and should do to reduce potential conflicts with wildlife and economic losses. Understanding the basics of WDM and the general principles of IPM enables homeowners, gardeners, landowners, and others to deal with a wide range of human-wildlife conflicts.

This manual will help you understand federal laws and regulations pertaining to control of vertebrate pests, specifically mammals and birds. When dealing with wildlife, you need to understand local and state laws, as well as the major federal regulations. Those who wish to assist others or themselves in WDM should know which species can be managed, the management methods that can be used legally, and the considerations and safeguards needed to protect nontarget species. They should know how to obtain information from state and

federal websites. Some violations (e.g., violating the Endangered Species Act) may result in criminal charges.

Identification is a critical component of WDM. Those who want to deal with wildlife damage should be able to identify the common mammals and birds that cause problems in both urban and agricultural environments. It is important to identify the species by its tracks, sign, and types of damage. It is helpful to understand whether the species is native or invasive, as legal requirements for management may vary. This manual contains information on species that commonly cause conflicts to yards and gardens in Nebraska.

A certain amount of knowledge of vertebrate biology and ecology is necessary to understand how to manage a problem species. Knowledge of the species' litter size, food and water requirements, preferred habitat, and activity cycles will help in the creation of a successful management plan for the problem species.

The importance of safety in any program cannot be overstated. Dealing with problem wildlife can be hard and dangerous work. One of the most frequent causes of injuries when dealing with problem wildlife is a fall from a ladder. In addition, animal behavior can be unpredictable, resulting in bites, scratches, and attacks. Animals can carry diseases and parasites that can harm people or pets. Pay close attention to health and safety recommendations. If you have concerns about your ability to handle a certain task, we suggest hiring a professional.

Success in WDM is obtained when the problem is reduced to a tolerable level. Successful resolution of human-wildlife conflicts uses the following process:

1. set an economic threshold,
2. identify the pest,
3. locate and monitor the pest or damage,
4. determine the legal status of the pest and obtain necessary permits, and
5. choose prevention or control methods.

The goal of this manual is to provide the information needed to make good decisions when performing WDM activities. Some procedures, such as shooting or trapping, require a higher level of skill than others. Many prevention measures, such as habitat modification, exclusion, and sanitation can be performed by most people.

Integrated pest management (IPM) is a key component of WDM. The goals of any good pest management program are to start with what is easy, least expensive, and has the lowest risk to the environment and nontarget species. Prevention and control measures must be legal, and used ethically and with integrity.

## What is Wildlife IPM?

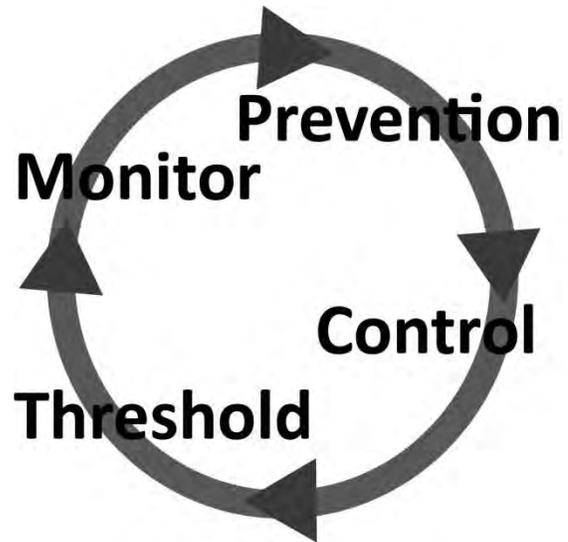
Wildlife IPM is an effective and environmentally-sensitive approach to WDM that relies on a combination of common-sense practices. Wildlife IPM programs use current, comprehensive information on the life cycles of problem animals and their interactions with the environment. This information, in combination with available prevention and control methods, enables us to manage wildlife damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach for WDM can be applied to both agricultural and nonagricultural settings, such as the home, garden, and workplace. Also, this approach takes advantage of all appropriate management options including, but not limited to, the judicious use of lethal control methods, including toxicants, shooting, and trapping. This approach also takes into account the conservation and preservation of our natural resources, and attempts to enhance the enjoyment of wildlife through balanced efforts of control and management.

## How do Wildlife IPM programs work?

Wildlife IPM is not a single animal control method, but rather, a series of wildlife management evaluations, decisions, and control activities. In practicing WDM, those aware of

the potential for wildlife problems should follow a four-tiered approach (*Figure 1*).



**Figure 1.** The four steps of IPM in WDM. Image by Stephen M. Vantassel.

The four steps include:

### *Set Action Thresholds*

Before implementing any method, WDM first sets an action threshold, a point at which environmental or economic conditions indicate that a wildlife management action must be taken. Observing an animal in the backyard does not always mean control is needed. The level at which wildlife will become an intolerable problem, a safety or health concern, or become an economic threat, is critical to guide WDM decisions.

### *Identify and Monitor Problem Animals*

Only a few species require control. Many wildlife species are innocuous, and some are beneficial. A WDM program accurately identifies problem animals and monitors their activity so that appropriate decisions on prevention and control measures can be made. Accurate identification and monitoring are the first steps in reducing the possibility that an inappropriate method will be used when it is not really needed, or that nontarget animals will be impacted.

## Prevention

As a first line of defense, WDM programs work to manage the garden, home landscape, or indoor space to prevent animals from becoming a threat. Exclusion and habitat modification are powerful, longterm management methods. This could include selecting animal-resistant varieties of ornamental plants, or planting garden crops that are not attractive to wildlife. It also could mean using nets, fences, or setting up the garden in a controlled space, such as a yard patrolled by a dog. Removing food attractants, such as spilled birdseed, is very important. Also making sure that chimneys are capped, and buildings are in good repair, is critical. These management methods can be very effective and cost-efficient, and present no risk to people or the environment.

## Control

Once monitoring, identification, and action thresholds indicate that wildlife control is required, and preventive methods are no longer effective or available, WDM programs then evaluate potential control methods both for effectiveness and risk. Effective methods with less risk are chosen first, which may include trapping and removal of wildlife, or the judicious use of toxicants. Lethal control methods often are a last resort.

## Do most homeowners use WDM?

With these steps, WDM is best described as a continuum. Most landowners identify the exact species of nuisance wildlife before taking action. A smaller subset of homeowners use only less risky methods such as nets and fences, habitat modification, and a high level of sanitation. Some resort to lethal control. All of these methods are on the IPM continuum, ranging from low risk to higher risk. The goal is to move clients only as far along the IPM continuum as needed to resolve a conflict.

## If I grow my own fruits and vegetables, can I practice WDM in my garden?

Yes, WDM principles can be applied to home gardens and landscapes by following the four-tiered approach outlined earlier. For more specific information on practicing WDM in your garden, contact UNL Extension for assistance.

*Wildlife Damage Management for Nebraska Master Gardeners* is designed to convey the basic knowledge needed to perform WDM. Check out the professional version of this program at <http://WildlifeControlTraining.com> or consult *Prevention and Control of Wildlife Damage*. The 1994 version is available at <http://icwdm.org/handbook/index.aspx>, and is a resource for anyone who deals with wildlife damage problems—from professionals to the general public.

# Module 1 Principles of Wildlife Damage Management

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Module 1 covers the basic principles of wildlife damage management (WDM), such as key definitions, important objectives, and social and ethical considerations.

## Learning Objectives

1. List three reasons why WDM is necessary.
2. Describe three objectives of WDM.
3. Explain why the concept of “balance of nature” is misleading.
4. List the four major strategies of WDM.
5. Provide some reasons why the removal of wildlife could fail to control the damage.

## Introduction

Wildlife is an important resource in the US. According to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 90 million US residents fished, hunted, or watched wildlife in 2011. They spent over \$145 billion pursuing these recreational activities, contributing to millions of jobs in industries and businesses that support wildlife-related recreation. In addition to hunting and fishing, fur trapping is an important industry. Usually, wild animals are not a problem and people enjoy seeing wildlife around their homes. However, some wildlife species do well in the landscapes we create and cause conflicts with humans.

Wildlife damage management is founded in the traditions of hunting and trapping. Many state and federal regulations regarding the control of certain species are based on hunting and trapping regulations. Wildlife pest control or wildlife control operators (WCOs) are an outgrowth of urbanization and human-wildlife conflicts, and the movement of problem wildlife into suburban backyards. Laws or regulations pertaining to hunting and trapping may or may not apply to wildlife damage issues. The training and skills required to hunt and trap are similar to some of the control methods for WDM. A different set of skills, however, also is needed to manage wildlife in urban and suburban settings.

The management of wildlife damage has moral, economic, social, and biological dimensions. Concerns about animal welfare, property damage, safety, species diversity, and habitat destruction pose philosophical questions that must be answered professionally, fairly, and legally. Public awareness, appropriate legal oversight, and research by wildlife professionals are required to make sure that human-wildlife conflicts are managed properly.

## Definitions

Wildlife become pests for three main reasons.

- **Economic** – personal and social costs associated with damage.
- **Safety** –wildlife attacks, vehicle collisions, and transmitted diseases.
- **Nuisance** –noise, defecation, odors, and unsightly impacts.

Wildlife damage management is defined as the process of resolving conflicts associated with vertebrate species that:

1. cause damage to food, fiber, personal property, and natural resources (e.g., feral pigs cause \$800 million of damage to US crops each year);
2. threaten human health and safety through disease, strikes, and attacks (e.g., tick-borne disease associated with deer); and
3. become a nuisance (e.g., geese on golf courses, skunks under a deck, and phobias related to snakes).

## Objectives of WDM

The objectives of WDM are to: (1) reduce damage to a tolerable level, (2) use methods that are low-risk for people and the environment, and (3) implement control methods in a cost-effective way. A WCO is an individual trained and licensed to resolve wildlife damage and nuisance wildlife situations, usually for profit. Many common problems associated with wildlife, however, can be resolved by the landowner using exclusion or

habitat modification. This manual will focus on methods to prevent wildlife damage. Contact a trained professional for situations where safety is a concern or the wildlife problem is complex.

## WDM Considerations

### *Look for practical solutions to human-wildlife conflicts*

Homeowners should set reasonable wildlife management goals. Be respectful and prudent when people explain their negative feelings about an animal. Do not reinforce inappropriate stereotypes or be drawn into a “problem” that does not need solving (*Figure 1*).



**Figure 1.** A difference exists between raccoons living as a nuisance in a home and raccoons passing through a backyard. Photo by Steve Stronk.

The focus of WDM is to prevent or resolve a specific problem. The goal is not to reduce the number of animals in an area. Landowners should target only the animals causing a specific conflict and prevent the situation from recurring.

### *Act legally and morally*

Is the pest protected? Is legal permission required to remove or contain it? Is certification needed or are permits required? Homeowners experiencing wildlife damage may be under severe stress and suffering high economic losses, which could lead them to encourage the use of dangerous or illegal techniques. Just because a method works does not mean it should be used. For example, mixing strychnine with cat food or setting out a bowl of radiator antifreeze may be effective in killing opossums and raccoons. However, these techniques are

illegal and irresponsible, and can result in the poisoning of nontarget animals and unnecessary suffering. Recommend the techniques you believe to be most appropriate for solving the problem. If a homeowner requests something beyond what you believe is legal, reasonable, moral, or safe, suggest appropriate alternatives.

### *Use cost-effective control*

How much will it cost to execute and maintain a strategy? People have limited financial resources. Be sure to evaluate costs and benefits over the longterm. If the expense of resolving a problem costs more than the problem itself, it may not be practical to control the damage. The true cost of a method, however, must be considered over time. For example, it would take truckloads of vegetables and many years to recover the cost of installing a \$500 fence to protect a garden from hungry animals. However, installing a \$250 stainless-steel chimney cap to keep raccoons and other wildlife out of a chimney is inexpensive, given the cost of their removal. If the cap lasts 20 years, the annual cost of the cap will be just \$12.50.

Patience is needed to deal with clients, wildlife problems, and potential solutions. Some problems may be very complex and require you to coordinate costs, timelines, and legal requirements. Other necessities are required for effectively dealing with WDM.

- **Preparation.** Be prepared to understand the wildlife problem in the context of the environment, landscape, or building.
- **Knowledge.** Have knowledge of the biology and basic behavior of the species.
- **Resources.** Know what will be needed to deal with the problem safely and effectively. Have the right protective gear and specific tools to safely exclude or remove the target species.
- **Skills.** Have the skills to manage the methods and equipment to effectively resolve the concern.

## Strategies to Prevent and Control Wildlife Damage

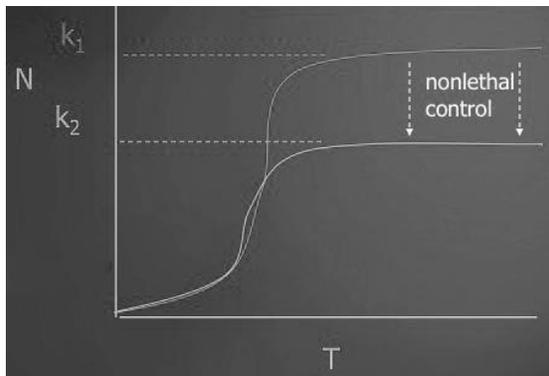
Specific methods to manage damage will be repeated throughout this manual and form the basis of most effective strategies. Prevention typically is the best, safest, and most effective approach to WDM. It is important to understand and apply prevention and control methods properly. Methods for individual species are included in this manual.

Methods for WDM often are classified into four categories.

1. **Habitat modification.** Reduce the availability of food, water, and shelter to reduce the number of animals that can be sustained over time.
2. **Exclusion methods.** Prevent animals from accessing a location.
3. **Repellents and frightening devices.** Repel or divert animals from a location.
4. **Lethal control.** Reduce the number of animals through shooting, trapping, and the prudent use of toxicants.

### *Habitat modification*

The number of animals the land can sustain, known as the carrying capacity (symbolized by the letter “k” in *Figure 2*), can be reduced by decreasing the resources necessary for population growth.



**Figure 2. Removal of resources can reduce the carrying capacity (k) of a location and thereby reduce the number of problem animals.**  
Image by Scott E. Hygnstrom.

For example, if someone is having conflicts with mice, removing available food by reducing spillage of bird feed, protecting food storage bins, and securing trash and compost will slow the increase in the number of mice. While you could aggressively trap to reduce the number of mice, your efforts would yield short-term results without also addressing the availability of food, because populations of mice can rebound quickly.

### *Exclusion*

When practical, physically preventing access of target animals to an area of concern often is the best longterm solution. Exclusion techniques range from simply sealing entry holes on buildings to installation of bird exclusion devices and animal-proof fences. Although exclusion initially may cost more than trapping, it provides a longterm solution to prevent further problems and damage.

### *Repellents and frightening devices*

Another WDM strategy is to repel or scare animals from a location. Repellents are chemicals based on pain, fear, touch, or conditioned aversion. Frightening devices are visual, audible, a combination of the two, or biological. The effectiveness of the technique greatly depends on how motivated animals are to access the protected location or food sources. The impact of repellents and frightening methods almost always is short-term.

### *Lethal control*

The number of problem animals can be lowered using lethal control methods, such as toxicants, trapping, or shooting. Such actions typically lead to a quick decrease of the target population to a level in which they or their associated damage can be tolerated. Lethal control is especially appropriate when animals pose risks of disease or safety. However, animal removal usually brings short-term results if suitable habitat remains.

Habitats with plenty of food and shelter allow animals to live well. Well-fed animals often have larger litters and greater success in raising young to maturity. The killing of animals may be

effective in reducing damage, but habitat modification often is necessary to prevent future damage.

Wildlife dispersal, the movement of an animal from where it was born and reared, also may cause population reduction to fail in some cases (Figure 3). For example, a person may have a chipmunk problem in a yard. Four chipmunks are trapped and removed, yet several weeks later the person complains that the problem is back. The action was effective, as the chipmunks residing on the property were removed. What the person may not understand was that other chipmunks moved in from neighboring properties (the reservoir) and occupied the habitat previously used by the chipmunks that were removed.



Figure 3. Introduction of problem animals through dispersal. Image by Stephen M. Vantassel.

## The WDM Process

When presented with a wildlife problem, inspect the site. Search landscapes and buildings for signs of wildlife activity. One or more of these methods – habitat modification, exclusion, repellents and frightening devices, and perhaps lethal control – will fit into an overall or longterm WDM plan.

Once animals gain entry to buildings, homeowners must use WDM methods appropriate to the situation and structure. Monitor animal activity to observe the effectiveness of the selected method. Be certain that the problem is truly resolved or effectively contained. If it is not, select another method.

## Public Perceptions

### *Will predators solve the problem?*

Wildlife populations are not stable (Figure 4). People suffering from wildlife damage often wonder why the problem is happening now. While reasons vary, it is important that homeowners understand that wildlife populations fluctuate, sometimes dramatically, both within a year, and from year to year. For example, rodent populations frequently increase in response to improved rainfall, because the enhanced growth of plants produced more food. As prey numbers increase, predator numbers also may increase, although usually in the following year.

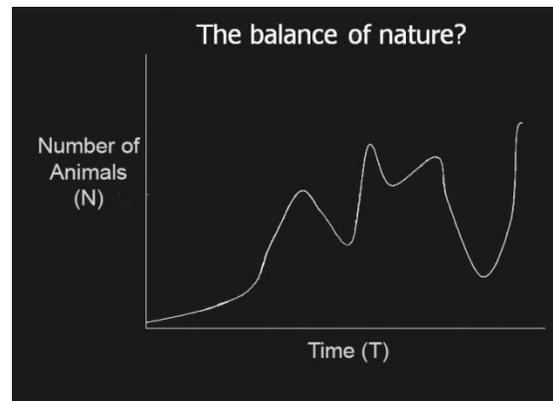


Figure 4. The graph shows how an animal population may fluctuate across a period of years. Image by Scott E. Hygnstrom.

Locally, populations can change due to human activity such as construction, and the addition or removal of bird feeders, trash receptacles, and gardens. The bottom line is that environmental issues often are out of the control of your clients. Help homeowners refocus on their property and how they can make appropriate changes to reduce wildlife damage.

A common misconception is that wildlife is “out of balance” with nature because humans have removed predators from the system. While it is true that top-level predators may be present in low numbers or even absent, it is unlikely that restoring their populations would solve most human-wildlife conflicts. Human tolerance of damage by wildlife often is quite low. Homeowners do not want to have fewer squirrels in their attic; they want NO squirrels in

their attic. If a predator substantially reduces prey populations, the predator would threaten its own existence by eliminating its food source. For example, having bats in a backyard will never make the yard free of insects, and even a cat that is a great mouser cannot control every rodent living in a house (*Figure 5*). In addition, many predators are not selective in their choice of prey, so nontarget animals likely will be taken as well.



**Figure 5.** Although often recommended, cats are not very effective for control of rodents. Photo by Stephen M. Vantassel.

### *Whose home?*

Many people believe that wildlife cause damage to property because “humans have taken away their homes.” Although this logic is understandable, many species (e.g., raccoons and squirrels) actually do well in suburban areas and animal densities may be much higher than in nearby rural areas. Urban sprawl has created and supplied habitat and food for species that often cause damage. In fact, some animals thrive in human-impacted environments because:

1. urbanization creates new shelter such as attics or chimneys;
2. urbanization provides food for animals through bird feeders, trash cans, compost piles, fruit trees, and pet dishes;
3. environmental legislation has allowed some wildlife populations to rebound; and
4. lethal control of wildlife (e.g., hunting and trapping) may be illegal in some areas due to safety concerns and local regulations.

Populations of white-tailed deer (*Figure 6*), for example, have increased dramatically across much of the US for several reasons, including:

1. expansion of their preferred edge habitat (e.g., mixed lands, woods, and fields),
2. subsidized food sources such as garden and ornamental plants or bird feeders,
3. reduced hunting pressure (fewer hunters and more land is closed to hunting), and
4. lower numbers of natural predators (automobile strikes, however, kill hundreds of thousands of deer each year).



**Figure 6.** Numbers of white-tailed deer are on the rise due to changes in human behavior and landscapes. Photo by Paul D. Curtis.

## Who Can Perform WDM?

Anyone can use basic strategies for wildlife damage management. Prevention of problems is the preferred solution. If you want to properly manage a wide variety of wildlife concerns, you must gain skills and competency in safe practices, site inspection, use of equipment, and communicating with clients and local authorities. In addition, you must be knowledgeable of species biology, legal requirements, and ethical considerations.

## Questions for Reflection

1. Explain why the statement “balance of nature” may be misleading.
2. A homeowner has a rodent problem but does not want to stop feeding birds that are constantly scattering bird seed. What would you tell the person?
3. You recommend installing screening under a deck to protect the area from skunks. The added protection of burying the base of the screen increases the cost. The homeowner expresses resistance over the price. How would you help the person appreciate the value of the exclusion?
4. You have had difficulty in removing muskrats from a pond. The landowner, angry over the damage to the water-control dam, suggests dumping motor oil in the pond to eliminate the muskrats. How would you respond?

## Objective Questions

1. A goal of WDM is to
  - a. change the habitat
  - b. remove animals
  - c. reduce the damage to a tolerable level
  - d. do whatever the client wants
  - e. none of the above
2. True or False. Repellents and frightening devices provide longterm solutions to wildlife conflicts.
3. Habitat modification
  - a. reduces the total number of wildlife that can be present
  - b. reduces wildlife numbers over the long term
  - c. is considered a nonlethal form of control
  - d. all of the above
4. True or False - People have problems with wildlife because construction and development has removed animal habitat.
5. True or False - Introducing predators to an area usually reduces nuisance wildlife to levels acceptable by people.

## Module 2 Physical Safety

The purpose of this module is to provide information to prevent injuries associated with wildlife damage management (WDM). Check state and local guidelines as well as regulations by the Occupational Safety and Health Administration (OSHA). When advising people on dealing with human-wildlife conflicts, it is important to emphasize physical safety in the work environment. WDM can be dangerous work. Hazards arise from animals, diseases, tools, and work environments.

### Learning Objectives

1. Describe important safety considerations when choosing work clothing such as shoes, shirts, and pants.
2. Explain when to consider using respiratory protection.
3. Describe three considerations for safe handling of animals.
4. Explain how animals can transmit diseases to humans.

### Risks Associated with WDM

Wildlife damage management is a physically demanding job that can expose you to a wide variety of threats to physical well-being. Risks related to WDM are associated with:

1. the physical environment,
2. environmental conditions,
3. specialized equipment, and
4. handling animals.

The physical environment refers to dangers such as drop-offs (*Figure 1*), low-hanging branches, and enclosed spaces. Environmental risks include working in hazardous weather conditions (e.g., icy roofs) and extreme temperatures. The equipment you use in WDM can be hazardous and animals can bite, scratch, and transmit diseases. Reducing the risk of contracting diseases will be addressed in Module 3, Wildlife Diseases.



**Figure 1.** Falls from embankments can occur if you are distracted. Photo by Stephen M. Vantassel.

### Reducing Risk

#### *Awareness*

Remember the proverb “familiarity breeds contempt” when dealing with safety issues. When you become comfortable, you may become complacent. Complacency often results in injuries. The best safety equipment is useless if you lack awareness of the threats posed by misuse of the equipment. Always ask yourself about the potential dangers you face before engaging in a particular activity. Anticipating risks and preparing for them is the best way to avoid injuries.

#### *Safety against physical and environmental threats*

Beware of hyperthermia and hypothermia, especially when working in extremely hot or cold environments. Other physical and environmental hazards include utility wires, branches, uneven terrain, and other features that can cause scrapes, punctures, or falls.

#### *Clothing*

**Shoes** should cover your entire foot and be comfortable to wear. Soles should be appropriate for the ground conditions you will encounter. Safety shoes with impact-resistant toes and insoles protect against injury.

**Shirts** should be comfortable and loose fitting to allow freedom of movement. Wear a long-sleeved shirt or jacket to protect against the sun, abrasion, and other environmental hazards.

**Pants** should be comfortable and allow for full leg movement. Choose pants made of material that resists wear due to abrasion when squeezing into small spaces. Generally, long pants are preferable.

### *Safety Equipment*

**Flashlights** and good lighting are critical for safety. In fact, good lighting can prevent the need to enter dangerous situations.

**Leather gloves** (Figure 2) have multiple uses. Have a pair for general protection and a thicker pair for handling animals. Some people prefer welder's gauntlets. Select gloves that you actually will wear. Leather gloves should be large enough to fit latex or nitrile gloves inside of them. We recommend that you always wear gloves while performing any wildlife control activity.



**Figure 2.** Plastic and leather gloves are essential safety items. Photo by University of Nebraska–Lincoln.

A **respirator** may be one of the most infrequently used pieces of safety equipment, but it is important in certain circumstances. Get a medical evaluation to ensure you are healthy enough to use a respirator. Proper fit testing is essential. A good feel does not necessarily mean a mask has a good seal. Replace filters in accordance with the manufacturer's recommendations. Select a half-face respirator

(Figure 3) with a particulate-filtering face piece rated at N100 by the National Institute for Occupational Safety and Health (NIOSH). This respirator will be sufficient for most general inspections of sheds and basements.

Wear a full-face mask before entering crawl spaces, attics, or when the risk of airborne dust is high. Consult <http://OSHA.gov> for the latest guidelines on use of face masks.



**Figure 3.** Half-face respirator suitable for routine attic inspections. Photo by Wildlife Control Supplies, LLC.

Have a **first aid kit** available and up to date. Cuts and scrapes occur when performing wildlife control. A kit should include Band-Aids®, gauze bandages, tape, antiseptic ointment, and triangular bandages.

**Waterless hand sanitizers** reduce the risk of infection when soap and water are not available. Choose a brand containing at least 60% alcohol. Smear a light coating over your hands to kill bacteria. Work it around your hands and between your fingers until they are dry. Cloth wipes have the added benefit of helping to scrub away organic material where germs can hide.

**Eye protection** is critical when working with materials that can spray or fall into your eyes. Wear a full-face mask if biologically hazardous dust, aerosolized feces, or other potential contaminants are present.

### *Basic crawl space safety*

If an animal problem is under a deck or in a crawl space, wear a properly fitted full-face mask before opening the entrance. Always carry two sources of light and have someone else present. Illuminate the area before entering. Look carefully before crawling in as you may come in contact with feces or animals.

### *Use of equipment*

The tools that are necessary for any particular job can pose risks to the user. Be aware of any potential danger from handling equipment. For instance, you may cut yourself on the sharp edge of a cage trap. Keep all equipment in optimal working condition, read and follow all manufacturer instructions, and obtain training whenever possible.

### *Injury due to wildlife*

Wild animals are unpredictable. Do not underestimate the strength, quickness, and agility of animals. While an attack from an animal is unlikely, it can occur when animals are startled or cornered. Animals can cause injury through bites and scratches.

Keep your distance from animals. You cannot be bitten or scratched if an animal cannot touch you. If you cannot keep your distance, use tools such as catch poles, snake tongs, or cat graspers. When there appears to be a choice between getting bitten and allowing the animal to escape, let the animal get away.

Inform your doctor that you work with wildlife so he or she will consider some of the wildlife-related diseases and vaccinations that normally would not be considered for the general public. Tell your doctor about any work with animals you have performed. Carry a card that, in the case of an emergency, will inform medical personnel of your risk of exposure to diseases transmitted by wildlife (*Figure 4*). Wildlife diseases will be covered in more detail in Module 3.

#### **ATTN: Medical Personnel**

This person works with wildlife and may have been exposed to certain zoonotic diseases not routinely considered in the differential diagnoses of febrile illnesses. In case of sickness in this individual, please consider zoonotic diseases including, but not limited to the following:

**Anthrax, Arbovirus encephalitis, Brucellosis, Giardiasis, Hantavirus, Hendra Virus, Highly Pathogenic Avian Influenza, Histoplasmosis, Leptospirosis, Lyme Disease, Monkeypox, Mycotoxicosis, Nipah Virus, Psittacosis, Q Fever, Rabies, Rocky Mountain Spotted Fever, Salmonella, Sylvatic Plague, Tularemia, Typhus, & West Nile Virus.**

(continued on back)

For more information on the occurrence of these diseases in humans,

**please contact:**

The Centers for Disease Control and Prevention  
1600 Clifton Rd.  
Atlanta, GA 30333  
1-800-232-4636 (1-800-CDC-INFO)  
<http://www.cdc.gov/>



For more information on the occurrence of these diseases in wildlife,

**please contact:**

USGS National Wildlife Health Center  
6006 Schroeder Rd.  
Madison, WI 53711-6223  
(608) 270-2400  
<http://www.nwhc.usgs.gov/>



**Figure 4.** This card can help inform medical personnel that you work with wildlife. Image by the CDC, USGS.

## Questions for Reflection

1. Gather various types of gloves or hand protection equipment. Try them on and evaluate how much protection they may provide and how much dexterity you have when wearing them. Which gloves provide the best balance of protection and dexterity?
2. List three physical threats you may encounter while performing wildlife control.
3. List four pieces of safety equipment and explain their use.
4. Describe how you would prepare to enter a crawl space.
5. List what you would include in a first aid kit and provide reasons for your selections.

## Objective Questions

1. How many sources of light should be carried into a crawl space?
  - a. 0
  - b. 1
  - c. 2
2. When should you wear your respirator?
  - a. before opening an attic hatch
  - b. before putting your head into an attic
  - c. after entering an attic
  - d. when you perform clean-up in an attic
  - e. none of the above
3. True or False - Awareness is an essential element of being safe.
4. Waterless hand sanitizers should contain at least \_\_\_\_\_ alcohol.
  - a. 40%
  - b. 50%
  - c. 60%
  - d. 70%
5. True or False – You should advise your doctor at each visit that you have worked with or handled wildlife.

## Module 3 Wildlife Diseases

Module 3 provides basic information about wildlife diseases, specifically those that wildlife may transmit to humans, called zoonotic diseases. Everyone needs to be aware of the dangers of wildlife diseases and how to safely avoid infection, as well as reduce the risk of spreading diseases to other people or animals.

### Learning Objectives

1. List the most common zoonotic diseases.
2. Describe the groups most vulnerable to disease transmission.
3. Explain the need for protective equipment.
4. Identify the causes of the most common zoonotic diseases.

### Introduction

Zoonotic diseases, or zoonoses, are infections that animals can pass to people through direct contact, feces and urine, or other vectors. About 200 zoonotic diseases are known at this time. Unfortunately, biological hazards encountered in nature are not accompanied with warning signs (*Figure 1*).



**Figure 1. Universal warning sign for a biological hazard.**  
Image from Safety Image CD.

Many wildlife diseases are harmful and even fatal to people, so you must be cautious. Avoid becoming paranoid, however. Several simple safety practices can substantially reduce your risk.

Improper handling of animals also can spread diseases to other species and devastate their populations. As a responsible citizen, you are expected to behave in ways that minimize the risk of exposing people and other animals to diseases, and help prevent their spread to other areas.

Knowledge of zoonotic diseases will help you make wise decisions concerning procedures for animal handling and disposal, choice of protective gear, and clean-up strategies for the site and your equipment.

### Terms

- **Agent** - organism or entity that causes disease. Lyme disease is caused by a bacterial agent.
- **Vector** - route of infection (typically an organism). Ticks (*Figure 2*) are vectors of Lyme disease.
- **Reservoir** - organism that sustains the disease but is not harmed by it. Deer mice are a reservoir species that become carriers of Lyme disease bacteria.
- **Host** – organism that is negatively affected by the disease. A human can be the host that suffers from Lyme disease.

Awareness of how humans are infected by diseases will help you take proper precautions to prevent exposure. Disease agents may be:

- bacteria,
- viruses,
- protozoa (single-celled organisms),
- rickettsia (an entity that combines aspects of both bacteria and viruses),
- fungi,
- nematodes (multi-celled worms), and
- prions (modified proteins).



**Figure 2.** Black-legged ticks (*Ixodes scapularis*) can transmit the agent of Lyme and other diseases. Photo by Michael L. Levin.

## Avenues of Disease Transmission

**Disease agents** can enter your body through:

- injection by an insect or animal bite,
- ingestion (biting fingernails, eating contaminated food),
- inhalation (breathing contaminated dust, airborne spores, or eggs), and
- absorption (organism enters through mucosal membranes around the eyes and mouth).

It is rare for a disease to enter the body through intact skin. Disease agents can enter the body through minor cuts or scrapes, however, so wear protective equipment. The equipment mentioned in Module 2 is useful and important to prevent exposure to disease agents.

## Reduce Risks

**Before you start:**

1. get a tetanus shot, and keep your vaccinations current;
2. have emergency telephone numbers handy for contacting your local police, animal control, county department of health, state wildlife department (Nebraska Game and Parks Commission), and your doctor;
3. have your pets vaccinated; and
4. purchase protective gear and know how to use it properly.

If you live in an area where rabies is endemic (regularly found) and you plan on working with wildlife, we suggest receiving pre-exposure vaccinations for rabies.

**While you are working:**

1. wash your hands thoroughly and often, especially before you eat, drink, smoke, or use a restroom;
2. keep your gear clean;
3. record all animal contact in a daily log;
4. be careful when handling a sick animal or one that is behaving oddly;
5. remind your doctor during each visit that you work with wildlife;
6. if you have been bitten or scratched, or are sick, go to the doctor promptly and tell your doctor about your activities; if at all possible, capture the animal in a manner that does not damage its brain, and have it tested for rabies; and
7. safely dispose of animals and contaminated materials.

**When you are done working for the day:**

1. clean any equipment you used,
2. remove work clothing and wash separately from family clothing, and
3. wash well and shower before greeting family or friends.

### *Bottom line*

Adopt a healthy lifestyle, be aware of the risks, and wear appropriate protective equipment for the best protection against zoonotic diseases. Since many zoonoses have symptoms that mimic the flu, regularly remind your doctor that you work with wildlife and in areas laden with fecal contamination. This will help your doctor consider other possible diseases when examining you.

The following chart is a summary of the important zoonotic diseases, including names of diseases, how people catch the disease, and precautions to reduce the risk of catching the disease.

How people catch diseases	Precautions
<p><b>Bites or scratches</b></p> <ul style="list-style-type: none"> <li>• Rabies (<b>mammal bites or scratches</b>)</li> <li>• West Nile virus (<b>mosquito bites</b>)</li> <li>• Lyme disease (<b>tick bites</b>)</li> <li>• Hantavirus (<b>can transmitted by rodent bites</b>)</li> <li>• Tularemia (<b>fly bites</b>)</li> </ul> <p><b>Boldface type</b> indicates a common way that people catch that disease.</p>	<p><b>Mammal bites or scratches</b></p> <ul style="list-style-type: none"> <li>• Get rabies pre-exposure vaccination and keep it current</li> <li>• Wear suitable gloves when handling animals</li> <li>• Use a restraining device (catch pole)</li> <li>• Capture animals in traps</li> <li>• Avoid contact with animal’s mouth and saliva</li> <li>• Shower soon after work, every day</li> </ul> <p><b>Mosquito or tick bites</b></p> <ul style="list-style-type: none"> <li>• Wear loose-fitting, light-colored clothing (harder to bite through and easier to see small ticks)</li> <li>• Use insect repellent (DEET or Permethrin)</li> <li>• Tuck pant legs into socks (keeps ticks from crawling into pant legs)</li> <li>• Check yourself for ticks frequently; remove any you find</li> </ul>
<p><b>Inhale disease organism</b></p> <ul style="list-style-type: none"> <li>• Histoplasmosis</li> <li>• Hantavirus</li> </ul>	<ul style="list-style-type: none"> <li>• Wear an appropriate and properly fitted respirator, disposable clothing, goggles, gloves, and hood</li> <li>• Ventilate area if possible</li> <li>• Dampen contaminated materials, wipe with wet sponge</li> <li>• Spray contaminated area or dead animals with disinfectant (10% bleach/water mix)</li> <li>• Schedule job for cool, damp weather</li> </ul>
<p><b>Contaminated hand or glove touches mouth, eyes, or nose</b></p> <ul style="list-style-type: none"> <li>• Raccoon roundworm (<b>mouth</b>)</li> <li>• Toxoplasmosis (<b>mouth</b>)</li> <li>• Rabies (<b>infected saliva enters through the mouth, eyes, nose, or breaks in the skin</b>)</li> <li>• Hantavirus (<b>mouth, eyes, or nose</b>)</li> <li>• Tularemia (<b>absorbed through skin</b>)</li> </ul>	<ul style="list-style-type: none"> <li>• Wear a proper respirator, disposable clothing, latex or nitrile gloves</li> <li>• Wash hands thoroughly with soap and water, especially before eating, drinking, or smoking</li> <li>• Avoid contact between hands and face</li> </ul>

<p><b>Disease organism enters wound</b></p> <ul style="list-style-type: none"> <li>• Rabies</li> <li>• Hantavirus</li> </ul>	<ul style="list-style-type: none"> <li>• Protect wounds with bandages if practical</li> <li>• Wear gloves or clothing that covers wound</li> <li>• Check wounds and keep them clean</li> </ul>
<p><b>Eat contaminated food or put contaminated object into mouth</b></p> <ul style="list-style-type: none"> <li>• Raccoon roundworm (<b>contaminated object</b>)</li> <li>• Toxoplasmosis (<b>contaminated meat or object</b>)</li> <li>• Hantavirus (<b>contaminated food or water</b>)</li> </ul>	<ul style="list-style-type: none"> <li>• Wash your hands thoroughly after outdoor activities and especially before eating, drinking, or smoking</li> <li>• Cook meat thoroughly</li> </ul>
<p><b>Handle infected animal or contaminated equipment</b></p> <ul style="list-style-type: none"> <li>• Mange</li> </ul>	<ul style="list-style-type: none"> <li>• Wear gloves</li> <li>• Minimize contact with mangy animal by using restraining devices</li> <li>• Minimize contact with contaminated clothing and equipment</li> <li>• Dry clothing with high heat to kill mites</li> </ul>

## Questions for Reflection

1. Name three ways you can be infected with a zoonotic disease.
2. You notice a lot of bird droppings below a tree and you see a person raking the leaves around it. What, if anything, should you tell the person?
3. You enter a shed and notice several brown and black specks scattered around the floor. What would you do and why?
4. After working with wildlife, why is it important to change clothes and shower before greeting your family?
5. Explain how you would reduce the likelihood of contracting a disease through a tick bite.

## Objective Questions

1. Match the term to the definition
  - a. host
  - b. reservoir
  - c. vector
  - d. agent

\_\_\_ carries but is not negatively affected by the disease

\_\_\_ negatively affected by the disease

\_\_\_ the route or transporter of infection

\_\_\_ direct cause of infection
2. Diseases normally enter your body through all the following ways EXCEPT
  - a. intact skin
  - b. mucous membrane
  - c. injection
  - d. inhalation
  - e. ingestion
3. True or False - The trouble with diagnosing zoonotic diseases is that the symptoms often resemble those of the flu.
4. A raccoon has bitten a person. What disease should the person be concerned about?
  - a. rabies
  - b. raccoon roundworm
  - c. mange
  - d. distemper
5. To protect yourself from zoonotic diseases and their impact on your health, you should
  - a. wear personal protective equipment
  - b. avoid contaminated areas
  - c. get vaccinated
  - d. inform medical personnel you work with wildlife
  - e. all of the above

## Module 4 Site Inspection

A thorough site inspection is the foundation of effective wildlife damage management (WDM) and is covered in Module 4 because you cannot manage what you have not correctly identified. This module discusses how to perform a site inspection as well as the skills and equipment needed.

### Learning Objectives

1. Describe the inspection process.
2. List the proper tools needed to do the job.
3. Explain when to use the tools.
4. List the questions to ask to obtain needed information.

### Introduction

Take the time to determine the nature of the problem. Even if you cannot conclusively determine the cause, a site inspection will help narrow down the list of suspect animals.

Through the inspection, try to answer these three questions:

1. What is the nature and validity of the problem?
2. How can the problem be resolved?
3. What potential problems can be prevented?

### Requirements for an Effective Inspection

Effective site inspections require coordination of three elements: persistence, knowledge, and equipment. Weakness in any area will result in less than adequate inspections.

#### *Persistence*

Wildlife damage inspections put a strain on you and your equipment. For example, you have to put up with weather conditions, such as summer heat and winter cold, snow, and ice. It takes time to conduct a thorough inspection, so plan accordingly.

#### *Knowledge*

For effective WDM, you need to know about animals, their biology and habits, and the damage they cause. With each inspection, you will gather more experience reading the clues at the site.

#### *Equipment*

1. **Quality flashlights** are needed to inspect areas hidden in the shadows or at night.
2. **Protective equipment**, such as gloves, knee pads, and goggles will reduce the chance of injury.
3. **Magnifying glasses (5x or 10x) and binoculars** (8-power with a 30° field of vision or greater) improve visual inspection.
4. **Multi-purpose tools** such as a Leatherman™ are useful for pulling apart scat and measuring scat and tracks.
5. **Digital cameras (or smart phone cameras)** with a minimum of 3 megapixels that are small enough to fit in a shirt pocket (*Figure 1*) are important for documenting inspections and sending photos out for expert opinion.
6. **A notebook** is essential to record findings. Don't rely on your memory.



**Figure 1. Pocket-sized digital camera.**  
Photo by Stephen M. Vantassel.

## Inspection Process

Inspection is a process, not an event. Discipline yourself to go through the entire inspection process every time. Develop a methodical way to check for evidence of wildlife access or damage.

### Preparation

You must gain an understanding of the common wildlife species in your area. Start by developing a list of animals that often have conflicts with humans. Your list should include about 20 species or species groups. Next, read about the biology, diet, and behavior of the species on your list, as they will be primary suspects when you discuss the wildlife conflict a person is experiencing.

Learn the behavior of the animals in your geographic area. The inspection process is all about ruling out possible suspects. Consult the species information in this manual for insights into animal biology and the signs for the damage each species causes.

### Observation

In our busy world, we encounter many distractions that prevent us from learning how to observe, or how to *really* look at something. Critical observation, the kind necessary for WDM inspections, requires you to focus your eyes on a single spot at a time. Peripheral or broad vision simply is not focused enough. Narrow your focus to see how a branch was cut or how a track was placed. The effort may be tiring initially, but with practice it will become second nature.

Use the following test to ensure that you are able to focus properly. Take a newspaper and find a photo in it. Look at the photo closely. When you are able to distinguish the spots that make up the photo, you have focused carefully enough.

### Step 1 - Pre-inspection

You must think like a detective and ask pointed questions to gather accurate information. Clients frequently change their stories and provide contradictory information. Your task is to tease out the accurate information. Here is a list of sample questions.

1. What is the nature of the problem? Is it damage from browsing, clipping, gnawing, pecking, digging, or tunneling? Have the client provide specific details.
2. Has the client seen the animal? Be careful here as sometimes the animal that is seen is blamed for damage done by other animals. Turkeys are a great example of this. They often get blamed for crop damage even though it was done by other animals.
3. How long has the problem been occurring?
4. How severe is the problem? Have the client quantify the extent of the damage.
5. What time of day does the problem occur? Does the damage occur during the night, day, or at dusk or dawn?
6. Has the client taken any actions to resolve the problem? What were those actions? Did those actions have any effect?

### Step 2 - Site Visit

1. As you approach the location, consider the neighborhood and the habitat it contains.
  - a. Are wooded areas nearby?
  - b. Is a stream or body of water nearby?
  - c. Where would wildlife live and eat?

2. Determine the location of the damage.

We emphasize the location of damage or sign because it is one of the best clues for identifying the cause of the problem.

3. Use the following questions to help narrow down your list of suspects.
  - a. Is the damage below ground? Consider moles and voles.
  - b. Is the damage at ground level? Consider beavers, raccoons, skunks, tree squirrels, voles, and woodchucks,
  - c. Is the damage within one foot of the ground surface? Consider deer, rabbits, raccoons, and woodchucks.
  - d. Is the damage occurring more than one foot off the ground? Consider birds, deer, tree squirrels, raccoons, opossums, and woodpeckers.

These terms will help you put a name to the sign you are seeing.

**Disappearance** – Plant item is removed without leaving any plant material behind.

**Divot** – A scrape or dug out portion of the soil where you can see the bottom of the depression (*Figure 2*).



**Figure 2.** Divot created by a tree squirrel. Photo by Stephen M. Vantassel.

**Clipping** – nibbling or biting the end of a stem or branch into short sections (typically less than 3 inches; *Figure 3*).



**Figure 3.** Branch clipped at a 45°-angle by a cottontail. Note the clean cut. Photo by Stephen M. Vantassel.

**Furrow or groove** – linear depression in the soil or turf caused by animals repeatedly traveling or foraging on the same strip of land (*Figure 4*).



**Figure 4.** Groove in the grass created by voles. Photo by Stephen M. Vantassel.

**Gnawing** – Animal biting or chewing on an object (*Figure 5*).



**Figure 5.** Gnawing of bark done by a cottontail rabbit. Photo by Stephen M. Vantassel.

**Hole** – If you can't see the bottom of a depression in the soil, then it's a hole (*Figure 6*).



**Figure 6.** A hole dug by a 13-lined ground squirrel.  
Photo by Stephen M. Vantassel.

**Run** – The eruption of soil in a trail caused by a mole digging just below the surface. It collapses when depressed (*Figure 7*).



**Figure 7.** Runs created by moles, visible here because of dead grass. Photo by Stephen M. Vantassel.

### *Put it all together*

Look for tracks or scat that might confirm the suspect animal. Don't be surprised if you don't find any. Tracks are difficult to find on compacted soils and asphalt. Scat isn't always available or may be washed away by rain.

Ultimately, you have to put all the pieces together, and like a detective, rule out suspects and narrow down the list of likely candidates. In some cases, it isn't necessary to determine the specific species. Even narrowing down the suspect to a type of animal (climbing, walking, or flying) may be enough to suggest a plan of action.

### *Take quality photographs*

Sometimes you need another opinion to identify specific sign. The sign may be a track, scat, hole, or nibbled twig – any indication of the culprit. Photographs are an excellent way to have a colleague view what you are seeing. Here are a few tips.

1. Set your camera at the highest resolution.
2. Set your camera to macro mode when taking photos within 1 foot of the subject.
3. Provide scale. Set a ruler or standard-sized object in the frame to show how large or small the sign is.
4. Take wide-angle photos of the area to help the viewer see the context surrounding the sign.
5. Position the sign between yourself and the sun so that the shadow provides the best contrast.

## Inspecting Animal Damage to Structures

In addition to the damage wildlife inflict on the landscape, they may enter structures. Investigate the structure carefully for the location(s) where the animal(s) entered. Clients will want to discuss what they heard or smelled, but the size of the hole or entryway remains the most accurate way to identify the species entering the structure.

Holes can be identified easily by use of a powerful flashlight. Shine the light at the dark spot. If the spot remains dark, then the location is a hole (*Figure 8a*). If it is illuminated (*Figure 8b*), then the structure is reflecting light back to you and a hole is not present.



**Figures 8a (top) and 8b (bottom).** The dark spot in 8a remains a suspected entry point for bats until it is fully illuminated. In 8b, the light is reflecting off a board that blocks entry. Photos by Stephen M. Vantassel.

The following sizes are the smallest diameter openings required for the listed species to enter.

- ¼ inch – house mice, some snakes
- ⅜ inch – bats
- ½ inch—small rats
- 1 inch—rats, flying squirrels, red squirrels
- 2 to 3 inches—fox squirrels, gray squirrels
- 4 inches—raccoons, skunks, and opossums

To determine if a hole is active, plug it with newspaper. Newspaper is easy for most animals to remove, except for bats and bees. If the paper is undisturbed for 5 days during good weather conditions, you can be reasonably certain the opening is no longer being used, assuming the animal doesn't hibernate. Do not secure the hole unless there have been several days of good weather with warm temperatures. NEVER secure a hole unless you are certain it is no longer being used.

## Mysterious Situations

Sometimes you will not be able to identify the source of the problem. Select from the following techniques that are most suitable for your situation.

1. Set a cage trap with bait that is attractive to a wide range of species.
2. Create a track trap (to capture tracks!) with sifted soil, flour, or talc. Flour is very effective when dealing with rats (they eat flour) but it can attract insects. Track traps must be protected from rain, wind, snow, or other elements.
3. Plug a questionable opening with newspaper to determine if it is an active entryway.
4. Install a trail camera capable of taking photos in the dark when a motion sensor is triggered.
5. Ask neighbors to monitor the situation.

## Questions for Reflection

1. Explain the steps of the inspection process.
2. How do you know if a dark spot is a hole?
3. List the three tools you believe are the most important for performing an inspection and explain the reasons for your choices.
4. Identify two techniques to use when you cannot figure out what species is causing a problem.
5. Why is scale and resolution so important when taking photos of wildlife damage?

## Objective Questions

1. Match the hole diameter with the species
  - a.  $\frac{1}{4}$  inch
  - b.  $\frac{3}{8}$  inch
  - c. 3 inches
  - d. 4 inches  
 gray or fox squirrel  
 bat  
 mouse  
 raccoon
2. When should you begin an inspection process?
  - a. when you get the call
  - b. when you are driving up to the site
  - c. when you exit the vehicle
  - d. when you get your equipment
4. True or False – Holes should be sealed as soon as they are discovered.
5. True or False – Divots are shallow depressions in the ground.
6. True or False – Tracks usually are not visible because the ground usually is too compacted.

## Module 5 Wildlife Damage Management Methods

In wildlife damage management (WDM), a variety of methods and tools are used to reduce wildlife conflicts to tolerable levels. Several methods exist because usually no single technique will eliminate all conflicts. This module highlights those methods and tools.

### Learning Objectives

1. Explain the need and importance of having a variety of techniques for WDM.
2. List tools suggested for WDM.
3. Describe methods for resolving wildlife conflicts using Integrated Pest Management (IPM) methods.

### Introduction

When you consider the diversity of species and problem situations, it becomes apparent that WDM is not a one-size-fits-all activity. Furthermore, many methods can be used in combination with others. In fact, it is advisable to use several techniques whenever practical, particularly to address long-standing damage situations.

### WDM Methods

Methods for WDM fall into the broad categories listed below. To take an IPM approach means using nonlethal control techniques when possible and consider what is least damaging to the environment. If the nuisance or damage is below a tolerable threshold, begin with the first four methods.

- Habitat modification
- Exclusion
- Frightening devices
- Repellents
- Toxicants
- Shooting
- Trapping
- Other methods

### *Habitat Modification*

All animals need water, food, and shelter. Eliminate any of these elements and animals cannot survive. Habitat modification addresses all three of these life requisites. An extreme example of habitat modification is to pave a lawn with asphalt to stop mole damage. Although extreme, it would be effective and relatively permanent. Most habitat modifications are more subtle, such as cutting brush around the perimeter of the yard, but they play an important role in longterm WDM. Keep in mind, however, that changes in the habitat to hinder one species may encourage population growth in others.

#### Typical habitat modifications include:

1. modifying bird feeders to reduce the spilled seed from reaching the ground,
2. cutting back bushes and trees to reduce cover and access to structures, and
3. removing vegetation near a building foundation (*Figure 1*), and eliminating brush, woodpiles, and junk.



**Figure 1.** Crushed rock is used to modify habitat around a building to reduce the availability of food, water, shelter, and access. Photo by Stephen M. Vantassel.

Another example of habitat modification is to mow tall grass to reduce the presence of voles, or to let grass grow to discourage geese. Even small modifications can increase the effectiveness of other techniques. Habitat modification can

provide longterm solutions to difficult wildlife conflicts. Unfortunately, some modifications can be expensive, so expect some client resistance. When longterm effects are considered, however, habitat modification may prove cost effective.

### Exclusion

Exclusion includes the use of barriers, such as nets, cylinders, and fences, to prevent wildlife from accessing areas and causing damage. This method can provide high levels of protection over the short- and longterm, but exclusion can be very costly when large areas need protection. Exclusion is a popular IPM method and friendly to wildlife. Some experts consider exclusion to be part of habitat modification, but we treat it separately because so many specific tools and techniques for exclusion are available that it warrants a separate module. **See Module 6.**

### Frightening Devices

Frightening devices scare wildlife from a location through nonchemical means. Frightening devices fall into four categories: visual, audio, audio-visual, and biological. Wildlife often quickly habituate to frightening devices, except, perhaps, biological frightening.

#### Visual

Visual frightening devices include effigies such as plastic owls (*Figure 2*), scary-eye balloons, and Mylar® tape. Visual devices range dramatically in price, sophistication, and effectiveness.



**Figure 2.** The owl effigy on this roof does not distress the gulls. Photo by Stephen M. Vantassel.

For example, some scarecrows actually move. Animated “human effigies” tend to work much better than the home-made scarecrows, which are better considered as garden decorations.

Stationary visual frightening devices are the least effective, as birds tend to habituate to these devices in a few days. Whenever possible, choose a frightening device that moves, such as a Scary-eye balloon swaying in the wind (*Figure 3*).



**Figure 3.** Scary-eye balloon. Image courtesy of Bird-X, Inc.

Strobe lights are marketed to frighten wildlife such as squirrels and raccoons. Geese and crows can be dispersed from a night roost by pointing a spotlight, laser pointer, or laser pistol (such as the Avian Dissuader®) at them. As a general rule, green lasers work on diurnal birds and red lasers work on nocturnal species. Always use lasers safely. Do not shine them directly in the eyes of birds or humans. Try to position the laser so its beam shines parallel to the ground.

#### Audio

Audio or audible devices include propane cannons and distress calls. Propane cannons (*Figure 4*) produce a noisy boom that is suitable only for rural settings. Distress calls have more versatility and can target a specific species, such as crows.

Check local ordinances and consider the effects on the neighbors before using any noisemakers. As for ultrasonic devices, no evidence is available that supports any claim that they are effective in repelling wildlife.



**Figure 4. Propane cannon. Photo by the University of Nebraska–Lincoln (UNL).**

### Audio-visual

These use sight and sound to frighten wildlife. Fireworks-based noisemakers, known as “pyrotechnic devices,” will effectively disperse birds over the short-term. Use of pyrotechnics requires training and consideration of safety and legal issues.

### Biological

Guard animals such as dogs and llamas sometimes are used to protect livestock, especially sheep, from predators. The livestock and the guard animal must be kept within a fenced area. Dogs can protect orchards, Christmas tree plantations, or vineyards from deer or turkey damage. Dogs within an invisible-fence system may reduce deer damage to home garden and landscape plantings.

Hazing involves the use of dogs, hawks, falcons, or radio-controlled aircraft or boats to drive nuisance animals from a site. Canada geese can be hazed with border collies to remove the birds from golf courses, public parks, or similar locations. Occasionally, hawks are used to chase other birds from airport runways or vineyards.

Birds cannot be hazed in their nesting areas during the nesting season because of the Migratory Bird Treaty Act (MBTA). Do not haze geese during their molt (usually mid-June to mid-

July), because they are vulnerable and cannot fly. Secure a permit that allows the taking of geese before beginning hazing activities. Even a well-trained dog might accidentally injure a goose while chasing it. Without a permit, this would be a violation of the MBTA.

### Repellents

Repellents are chemicals that deter animal activity through, pain, fear, touch, or aversive conditioning. In Nebraska, you must have a pesticide applicator license to use these products commercially. Homeowners can purchase and use over-the-counter products on their property. The effectiveness of repellents often is highly variable, depending on the motivation of problem animals, alternative resources, weather, skill of the applicator, the animal’s previous experience with the repellent, and the active ingredients in the repellent. Be aware that manufacturers only have to prove a product is safe when used as labeled to sell as a repellent. They do not have to show it works, and many repellents have not been adequately tested.

**More information on repellents is in Module 7.**

### Toxicants

Toxicants are chemical compounds used to kill problem animals such as house mice, Norway rats, pigeons, starlings, and house sparrows (*Figure 5*). When using toxicants, considerable care must be taken to minimize risks to nontarget animals, including wildlife, livestock, pets, and people. The US Environmental Protection Agency (EPA) requires that all applicators must be trained and certified to use restricted use pesticides, covered in Module 7.

Toxicants should be integrated with other WDM methods, such as habitat modification and exclusion, to increase their effectiveness. Always read the label for details and restrictions on the use of a toxicant. For example, most toxicants for rats and mice only can be used “in and around structures” and are not legal for use in landscapes away from buildings.

**More information is available in Module 7.**



**Figure 5.** Three formulations of rodenticide bait (blocks, pellets, place packs). Photo by LiphaTech®.

## Shooting

Firearms include pistols, shotguns, rifles (Figure 6), and air rifles (high-end pellet guns).



**Figure 6.** Shotguns and rifles are important tools for WDM. Photo by UNL.

Shooting is appropriate for medium to large mammals (the size of a squirrel and larger), birds, and reptiles. Shooting requires training and skill and is not recommended for homeowners and Master Gardeners. We list it here as it is sometimes the most viable and cost-effective way to deal with a wildlife conflict. Safety concerns and legal restrictions must be considered before shooting. For proper training in the use of firearms, attend a hunter education course or a training course sponsored by the National Rifle Association.

Although shooting may be common in rural areas, many states and communities have laws or ordinances that regulate the discharge of firearms. For example, it is illegal to discharge a

firearm while hunting within 200 yards of a building without the landowner's permission. Some communities have completely banned the discharge of firearms. You must know all related state and local laws and regulations before shooting to remove problem wildlife. Contact your local police department, municipal office, or the Nebraska Game and Parks Commission (NGPC) for specific information.

## Trapping

The information on trapping will familiarize you with the various types of traps and their use. Traps are among the most common tools used to manage wildlife damage, so it is important to understand how they work and how to use them. People often misapply the term live trap to refer to cage and box traps, when in fact many other traps also catch animals alive. In this manual we will use the more accurate terms cage traps and box traps (Figure 7) to describe those that imprison animals. In general, we recommend that Master Gardeners and homeowners use cage and box traps for the majority of their trapping.



**Figure 7.** Cage traps have wire-mesh walls (left) while box traps (right) have solid walls. Photo by Stephen M. Vantassel.

Use of a cage or box trap offers many advantages. For example, you can see what you have caught and then can release nontarget animals. Cage and box traps are easy to set and double as carriers. An animal enters a cage or box trap and steps on a treadle, which causes the door(s) at the end(s) of the trap to close. Typically, little site preparation is needed. These traps generally are safe for

children and pets. Most people think they are humane, but some animals may hurt themselves due to the stress of being restrained, or while trying to escape.

Disadvantages to cage or box trapping include the time required to check traps frequently and the possibility of capturing unwanted animals. If these traps are used improperly, an animal may die in it from attacks by wildlife, pets, or people; lack of food or water; or exposure to weather extremes. Cage and box traps are not universally effective in capturing animals. Some species, such as coyotes and foxes, may avoid them. Even individuals of species that are easy to catch in cage traps, such as raccoons and gray squirrels, can become “trap-shy,” especially if they have been captured previously.

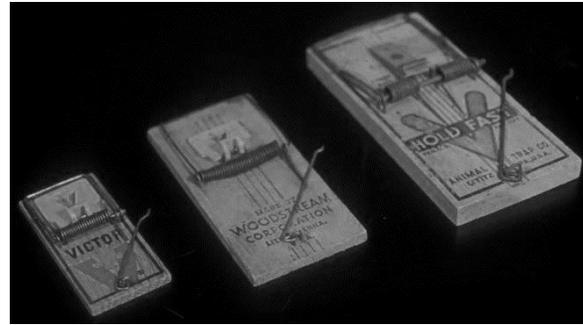
Proper bait selection and trap location can reduce the risk of capturing nontarget animals. For example, raccoons like sweet baits and using them will reduce captures of cats, skunks, and other animals that are attracted to fish-based baits.

Always have a plan for animal disposition before you start trapping. In Nebraska, it is illegal to transport live wildlife more than 100 yards without a permit or license from NGPC. This regulation is intended to increase humaneness and reduce the spread of disease. Humane euthanasia of wildlife, an alternative to relocation, often is difficult in urban areas without specialized equipment. Training and experience are needed to catch and handle animals humanely.

**Additional information is provided in Module 8.**

### Mouse and rat snap traps

The familiar mouse trap (*Figure 8*) is a type of body-gripping trap. Your trapping strategy will vary depending on whether you are capturing mice, rats, or other small mammals. If the targets are mice or rats, you will need many traps, so use a model that is easy to set. Many options besides the traditional mouse snap trap are available.



**Figure 8.** Mouse- and rat-sized snap traps come in expanded (left and middle) and narrow triggers (right). Photo by UNL.

Snap-back traps with expanded triggers and the “clothespin” design (*Figure 9*) are much easier to set than the traditional mouse trap. The Quick Kill Mouse Trap® made by Victor® has a lid over the bait cup. Only animals that seek the bait will lift the lid, which is what triggers the trap. An animal can accidentally step on the lid without setting off the trap. The bait cup is located to position the mouse in the perfect strike position.



**Figure 9.** Clothes pin or clamshell mouse trap. Photo by Stephen M. Vantassel.

This trap is more selective and more effective than a traditional mouse snap trap. It has a safety catch and will not fire if it is picked up.

### Multiple-capture traps

Multiple-capture rodent traps can catch more than one animal without having to be reset. Most are designed for mice. Some brands, such as Ketch-All®, will catch animals up to the size of chipmunks. Some designs (e.g., Ketch-All® and Kwick Katch®) have a wind-up spring that powers a rotating mechanism. Other traps (e.g., Victor Tin

Cat®) have one-way doors that allow mice to enter but not leave. As with all live traps, you must check it frequently so that animals are not exposed to extreme temperatures or attack by other animals taking advantage of restrained prey.

### Lures and baits

Lures can help bring the target animal to your trap. Lures are concentrated odors and may be detected by wildlife from great distances. They tend to be liquid and fall into three categories: food-based, gland-based, and curiosity.

**Food-based lures** trigger hunger. They are subdivided into sugary baits called “sweet baits” or oil and protein baits called “meat baits” or “fish baits.”

**Gland-based lures** trigger sexual or territorial behavior. Urine is a gland-based lure and should be treated as a biohazard. Do not expose your face or hands to urine.

**Curiosity lures** are odors that likely are unfamiliar to the animal, yet attractive enough to cause the animal to investigate.

**Baits** typically are food-based materials used to attract animals into traps. They come in chunks, pastes (*Figure 10*), and powders.



Figure 10. Paste bait. Photo by Tomahawk Live Trap, LLC.

## Other Methods

### Biological control

Biological control typically involves the introduction of a disease or predator to manage a target population. Control using diseases rarely is employed due to the risk of unexpected consequences. No disease-based products are registered for wildlife control in the US.

Wildlife control with predators, although widely praised by the public, rarely works. For example, some people think that mice and voles can be controlled by placing perch poles around a field to encourage the presence of raptors. However, predators rarely reduce prey populations low enough to meet landowner expectations. Even though house cats may be good “mousers,” they cannot effectively control high populations of rodents, and they may take nontarget species such as songbirds and other small mammals.

### Fertility control

Fertility control essentially is birth control for wildlife. Most contraceptive methods still are experimental and require permits available only to researchers and veterinarians. However, Innolytics, LLC has an over-the-counter product that, when fed to feral pigeons for a sufficient amount of time, may stop them from laying fertilized eggs. OvoControl P is a general use pesticide in Nebraska. Many species of wildlife are long-lived and few examples are available in which longterm use of fertility control agents have actually reduced wildlife abundance and associated damage. Also, in open populations, movement of new animals into the area may offset the lack of reproduction. In some cases, fertility control has stabilized population growth but not reduced animal numbers or their negative impacts.

## Questions for Reflection

1. Provide some examples of habitat modification and the species for which the technique would be appropriate.
2. Explain the four different categories of frightening devices.
3. If trapping an animal that is causing damage, how would you decide which of the three categories of lures to use?
4. A homeowner has rodents eating grain in the barn and firmly believes that getting two or three cats would take care of the problem. What would you tell the homeowner?
5. Explain the advantages and disadvantages of using fertility control for pigeons.

## Objective Questions

1. Matching (items may be used more than once)
  - a. habitat modification
  - b. exclusion
  - c. frightening devices
  - d. repellents
  - e. shooting
  - f. trapping
  - g. other methods

\_\_\_\_\_ cat grasper  
\_\_\_\_\_ fertility control  
\_\_\_\_\_ strobe light  
\_\_\_\_\_ netting  
\_\_\_\_\_ chimney cap  
\_\_\_\_\_ cable-restraints  
\_\_\_\_\_ modify bird feeders
2. Which bait is most appropriate to avoid catching house cats?
  - a. fish oil
  - b. hamburger
  - c. cheese
  - d. molasses
3. True or False – Frightening devices may be used on birds during the nesting and molt seasons.

## Module 6 Exclusion

### Learning Objectives

1. Identify common ways that wildlife may enter areas.
2. Explain how to determine if an opening is being used by wildlife.
3. List commercial products used for excluding wildlife.
4. Describe techniques that should be avoided and why.

### Definition

In the context of wildlife damage management (WDM), exclusion refers to the use of barriers to reduce access of wildlife to resources such as food, cover, and water. This method is both a type of habitat modification and a form of damage prevention.

### Pros and Cons of Exclusion

Exclusion has many advantages. First, it can be used before any damage occurs. When planting trees in an area with a high deer population, protect newly planted trees with fencing to prevent damage. Second, exclusion does not use chemicals that may harm nontarget animals or people. Third, exclusion provides immediate, longterm, and often complete protection.

Unfortunately, exclusion also has several disadvantages. Frequently, clients consider exclusion to be too costly, particularly when large areas need protection (*Figure 1*). Before clients reject exclusion, advise them to consider the value of exclusion over the longterm.

The second disadvantage with exclusion is the perception that exclusion disrupts the beauty of the landscape. Although aesthetic arguments may be over stated, exclusion often can be made less obtrusive. For example, well-maintained wooden fences can add to home values and be attractive. Shrub plantings can be used to conceal fences.



**Figure 1.** Fences are effective for excluding deer from areas. Photo by Paul D. Curtis.

### When Considering Exclusion

#### *Know the animal*

Different animals require different approaches to exclusion. For instance, does the species burrow, climb, jump, or fly? Can the animal chew through fence materials? Each of these abilities demands a different kind of exclusion.

#### *Caution*

Whenever exclusion is used, you run the risk of entrapping an animal within the excluded area or building. Never secure openings unless you are certain that animals are not using them. When you are uncertain about whether animals are using an opening, monitor activity by placing dry sticks in front of the opening. If an animal moves through, it will push aside the sticks (*Figures 2a* and *2b*). You also can use crumpled newspaper to plug the hole. Monitor the hole for at least 5 consecutive days of fair, warm weather. Some animals, such as woodchucks, hibernate during winter in cold climates and will not be active between November and January.



Figures 2a (upper) and 2b (lower). Place dry sticks in front of openings to determine whether animals are using them. Photos by Stephen M. Vantassel.

## Exclusion for Specific Situations

The type of exclusion to use depends on what is being protected, as well as the type of wildlife you are trying to exclude.

### *Protecting decks, sheds, and foundation crawl spaces*

Structures that lack full foundations (e.g., trailers, sheds, and decks) are vulnerable to entry by skunks, raccoons, woodchucks, and other burrowing animals. Use trench screen to prevent animal access (Figure 3). Increase the depth and skirting of the screen in locations subject to frost heaving or when dealing with wildlife, such as woodchucks, that have a tendency to dig aggressively. Use ½-inch, galvanized mesh wire if

more airflow is needed. Pay special attention to corners to ensure that they are properly protected. Screens should overlap 4 to 6 inches to prevent any gaps that could be exploited by digging animals. Crushed gravel is not sufficient for these situations.

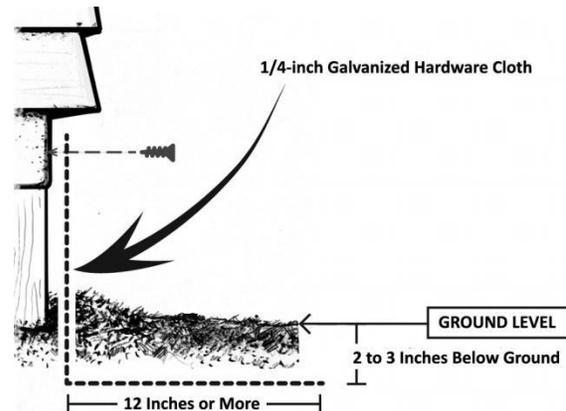


Figure 3. Trench screen installed to protect a crawl space. Image by Michael S. Heller.

### *Protecting individual trees and plants*

Use wire or plastic tree guards to protect trees from trunk girdling. More expensive wire guards provide longer-term damage prevention. When using tree tubes to protect plants, place plastic screen over the top to prevent trapping cavity-nesting birds.

Protect young trees and shrubs from deer damage by installing a wire or plastic mesh fence around the plant (Figure 4). Anchor the fence securely to posts, as animals will bend it to reach branches or the trunk. Fences should be at least 6 feet high to protect individual plants from deer.

For protection from beavers, place wire fences with 1- x 2-inch mesh wire at least 4 inches away from the trunk. Extend the fence 4 feet high and bury the bottom 6 inches into the soil to prevent a beaver from digging under it.

Use nets to protect trees and other fruit-bearing plants from bird depredation. Ensure that the nets reach the ground, as birds may try to fly or walk underneath. Poles and wires often are needed to

support nets for low shrubs such as blueberries or raspberries.



Figure 4. Mesh fences protect shrubs from deer. Photo by Paul D. Curtis.

### *Protecting large areas and gardens from mammals*

Fences are the most reliable exclusion technique for preventing damage by mammals to nursery stock, gardens, and home landscapes. Nonelectric barriers prevent access to many species and have the added benefit of low maintenance. Electric wires can be added to the outside of nonelectric barriers (Figure 5) to stop climbing animals such as raccoons and squirrels.

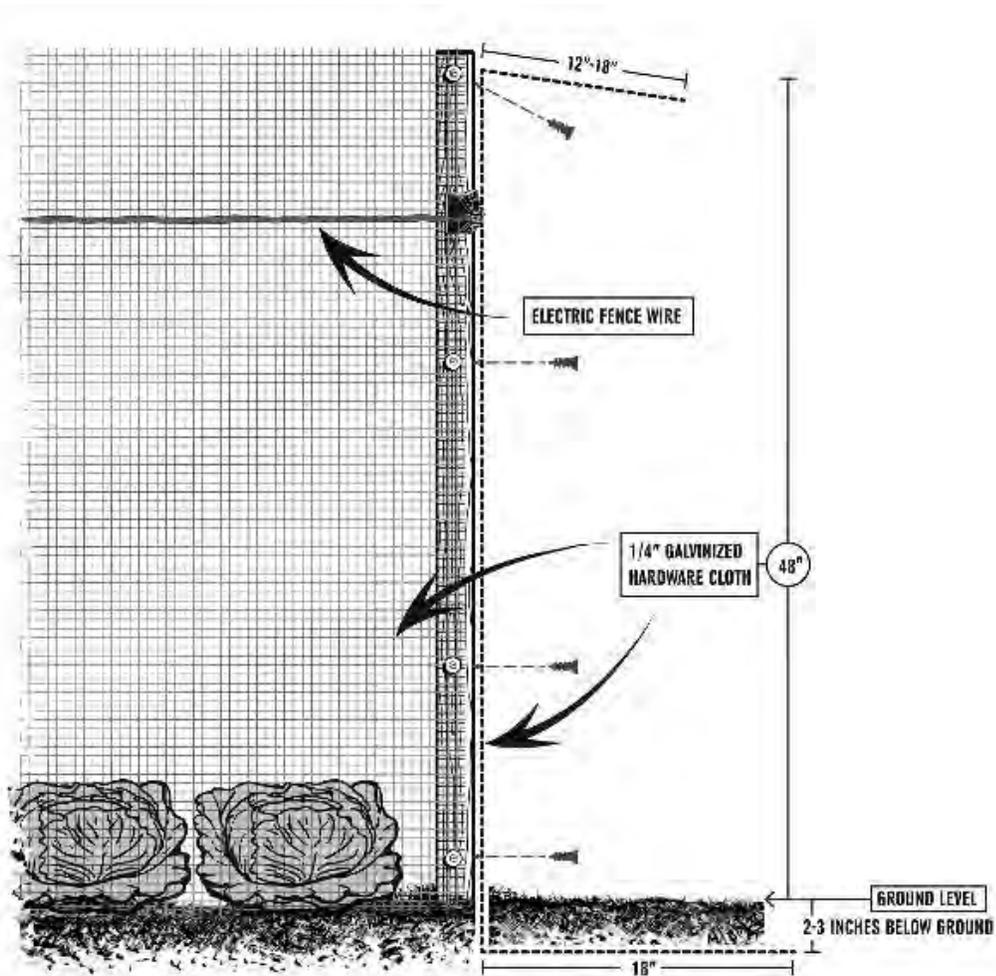


Figure 5. Wire mesh fence with added electric wires prevent animals from burrowing or climbing into a garden. Image by Michael S. Heller.

Different animals require different fence designs, so we have provided dimensions and types of fences for excluding common species (*Table 1*).

**Table 1. Types of fences to exclude wildlife**

Species	Fence type	Minimum fence dimensions
Deer	Barrier	8 feet high for large areas; 6 feet high for individual plants.
Deer	Electric	2 strands, 1 foot and 3 feet from the ground for small areas; 7-wire vertical fence for large areas.
Rabbits	Barrier	1-inch mesh wire buried 4 inches into the soil and extending 3 feet above the ground
Raccoons	Electric enhanced Barrier	1-inch mesh buried 2 inches and extended underground 1 foot. Fence should extend 4 feet above ground with an electrified wire 6 to 8 inches from the top.
Raccoons	Electric	2 strands of electric wire 5 and 10 inches above the ground.
Woodchucks	Barrier	1-inch wire mesh buried 2 inches, extending underground 1 foot. Fence should extend 4 feet above ground and have a 1-foot overhang or electric wire 6 to 8 inches below the top to prevent climbing.
Woodchucks	Electric	Two strands of electric wire 5 and 10 inches above the ground.

Unfortunately, fences can be expensive if large areas require protection. Barrier fences typically cost much more than electric fences due to the high cost of woven-wire, posts, anchors, braces, fasteners, and labor. It is common to pay \$6 to \$8 per linear foot to install wire barrier fences.

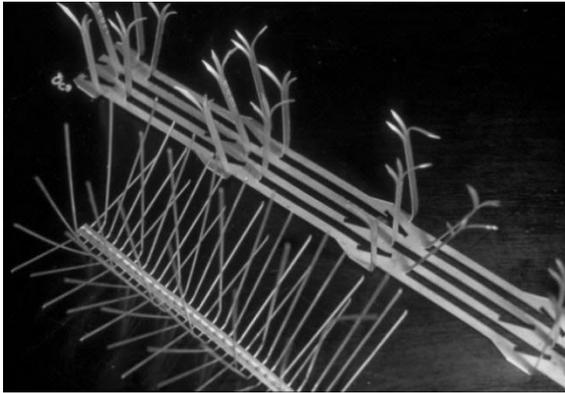
Depending on the design, simple electric fences may cost only \$1 to \$1.50 per linear foot, with most of the cost attributed to the fence charger. Electric fences use a painful but harmless shock to create a psychological barrier to animals. Frequent monitoring and control of vegetation are required to maintain sufficient shocking power (at least 3,000 volts) on the fence. Electricity can be used exclusively, as with the “poly-tape fence” (*Figure 6*), or in conjunction with a nonelectric fence. Fences can be powered through electric outlets, disposable batteries, or rechargeable batteries connected to a solar panel. Modern low-impedance chargers deliver pulses of electricity that deliver a painful, but not continuous, jolt of electricity. The gap in the pulse allows people and animals to move away from the fence. While the shock generally is safe for adults and older children, it could harm young children and people with heart pacemakers. Many chargers can power over 200 miles of fence. Electric fences can be used to protect home gardens from deer and woodchucks during the growing season.



**Figure 6. A two-strand electric fence can keep deer out of corn. Photo by UNL.**

### Protecting areas from birds

The mobility of birds makes them difficult to exclude from sensitive areas. Several techniques are available, however, to help reduce conflicts. Use ledge products (either barrier or electric) to prevent birds from roosting or nesting on ledges (*Figure 7*). These devices are easy to install and make it difficult or uncomfortable for birds to perch at treated locations. Install ledge products on surfaces out of reach of the public.



**Figure 7.** Cat Claw<sup>®</sup> (upper) and Nixalite<sup>®</sup> spikes (lower) are two of the many models of nonelectric ledge products. Photo by UNL.

Nets are useful for preventing bird access to buildings, fruit trees, and gardens (*Figure 8*). Mesh size of 2 inches will exclude pigeons or larger birds. Use ¾-inch-mesh netting to exclude smaller birds. Select nets that are resistant to ultra-violet rays. Before winter, remove nets that are suspended horizontally or secure them with additional support so that they can withstand the weight of snow or freezing rain.



**Figure 8.** Nets must be maintained to prevent bird access to sensitive areas. Photo by Stephen M. Vantassel.

### Protecting bird feeders

Many gardeners enjoy birds and maintain feeders to encourage birds to visit their yards. Unfortunately, many unwanted animals (e.g., skunks, raccoons, rats, mice, or squirrels) may be drawn to the feeder as well. Homeowners should not feed birds during the summer, as birds do not need this food source when natural foods are plentiful.

Many tactics are available for protecting bird feeders. First, place bird feeders on poles 10 feet or more from ledges or tree branches from where squirrels can jump. Install baffles on the pole to prevent animals from climbing. Finally, reduce the amount of spilled seed that can reach the ground by installing catch basins (*Figure 9*). For detailed instruction, consult *Selective Bird Feeding: Detering Nuisance Wildlife from Bird Feeders* at <http://ianrpubs.unl.edu/epublic/live/ec1783/build/ec1783.pdf>.



**Figure 9.** This properly installed bird feeder has a baffle and pan for fallen seed. Photo by Stephen M. Vantassel.

### *Protecting window wells*

Many people are not aware that wildlife can become trapped in window wells that are 4 inches deep or more. Cover window wells to help prevent this and the potential for a smelly experience when a skunk falls in (*Figure 10*).



**Figure 10. Window well cover. Photo by Stephen M. Vantassel.**

### *Protecting chimneys*

Some cavity-nesting birds (e.g., swallows, wood ducks) and mammals (e.g., tree squirrels, raccoons) view open chimneys as potential nesting or sites. They can gain access to structures through an open damper in the chimney or build a nest on a closed damper, which could result in a fire. Cap all chimneys with approved commercial covers (*Figure 11*).



**Figure 11. Examples of commercial chimney caps. Attach the cap to the flue so that it cannot be removed by raccoons. Photo by Lynn Braband.**

## Supplies

This module highlighted only a sample of the products available to exclude wildlife. We encourage readers to obtain product catalogs from wildlife control supply companies. Members of trade association such as the National Wildlife Control Operators Association are always testing new products and are a good source of information. If you are interested in this topic, we suggest that you enroll in the professional National Wildlife Control Training Program.

## Questions for Reflection

1. Define exclusion and provide two examples.
2. A client says she is in a hurry and just wants to seal a hole. How would you respond?
3. A client complains that the cost of exclusion is too high. How would you respond?
4. What options are available for excluding birds?
5. Describe how you would prevent skunks from accessing the space under a deck.

## Objective Questions

1. Electric fences
  - a. have a low initial cost
  - b. modify animal behavior
  - c. give a harmless shock
  - d. all of the above
  - e. a and c only
2. How many days should a hole be monitored before it is closed?
  - a. 1 day, regardless of weather
  - b. 2 days, regardless of weather
  - c. 3 days, regardless of weather
  - d. none of the above
3. Window wells should be covered when they have a depth of at least ...
  - a. 2 inches
  - b. 3 inches
  - c. 4 inches
  - d. 5 inches
  - e. window wells do not need covering
4. Advantages of exclusion include all of the following EXCEPT
  - a. immediate results
  - b. longterm results
  - c. lowest-initial cost
  - d. chemical-free
5. True or False – Bird feeders should be positioned at least 10 feet from the closest spot where a squirrel can jump to the feeder.

## Module 7    Repellents and Toxicants

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Module 7 addresses many of the issues and concerns regarding repellents and toxicants that are used when dealing with human-wildlife conflicts.

### Learning Objectives

1. Explain the difference between anticoagulants and acute toxicants.
2. Describe general application techniques for rodenticides.
3. Give an example of the dangers of toxicants to nontarget species.

### Introduction

Public attitudes toward chemicals such as repellents and toxicants vary greatly. Some people have a “spray and pray” mentality, in which pesticides are the first, and often only control method considered when confronted with a pest problem. Alternatively, some people are so opposed to the application of chemicals in the environment that they oppose all use of repellents and toxicants.

Integrated pest management (IPM) seeks to use effective, selective, and humane techniques to reduce damage to tolerable levels. We recommend considering the use of repellents and toxicants as part of an integrated approach to wildlife damage management (WDM). Pesticides may be an important component for reducing wildlife damage when used with other control methods, such as sanitation and exclusion.

### Definitions

The US Environmental Protection Agency (EPA) is the federal agency responsible for regulating pesticides. A pesticide is any substance, or mixture of substances, intended for preventing, destroying, repelling, or mitigating any pest problem, including plants.

**Repellents** - pesticides used to deter animal activity while not causing permanent harm or injury.

**Toxicants** - chemical compounds used to intentionally kill or impair target species.

**Target species** – management activities are directed at these specific animals.

**Nontarget species** or **nontargets** - wildlife, livestock, pets, and people which are not intended to be the recipients of or affected by a pesticide application. When misused, misapplied, or sometimes just due to unfortunate circumstances, toxicants can pose a threat to nontarget species. Safeguards are available to minimize these risks, but in some cases, it is best to use reduced-risk alternatives to toxicants.

**Primary exposure** - the effects on an animal that has directly encountered the pesticide. A mouse that dies due to ingestion of a rodenticide is an example of primary exposure.

**Secondary exposure** -the effects on an individual that has eaten an animal with primary exposure. An owl that eats a poisoned mouse is an example of secondary exposure.

**Active ingredients** - specific chemical compounds that produce the desired outcome in the target species. Repellents and toxicants include a wide range of active ingredients. Some are refined and concentrated forms of naturally-occurring compounds (capsaicin, blood, urine, strychnine, warfarin, and carbon dioxide), while others are synthesized for the desired effects (phosphine, bromethalin, and brodifacoum).

**Formulation** - the way the active ingredient is packaged for delivery to the intended target species. Pesticides are formulated to increase their effectiveness, attractiveness, and uptake by target animals.

For example, bait formulations include active ingredients and attractants (e.g., grains, fats, and flavor enhancers) that entice target animals to eat them. Baits may be formulated into blocks, pastes, place packs, and loose grains (*Figure 1*).

Bait blocks are the most common formulation for the control of rats and mice that live in close association with people. Bait blocks are easy to use, highly effective, and can be secured in bait boxes. Bait blocks come in several shapes, colors, flavors, and active ingredients that are appealing to different species.



**Figure 1. Clockwise from top. Block, pellet, and meal formulations of a rodenticide. Photo by LiphaTech®, Inc.**

## Regulations

The registration and use of most pesticides is regulated by the EPA through the authorization of the Federal Fungicide, Insecticide, and Rodenticide Act (FIFRA). Rules and regulations enforced by the EPA control the production, testing, labeling, transportation, storage, and application of all pesticides.

In addition, vertebrate pesticides are regulated by state departments of agriculture, human health, environmental conservation, and consumer protection. Some counties and local municipalities may have additional restrictions. Local and state regulations must be identical to or more restrictive than federal regulations. Check with your local agencies to ensure that you are in compliance with all pesticide regulations. In Nebraska, anyone using restricted use pesticides in a commercial application must be a certified pesticide applicator, which requires coursework, examination, and state licensing.

The EPA classifies some pesticides as restricted use pesticides (RUPs). The RUPs are available only to people with a certified applicators license.

Those not classified as RUPs are considered general use pesticides (GUPs) and may be purchased over the counter. Many GUPs have the same active ingredients used in RUPs. The difference is that GUPs present less risk to people and the environment. They generally have lower concentrations of the active ingredient, are sold only in small quantities (1 pound or less), or in formulations such as wax blocks or soft baits that present lower risk to nontargets because rodents cannot move the toxicant easily.

In general, services of a certified pesticide applicator are required whenever a person wishes to apply pesticides commercially, or on someone else's property.

Prior to purchasing and using a pesticide, read the label for specific information on the target species, site of use, methods of application, hazards, and safety requirements. Use of a pesticide contrary to the label is illegal, and punishable by federal and state laws.

## Repellents

Repellents are classified by their mode of action - pain, fear, touch, or aversive conditioning.

Active ingredients used to repel animals by pain include capsaicin and methyl anthranilate, which are irritants for mammals and birds, respectively. An animal must taste or inhale the repellent for it to be effective.

Active ingredients that use fear to repel animals include putrescent whole egg solids and coyote urine. Fear-based repellents are designed to make target animals think a predator is nearby and thereby avoid the location.

Repellents based on touch include polybutene-based caulks. Their stickiness makes animals avoid treated locations (*Figure 2*). Because polybutene-based caulks trap dust and may stain surfaces, they should be used only on properly-treated areas for short-term relief. Such repellent caulks usually are applied indoors.



**Figure 2.** Two brands of polybutene-based caulks used to deter wildlife. Photo by University of Nebraska–Lincoln (UNL).

Finally, repellents using aversive conditioning are quite different in that the reaction of target animals is delayed. Animals first consume the product, and in a few hours feel sick. They associate the illness with the food or area where they fed. This is the mode of action for the goose repellent Flight Control™. Geese that consume turf sprayed with anthraquinone quickly learn that treated grass causes nausea, and avoid eating treated grass in the future.

The effectiveness of repellents varies considerably depending on the motivation of problem animals, alternative foods, previous experience, and active ingredients of the repellent. Repellents often fail to deter animals, and it is rare for repellents to consistently end wildlife conflicts. Consequently, landowners must learn to tolerate some damage when using repellents. Read labels carefully before application, as some repellents cannot be used on plants destined for livestock or human consumption.

## Toxicants

Toxicants can be beneficial and cost-effective tools for controlling vertebrates such as house mice and Norway rats (Figure 3). Vertebrate pesticides can be applied in many formulations, using delivery methods to protect structures, turf, landscapes, cropland, rangeland, and other sites. Some toxicants are available for use on unprotected birds (e.g., European starlings and pigeons), but these are registered for use only by certified applicators trained in bird control.



**Figure 3.** Toxicants in the form of bait blocks with bait stations are used to control house mice and Norway rats. Photo by Stephen M. Vantassel.

As with repellents, toxicants have varying modes of action. Some reduce the ability of blood to clot (anticoagulants, such as warfarin), and others affect the nervous system (bromethalin), metabolic processes (phosphine), and heart function (vitamin D<sub>3</sub>). Selection of the appropriate active ingredient depends on the target species,

potential risks, previous methods used, application methods, and cost.

Toxicants are formulated to increase their effectiveness, attractiveness, and uptake by target animals. Baits include active ingredients and attractants that entice target animals to eat them.

## Pesticide Labels

The EPA is responsible for registering pesticides. Pesticide labels are legal documents and contain information that will reduce the risk of harming people or the environment. While only a few elements will be discussed here, always read the entire label before making an application. A thorough understanding of the use, risks, and storage is essential to the effective and responsible use of pesticides. In addition, the label is the law. Below are eight sections of a rodenticide label (*Figure 5*, next page) that require further consideration.

**Section 1 provides the list of target species for which this rodenticide is approved.** Use of the toxicant for species other than those listed is a violation of the label and the law.

**Section 2 provides the amount of active ingredient and inert ingredients contained in this formulation of the toxicant.** The active ingredient is the chemical difethialone, which kills rodents. Inert ingredients are the grain and materials used to encourage rodents to feed on the bait.

**Section 3 displays the human hazard signal word.** Signal words, in descending order of hazard, are Danger, Warning, and Caution. First Strike® has the signal word, "Caution," the lowest hazard rating.

**Section 4 contains safety information.** Safety is of utmost importance when applying toxicants. The pesticide label contains the minimum requirements to safely use each product. This section also contains information on what to do if someone ingests the toxicant or if other types of exposure occur, such as to the eyes, skin, or clothing.

Harm to people is not the only concern. Pets are extremely valuable to their owners and the illness or death of a pet could result in a lawsuit. The label explains how to reduce risk to pets and nontarget wildlife, in addition to the environment. For many pesticides, proper use is vital to protect water quality. The label will give instructions such as "Always rinse items away from wells, drains, and streams." It is up to you to follow all of the safety requirements and recommendations.

Wear the proper personal protective equipment (PPE) when applying pesticides. The required PPE will vary according to the active ingredient and formulation of the toxicant. First Strike® requires standard PPE consisting of gloves (specifically waterproof gloves), a long-sleeved shirt, long pants, shoes, and socks.

Do not eat, drink, or smoke when applying pesticides. Some pesticides may require additional safety equipment, such as respirators, face shields, and protective suits. Check the pesticide label for detailed information before using any product. Always wash thoroughly after handling any pesticide (*Figure 4*).



**Figure 4.** Always wash after handling pesticides.  
Photo by Stephen M. Vantassel.

# FIRST STRIKE

## SOFT BAIT

**4 PRECAUTIONARY STATEMENT**  
**Hazard to Humans and Domestic Animals**  
**CAUTION:** Harmful if swallowed or absorbed through the skin. Causes moderate eye irritation. Avoid contact with eyes, skin or clothing. Keep away from children, domestic animals and pets. All handlers (including applicators) must wear long-sleeved shirt, long pants, socks, and water-proof gloves. Any person who believes necessary or unused bait following application of this product must wear water-proof gloves.  
**User Safety Requirements:** Follow manufacturer's instructions by cleaning remaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash hands thoroughly after applying bait and before eating, drinking, blowing gum, using tobacco or using the toilet, and change into clean clothing.  
**FIRST AID**  
 Have this label with you when obtaining treatment advice.  
**If swallowed:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor.  
**If in eyes:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor immediately for treatment advice.  
**If on skin or clothing:** Take off contaminated clothing. Rinse skin with plenty of cool water for 15-20 minutes. Call a poison control center or doctor immediately for treatment advice.  
**TREATMENT FOR PET-POISONING:** If animal eats bait, call veterinarian at once.  
**NOTE TO PHYSICIAN OR VETERINARIAN:** Contains the anticoagulant difethialone. If swallowed, this material may reduce the clotting ability of blood and cause bleeding. For humans or animals ingesting bait and/or showing obvious poisoning symptoms (bleeding or prolonged prothrombin times), give Vitamin K1 intramuscularly or orally. Also for pets, if needed, check prothrombin times every 3 days until values return to normal (up to 30 days). In severe cases, blood transfusions may be needed.  
**ENVIRONMENTAL HAZARDS:** This product is extremely toxic to mammals and birds. Dogs, cats and other predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten this bait. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water or rinsate.

**7 DIRECTIONS FOR USE**  
 It is a violation of Federal law to use this product in a manner inconsistent with its labeling.  
**READ THIS LABEL** and follow all use directions and precautions. Use only for the sites, pests, and application methods described on this label.  
**IMPORTANT:** Do not expose children, pets or other nontarget animals to rodenticides to help prevent accidents.  
 To help prevent accidents:  
 1. Store product not in use in a location out of reach of children and pets.  
 2. Apply bait in locations out of reach of children, pets, domestic animals, and nontarget wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining or eating bait.  
 3. Bait can be taken from stations when they are lifted, units must be secured or otherwise immobilized. Even triggered bait stations are needed in areas open to fooded rodents, raccoons, boars, other potentially destructive animals, or in areas prone to vandalism.  
 4. Dispose of product container, unused, spilled, and unconsumed bait as specified on this label.  
**Note:** Bait stations are mandatory for outdoor, above-ground use. Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait.  
**USE RESTRICTIONS:** This product may only be used to control Norway rats, roof rats and house mice in and around homes and residential buildings, food processing facilities, industrial, commercial, agricultural and public buildings, and similar man-made structures. It may also be used in transport vehicles (ships, trains, aircraft) and in and around related port or terminal buildings. This product may also be used in alleys. Do not apply further than 50 feet from buildings. Do not seal this product in individual containers holding less than 16 pounds of bait. Do not place near or inside ventilation duct openings. Do not contaminate water, food, feedstuffs, food or feed handling equipment, or mix or meal handling equipment. Do not broadcast bait.  
**Selection of Treatment Areas:** Determine areas where rats and/or house mice will most likely live and consume bait. Generally, these are along walls, by ground openings, in corners and concealed places, between floors or walls, in or beside tunnels, or in locations where rats and/or house mice or their signs have been observed. Remove as much alternative food as possible.  
**APPLICATION DIRECTIONS:**  
**House Mice:** Apply 1 pouch per placement, usually spaced 8 to 12 feet apart. Up to 4 pouches may be needed at points of very high house mouse activity. Maintain a constant supply of fresh bait for 15 days or until signs of house mouse activity cease.  
**Rats:** Apply 6 to 25 pouches per placement, usually spaced 15 to 30 feet apart. Maintain a constant supply of fresh bait for 10 days or until signs of rat activity cease.  
**Follow-up:** Replace contaminated or spoiled bait immediately. Wear water-proof gloves, collect and dispose of all visible dead animals and leftover bait, as well as any bait that has become accessible to non-target animals. To discourage reinfestation, limit sources of rodent food, water and harborage as much as possible. If reinfestation does occur, repeat treatment. For a continuous infestation, set up permanent bait stations and replenish bait as needed. (070110)

**1 FOR INDOOR AND OUTDOOR USE**  
**KILLS NORWAY RATS, ROOF RATS, HOUSE MICE**  
**AND WARFARIN-RESISTANT HOUSE MICE**  
**NORWAY RATS AND HOUSE MICE CAN CONSUME**  
**A LETHAL DOSE IN ONE NIGHT'S FEEDING**  
**WITH FIRST DEAD RODENTS APPEARING**  
**FOUR OR FIVE DAYS AFTER FEEDING BEGINS**

**2**

Active ingredient: difethialone .....	0.0025%
Inert ingredients .....	99.9975%
Total .....	100.00000%

**3 CAUTION** (See state panel for additional precautionary statements.)  
**KEEP OUT OF REACH OF CHILDREN**

**5 STORAGE AND DISPOSAL**  
**Do not contaminate water, food or feed by storage or disposal.**  
**Pesticide Storage:** Store in original container in a cool, dry place inaccessible to children and pets.  
**Pesticide Disposal:** Wastes resulting from the use of this product may be disposed of in trash or in an approved waste disposal facility.  
**Container Handling:** Nonrefillable container. Do not reuse or refill this container. Triple rinse (or equivalent) then offer for recycling or reconstruction, or purchase and dispose of in a sanitary landfill.

**6**  
**EPA Reg. No. 7173-268**  
**EPA Est. No. 7173-WI-1**

LiphaTech, Inc.  
 3600 W. Elm Street  
 Milwaukee, WI 53209  
 (800) 351-1476

Figure 5. Sample EPA label for a rodent toxicant containing the active ingredient difethialone. Image by LiphaTech®, Inc.

**Section 5 explains how to store and dispose of the toxicant.** First Strike® must be stored in a location that is cool, dry, and inaccessible to children. For some toxicants, the label will provide specific information on how the product must be transported, including placement in the vehicle and whether safety placards are required. Safe practices and equipment for handling and applying pesticides vary according to the active ingredient, formulation, and target species.

Notification of pesticide application is an important element of pesticide safety. In many cases, proper notification is required regarding location and time of application so that clients and the public are aware of potential threats to health and safety. The safety of nontargets, including clients, the public, pets, livestock, and wildlife always must be a primary factor when considering the use of toxicants.

**Section 6 contains two sets of numbers that identify the pesticide and the manufacturer site, respectively.** “EPA Reg. No.” is an abbreviation for EPA Registration Number. The First Strike® registration number is 7173-258. It identifies the product and company that produced it. The EPA Est. No. or EPA Establishment Number identifies the specific manufacturing plant where the completed bait was produced. You can use these numbers to find research related to the product. Type “EPA Registration Number xxxxx-xxxx” into an Internet search engine to find out what information is available.

**Section 7 explains how to apply the product, including where it may and may not be used.** The information in Section 7 and Section 1 must be combined to properly use the product. It states that you may apply the toxicant only where the label allows, and for the appropriate target species.

**Section 8 explains how *NOT* to use the product.** First Strike® provides detailed information that limits how far from a building this bait may be used. Farther down the column, the amount of toxicant applied in a given area is limited. It explains that the maximum amount of bait you may use is four pouches every 12 feet when

targeting house mice. The application rate is different for rats. The use of too little toxicant will result in reduced rodent control, and the use of too much violates the law. If you ever have questions about the interpretation of a label, contact the Nebraska Department of Agriculture, the agency in Nebraska that regulates pesticides.

## Toxicology

Toxicology is the study of chemical agents that kill animals. It is important to understand how toxicants work to maximize their efficiency on target species, and safety for nontargets. All pesticide labels indicate the percent active ingredient contained within the product (e.g., 2% zinc phosphide). The percentage of animals that die from an application of a toxicant varies depending on the active ingredient, amount ingested, weight of the animal, period of exposure, sex and age of the animal, and other factors.

The toxicity of a pesticide is measured by its LD<sub>50</sub> (lethal dose, 50 percent). This describes the dose of a pesticide that will kill half of a group of test animals (rats, mice, or rabbits) from a single exposure or dose by absorption through the skin, ingestion, or inhalation. The LD<sub>50</sub> is given as the dose per unit of body weight, such as milligrams per kilogram (mg/kg). A pesticide with a lower LD<sub>50</sub> is more toxic than a pesticide with a higher number because it takes less of the pesticide to kill half of the test animals. An active ingredient such as strychnine, with an LD<sub>50</sub> of 10 mg/kg in rats, is highly toxic and far more hazardous than an anticoagulant such as warfarin that has an LD<sub>50</sub> of 1,000 mg/kg in rats. Avoid the use of highly-toxic active ingredients in areas that are frequented by livestock, pets, children, and other nontargets. Always read the pesticide label for safety information.

## Rodenticides

Rodenticides are classified by their modes of action. The majority of registered rodenticides are anticoagulants. When ingested, anticoagulants inhibit blood clotting. Animals die from internal bleeding (caused by stress), or bleeding from external wounds. While the effects of all

anticoagulants are cumulative, some may be effective with a single dose. Active ingredients include first-generation rodenticides (multiple-dose rodenticides such as warfarin), and more recently developed second-generation rodenticides (single-dose rodenticides including brodifacoum, chlorophacinone, difethialone, and diphacinone). Keep fresh bait available continuously for at least 2 weeks, or until all feeding ceases.

Due to the low amounts of active ingredients, anticoagulant rodenticides seldom are primary hazards. Nontarget animals have to consume a considerable amount of anticoagulant bait to experience immediate negative effects. In addition, vitamin K<sub>1</sub> can be used as an antidote to counteract the effects of most anticoagulants. Nevertheless, no pesticide is “safe,” and it is illegal to make such a claim regarding pesticides.

The best way to reduce primary hazards with rodenticide baits is to avoid using them where pets, livestock, children, and other nontargets are present. Apply baits only in tamper-resistant, locking bait boxes that prevent access by nontarget species. If not applied correctly, nontarget animals are at risk. Animals that die from anticoagulant exposure often show signs of bleeding near their mouth or anus (*Figure 6*).

Anticoagulants may pose hazards for nontarget animals. A rodent that has eaten an anticoagulant (primary exposure) has concentrated levels of that compound in its body (especially in the liver) for several days. A predator or scavenger that consumes intoxicated rodents (secondary exposure) may receive a high dose of the toxicant, which in turn can lead to impaired clotting of its blood and death. Brodifacoum and diphacinone are particularly toxic to dogs, and have relatively long biological half-lives. Half-life refers to the amount of time needed for the body to excrete or process ½ of the active ingredient from the body.



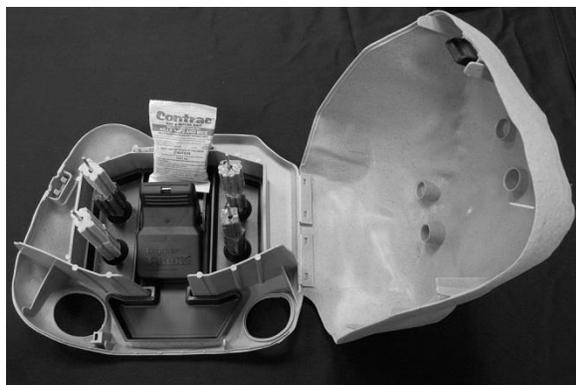
**Figure 6. An opossum shows the effects of poisoning by anticoagulants. Photo by a concerned WCO.**

The following list outlines tactics to reduce hazards from anticoagulant rodenticide baits.

1. Avoid using them where pets, livestock, children, and other nontargets are present.
2. Use the toxicant with the lowest hazard (i.e., a high LD<sub>50</sub>) that still will be effective.
3. Apply toxicants in tamper-resistant bait boxes designed to protect bait against weather and access by children and other nontargets (i.e., EPA bait station Tier 1 - resistant to weather and to tampering by children and dogs, and to be used indoors, and outdoors within 50 feet of buildings defined as structures that possess walls and a roof).
4. Remove dead and impaired rodents found during daily inspections.
5. Use toxicants as part of an integrated WDM program when other less hazardous methods have failed or will not meet management goals.

### Bait Stations

Bait stations (*Figure 7*) are the most common way to apply rodenticides. Bait stations come in a variety of shapes and sizes, all of which are used to protect the bait, increase consumption of the bait by rodents, and minimize access to the bait by nontarget animals.



**Figure 7. Bait station for rodents. Block and trap placement is shown. Photo by Stephen M. Vantassel.**

As part of EPA's new risk mitigation for rodenticides, all rodenticide bait products marketed to residential consumers must be sold with, and used in protective, tamper resistant bait stations (bait boxes). These increase both the effectiveness and safety of rodenticides.

Bait stations are useful because they:

1. protect bait from moisture and dust,
2. provide a protected place for rodents to feed,
3. keep nontarget animals and children away from hazardous bait,
4. allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to nontargets, and
5. prevent accidental spilling of bait.

Some bait stations are large enough that bait and water can be placed inside. Place bait stations where rodents are active, especially where there are signs such as fresh droppings and gnaw marks along walls, under pallets, and behind equipment. Secure bait stations with screws, anchor bolts, or other fasteners. Use locks, seals, and concealed latches to make bait boxes tamper-resistant. Check stations regularly, daily if possible, during the first week, and at least once per week thereafter. Gradually reduce to monthly inspections, and refresh or replace bait as need.

Other rodenticides are acute (i.e., quick acting) toxicants and have other modes of action. The concentration of active ingredient (usually

percentage by weight) in most formulations typically is much higher than in anticoagulant rodenticides. No antidotes exist for acute toxicants, so even greater care must be used during application. Acute toxicants may cause the quick reduction of a rodent population (often within a day), while anticoagulants typically reduce a population within 1 to 3 weeks. Quick-acting toxicants are useful when the disease hazard is high, or when a very large population must be reduced in a short period of time. Only use an acute toxicant once or twice per year in the same locality to avoid the development of bait shyness in rodents.

## Avicides

Fewer toxicants are available for bird control than for rodents. Starlicide Complete™ (p-n2-toluene) is available to certified pesticide applicators for controlling starlings at livestock feedlots.

Avitrol™ (4-amino-pyridine) is a restricted use pesticide (RUP) classified as a chemical frightening agent (repellent). It is applied to disperse birds rather than kill them. The chemical is mixed in a ratio of 1 treated corn kernel to 99 untreated kernels. When the bait is ingested, affected birds have convulsions, exhibit erratic behavior, and die. In doing so, they frighten other birds from the area.

Fertility control agents are considered pesticides and must be applied by a certified applicator. Products used to reduce the potential for eggs to hatch (e.g., OvoControl™, active ingredient nicarbazin) are pesticides and registered by the EPA. In some states, even food-grade corn oil is considered a pesticide when applied to eggs to reduce hatchability. State pesticide regulations vary considerably. Anyone who makes a commercial application must be licensed and know state laws and regulations. Contact the Nebraska Department of Agriculture (NDA) for more information.

## Other Vertebrate Pesticides

While only a few toxicants are available for the control of rodents and birds, even less are available for use on other vertebrate species. Wildlife is beneficial and many regulations are in place to protect wildlife. In addition, many vertebrate pesticides affect humans and other nontarget species, so their use is not widespread.

Bromethalin and warfarin are registered for mole control in turf. They are formulated as pellets and plastic worms or gels, and can be applied only in underground tunnels that are frequented by moles.

## Fumigants

Fumigants kill animals via toxic gas. Fumigants typically are used for mammal control in burrows or dens away from human structures. Charcoal-based gas cartridges are GUPs, and may be used for woodchucks.

Fumigants with aluminum phosphide as the active ingredient are RUPs, and available only to certified applicators. Aluminum phosphide is extremely toxic and its use has been more strictly regulated since the deaths of two children in Utah in 2010. Fumigants carry multiple primary hazards, including risk of fire. Find out if you must be a certified applicator to apply a particular fumigant, and if a Fumigation Management Plan must be developed prior to use. Seek training before using fumigants.

## Conclusion

Relatively few toxicants are available for use on vertebrate pests and their use is highly regulated by federal and state agencies. Nevertheless, pesticides may be a valuable tool in an overall IPM strategy, provided they are used responsibly.

## Web Resources

<http://wildlifecontroltraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

Contact the following agencies or organizations for additional information.

- US Environmental Protection Agency  
<http://www.epa.gov/pesticides>
- US Fish and Wildlife Service  
<http://www.fws.gov>
- University of Nebraska Extension  
Pesticide Safety Education Program  
<http://pested@unl.edu>
- Nebraska Department of Agriculture,  
Pesticide Program  
<http://www.nda.nebraska.gov/pesticide/>
- Nebraska Game and Parks Commission  
<http://outdoornebraska.ne.gov/>

## Questions for Reflection

1. A client is concerned about the risk of using an anticoagulant rodenticide near her dog. How would you respond?
2. What are some ways you can reduce the risk of toxicants to nontarget animals?
3. Why is it important to wash your hands after every rodenticide application?
4. Provide an example of when a pesticide is not considered a toxicant.
5. Explain the difference between primary and secondary pesticide exposure.

## Objective Questions

1. True or False - "Target species" refers to those animals that are the intended subjects of control activities.
2. What can toxicants potentially harm?
  - a. the applicator
  - b. animals
  - c. clients
  - d. all of the above
3. How do anticoagulant rodenticides kill an animal?
  - a. interfering with clotting of the blood
  - b. interfering with heart muscle activity
  - c. interfering with the nervous system
  - d. interfering with the respiratory system
4. First-generation anticoagulants
  - a. require one feeding to kill
  - b. require multiple feedings to kill
  - c. are older than second-generation anticoagulants
  - d. a and c only
  - e. b and c only
5. True or False – The pesticide label offers suggestions to consider when using a pesticide.

## Module 8 Trapping

Trapping involves the use of mechanical devices that capture animals without the trapper being present. Trapping is one of the most common and effective methods that landowners use for managing wildlife damage because traps are time savers. Traps work even when you are not present.

### Objectives

1. List the different types of cage and box traps.
2. Identify the parts of a cage and box trap.
3. Describe different sets used to capture animals.
4. Explain principles and techniques used to reduce capture of nontarget animals.

### Definitions

In Module 5, *Wildlife Control Methods*, we reviewed the methods available to control wildlife. In this module, we will focus on the use of cage and box traps to manage wildlife that cause conflicts. Many people use the term “live trap” to identify traps that capture animals by imprisonment in a box. We find the term “live trap” to be misleading, as well as inaccurate, because some traps that grasp parts of the animal’s body (e.g., footholds or cable-restraints), also capture animals alive. Instead, we prefer to use the terms cage traps and box traps to identify devices that capture animals by imprisoning them. Cage traps have walls made of wire mesh. Box traps have solid walls usually made of wood, plastic, or sheet metal (*Figure 1*).

### Types of Cage & Box Traps

Manufacturers produce cage traps (*Figure 2*) and box traps with different features. This section will discuss a few of the more important ones.

**1. Gravity vs. spring-loaded doors.** Gravity doors, as the name suggests, means that when the trap is sprung, the door falls due to gravitational force. Spring-loaded doors close with the aid of a spring.

Spring-loaded doors require the trapper to manually depress the spring to open the door.



Figure 1. Cage trap (left), box trap (right). Photos by Stephen M. Vantassel.

Each type of door has advantages and disadvantages. Gravity-door traps tend to be less expensive and don’t have springs that can wear out. Nontarget animals can be released easily by gently rolling the trap over on its top. The disadvantage is that animals sometimes roll the trap over and escape when the door opens. Spring-loaded doors allow fewer escapes because the door can’t open if the trap is rolled over, and the door will close even when the trap is not on level ground.

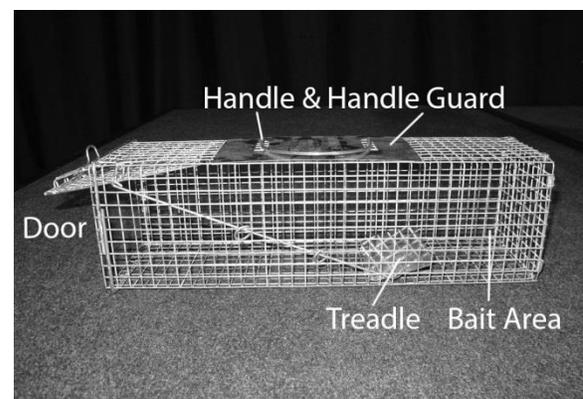


Figure 2. Main parts of a single-door cage trap. Photo by Stephen M. Vantassel.

**2. Single-door or two-door traps.** Single-door traps are the most common type of cage and box trap. Bait is placed on one end and the animal must enter the other end to reach the bait. A two-door trap has an opening on both ends, giving the appearance of a tunnel to an animal.

## Traps for Homeowners vs. Professionals

Manufacturers produce cage traps for homeowners (retail-grade) as well as professionals, such as wildlife control operators (WCOs). Although the traps may appear the same, closer inspection reveals they can be quite different. In general, retail-grade traps have thinner-gauge metal and wider mesh (i.e., 1- x 1-inch; *Figure 3a*). They may not have handle guards. Professional traps typically are made with 1- x ½-inch mesh for much of the cage (*Figure 3b*). The benefit of using traps with narrower mesh is that captured animals are less likely to tear up turf or damage items nearby. In addition, it is harder for them to scratch you as you carry the cage. Handles are positioned to keep the cage in balance, and the guards are large enough to protect your hands. Both versions are effective in capturing animals.

## Effective Use of Traps

The apparent simplicity of cage and box trapping is deceiving. While setting cage or box traps does not require a college degree, effective trapping involves attention to details for improving capture success.

### Step 1. Safety first

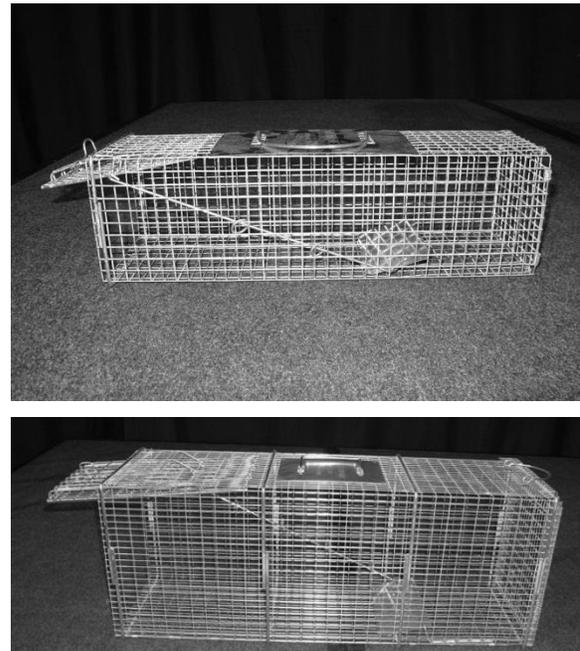
Always wear protective work gloves when handling traps. Gloves help protect you from cuts from sharp edges on the metal, as well as any contaminated material that may be adhering to the trap.

### Step 2. Know how to handle a trapped animal BEFORE you set a trap

People often capture animals without a plan for handling them. This is particularly true for people who accidentally capture a skunk.

### Step 3. Know the target animal

The target species determines the size and type of trap needed. As a general rule, use the smallest trap necessary to capture the target animal. Smaller traps help you avoid captures of nontargets because smaller sizes make it hard for larger animals to enter.



**Figure 3a (top).** A retail-grade squirrel trap. Photo by Woodstream Corp. **Figure 3b (bottom).** A professional-grade raccoon trap. The professional trap has smaller gaps in the mesh. Photo by Stephen M. Vantassel.

### Step 4. Choose a good location

Place the trap so that the target animal can reach it easily. Place traps at least 12 inches away from sensitive items to prevent trapped animals from damaging personal property (*Figure 4*).

### Step 5. Set the trap so it does not wobble

Even though the ground may look level, it often has bumps and depressions that can cause a trap to wobble as the animal steps on the trap floor. Wobbly traps are empty traps. To ensure the trap is stabilized properly, scrape the soil to level it. Press down on various areas of the trap to see if it will tip.



**Figure 4.** This raccoon grabbed a cord and wood and pulled them inside the trap.  
Photo by Stephen M. Vantassel.

### Step 6. Select the right set, and monitor traps on a daily basis

Sets are discussed later in this module. Traps must be checked every day regardless of weather or holiday status. If you can't check the traps daily, either close the traps, or secure the doors so that they cannot close. If practical, check traps in the morning and evening so that animals will be in the trap for less time.

### Step 7. Use plenty of traps

Setting one trap can be effective; however, this is like hunting with one bullet. We recommend setting three traps when trying to capture animals squirrel-sized and larger. Use more when trying to capture smaller animals.

## Trapping Sets

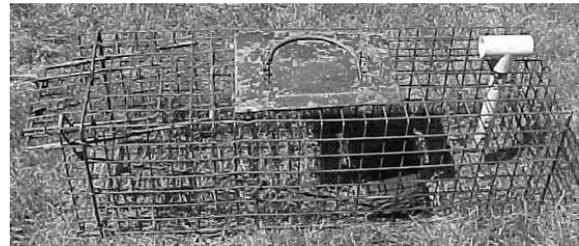
A set encompasses the use of the trap and its entire placement. Sets are categorized as baited, blind, and positive.

**Baited sets** are the most common, and they rely on a lure or bait to attract an animal into the trap. Use bait that selectively attracts the target species.

Trappers usually exploit an animal's sense of smell. Bait a trap so that the odors of the food or lure have an opportunity to disperse into the air. One method uses a forked stick. Scoop out some of the bait from its container with the stem of the stick. Insert the stem towards the back half of the bait area of the cage trap, so that the forks grab

onto the trap mesh, and allow the stem to dangle. Make sure that the stick will not move much in the wind. Failure to consider this may allow the animal to grab the bait without getting close enough to depress the treadle. With this method, the bait has very high exposure to air, while keeping bait off the ground and away from ants.

An alternative bait stick consists of a T-shaped plastic (PVC) pipe with holes in it (*Figure 5*). The PVC pipe is long-lasting and will not be thrown off center when you cover the cage with a cloth. To use the PVC bait stick with liquid bait, attach a cap to the end of the PVC pipe. The location of the first drilled hole will determine the amount of liquid bait held. Push the end-cap on without using glue to allow the liquid bait to seep out slowly, permeating the area with attractant.



**Figure 5.** PVC pipe bait stick.  
Photo by Stephen M. Vantassel.

Liquid bait can also be held in a 2-inch PVC pipe (*Figure 6.*) Seal the bottom opening with an end cap and use a screw cap for the top. Drill holes in the upper portion so that odors can escape.

Another way to bait a cage trap is by using trapper's wire and cotton balls. This technique is useful for liquid-based baits and lures because cotton absorbs the liquid. Skewer six cotton balls with wire and bend the wire so they will not slide off. Make a loop in the other end to hang the wire from the cage. Hang the bait wire toward the back half of the bait area. As with any hanging method, make sure that the wire will not move much in the wind. Otherwise an animal may grab the bait without getting close enough to depress the treadle.



**Figure 6.** This two-inch PVC pipe can hold liquid or loose bait. Photo by Stephen M. Vantassel.

In situations where hanging bait is not possible or practical, use eye appeal. One WCO uses Chef Boyardee® microwave lunch buckets to trap raccoons. The small white plastic bowls have lids with holes. Bait is placed in the bowl and covered with the lid. The white bowl attracts the raccoon, the holes allow the odor to disperse through the air, and the lid helps protect the bait from getting washed out by rain. Yogurt containers with holes cut in the lids also work. Ensure that baited containers weigh enough to prevent them from being blown over by the wind. Add small rocks to a container to keep it in place. Sight attractants are especially important for skunks or raccoons. Place marshmallows in the back of a trap to attract them in the dark.

**Blind sets** rely on the movement of the animal to trigger the trap, and no bait is used. A two-door trap set in an animal's trail is a classic example of a blind set (*Figure 7*).

Advantages of this type of set include no bait to maintain or that might be refused by the animal, and the set only captures animals using the trail or path. The disadvantage is that these traps are larger and tend to be more expensive than single-door traps.



**Figure 7.** Place a two-door trap on a trail to increase trapping success. Photo by Stephen M. Vantassel.

**Positive sets** refer to traps placed over or in front of an entrance hole, and barricaded to funnel the animal(s) into the trap (*Figure 8*). Positive sets catch only problem animals as only animals exiting the hole can be captured. Positive sets are used to remove animals from under sheds, decks, or in den holes.



**Figure 8.** A box trap is placed in front of a skunk hole and barricaded to force the skunk into the trap. Photo by Stephen M. Vantassel.

## Humane Trapping

Many people mistakenly think that cage and box traps automatically are humane. The fact is that humane trapping involves not only the device, but also the skill of the trapper. Foothold traps used by an experienced trapper can be more humane than a cage trap used by an inexperienced landowner.

A few simple steps can significantly improve the welfare of animals in cage and box traps. First, consider weather conditions and reduce the animal's exposure to temperature and weather extremes. For example, cover half the length of a cage trap to provide an area where a caged animal can obtain shelter from wind, rain, sun, and prying eyes (*Figure 9*).



**Figure 9.** Cover half the length of cage trap to provide cover to a trapped animal. Photo by Stephen M. Vantassel.

Plastic box traps keep animals up to 12°F warmer than comparable cage traps. While plastic traps provide greater warmth for animals in the winter, they may get too hot for animals in the summer. Likewise, cage traps may be too cold in the winter, but may be a better choice in the warmer months. Consider how wind, snow, rain, and sun will affect the trapped animal and try to minimize those impacts.

Second, check traps frequently. As stated earlier, traps must be checked daily. If possible, check traps twice a day (morning and evening) to reduce the length of time an animal is in the trap.

Third, use selective trapping techniques to reduce the likelihood of capturing nontarget animals. Use as many of the approaches listed below as are practical.

- Use the smallest trap possible to catch the target animal.
- Locate traps where target animals are traveling.
- Use baits and lures that are less attractive to nontargets. For example, sweet baits such as molasses and sugar wafers are less attractive to house cats, but are desirable to raccoons.
- Close traps during the day when trapping nocturnal animals, and at dusk when trapping diurnal animals.

Trapping has an important place when using IPM in wildlife damage management. Diligence in selecting a location, setting, and monitoring traps will ensure not only success but also the humane treatment of captured animals.

Module 9 addresses what to do with animals that have been trapped. In Nebraska, captured wildlife cannot be transported more than 100 yards without special permits from the NGPC. This requirement helps to ensure humane treatment of wildlife and reduce the spread of disease.

## Questions for Reflection

1. Why is it important to understand the different types of cage and box traps?
2. Why is it inaccurate to use the term live trap to refer only to cage and box traps?
3. What does it mean to trap humanely?
4. Why is proper baiting technique important when using cage and box traps?
5. List a few aspects involved in setting cage and box traps properly.

## Objective Questions

1. Selective trapping can be accomplished by considering what?
  - a. set type
  - b. bait
  - c. size of trap
  - d. all of the above
  - e. none of the above
2. To reduce the likelihood of cage-trapped animals damaging nearby items, keep traps at least \_\_\_\_\_ away.
  - a. 6 inches
  - b. 8 inches
  - c. 12 inches
  - d. 16 inches
3. True or False – An advantage of using a positive set is that only the problem animals are trapped.
4. At a minimum, traps should be checked
  - a. weekly
  - b. every three days
  - c. daily
  - d. when convenient
5. True or False – Cage traps should have half of their length covered to provide shelter to the captured animal.

## Module 9 Animal Handling

Module 9 discusses how to handle animals and the treatment of wildlife while under the direct control of a person, trap, or other control method.

### Learning Objectives

1. Describe the principles behind proper animal handling.
2. Identify three tools used in animal handling.
3. List appropriate animal handling procedures.
4. Define relocation and translocation.

### Preparation

Wildlife that is captured can become extremely stressed when approached and handled by people. Proper animal handling begins before the animal is captured.

Use quality equipment and ensure that it is in proper working order. Initial equipment includes durable heavy **leather gloves**, such as welding gloves, and a **blanket** made of smooth but durable fabric, such as denim.

### Strategies to Reduce Stress

Recall in Module 8 how humane trapping required attention to trap selection, placement, and monitoring. Listed below are additional strategies to consider.

1. Equip cage and box traps with water bottles and food for animals that are trapped. Check traps daily to ensure that they always contain fresh food and water.
2. Keep external noise and excessive handling or movement of traps to a minimum. Wild animals, particularly prey species, perceive noise and excessive movement as threats.
3. Handle animals as briefly as possible. Animals often become stressed near humans, so reduce the amount of time spent in hand. Do not allow animals to be used for “show and tell” to neighbors and friends.

### Handling Snakes

Snakes require more specific handling information and skills than other wildlife.

1. Whenever possible, use snake tongs to handle snakes. Most people are not experienced enough to distinguish nonvenomous from venomous snakes. Even a nonvenomous snake can inflict a painful bite requiring medical treatment. Hold a snake behind the head to avoid being bitten (*Figure 1*); support its body to reduce the likelihood of it suffering injury as it struggles. Be careful how hard you squeeze the snake with the jaws of the snake tongs, as vertebrae of snakes are easily crushed. Practice control of the tongs by picking up Ping-Pong® balls, or thin skinned fruit such as tomatoes, to help gauge your pressure. Tongs with wide, flat jaws are less likely to injure snakes.



**Figure 1. Proper hand-hold of a nonvenomous snake.**  
Photo by Stephen M. Vantassel.

2. Place the captured snake in a pillow case and tie the end securely, ensuring that the snake is not in the knot. When transporting a snake, place the pillow case in a bucket, cooler, or

other hard-sided container with a cover to prevent injury. Always ensure that animals have proper ventilation.

3. Place captured snakes in a cool, preferably shaded, area between 40° and 75° F.

## Animal Removal

### *Trapped animals*

Move captured animals out of public view as quickly as possible to reduce stress to the animal and minimize the risk that well-meaning or curious onlookers will be injured. Ensure that the holding area for animals is neither too hot (out of direct sun) nor too cold (out of rain, snow, or wind). In general, small mammals have a low tolerance to extreme heat or cold, while large animals (raccoon-sized and larger) have greater tolerance. Sometimes, moving the traps and animals to a shaded area or out of the elements is sufficient. Always keep cages partially covered to help reduce animal stress.

### *Disposing of animals*

Depending on state laws, three options are available for disposal of captured animals: on-site release (relocation), translocation, or euthanasia.

### *On-site release (relocation)*

Relocation refers to releasing an animal within its home range. On-site release is the easiest and usually most convenient option. Open the trap and release the animal on the property where you caught it. Use caution when releasing an animal to minimize injury to you and the animal. The following recommendations may help an on-site release go smoothly.

1. If you are not the landowner, obtain written permission in advance of release.
2. Without handling the animal, inspect it to ensure it is free of debilitating injuries or signs of illness. Only release animals that appear healthy.

3. Ensure that nearby structures are properly secured. Skunks tend to walk into open garages.
4. Keep children and pets away from the area. Although it is unlikely that the animal will turn and attack, it is possible.
5. Whenever possible, release the animal towards cover and away from roads and people.
6. Release nocturnal animals at dusk and diurnal animals in the morning.

### *Translocation*

Translocation refers to moving and releasing an animal outside of its home range. While legal in some states, many wildlife biologists have serious reservations about its use. Animals moved from their home range suffer higher-than-normal mortality rates, are more likely to repeat problem behaviors, and may transmit diseases to animals in the new area. Nebraska does not allow landowners to move problem wildlife over 100 yards. A Wildlife Control Operator (WCO) license or a permit may be required for live transport of wildlife.

Translocation is stressful and may be inhumane to released animals. When species such as raccoons and tree squirrels are released into an area where territories are already occupied, resulting disputes can lead to injury and death to both released and resident animals.

## Handling Animals that Won't Leave a Trap

Sometimes, despite our best intentions, animals refuse to leave their cage or box traps. This behavior is particularly common with skunks and opossums (*Figure 2*).



**Figure 2. A juvenile opossum hunkers down in the back of a box trap. Photo by Stephen M. Vantassel.**

Several methods can be used to encourage an animal to leave a trap.

1. Remove any trap covering to expose the animal to sunlight or the elements.
2. Ensure the animal can see a pathway for escape.
3. If, after several minutes, the animal doesn't move, consider securing the door in an open position and leaving it overnight.

With a skunk in a cage trap, remove the cover and gently spray water on it to encourage it to leave. Do not use this method when using a box trap or during cold weather.

## Euthanasia

In Nebraska, euthanasia of captured animals may be the best course of action, due to regulations against translocation and the potential for disease transmission. Euthanasia must be performed in accordance with your state regulations. Guidelines for euthanasia have been established by the American Veterinary Medical Association (AVMA) but their application in field settings may be difficult. Recommendations are available at <http://icwdm.org>. In addition, organizations such as the National Wildlife Control Operators Association and The Wildlife Society are working on guidelines for humane euthanasia in field settings. Module 10 has more information on euthanasia.

## Questions for Reflection

1. Explain the difference between relocation and translocation.
2. Which activity (relocation or translocation) do some wildlife biologists have serious concerns about? Explain their view.
3. Your client wants to translocate an animal that appears ill. What would you say to that person?
4. A major snow storm is in the forecast, and your client desperately wants the trapping project to begin now. What should you recommend?
5. Describe some ways to encourage an animal to leave a trap.

## Objective Questions

1. When should you begin using proper animal handling techniques?
  - a. before you capture an animal
  - b. when the animal is in sight
  - c. when the animal is in hand
  - d. when the animal is disposed
2. What temperature is ideal for holding snakes?
  - a. 30 to 40 °F
  - b. 40 to 75 °F
  - c. 50 to 85 °F
  - d. none of the above
3. When grasping a snake by the head to avoid being bitten, use care to
  - a. support the body
  - b. keep the head below the body
  - c. keep the head above the body
  - d. none of the above
4. If translocation is legal, what is the minimum distance you should take a squirrel to reduce the likelihood of its return?
  - a. 5 miles
  - b. 10 miles
  - c. 15 miles
  - d. 20 miles
5. A cage trap should be covered for at least half of its length because covers
  - a. provide animals shelter from elements
  - b. provide animals shelter from predators
  - c. hide the catch from public view
  - d. all of the above

## Module 10 Euthanasia & Carcass Disposal

Euthanasia means good death (“eu” = good; “thanasia” = death), and refers to techniques that are used to kill an animal as painlessly as possible. To be considered euthanasia, death must occur instantaneously or while the animal is unconscious.

### Learning Objectives

1. Compare and contrast the differences between capture methods and euthanasia techniques.
2. Explain the reasons for using proper euthanasia techniques.
3. Identify signs that confirm death of an animal.
4. Explain when a method meets guidelines of the American Veterinary Medical Association (AVMA).
5. List options for appropriate disposal of carcasses.

### Introduction

While some sharpshooters are able to shoot animals so precisely that animals die without suffering, euthanasia usually occurs in a controlled setting, such as at an animal clinic or shelter.

Because euthanasia is difficult to accomplish in the field, sometimes humane killing techniques must be used instead. Humane killing involves the rapid death of an animal, but it may still experience brief pain or distress. Humane killing does not meet the criteria for euthanasia because the animal experiences pain.

Examples of humane killing include snap traps for mice and rats. While their primary function is to capture the animal, the animal often dies rapidly enough to be considered humane killing. While the distinctions between euthanasia and humane killing may seem trivial, they must be kept in mind to have a realistic discussion about the use of lethal control for wildlife.

Certainly, euthanasia techniques should be used whenever practical as the animal will suffer the least. In situations where euthanasia is impractical, use humane killing techniques. Regardless of the method used to kill an animal, reduce stress to the animal as much as possible.

The emotional involvement people have with wildlife dictates that all killing of wildlife, whether by euthanasia, humane-killing, or capture device, be done out of public view. In addition, make every reasonable effort to reduce stress to animals before and during efforts to kill them. Failure to follow this advice may result in a great deal of scrutiny and unwanted attention.

### Disposition of Injured Wildlife

Wild animals that are captured, injured, and unfit to be released in accordance with state, county, or city regulations normally should be euthanized or humanely killed. Check your state and local laws BEFORE you begin any control program.

### Euthanasia Techniques

#### *Carbon dioxide*

Many people in the wildlife control industry consider euthanasia by carbon dioxide-induced narcosis to be the most user-friendly of the methods recommended by the AVMA. The method requires a chamber in which CO<sub>2</sub> replaces the available oxygen. With this method, the animal can be euthanized without injection, handling, or transfer.

Carbon dioxide (CO<sub>2</sub>) is readily available at welding supply centers, is relatively safe for humans to use, and will suppress the ability of an animal to experience pain prior to death. For commercial operators, a euthanasia chamber (*Figure 1*) is essential. They can be purchased from various supply companies or constructed on your own.

For more information on how to build and use a CO<sub>2</sub> chamber, consult the Internet Center for Wildlife Damage Management (<http://icwdm.org>).



**Figure 1.** A cage trap enclosed in a carbon-dioxide euthanasia chamber constructed with Plexiglas®. Photo by Stephen M. Vantassel.

## Shooting

Personnel should be trained in the safe use of firearms and the anatomy of the species involved. We do not recommend that nonprofessionals be involved in euthanizing animals by shooting. However, shooting is a common and useful control method for trained professionals. State and local laws often restrict firearm discharge in non-rural areas.

For more information on shooting as a control method, consult the Internet Center for Wildlife Damage Management (<http://icwdm.org>).

## Humane Killing Techniques

Shooting a free-ranging animal is a common form of humane killing. Snap traps capture animals while humanely killing them.

Other kill traps (e.g., tunnel traps and body-gripping traps) also are suitable devices to accomplish humane killing. Because these devices require additional training, we suggest that readers consult the Nebraska Game and Parks Commission (NGPC) or contact experienced trappers or wildlife control professionals first.

## Confirmation of Death

Confirmation of death can be difficult in field settings. We recommend that you consider all the possible signs when determining whether the animal truly is deceased.

1. **Respiration has stopped** - check to see if the chest has stopped expanding and contracting for at least 3 minutes. You may have to look carefully, as some animals have very shallow breathing.
2. **Corneal reflex has ceased** - the animal should no longer blink (even when touching the eye), the eyes should be fixed, and the pupils (the black portion of the eye) dilated.
3. **Muscle tone is limp** - dead animals will not be able to stand and should appear limp and flaccid.
4. **Heart has stopped beating** - a stethoscope and training are needed to determine if an animal is dead.

## Disposal of Carcasses

Disposal of carcasses must be done safely, in a manner respectful of public sensitivities, and in accordance with state and local guidelines. Proper disposal methods include:

- 1) aboveground,
- 2) belowground, single-use burial area,
- 3) belowground, repeated-use burial area,
- 4) incineration, and
- 5) disposal in a licensed landfill.

Always wear thick leather gloves to reduce the risk of being scratched or exposed to animal fluids when handling carcasses. Welder's gloves are durable and provide protection to the hands and wrists. For additional protection, wear latex or vinyl gloves inside the leather gloves (*Figure 2*). Ticks and fleas present a health risk as they leave the dead carcass in search of a new host.



**Figure 2.** Top left and moving clockwise: Latex gloves, rubberized cloth gloves, and welder's gloves. Photo by Stephen M. Vantassel

### *Aboveground*

Aboveground disposal is easy because no digging is involved. It is gaining in popularity as an environmentally-responsible way of recycling wildlife in the ecosystem. Aboveground disposal increases the likelihood of attracting scavengers that feed on carcasses.

Aboveground disposal requires landowner permission and is not recommended for carcasses of sick or poisoned animals. Choose isolated locations to reduce encounters with pets and people, and do not overuse a location. Sites should be more than 150 feet from ponds, streams, and wells. Runoff from the site should not flow toward water sources.

### *Belowground individual grave*

Bury animals in individual graves.

1. Consult with companies that locate underground utilities, such as Dig Safe® or Diggers Hotline (dial 811) prior to digging.
2. Choose burial sites that are at least 300 feet from surface water to reduce the risk of contamination.
3. Bury carcasses at least 4 feet belowground (*Figure 3*). If this is not practical, ensure that the carcasses are covered with sufficient materials, such as rocks, to reduce the possibility of access by scavengers.



**Figure 3.** Woodchuck placed in an individual grave, prior to burial. Photo by Stephen M. Vantassel.

### *Incineration*

The incinerator must be approved by state and local authorities to burn animal carcasses. Incineration can cost more than \$0.50 per pound, making it relatively expensive. Contact your local veterinarian for details on incineration sites. A burn barrel is not an incinerator. It cannot sustain the required high temperatures for a long enough period of time.

### *Landfill*

Carcasses taken to a landfill must be securely enclosed in a plastic bag or other suitable airtight container to prevent noxious odors. They may be disposed of at a Type-II, licensed, solid-waste disposal facility (standard landfill), or at an out-of-state facility, in accordance with that state's solid waste disposal regulations.

## **Web Resources**

AVMA Guidelines on Euthanasia (2012) at [http://www.avma.org/issues/animal\\_welfare/euthanasia.pdf](http://www.avma.org/issues/animal_welfare/euthanasia.pdf)  
<http://wildlifecontroltraining.com>  
<http://icwdm.org/>  
<http://wildlifecontrol.info>

## Questions for Reflection

1. What does euthanasia mean?
2. What is humane killing and how is it different from euthanasia?
3. Provide three signs that you would use to determine if an animal is dead.
4. List the methods of carcass disposal and explain the requirements for their use.
5. A landowner grants permission for surface disposal of carcasses. What questions must be answered before disposing of any carcasses?

## Objective Questions

1. True or False – Carbon dioxide can be used in the euthanasia of wildlife.
2. True or False – The goal of euthanasia is to kill the animal in as painless a manner as possible.
3. When does the process of euthanasia begin?
  - a. before the animal is placed in the chamber
  - b. when the animal is placed in the chamber
  - c. after the gas has been turned on
  - d. none of the above
4. When selecting disposal sites for carcasses, what should you keep in mind?
  - a. Will humans or pets come across the carcasses?
  - b. Will carcasses threaten water supplies?
  - c. Do I need landowner permission?
  - d. all the above
  - e. none of the above
5. Carcasses should be buried at least \_\_\_\_\_ feet below the soil surface.
  - a. 1
  - b. 2
  - c. 3
  - d. 4

## Module 11 Hiring Professionals

Sometimes conflicts with wildlife require professional expertise or assistance. The decision to contact a wildlife control operator (WCO) will vary by individual, the species of concern, and the location of the human-wildlife conflict. This module will help you determine if you need the services of a professional.

### Learning Objectives

1. Determine when professional help is needed to resolve a wildlife conflict.
2. Explain how to locate and identify a qualified WCO.
3. Explain how licenses and certifications apply to wildlife damage management (WDM).

### When to Contact a WCO

Professionals can provide expert advice or actual control services. The reasons to contact a WCO fall into three general categories: legal issues, safety concerns, and other.

#### *Legal issues*

Consider contacting a WCO if the wildlife conflict involves any of the following:

- When the problem animal is a threatened or endangered species, which will be rare, as most nuisance wildlife species are abundant. Permits from the Nebraska Game and Parks Commission (NGPC) and US Fish and Wildlife Service (USFWS) likely will be required.
- When the problem animal is a bird, except for house sparrows, pigeons, and starlings. Nearly all other birds have protected status.
- When domesticated species, such as livestock, dogs, or cats are involved.
- When the client wants the animal transported alive off of his or her property. Nebraska does not allow landowners to move problem wildlife over 100 yards. A licensed WCO may

be able to secure permits from the NGPC to translocate certain wildlife.

#### *Safety concerns*

In addition, consider contacting a WCO if the wildlife conflict involves any of the following:

- When the environment is too dangerous, such as icy beaver ponds, extreme weather, or tall buildings.
- When a disease outbreak (e.g., rabies), makes you too uncomfortable to work with wildlife.
- When you lack expertise with the control devices needed to manage the situation.
- When you don't feel comfortable handling a species, perhaps because you are not familiar with its behavior or associated risks.
- When a lethal control method and additional expertise is needed.

#### *Other reasons*

Here are other reasons for which you might consider contacting a WCO:

- The problem requires a rapid resolution.
- The issue has not been resolved by your own efforts.
- You lack time and equipment to handle the concern.
- You have physical disabilities that prevent you from being able to handle the problem.
- The situation is particularly sensitive, such as at a school, day-care facility, or a location with high visibility.

### Finding a Qualified WCO

Quality and expertise can vary greatly among service providers. A Yellow Page ad or website does not guarantee that a company is reputable or qualified. This situation is especially true in Nebraska, where the WCO industry has few

government regulations and licensing requirements. Professional training and certification are required, however, for those who work with restricted use pesticides.

We begin by defining some terms. First, you must understand that **pest control operator (PCO)**, **wildlife control operator (WCO)**, fur trapper, and

**animal control officer (ACO)** are four different professions. At times, the activities of these professions overlap so keeping them separate can be confusing. We have provided a table to highlight similarities and differences among these professions (*Table 1*).

**Table 1. Responsibilities of professionals dealing with wildlife and damage management in Nebraska.**

	<b>Pest Control Operator (PCO)</b>	<b>Wildlife Control Operator (WCO)</b>	<b>Fur Trapper</b>	<b>Animal Control Operator (ACO)</b>
<b>Regulatory agency</b>	<sup>1</sup> NDA	<sup>2</sup> NGPC	NGPC	City or county government
<b>Manage</b>	Invertebrates, rats, mice, urban birds	Most vertebrate animals, including rats, mice, urban birds, and furbearers	Furbearers	Domestic species, dogs, cats, carriers of rabies
<b>Extent of regulation</b>	Highly regulated	Some regulation, but not all clearly stated and quite variable	Clearly-defined state regulations	Highly regulated, often a municipal employee
<b>Control methods</b>	Pesticides and some traps	Traps, direct capture, transport	Traps	Traps and nets
<b>Number of visits</b>	Monthly	Multiple visits until the problem is resolved	Daily visits until harvest rate drops or season ends	Often single and routine patrols
<b>Equipment</b>	Step ladders	Assorted ladders	No ladders	No ladders
<b>Time with Client</b>	Regular service	One-time service	Seasonal	One time
<b>Payment</b>	By client	By client	By fur buyer	Taxes and fees

<sup>1</sup>Nebraska Department of Agriculture (NDA)

<sup>2</sup>Nebraska Game and Parks Commission (NGPC)

To make matters more complicated, WCOs are known by a variety of terms, including wildlife controller, wildlife damage management professional, animal damage controller, nuisance trapper, nuisance wildlife control operator, and problem animal controller. We use the term WCO because “nuisance” doesn’t cover the diversity of problems associated with wildlife, and many do not like to refer to wildlife as a nuisance.

### *How qualified is the WCO?*

States often require a person to participate in a training course or pass an exam to demonstrate a level of understanding and proficiency in wildlife damage management. Some states require a trapper education course to be licensed. Nebraska does not require individuals who work with nuisance or problem wildlife to be certified or licensed. With such low entry requirements, consumers should not assume that people offering to do WCO work are qualified to perform the service.

We suggest that consumers ask the following questions of the WCO, and get recommendations from others before hiring a WCO.

- Consult with Nebraska’s Conservation Officers and NGPC staff. Ask them who they recommend in your area.
- Is the WCO licensed or certified? Certification typically demonstrates a higher level of professionalism.
- Ask the WCO for references from satisfied clients.
- How many years has the WCO been involved in WDM? Don’t confuse this question with how many years the WCO has been in the pest control business. Controlling insects is very different from controlling wildlife.
- Does the WCO have liability insurance? If so how much? Coverage of \$300,000 is very easy to obtain in this industry. There is no excuse for not having liability insurance.
- Does the WCO have Worker's Compensation insurance? This insurance protects the worker if he or she gets injured on the job. Most WCOs are self-employed and may not be required by law to carry Worker’s Compensation, but they may if they have other employees.
- Did the WCO present you with a variety of control options - exclusion, trapping, eviction, habitat modification, or perhaps suggest that nothing be done? Ask the WCO if other options are available.
- Does the WCO clearly describe the service in a written contract?
- Will the WCO provide services according to your preference and in accordance with local laws? Keep in mind that your preferences may change the duration and cost of the service.

### *Licenses and Certifications*

Governments grant licenses to give individuals or companies legal permission to perform an activity. For example, you received a license from your

state to drive a car. While a license may provide some evidence of competence, we suspect that most readers will realize that a driver’s license does not guarantee the individual is a responsible driver! Certifications, on the other hand, are bestowed by industry or educational groups to those who have fulfilled certain qualifications. Certifications are only as good as the standards and organizations behind them. Presently, the WCO industry has only a handful of certifications.

**Basic Wildlife Control Operator (BWCO).** The BWCO certification is granted by the National Wildlife Control Operators Association (NWCOA, <http://www.nwcoa.com>) to those who pass a 100-question objective exam based on the **National Wildlife Control Training Program: Core Principles and Information** produced by the University of Nebraska-Lincoln and Cornell University. The BWCO seeks to establish minimum competency for WCO work. Some states (e.g., Delaware, New York) have adopted the National Wildlife Control Training Program for licensing its wildlife control operators.

**Certified Wildlife Control Professional (CWCP).** The CWCP was designed by NWCOA to recognize WCOs who have demonstrated advanced competency in WDM. Individuals must have 3 years of full-time experience, complete 200 continuing education credits spread over three categories, sign an ethics statement, and pass a competency exam before being certified. Certification must be renewed every 5 years. A list of certified WCOs is available at <http://NWCOA.com>.

**Bat Standards Compliant (BSC).** Individuals obtaining the BSC have completed 4 hours of training and passed an exam on the proper handling and control of bats. This training does not detail how to specifically control bats. Instead, the training sets standards and protocols for properly working with bats.

Other certifications are granted by individual companies, such as bird control suppliers. Some WCO companies have internal certifications for their own work force. As the WDM industry matures, expect to see more training and

certifications. Take the time to investigate the certification to see if it is meaningful.

### *The Cost of Hiring a WCO*

Customers frequently are surprised at the cost of assistance in WDM. While costs can vary significantly between WCOs, keep in mind the many factors that impact prices.

- How dangerous is the job? Ladder work always is dangerous.
  - How difficult is it to control the species? Some species, such as gray squirrels, are easy to control, while red squirrels can be more difficult.
  - How much travel and equipment is involved to resolve the problem? If the WCO has to travel 20 miles to reach your location, payment must at least cover the round trip cost of 40 miles.
- What is the cost of living in your area? Often WCOs in urban areas are paid more than those residing in rural areas.
- What kind of warranty or guarantee does the WCO provide? Depending on the species, a month to a year is sufficient. Also, guarantees are only as good as the company who gives them. If the company goes out of business, the guarantee means nothing.
  - Does the WCO have higher expenses due to insurance, good equipment, and training? While high prices don't guarantee quality, extremely low prices almost always guarantee that the WCO lacks insurance, doesn't have good equipment, or has not attended training or conferences to keep current with advances in the profession.
  - How busy is the WCO? Sometimes WCOs raise prices due to excessive demand. At other times, prices may be lower due to reduced demand.

## Questions for Reflection

1. List several reasons why a person should hire a professional WCO.
2. Why is a license to perform wildlife control not enough to assure quality workmanship?
3. What is the difference between licensing and certification?
4. List three questions every customer should ask before hiring a WCO.
5. What are the licensing requirements for WCOs in Nebraska?

## Objective Questions

1. Wildlife control operators have the most in common with
  - a. pest control operators
  - b. animal control operators
  - c. fur trappers
  - d. none of the above
2. True or False – You should hire a professional if you have physical challenges that limit your ability to perform the control activities.
3. The cost of a job is determined by
  - a. the distance to your location
  - b. level of risk in performing the service
  - c. time of year
  - d. overhead of the company
  - e. all of the above
  - f. none of the above
4. True or False – Several certifications are available for WCOs.
5. Several synonyms exist for WCOs, including
  - a. animal damage controller
  - b. problem animal controller
  - c. nuisance trapper
  - d. all the above
  - e. none of the above

## Module 12 Laws and Ethics

Local, state, and federal regulations are designed to protect wildlife and the public. This module covers some of the agencies and laws that address wildlife damage management (WDM). In addition to legal requirements, think about the ethical aspects of WDM.

### Learning Objectives

1. List the agencies that are involved in regulating how we deal with wildlife and WDM.
2. List the laws are associated with the lethal control for a particular species.
3. Explain the law as it relates to the release of caged and trapped animals.
4. Identify some of the ethical issues involved in resolving human-wildlife conflicts.

### Introduction

Be aware of the current status of laws at state national levels of authority. State and local regulations frequently are more restrictive than federal regulations. Different laws and regulations apply to those who manage wildlife damage, apply pesticides, hunt and trap animals, and rehabilitate wildlife.

### Federal Agencies

Four major agencies are involved with regulating the WDM industry at the federal level.

1. The US Fish and Wildlife Service (USFWS) in the US Department of Interior protects and manages threatened and endangered species and migratory birds (<http://www.fws.gov>).
2. The US Environmental Protection Agency (EPA) regulates the use of repellents and pesticides (<http://www.epa.gov>).
3. The Occupational Safety and Health Administration (OSHA) in the US Department of Labor regulates worker-safety rules (<http://www.osha.gov>).

4. The Centers for Disease Control and Prevention in the US Department of Health and Human Welfare make recommendations for the prevention of human and other zoonotic diseases (<http://www.cdc.gov>).

In some circumstances, other federal agencies may have jurisdiction. The US Department of Agriculture, Animal and Plant Health Inspection Service, Division of Wildlife Services (USDA-APHIS-WS) provides federal assistance in addressing wildlife damage issues, but does not have a regulatory role. They help manage wildlife to reduce damage to agriculture and natural resources, minimize risks to human health and safety, and help protect endangered and threatened species. The Federal Aviation Administration supervises the management of wildlife at airports.

### State Agencies

The major agencies involved in wildlife-related work at the state level include:

1. Nebraska Game and Parks Commission,
2. University of Nebraska-Extension Pesticide Safety Education Program,
3. Nebraska Department of Agriculture, and
4. Nebraska Department of Health and Human Services.

### Local Agencies

The major agencies involved in wildlife-related work at the local level include:

1. Municipal animal control officers,
2. Humane societies,
3. County sheriff and police departments, and
4. County Departments of Health and Human Services.

## Federal Laws

The following discussions include brief descriptions of pertinent federal laws and regulations that affect WDM. These are part of the US Code of Federal Regulations, and are found online and at most public libraries: "16 U.S.C. 1531-1544, 87 Stat. 884."

### *Endangered Species Act*

The Endangered Species Act (ESA) was passed in 1973 to protect imperiled plant and animal species. The ESA requires that endangered or threatened species must not be injured or harassed by WDM activities. Endangered and threatened species cannot be killed, harmed, or collected except under carefully described circumstances, and only with appropriate federal and state permits.

If endangered or threatened species exist in your area, you must take special precautions. The presence of endangered or threatened species will affect how you can set traps or apply pesticides. One measure of professionalism is the level of effort put forth to protect nontarget species, whether or not they are endangered. Endangered species usually are not present in most urban settings, however protected birds often are. Many species of wildlife are protected under state regulations, but are not threatened or endangered. For more information on the ESA, visit <http://www.fws.gov/endangered/laws-policies/index.html>.

### *Migratory Bird Treaty Act*

The Migratory Bird Treaty Act (MBTA) protects all migratory birds, as well as their feathers, nests, and eggs. It does not include pigeons, house sparrows, or starlings, as they are not native species. You must have a federal permit to take (kill), possess, or transport migratory birds, nests, or eggs. The law does not require a permit for you to rescue a raptor trapped in a building provided the bird is not harmed, and is released outdoors immediately.

Before you attempt to control a migratory bird (e.g., woodpeckers, raptors, and waterfowl) the

landowner must obtain a 50 CFR Depredation Permit from the USFWS (USFWS Bird Depredation Permit) (<http://www.fws.gov/forms/3-200-13.pdf>). The permit allows the taking of migratory birds that have become a nuisance, are destructive to public or private property, or are a threat to public health or welfare. The permit spells out the conditions under which birds may be controlled and the methods that may be used. Permit holders may control migratory birds that are causing, or are about to cause, serious damage to crops, nursery stocks, or fish in hatcheries. A fee is required for the permit.

State and local ordinances may further define control activities. Local laws may limit the types of treatments (e.g., pyrotechnics or firearms) that can be used to manage birds. Check local and state laws before attempting to manage any bird species.

### *Federal Insecticide, Fungicide and Rodenticide Act*

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) regulates the availability and use of pesticides, including repellents and toxicants. Only a licensed pesticide applicator can apply pesticides on someone else's land, or apply restricted use pesticides.

### *Occupational Safety and Health Act*

The Occupational Safety and Health Act (OSHA) sets standards to promote worker safety. For example, workers must be informed in advance about potential job hazards such as possible exposure to histoplasmosis from contact with pigeon droppings. The OSHA also oversees the investigation of employee complaints that may be related to the use of pesticides. Even if you do not have more than 10 workers, review OSHA standards and training recommendations, especially those on safe practices in confined spaces and the use of respirators.

## State Laws and Regulations

In general, state laws and regulations add restrictions to federal laws. States typically classify wildlife in the following ways.

1. Game species may be legally hunted and typically taken for meat. A state hunting license is required to capture or “take” a game animal.
2. Furbearer species are captured for fur, usually through trapping. A state hunting or trapping license is required to capture or “take” a furbearer.
3. Nongame species are not harvested, and no open seasons are available. Most nongame wildlife species are protected and cannot be harmed.

Some wildlife species, such as migratory birds, eagles, and marine mammals, are protected by state and federal laws and regulations. Some nuisance species are unprotected, and have no restrictions on their take. Typically, licenses or permits are not required to shoot, fish, or trap these species (e.g., European starlings, Asian carp, Norway rats, or house mice).

## Local Laws and Regulations

In recent years, animal control agencies have attempted to apply humane regulations regarding the treatment of domesticated animals to the treatment of problem wildlife. For example, people have been cited for animal cruelty because cage-trapped animals did not have access to water. Animal protection groups claim that state laws that protect animals against cruelty apply to wildlife as well. We expect this trend to continue until officials and the courts decide the matter. Therefore, it is imperative that your WDM activities be as discrete as possible and use the highest standards. Just because a technique is legal, does not mean it is wise or appropriate. Always consider how a conflict situation might be perceived by others. Keep in mind that with public access to cell phone cameras, any of your activities might be filmed and appear in the media.

## Nontarget Animals

In general, a nontarget animal is an individual or species that is incidentally captured or taken (*Figure 1*). In Nebraska, a captured animal must be

euthanized or released within 100 yards of where it was captured.



**Figure 1. A nontarget dog captured in a cage trap.**  
Photo by Stephen M. Vantassel.

The legal situation becomes more unclear when the nontarget is a domestic animal, as these are normally under the jurisdiction of animal control officers (ACOs), as well as considered to be private property. House cats frequently enter cage traps. If the cat is owned, it must be released. However it often is unclear if feral cats are considered wild or domestic. Nebraska does not clarify the legal status of feral cats, so work with local animal shelters when capturing feral domestic animals. Your local government may require domestic species to be taken to your local animal shelter for final disposition. Always understand the laws and regulations before you act.

## WDM Ethics

Ethics are the principles that guide the way you perform activities. Your behavior flows from your moral value system. In short, every action exhibits ethical standards, but not every action represents commendable standards.

Your effort to manage wildlife damage must follow the highest ethical and humane practices because the public holds wildlife in such high regard. Consider how your actions affect the animal. Many traditions teach that proper ethical behavior requires us to treat others the way we would like to be treated. Respect is the quality of treating people, animals, and things relative to their inherent value and dignity. Be empathetic and respectful of others, and you likely will make correct decisions.

## Conclusion

While many decisions are clearly right or wrong, many more depend on the situation. Reasonable people can disagree over a specific course of action, but always consider whether you can defend your decisions. If you will be ashamed of an action, then you should not do it. Always consider how your actions will affect others and the environment. Sometimes no perfect options exist, but you can always choose the options with the fewest negative consequences.

## Nine Principles of WDM

Ethical WDM adheres to nine principles:

1. Strictly follow all laws and regulations related to Wildlife Damage Management.
2. Behave in a professional manner. Exemplify honesty, sincerity, and dedication.
3. Treat people, property, and wildlife with respect.
4. Be sensitive to different viewpoints on WDM.
5. Promote competence and present an image worthy of the activity by supporting high standards of education, employment, and performance.
6. Treat others in a courteous and respectful manner.
7. Strive to broaden knowledge, skills, and abilities to advance the practice of WDM.
8. Attempt to resolve wildlife damage conflicts with the most humane, selective, practical, and effective management techniques available.
9. Encourage others involved in the situation to do the same.

## Questions for Reflection

1. Name three federal agencies and describe their involvement with WDM activities.
2. A client's home has suffered thousands of dollars in damage from a woodpecker. The use of frightening devices has not diminished the activity. While on site, you notice a baited rat trap attached to the house near some fresh woodpecker damage. How would you respond?
3. A cage-trapped raccoon looks ill. The homeowner wants to release it because he/she does not want the animal to be killed. What would you advise?
4. While trying to catch a woodchuck, a homeowner captured a skunk in a cage trap under his deck. What would you recommend?
5. Which of the nine ethical principles listed do you think are the most important?

## Objective Questions

1. Three federal agencies involved in regulating WDM activities are
  - a. EPA
  - b. OSHA
  - c. USFWS
  - d. DOD
  - e. FIFRA
2. A client is having a problem with a woodpecker. What agencies should she contact for permission to use lethal control? Circle all that apply.
  - a. USFWS
  - b. Nebraska Game and Parks Commission
  - c. humane society
  - d. local animal control
  - e. police department
3. Do you need a permit to rescue a falcon or other raptor trapped in a building?
  - a. yes
  - b. no
  - c. it depends
4. You have caught an uninjured, collared, and licensed cat in your cage trap set for raccoons. What should you do?
  - a. release it
  - b. bring to local animal control
  - c. euthanize it
  - d. ask the client
5. True or False. – State laws cannot be more restrictive than federal laws.

## Case Studies Illustrating the Complex Dynamics of WDM

### Introduction

The following three case studies illustrate the issues and challenges involved in resolving human-wildlife conflicts. While these case studies are composites and do not necessarily reflect a specific incident, they represent real occurrences. We have selected these three species based on the frequency and diversity of issues they raise. Resolving these concerns will illustrate the overall process for implementing wildlife damage management (WDM) approaches.

As you review the case studies, keep in mind the material that was presented in the modules just covered. Apply the basic principles of WDM and Integrated Pest Management (IPM, *Figure 1*). Be conscious of safety and protect yourself from zoonotic diseases. Identify the problem wildlife species. Determine what animal control techniques to use and if there will be extensive animal handling. Will euthanasia be required? Will there be any ethical or legal considerations?

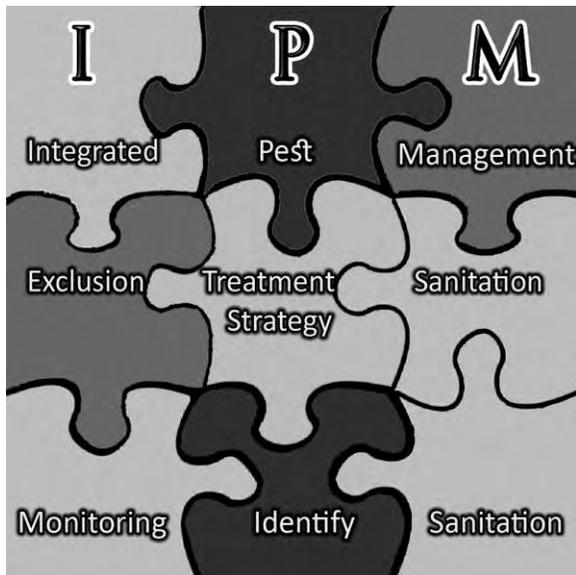


Figure 1. Parts of the IPM Strategy. Image by Stephen M. Vantassel.

Successful IPM solutions contain the following elements:

1. identify the pest,
2. locate and monitor the pest or damage,
3. determine the legal status of the pest and obtain necessary permits,
4. choose prevention or control methods,
5. set an economic or damage threshold, and
6. evaluate the success of the action.

### Case Study #1: Fox Squirrels in an Attic

As a group, tree squirrels (e.g., fox, gray, and flying squirrels) frequently cause human-wildlife conflicts. Their climbing ability, high reproductive rate, and gnawing behavior make them a challenge to control. You just received a call from a homeowner complaining about squirrels in the attic and she is asking for your help on how to deal with them. Follow the steps below to help diagnose the problem and make a recommendation.

#### Diagnosing the Culprit

**Question 1:** Determine where the client lives. For example, if the client is in eastern Nebraska, you know that the species of squirrel most likely to be encountered is the fox squirrel.

**Question 2:** Determine what kind of habitat the client lives in. For example, fox squirrels can be almost anywhere in wooded areas of eastern Nebraska, including cities.

**Question 3:** Ask the homeowner how she knows that squirrels are in the house. If she has seen the squirrels entering a hole in the attic, that is helpful. However, often the client says she hears scratching or scurrying noises in the ceiling, and just assumes it is caused by squirrels because they are too loud to be mice. The client could be correct. Noise is difficult to evaluate, however, because people “hear” things differently.

**Question 4:** Ask the client to walk around the house and look at the eaves, roofline, and vents for holes 2 inches in diameter (*Figure 2*). Ask if tree branches are within 4 feet of the roof line or if they have noticed squirrels on the roof, or walking power lines to the house.

**Question 5:** If the client cannot locate a hole large enough for a squirrel to enter, should you recommend that she enter the attic? We suggest that clients enter attics only if they have proper respiratory protection and are physically capable of looking in the attic safely. In our experience, about 90% of squirrel holes can be identified while standing on the ground outside of the structure. Another 5% can be identified from the attic, and the remainder requires inspection with a ladder. If the person is not capable of entering the attic safely for inspection, have her call a wildlife control professional.



**Figure 2.** Tree squirrel hole in a soffit.  
Photo by Stephen M. Vantassel.

## Potential Solutions

Once the wildlife species causing the problem has been positively identified, you must explain the various control options.

**Question 6:** Does the client want nonlethal control, or the animal killed and removed?

Many clients will say they want **nonlethal control**. Various options include:

**Frightening devices** - Clients may ask about whether radios, strobe lights, or effigies will convince squirrels to leave. You need to explain that the effectiveness of these devices is mixed. For instance radios and strobe lights can cause animals to move, but the squirrel may simply move to another part of the house, damaging more insulation along the way. Research has not demonstrated that ultrasound and similar devices are effective for evicting squirrels from locations.

**Repellents** - Clients will ask whether mothballs or ammonia are effective in evicting squirrels. Both materials are noxious to mammals. The problem is that they are not labeled for this use, and therefore are illegal. These home remedies cannot be recommended by Extension staff or volunteers. Also, application of the repellents at sufficient strength to cause the animal(s) to leave the building may be hazardous to some people.

**Translocation** – In Nebraska, captured animals can only be moved up to 100 yards to help ensure humane treatment and reduce the spread of diseases. Translocation may just move a problem to another building, and survival of animals moved out of their home range often is poor.

**One-way doors** - One-way doors allow squirrels to leave a structure but not return. Although simple in concept, one-way doors require some careful consideration. First, is it possible that young squirrels are present in the attic that could be abandoned (e.g., March-April or August-September rearing seasons)? Second, is the structure secure enough to reduce the likelihood that the evicted squirrels would re-enter elsewhere? If not, will the owners be able to screen vents, seal unused holes, and repair weak boards or soffits prior to installing the one-way door? If not, then the one-way door should not be used.

**Question 7:** If the person chooses lethal control, several options are available. Killing nursing females will result in the young perishing, which is inhumane and should be avoided.

**Shooting** - Shooting is a very effective method for the lethal control of squirrels. In most situations,

laws governing or prohibiting the discharge of firearms in suburban areas will eliminate the use of this technique. Homeowners should note that air rifles and other projectile-shooting devices are considered “firearms.”

**Trapping** - Trapping is the most common method for removing squirrels from structures. The owner has several options when dealing with fox squirrels. We suggest that cage traps are the best tool for nonprofessionals. We have broken down the process into several steps. Always be safe and wear gloves when handling traps. Have a plan for dealing with captured squirrels *before* catching the first animal. Translocation is not legal in Nebraska, so be prepared to release the squirrel on-site after excluding or euthanizing the squirrel. Follow these steps for catching squirrels in cage traps.

Step 1- Determine the travel route used by the squirrels to enter the house. Typically, squirrels will climb a tree, walk on a branch, jump to the roof, and scurry directly to the hole. Select a spot on that trail to set your trap(s). Use multiple traps to remove animals quickly. Location is important because the goal is to capture the problem squirrel(s), not all the squirrels in the neighborhood. Do not approach or trap near power lines unless they have been properly shielded by the power company. Place traps as close to the entry hole as feasible. Make sure traps set at heights are securely anchored to prevent injuries to people below. Traps should be at least 5 x 5 x 18 inches, and ½- x 1-inch mesh is preferred as it reduces likelihood of squirrels getting scraped noses.

Step 2- Remove bird feeders and other sources of food that could interfere with the trapping process.

Step 3- Bait traps with peanut butter and sunflower seeds. Spread bait on the treadle. Cover the back half of the cages with cloth, cardboard, or other material to provide a sheltered area. In summer, include sliced apples for moisture.

Step 4- Monitor traps daily. Ideally, check traps in the morning and evening. Euthanize squirrels with carbon dioxide or shooting as allowed. Re-bait and return traps to their original location. Plug the entry hole used by the squirrels with newspaper to monitor movement through the hole. Replace paper as needed.

Step 5- Continue trapping until the newspaper has not been moved from the entry hole for at least 5 days of good weather. Clients should not hear squirrel activity in their walls or attic.

Step 6- Secure the entry hole by filling it with expanding foam and covering it with aluminum flashing or wood. Paint to match the building or trim.

#### **Preventing Future Problems:**

Conflicts with squirrels are preventable. The following list contains tips on preventing squirrel problems on your property. Implement as many of the suggestions as possible for best results.

1. Trim tree branches near the roof line. Ideally, branches should be 10 feet from the building. Shrubs should be no closer than 4 feet.
2. Modify bird feeders to prevent squirrels from accessing food. Remove bird feeders during the summer months if possible.
3. Install professionally-manufactured chimney caps on all flues.
4. Install protective metal screens on all passive attic vents. Depending on the situation, use ¼-inch weave hardware cloth or professionally manufactured screens.
5. Never screen a motorized fan vent from the inside. Always protect them from the outside to prevent animals from placing nesting material on the motor.
6. Check the roof and gutter line of the structure for gaps. Secure gaps with sealant, wood, or metal flashing as soon as possible to prevent squirrels from enlarging them.

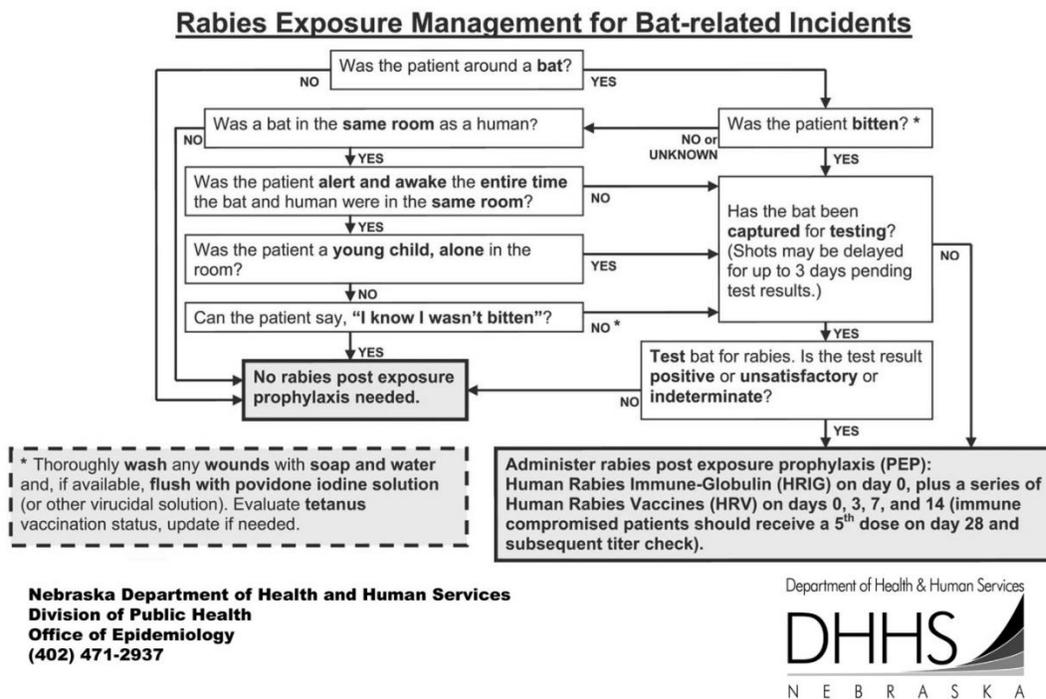
## Case Study #2: Bats in Structures

Bats in structures present special challenges to property owners. Bats can transmit zoonotic diseases, such as rabies and histoplasmosis, as well as cause structural damage through their feces and urine. Many people have phobias about bats due to their association with vampires and Halloween.

You just received a call from a homeowner complaining of bats. Your first task is to determine the type of problem and to rule out the possibility that the client, a family member, or a pet has been exposed to rabies.

## Potential for Rabies Exposure

If there is a possibility that a bat has made contact with a person or pet, capture the bat for rabies testing (Figure 3). Possibility of contact includes finding a bat in a room with a sleeping person, a previously unattended child, or a mentally disabled or intoxicated person. In these situations, it is very important to catch the bat. Wear thick gloves. Place a towel or box over the bat to avoid any direct contact. Avoid damaging the bat's head during capture, as brain tissue is needed for the test. **Do not release the bat.** Contact local health officials for additional information on rabies treatment and testing. If the bat is not available for testing, consult health professionals about treatment needed for people or pets.



\*Based on the algorithm, "Bat Exposure: Rabies Exposure Management for Bat-related Incidents," developed by the Iowa Department of Public Health (<http://www.idph.state.ia.us/Cade/Rabies.aspx>), accessed August 29, 2011.

Figure 3. Rabies treatment protocol. Image by Nebraska Department of Health and Human Services.

## Exterior Bat Issues

Problems occur when bats are found on the outside of the structure either flying or resting in unscreened porches, behind shutters, or flying

around lights. You can direct bright light at the resting site to encourage bats to abandon the location. Bats roosting under over-hangs may be moved by shining bright lights at the roost site. Ultrasound devices have not been proven to be

effective in deterring bats. Remove or secure shutters away from buildings to prevent bats from roosting behind them.

Turn off exterior lights to prevent flying insects from gathering. If light is needed for safety, change the bulb to a yellow “bug light” to reduce the number of insects attracted to the area.

Consider adding a motion sensor to reduce the duration of illumination.

## Bats inside a Building

Bats sometimes are found in the living space of a home. Bats occasionally find their way into houses in the early evening, when seeking shelter, or feeding on insects attracted by doorway lights. ***If there is a possibility that the bat has made contact with a person or pet, do not release the bat*** (see Figure 3). Capture the bat following the instructions below and contact your local health department as soon as possible.

Discuss with the client how the bat may have entered the living space. Options include an open damper in the fireplace, an open furnace vent, open window, door or screens with a gap, or poor sealing to attic areas or pipe chases. Seal all openings that could be potential entryways to prevent further problems.

## Individual Bat Capture

Fortunately, these incidents can be dealt with quite easily. A bat flying inside a house usually will circle a room several times in search of an exit and may find its own way out. Resist the urge to chase or swat at the bat, as doing so will cause it to panic and fly erratically around the room, making capture more difficult. Follow the steps listed, and remember to ***never*** handle a bat, or any other wild animal, with your bare hands.

1. Remove pets or children from the room.
2. Put on a pair of leather gardening or work gloves.
3. Shut all doors leading into other rooms to confine the bat to as small an area as possible.
4. Watch the bat and wait for it to land. Place a container, such as a large plastic bowl or coffee can, over the bat as it rests on the wall. At this point, the bat probably is exhausted and disoriented, and will not fly as you approach it.
5. Slide a piece of rigid cardboard (if unavailable, use a magazine, or a lid from the coffee can or bowl) between the container and the wall to trap the bat. Hold the cardboard firmly against the container and carry the container outside.
6. If the bat is located in a hard-to-reach place, such as the corner of a room, and a flat surface is not available to use a coffee can or bowl, use a fine-meshed insect net with a long pole to capture the bat. Forceps (9 to 12 inches in length, rat-toothed) also may be used to capture the bat and transfer it to a container.
7. Once the bat is captured, and you are ***positive*** no contact with people or pets has occurred, take the container outside, place it on its side (facing away from you) on a secure place above the ground—such as on a ledge, or against a tree—and slide the cardboard away. The bat will not fly right away, so releasing it above the ground keeps it safe from predators until it has its bearings. Unlike birds, most bats must drop from a perch and catch air under their wings before they can fly.

If you have recurring problems with bats entering your home, you should inspect your home, including your attic, to determine if you are housing a bat maternity colony. Wear appropriate personal protection equipment before performing any inspection.

## Removing a Bat without Capture

1. Remove pets or children from the room.
2. Put on a pair of leather gardening or work gloves.
3. Open all windows and doors leading outside to give the bat a chance to escape on its own. Leave the lights on, stand quietly against a wall or door, and watch the bat until it leaves. Make sure that someone stays in the room with the bat at all times. Otherwise, the bat may move out of sight and appear to have left when it still is inside.
4. Do not try to herd the bat toward a window. Just allow it to calmly get its bearings, and don't worry about it swooping at you. When indoors, a bat makes steep, banking turns, so it flies upwards as it approaches a wall and swoops lower near the center of the room.
5. Within 10 to 15 minutes the bat should settle down, locate the open door or window, and fly out of the room.
6. If the bat does not leave on its own after 15 minutes, wait for it to rest on a wall or other surface where it can be captured safely. Release the bat outdoors high on a tree branch or ledge (NOT on the ground).

## Bat Colonies

Bats may be actively roosting inside a structure (usually the attic), but not in the living space. People frequently wonder if the discovery of a bat means that bats have a colony in their home. Bats likely have a colony if they are discovered during the winter, or when two or more isolated bats are found in the living space between March and October. Homeowners frequently encounter bats in July, when the young move around but are not strong enough to forage with adults. Once they begin flying, young bats also are more likely to make mistakes, such as inadvertently flying inside a window or door.

Droppings are the most common sign that bats are present in a building. Individual droppings are small ( $\frac{1}{8}$  to  $\frac{1}{4}$  inch long), black, and dotted with

speckles. Bat droppings can be distinguished from mouse droppings by their speckled appearance (fragments of insect wings), rough surface, and the number of droppings in one location.

Droppings often are found on attic and porch floors and under eaves and shutters (*Figure 4*). Droppings and urine accumulate beneath a colony of bats over time, leading to staining and a rather pungent odor in enclosed spaces.



**Figure 4.** Bat droppings below the hole the bats use to enter the structure. Photo by Stephen M. Vantassel.

Bats can enter through openings as small as  $\frac{3}{8}$  inch in diameter. When bats are residing in a structure, they will use the same opening(s) every evening. The presence of smudges, caused by oil and dirt rubbing off of the bats' fur, indicate that an animal has used the opening. Look for rub marks at entry points near eaves, vents, chimneys, cracks, and other openings. Occasionally the squeaking and scratching of individual bats can be heard in a wall void, ceiling, and other spaces.

Another way clients can determine if bats are present in their house is to simply enter the attic and look for roosting bats. During the day, bats likely will be roosting in narrow crevices in the attic walls, between or on the rafters, or tucked into the space between the rafters and roofing material. Before entering an attic, we suggest the owner wear a protective respirator (HEPA filter) and gloves. People with lung or heart issues should be examined by medical personnel before wearing a respirator. When a person enters the attic, bats will retreat out of sight quickly rather than taking flight. If they can't be seen, look for

piles of guano and listen for the squeaking or scurrying sounds that will verify their presence.

If bats are living in the attic during the day or if large accumulations of bat droppings are found, a maternity colony likely is in the house.

## Dealing with Bat Colonies

If bats are residing in an attic or a hidden area in a structure, the only definitive way to remove them is by exclusion. One-way doors, check-valves, or netting allow bats to leave, but not re-enter the structure. Exclusion must occur before young bats are born in early May, or after mid-August when the young will be mature enough to leave the roost. **Do not exclude bats during summer when young are present.** Young bats abandoned or sealed in a structure will move about the attic looking for a way out, and will eventually die. Dead bats in a structure will decay and may cause odor and insect problems. Exclusion can be performed using the following method.

1. Locate all exit and entry points by standing outside of the structure at dusk on clear summer evenings and look for bats that are exiting the building to forage at night (a bat watch).
2. Secure all unused openings with ¼-inch screening or sealant.
3. Cover all exit or entry points by hanging 1-foot strips of flexible ¼-inch nets or exclusion tubes to permit bats to exit but not re-enter the building.
4. Allow at least 1 week to pass, then seal and patch all entry points.
5. Conduct another bat watch to confirm all bats are out of the structure and no entry points were missed.

## Repellents

The best way to remove bats is by using the exclusion and prevention methods already described. Several commercial products are

available to repel bats. However, the effectiveness of these products is questionable, and has not been well-studied. Do not use mothballs to repel bats. The two ingredients used to manufacture mothballs, naphthalene and para-dichlorobenzene, are considered possible human carcinogens by the Environmental Protection Agency (EPA).

## Toxicants

No toxicants are registered for bat control in the US. Because bats feed exclusively on live insects, it is unlikely that any toxic bait would entice bats to eat it.

In extreme cases, (e.g., where public health is threatened by rabies), the Centers for Disease Control and Prevention (CDC) and the EPA may provide special permits for licensed professionals to use toxic tracking powder to control bats.

## Diseases

Bats are associated with two important diseases that can be transmitted to humans, rabies and histoplasmosis. These diseases can be avoided, and should not be used as an excuse to kill bats. Because untreated rabies exposure is almost always fatal, it was discussed at the beginning of this case.

Histoplasmosis is a fungal disease that is associated with guano from bats. The fungus grows best in dark and humid areas with large accumulations of guano. Inhalation of fungal spores is the primary mode of infection. Spores become airborne when guano is disturbed. Do not remove large guano deposits without appropriate training and protection. To learn more, read the online document published by the Department of Health and Human Services, *Histoplasmosis-Protecting Workers at Risk* (Publication number 2005-109).

## Preventing Future Problems with Bats

Prevention is the best way to avoid having bats in your home. Fortunately, bats cannot create their own entry holes. They do not gnaw like mice and rodents. Therefore, it is important to seal all cracks, plug all holes, and use good screens and tight fitting doors prior to having a problem. Hardware cloth ( $\frac{1}{4}$ -inch or smaller mesh), caulk, sealant, and weatherproof foam strips are excellent materials for excluding bats (*Figure 5*). Foam insulation will degrade under UV light and is not recommended. Install a stainless-steel chimney cap with  $\frac{3}{8}$ -inch wire mesh to reduce access by bats. Never secure an opening unless the client is certain it is not being used by wildlife.



**Figure 5.** Bats hanging on an attic screen (view from inside attic looking out). Photo by Stephen M. Vantassel.

## Case Study #3: White-tailed Deer Damaging Plants

Deer populations have increased dramatically in suburban areas over the past several decades. As a result, conflicts with landowners have increased in both number and severity.

## Diagnosing the Culprit

Typically, most callers will know that the damage they are experiencing is caused by deer. However, to ensure that the culprit has been identified properly, you may need to review the following points with the client.

- Deer have been seen in the yard during day or night.
- Branches and leaves have a ragged, torn appearance (not clipped sharply).
- Damage occurs up to 6 feet above ground on plants reaching that height.
- Tracks and scat have been identified.

## Potential Solutions

Homeowners have a variety of tools available to manage damage caused by deer. The suitability of the techniques depends on their particular situation and the intensity of damage being experienced.

**Situation 1-** Deer damage is infrequent and does not last long. In situations where deer are perceived by the owner as more of a nuisance, suggest the following techniques.

- Use deer-resistant plant varieties (contact your local Extension office for a local plant lists).
- Spray repellents on affected nonfood plants. Repeat applications every 4 to 5 weeks as needed. Research has shown that repellents containing rotten eggs or capsaicin often are the most effective.
- Use fences, such as rope fences with repellents, snow fences, or a peanut-butter polytape fence.

**Situation 2-** Deer are causing structural damage to plants several months of the year. In situations where the client complains of significant economic losses and unacceptable levels of damage, more aggressive approaches must be used.

- Peanut-butter, polytape electric fence (for damage during the growing season or small areas).
- Individual plant protection with plastic mesh or wire fences (*Figure 6*).
- 8-foot-tall, nonelectric barrier fencing.
- Hunting to reduce the number of deer (where discharge of firearms and bows are legal and feasible).



**Figure 6.** A fence to protect a sapling from browse damage. Photo by Stephen M. Vantassel.

## Legal Issues

The Nebraska Game and Parks Commission (NGPC) regulates the management of deer in Nebraska. Outside of hunting seasons, deer may be killed only under the authority of a depredation or nuisance deer permit. In addition, the discharge of firearms (including bows) may be regulated by both the state and municipality. Consult with employees of the NGPC to explore deer management options.

Some communities forbid the use of electric fences, while others forbid the installation of any fence that doesn't meet with community aesthetic standards or height restrictions. Clients should consult with relevant local authorities before constructing a fence to determine if restrictions apply.

## Wildlife Species Information

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**Figure 1.** Red-headed woodpecker (*Melanerpes erythrocephalus*). Photo by Ron Case.

Management of wildlife damage requires having good information on the species involved (e.g. *Figures 1 and 2*). Understanding the biology and ecology of the problem animal allows a person to effectively use methods to control or eliminate the unwanted behavior or conflict.

This section has basic information needed to help people resolve many of the common wildlife conflicts. It is designed to help volunteers and their clients manage wildlife problems by identifying the species and proposing solutions, based on the principles of integrated pest management (IPM).

Follow safety practices when dealing with wildlife conflicts. In addition, you will need knowledge of the biology, habitats, signs, and damage caused by various species. Animal-handling and control techniques must be learned, practiced, and mastered. If an animal must be killed or euthanized, it should be done as humanely as possible.

Information in this section is based on the National Wildlife Control Training Program (NWCTP) species accounts - some of the best in the world. Created by wildlife biologists, academics, and private practitioners, and reviewed by experts in the field, these species accounts explain what you need to know and what control methods can be used to manage a wildlife problem.



**Figure 2.** Female white-tailed deer (*Odocoileus virginianus*). Photo by Greg Clements.

## Bats

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Research-based, certified wildlife control training programs to solve human-wildlife conflicts.  
Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Big brown bat (*Eptesicus fuscus*). Photo by Bat Conservation International (BCI).

### Objectives

1. List the signs of the presence of bats.
2. Explain the process involved in excluding bats from a structure.
3. Explain control options to clients.

### Species Overview

#### Conflicts

Bats occasionally enter living quarters where they can pose a risk of disease. In addition, their droppings and urine can contaminate and deface surfaces.

#### Legal Status

Bats are considered nongame wildlife in Nebraska and are afforded relatively little protection. Some species of bats in the eastern US, however, have been decimated by white nose syndrome and are

protected as either federally or state-listed endangered species. Enforcement and public education must accompany legislation to accomplish the intended goal of protecting the public and endangered bats. Contact the Nebraska Game and Parks Commission for additional information.

### Identification

Bats are the only mammals that truly can fly. The ability to fly, secretiveness, and nocturnal habits have contributed to bat folklore, superstition, and fear. About 1,100 species are distributed worldwide, second in number only to rodents among mammals. About 40 species of bats are found north of Mexico and 13 occur in Nebraska. Only a few cause problems for humans. Vampire bats are not found in the US or Canada.

Bats that congregate in colonies are called colonial bats; those that do not are solitary bats. The species most often encountered in and around buildings in Nebraska are big brown bats (*Figure 1*).

Solitary bats typically roost in tree foliage or under bark but occasionally are found in buildings, usually as transients during migration. These include Keen's bats (*Myotis keenii*), red bats (*Lasiurus borealis*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*). Excellent illustrations of the bats discussed herein can be found at Bat Conservation International (BCI) and the University of Michigan's Animal Diversity Website.

While species characteristics can differ greatly, control methods do not.

## Physical Description

The big brown bat's name is highly descriptive. Its fur is uniformly medium to dark brown on the upper parts, with slightly paler under parts. The fur is relatively long and silky in appearance, compared to other bats. The ears and wing membranes are dark brown. The species is larger in size than little brown bats, from about 4 to 5 inches in body length, with an 11- to 13-inch wingspan, and weighing  $\frac{1}{2}$  to  $\frac{5}{8}$  ounce.

## Species Range

Big brown bats are the most common of the 14 species of bats found in Nebraska. They, along with many others, are found throughout the state, especially in wooded riparian and urban areas.

## Health and Safety Concerns

Bats are associated with two important diseases that can be transmitted to humans, rabies and histoplasmosis. These diseases can be avoided, and should not be used as an excuse to kill bats. Although less than one-tenth of 1% of all bats have rabies, the percentages increase to less than 5% for bats that interact with people and animals, and are tested.

If there is a possibility that a bat has made contact with a person or pet, capture the bat for rabies testing. Assume contact has occurred if you find a bat in a room with a sleeping person, a previously unattended child, or a mentally disabled or intoxicated person. In these situations, it is very important to catch the bat. Wear thick gloves. Place a towel or box over the bat to avoid any direct contact. Avoid damaging the bat's head during capture, as brain tissue is needed for the rabies test. **Do not release the bat.** Contact local health officials for additional information on rabies treatment and testing. If the bat is not available for testing, consult health professionals about treatment needed for people or pets.

Histoplasmosis is a fungal disease that is associated with guano from bats. The fungus grows best in dark and humid areas (e.g., attics) with large accumulations of guano. Inhalation of

fungal spores is the primary mode of infection. Spores become airborne when guano is disturbed. Do not remove large guano deposits without appropriate training and protection. To learn more, read the online document published by the Department of Health and Human Services, *Histoplasmosis-Protecting Workers at Risk* (Publication number 2005-109).

Numbers of bats have declined dramatically during the past decade due to white-nose syndrome (WNS) caused by a fungal infection at their winter cave roosts. The US Fish and Wildlife Service (USFWS) estimates that over 5 million bats have died from contracting WNS. This fungus does not affect humans.

## General Biology, Reproduction, and Behavior

### Reproduction

Bats generally mate in the fall and winter but females retain sperm in the uterus until spring, when ovulation and fertilization take place. In Nebraska, pregnant females usually congregate in maternity colonies in buildings.

Birth typically occurs from early May through July. Young bats grow rapidly and are able to fly within 3 weeks. Weaning occurs in July and August, after which nursery colonies disperse. Young bats in Nebraska should be able to fly by mid-August.

### Nesting/Denning Cover

Bats do not build nests. Pregnant females usually congregate in building attics or bat houses. The females select locations with high temperatures, needed for rapid development of their young.

### Behavior

Bats prepare for winter around the first frost. Big brown bats migrate relatively short distances, usually less than 150 miles. Bats in the northern US and Canada may hibernate from late September through late April. In Nebraska, big

brown bats may become active in buildings during warm, sunny days in winter.

## Habitat

Bats tend to inhabit structures that have significant exposure to sunlight, are large, and are within ½ mile of a fresh water source.

## Food Habits

Bats in Nebraska feed on a variety of flying insects. Many of the insects are crop pests. Although there are some limitations such as body size, flight capabilities, and jaw opening, insectivorous bats apparently consume a wide range of prey.

A big brown bat may fill its stomach (roughly 0.1 ounce) in about an hour with prey including beetles, moths, flying ants, true bugs, mayflies, caddis flies, and other insects. A colony of bats can eat an extremely large number of insects each night.

## Voice, Sounds, Tracks, and Signs

Most bats emit high frequency sounds (ultrasound) inaudible to humans and similar to sonar. This allows them to avoid obstacles, locate and capture insect prey, and communicate. Bats also emit audible sounds that may be used for communication between individuals.

## Damage Identification

### Damage to Landscapes

Bats do not damage landscapes, although their droppings may accumulate around extremely large colonies.

### Damage to Crops and Livestock

Bats do not damage crops. Bats that are infected with rabies can transmit the disease to pets and livestock during encounters.

## Damage to Structures

Bats may live in attics and walls. Guano and urine may be visible, especially near large colonies. Fecal pellets indicate the presence of bats and are found on attic floors, in wall recesses, and outside the house. Fecal pellets along and inside walls also may indicate the presence of mice, rats, or even roaches. Because house bats Nebraska are insectivorous, their droppings are easily distinguished from droppings of small rodents. Bat droppings tend to be segmented, and elongated (*Figure 2*). When crushed, they become powdery and reveal shiny bits of undigested insect remains. In contrast, droppings from mice and rats tend to taper, are not segmented, are harder and more fibrous, and do not become powdery when crushed (unless they are extremely aged).

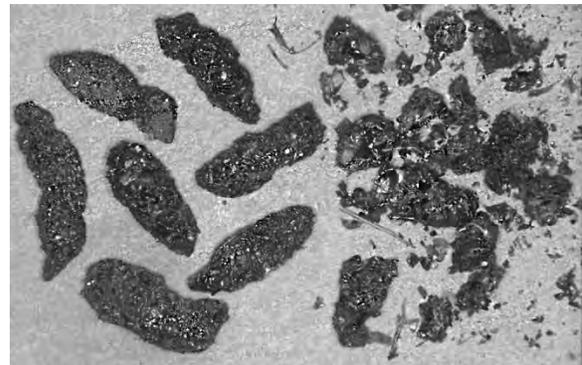


Figure 2. Bat guano (whole, left; crushed, right) look similar to mouse droppings except for the shiny speckles and susceptibility to crumble. Photo by University of Nebraska–Lincoln (UNL).

## Damage Prevention and Control Methods

Prevention is the best way to avoid having bats in your home. Fortunately, bats cannot create their own entry holes. They do not gnaw like mice and other rodents. Therefore, it is important to seal all cracks, plug all holes, and use good screens and tight fitting doors prior to having a problem. Hardware cloth (¼-inch or smaller mesh), caulk, sealant, and weatherproof foam strips are excellent materials for excluding bats. Foam insulation will degrade under UV light and is not recommended. Install a stainless-steel chimney

cap with  $\frac{3}{8}$ -inch wire mesh to reduce access by bats. Never secure an opening unless the client is certain it is not being used by wildlife.

## Habitat Modification

In outdoor settings, swap white light bulbs for bulbs less attractive to insects. Increased lighting has been reported to be effective at moving bats out of structures. Where possible, add windows to brighten an attic and reduce the desirability of the roost site. Floodlights strung through an attic to illuminate all roosting sites may cause bats to leave. Large attics may require many 100-watt bulbs or 150-watt spotlights to be effective. Fluorescent bulbs may be used. In some situations such lighting is difficult, costly, and may be an electrical hazard. All wiring should be done by a qualified electrician. Bright light may drive bats into wall voids where control can be more difficult.

Air drafts have been successful in repelling bats in areas where people can open doors and windows, or create strong breezes with electric fans. The addition of wall and roof vents will enhance this effort, as this will lower roost temperatures.

Discourage bats from roosting behind shutters by removing the shutters completely or by adding small blocks at the corners to space them a few inches away from the wall.

## Exclusion

Exclusion is the best option for eliminating and preventing bats from residing in structures. It is tedious, but important, to locate all active and potential openings available to bats. Conduct a bat watch at dusk to determine where bats are exiting and entering a building. You also can identify active holes by rub marks, guano, and sometimes odor. Except for the actively used holes, seal all gaps of  $\frac{1}{4}$  x  $1\frac{1}{2}$  inches and openings  $\frac{3}{8}$  x  $\frac{7}{8}$  inch or greater. Bats use some of the same holes in buildings through which heated or cooled air is lost.

Install one-way doors on holes that bats are actively using to enter or exit the structure. Timing

is important to reduce the risk of separating adults from flightless young. In Nebraska, do not install one-way doors from May 1 through August 15. One option is to seal unused holes, but leave active holes open until the exclusion date is past. After installation, leave one-way doors in place for at least 5 days. During periods of inclement weather (e.g., rain), leave the doors in place longer.

Screening and netting with  $\frac{1}{4}$ -inch mesh will create a check-valve and exclude bats. Tubes, such as the Batcone® (Figure 3), provide another tool to create a one-way door. Center the tube hole over the exit used by the bats to provide an easy exit.



Figure 3. Batcone™. Photo by Westchester Wildlife, LLC.

The exclusion process may cause bats to find their way into the living quarters of a home, a behavior most often associated with young bats. Some bats may shift to an alternative roost already in use, such as a night roost, or to a roost used in previous years.

Sealant caulk, flashing, screening, and insulation often are needed to complete an exclusion job. The combination of materials used will depend on the location, size, and number of openings and the need for ventilation. Weather stripping and knitted-wire mesh (Guard-All®, Stuf-fit®) are best applied during dry periods when wood cracks are widest. Caulk can be applied with a caulking gun (in gaps up to 0.4 inch wide) and include latex, butyl, and acrylic compounds, which last about 5

years. Elastomeric caulks, such as silicone rubber, will last indefinitely, expand and contract, do not dry or crack, and tolerate temperature extremes.

Conventional draft sweeps (metal, rubber) and other weather stripping supplies (felt, vinyl, metal) will seal the gap between the bottom of a door and the threshold or around windows. Install sweeps to attic and basement doors whenever the floor gap exceeds ¼ inch.

Use flashing to close gaps at joints (e.g., where the roof meets a chimney). Materials include galvanized metal, copper, aluminum, stainless steel, and self-adhesive stainless steel “tape.”

Insulation provides some barrier to bat movements. It is available in several forms and types including fiberglass, rock wool, urethane, vermiculite, polystyrene, and extruded polystyrene foam. Inorganic materials are fire- and moisture-resistant. The safest appear to be fiberglass and rock wool.

Gaps under corrugated and galvanized roofing may be closed with knitted-wire mesh, self-expanding foam (but avoid causing roofing to lift), or with fiberglass batting (may retain moisture).

To prevent bats from entering chimney flues, completely enclose the flue discharge area with rust-resistant spark arresters or pest screens secured to the top of the chimney. Do not attach these permanently; they may need to be removed rapidly in the event of a chimney fire. Review fire codes before installing flue covers. Keep dampers closed except during the heating season.

## Frightening Devices

Frightening devices are not appropriate for the control of bats. Numerous ultrasonic devices have been removed from homes because the bats remained in the roost after the devices were activated. Little brown bats exposed to ultrasound in semi-natural roosts have shown little response. Recorded distress cries of bats can attract bats to nets or traps, but do not serve as an effective repellent. Big brown bats respond to their own distress cries, but not to the cries of other species.

## Repellents and Toxicants

No repellents or toxicants are registered for use on bats.

## Shooting

Shooting bats is not practical for dealing with bats.

## Trapping

Trapping of bats is controversial and should only be performed by experienced individuals with rabies pre-exposure immunization.

## Disposition

### Relocation

Release bats outdoors provided they have not been in contact with people or pets. Place the bat at least 5 feet above the ground on a tree or ledge. Bats need the height to avoid predators and to obtain the lift needed to fly away.

## Translocation

In Nebraska, animals cannot be moved over 100 yards, so bats only can be relocated outside of structures.

## Euthanasia

Use a carbon dioxide chamber to euthanize bats. Carbon dioxide will not invalidate rabies testing if such testing is required.

## Web Resources

Bat Conservation International at <http://www.batcon.org/index.php/all-about-bats/species-profiles.html>

University of Nebraska-Extension at <http://www.ianrpubs.unl.edu/sendIt/g1667.pdf>  
<http://www.ianrpubs.unl.edu/sendIt/z1667.html>

University of Michigan Animal Diversity at <http://animaldiversity.ummz.umich.edu/site/accounths/information/Chiroptera.html>

# Beavers

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.

Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Beaver (*Castor canadensis*).  
Photo by US Fish and Wildlife Service (USFWS).

## Objectives

1. Identify beaver sign and damage.
2. List management options available.
3. Identify the risks of working with beavers.

## Species Overview

### Conflicts

Most conflicts with beaver (*Castor canadensis*) are associated with dam-building and flooding, or feeding damage and cutting of valuable trees. Usually conflicts with beavers occur near water, where beaver lodges or bank dens are constructed. Flooding may wash out roads, damage septic systems, or kill trees in low-lying areas.

### Legal Status

Beavers are considered furbearers in Nebraska and are protected under state laws and regulations. They may be taken, however, when causing damage to personal property. Contact the Nebraska Game and Parks Commission for additional information.

## Identification

Beavers (*Figure 1*) are the largest rodents in North America. They are mainly aquatic, and easily recognized by their large, flat tails.

## Physical Description

Beavers can remain submerged underwater for long periods of time, and can close their nose and ears to prevent water entry. Their lips can close behind their four large incisor teeth, allowing them to gnaw underwater without swallowing water. The underfur is dense and generally gray in color. The guard hair is long and coarse, ranging in color from yellow-brown to black, with red-brown as the most common coloration. The flattened tail is scaly and nearly hairless. It is used as a rudder when swimming, a warning signal when slapped on the water, and a prop when sitting upright. Beavers have four large, bright orange, front incisor teeth that grow continuously throughout their lives. The incisors are beveled, and sharpened through gnawing and chewing.

The only way to externally distinguish the sex of a beaver, unless it is a lactating female, is to feel for the presence of a baculum (a penis bone). Adult beavers typically weigh 35 to 50 pounds, with some reaching 70 to 85 pounds.

## Species Range

Although once extirpated from Nebraska, beavers now are found throughout much of the state where streams, rivers, ponds, and reservoirs exist.

## Health and Safety Concerns

In urban areas, beavers may become habituated to humans and may be aggressive if approached. Beavers infected with rabies, which is very uncommon, may attack people. Beavers are hosts

to several ectoparasites and internal parasites, including nematodes, trematodes, and coccidia. Beavers contaminate water with *Giardia lamblia*, a pathogenic intestinal parasite that causes intestinal problems in humans. Trappers should avoid splashing water in their faces, and carefully wash their hands before eating or smoking. Anyone who develops severe abdominal cramps or persistent diarrhea while working with beavers should consult a physician. Tularemia has been reported in beavers from Canada and the northern US. Trappers should wear rubber gloves when skinning or eviscerating beaver carcasses.

Floods caused by beaver dams undermine roads and interfere with septic systems. Bank dens cause the collapse of banks along farm and shoreline properties. Falling trees pose threats to structures, power lines, and people.

## General Biology, Reproduction, and Behavior

### Reproduction

Beavers become sexually mature in 1½ years and form life-long pair bonds. Beavers mate from November through March. They produce one litter per year, and three or four young are born about 105 days after mating. Young beavers typically are weaned in 2 weeks.

### Nesting/Denning Cover

Beavers are skilled at building dams in streams. They build lodges in ponds and dens in stream banks, depending on what habitat is available (Figure 2). Beavers use the lodge or den for raising young, sleeping, protection from predators, and food storage.



Figure 2. Cross-section of a beaver lodge. Image by Prevention and Control of Wildlife Damage (PCWD).

### Behavior

Beavers are very territorial. A colony generally consists of four to eight related individuals that resist outsiders to the colony. Young beavers commonly are displaced from the colony shortly after they become sexually mature at about 2 years of age. They often move to another pond to begin a new colony, although some become solitary and inhabit abandoned ponds.

Dam-building and tree-cutting activities tend to increase as beavers prepare for freezing winter temperatures. Beavers stockpile or cache tree limbs, grass, cattails, and cornstalks below the surface of the water to ensure access to food below the ice. A fresh food cache is a sign of an active lodge.

### Habitat

Beavers may be abundant wherever aquatic habitats and trees are available.

### Food Habits

The size and species of trees cut by beavers can vary from softwoods that are 1-inch diameter-at-breast-height (DBH), to hardwoods that are 6-foot DBH. Beavers feed on a variety of trees, especially the bark from branches and small limbs. Beavers use many species of trees and shrubs to build dams.

### Voice, Sounds, Tracks, and Signs

Beavers use their tails to warn others of danger by abruptly slapping the water surface. Beavers have

several vocalizations including churrs, mumbles, whines, snorts, and hisses.

Freshly cut trees or mud slides along pond and stream edges indicate recent beaver activity.

## Damage Identification

### Damage to Landscapes

Beavers damage gardens and landscapes through flooding and removal of plants. Valuable ornamental trees may be at risk near ponds or streams inhabited by beavers.

Beaver ponds can provide short-term benefits to warm-water fish species, but longterm negative impacts to streams are a concern. High quality trout streams are threatened by beavers due to increased sedimentation, water temperature, and acidity, as well as decreased dissolved oxygen.

### Damage to Crops and Livestock

Beavers may cut cornstalks for food, or use as building materials for dams or lodges. Cropland and commercial forests have been flooded due to beaver activity. Beavers generally are not a threat to livestock or pets.

### Damage to Structures

Floods and falling trees pose severe risks to structures. Low-grade streams (less than 3% slope) with culverts or constricted areas are at highest risk for dams and resulting flooding. Beaver ponds created by dams may flood highways or railroads. Softened railroad beds may result in train derailments. Earthen dams may be destroyed by beavers burrowing in banks. Residential developments have been threatened by flooding. Plugged ditches, drain pipes, and culverts must be cleared and sometimes replaced.

## Damage Prevention and Control Methods

### Habitat Modification

Beavers modify their habitat extensively, so disturbance by humans has little impact on them. Destruction of dams and daily removal of materials used to construct dams may cause beavers to move to another site. Such activities are labor-intensive and expensive. Landowners in Nebraska can remove beaver dams if beavers are causing economic damage.

Eliminate food, trees, and woody vegetation that are adjacent to roadways when possible. It is usually only feasible to do such drastic landscape changes for large highway projects.

Flow pipes can provide sufficient relief from flooding in some circumstances. Flow pipes are popular because beavers do not have to be killed. Installation of flow pipes, however, may result in the beavers simply constructing new dams up or down stream. Install flow pipes only when:

1. landowners can tolerate damage to trees or other plant life,
2. water depth is sufficient to allow activity of beavers under ice (4 feet minimum),
3. the area has sufficient room to handle typical spring flooding, and
4. standing water will not undermine roads or septic systems.

Consult the Internet Center for Wildlife Damage Management (ICWDM) at <http://ICWDM.org> for literature on the construction of flow pipes.

### Exclusion

It is often cost-prohibitive to exclude beavers from ponds, lakes, or impoundments. Protect valuable trees near waterways by encircling them with hardware cloth, woven wire, or other metal (*Figure 3*).



Figure 3. This fence would have worked if it had been installed before beavers damaged the tree.  
Photo by Stephen M. Vantassel.

Construction of concrete spillways or other permanent structures may reduce the impact of beavers. A variety of techniques are available to protect culverts from obstruction by beaver dams, including barrier fences. Consult the resources at <http://ICWDM.org> for details on constructing and maintaining these devices.

## Frightening Devices

None are effective for the control of beavers.

## Repellents

None are registered for management of beavers. Some trees may be protected by applying a mixture of 8 ounces of fine sand (30 mil, 70 mil, or mason sand) to 1 quart of latex paint. The color of the paint is a personal preference. Stir the mixture frequently to keep the sand in solution. Protect the tree bark from the ground to a height of 4 feet. Avoid painting young trees less than 6 feet tall. The sand-paint technique works best when beavers have alternative food sources available

## Toxicants

None are registered for the control of beavers.

## Shooting

Shooting is suitable for removing one or two beavers. Hire a professional if shooting is determined to be the best option. In many suburban areas, firearms may not be discharged within 500 feet of dwellings without a permit.

## Trapping

The use of traps often is the most effective, practical, and environmentally safe method for control of beavers. Several methods and types of traps are effective, depending on the situation. The effectiveness of trapping depends on the knowledge of the trapper and the ability to read beaver sign, recognize food preferences, and use the proper trap and trap placement. An experienced trapper with a dozen traps generally can remove all the beavers associated with a single dam in a week. More effort will be required in watersheds with several colonies. Traps should be checked daily.

## Disposition

### Relocation

Relocation of beavers is feasible only for rescue of captured beavers.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so beavers can be translocated only when recommended by Nebraska Game and Parks Commission staff.

## Euthanasia

Carbon dioxide chambers are effective for euthanizing beavers. A single bullet (.22-caliber or higher) to the brain is effective, but must be done carefully, as low-powered bullets may ricochet off the skull. Be careful if shooting in or near water.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

# Fruit-eating Birds

**Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)**  
 Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.  
 Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. American robin (*Turdus migratorius*).  
 Photo by Dave Menke.

## Objectives

1. Identify common species of fruit-eating birds.
2. Explain key elements about the biology of fruit-eating birds that are important for their management.
3. Understand federal and state laws and regulations restricting the control of migratory birds.
4. Explain management options for fruit-eating birds and their relative effectiveness.

## Species Overview

### Conflicts

Several species of birds eat fruit and in doing so, can cause problems for fruit producers, vintners, gardeners, and backyard enthusiasts who raise apples, grapes, blueberries, cherries, strawberries, melons, and other fruits.

### Legal Status

Most fruit-eating birds are protected by the federal Migratory Bird Treaty Act (MBTA; *Figure 1*). Under the MBTA, birds cannot be killed

without a federal permit. Exceptions include European starlings (*Figure 2*), house sparrows, and pigeons, which are invasive, exotic species, and are unprotected.



Figure 2. European starling (*Sturnus vulgaris*).  
 Photo by Thomas G. Barnes.

The MBTA states that “a federal permit shall not be required to control red-winged, yellow-headed, and Brewer’s blackbirds; cowbirds, all grackles; crows; and magpies when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance.”

State or local laws may prohibit certain activities of control, such as shooting or trapping. Check with the Nebraska Game and Parks Commission (NGPC) for specific rules and regulations before initiating lethal control.

### Identification

Many backyard birds, such as American robins (*Figure 1*) and house finches, take fruit and can cause significant damage. The European starling (*Figure 2*) is one of the most common species of fruit-eating birds in North America. Consult a bird

field guide to help you identify the species taking fruit in your location.

## Physical Description

Starlings are easy to identify with their black plumage flecked with specks, and pointed yellow bill. They are common in areas near people, and tales of their intelligence often are noted. Most other fruit-eating birds are abundant and common, and can be recognized easily with the aid of a field guide.

## Species Range

Several species of fruit-eating birds occur in Nebraska and they are distributed widely throughout the state. Consult a field guide for more information about a particular species.

## Health and Safety Concerns

Starling roosts that have been in place for several years may harbor the fungus that causes histoplasmosis. This disease can infect people who inhale the airborne spores when soil at a roost site is disturbed.

The occurrence of bird droppings on fruit in an orchard typically is low and washing fruit may be an option. Droppings on fruit stored in buildings, however, may pose a problem.

## General Biology, Reproduction, and Behavior

### Reproduction

Breeding behavior varies considerably by species. For example, robins mate two to three times per year, with three to five eggs per clutch. Consult a field guide for more information about clutch size and nesting behavior for different bird species.

### Nesting/Denning Cover

Depending on the species, nests usually consist of twigs, sticks, and coarse stems. They may be lined with shredded bark, feathers, grass, cloth, or string. Starlings nest in cavities, both human-made

and natural. Other songbirds usually nest in trees or shrubs to avoid ground predators.

## Behavior

Starlings are considered commensal because they thrive in human-impacted environments. Historically, populations of starlings have benefited from food produced by agriculture. Large flocks often feed on spilled grain near barns and livestock facilities.

Flocking birds, such as starlings and wild turkeys, often have daily patterns of movement. Usually they forage most heavily early in the morning after leaving their night roost. Heavy feeding may occur again in late afternoon before the birds roost for the night. Resident birds, such as robins, that nest near fruit crops may forage sporadically all day long.

## Habitat

Many songbirds prefer habitats that include shrub lands and woodlots with trees for nesting and roosting. They commonly use woodlots, wooded areas along streams and rivers, farmlands, orchards, parks, and suburban areas. Fruit crops near woodlands may suffer heavier bird damage than those in more open areas.

## Food Habits

Fruit-eating birds usually take a variety of other food types. For example, insects often are important in the diet of young birds for feather development. Most fruit-eating birds also take seeds, nuts, grains, insects, and invertebrates, depending on the season and availability of other local foods.

## Voice, Sounds, Tracks, and Signs

Birds vocalize with several calls, including distress calls. Fruit-eating birds usually are small, and often consume fruit while perched. Therefore, tracks are seldom seen.

## Damage Identification

### Damage to Landscapes

Fruit-eating birds typically do not cause landscape damage.

### Damage to Crops and Livestock

Birds cause damage to fruit in orchards, vineyards, gardens, and backyards by pecking, slashing, and consuming fruit whole. Pecking and slashing opens wounds that allow access to damaging bacteria, fungi, and insects and leaves blemishes that render fruit less marketable or unmarketable. Small fruits, such as grapes and blueberries, often are consumed whole. Large flocks of birds and repeated daily feeding can dramatically reduce yields of fruit. Robins eat cherries, grapes, blueberries, and other small fruits whole. Starlings eat small fruits whole and peck holes in apples. Grackles slash openings through the skin of apples. Crows peck deep triangular-shaped holes in apples. House finches and house sparrows peck holes in small fruits. Several other species, such as waxwings, catbirds, mockingbirds, and orioles regularly eat fruit.

The amount and degree of bird damage in fruit crops is highly variable among places and years. Several factors contribute to the complexity of problems created by birds, including season, local weather, type and variety of fruit produced, time of harvest, and availability and distribution of natural foods.

Generally, fruit-eating birds cause no direct impacts to livestock or pets.

### Damage to Structures

Large starling roosts cause serious problems in some areas, particularly when located in urban sites. Roosts may be objectionable because of the odor of droppings, concerns for human health, noise, and damage to trees.

## Damage Prevention and Control Methods

Control birds before they become habituated to a location. Flock sizes can grow quickly when food and cover are plentiful.

### Habitat Modification

Vegetation management has effectively dispersed starling roosts. Roosts usually occur in dense stands of young trees. Thin up to ⅓ of the branches of specific roost trees or thin trees from dense groves to reduce the availability of perches and open the trees to the weather.

Fruit-eating birds also like having perches nearby (trees, wires) when they are feeding. Fields more distant from perches suffer fewer attacks. Starlings frequently are attracted to cornfields, especially in late summer, when ears are developing. Planting small fruits away from such spots may reduce the risk of problems.

### Exclusion

Exclusion, generally, is the most effective method for protecting fruit crops from birds. Nylon or plastic nets often are useful for excluding birds from high-value fruits in small areas.

Often a support trellis or overhead wires are needed to support nets. In grapes, nets can be stretched over entire rows (*Figure 3*), or side panels of nets can be secured to the trellis wires.



Figure 3. Nets over a row of grapes to protect fruit from birds. Photo by Paul D. Curtis.

To keep birds from roosting on rafters and contaminating fruit, apply bird netting to the overhead area. Black netting is inexpensive and not very noticeable to people. Sticky substances such as Tanglefoot Bird Repellent can be smeared on rafters, but these are messy and need periodic renewal. Secure or plastic bird spikes to perches.

## Frightening Devices

Frightening devices can be effective for short-term dispersal of birds from fruit crops. Strips of Mylar® tape or scary-eye balloons (Figure 4) may be helpful in some cases.

Birds usually learn whether a device presents real danger or not, and they may quickly habituate to stationary effigies. A combination of several frightening techniques used together may work better than a single technique. Vary the location, intensity, and types of frightening devices to improve their effectiveness.



Figure 4. Scary-eye balloon for frightening birds. Photo by Paul D. Curtis.

Hawk models (Figure 5) can frighten birds from gardens and small fields. Effigies usually are more effective if animated. Suspend hawk models from tall poles to allow them to move freely in the wind.



Figure 5. Hawk model and an acoustic device intended to frighten birds. Photo by Paul D. Curtis.

Other frightening devices include gas-operated exploders (Figure 6), battery-operated alarms, and pyrotechnics (shell crackers and bird bombs). Various distress calls may provide short-term control for dispersing birds.



Figure 6. A propane exploder to deter birds from a vineyard. Photo by Paul D. Curtis.

Several devices on the market use distress calls to scare birds from crops (Figure 7). Sometimes distress calls are combined with predator calls to add an element of fear. These devices may be effective for short-term control, depending on the type of crop, bird species, and location. Ultrasonic sounds (high frequency, above 20 kHz) are not effective for frightening birds.



Figure 7. Device using both bird distress calls and raptor calls to deter birds from fruit crops. Image by Paul D. Curtis.

Supplement frightening techniques with lethal control of starlings by shooting, where permitted, to improve effectiveness. See the Shooting section for more information.

## Repellents

Taste repellents may be appropriate for some fruit crops but not for others. For example, grape growers may not want to apply taste repellents on their fruit as it might affect the taste of table grapes or wine.

At least two products on the market for use on fruit contain the taste repellent methyl anthranilate. Methyl anthranilate is a grape-flavored food additive that, at high concentrations, is a repellent for birds. Several formulations are available for protecting fruit crops. This material is quite volatile, so the effectiveness diminishes 2 or 3 days after spraying. Rejex-it® and Fruit Shield® are the trade names. Rejex-it® is federally registered for cherries, blueberries, and grapes. The label lists particular target species, including robins, starlings, and waxwings. The spray can be applied up to the day of harvest. Check pesticide labels to determine which formulations are available for specific bird species and crops in Nebraska.

Efficacy of this repellent has been mixed, depending on the fruit crop, species of bird, and location. More research is needed to evaluate the effectiveness of methyl anthranilate for specific fruit crops.

## Toxicants

No toxicants are registered for controlling birds in fruit crops.

## Shooting

Most fruit-eating birds are protected by the MBTA. The US Fish and Wildlife Service (USFWS) and Nebraska Game and Parks Commission (NGPC) rarely issue permits to shoot protected birds unless there is a risk to human health or safety. Shooting unprotected birds such as starlings may be practical for commercial growers, but only in a limited number of situations. Starlings can be shot in rural areas where discharging firearms is permitted (check state and local laws). A twelve-gauge shotgun set at full choke with No. 7½ shot works well within 40

yards. Permits may require the use of nontoxic steel shot so that lead pellets don't become lodged in fruit. Nontoxic shot is required when shooting blackbirds. Air rifles (.22-caliber or high-velocity .177-caliber) are effective on perching starlings within 30 yards.

The shooting of starlings is more effective as a dispersal technique than as a way to reduce numbers, as starlings often congregate in large flocks. In general, the number of starlings killed by shooting is small in relation to the numbers involved in damaging fruit crops. Shooting can help supplement and reinforce other techniques, however, when the goal is to frighten and disperse birds rather than reduce numbers.

## Trapping

All birds other than European starlings, English sparrows, and pigeons are protected by the MBTA. Any protected species must be released unharmed. Trapping often is less useful than other techniques because of the wide-ranging movements of starlings, the time necessary to manage traps, and the number of starlings that can be captured compared to the total number in the area. Use of traps can be successful at locations where a small, resident population is causing damage, or where other techniques cannot be used. Trapping starlings may be cost-effective when used as a supplemental method to protect a high-value crop. Using trapping as a stand-alone method rarely provides sufficient crop protection.

**Cage Traps** - The European starling trap (*Figure 8*), a decoy trap, can be used in areas where starling flocks are damaging fruit. Construct the sides and top in separate panels to facilitate transportation and storage.

Place the trap where starlings are likely to congregate or perch near fruit crops. The most attractive bait is fruit that they are eating. Place the bait under the openings in the top of the trap and provide water. Do not visit the trap for 24 hours after first applying the bait. Then, check it daily when birds begin to enter the trap. Replace

the bait as soon as it loses freshness. Remove all starlings captured except for about five to be left in the trap as decoys.

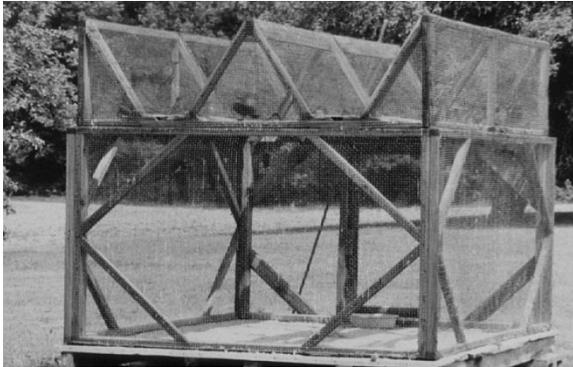


Figure 8. European starling trap. Image by Paul D. Curtis.

Remove captured starlings at dusk to facilitate handling. Release nontarget birds immediately. A well-maintained decoy trap can capture several starlings each day, depending on size, location, and time of year.

## Other Control Methods

Falconry is carefully regulated by federal and state authorities. Falconry offers potential for bird control, but with so few licensed falconers, it is not realistic at this time. Currently, this option is unlikely to work for the vast majority of fruit growers. The application of falconry is expanding in the Pacific Northwest and Michigan, however, and this method may soon be a viable option for commercial growers.

If hawks frequent a farm, fruit-eating birds may be less likely to feed there. Raptor nest boxes may help in some situations and must be cleaned annually. Setting out prominent perches for raptors, if they are lacking, also could help. This method may have limited practical application in Nebraska. The American kestrel is a local, cavity-nesting species that offers the greatest promise. In some parts of Nebraska, sharp-shinned and Cooper's hawks specialize in attacking birds, but they don't readily use nest boxes or nest platforms.

Use of hawks probably won't work in U-pick berry operations, as hawks will not hunt in an area while people are active.

Some research groups are experimenting with the use of unmanned aircraft (drones) for scaring birds from fruit crops. Many technological problems still need to be resolved, but in time it may be possible to overcome them.

## Disposition

### Relocation

Release of starlings and house sparrows is not recommended because they are nonnative invasive species. Other species of birds should be released where captured.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so birds should only be relocated outside of structures. Translocation of starlings and house sparrows is not recommended.

### Euthanasia

Euthanize starlings and house sparrows with carbon dioxide or cervical dislocation. Release all other species on site unless you have specific permits that allow for lethal control.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

## Unprotected Birds

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

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Figure 1. Male house sparrow (*Passer domesticus*).  
Photo by Stephen M. Vantassel.

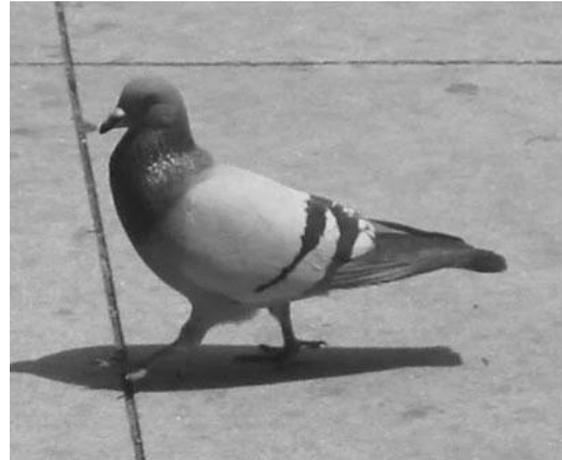


Figure 3. Pigeon (*Columba livia*). Photo by Erin Bauer.



Figure 2. European starling (*Sturnus vulgaris*).  
Photo by Thomas G. Barnes.

### Objectives

1. Identify three species of common unprotected, nonnative birds.
2. Explain bird control options to clients.
3. Evaluate the risks involved with buildings infested with unprotected birds.

### Species Overview

#### Conflicts

House sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), and pigeons (*Columa livia*) are nonnative species that cause a variety of problems in both urban and rural areas. Birds may contaminate areas with their messy nests and droppings. Others consume and damage fruits and grains. Some kill or compete with native birds for nesting sites.

#### Legal Status

House sparrows, starlings, and pigeons are not protected by the Migratory Bird Treaty Act (MBTA) because they are not native to the US. However, some communities may restrict management activities. Before initiating control activities, accurately identify the species, as they can be easily confused with protected birds. Refrain from trying novel methods that may cause suffering and impacts to nontarget species.

## Identification

Unprotected birds include the house sparrow, European starling, and pigeon, also known as the rock dove. They are nonnative species that cause considerable damage.

## Physical Description

**House sparrows** are the smallest of the unprotected birds at about 6½ inches long and weigh less than an ounce (*Figure 1*). Both genders are mostly brown with black streaks above and grayish below. Males have a black throat-bib flanked by white spots. Immature male house sparrows look like females. Do not confuse house sparrows with native sparrows (i.e., chipping sparrow, grasshopper sparrow, song sparrow) that are beneficial and protected by federal and state regulations.

**European starlings** (*Figure 2*) are robin-sized, short-tailed black birds about 8½ inches long, and weigh about 3 ounces. Plumage color changes with gender and season. In summer, adults are glossy black with light speckles. In winter, birds have larger speckles, making them look browner from a distance. The dark pointed beak becomes bright yellow in spring. Both males and females have pinkish-red legs. Other native “blackbirds” (e.g., red-winged blackbird and common grackle) are protected by federal and state regulations.

**Pigeons** are the largest of the three species, at about 12 inches long, and weigh 12 to 17 ounces. Typically they are blue-gray with two black bands on the wings and a black band on the tail that contrasts with its white rump (*Figure 3*). Color ranges from all white to mottled brown to sooty black. They are larger than the tawny-brown mourning doves that are native to the US and protected by federal and state regulations.

## Species Range

All three species of unprotected birds are found throughout Nebraska, especially in human-altered environments.

## Health and Safety Concerns

These birds can carry and transmit diseases that are infectious to humans. Diseases of particular concern include aspergillosis, histoplasmosis, psittacosis, and salmonellosis. In addition, all three bird species may pose significant hazards with bird-aircraft strikes at airports.

## General Biology, Reproduction, and Behavior

### Reproduction

Female house sparrows lay three to nine eggs in a single clutch, and may nest twice a year beginning in early April. Female starlings lay four to six eggs per clutch and also can nest twice a year. Pigeons mate year-round, but most of their five to six broods produced annually are raised during the spring and summer, when temperatures are above freezing. Female pigeons usually lay two eggs per clutch.

### Nesting/Denning Cover

Nests of house sparrows are messy piles of grasses, string, paper, and twigs that fill a void or crevice where the nest is placed (*Figure 4*).



**Figure 4.** Nest of a house sparrow.  
Photo by Stephen M. Vantassel.

Nests of European starlings are less conspicuous and usually associated with a cavity. Sometimes cavities inhabited by starlings can be identified by the fan-shaped spray of feces on the wall below the opening. While preferring to construct nests in

cavities, starlings may construct very large nests as they try to “fill” a void (*Figure 5*).



Figure 5. Starling nest in an attic. Photo by Paul C. Hay.

Pigeon nests usually are found on sheltered ledges and consist of sticks and hardened feces (*Figure 6*).



Figure 6. Pigeon nest with 2 eggs. Photo by Stephen M. Vantassel.

## Habitat

All three species use habitats in both urban and rural areas.

## Food Habits

All unprotected birds eat grains, but each has its own dietary preferences. Sparrows and starlings also eat fruit, seeds, and suet. Both of these species increase consumption of insects during the nesting season. Pigeons require access to water (approximately 1 ounce per day) and grit to help them grind their food for digestion. Starlings

and house sparrows also use grit but do not require it as often when feeding on insects.

## Voice, Sounds, Tracks, and Signs

Calls of sparrows are easily identified by a loud and repetitive “chirp.” Calls of starlings are quite diverse as they can mimic the sounds of other birds. Calls of pigeons consist of a soft and throaty cooing.

## Damage Identification

### Damage to Landscapes

Starlings can damage turf when foraging for insects. Sidewalks covered with bird droppings are aesthetically unpleasing (*Figure 7*).



Figure 7. Starling droppings on a sidewalk. Photo by Stephen M. Vantassel.

### Damage to Crops, and Livestock

Starlings damage cultivated fruits such as grapes, peaches, blueberries, strawberries, raspberries, apples, and cherries. They also damage ripening corn. All three species of birds consume grain intended for livestock, and may contaminate feed with their feces.

### Damage to Structures

Bird droppings are easily noticeable by telltale white stains. Droppings are acidic and can deface

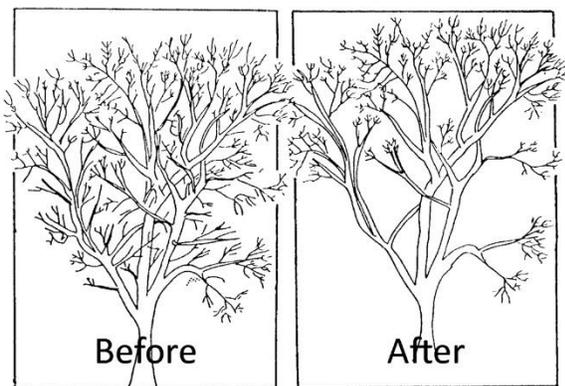
and accelerate deterioration of buildings. Accumulated droppings can plug gutters and cause water damage. The weight of droppings can collapse ceilings. Nests and feathers may obstruct exhaust vents and may cause fires.

## Damage Prevention and Control Methods

### Habitat Modification

Remove food and water sources to reduce the attractiveness of a property to birds. Secure trash in covered containers to prevent birds from accessing food waste. Remove spilled seed from grain storage facilities. Encourage officials to enact local ordinances to ban the feeding of birds in public areas. Reduce the availability of free water by repairing leaky faucets, clearing drains, and grading surfaces to remove water. Ensure that water from air conditioner condensers does not pool on roofs or the ground. Angle gutters to permit proper drainage.

Birds are attracted to trees with dense branches and leaf cover in the winter. Regular pruning of up to ⅓ of the branches can discourage birds from using trees as roost sites (*Figure 8*). Hire a certified arborist for pruning landscape trees. Contact an electric company if trees are near power lines.



**Figure 8.** Prune branches to help reduce attractiveness of trees to birds. Image by Prevention and Control of Wildlife Damage (PCWD).

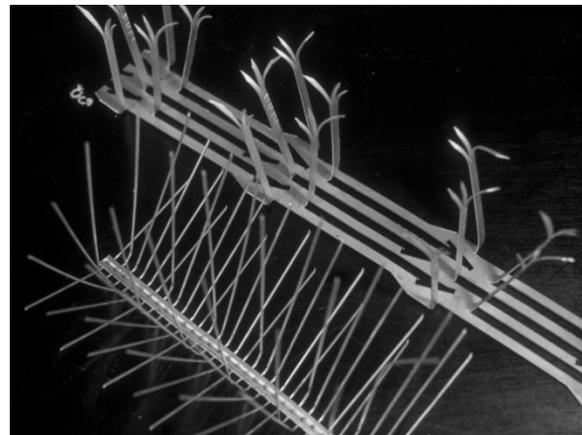
### Exclusion

Nets with ½-inch mesh (*Figure 9*) will prevent birds from gaining access to a location. The use of netting is labor intensive, but often is the best way to prevent birds from accessing rafters and a building frontage with many ledges. Zippers allow nets to be used in areas where access is needed, such as doorways and lights.



**Figure 9.** Nets are effective in preventing bird roosting when maintained. Photo by Stephen M. Vantassel.

Ledge products prevent birds from roosting on flat surfaces. The nonelectric products include spikes (*Figure 10*), wires, coils, 45° angle inserts, and specialty products.



**Figure 10.** Nixalite® (bottom) and CatClaw® (top) are spiked products used to prevent bird roosting on ledges. Photo by University of Nebraska–Lincoln.

Electric-shock products (*Figure 11*) may be powered by solar chargers or electrical outlets.

When birds land, their feet complete the connection and they receive a mild shock, causing them to flee.



Figure 11. Bird Shock Flex Track®. Photo by Bird Barrier Inc.

## Frightening Devices

Several devices are available that employ audible and/or visual stimuli to frighten birds. Frightening only provides short-term damage reduction, as birds often become acclimated to the devices. Vary the timing, placement, and selection of devices to increase effectiveness. A wide variety of tools are available, such as distress calls, Mylar® tape, Mylar® balloons, scary-eye balloons (Figure 12), predator kites, and owl effigies.

Shell crackers and other pyrotechnics are among the most effective devices. However, the explosive nature of these projectiles limits their use in urban areas. Always consult local authorities before using pyrotechnics.



Figure 12. Scary-eye balloons move in the wind and frighten birds. Photo by Jan R. Hygnstrom.

Avoid ultrasonic devices, as no reliable evidence indicates that they are effective. A Long Range Acoustic Device (LRAD) projects a high-decibel sound up to 153 dB out to 200 to 300 yards. The farther animals are from the source of the sound, the lower the decibel level. The LRADs are useful for hazing birds out of trees or off of surfaces.

## Repellents

Tactile repellents (e.g., sticky gels) can be used to prevent birds from perching on ledges and other horizontal surfaces. These repellents are quickly fouled by dust or dirt, and best used indoors. Methyl anthranilate (MA) is an oil-based chemical derived from grapes that irritates birds. It can disperse birds from large spaces such as warehouses when applied with a fogger.

## Fertility Control

OvoControl® P is an oral fertility control agent that prevents pigeon eggs from hatching, thereby interrupting the reproductive cycle. Use of OvoControl® P does not require licensing in Nebraska.

## Toxicants

Starlicide™ Complete is an avicide developed for starling control. It is only available for certified applicators trained in bird control.

## Shooting

Populations of unprotected birds causing problems can be reduced immediately through shooting. Use .177-caliber or .22-caliber rifles, and shoot at night, when the birds are roosting. Several birds can be shot before the remaining birds become startled and leave. Shotguns with No. 7½ shot are useful when controlling large flocks of birds in flight. Check local ordinances and state discharge laws before shooting. Always follow shooting safety guidelines and regulations. Usually, shooting is restricted in urban areas.

## Trapping

Traps provide an excellent means of control in situations where other methods are not feasible, or there is risk of harm to protected species. Traps range from multiple-catch traps capable of capturing dozens of birds (*Figure 13*), to single-capture devices (*Figure 14*). Place multiple-catch traps where birds can see them easily, such as rooftops and raised platforms. When trapping large flocks, improve success by leaving a few decoy birds inside multiple-catch traps to lure others. Provide food and water for decoy birds and protect them from the elements. Pre-bait areas and check traps daily.



Figure 13. Pigeon traps. Photo by Stephen M. Vantassel.

Single-capture or nest-style traps (*Figure 14*) can be effective for sparrows and starlings inside structures.

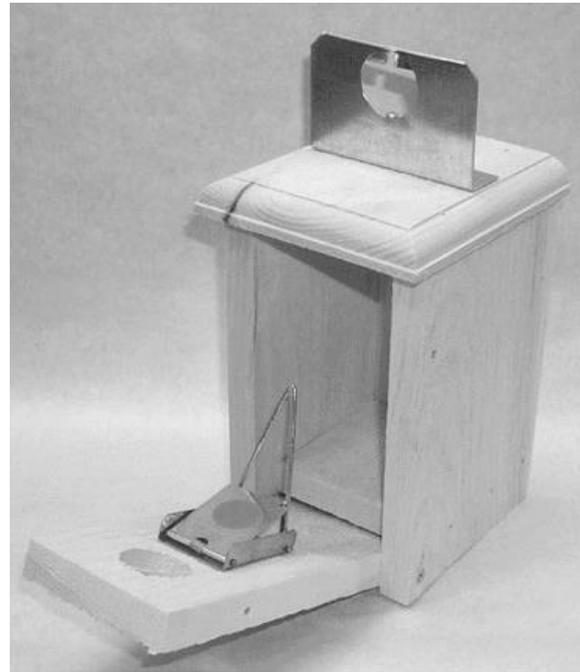


Figure 14. Bird house English sparrow trap. Photo by Wildlife Control Supplies, LLC.

## Other Methods

House sparrow and pigeon nests are conspicuous, and often can be removed to reduce reproduction. The nests, eggs, young, and adults of these species are not protected by federal or state laws. Birds may re-nest, so repeated nest destruction is required for success.

Use a ladder or a long pole with a hook at the end to reach nests that are high above the ground. Always use caution when setting and climbing ladders and reaching for nests, especially in the vicinity of overhead wires. To avoid contact with nest mites and lice, wear gloves and place nesting material and eggs in a plastic bag for disposal. If young chicks are present, quickly euthanize them with carbon dioxide, cervical dislocation, or thoracic compression.

## Disposition

### Relocation

Release of starlings, house sparrows, and pigeons is not recommended because they are nonnative invasive species. Other species of birds should be released where captured.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so birds should only be relocated outside of structures. Translocation of starlings, house sparrows, and pigeons is not recommended.

### Euthanasia

Carbon dioxide is the preferred method of euthanasia. Cervical dislocation or thoracic compression are other options for people with training or experience.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Canada Geese

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Figure 1. Canada goose (*Branta canadensis*).  
Photo by Stephen M. Vantassel.

## Objectives

1. Explain key elements about the biology of Canada geese important for their control.
2. Be able to explain the options for control of Canada geese to clients.

## Species Overview

### Conflicts

Canada geese damage turf through their feeding and excrement. Parks, athletic fields, and golf courses often are damaged by flocks of geese. Feathers and feces may foul water, and excessive grazing may result in shoreline erosion. Geese may become aggressive when nesting, and disturb area residents with their honking. Geese should be deterred from airport areas and flight paths for planes.

## Legal Status

All Canada geese (*Branta canadensis*), including resident flocks (nonmigratory geese that may inhabit areas throughout the year), are protected by federal and state laws and regulations. These govern the capture, handling, and killing of Canada geese, including disturbance of nests and eggs. Permits are required for most control activities other than hazing. Contact Nebraska Game and Parks Commission (NGPC) for detailed information.

## Identification

Canada geese (*Figure 1*) are one of our largest species of waterfowl. They are a valuable natural resource and provide considerable recreation and enjoyment to bird watchers, hunters, and the general public. The “V” formation of a flock of flying Canada geese is a sign of the changing seasons. Geese that migrate may cause short-term damage, and mix with resident geese. In this module, we refer mostly to flocks of resident or local-breeding Canada geese.

## Physical Description

A Canada goose is black and tan with a large, white patch on each cheek. The male (gander) and female (goose) look similar, but males are slightly larger. Geese are 22 to 48 inches tall and weigh up to 24 pounds.

## Species Range

Canada geese occur throughout Nebraska, but are most common along rivers, reservoirs, lakes, and in urban areas. Numbers of Canada geese increase dramatically in spring and fall when migratory birds are passing through the state. Some Canada geese do not migrate, but rather stay all year in

urban areas where sufficient food and water are available.

## Health and Safety Concerns

Canada geese may charge or attack people and pets if nests are approached. They may inflict a painful bite or strike with the edge of a wing. People may be injured after slipping on goose droppings.

Geese may create hazards on roads and cause traffic accidents in urban areas. They are a significant threat to public health and safety when near airports. Military and commercial aircraft have hit geese on takeoff, in the air, or during landing in thousands of cases. The most significant military aircraft disaster caused by birds occurred at Elmendorf Air Force Base in 1995, when an aircraft struck several Canada geese on take-off and crashed, killing 24 people. In 2009, US Airways Flight 1549 was forced to land in the Hudson River after colliding with a flock of geese.

Canada geese contaminate turf grasses with their feces, which can become a public health hazard in parks, athletic fields, golf courses, and residential areas. People should wash their hands before eating and change shoes before entering their homes or vehicles. Droppings from Canada geese may contain cryptosporidium, *Giardia*, toxoplasmosis, campylobacter, chlamydiosis, *E. coli*, listeria, *Pasteurella multocida*, salmonella, avian influenza, and encephalitic viruses. Although droppings of geese may carry several diseases, few cases of human illnesses have been attributed to goose feces.

## General Biology, Reproduction, and Behavior

### Reproduction

Geese form life-long pair bonds, but if a member of a pair dies, the survivor will find another mate. Families migrate together, stay together in the winter, and return to the same area for nesting each year.

Adult pairs return to nesting areas in late winter, typically in late February or March or as soon as the ice melts. During a 1- to 2-week time span, a goose lays five to six eggs and incubates them for 4 weeks during late March or April. Eggs hatch in late April or early May, depending on the location. Most geese begin breeding when they are 2 or 3 years old and nest every year for the rest of their lives. Resident geese may live more than 20 years in suburban areas. One female Canada goose has the potential to produce more than 50 young in her lifetime.

Young geese (goslings) weigh 3 to 4 ounces when they hatch. Geese are precocial, and within 24 hours, hatchlings are able to swim. Goslings hatch with their eyes open, covered in down, and can move about freely. In contrast, altricial birds, such as robins, are born helpless and need parental support. Geese aggressively defend their nests and may attack if approached. After eggs hatch, families of geese may move up to 2 miles from nesting areas to brood-rearing areas, appearing suddenly at ponds bordered by lawns.

Geese that are not breeding often remain nearby in large feeding flocks during the nesting season. A high percentage of nonbreeding geese molt-migrate north into Canada in early June and spend the rest of the summer there.

### Nesting/Denning Cover

Canada geese build nests of twigs, grass, bark, leaves, and moss on the ground near water. Islands are preferred. At one urban pond in Nebraska where virtually no suitable habitat was available on the bank, geese nested on mats of floating, dead cattails. Geese also will nest on the tops of muskrat houses.

### Behavior

Each year geese undergo an annual molt when they shed and re-grow their outer wing feathers. This occurs for a 4- to 5-week period after nesting, from mid-June through mid-July. Birds cannot fly when they are molting. The birds resume flight by late July. During the molt, geese congregate at ponds or lakes that provide a safe place to rest

and feed. Severe conflicts with people often occur during the molt because geese concentrate on lawns next to water and cannot leave. Before molting, some geese without young travel hundreds of miles to favored areas for molting and migration, accounting for the disappearance or arrival of some local flocks early in June. After the molt and throughout the fall, geese gradually increase the distance of their feeding flights and are more likely to be found away from water.

Resident Canada geese spend most of their lives in relatively small areas, although some travel hundreds of miles to areas for molting or to overwinter. Resident geese are distinct from the migratory populations that breed in northern Canada. Canada geese have a strong tendency to return to where they hatched and use the same nesting and feeding sites year after year, making them difficult to move once they become settled in an area. In addition, geese disperse from areas of higher concentration to lower concentration. Removal of geese from a particular pond will not guarantee that geese will not inhabit the pond during the same season or the following year.

## Habitat

Canada geese prefer habitats with standing water less than 50°F and low-sloping banks. Geese need access to growing grass for foraging. Mowed and fertilized lawns or turf areas near water are ideal habitats.

## Food Habits

Canada geese are herbivores. They eat grasses, a variety of terrestrial plants, aquatic plants, and occasionally agricultural crops such as corn, soybeans, and wheat. They feed during early morning and late afternoon.

## Voice, Sounds, Tracks, and Signs

Canada geese communicate through body language, calls, and honking.

The droppings of Canada geese usually are tubular (Figure 2). Droppings are green when geese are

eating grasses. Tracks are easy to find in soft soils or sand (Figure 3).



Figure 2. Fresh dropping of a Canada goose.  
Photo by Stephen M. Vantassel.

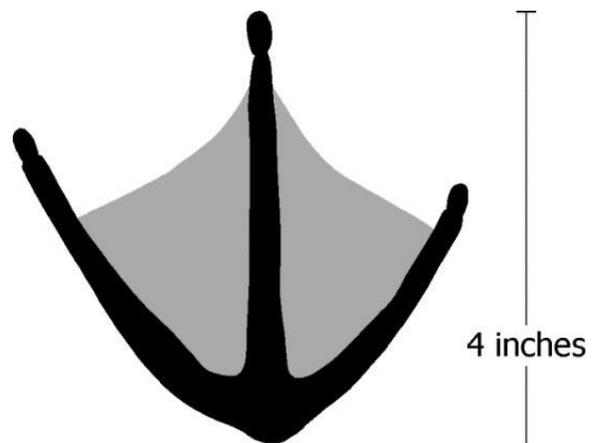


Figure 3. Track of a Canada goose. Image by Dee Ebbeka.

## Damage Identification

### Damage to Landscapes

Canada geese are particularly attracted to lawns and ponds near apartment complexes, houses, office areas, and golf courses. The birds can rapidly denude lawns, turning them into barren areas of dirt. Erosion may be a problem on the banks of a pond.

## Damage to Crops and Livestock

Canada geese eat crops such as corn, soybeans, wheat, rice, alfalfa, and grasses grown for lawns and golf courses. In some areas, crops that are sprouting can be severely damaged by grazing. Muddy fields can be compacted by trampling, which may result in reduced yields.

## Damage to Structures

Canada geese generally do not damage structures.

## Damage Prevention and Control Methods

### Habitat Modification

Plant trees near pond edges to interfere with flight lines. To discourage geese from turf areas, plant fescue grasses. Allow the grass to grow tall, and avoid fertilizing to reduce lush plant growth. Prohibit public feeding of geese. Create vegetative or stone barriers along shorelines. Where geese have established feeding or nesting patterns, such modifications likely will be marginally successful.

### Exclusion

Geese normally rest on open water or along shorelines. They tend to land and take off from open water. Where practical, construct a system of suspended wires over water to deny geese access to such areas. Single strands of 14-gauge wire, 80- to 100-pound test monofilament line, or stainless-steel cable can be arranged in a grid with 10 to 15 feet between lines. Secure each line so that it remains 12 to 18 inches above the water surface. Perimeter fences may be needed to keep geese from walking under the grid lines. To reduce the risk of birds flying into the grid, attach brightly colored rope, flagging, or other markers to make the lines more visible.

Grid systems are not practical for areas more than one acre, or for water that is used for swimming, fishing, or other types of recreation. Golf course ponds, reflecting pools, wastewater ponds, and newly-seeded lawns with limited access to the

public may be suitable. Vandalism of grid systems may be a problem in public areas.

Fences can be effective where geese land on water and walk onto adjacent lawns. Fences should be at least 30 inches tall and solidly constructed. Welded-wire fencing made with 2- x 4-inch mesh is durable and will last for many years. Less expensive plastic or nylon netting is effective but must be replaced more often.

Fences work best during the summer molt, when geese are unable to fly and must walk between areas for feeding and resting. Fences, dense shrubbery, or other physical barriers installed close to the edge of the water are effective ways to control the movements of geese that are molting. Fences must completely enclose the site to be effective. Fences also may be used to block aggressive birds nesting near buildings or walkways. Fences around large open areas, such as athletic fields or ponds, have little effect on free-flying birds.

Snow fence or erosion-control fabric may be used as a temporary barrier for geese that are molting. Fences made of two parallel monofilament fish lines (20-pound test), strung 6 and 12 inches above ground, and secured by stakes at 6-foot intervals may work, but are less reliable.

Successful control of geese has been reported with high-voltage electric fences. Use two strands of at least 17-gauge wire, 8 inches and 16 inches off the ground, respectively; or three strands at 5, 10, and 15 inches above the ground.

## Frightening Devices

Frightening devices may be used for short-term control of nuisance behaviors, before geese become habituated to a location. Do not use frightening devices when geese are nesting or flightless. Human-operated frightening devices tend to be more effective than stationary ones. Consider the timing of frightening activities, as geese may flee into traffic or aircraft.

Locate stationary frightening devices where they will not become entangled or obstructed by tree

branches or power lines. Devices may be subject to theft or vandalism in areas that are open to the public. Relocate stationary devices frequently to avoid acclimation by geese. Geese quickly learn whether something poses a real danger, and quickly habituate to most devices. When birds become habituated, devices are less effective.

Visual devices may be used to deter geese if they are not already established on a site. Quietness is a key advantage of visual frightening devices, and makes them a suitable tool for use in populated areas. Visual frightening devices are not likely to be effective on suburban lawns where there are trees or other objects overhead, or in areas where geese have been established for years.

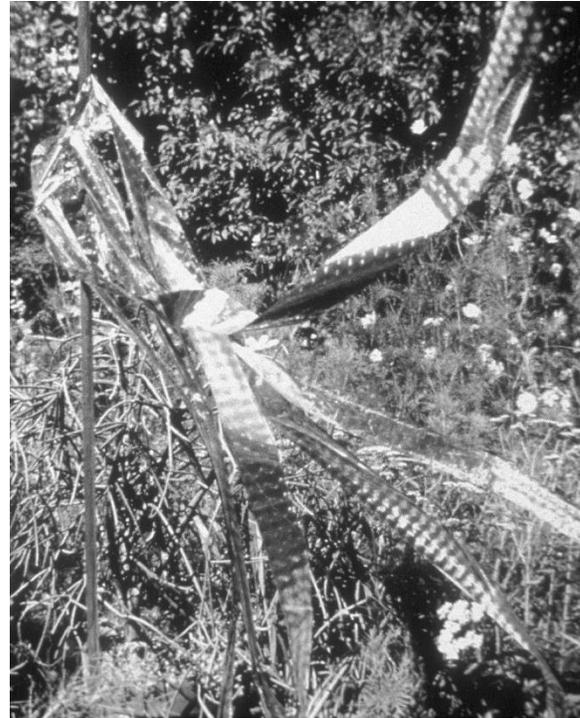
Effigies of humans (e.g., scarecrows) or predators (*Figure 4*) attempt to portray visual threats to geese. Effigies with moving or flapping parts are more effective than immobile ones. Reposition effigies every few days.

Flags or balloons can be placed on poles (6 feet or taller) in and around an area to be protected. Geese normally are reluctant to linger beneath an object hovering overhead. Flags can be made of 3- to 6-foot strips of 1-inch colored plastic tape, or 2- x 2-foot pieces of orange flagging. Balloons with large eye-spots and filled with helium are sold at some garden or party-supply stores. Several flags or balloons may be needed to protect each acre of open lawn.



**Figure 4.** A silhouette of a coyote may frighten geese. Photo by Stephen M. Vantassel.

Mylar-style tape reflects sunlight to produce a flashing effect and may be an effective short-term deterrent for geese (*Figure 5*). When the tape moves in the breeze, it pulsates and produces a humming sound that repels birds. Secure 6- x 30-inch strips of Mylar-style tape to 4-foot wooden stakes. Reinforce tape at the points of attachment to prevent tearing by the wind.



**Figure 5.** Irri-tape® is a Mylar-style tape that is attached to poles to scare geese. Photo by Bird-X, Inc.

Red and green lasers have proven effective for dispersing geese at night from lakes less than 20 acres in size. Use lasers as soon as darkness permits. Point lasers several yards in front of floating geese and slowly move the dot closer. Geese will be easier to move if lasers are used during several successive nights. Always keep the beam below the line of the horizon. Do not point the laser beam at buildings, people, or planes. High-powered spotlights can produce the same effect.

Geese also may be discouraged from an area through the use of noisemakers. Noisemakers work best as preventive measures before geese become established in an area. At sites with a

history of frequent use by geese and people, the birds may become acclimated in 1 to 2 weeks. Noisemakers may be prohibited or unsuitable in urban areas.

Propane cannons ignite propane gas to produce loud explosions at timed intervals. They are effective for migrant geese in agricultural fields, but are not suitable for residential or public areas.

Long Range Acoustic Devices (LRAD) project a high decibel sound (up to 153 dB) from 200 to 300 yards. The closer the animal, the higher the decibel. The LRAD is useful for hazing birds off of surfaces such as airports, parks, and golf courses.

Alarm and distress calls of Canada geese have been used to disperse geese from areas with varying results. Geese merely may move to another side of the pond and may acclimate to the calls, but a commercially-available device (Goose-Be-Gone™) is purported to overcome some of the reported limitations.

Where discharge of firearms is allowed, occasional shooting of geese can increase the effectiveness of noisemakers, as geese associate the sound with a real threat. Federal and state permits are needed to shoot geese outside of established hunting seasons.

Pyrotechnics are special fireworks that are launched from a 12-gauge shotgun or starter pistol. Shell crackers are fired from a 12-gauge shotgun that project a firecracker up to 100 yards. Other devices, such as screamer sirens, bird-bangers, and whistle bombs, are fired into the air from a hand-held, 6-mm pistol launcher. They generally have a range of 25 to 50 yards. Read and follow safety instructions before using pyrotechnics.

Check with local law enforcement agencies about ordinances for noise control, codes for fire safety, or restrictions on possession and discharge of firearms before using any of these techniques. Obtain permits if necessary. In some areas, starter pistols are considered handguns, and their possession and use may be regulated.

Remote controlled boats have been successful for hazing geese (*Figure 6*). Select boats that are appropriate to the size of the water body. Boats work best on relatively small ponds that are 5 acres or less, when the water is calm. Boats can be used in conjunction with pyrotechnics in some areas to increase effectiveness.



Figure 6. Remote controlled motorboats can be an effective way to haze geese. Photo by Stephen M. Vantassel.

Trained dogs are very effective for controlling geese. Dogs are used to disperse geese from golf courses, parks, athletic fields, airports, and corporate properties. Breeds with instincts for herding, such as border collies, tend to work best. Hazing with dogs is most practical where the dog and handler are on-site at all times, or where daily service is available. The dogs must be closely supervised, and except where permitted, in compliance with local leash laws or park regulations. Initially, hazing must be done several times per day for several weeks, after which less frequent, regular patrols will be needed. Another approach is to allow dogs to roam freely in a fenced (above ground or “invisible” dog fence) area that is not open to the public, but this may be less effective. Geese do not acclimate to being chased by dogs.

The use of dogs may not be practical near busy roads or where a property is divided into many small sections by physical barriers. Dogs cannot easily repel geese from large bodies of water, but

may be able to keep geese off shorelines or beaches.

## Repellents

Anthraquinone and methyl anthranilate are registered as repellents for the control of Canada geese feeding on turf. Several commercial products and formulations are available. Follow label directions for use. Repeated applications may be needed after mowing.

## Fertility Control

If prevention of nesting fails (see Other Methods), eggs can be treated to inhibit hatching. Puncturing, shaking, freezing, or applying corn oil to all of the eggs in a nest will prevent hatching. After treatment, replace the eggs in the nest so the female will continue incubation until the nesting season is over. If the nest is destroyed or all the eggs are removed, the female likely will lay new eggs.

Destruction of eggs reduces the number of geese that will be present on a site later in the year. Geese without young are easier to repel from a site after nesting season. If conducted on a large scale (throughout a town), treatment of eggs can help slow population growth and lead to stable numbers. Treatment of eggs may be necessary for 5 to 10 years before effects on local populations are evident.

Federal and state regulations apply to any disturbance or treatment of Canada goose nests or eggs. Federal rules only require that people register online at <https://epermits.fws.gov/eRCGR> before initiating the destruction of eggs.

## Toxicants

None are registered for the control of Canada geese.

## Shooting

Federal and state agencies manage goose populations through regular waterfowl hunting seasons. However, due to firearm restrictions in

suburban areas, hunting may not impact numbers of local-breeding geese. Depredation permits may be needed to reduce local flocks. Sharpshooting with special shotguns (e.g., Metrobarrels and subsonic rounds) may be more appropriate in urban areas.

## Trapping

When geese are molting and therefore flightless, they can be rounded up and removed. During other times, geese may be captured with large nets fired by compressed air. Both of these techniques require specialized equipment, skills, and permits. They are best handled by professionals, so consult with NGPC.

## Other Methods

In spring, Canada geese usually return to the area where they hatched or previously nested. This often leads to an increase in the number of geese in areas that once had just a few birds. Local growth of populations may be controlled by preventing geese from successfully nesting. Although it is difficult to eliminate habitat, daily harassment in early spring may deter geese from nesting at a particular site. The geese may still nest nearby where they are not subject to harassment.

## Disposition

### Relocation

Relocation of geese is not effective except in rescue situations.

### Translocation

Geese that are translocated short distances (less than 50 miles) may return when they are able to fly. Adult geese are most likely to return, whereas goslings moved during the molt often will join a local flock, and remain in the area of release. Translocation may increase the risk of spreading diseases to wildlife in other areas. Specific permits are required to translocate Canada geese.

## Euthanasia

Federal permits are required to kill Canada geese. Geese are easily euthanized with carbon dioxide. They also may be euthanized by cervical dislocation, which requires training, strength, and skill.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Crows

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Research-based, certified wildlife control training programs to solve human-wildlife conflicts.  
Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. American crow (*Corvus brachyrhynchos*). Image courtesy of Wildlife Control Consultant, LLC.

## Objectives

1. Explain key elements about crow biology important for their control.
2. Understand federal and state laws and regulations restricting crow management.
3. Explain management options for crows.

## Species Overview

### Conflicts

American crows (*Corvus brachyrhynchos*) can form large roosts and disturb nearby residents with their cawing and excrement. The size and number of winter crow roosts in urban areas has increased dramatically in the last decade. Crows also can damage crops, garden plantings, and fruit trees. Crows may feed on the eggs and young of other birds.

### Legal Status

Crows are protected by the Migratory Bird Treaty Act (MBTA). Under the MBTA, crows may be controlled without a federal permit when found “committing or about to commit depredations

upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner to constitute a health hazard or other nuisance.”

Federal guidelines permit states to establish regulations and crow hunting seasons. Regulations vary among states, and state or local laws may prohibit certain activities for control, such as shooting or trapping. Check with the Nebraska Game and Parks Commission (NGPC) for specific rules and regulations before initiating control.

## Identification

The American crow (*Figure 1*) is the most common species of crow in North America. Northern ravens (*C. corax*) look similar to crows, but are much larger, and typically inhabit mature forests away from urban areas.

## Physical Description

American crows are easy to identify with their black plumage and relatively large size. They are 17 to 21 inches long and weigh about 1 pound. They are common in areas near people. Males and females are similar in appearance.

Common ravens are distinguished from crows by their larger size, call, wedge-shaped tail, and flight pattern that commonly includes soaring or gliding. In contrast, crows have a frequent steady wing-beat with little or no gliding.

## Species Range

Crows occur throughout Nebraska, where food, water, and wooded cover are available. They are most common in urban areas during fall and winter, where numbers exceed hundreds if not thousands in communal roosts.

## Health and Safety Concerns

Crows and their roosts may threaten aircraft safety when their flight paths are near airports.

In some situations, large flocks of crows may become a factor in the spread of disease. When feeding in and around buildings that house swine, crows have been implicated in the spread of transmissible gastroenteritis (TGE). The scavenging habits of crows, and the apparent longer incubation time for avian cholera in crows, are factors that increase the potential for crows to spread this disease.

Roosts of crows, blackbirds, and starlings that have been in place for several years may harbor the fungus *Histoplasma capsulatum*, which causes histoplasmosis. This disease can infect people who inhale the airborne spores when soils at a roost site are disturbed. American crows are very susceptible to West Nile Virus (WNV) and are thought partly responsible for its rapid spread across the US.

## General Biology, Reproduction, and Behavior

### Reproduction

American crows are capable of breeding after 2 years. Crows nest in February to May in Nebraska. Mates appear to remain together throughout the year, at least in nonmigratory populations. They maintain pair bonds, even in large winter migratory flocks. Both sexes build the nest and feed the young. Occasionally, juveniles (nest associates) help with nesting activities. The female incubates the eggs, and is fed during incubation by the male and nest associates. Usually one brood is produced per year. The average clutch size is four to six eggs, which hatch in about 18 days. The young fledge about 30 days after hatching, and forage with their parents throughout the summer.

Nest success is lowest in populations in urban areas, which averages only one fledging per brood. Rural crows have the highest nest success

with an average of 1.6 young per brood. Loss of broods may result from a variety of factors including predation by raccoons (*Procyon lotor*) and great horned owls (*Bubo virginianus*), starvation, and adverse weather.

### Nesting/Denning Cover

Nests consist of twigs, sticks, and coarse stems and are lined with shredded bark, feathers, grass, cloth, and string. Usually they are in trees 18 to 60 feet above ground. Nests rarely are located in deep forests. Where few trees exist, crows may nest on the ground or on the crossbars of telephone poles.

### Behavior

Crows are considered commensal because they thrive in environments impacted by humans. Crows rarely breed more than 3 miles from areas habituated by people. Historically, crow populations have benefited from agriculture as a source of food, and from fire suppression, which allows the growth of trees for roosting.

Crows are among the most intelligent of birds. American crows can count to 3 or 4, are good problem solvers, have good memories, use a diverse and complex range of vocalizations, and quickly learn to associate specific noises and symbols with food. One report describes an American crow that dropped palm nuts onto a residential street and waited for passing automobiles to crack them.

Crows are wary birds, as may be evidenced by the number of crows that scavenge along highways, versus how few are hit by autos.

Crows often post a sentinel while feeding. Studies indicate that the sentinel may be part of a family group, although unrelated crows and other birds in the area likely benefit from the sentinel's presence.

Research indicates that roosting crows may have two distinct, daily patterns of movement. Some fly each day to a diurnal activity center, maintained by four or five birds. Individuals within the groups

typically fly different routes and make different stops. Other crows appear to be unattached and without specific, daily activity centers or stable groups. The unattached birds, possibly migrants, are not faithful to a specific territory and feed at sites such as landfills.

Few wild crows live longer than 6 years, but some have lived to age 14, and crows in captivity have lived for over 20 years. One researcher reported a wild crow that lived 29 years. Adult crows have few predators, with the occasional exceptions of large hawks and owls.

One important and spectacular aspect of crow behavior is the congregation into huge flocks in fall and winter (*Figure 2*).



**Figure 2.** A flock of crows flying to a night roosting site. Photo by Stephen M. Vantassel.

Large flocks are the result of many small flocks gradually assembling as the season progresses, with the largest concentrations occurring in late winter. The Auburn area in central New York has a communal roost that holds tens of thousands of crows each winter. In several other states, crows commonly roost in towns, resulting in mixed opinions on how to deal with them. Flocks roost together at night and may fly 6 to 12 miles outward from a roost each day to feed.

## Habitat

American crows prefer habitats that include open fields where food can be found, and woodlots with trees for nesting and roosting. They commonly use woodlots, wooded areas along streams and rivers, farmlands, orchards, parks, and suburban areas. American crows select trees for roosting that are larger and have more canopy cover than other trees, in areas with high light levels at night that are less than 2 miles from sources of food.

## Food Habits

Crows are omnivorous. They will eat almost anything, and they readily adapt foraging habits to changing seasons and available supplies of food. They appear equally adept at hunting, pirating, and scavenging. Crows consume over 600 different food items.

About  $\frac{1}{3}$  of the annual diet of crows consists of animal matter, including grasshoppers, beetles, beetle larvae (white grubs), wireworms, caterpillars, spiders, millipedes, dead fish, frogs, salamanders, snakes, eggs, young birds, and carrion. Garbage is a primary source of food, particularly in urban areas. The remainder of their diet consists of vegetable or plant matter, particularly corn, much of which is obtained from fields after harvest. Crows also consume acorns, wild and cultivated fruits, watermelon, wheat, sorghum, peanuts, and pecans.

## Voice, Sounds, Tracks, and Signs

American crows vocalize with several calls, including a warning call, “caw, caw.” Crows can mimic sounds made by other birds and animals, and have been taught to mimic voices of humans.

The gregarious behavior of crows, accompanied by frequent vocalizations, allow for easy identification. Tracks may be found in soft soils (*Figure 3*).

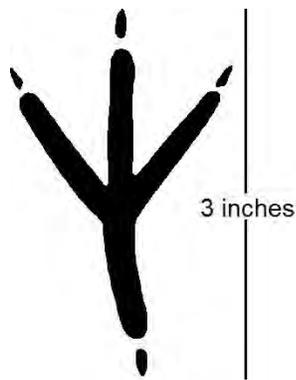


Figure 3. Track of an American crow.  
Image by Dee Ebekka.

## Damage Identification

### Damage to Landscapes

The amount and degree of damage is highly variable among places and years. Crows may tear up turf searching for worms and other invertebrates in the grass. Large roosts can foul areas with their excrement.

### Damage to Crops and Livestock

Crows may damage crops, although many problems are more commonly associated with other species of wildlife. Crows damage seedling corn plants by pulling the sprouts and eating the kernels. Similar damage also may be caused by other birds (pheasants, starlings, blackbirds) and rodents (mice, voles, squirrels). Crows consume ripening corn during the milk and dough stages, although such damage also is commonly caused by blackbirds. Crows also damage grain sorghum, commercial sunflowers, fruits, and watermelons.

In rare situations, crows attack very young calves, pigs, goats, and lambs, particularly during or shortly after birth. Depredation is associated more often with ravens, and is most likely to be done by crows where livestock births occur in unprotected, open fields near large crow flocks.

Crows sometimes consume the eggs and young of waterfowl, pheasants, and other birds during nesting season. Depredation may be locally severe where breeding waterfowl are concentrated, and where little habitat exists to conceal nests. For

example, crows find nests more easily when they are located in narrow fence rows, or at the edge of potholes that have little surrounding cover. Crows typically consume large eggs (2.3 x 1.7 inches or greater) at the nest, and may take smaller eggs away from the site.

## Damage to Structures

Large winter roosts in urban areas may be objectionable because of the odor of droppings, concerns for human health, noise, and damage to trees. It is not uncommon for winter crow roosts to contain 10,000 to 30,000 crows or more.

## Damage Prevention and Control Methods

### Habitat Modification

Remove or modify roost trees by removing up to 1/3 of the branches to open up the canopy (Figure 4) and reduce protection from cold winds. If possible, reduce night time lighting near winter roosts, as this may change crow behavior.



Figure 4. Thin branches to reduce roosting cover for crows. Image by Prevention and Control of Wildlife Damage (PCWD).

Secure trash cans and dumpsters, and remove carrion. Provide alternate foods, such as broadcasting cracked corn through fields to protect newly planted corn.

## Exclusion

Generally, exclusion is not practical for controlling crows, but may be useful in some situations. Nylon or plastic nets might be useful for excluding crows from high-value fruit or vegetable crops or small areas.

Stretch cord or fine wire across gardens at a height of 6 to 8 feet to protect crops from crows. Lines appear to represent an obstacle that is difficult for a flying bird to see, especially when rapid escape may be necessary. Strips of aluminum or cloth, or aluminum pie pans may be tied to the wires, but have mixed results. Species of birds respond differently to lines, and adult birds generally are more repelled by lines than juveniles. Other factors such as season; activity of the birds; and type of lines or wires, spacing, and height need further research and development.

Protect ripening corn in small gardens by placing a paper cup or sack over each ear after the silk has turned brown. The dried, brown silk indicates that the ear has been pollinated, a necessary step in the development of corn grain.

## Frightening Devices

Frightening devices can be effective for dispersing crows from roosts, crops, and other sites. A combination of several frightening techniques used together may work better than a single technique. Vary the location, intensity, and types of frightening devices to improve their effectiveness. Supplement frightening techniques with lethal control, where permitted, to improve effectiveness. The addition of lethal control only has a short-term effect on the behavior of remaining birds.

Effigies may frighten crows from gardens and small fields. Effigies may be immobile (*Figure 5*) or animated, and animated models are often more effective.



Figure 5. Effigy of an owl intended to frighten crows. Photo by the University of Nebraska–Lincoln (UNL).

One of the animated effigies is a “crow-killing” model, made from a plastic owl with a crow model attached in the talons of the owl. Movement is generated by mounting the model on a weather vane, and by adding wind or battery-powered wings to the crow.

In urban areas, strips of Mylar® tape hung in roost trees may be helpful.

Ultrasonic sounds (high frequency, above 20 kHz) are not effective in frightening crows and most other birds.

Lasers may cause crows to flee a roost, but their quick return, even after repeated treatments, suggests that lasers are not effective as a long-term technique. Crows can be dispersed from urban roosts using pre-recorded crow distress

calls broadcast from a portable player. Play the sound before the flock lands at the roost.

Clapper devices that produce an intermittent “clap” can be placed in trees, or at other sites close to crow perches. As with other frightening techniques, clappers appear to be most effective with wary populations. Crows that have habituated to people and disturbance may not respond. Beat on tin sheets or barrels with clubs to scare birds. Spray crows with water from sprinklers mounted in the roost trees as they land to disperse roosts in some situations.

Long Range Acoustic Devices (LRADs) project a high decibel sound up to 153 dB at 200 to 300 yards. The LRAD may be useful for hazing birds out of trees or off surfaces. Check local noise ordinances in urban areas before using LRADs.

## Repellents

Methyl anthranilate is a grape-flavored food additive that also is a bird repellent in high concentrations. In aerosol form, it irritates the nasal passages of birds causing them to flee the treated area. Foggers and ultra-low volume devices are used to apply the product and disperse roosting birds. It is a general use pesticide (GUP).

Tactile repellents made of polybutene are available to repel crows from roosts. Avoid applying the product directly to structural surfaces. Place tape or other removable material on the surface first. Polybutenes collect dust and lose effectiveness over time. They are most useful for indoor applications to repel birds. Polybutenes are general use pesticides (GUPs).

## Toxicants

No toxicants are registered for controlling crows.

## Shooting

Crows are protected by the MBTA. The US Fish and Wildlife Service (USFWS) and Nebraska Game and Parks Commission may issue permits to shoot crows. Check your local and state regulations

before shooting crows. A twelve-gauge shotgun set at full choke with No. 6 shot works well within 40 yards. Air rifles (.22-caliber or high-velocity .177-caliber) are effective on perching crows within 40 yards.

Shooting crows is more effective as a dispersal technique than as a way to reduce numbers, as crows are difficult to shoot during the day. They may be attracted to a concealed shooter by using decoys or crow calls. In general, the number of crows killed by shooting is small in relation to the numbers involved in damage or nuisance behavior. However, shooting can help to supplement and reinforce other techniques when the goal is to frighten and disperse crows rather than reduce numbers.

Crow hunting during open seasons may be effective in rural areas in Nebraska. The effectiveness varies depending on movements of crows, the season in which the damage occurs, and other factors. Crows tend to be more wary of people when they are hunted, and thus more easily dispersed from roosts or other areas. Further study is needed to better understand the relationships between hunting and wariness, and whether a pattern exists that might be used to improve management of crows.

## Trapping

Crows are protected by the MBTA. The USFWS and Nebraska Game and Parks Commission may issue permits to trap crows. Check your state and local regulations before trapping crows. Trapping often is less useful than other techniques because of the wide-ranging movements of crows, the time necessary to manage traps, and the number of crows that can be captured. Crows are smart and wary, and quickly become trap-shy.

## Other Methods

Crows may be removed with nets launched by rockets or compressed air. Crows must be prebaited to the site. It is critical for net operators to be hidden while firing the nets. Crows are wary and smart, and often difficult to trap with rocket or cannon nets.

## Disposition

### Relocation

Relocation of crows is not recommended except to rescue individuals.

### Translocation

Translocation of crows is not recommended.

### Euthanasia

Specific permits are required to control crows with lethal methods. Euthanize crows with carbon dioxide or cervical dislocation.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Deer

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Research-based, certified wildlife control training programs to solve human-wildlife conflicts.  
Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Female white-tailed deer (*Odocoileus virginianus*). Photo by Greg Clements.

## Objectives

1. Explain key elements about deer biology that are important for their management.
2. Effectively communicate options for managing deer damage to clients.
3. Identify the risks involved with managing deer damage.

## Species Overview

### Conflicts

Despite their economic and aesthetic values, white-tailed deer (*Odocoileus virginianus*, Figure 1) and mule deer (*O. hemionus*) can conflict with a variety of human interests. Deer cause damage to garden vegetables, flowerbeds, fruit trees, and ornamentals. They feed on agricultural crops, and when overabundant, can negatively impact native

plant communities. Deer threaten human health and safety by their involvement in deer-vehicle collisions and transmission of diseases.

### Legal Status

White-tailed and mule deer are game species and protected year-round in Nebraska. Where severe or persistent damage to personal property occurs, landowners may be issued depredation permits to allow shooting of deer at times other than legal hunting seasons. The popularity of deer as game animals and the need to curb poaching have led to the development of severe penalties for illegal possession. Lethal control of deer cannot be initiated before consulting Nebraska Game and Parks Commission (NGPC). The NGPC typically provides technical assistance and even materials for damage caused by deer, but they do not provided compensation for damage.

### Identification

White-tailed and mule deer are even-toed animals (ungulates) of the deer (Cervid) family. Economically, they are the most important species of wildlife in Nebraska, as fees for hunting licenses fund wildlife programs for all species across the state. Since most damage problems are caused by white-tailed deer, this chapter primarily will address this species, but methods to prevent and control damage apply to both.

### Physical Description

At birth, young white-tailed deer (fawns) are rust-colored with white spots. The spotted coats are shed in 3 to 4 months and replaced by a grayish-brown winter coat. The summer coat of an adult deer is reddish-brown. The area under the tail, the belly, chin, and the throat always are white. Antlers grow on males (bucks) from April to

August. Development of antlers is nourished by a layer of soft, vascularized “velvet.” The dried velvet is rubbed off and the antlers polished during the fall breeding season (rut). Size of antlers depends on nutrition, age, and genetics. Bucks shed antlers in mid- to late winter.

Size of adults varies with latitude. In northern states, a mature buck may weigh 150 to 250 pounds. Females (does) typically weigh 30% less than bucks.

## Species Range

White-tailed deer are most common in farmland, wooded, and riparian habitats in eastern Nebraska, but they are found throughout the state. Mule deer, in general, inhabit the western half of Nebraska and most often are found on plateaus, in the Sandhills, and around brushy draws.

## Health and Safety Concerns

Deer-vehicle collisions are the biggest threat to human safety. In addition to the economic loss from damaged vehicles, 100 to 200 people in the US die each year, along with thousands who are injured by hitting or avoiding deer (*Figure 2*). To reduce the chances and impacts of a deer-vehicle collision, drive cautiously, follow the speed limit, wear a seatbelt, observe deer-crossing signs, and be extra vigilant during the fall mating season and spring dispersal periods. When you see one deer, anticipate that more deer may be present.

About 65% of the deer-vehicle collisions that occur annually happen during the rut (mating season) in October through December. **Do not swerve** to miss a deer, as this frequently leads to serious injuries due to rollovers and collisions with other vehicles and objects.



**Figure 2.** Deer-vehicle collisions constitute a significant threat to human safety. Photo by Paul D. Curtis.

Deer are susceptible to several diseases, but only a few are of concern to humans. Deer are associated with the movement and development of ticks that carry Lyme disease, ehrlichiosis, and babesiosis. Deer can be reservoirs for bovine tuberculosis, which threatens the health of livestock and humans. On rare occasions, deer have attacked people.

## General Biology, Reproduction, and Behavior

### Reproduction

White-tailed deer breed from October to January, depending on latitude. Peak activity for breeding is in November. Does are in heat for 24 hours every 28 days for two or three consecutive cycles. One buck may inseminate several does, and no pair-bonding takes place. Most does breed during their second autumn, although in good habitat, up to 30% of doe fawns (6 months old) will breed. Gestation is about 202 days. Fawns usually are born in late May or June. Most reproducing fawns give birth to a single fawn, but adult does typically bear twins. Reproductive potential depends on nutrition. Fawns weigh 7 to 8 pounds at birth and increase in weight for 5 to 6 years.

### Nesting/Denning Cover

Bedding areas vary, depending on the time of year and location. Deer may bed in woodlands, grasslands, and agricultural fields. During windy winter days, deer seek out heavy cover. In urban

areas, deer may bed along home foundations to take advantage of the warmth.

## Behavior

Female white-tailed deer typically have home ranges of about 1 square mile that varies with season, quality of habitat, and interaction with other deer. Home ranges of males are about three to four times the size of females'. Life expectancy primarily depends on pressure from hunting and winter weather. Deer can live for up to 20 years, although 10 years is above average in the wild.

## Habitat

Ideal habitat for deer is forest edges rather than dense, old-growth forests. They thrive in agricultural areas interspersed with woodlots and riparian habitat. Deer favor early successional habitats where brush and saplings are within reach (typically 6 feet tall or less).

Many populations of deer flourish in urban areas because of the diversity in plant foods, and lower or no hunting pressure. In Nebraska, deer densities may exceed 150 animals per square mile in suburban areas that have patches of forest habitat or park lands. This could be four to five times the typical deer density in rural areas.

## Food Habits

Deer browse on leaves, stems, and buds of woody plants all year long. Forbs are eaten in spring and summer, when available. Fruits and nuts, especially acorns, are important in fall. Grasses are relatively unimportant in the diet.

In urban areas, deer consume a variety of landscape ornamentals and garden plants. There are very few plants that deer will not consume if they are food-stressed in winter.

Agricultural crops such as corn, soybeans, grains, alfalfa, vegetables, nursery stock, and fruit trees are eaten readily. Daily consumption for adult males is greatest in spring and is about 4½ to 6½ pounds of food per day. Consumption drops by half during winter.

## Voice, Sounds, Tracks, and Signs

Deer may emit a warning snort when alarmed and bleat when in distress.

## Damage Identification

### Damage to Landscapes

Deer may damage a wide variety of ornamentals. Ornamental trees may be permanently disfigured by browsing or rubbing. In addition to the immediate loss, feeding by deer can affect the future yields for fruit trees.

High densities of deer may severely impact native plant communities, and impair regeneration of several tree species and wildflowers. Deer are changing future forest composition in the Eastern US.

### Damage to Crops and Livestock

Deer may cause damage to a wide variety of row and forage crops, vegetables, fruit trees, nursery stock, and stacked hay.

The feeding habits of deer may compete with livestock. Deer can be reservoirs for bovine tuberculosis, which threatens the health of livestock and the economic viability of dairy industries. Deer also are involved in the maintenance of the strains of virus that cause epizootic hemorrhagic disease and bluetongue in cattle. On occasion, deer attack dogs.

### Damage to Structures

In general, deer do not damage structures. They occasionally run through and break fences and plate-glass windows. Young bucks are most often involved with structural damage.

## Damage Prevention and Control Methods

The NGPC often provides technical assistance and materials for deer damage control. Materials can be very costly but probably are necessary where large deer herds exist in agricultural landscapes.

## Habitat Modification

Harvest crops as early as possible to reduce damage by deer. Use deer-resistant ornamental plants in home landscapes. In a few cases, lure crops have diverted the interest of deer away from valued resources.

## Exclusion

Protect individual trees with woven-wire or plastic cylinders at least 6 feet high. High-tensile, woven-wire fences provide premium protection for orchards, nurseries, truck farms, backyards, and other valuable resources. High-tensile, multi-strand electric fences are a lower-cost option for row crops, forages, livestock, and other farm facilities. However, deer may learn how to penetrate electric fences, and the fences are less effective on large fields (10 or more acres). Single-strand, baited polytape electric fences are the lowest cost option for protecting gardens, small farm fields (less than 5 acres), and other areas from deer damage during the growing season.

## Frightening Devices

In general, frightening devices are only minimally effective in protecting valued resources from white-tailed deer. Deer acclimate quickly to noises and new features in the environment, especially if they are motivated by hunger. Thus, gas exploders, strobe lights, sirens, and scarecrows do not provide reliable protection. The most effective frightening devices have been pyrotechnics, guard dogs, and deer-activated bioacoustics devices.

## Repellents

Several repellents are registered for use to prevent deer damage to plants, including putrescent whole egg solids, ammonium soaps, thiram, capsaicin, garlic, and blood meal. Several home remedies, such as human hair and soap are reported to be effective, but research does not support these claims. In general, the effectiveness of repellents is highly variable and dependent on alternative resources, deer densities, habituation, and motivation of individual deer. Repellents must be reapplied every 4 to 5 weeks if deer feeding

pressure is high, and those applied to plants must be reapplied to new growth. In some parts of Nebraska, cold temperatures and snow limit applications during the winter months when deer damage to woody ornamentals and young trees is greatest.

## Fertility Control

Reproduction in white-tailed deer can be altered by immunocontraceptive agents (injectable porcine zona pelucida and gonadotropin releasing hormone vaccines are EPA-registered), and surgical sterilization. However, application of these procedures is limited due to expense, practicality, and regulatory issues. State permits are required to treat deer, and such programs only can be accomplished by trained professionals. Given high urban deer densities and costs, the scale of these programs often is limited. It may only be practical to treat areas a few square miles in size.

Deer fertility control does little to reduce densities of overabundant deer in the short term as urban deer may live 10 or more years. Similar to shooting programs, success depends on having access to a high percentage of deer (90% or more), the vulnerability of deer, professional skills, cost, and public acceptance. Contact NGPC for more information.

## Toxicants

No toxicants are registered for the control of white-tailed deer.

## Shooting

Unlike moles, rats, and other unprotected wildlife, deer cannot be eliminated casually when in conflict with humans. Shooting through regulated sport and managed hunting during the fall and winter can help maintain or reduce deer densities. Depredation or nuisance deer permits are available from NGPC during nonhunting seasons to reduce local densities and remove offending animals in agricultural and urban areas.

Sharpshooting is a specialized form of population reduction, typically conducted by trained teams in urban and suburban areas where deer are overabundant, under highly controlled conditions. The effectiveness of shooting as a control method is dependent on access to deer, vulnerability of deer, skill of the shooters, cost, and public acceptance. Depredation permits may allow shooting of deer at night, and the use of bait to attract animals to specific safe shooting sites.

## Trapping

Several techniques are available for capturing deer (e.g., cage traps, drop nets, cannon nets, net guns, and dart guns). All methods require authorization by NGPC. Each method requires high levels of expertise, and all are expensive to apply because of high labor costs. Generally, deer trapping is done by professionals, and may be used in conjunction with an urban sterilization program. Trapping and translocation of deer is usually not feasible because of poor survivorship.

## Disposition

### Relocation

Live capture and relocation of deer is seldom practical unless there is a rescue situation, or public relations mandate live removal.

## Translocation

Translocation of deer is very expensive and can lead to stress and death of the deer. Deer are abundant in most parts of Nebraska and few places exist where deer can be released where they will not cause additional conflicts. Nebraska currently does not allow translocation of deer.

## Euthanasia

The most convenient method of euthanasia is shooting. However, captive-bolt devices may be needed for captured deer in suburban areas because of restrictions on discharging firearms. For more information, see the National Wildlife Control Training Program.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# House Mice

**Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)**  
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 Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. House mouse (*Mus musculus*). Photo by US Department of Health and Human Services-National Institutes of Health.

## Objectives

1. Identify damage caused by house mice.
2. Be able to explain management options to a client.
3. Identify risks of working with house mice.

## Species Overview

### Conflicts

House mice consume and contaminate food, damage structures by gnawing on building materials and wires, burrow through insulation, and spread diseases.

### Legal Status

As a nonnative species, house mice are not protected by state or federal laws and are considered pests. They can be controlled using pesticides that are registered for the control of mice and they may be trapped without permits.

## Identification

Native to central Asia, house mice (*Mus musculus*) arrived in North America with settlers from Europe. House mice often live in close association with humans and therefore are called “commensal” (table-sharing) rodents. House mice are more common in residences and commercial structures than rats.

## Physical Description

House mice are small, slender rodents with a slightly pointed nose; small, black, somewhat protruding eyes; large, sparsely haired ears; and a nearly hairless tail with obvious scale rings (Figure 1). They are considered among the most troublesome and economically important rodents in the US.

House mice are gray-brown with a gray or buff-colored belly. Similar species in Nebraska include the native deer mice, white-footed mice, and jumping mice, which have white bellies that contrast sharply with the brown dorsal fur. Harvest mice have grooves on their upper incisors. For more details on identification of species, consult a field guide to the mammals.

Adult house mice are 3 to 4 inches long (nose to base of tail) with a tail that is 2 to 4 inches long. They typically weigh 0.4 to 0.9 ounces.

## Species Range

House mice exist throughout Nebraska and in human-altered environments across the continental US, Hawaii, and Alaska.

## Health and Safety Concerns

House mice may bite when handled or trapped on glueboards. Always wear gloves when handling

mice or any other wildlife. House mice and their parasites transmit salmonellosis (food poisoning), rickettsial pox, and lymphocytic choriomeningitis to humans. They also may carry leptospirosis, rat bite fever, tapeworms, and the organisms that cause ringworm, a fungal skin disease of humans. Urine of mice may be an asthmatic trigger in some people.

## General Biology, Reproduction, and Behavior

### Reproduction

Litters of five or six young are born 19 to 21 days after mating. Newborn house mice are hairless and their eyes are closed. Young grow rapidly, and after 2 weeks are covered with hair and their eyes and ears are open. They begin to make short excursions from the nest and eat solid food at 3 weeks. They are weaned soon after and are sexually mature within 6 to 10 weeks of birth. House mice may breed year-round, but when living outdoors they breed mostly in spring and fall. A female may have 5 to 10 litters annually, causing populations to grow rapidly under optimal conditions. Survival and breeding of young decline markedly when densities are high.

### Nesting/Denning Cover

House mice may burrow into the ground when other shelter is not readily available. They may nest in any sheltered location. Nests are constructed of fibrous materials and usually are 4 to 6 inches in diameter. They prefer to nest next to sources of heat, such as compressors, pilot lights, and hot water heaters.

### Behavior

House mice are active year-round and are most likely to invade structures as temperatures cool in the fall. They are mainly nocturnal, although considerable activity may occur during the day. Seeing house mice during the day does not necessarily mean that a large population is present, although this usually is true for rats.

One house mouse travels an area about 10 to 30 feet in diameter during daily activities. They seldom travel far for food or water. Limited movement and food-gathering behavior, which differs from rats, make control of house mice difficult in many situations.

House mice leave and return to their nests up to 40 times in a day. They explore, learn, and memorize the locations of pathways, obstacles, food, water, shelter, and other elements in their habitat. They quickly detect new objects but do not fear them. They almost immediately enter bait stations and sample bait. The degree to which they consume a particular food depends on the flavor and its physiological effect. Mice may reject bait simply because it does not taste as good as other available foods.

### Habitat

House mice live in and around homes, farms, commercial establishments, and open fields. They may be found far from humans, particularly in moderate climates. As a general rule, house mice may be present wherever humans are.

### Food Habits

House mice eat many types of food but prefer seeds and grain. They sample new foods and are considered “nibblers.” Foods high in fat, protein, or sugar (e.g., bacon, chocolate, butter, nuts) may be preferred, even when grain and seeds are present. An individual house mouse consumes about  $\frac{1}{10}$  of its body weight each day and up to 8 pounds of food per year. They contaminate far more food with their urine and feces than they consume.

Unlike Norway and roof rats, house mice can obtain water from the food they eat. They need only about  $\frac{1}{2}$  ounce of water per day and often lap condensation on pipes or drips from faucets. They drink water when it is available. Absence of liquid water or food with adequate moisture content may reduce breeding potential.

## Voice, Sounds, Tracks, and Signs

House mice emit high-pitched squeaks. Sounds of gnawing, climbing in walls, and running across ceilings are common if mice are present.

Tracks (Figure 2), including footprints and marks from tails, may be seen on dusty surfaces or in mud. Before nightfall, place a tracking patch made of flour and rolled smooth with a cylindrical object in pathways to determine if mice or rats are present (Figure 3).

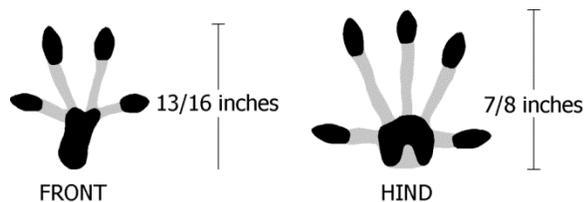


Figure 2. Tracks of a house mouse. Image by Dee Ebbeka.

**Droppings** may be found along runways, in feeding areas, and near shelter. It may be difficult to differentiate between mouse droppings and those of certain insects. Droppings of house mice average  $\frac{1}{4}$  inch long, whereas those of cockroaches usually are  $\frac{1}{8}$  to  $\frac{1}{4}$  inch long and, when viewed under a magnifying glass, show distinct longitudinal ridges and squared-off ends. In comparison, droppings of bats contain fragments of insects and are crushed easily. In addition, bat droppings tend to be found in clusters while house mice droppings tend to be scattered throughout their trails.

**Marks from gnawing** may be visible in corners and on surfaces of walls, doors, ledges, and stored materials wherever house mice are present. Gnaw marks of house mice are  $\frac{1}{32}$  inch, and those of Norway rats are  $\frac{1}{16}$  inch in diameter. Fresh accumulations of wood shavings, insulation, and other materials that have been gnawed indicate active infestations. Entry holes of mice are less than  $1\frac{1}{2}$  inches in diameter, whereas entry holes of rats are larger. Like rats, mice have paired incisor teeth that grow continuously. The incisors are worn down by gnawing on hard surfaces and by working the teeth against each other.

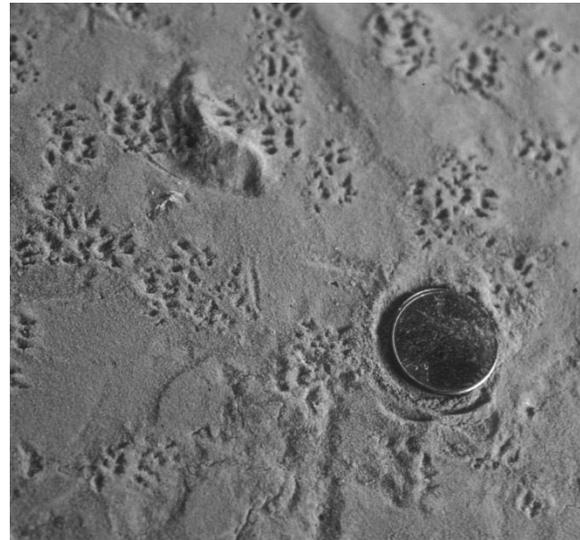


Figure 3. Tracks of house mice in flour. Photo by Ron Case.

**Visual sightings** may be possible during daylight. Mice can be seen after dark with the aid of a flashlight, spotlight, or infra-red light.

**Nests** may be found in garages, closets, attics, basements, and outbuildings where house mice are present. Nests consist of fine, shredded, fibrous materials.

**Odors**, especially musky odors, are a positive indication that house mice are present. These odors can be used to differentiate their presence from that of rats.

## Damage Identification

Inspect the premises thoroughly when looking for signs of house mice. Search for signs of mice in attics, basements, crawl spaces, around foundations, and behind and under stored materials. Wear safety equipment appropriate to the environment.

## Damage to Landscapes

Damage to landscapes by house mice usually is limited in scope. In situations where noticeable damage occurs, the culprits often are voles or native mice.

## Damage to Crops and Livestock

House mice consume fresh vegetables, such as cucumbers, tomatoes, beans, and peas, as well as fruits. They gnaw on the bark of young trees, feed on newly-planted grain, and cause damage to crops before harvest. The greatest concern with house mice, however, is the consumption and contamination of stored grain. Contamination from droppings and urine make food unfit for consumption by humans and livestock.

## Damage to Structures

House mice cause damage to structures through gnawing and nest-building. They quickly can cause extensive damage to insulation inside walls and attics (*Figure 4*).

House mice often damage large electrical appliances by chewing wires and insulation, resulting in short circuits, fire hazards, and other costly malfunctions. They also damage items stored in attics, basements, garages, and museums. Heirlooms, paintings, books, documents, and other such items often are impossible to replace if they are damaged by house mice.



**Figure 4.** Insulation that has been damaged by house mice. Photo by Robert M. Timm.

## Damage Prevention and Control Methods

House mice are active year-round and should be controlled as soon as they are noticed. Effective prevention and control of damage involves sanitation, rodent-proof construction, and reduction of the population with traps and toxicants. Sanitation and rodent-proofing are useful to prevent damage by house mice, but when an infestation already exists, population reduction likely is necessary.

## Habitat Modification

Sanitation, which includes the removal of available food, water, and shelter, is essential for the control of house mice. Even the best sanitation, however, will not eliminate house mice. It will permit easier detection of sign, increase effectiveness of traps and bait by reducing the amount of competing food, and prevent large populations from developing.

House mice are less dependent on humans than Norway rats. House mice require little space and small amounts of food. They may inhabit buildings before construction is complete. In offices, they may live behind cabinets or furniture and feed on scraps or crumbs from food kept in desks. In homes, they find ample food in kitchens. In garages, they eat sacked or spilled pet food and bird food, as well as insects. Most buildings in which food is stored, prepared, or consumed will support at least a few mice, regardless of sanitation. Sites must continuously be monitored for house mice.

Stack sacked and boxed foods in rows on pallets in a way that allows thorough inspection for evidence of rodents. Store materials at least 8 inches away from walls. Paint a 12-inch wide white band on the floor adjacent to the wall to aid in detecting droppings and other signs of rodents. Sweep floors frequently to enable detection of fresh signs. Left-over food in pet dishes is a common source of food for rodents in and around homes. Give pets only what they will eat at a single feeding.

House mice can jump up to 10 inches from a flat surface. Keep pallets used to store food or feed at least a foot off the ground. House mice are good climbers and can walk up surfaces such as wood or concrete, unless the surface has a slick finish. They can live for long periods of time within a pallet of feed without going to the floor.

Keep the perimeter of buildings and other structures clear of weeds and debris, including stacked lumber and firewood, to discourage house mice and to allow easier detection of sign. A strip of heavy gravel adjacent to foundations, known as a weed-free zone, may reduce burrowing.

## Exclusion

“Rodent-proofing” plays a critical part in the control of house mice. Store bulk and pet foods in rodent-proof containers, such as metal cans or barrels with tight-fitting lids. Build or modify structures to exclude rodents. Inspect existing structures to identify ¼-inch openings through which mice could gain access. Look carefully outside and inside at sill plates, foundations, door thresholds, utility lines, and other potential points of entry. Seal all openings larger than ¼ inch with hardware cloth. Copper Stuf-fit® and Xcluder® fabric can be used to secure small crevices and gaps (*Figure 5*). Foam that expands is useful to reduce heat loss but by itself will not prevent rodent entry.

## Frightening Devices

House mice are wary and easily frightened by unfamiliar sounds that come from new locations. Unusually loud, novel sounds frighten house mice and cause temporary avoidance. They quickly become accustomed to new sounds, however, if they hear them repeatedly.

No research has shown that ultrasound can drive house mice from a structure after they have taken up residence. Until more conclusive information is available, commercial ultrasonic devices are not recommended as a solution to infestations.



Figure 5. Xcluder® fabric placed in a crevice on the foundation. Photo by Stephen M. Vantassel.

## Repellents

Rodents find some types of tastes and odors objectionable, but chemical repellents are seldom practical solutions for resolving infestations of house mice. Ro-Pel® is registered for use in repelling house mice from trees, poles, fences, shrubs, garbage, and other objects. Little information is available on its effectiveness against house mice.

A variety of natural oils, including mint oil and balsam fir oil, are sold as repellents for house mice. Little information is available regarding the effectiveness of these products against house mice.

## Toxicants

Nebraska requires having a commercial pesticide applicator license before applying rodenticides as a business service in most instances. General use pesticides (GUPs) are toxicants that homeowners can purchase over-the-counter without a license for use on their own property. Always read the

label on the pesticide container and check reputable sites on the Internet for the most recent regulations. Rodenticides are classified as anti-coagulants and non-anticoagulants.

**Anticoagulant** rodenticides inhibit the clotting of blood and impair capillary action, leading to death in house mice within 5 to 21 days. Anticoagulant rodenticides are slow-acting, so the mouse does not associate subsequent illness with the bait, even if a sub-lethal dose is consumed. Bait shyness usually does not occur, and prebaiting is not needed with anticoagulant rodenticides.

First-generation anticoagulants (*Table 1*) usually are less toxic and require more feedings to produce death than second generation anticoagulants (*Table 2*).

**Table 1. First-generation anticoagulant rodenticides (multi-feed) that are general use pesticides (GUPs) for controlling house mice.**

Common Name	Percent Active Ingredient
Chlorophacinone	0.005 (baits) 0.2 (tracking powder)
Diphacinone	0.005 (baits) 0.2 (tracking powder)
Warfarin	0.025 (baits)

**Table 2. Second-generation anticoagulant rodenticides (single feed) that are restricted use pesticides (RUPs) for controlling house mice.**

Common Name	Percent Active Ingredient
Brodifacoum	0.0025 to 0.005 (baits)
Bromadiolone	0.005 (baits)
Difenacoum	0.005 (baits)
Difethialone	0.0025 (baits)

Directions on the label commonly instruct the user to “maintain a continuous supply of bait for 15 days or until feeding ceases,” thus ensuring the entire population has ample opportunity to eat

lethal doses of the bait. The sensitivity to the toxicants varies among species. In general, the hazard of secondary poisoning to other animals from anticoagulants is relatively low. Fortunately, vitamin K is an antidote for all anticoagulant intoxication.

Occasionally, house mice will accept bait well, resulting in an initial reduction of the population. Acceptance of bait may drop, however, even though some mice remain. In such instances, the remaining house mice probably never accepted the bait, either because of its formulation or placement. The best strategy is to switch to different formulations, place baits at different locations, and use other methods of control, such as trapping. Always follow directions on the label.

**Non-anticoagulant Rodenticides** - Three non-anticoagulant rodenticides are registered for use against house mice (*Table 3*). They are useful in providing a quick reduction in a population. In general, they are more toxic and hazardous to use than anticoagulants. No antidotes are available.

**Table 3. Non-anticoagulant rodenticides that are restricted use pesticides (RUPs) for controlling house mice.**

Common Name	Percent Active Ingredient
Bromethalin	0.01 (baits)
Cholecalciferol	0.075 (baits)
Zinc phosphide	2.0 (baits) 10.0 (tracking powder)

Bromethalin and cholecalciferol are formulated to serve as chronic rodenticides. They are applied so that house mice have the opportunity to feed on the baits one or more times over 1 to 7 days. Acceptance of bait generally is good with proper formulations. Rodents typically stop feeding once a lethal dose has been ingested.

Zinc phosphide differs from the other rodenticides in that prebaiting is recommended to increase acceptance of bait. Bait shyness occurs when bait produces an ill effect, but not death, within a few hours of consumption. Intoxicated animals often associate the bait with the illness, and thereafter avoid it. Pre-baiting will reduce sub-lethal doses

and thus bait-shyness. Always follow the directions on the label.

### Bait Selection and Formulation

House mice have poor eyesight and rely on hearing, smell, taste, and touch. Since they are color-blind, bait can be dyed distinctive colors without causing avoidance. A wide selection of ready-to-use baits is commercially available. Monitor consumption of baits to determine preferences.

Ready-to-use baits come in a variety of formulations including loose grain, pelleted, paste, blocks, and liquid. Grain baits and pelleted baits can be carried more easily by house mice to other locations. House mice often hoard food, which may result in bait being moved to places where it is undetected, difficult to recover, or hazardous to nontarget species. Conversely, wax and extruded blocks (*Figure 6*) can be secured within bait stations, preventing house mice from moving the bait. In addition, wax and extruded baits are resistant to spoilage in moist areas, such as basements.

### Bait Stations

As part of EPA's new risk mitigation for rodenticides, all rodenticide bait products marketed to residential consumers must be sold with, and used in protective, tamper-resistant bait stations. Bait stations (bait boxes) increase both the effectiveness and safety of rodenticides. Bait stations are useful because they:

1. protect bait from moisture and dust,
2. provide a protected place for rodents to feed,
3. keep nontarget animals and children away from hazardous bait,
4. allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to nontargets, and
5. prevent accidental spilling of bait.



Figure 6. Mouse on bait blocks secured inside a bait station. Photo by Liphatech®, Inc.

**Types of Bait Stations** - Bait stations (boxes) made of plastic, cardboard, or metal are available (*Figure 7*) in sizes for rats and mice.

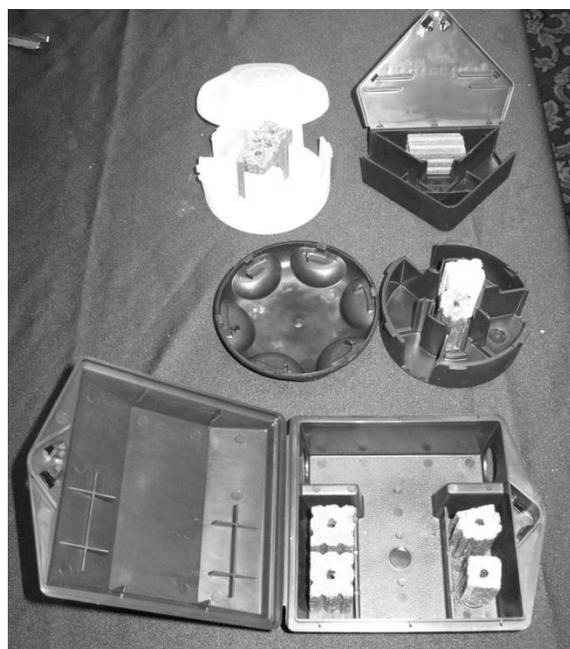


Figure 7. Tamper-resistant bait stations for rodent control. Photo by Stephen M. Vantassel.

The EPA uses the following system to distinguish bait stations. Choose the type of bait station appropriate for your situation (*Table 4*). Follow the manufacturer's instructions for securing bait stations.

**Table 4. Rodenticide bait stations and levels of tamper- and weather-resistance.**

<b>Bait station capabilities</b>	<b>Tier 1</b>	<b>Tier 2</b>	<b>Tier 3</b>	<b>Tier 4</b>
<i>Resistant to children</i>	Yes	Yes	Yes	No
<i>Resistant to dogs</i>	Yes	Yes	No	No
<i>Resistant to outdoor weather</i>	Yes	No	No	No
<i>Resistant to indoor conditions</i>	Yes	Yes	Yes	Yes

**Bait Station Maintenance** - Provide enough fresh bait to allow rodents to eat all they want. When bait boxes initially are deployed, check them daily and add fresh bait as needed. After 7 to 10 days, the number of rodents and amount of feeding will decline. After that, you only will need to check the boxes every 2 to 4 weeks. If the bait becomes moldy, soiled, or infested with insects, empty the box, clean it, and refill it with fresh bait. Follow all directions on the label of the product you are using.

Use caution when cleaning stations heavily contaminated with rodent droppings as they may contain dangerous pathogens. Hantavirus is not associated with house mice, but it is with deer mice, which also may visit the station. We recommend wearing a respirator (preferably full-face mask), gloves, and coveralls when cleaning contaminated bait stations.

**Placement of Bait Stations** - House mice usually are active in small areas. Proper placement of baits or bait stations is important. Mice will not visit bait stations, regardless of contents, if they are not located in areas where they are active.

Place bait boxes between the shelter and food supply. Put bait boxes near burrows, against walls, and along travel routes. Never place bait stations where children or nontarget animals can knock them over. Spilled bait may become a hazard, particularly to small animals. Permanent bait stations can be placed inside buildings that are not rodent-proof, along the outside of the foundation, and around the perimeter. Bait

stations help keep populations low when regularly maintained with fresh anti-coagulant bait. Rodents moving in from nearby areas will be controlled before they can reproduce and cause significant damage.

## Shooting

The shooting of mice is not recommended.

## Trapping

Control can be achieved with traps, but trapping requires more labor than other methods. It is recommended in situations where toxicants are inadvisable or to reduce the number of mice before using toxicants. The use of traps is the preferred method in homes, garages, and other structures where small numbers of house mice may be present. The use of traps has several advantages:

1. it does not rely on rodenticides,
2. it permits the user to view the success, and
3. it allows for disposal of the carcasses, thereby eliminating odor problems from decomposing carcasses that may remain when using toxicants.

Use enough traps to make the control effort short and decisive. House mice seldom venture far from their shelter and food, so traps should be spaced no more than 6 feet apart in areas where mice are active.

**Body-gripping Traps** - Simple, inexpensive, wood-based snap-traps are available in most hardware and farm supply stores. Bait traps with peanut butter if allergies are not a concern, or with pieces of marshmallows, hot dog, bacon, or nutmeat tied securely to the trigger. Nonallergenic baits are available and should be considered, especially in public use areas.

Set traps close to walls, behind objects, in dark places, and in locations where house mouse activity is seen. Place the traps so that mice pass directly over the trigger when they follow their natural course of travel, such as close to a wall

(Figure 8). Set traps so that the triggers are sensitive and spring easily. Effectiveness can be increased by enlarging the trigger, or using a trap with an expanded trigger. Clamshell-style traps are more expensive but are easier to set and clean. Removal of trapped mice is easier as well.



Figure 8. Proper placement of snap traps (these are narrow trigger). Note that the trigger abuts the wall. Photo by University of Nebraska–Lincoln (UNL).

**Cage and Box Traps** - Multiple-capture (automatic) mouse traps, such as the Ketch-All® (Figure 9) and Victor Tin Cat® are available from hardware and farm supply stores, or from distributors of pest control equipment. Multiple-capture traps work on the principle that mice enter small holes without hesitation. The traps may catch several mice in a single setting, and should be checked and emptied regularly so that mice do not die in the traps.

**Glueboards** - These catch and hold mice that attempt to cross them, in the same way flypaper catches flies. Glueboards have a lower rate of capture than other traps and should not be used as the primary tool for controlling house mice.

Place glueboards where house mice travel, such as along walls. Glueboards lose their effectiveness in dusty areas unless they are covered. Do not place peanut butter directly on a glueboard, as the oil will dissolve the glue. Place peanut butter inside a plastic bottle cap and then put the cap in the middle of the glueboard. Do not use

glueboards where nontarget animals can come in contact them. Nontarget captures can be released using vegetable oil to dissolve the glue. Some organizations oppose the use of glueboards because of questions concerning humaneness.



Figure 9. Multiple-catch mouse trap next to an expanded-trigger snap trap. Photo by UNL.

## Other Methods

Some dogs and cats will catch and kill mice, but pets generally do not control large populations. In urban and suburban areas, it is common to find house mice living in close association with cats and dogs, relying on pet food for nourishment. Around most structures, house mice can find many places to hide and rear their young out of the reach of predators. Cats also place their owners at increased risk by exposure to toxoplasmosis, and the impact of free-ranging cats on native wildlife is a concern.

## Disposition Relocation

Relocation of house mice is not recommended. They are a nonnative invasive species and likely will move back to the place where they were removed.

## Translocation

Translocation of a house mouse is not recommended because it is an exotic and invasive species that causes significant property damage.

## Euthanasia

Euthanize house mice by carbon dioxide asphyxiation. Cervical dislocation also is acceptable. For mice caught on glueboards, use a sturdy rod or stick to deliver a sharp blow to the base of the skull.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

<http://www.epa.gov/pesticides/mice-and-rats/consumer-prod.html>

# Moles

**Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)**  
 Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.  
 Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Eastern mole (*Scalopus aquaticus*). Photo by Dallas Virchow.

## Objectives

1. Communicate options for managing mole damage to clients.
2. Identify common mole species and distinguish them from voles and shrews.
3. Explain typical mistakes made in managing mole problems.

## Species Overview

### Conflicts

Moles cause damage to lawns, golf courses, and athletic fields when they burrow tunnels or pile mounds of soil on top of turf.

### Legal Status

Moles are unprotected in Nebraska and can be controlled without permits if causing damage or nuisance problems.

### Identification

Moles are small mammals that spend most of their lives underground. They feed primarily on

soil-borne insects and larvae (grubs), as well as earthworms that they encounter while tunneling beneath the surface. The eastern mole (Figure 1) is the most common and widespread mole in Nebraska.

## Physical Description

Moles have several physical characteristics (Figure 2) that distinguish them from voles and shrews. The snout is hairless and extends nearly ½ inch in front of the opening of the mouth. The small eyes and openings of the ear canal are concealed with fur. They lack external ears. The forefeet of moles are large and broad, with palms wider than they are long. The toes are webbed to the base of the claws, which are broad and depressed. The fur is short, dense, and very soft with no knap, allowing moles to travel backwards in tunnels.



Figure 2. View of an eastern mole on its back, showing its tail, hind feet, enlarged front feet, and pointed nose. Photo by University of Nebraska–Lincoln (UNL).

## Species Range

Eastern moles occur in the Midwest and are the most common species of mole in Nebraska. They prefer wooded areas associated with turf where soil-born insects are abundant.

## Health and Safety Concerns

No human health or safety concerns are associated with moles.

## General Biology, Reproduction, and Behavior

### Reproduction

The mole gestation period is about 42 days. A litter of three to five young is produced each year, mainly in late spring or early summer. Pups leave their mother after only 30 days, and are sexually mature about 10 months after birth. They may live 3 to 5 years.

### Nesting/Denning Cover

Mole nests are typically located in the root system of trees. Deep runways lead from the den to hunting grounds. The den consists of irregular chambers connected to deep runways. The runways follow a course 5 to 8 inches beneath the surface of the ground. The chambers from which the runs radiate are about the size of a quart jar.

### Behavior

Moles are not social. Two or three moles may be trapped at the same spot, but that does not necessarily mean they had been living together in a burrow. Networks of runways that were made independently occasionally join with separate burrows. Moles do not hibernate and are active year-round. They are most active when searching for food during periods of rain in late spring and early summer.

The home range of a male eastern mole is thought to be about 3 acres. Moles cover a larger area than do most subterranean animals due to their substantial food requirements. Three to five moles per acre is considered an average to high density.

### Habitat

Moles live in underground burrows and rarely come to the surface. They favor wooded habitats

where the soil is loose and moist. Moles cannot survive in hard, compact, semi-arid soils. They make nesting burrows in high, dry areas, but prefer to hunt in soil that is shaded, cool, moist, and populated by worms, grubs, and other insects. This accounts for the often abundant populations of moles in lawns and parks. When the season gets very dry, moles often move to irrigated areas.

Most of the runway system consists of shallow tunnels ranging through its hunting area. The subterranean hunting paths are 1¼ to 1½ inches in diameter. The tunnels may be used just once, or may be used at irregular intervals. Eventually, the tunnels fill with soil as they settle, especially after heavy rain. In some cases, moles push the soil they have excavated from their deep runways into shallow tunnels. Mole tunnels usually ridge up the surface of the soil so they can easily be followed. In wet weather, runways are very shallow. During dry periods, they range deeper, following the course of earthworms and insects.

### Food Habits

The diet of moles consists mainly of worms and soil-borne insects, including grubs. Moles take plant material inadvertently, or when alternative foods are unavailable. Digging through soil requires a tremendous amount of energy and thus large amounts of food. Moles consume 70% to 100% of their body weight each day.

### Voice, Sounds, Tracks, and Signs

Moles rarely make sounds that can be heard by humans, but cats and dogs can hear moles tunneling in yards.

## Damage Identification

### Damage to Landscapes

Moles “swim” through soil, often near the surface of ground, in their search for food. In doing so, they may damage plants by disrupting the roots. You can identify areas that have been used for feeding by the number of short, crooked, tunnels in a concentrated area (*Figure 3*). Mounds indicate

where moles have pushed soil to the surface to clear deep tunnels.

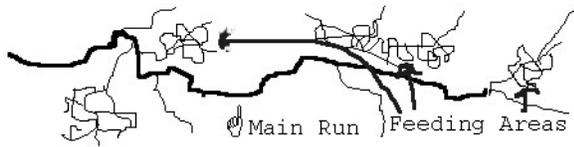


Figure 3. Bold arrows point to feeding areas.  
Image by Stephen M Vantassel.

Moles frequently are blamed for damage to gardens, although the majority of direct damage is caused by rodents using mole tunnels to gain access to plants. Mole damage, particularly to turfgrass, tends to be limited to the separation of roots from the surrounding soil, caused by tunneling.

Moles remove many damaging insects, including grubs, from lawns and gardens. However, burrowing by moles disfigures lawns and parks, destroys flowerbeds and the roots of grasses, and creates havoc in small gardens.

## Damage to Crops and Livestock

Moles do not pose a threat to crops or livestock.

## Damage to Structures

Damage to structures tends to be limited to patios made of brick or to pool areas, where digging can undermine foundations.

## Damage Prevention and Control Methods

### Habitat Modification

The use of soil insecticides often is not effective for reducing damage done by moles. They are difficult to apply correctly, and if populations of soil-borne insects are reduced, moles may increase digging in search of food, possibly increasing damage to turf or gardens. A lawn can be free of grubs and still have moles. Moles eat grubs, but also feed on worms and ants.

## Exclusion

Generally, exclusion is not practical. For small areas, such as seed beds, install a fence of 24-inch roll sheet metal or hardware cloth. Place the fence at the surface of the ground, bury it to a depth of at least a foot, and bend it to a 90° angle (Figure 4).

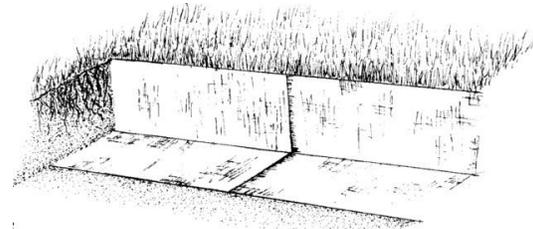


Figure 4. Fence to exclude moles. Image by Prevention and Control of Wildlife Damage (PCWD).

## Frightening Devices

Frightening devices have not been shown to be effective for repelling moles.

## Repellents

Products made with castor oil, such as MoleMed®, have shown limited effectiveness in repelling moles. The product containing castor oil must be thoroughly watered into the lawn, following the directions on the label. For best results, spray the entire area to be protected. Moles may burrow under a treatment made along a perimeter.

Gopher purge (*Euphorbia lathyris*), also known as “mole plant,” has been promoted as a mole repellent, but has not been proven to be effective. It is poisonous to people, and is a weed that may become a problem.

## Toxicants

Moles primarily feed on insects and earthworms. Consequently, grain- or nut-based toxic baits (usually containing zinc phosphide), are not likely to be eaten by moles.

Two other bait products, Kaput® and Talpirid®/Tomcat® may be more effective for the control of moles. Kaput® is a gel with warfarin

that is squirted into a run. Talpirid®/Tomcat® is formulated as a synthetic replica of a worm that contains bromethalin. It is a general use pesticide (GUP). Follow all instructions on the label. There is little research to validate the effectiveness of these toxicants. Success has been mixed based on anecdotal reports.

Aluminum phosphide and gas cartridges are fumigants that are registered for mole control in some states. Fumigants are most effective when placed in deep burrows rather than surface runways. Fumigants are ineffective where soils are porous and dry, or where there are extensive feeding tunnels near the surface. Check your state pesticide regulations, and follow all label directions.

## Shooting

Shooting is not a practical method for moles.

## Trapping

The most successful and practical method for controlling moles is trapping. Several styles of mole traps are on the market (*Figure 5*). Each type of trap is effective if used properly.

To increase effectiveness in mole trapping, survey the yard area looking for straight runs (ridges) that lead to overhead protection, such as a large tree or patio. Press down ridges in several places and mark the sites with flags. Inspect the flagged sites after 2 to 3 hours to determine which ridges have been raised and which runs are active. Set a trap on each active run. Reset traps that are successful in capturing moles.

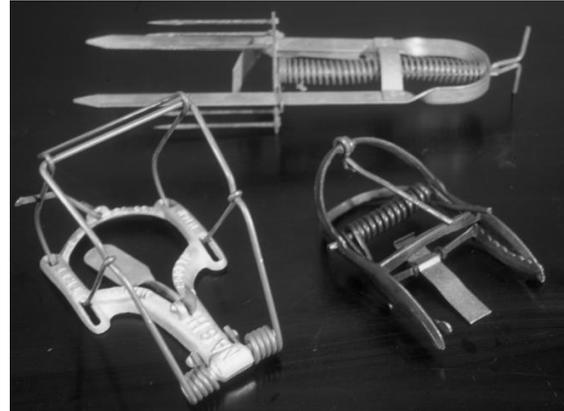


Figure 5. Traps for moles, listed in clockwise from the top: Victor® (harpoon), Out O' Sight® (scissor-jawed) and Nash® (choker loop). Photo by UNL.

## Disposition

### Relocation and Translocation

Relocation and translocation are not practical.

### Euthanasia

Use carbon dioxide to euthanize moles, if necessary.

## Web Resources

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Opossums

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

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Figure 1. Opossum (*Didelphis virginiana*) with young. Photo by Dave Schmidt.

## Objectives

1. Describe the behavior of opossums.
2. Communicate the options for damage management to clients.
3. Describe the risks that opossums pose to animal health.

## Species Overview

### Conflicts

Opossums (*Didelphis virginiana*) can damage garden produce, and may be a nuisance in garbage cans and compost piles. They are a host for a disease that can kill horses, and may carry fleas and ticks.

### Legal Status

In Nebraska, opossums are considered furbearers, with open seasons for hunting or trapping. Landowners are allowed to shoot or trap opossum outside the normal season on their own property if the animals are causing damage.

## Identification

Opossums (*Figure 1*) are the only marsupials (pouched mammals such as kangaroos and wombats) in North America. The color of their fur ranges from snow-white to jet-black. The underfur is dense with sparse guard hairs. Its tail is rat-like, hairless, and slightly less than half the total length of the opossum. The tail is moderately prehensile.

## Physical Description

Opossums are about the same size as house cats, but can grow to a length of 40 inches. Opossums may weigh up to 14 pounds, but the average weight is 4 to 12 pounds, with males generally larger than females. The face is long and pointed with a skull that is usually 3 to 4 inches long and holds 50 teeth, more than any other mammal in North America.

## Species Range

Opossums are found throughout Nebraska, especially in wooded areas associated with farmland and riparian areas.

## Health and Safety Concerns

Opossums often harbor parasites such as fleas and ticks, and are more resistant to rabies than any other mammal, although they are not completely immune.

## General Biology, Reproduction, and Behavior

### Reproduction

Opossums are solitary, except when mating or caring for young. Female opossums usually raise two litters per year. Young are born blind, hairless,

and helpless 13 days after mating. When young are born, they find their way into the female's pouch, where they each attach to one of 13 teats. About 23 young are born, but only those that attach to a teat survive. The rest quickly perish. The average litter size is seven to eight. They remain in the pouch for 7 to 8 weeks, and are not weaned until 96 to 108 days after birth. Most young die during their first year, and opossums may live 2 to 3 years in the wild.

## Nesting/Denning Cover

Opossums do not dig their own burrows, but will use burrows abandoned by other animals. Other den sites include tree cavities, brush piles, rock crevices, and abandoned squirrel nests. Opossums sometimes den under homes, in attics, and in garages where they may make messy nests.

## Behavior

Opossums are usually solitary and nomadic, with a home range of 10 to 50 acres. They have a top running speed of 4.5 miles per hour, and escape predators by entering burrows, climbing trees, or swimming. When threatened, opossums may bare their teeth, growl, hiss, bite, screech, and exude a yellow-green fluid from the anal glands that smells mildly like skunk musk. An opossum may "play dead" by rolling on its back and going limp, sometimes with the tongue hanging out of its mouth.

Opossums do not hibernate. During very cold weather, they enter dens for short periods until temperatures warm. Although primarily nocturnal, they may forage during the day, especially in cold weather.

## Habitat

Opossums live in a wide range of habitats, from arid to moist, and wooded to open fields. They prefer environments near streams or swamps. Opossums take shelter in burrows of other animals, tree cavities, brush piles, and other cover.

## Food Habits

Opossums are opportunistic omnivores. They eat animals and plants, including insects, worms, snakes, lizards, mice, rats, grasses, fruits, and vegetables. Opossums may feed at compost piles, garbage cans, or pet food dishes. They can be considered beneficial because they feed on insects, mice, and rats. They readily take carrion, and are often hit by vehicles while feeding on road-killed animals.

## Voice, Sounds, Tracks, and Signs

When frightened, opossums hiss, growl, screech, and bare their teeth, depending on the level of threat that they perceive. Males and females signal each other with a clicking sound during the breeding season.

## Damage Identification

Signs of opossum damage are often confused with those of skunks or raccoons. Often, seeing an opossum is the only way to confirm its presence.

## Damage to Landscapes

Opossums consume garden produce and tree fruits. They also may feed on food scraps in compost piles.

## Damage to Crops and Livestock

Opossums generally do not cause crop losses. They typically avoid pets and livestock. Opossums may prey on chickens, ducks, pigeons, and eggs. Opossum can carry the microorganism that causes Equine Protozoan Myeloencephalitis (EPM), which kills horses. The protozoan is shed in feces, so an opossum that is denning or feeding in stable areas may contaminate feed and water used for horses.

## Damage to Structures

Opossums may enter trailer houses and climb into insulation under the floor. They often are encountered moving about the ductwork of mobile homes. Opossums are not destructive or strong, so they typically enter areas where an opening already exists. They commonly enter

living quarters through large gaps around pipes and drains under sinks. In contrast, raccoons are powerful and often create openings.

## Damage Prevention and Control Methods

### Habitat Modification

Remove pet food, fruits, and other foods that might attract opossums. Opossums eat birdseed, so hang a bird feeder on a wire between trees, or on a baffled pole to prevent raiding. Reduce the amount of seed that falls to the ground by using one type of seed per feeder and using feeders that recapture fallen seed.

Secure lids on trash cans and enclose compost piles in bins. Place only nonfood plant materials (e.g., leaves and grass clippings) in compost piles to avoid attracting opossums, skunks, raccoons, and other scavengers.

### Exclusion

Install sunken perimeter fences around crawl spaces below decks or buildings. Cover structure openings with hardware cloth. Use electric fences or porcupine-wire to prevent climbing. Install one-way doors (6- x 6-inch) to evict opossums from buildings. Once they leave a structure, they will not be able to re-enter.

### Frightening Devices

Frightening devices are not practical for dispersing opossums. However, dogs may discourage opossums from visiting an area.

### Repellents

No repellents are registered for opossums.

### Toxicants

No toxicants are registered for opossums.

## Shooting

A .22-caliber rifle or pistol, or a shotgun with No. 6 shot in the hands of an experienced shooter, is effective for killing opossums. Local or state regulations may limit shooting in urban areas.

## Trapping

Opossums are relatively unwary and easy to trap. In suburban areas, cage traps (e.g., 10- x 12- x 32-inch single-door, or 7- x 7- x 24-inch two-door) are preferred for capturing opossums. Use cat food, fruit, or marshmallows as bait. Body-gripping traps (No. 160 or 220) and foothold traps (No. 1 or 1½ padded jaw trap) also can be used to capture an opossum in rural areas where pets are not at risk.

## Other Methods

Opossums are easy to corner in enclosed areas and can be captured with catch poles, cat-graspers, or hand nets. Do not grab an opossum by the tail. Wear gloves to hand-capture an opossum; grasp the back of the neck and use the other hand to support the back. Opossums usually will relax when restrained. Trained dogs can be used to locate opossums (*Figure 2*).



Figure 2. Dogs may help locate opossums. Photo by Dave Schmidt.

## Disposition

### Relocation

Relocation of opossums is appropriate for rescues. Release the opossum into cover away from roads and structures.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so opossums can only be relocated outside of structures.

## Euthanasia

Carbon dioxide gas is the most appropriate technique to euthanize opossums. Opossums also can be humanely killed with a gunshot or blow to the head, if legal and safe in your area.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Rabbits

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Figure 1. Eastern cotton-tailed rabbit (*Sylvilagus floridanus*). Photo by Dallas Virchow.

## Objectives

1. Explain how the rabbit biology impacts their management.
2. Communicate to clients the options for damage management.
3. Describe the health risks posed by rabbits.

## Species Overview

### Conflicts

Eastern cotton-tailed rabbits (*Sylvilagus floridanus*) damage trees, shrubs, and other ornamentals in backyards by clipping twigs and girdling bark. They frequently feed on garden vegetables and plants in flower beds. Occasionally they carry tularemia, a severe infectious disease.

### Legal Status

Cotton-tailed rabbits are classified as game animals and are protected in Nebraska. Landowners are allowed to trap or shoot rabbits outside the normal seasons on their own property if the animals are causing damage. Check with the Nebraska Game and Parks Commission (NGPC)

and local authorities for options in dealing with cottontails.

## Identification

The eastern cotton-tailed rabbit (*Figure 1*) is one of three species of rabbits and hares that occur in Nebraska. This module will focus on the eastern cottontail, as it is by far the most common and is involved in most conflicts with humans.

## Physical Description

The eastern cotton-tailed rabbit appears gray or gray-brown with a characteristic rusty brown spot on the nape of the neck. They have large ears and their hind feet are much larger than the forefeet. The tail is short and white on the undersurface, similar to a cotton ball. Eastern cottontails are 15 to 19 inches long and weigh 2 to 4 pounds.

## Species Range

Eastern cotton-tailed rabbits are found throughout most of Nebraska. Their numbers typically are higher in the east than in the west.

## Health and Safety Concerns

Tularemia, or “rabbit fever,” is the most notable disease associated with cottontails. It is caused by bacteria and can be transmitted to humans through the bite of a rabbit, tick, or flea; or by handling the carcass of an infected animal. Avoid direct contact with rabbits that are dead, emaciated, or exhibit abnormal behavior such as lethargy, incoordination, and lameness. Wear latex or vinyl gloves when handling and butchering rabbits. Immediately discard rabbits having livers speckled with small, white spots. In case of illness, inform medical personnel of contact with rabbits. The symptoms of tularemia are similar to those for the flu.

## General Biology, Reproduction, and Behavior

### Reproduction

Rabbits generally live 12 to 15 months, and only 1 in 100 lives 3 years. Typically, a female produces two to three litters annually, with five to six young per litter in Nebraska. Their first litters are born in March or April. Gestation is 28 or 29 days, and females usually breed again within a few hours after giving birth. Young cottontails are born nearly hairless with their eyes closed. Their eyes open in 7 to 8 days. Young leave the nest in 2 to 3 weeks, and reach sexual maturity in less than 6 months. In good conditions, a pair of cottontails can produce about 18 young during the breeding season. Weather, disease, predators, encounters with cars and hunters, and other mortality factors combine to control rabbit populations.

### Nesting/Denning Cover

Cottontails do not dig burrows, but rather use natural cavities or burrows excavated by other animals. Piles of brush and other cover often are used as alternatives to burrows.

In spring and fall, rabbits use a small cavity on the surface of the ground called a "form" (*Figure 2*) to rear their young. The form provides the rabbits some protection from weather but is largely used for concealment.



Figure 2. A rabbit form is a small depression in which rabbits repeatedly lay. Photo by Jan R. Hygnstrom.

### Behavior

Cottontails are most active at dusk, dawn, and during the night. Most of their time is focused on eating, reproducing, and avoiding predators. When startled, they often freeze to avoid detection. Once observed, they can run very quickly in a zig-zag pattern.

Cottontails generally spend their entire lives in an area of 10 acres or less, but may move a mile or so from summer to winter range, or to a new food supply. In suburban areas, rabbits are numerous and mobile enough to fill any open habitat that is created when other rabbits are removed. Population density varies with habitat quality, but one rabbit per acre is common.

### Habitat

Cottontails frequent brushy fencerows, edges of fields, gullies filled with debris, brush piles, and backyards with extensive landscaping. They rarely are found in dense forests or open grasslands. Fallow crop fields may provide suitable habitat.

### Food Habits

Rabbits eat flowers (e.g., tulips) and vegetables (e.g., peas, beans, and beets) in spring and summer. In fall and winter, they clip twigs and gnaw bark (*Figure 3*) from trees and shrubs, particularly when snow is deep. Rabbits can reach 20 inches above ground or crusty snow.

Cottontails seem to prefer plants in the rose family. Apple trees, black and red raspberries, and blackberries are the most frequently browsed, fruit-bearing woody plants, although cherry, plum, and nut trees also may be browsed. Rabbits take a variety of ornamental trees and shrubs, especially *Euonymus*, dogwood, and roses.



Figure 3. Unprotected trees can be severely girdled by rabbits. Photo by Stephen M. Vantassel.

## Voice, Sounds, Tracks, and Signs

Rabbits generally are silent, but can emit high-pitched squeals when in distress.

Tracks of rabbits typically are found in snow or fine soil (Figure 4) and have a 1-1-2 pattern (Figure 5). Droppings of rabbits often are easy to identify as bunches of round, dry balls (Figure 6). Deer pellets are often, softer, darker, and more oblong in shape.

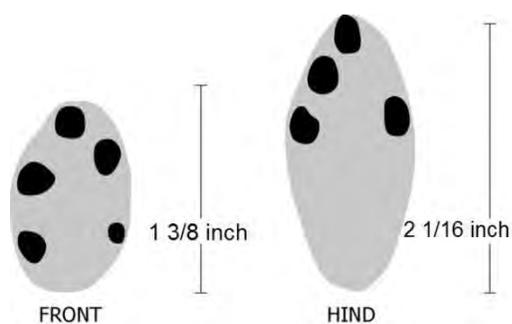


Figure 4. Tracks of an eastern cottontail rabbit. Image by Dee Ebbeka.



Figure 5. Tracks of an eastern cottontail rabbit in snow. Photo by Stephen M. Vantassel.



Figure 6. Droppings of rabbits in winter tend to be filled with remnants of fibrous plant material. Photo by Stephen M. Vantassel.

## Damage Identification

### Damage to Landscapes

Rabbits damage woody plants by gnawing bark or clipping off branches, stems, and buds. Young plants are clipped off up to 20 inches above the height of the snow, and large trees and shrubs may be completely girdled.

Among shade and ornamental trees, the species most often damaged by rabbits include mountain ash, basswood, red maple, sugar maple, apple, cherry, red and white oak, and willow. Sumac, rose, and dogwood shrubs are often damaged by cottontails. Young trees may be clipped, and older trees may be girdled and killed. When the ground is covered with snow for long periods,

rabbits may severely damage expensive plants in home landscapes, orchards, forest plantations, and nurseries.

Rabbits damage a wide variety of flowers. The most commonly damaged are tulips, especially the first shoots that appear in early spring. Rabbits eat peas, beans, beets, and other garden plants, often pruning them to ground level.

## Damage to Crops and Livestock

Rabbits generally are not a threat to crops or other animals. They may carry diseases and parasites that can infect pets if they come into proximity with one another.

## Damage to Structures

Rabbits rarely damage structures. If damage occurs, it usually is from gnawing on the edges of wood siding and trim.

## Damage Prevention and Control Methods

### Habitat Modification

Remove brush piles, woodpiles, debris, and other cover. Rabbits almost never are found far from protective escape cover.

Use plants in the landscape that rabbits do not prefer. For example, plant daffodil bulbs rather than tulips.

### Exclusion

Rabbits usually do not climb. Fences 24 inches high, with bases secured to the ground, will protect gardens, flowerbeds, and shrubs. Mesh must be small enough so that young rabbits cannot crawl through. Use cylinders made from hardware cloth to protect fruit trees and ornamental plants. Cylinders should be 20 inches higher than anticipated snow depths.

## Frightening Devices

No frightening devices are reliable for discouraging rabbits.

## Repellents

Most rabbit repellents are not registered for use on food crops. Repellents may work through either taste or odor. Effectiveness often depends on the feeding motivation of rabbits, and the availability of alternative foods.

Taste-based repellents make the plant less palatable, and typically are applied directly to the plant. Capsaicin extract from hot peppers found in Deer Off™, Get Away™, and Scoot™ may reduce feeding, but it tends to be short-lived.

Reapplication may be needed after rain, irrigation by sprinklers, or when new growth occurs.

Odor-based repellents keep rabbits from an area through fear or a foul smell. A wide variety of active ingredients are used, including ammonium soaps (Hinder™), putrescent eggs (DeFence® and Liquid Fence®), thiram (Spotrete™), predator urine (Shake-Away™), or garlic (Sweeny's® Deer & Rabbit Repellent). They typically are applied to the soil perimeter around bedding plants, and on foliage to repel rabbits. Effectiveness is quite variable, and there is little recent research with rabbits to provide reliable recommendations.

## Toxicants

No toxicants are registered for the control of rabbits.

## Shooting

Sport hunting and shooting with a .22-caliber rifle or shotgun with No. 6 shot may help to reduce populations of rabbits in a local area. Check NGPC and local regulations regarding the use of firearms, especially in urban and suburban areas.

## Trapping

Cage and box traps may be used to capture rabbits causing damage, and are more effective in winter when food is scarce. Use apple slices as bait. Always check with state and local authorities before attempting to trap rabbits. Rabbits are protected game animals, and permits may be required.

## Disposition

### Relocation

Relocation of rabbits is appropriate for rescues. Release the rabbit into cover away from roads and structures.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so rabbits can only be relocated outside of structures.

### Euthanasia

Carbon dioxide is the best method for euthanizing rabbits. They also can be humanely killed with a gunshot to the head, if legal and safe at your location.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Raccoons

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.

Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Raccoon (*Procyon lotor*).  
Photo by Greg Clements.

## Objectives

1. Demonstrate the ability to educate clients about management options for raccoon damage.
2. Identify three aspects of behavior that make raccoons difficult to deal with.
3. Identify the risks involved in working with raccoons.

## Species Overview

### Conflicts

Raccoons (*Procyon lotor*) cause considerable damage to several crops, especially sweet corn and sweet cherries. They can cause significant damage to turf while foraging for soil-borne insects. They kill poultry and take eggs. Raccoons can damage structures when seeking access for denning in attics or chimneys. They carry rabies, and spread raccoon roundworm and other diseases.

## Legal Status

Raccoons (*Figure 1*) are protected furbearers in Nebraska, with seasons established for running dogs, hunting, and trapping. Landowners in Nebraska can protect their own property without permits if raccoons are causing damage.

## Identification

Raccoons are native to Nebraska, and are common inhabitants of both rural and urban areas. Raccoons have a prominent black “mask” over their eyes, and a heavily furred, ringed tail.

## Physical Description

Their color is grizzled salt-and-pepper gray and black above, although some individuals are strongly washed with yellow. Raccoons are stocky mammals about 2 to 3 feet long and typically weigh 10 to 30 pounds.

## Species Range

Raccoons are found throughout Nebraska and are common in woodlands, suburban, and agricultural areas.

## Health and Safety Concerns

The number of reported cases of rabies in raccoons and other wildlife has increased dramatically over the past 30 years. While raccoons are the primary vector species for rabies in the northeastern US, skunks are the major vector in Nebraska.

Raccoon roundworm (*Baylisascaris procyonis*) can cause blindness, brain damage, and death. Raccoons are not the only carrier of this disease, but they are the definitive host. Avoid disturbing raccoon feces, and soil or other items contaminated by feces.

## General Biology, Reproduction, and Behavior

### Reproduction

Raccoons mainly breed in February or March. Gestation lasts about 63 days. Most litters are born in April or May. Average litter size is three to five young. Young first open their eyes at about 3 weeks, and are weaned between 2 and 4 months of age.

Family groups of raccoons usually remain together for the first year with young often denning with the adult female during winter. Raccoons may live up to 12 years in the wild, but such longevity is extremely rare.

### Nesting/Denning Cover

Den sites typically include hollow trees, ground burrows, brush piles, muskrat houses, barns and abandoned buildings, dense clumps of cattails, haystacks, rock crevices, sewers, under sheds and porches, in chimneys, and attics.

### Behavior

Raccoons are nocturnal. Adult males occupy territories of 3 to 20 square miles, compared to 1 to 6 square miles for females. Adult males tend to be territorial and their ranges overlap very little. Raccoons do not truly hibernate, but they “hole up” in dens and become inactive during severe winter weather.

### Habitat

Raccoons prefer hardwood forests near water. They also live around farmsteads and livestock watering areas, far from naturally occurring bodies of permanent water. They frequently are found in wooded parks, where they may find subsidized food sources in dumpsters.

### Food Habits

Raccoons are omnivorous, eating both plants and animals. Plant foods include fruits, berries, nuts, acorns, corn, and other types of grain. Animal foods include crayfish, clams, fish, frogs, snails, insects, turtles and their eggs, mice, rabbits, muskrats, and the eggs and young of ground-nesting birds and waterfowl. They will readily take garbage and other food wastes.

### Voice, Sounds, Tracks, and Signs

Raccoons emit several sounds including chirps, coos, chatter, distress calls, purrs, and complaints.

Raccoons usually leave plenty of signs of their presence. Tracks are very distinctive (*Figure 2*).

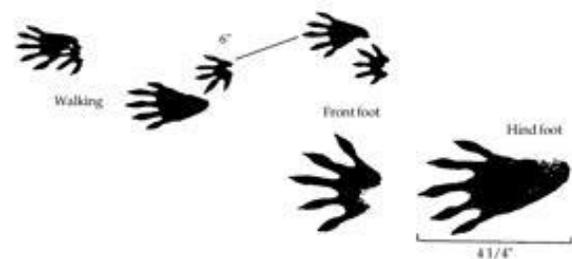


Figure 2. Five long rear toes and “hand-like” front prints are characteristic of raccoon tracks. Image by Prevention and Control of Wildlife Damage (PCWD).

Latrines, where raccoons regularly defecate (*Figure 3*), tend to be in areas open to the sky such as roofs, sand boxes, and fallen trees.



Figure 3. Latrine of a raccoon.  
Photo by Stephen M. Vantassel.

## Damage Identification

Raccoons may cause damage or nuisance problems in a variety of ways. Raccoons are superb climbers. They frequently enter buildings by climbing trees or downspouts, or by shimmying up the side of a building. Look for smudge or scratch marks on trees or at the corners of buildings (Figure 4). Latrines on roofs and in attics are classic signs of raccoons.

## Damage to Landscapes

Raccoons roll up sod in search of earthworms and grubs. This may occur in early summer when soils are damp and worms are near the surface, or during droughts in late summer.

## Damage to Crops and Livestock

Raccoons can cause considerable damage to garden or truck crops, particularly sweet corn. Damage to sweet corn is characterized by partially eaten ears with the husks pulled back. Raccoons also break stalks as they climb to get to the ears. A raccoon damages watermelons by digging a small hole in the melon and raking out the contents with a front paw.

Raccoons often attack and kill poultry inside coops after tearing their way through doors or light woven wire. Dead birds often are mangled, with

many feathers bitten through. Eggs will be broken and chewed thoroughly.

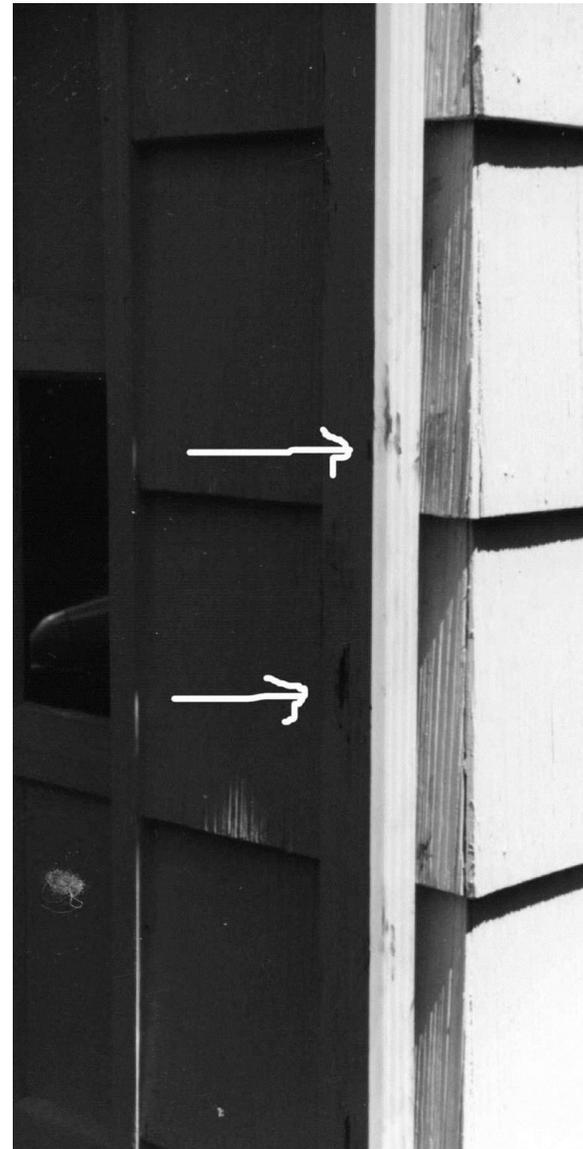


Figure 4. Arrows point to smudges indicative of climbing by raccoons. Photo by Stephen M. Vantassel.

## Damage to Structures

Raccoons cause problems around houses and outbuildings when they try to enter attics or chimneys. Raccoons learn that uncapped chimneys are good substitutes for traditional hollow trees used for denning sites. In extreme cases, raccoons may tear off shingles or fascia boards to gain access to an attic or wall space.

Raccoons need only a 4-inch gap to enter a space (Figure 5).



Figure 5. A raccoon entered this attic through the vent. Photo by Stephen M. Vantassel.

Raccoons often raid garbage cans and dumpsters in search of food. They also will take food scraps from compost piles, or consume pet food from dishes left out overnight.

## Damage Prevention and Control Methods

### Habitat Modification

Protect property by removing as many potential sources of food as possible. Place only plant matter (e.g., leaves and grass clippings) in compost piles to avoid attracting raccoons, opossums, skunks, and other scavengers. Avoid leaving food and water out overnight for pets. Put free-ranging poultry in fenced, predator-proof coops overnight. Avoid planting sweet corn patches near creek bottoms or other wooded areas.

Hang bird feeders on wire between trees, or on baffled poles to prevent raiding. Reduce the amount of seed that falls to the ground by using a single type of seed per feeder and using feeders that recapture fallen seed.

When raccoons are rolling up freshly laid sod to find grubs, pin the strips of sod down with long

wire pins, wooden stakes, or nylon netting to allow the grass to take root. Application of insecticides to control grubs is effective only if done before damage by raccoons begins.

### Exclusion

Exclusion usually is the best method for managing damage by raccoons. Damage to sweet corn or watermelons can be stopped almost immediately by excluding raccoons with an electric fence (Figure 6). Use electric fences with care and install appropriate caution signs to warn people.



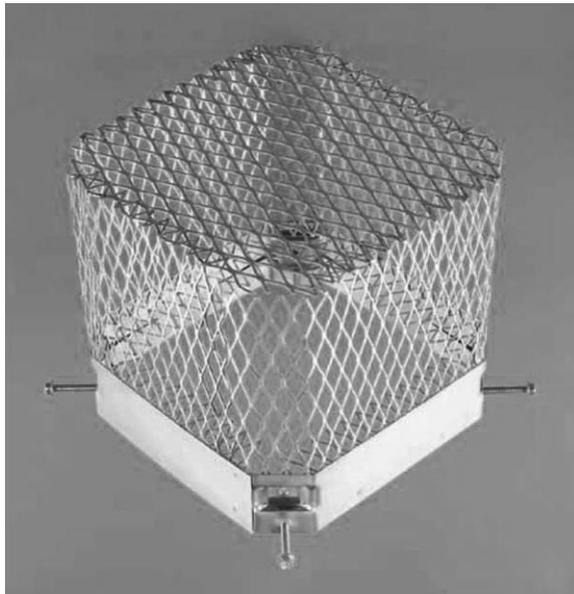
Figure 6. Electric fences, where legal, are effective in protecting property from damage by raccoons. Image by PCWD.

Prevent damage to poultry by excluding raccoons with tightly covered doors and windows on buildings, or heavy wire-mesh fences with an overhang surrounding poultry yards. Raccoons are excellent climbers and can gain access by climbing conventional fences. Use a fence charger to electrify a wire placed at the top of a fence to increase effectiveness.

Clients should store garbage in metal or plastic containers with tight-fitting lids. If a lid does not fit tightly, wire, weight, or clamp it down. Secure trash cans to a rack above ground, or tie them to a post. If possible, store trash cans in a secure building.

Limit access to rooftops by removing overhanging branches. Wrap sheet metal (at least 3 feet

square) around building corners to prevent a raccoon from getting a toehold for climbing. Prevent access to chimneys by securely fastening a commercial stainless steel chimney cap over the top of the chimney (*Figure 7*). Raccoons may pull off caps held by spring clips, so use a cap that screws against the flue.



**Figure 7.** A cap will keep raccoons and other animals out of a chimney. Photo by Hy-C Co., Inc.

Homeowners who attempt to exclude or remove raccoons in the spring and summer should be aware that young also may be present. Do not complete exclusion procedures until you are certain that all raccoons have been removed from the area. Contact a Wildlife Control Operator (WCO) for assistance.

## Frightening Devices

Frightening devices such as lights, radios, dogs, scarecrows, and pie pans may discourage raccoons temporarily, but none will provide adequate longterm protection in most situations.

## Repellents

Ro-Pel® is a contact/taste repellent that is applied directly to surfaces to keep chewing animals, including raccoons, from causing damage. Do not

apply Ro-Pel® to edible plants or crops that bear fruit because it will impart a bitter taste.

## Toxicants

No toxicants are registered for the control of raccoons.

## Shooting

Healthy raccoons are seldom seen during the day because of their nocturnal habits. Raccoons can be shot at night with proper lighting, and trained dogs can be used to tree the raccoons. A .22-caliber rifle will effectively kill a treed raccoon if shot placement is restricted to the head. Otherwise, use a shotgun with No.6 shot. Shooting is prohibited in most towns and cities. Check with Nebraska Game and Parks Commission (NGPC) and local authorities before using any lethal control methods for raccoons.

## Trapping

Raccoons are relatively easy to catch in traps, but it takes a sturdy trap to hold a raccoon. For homeowners with pets, and in urban areas, cage and box traps (*Figure 8*) usually are preferable to foothold traps.



**Figure 8.** A cage trap with a captured raccoon. Photo by Stephen M. Vantassel.

Cage and box traps for raccoons should be at least 10 x 12 x 32 inches and constructed with sturdy materials. Bait traps with sweet items to reduce nontarget captures. Commercial sweet pastes are good, along with sweet fruits (e.g., cherries or

grapes), marshmallows, or jelly spread on a coffee filter.

Place a pile of bait behind the treadle and scatter a few small bits of bait outside the opening of the trap and just inside the entrance. The back portion of the trap should be tightly screened with ½-inch or smaller mesh wire to prevent raccoons from reaching through the wire to pull out the bait.

Pay special attention to the 12-inch area around the trap. A cage-trapped raccoon will reach for anything it can and pull it into the trap, including shingles, grass, dirt, siding, and garden hose. Cage traps with ½- x 1-inch mesh, particularly in the lower portions of the trap, help reduce the risk of this problem. Secure traps to solid objects. Trapped raccoons have been known to move and flip traps over.

### *Direct Capture*

Sometimes a raccoon is sick, or in a location where immediate removal is required. Raccoons present special challenges due to their mobility and ability to climb. Required equipment includes gloves, a catch pole, cat grasper, hand net, and a raccoon-sized cage or box trap. If you are unsure of what to do, contact a WCO for assistance

## Disposition

### Relocation

Relocation of raccoons is appropriate for rescues. Release the raccoon into cover away from roads and structures. Typically, raccoons will climb a nearby tree or scurry to cover. Keep children and pets away. Raccoons may reinvade the home or a nearby residence.

## Translocation

Translocation puts considerable stress on both transported and resident raccoons. In addition, there is concern about the potential for transmitting diseases. In Nebraska, animals cannot be moved over 100 yards, so raccoons can only be relocated outside of structures.

## Euthanasia

Carbon dioxide is the preferred method of euthanasia for raccoons. Adult raccoons die relatively quickly, but juvenile raccoons may last 30 minutes or more, particularly when placed in a chamber with less than 100% carbon dioxide. A gunshot to the head is a safe and humane way to euthanize raccoons in a rural area. However, don't shoot a raccoon in the head if rabies testing is required.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Norway Rats

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)  
Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.  
Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Norway rat (*Rattus norvegicus*). Photo by US Department of Health and Human Services-Public Health Service.

## Objectives

1. Identify damage caused by Norway rats.
2. Be able to explain management options to a client.
3. Identify risks of working with Norway rats.

## Species Overview

### Conflicts

Norway rats (*Rattus norvegicus*) consume and contaminate food for people and livestock, prey on eggs and small animals, damage structures by their burrowing and gnawing, and spread diseases.

### Legal Status

Norway rats are exotic invasive species and are not protected by federal or state laws. Most communities have sanitation regulations that are designed to reduce populations of Norway rats and other urban pests.

## Identification

Norway rats (*Figure 1*) are burrowing rodents that were introduced to North America from Europe. They also are called brown rats, house rats, barn rats, sewer rats, gray rats, and wharf rats. Norway rats often live in close association with humans and therefore are called “commensal” (table-sharing) rodents.

## Physical Description

The fur of a Norway rat is coarse and usually brown or red-gray above and white-gray on the belly. The naked scaly tail is not as long as the body. Adult Norway rats weigh 12 to 16 ounces. Their paired incisor teeth grow continuously at the rate of about 5 inches per year. They keep their teeth worn down by gnawing on hard surfaces.

## Species Range

Norway rats have spread throughout much of the continental states, Alaska, and Hawaii. They thrive in human-altered environments in Nebraska, especially on livestock farms and in urban areas.

## Health and Safety Concerns

Norway rats transmit diseases such as murine typhus, leptospirosis, trichinosis, salmonellosis, and rat bite fever to humans and livestock. Plague is more commonly associated with roof rats than with Norway rats. When overabundant, Norway rats may bite infants and adults who are unable to defend themselves.

## General Biology, Reproduction, and Behavior

### Reproduction

Females produce three to six litters of 6 to 12 young per year. Newborn rats are hairless and their eyes are closed, but they grow rapidly. They eat solid food at 3 weeks, become independent at 3 to 4 weeks, and reach sexual maturity at 3 months of age.

### Nesting/Denning Cover

Norway rats usually construct nests in burrows belowground or at ground level (*Figure 2*). Nests may be lined with shredded paper, cloth, or other fibrous material. Each female has her own nest chamber, but Norway rats may share a burrow and raise their young together. In northern climates, rats prefer to locate nests near sources of heat.

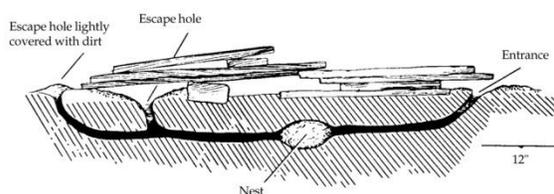


Figure 2. Diagram of a den of a Norway rat. Image by the Prevention and Control of Wildlife Damage (PCWD).

### Behavior

Norway rats are nocturnal. They usually become active around dusk, when seeking food and water. Some individuals may be active during the day when populations of rats are high.

Norway rats have poor eyesight and are considered color-blind. They rely on their excellent senses of hearing, smell, taste, and touch to locate food and recognize other rats. They can detect contaminants in food at 0.5 parts per million.

Norway rats gain entry to structures by gnawing, climbing, jumping, and swimming. A rat travels an area about 100 to 150 feet in diameter daily. Rats seldom travel more than 400 feet from their

burrows for food or water. Rats explore and learn about their domain, memorizing the locations of pathways, obstacles, food, water, and shelter. They quickly detect and tend to avoid new objects in their environment. Objects such as traps, baits, and bait stations often are avoided for several days.

### Habitat

Norway rats live in close association with humans. In urban and suburban areas, they live in and around residences, cellars, warehouses, stores, docks, and sewers. On farms they may inhabit barns, granaries, livestock buildings, silos, and kennels. They may burrow to make nests under buildings and other structures, beneath slabs of concrete, along banks of streams, around ponds, in dumps, and at other locations where suitable food, water, and shelter are present.

### Food Habits

A single Norway rat needs about 110 calories per day. Rats will eat nearly any type of food, but when given a choice, they select a nutritionally balanced diet and fresh items over stale or contaminated foods. They prefer grains, meat, fish, nuts, fruit, and insects such as cockroaches. Rats require  $\frac{1}{2}$  to 1 ounce of water per day when feeding on dry foods, but need less when moist foods are available. Food that is discarded in household garbage offers a well-balanced diet and satisfies the moisture needs of Norway rats.

### Voice, Sounds, Tracks, and Signs

Norway rats emit a variety of high-pitched squeaks. Noises from fighting, gnawing, and climbing also may be heard.

**Tracks**, including footprints and tail marks, may be seen on dusty surfaces or in mud (*Figure 3*). A tracking patch made of flour can be placed in pathways prior to nightfall to determine if rodents are present.

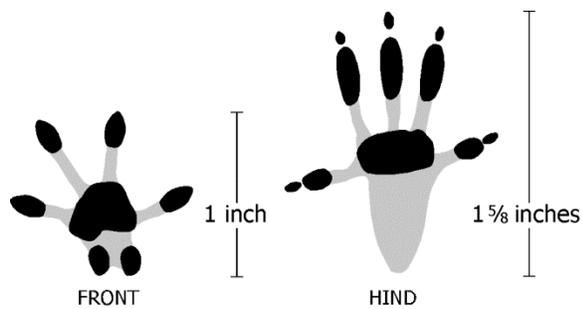


Figure 3. Tracks of the Norway rat. Image by Dee Ebbeka.

**Droppings** (Figure 4) may be found along runways, in feeding areas, and near shelters. Scat may be up to  $\frac{3}{4}$  inch long and  $\frac{1}{4}$  inch in diameter with blunt ends. Rats deposit about 40 to 50 droppings per day, which usually are clumped in small groups. Other rodents tend to disperse their scat. Fresh droppings have a soft texture.



Figure 4. Scat of Norway rats in corn. Photo by Kurt VerCauteren.

**Runs or burrows** may be found next to walls and buildings, along fences, and under bushes and debris. Active holes are 2 to 3 inches wide and clean of debris (Figure 5) and have rat hairs present around the entrance. Rats habitually use the same routes.



Figure 5. Entrance hole to a den of a Norway rat. Photo by Stephen M. Vantassel.

## Damage Identification

### Damage to Landscapes

Burrows of Norway rats can undermine slopes and pavement. Their trails can damage turf and are unsightly.

### Damage to Crops and Livestock

Norway rats may damage field crops prior to, during, and after harvest. Consumption and contamination of grain and livestock feed is a primary concern. Norway rats occasionally prey on chickens, ducks, racing pigeons, and their eggs.

### Damage to Structures

Rats cause damage to buildings by burrowing and gnawing. They undermine foundations, cause settling in roads and railroads, and damage the banks of canals and levees. Rats gnaw on electrical wires and water pipes. They gnaw through doors, windows, walls, ceilings, and floors. Activity from burrowing and nesting in walls and attics may cause considerable damage to insulated structures.

## Damage Prevention and Control Methods

Populations of Norway rats can build quickly, so they should be controlled as soon as they are noticed. Use an integrated approach that includes sanitation, rodent-proof construction, toxicants, trapping, and monitoring.

### Habitat Modification

Poor sanitation (*Figure 6*) contributes to moderate to high populations of Norway rats in urban and suburban areas. Populations of rats can be controlled by removing sources of food, water, and shelter. Sanitation will not eliminate Norway rats but will prevent their populations from flourishing.



**Figure 6.** Cluttered landscapes provides ideal habitat for Norway rats. Photo by University of Nebraska–Lincoln (UNL).

Sanitation includes proper storage and handling of food, feed, and garbage. Warehouses, granaries, mills for grain, silos, ports, and similar structures often provide excellent habitat for Norway rats.

Stack food and feed that are in sacks or boxes in rows on pallets in a way that allows thorough inspection for evidence of rats. Keep stored materials away from walls. A 12-inch, white band painted on the floor adjacent to the wall will aid in detecting droppings and other signs of rodents. Sweep floors frequently to permit detection of

fresh signs. Pet food often is eaten by Norway rats in and around homes. Provide only enough food and water necessary to satisfy pets in a single feeding.

Collect refuse regularly, before storage containers are filled to excess. Remove debris, stacked lumber, firewood, and other materials from around structures. Place a strip of gravel adjacent to building foundations to reduce burrowing by rats. Gravel should be at least 1 inch in diameter and laid in a band at least 2 feet wide and 6 inches deep. Mow grass to allow easier detection of rodents.

### Exclusion

Physical barriers can prevent Norway rats from gaining entry to structures. “Rat-proofing” is an important and often neglected aspect of the control of rats. Seal all holes and openings larger than ½ inch in diameter.

Rodent-proofing should be done with heavy materials that resist gnawing, including concrete mortar, 24-gauge galvanized sheet metal, and 18-gauge hardware cloth.

Store pet food and bulk foods in rodent-proof containers. A proper container is made of metal, heavy-duty, and equipped with a tight-fitting lid.

Use rodent-proof metal containers to store refuse at residences, apartment buildings, businesses, and housing projects (*Figure 7*). Large, metal containers (dumpsters) for refuse sometimes have holes for drainage that can allow access by rodents. Fit these holes with ¼-inch wire mesh or removable plugs.

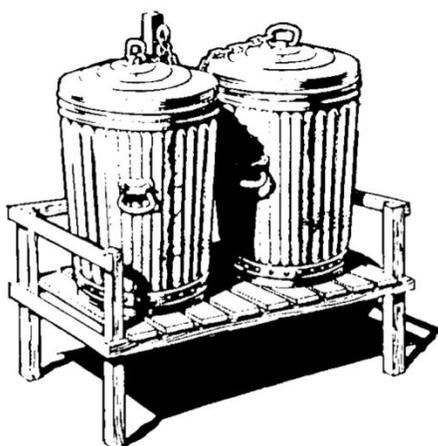


Figure 7. Galvanized garbage cans on an elevated platform. Image by PCWD.

## Frightening Devices

None have been found to be effective, including ultrasonic devices.

## Repellents

Chemical repellents seldom are practical. Ro-Pel® is registered for use in repelling Norway rats from gnawing on trees, poles, fences, shrubs, garbage, and other objects. Little information currently is available on its effectiveness against Norway rats.

## Toxicants

Nebraska requires having a commercial pesticide applicator license before applying rodenticides as a business service in most instances. General use pesticides (GUPs) are toxicants that homeowners can purchase over-the-counter without a license for use on their own property. Always read the label on the pesticide container and check reputable sites on the Internet for the most recent regulations. Rodenticides are classified as anticoagulants and non-anticoagulants.

**Anticoagulant** rodenticides inhibit the clotting of blood and impair capillary action, leading to death in Norway rats within 5 to 21 days. Anticoagulant rodenticides are slow-acting, so subsequent illness is not associated with the bait, even if a sub-lethal dose is consumed. Bait shyness usually does not

occur and prebaiting is not needed with anticoagulant rodenticides. First-generation anticoagulants (*Table 1*) usually are less toxic and require more feedings to produce death than second generation anticoagulants (*Table 2*).

**Table 1. First-generation anticoagulant rodenticides (multi-feed) that are general use pesticides (GUPs) for controlling Norway rats.**

Common Name	Percent Active Ingredient
Chlorophacinone	0.005 (baits) 0.2 (tracking powder)
Diphacinone	0.005 (baits) 0.2 (tracking powder)
Warfarin	0.025 (baits)

**Table 2. Second-generation anticoagulant rodenticides (single feed) that are restricted use pesticides (RUPs) for controlling Norway rats.**

Common Name	Percent Active Ingredient
Brodifacoum	0.0025 to 0.005 (baits)
Bromadiolone	0.005 (baits)
Difenacoum	0.005 (baits)
Difethialone	0.0025 (baits)

Directions on the label commonly instruct the user to “maintain a continuous supply of bait for 15 days or until feeding ceases,” thus ensuring the entire population has ample opportunity to eat lethal doses of the bait. In general, the hazard of secondary poisoning from anticoagulants is relatively low. Fortunately, vitamin K is an antidote for all anticoagulant intoxication.

Occasionally, Norway rats will accept bait well, resulting in an initial reduction of the population. Acceptance of bait may drop, however, even though some rats remain. In such instances, the remaining rats probably never accepted the bait, either because of its formulation or placement. The best strategy is to switch to different formulations, place baits at different locations, and use other methods of control such as trapping. Always follow directions on the label.

**Non-Anticoagulant Rodenticides** - Three non-anticoagulant rodenticides are registered for use against Norway rats (*Table 3*). They are useful in providing a quick reduction in a population. In general they are more toxic and hazardous to use than anticoagulants. No antidotes are available.

**Table 3. Non-anticoagulant rodenticides that are restricted use pesticides (RUPs) for controlling Norway rats.**

Common Name	Percent Active Ingredient
Bromethalin	0.01 (baits)
Cholecalciferol	0.075 (baits)
Zinc phosphide	2.0 (baits) 10.0 (tracking powder)

Bromethalin and cholecalciferol are formulated to serve as chronic rodenticides. They are applied so that rats have the opportunity to feed on the baits one or more times over 1 to 7 days. Acceptance of bait generally is good with proper formulations. Rodents typically stop feeding once a lethal dose has been ingested.

Zinc phosphide differs from the other rodenticides in that prebaiting is recommended to increase acceptance of bait. Bait shyness occurs when bait produces an ill effect, but not death, within a few hours of consumption. Intoxicated animals often associate the bait with the illness, and thereafter avoid it. Pre-baiting will reduce sub-lethal doses and thus bait-shyness. Always follow the directions on the label.

### Bait Selection and Formulation

Norway rats rely mostly on their senses of hearing, smell, taste, and touch. Since they are color-blind, bait can be dyed distinctive colors without causing avoidance. A wide selection of ready-to-use baits is commercially available. Monitor consumption of baits to determine preferences.

Ready-to-use baits come in a variety of formulations including loose grain, pelleted, paste, blocks, and liquid. Grain baits and pelleted baits can be carried more easily by Norway rats to

other locations. Rats occasionally hoard food, which may result in bait being moved to places where it is undetected, difficult to recover, or hazardous to nontarget species. Conversely, wax and extruded blocks can be secured within bait stations, preventing Norway rats from moving the bait. In addition, wax and extruded baits are resistant to spoilage in moist areas, such as basements.

### Bait Stations

As part of the US Environmental Protection Agency's (EPA) new risk mitigation for rodenticides, all rodenticide bait products marketed to residential consumers must be sold with and used in protective, tamper-resistant bait stations. Bait stations (bait boxes) increase both the effectiveness and safety of rodenticides. Bait stations are useful because they:

1. protect bait from moisture and dust,
2. provide a protected place for rodents to feed,
3. keep nontarget animals and children away from hazardous bait,
4. allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to nontargets, and
5. prevent accidental spilling of bait.

**Types of Bait Stations** - Use rat-sized bait boxes made of plastic, card-board, or metal (*Figure 8*).



Figure 8. Tamper-resistant bait stations for rodent control. Photo by Stephen M. Vantassel.

The EPA uses the following system to distinguish bait stations. Choose the type of bait station appropriate for your situation (*Table 4*). Follow the manufacturer's instructions for securing bait stations.

**Table 4. Rodenticide bait stations and levels of tamper- and weather-resistance.**

Bait station capabilities	Tier 1	Tier 2	Tier 3	Tier 4
Resistant to children	Yes	Yes	Yes	No
Resistant to dogs	Yes	Yes	No	No
Resistant to outdoor weather	Yes	No	No	No
Resistant to indoor conditions	Yes	Yes	Yes	Yes

**Bait Station Maintenance** - Provide enough fresh bait to allow rats to eat all they want. When bait boxes initially are deployed, check them daily and add fresh bait as needed. After 7 to 10 days, the number of rats and feeding will decline, and you only will need to check the boxes every 2 to 4 weeks. If the bait becomes moldy, soiled, or

infested with insects, empty the box, clean it, and refill it with fresh bait. Follow all directions on the label of the product you are using.

Use caution when cleaning stations heavily contaminated with droppings of rodents as they may contain dangerous pathogens. We recommend wearing a respirator (preferably full-face mask), gloves, and coveralls when cleaning contaminated bait stations.

**Placement of Bait Stations** - Norway rats typically occupy an area that is 100 to 150 feet in diameter. Place bait stations where rats are active, between the shelter and food supply. Put bait boxes near burrows, against walls, and along travel routes. Never place bait stations where children or nontarget animals can knock them over. Spilled bait may become a hazard, particularly to small animals. Permanent bait stations can be placed inside buildings that are not rodent-proof, along the outside of the foundation, and around the perimeter. Bait stations help keep populations low when regularly maintained with fresh anti-coagulant bait. Rodents moving in from nearby areas will be controlled before they can reproduce and cause significant damage.

Norway rats are afraid of new objects in their environment (neophobic), so it may take up to 2 weeks for rats to become comfortable enough around the stations to enter them.

Dead rats, particularly when toxicants are used, should be disposed of to prevent scavengers from feeding on the carcasses.

**Fumigants** can be used to control rats in burrows outdoors. Gas cartridges are GUPs that can be used in backyard, farm, and commercial situations. We recommend that only licensed pest control operators use fumigants. Do not use fumigants in burrows near buildings where structures might catch fire and occupants might be exposed to the fumes. To fumigate burrows of Norway rats, seal all openings of the burrow with soil or sod immediately after introduction of the fumigant.

## Shooting

Where use of firearms is allowed, rats can be shot with a pellet gun or .22-caliber firearm loaded with birdshot. Shotguns also may be used. However, shooting is rarely effective as a method for control.

## Trapping

The use of traps can be effective for controlling Norway rats, but requires more skill and labor than most other methods. Trapping is recommended where use of toxicants is not advised. Trapping is the preferred method to try first in homes, garages, and other structures where only a few rats are present. The use of traps has several advantages:

1. it does not rely on hazardous rodenticides,
2. it permits users to view their success, and
3. it allows for disposal of the rat carcasses, thereby eliminating odor problems from decomposing carcasses that may remain when using toxicants.

Place traps across obvious runways or where runs are confined. Expanded-trigger traps set directly on travel routes may catch rats immediately. Place bait in traps and don't set them until the bait has been taken at least once to reduce the chance of a rat escaping the trap and becoming trap-shy. Keep traps clean and in good condition. Plastic and metal traps can be cleaned with hot water and a stiff brush. Always wear proper personal protective equipment (PPE) when cleaning traps.

### *Body-gripping Traps*

Several kinds of body-gripping traps are available for capturing and killing rats (*Figures 9a and 9b*). Expanded-trigger snap-traps typically have less bait losses and twice the capture rate of the narrow-trigger versions.



Figure 9a. Metal (thin) trigger snap trap (top) and plastic expanded trigger (bottom). Photo by Stephen M. Vantassel.



Figure 9b. Clamshell-style traps (rat left, mouse right). Photo by Stephen M. Vantassel.

### **Follow these guidelines to improve your success:**

1. use plenty of traps,
2. avoid placing traps directly in front of holes to reduce refusals,
3. place traps where rats are traveling, such as along walls,
4. position traps with the trigger facing the wall so that rats will pass directly over the trigger,
5. place traps inside bait stations, under slanted boards, or in areas that are difficult to access to reduce likelihood of capturing nontarget animals,

6. leave traps unset for several days to help rats become accustomed to them,
7. use a combination of baited and blind (unbaited) sets,
8. use appropriate bait (e.g., pieces of hot dog, bacon, pepperoni, or nutmeat tied securely to the trigger; peanut butter; marshmallows; or commercially-available nonallergenic baits), and
9. refresh and replace bait as needed.

### *Cage Traps*

Wire-mesh cage traps, such as Tomahawk and Havahart® can be used to capture rats. Wire funnel-entrance traps also have been used to capture rats.

### *Glueboards*

Glueboards catch and hold rats that attempt to cross them, in the same way fly-paper catches flies. They are less effective for capturing adult rats than mice, as adult rats frequently free themselves from the glue. Place glueboards along walls or wherever rats travel. Do not use glueboards where nontarget animals may be captured. Nontargets can be released by applying vegetable oil to the glue. Glueboards lose effectiveness in areas that are dusty, unless they are covered.

### *Other Methods*

Pets rarely will control populations of Norway rats. It is common to find Norway rats living in close association with cats and dogs and relying on pet food for nourishment. Norway rats often live beneath dog houses and feed when dogs are absent or asleep. Some dogs and cats will catch and kill rats. Around most structures, Norway rats can find places to hide and rear their young out of the reach of predators. Cat owners have an increased risk of exposure to toxoplasmosis and the impact of free-ranging cats on native wildlife is a concern.

## Disposition

### Relocation

Norway rats are invasive to the US, so relocation is not recommended.

### Translocation

Norway rats are a nonnative and invasive in the US. Translocation is not recommended.

### Euthanasia

Euthanize rats by asphyxiation with carbon dioxide or use a baton to apply a sharp blow to the base of the skull.

### Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

<http://www.epa.gov/pesticides/mice-and-rats/consumer-prod.html>

# Skunks

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Researched-based, certified wildlife control training programs to solve human-wildlife conflicts.

Your source for training, animal handling and control methods, and wildlife species information.



Figure 1. Eastern striped skunk (*Mephitis mephitis*).  
Photo by Greg Clements.

## Objectives

1. Demonstrate the ability to educate clients about management options.
2. Identify the risks involved in working with skunks.
3. Describe options for controlling odor.

## Species Overview

### Conflicts

The odor of skunk spray (musk) is pungent, nauseating, and can cause severe reactions in some people. Skunks may kill poultry and eat eggs. Skunks damage turf when digging for grubs and other soil-born insects. They also may carry rabies.

### Legal Status

Striped skunks (*Mephitis mephitis*) are protected furbearers in Nebraska. Landowners are allowed to trap or shoot skunks outside the normal seasons on their own property if the animals are causing damage.

### Identification

Skunks are members of the weasel family. Most striped skunks are black with white stripes along the length of the body (*Figure 1*), and are easily recognized by most people. Spotted skunks also occur in Nebraska, but they are rare and cause little damage, so this chapter will focus on striped skunks.

### Physical Description

Striped skunks have short, stocky legs and feet equipped with well-developed claws that enable them to dig well. Skunks can discharge a nauseating musk from their anal glands and are capable of several discharges up to 10 feet.

An adult striped skunk is about the size of a house cat, up to 29 inches long and weighing about 8 pounds.

## Species Range

Striped skunks are common throughout the Midwest and most of Nebraska, in both rural and suburban areas.

## Health and Safety Concerns

Striped skunks are carriers of rabies. Any skunk showing abnormal behavior, such as daytime activity, may be rabid and should be treated with caution. People should report skunks that are behaving abnormally to the local police department or animal control office. If bitten or scratched by a skunk, contact your local health department, and promptly seek medical advice. Have the skunk tested for rabies if possible.

Skunks usually provide a warning before discharging their scent by stamping their forefeet rapidly, and arching their tails over their backs. Anyone observing such a threat should retreat quietly and slowly. Avoid making loud noises and quick, aggressive actions. Skunk spray is not known to contain the rabies virus.

## General Biology, Reproduction, and Behavior

### Reproduction

Adult skunks begin breeding in late January. Gestation usually is 7 to 10 weeks, and litters commonly consist of four to six young. Young stay with the female until fall. Both sexes mature by the following spring. Skunk can live up to 10 years, but few live beyond 3 years in the wild.

During the breeding season, a male may travel 4 to 5 miles each night. Typically, a female that does not wish to mate with a particular male will spray him.

### Nesting/Denning Cover

Skunks prefer to den under logs, in brush piles, and in abandoned woodchuck holes. They also den under decks, porches, crawl-spaces, and other secluded areas.

## Behavior

Skunks may be dormant for about a month or two during the coldest part of winter. They may den together in winter for warmth, but generally are not sociable. They are nocturnal, slow-moving, deliberate, and have great confidence in defending themselves against other animals.

## Habitat

Skunks inhabit clearings, pastures, open lands bordering forests, and even wooded urban areas.

## Food Habits

Insects are the preferred food of skunks. Grasshoppers, beetles, and crickets are the adult insects most often taken. Skunks dig in lawns for grubs and other insect larvae. Mice are a regular and important item in the diet of skunks, particularly in winter. Rats, cotton-tailed rabbits, and other small mammals are taken when other food is scarce.

## Voice, Sounds, Tracks, and Signs

Skunks make noises ranging from screeches and whimpers to chirps. They stomp their front feet in a thump-thump combination when agitated.

Tracks of the hind feet of striped skunks are approximately 2½ inches long (*Figure 2*). Both the hind and forefeet of skunks have five toes. In some cases, the fifth toe may not be obvious. Claw marks usually are visible in the tracks.

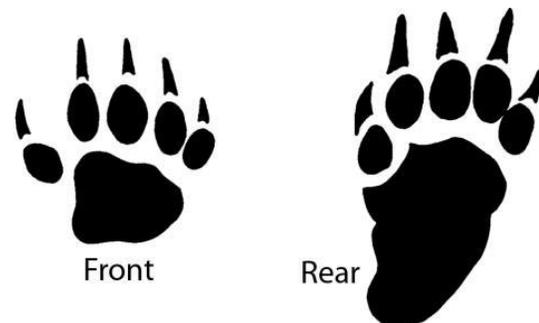


Figure 2. Tracks of a striped skunk. Image by Prevention and Control of Wildlife Damage (PCWD).

Droppings of skunks often can be identified by the undigested insect parts they contain. Droppings are  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in diameter, and 1 to 2 inches long.

The musk of skunks can be detected for up to a mile away, but odor is not always a reliable indicator of the presence or absence of skunks. Opossums also emit a skunk-like odor, and any sprayed animal can carry the odor long distances.

## Damage Identification

### Damage to Landscapes

Skunks dig holes in lawns, golf courses, and gardens to search for insect grubs found in the soil. Digging normally appears as small, 3- to 4-inch, cone-shaped holes or patches of upturned earth (*Figure 3*). Several other animals, including raccoons and domestic dogs, also may dig in lawns.

### Damage to Crops and Livestock

Skunks occasionally feed on corn, eating only the lower ears. If a cornstalk is knocked over, raccoons are more likely the cause of damage. Damage to the upper ears of corn often is indicative of birds, deer, or squirrels.

Rabid skunks bite and can transmit rabies to cattle, horses, dogs, and other domestic animals, which can in turn transmit rabies to humans.

Skunks occasionally kill poultry and eat eggs. They normally do not climb fences to get to poultry.

Rats, weasels, mink, and raccoons regularly climb fences. If skunks gain access, they normally feed on eggs, and occasionally kill fowl. Eggs usually are opened on one end with the edges crushed inward. Weasels, mink, dogs, and raccoons usually kill several chickens or ducks at a time. Dogs often severely mutilate poultry.



Figure 3. Damage by skunks in turf. Photo by Javier Gil.

### Damage to Structures

Damage to structures by skunks usually is due to sprayed musk. Odor can penetrate and linger in cloth furniture, clothing, and carpets. Skunk odor can contaminate items several floors away from the original source.

## Damage Prevention and Control Methods

### Habitat Modification

Remove garbage, debris, and lumber piles to reduce the attractiveness of an area to skunks. Skunks prefer cover, and areas filled with debris provide excellent hunting grounds. Properly dispose of garbage or other food sources that will attract skunks. Often, skunks are attracted to rodents living in barns, crawl spaces, sheds, and garages. Control programs for rodents may be necessary to reduce the attraction.

### Exclusion

Seal all ground-level openings to poultry buildings and close doors at night. Enclose poultry yards and coops that lack subsurface foundations with 3-foot, wire-mesh fencing buried a few inches below ground. Skunks can be excluded from window wells or similar pits with mesh fences or window well covers. Use tight-fitting lids on garbage cans.

Keep skunks from denning under buildings by sealing all foundation openings. Cover all openings with wire mesh, sheet metal, or concrete. Where skunks can gain access by digging, bury  $\frac{1}{4}$ -inch mesh fences 2 to 3 inches below the ground, and extend the mesh out perpendicular from the location being protected at least 12 inches (*Figure 4*).

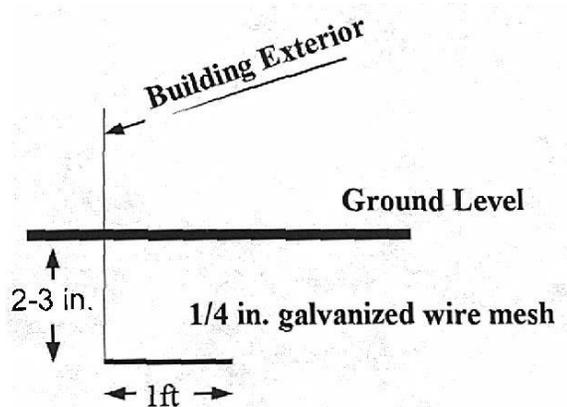


Figure 4. Diagram of below-ground exclusion fencing. Image by Stephen M. Vantassel.

When the risk of having immobile young is low, skunks can be excluded from a structure using a one-way door (*Figure 5*). Secure the perimeter of a deck or shed with trench screen. Install a one-way door (minimum size 4 x 4 inches) over the entrance so that skunks can easily exit. Return after several days of good weather to evaluate the location. When confident the skunks are gone, remove the door and secure the opening.



Figure 5. One-way door over the entrance to the den of a skunk. The thin vertical sticks in the back will be knocked over if an animal moves through. Photo by Stephen M. Vantassel.

## Frightening Devices

No frightening devices are effective on skunks.

## Repellents

No repellents are registered for use on skunks.

## Toxicants

Gas cartridges are registered for fumigating skunk burrows. Follow label directions and take care to avoid fire hazards and exposing nontarget animals, especially when used near structures. Light and hold the gas cartridge until it ignites before placing it deep in a burrow. Seal openings of the burrow with soil to secure the fumigant in the burrow.

## Shooting

Shooting is effective, but will likely result in the skunk emitting odor. If odor is not a problem and use of firearms is allowed, use a .22-caliber rifle or a shotgun with No. 6 shot.

## Trapping

Skunks can be captured with cage or box traps placed in areas where skunks are active. Because of the potential for skunks to spray or transmit rabies, it probably is best to hire a wildlife control professional to trap skunks.

Sometimes skunks must be captured directly, without the use of traps because the urgency of the situation demands immediate action. Again, contact a wildlife control professional.

## Other Methods

Skunks occasionally spray structures, pets, and people. Avoid touching sprayed surfaces with bare hands. Keep sprayed animals outdoors and wash them before handling. Deodorize a sprayed surface, skin, or hair by applying a mixture of  $\frac{1}{4}$  cup baking soda, 1 quart of 3% hydrogen peroxide, 1 teaspoon of dish soap, and 1 gallon of water. Avoid getting the mixture in eyes. Rinse with water.

If a skunk is suspected of being rabid, it should be humanely killed, while avoiding injury to the head. Call your local health department and follow instructions for submitting the skunk for testing.

Pet owners must, by law, protect their animals through timely vaccinations against rabies. Owners of livestock in areas with rabies outbreaks also should consider pre-exposure vaccinations. Owners should consult a veterinarian about further treatment for pets and livestock potentially exposed to rabid animals. For human exposures, consult a physician and local health department about post-exposure rabies vaccination.

## Disposition

### Relocation

On-site release is required when rescuing skunks from window wells and garages. Be sure the client and neighbors keep their doors closed, pets restrained, and children away from the area. Release the skunk in an out-of-the-way area with ground cover. If possible, release the skunk close to nightfall.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so skunks can only be relocated outside of structures. Translocation of skunks is not advised because they may transmit rabies.

## Euthanasia

Carbon dioxide is the preferred euthanasia method for skunks. Skunks are tolerant to CO<sub>2</sub>, so it may take up to 20 minutes for an animal to die. Observe the chest for motion for at least 3 minutes to ensure that breathing has stopped. Skunks have been known to spray during asphyxiation. Often, their sphincters loosen, allowing for some fluid release.

Where odor issues are not a priority, use a .22-caliber firearm, where allowed and safe. The shot usually is directed to the head, unless rabies testing is required. Some professionals use low-power ammunition such as .22-caliber “CB caps” or “short” rounds. An extremely intense spraying is almost always associated with the shot. Other euthanasia methods may be preferable. Take a certified firearm safety course before attempting to shoot, and follow firearm safety procedures at all times. Shooting is best left to someone with experience, and usually is limited to rural areas.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Snakes

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**Figure 1. Common garter snake (*Thamnophis sirtalis*), a nonvenomous snake. Photo by Aaron Hildreth.**

## Objectives

1. Describe the key characteristics used to identify snakes.
2. Explain key elements about the biology of snakes that are important for their management.
3. Communicate management options to clients.
4. Describe the steps involved in properly treating snake bites.

## Species Overview

### Conflicts

Many people fear snakes, including the common garter snake (Figure 1), the plains garter (*Thamnophis radix*), and other nonvenomous snakes. Even though these species rarely cause damage, people often kill them. On rare occasions, venomous snakes bite pets, livestock, or humans and cause some physical injury. Most people bitten by a venomous snake were handling

the snake. A bite from a venomous snake requires immediate medical attention.

## Legal Status

Snakes are considered nongame wildlife and are protected by law, unless they are about to cause damage to people or livestock. The massasauga rattlesnake (*Sistrurus catenatus*) is a threatened species in Nebraska. Many snakes in Nebraska are listed as species in “Need of Conservation.” Species placed in this classification cannot be taken, possessed, transported, sold, processed, or exported without specific authorization. Snakes listed as needing conservation include the western worm snake (*Carphophis vermis*), timber rattlesnake (*Crotalus horridus*), prairie kingsnake (*Lampropeltis calligaster*), speckled kingsnake (*Lampropeltis getula*), Kansas glossy snake (*Arizona elegans*), smooth green snake (*Liochlorophis vernalis*), Grahams crayfish snake (*Regina grahamii*), plains blackhead snake (*Tantilla nigriceps*), western ribbon snake (*Thamnophis proximus*), redbelly snake (*Storeria occipitomaculata*), Osage copperhead (*Agkistrodon contortrix*), and western terrestrial garter snake (*Thamnophis elegus*).

## Identification

Snakes are specialized reptiles with elongated bodies and no legs. They have no ears or eyelids, but transparent scales cover the eyes. Snakes have a long, forked tongue, which aids the sense of smell.

About 150 species of snakes occur in North America, of which over 90% are nonvenomous. All native snakes are beneficial to the environment. Nebraska has 29 native snakes and only 4 are venomous: the prairie rattlesnake (*Crotalus viridis*), copperhead (*Agkistrodon contortrix*), timber rattlesnake (*Crotalus horridus*), and

Massasauga (*Sistrurus catenatus*). Consult a reptile field guide or <http://snr.unl.edu/herpneb/> for detailed descriptions of snakes.

The majority of this module will discuss garter snakes. Other snakes will be mentioned in passing.

## Physical Description

Garter snakes can reach lengths of up to 3 feet when fully grown, with some reaching 4 feet. They tend to be larger in western and smaller in eastern Nebraska. Some garter snakes can be as thick as an adult index finger.

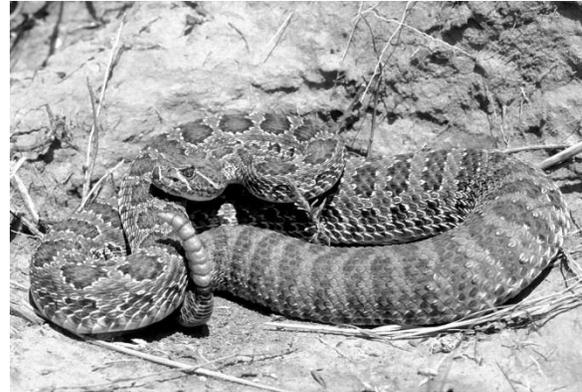
Avoid relying on color alone to identify snakes because coloration can vary greatly by area, genetic variation, and age of the snake. All garter snakes are extremely variable in coloration of their lines and background pattern. While most have cream, yellow, and orange stripes along the length of their bodies, some may have very dark or even bright red colored markings. Garter snakes with white and bluish coloration have been found in some urban areas of Nebraska.

Awareness of patterning of colored lines is a better way to identify garter snakes. Garter snakes have contrasting colored lines running the length of the entire body. Usually three lines occur; one down the middle of the back and one on each side. The position of the lateral or side lines differs with each species. A rule of thumb in Nebraska is any snake with a line running down its body length mid-center and on each side is one of our garter snakes.

## Venomous versus Nonvenomous Snakes

In Nebraska, it is very easy to avoid venomous snakes by keeping away from snakes with a rattle at the end of the tail (*Figure 2*). Frequently, you will hear the sound of the rattle before you see it. If you do, hold still and look towards the location of the sound. Back away slowly.

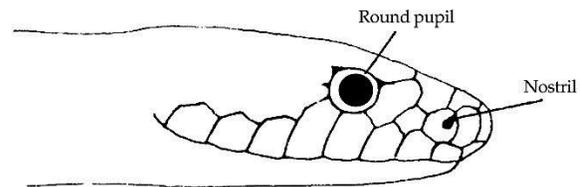
While copperhead snakes are an exception to the above rule, they occur only in 3 counties on the border with Kansas in southeast Nebraska.



**Figure 2. Prairie rattlesnake with rattle being held vertically. Photo by Dan Fogell.**

If you find a dead snake and want to know if it is venomous, look for the following characteristics to distinguish pit vipers (venomous) from nonvenomous snakes. Avoid the mouth as venom is still dangerous even if the snake is dead.

- Look for a pit. All pit vipers have a deep pit on each side of the head, midway between the eye and nostril. Nonvenomous snakes do not have pits.
- Check the pupils. The pupils of pit vipers are vertically egg-shaped. In very bright light, the pupil may be a vertical line due to extreme contraction to shut out light. The pupils of nonvenomous snakes are perfectly round (*Figure 3*).



**Figure 3. Nonvenomous snakes have round pupils and no pit between the eye and the nostril. Image by Prevention and Control of Wildlife Damage (PCWD).**

## Species Range

Garter snakes are common in urban gardens and residential areas across Nebraska. In many regions they are more abundant in urban and suburban yards than in wild areas. Garter snakes are one of the few snakes that do well in urban habitats.

Consult a reptile field guide for detailed range maps for different snake species. State-specific guides to snakes also can be very helpful such as <http://snr.unl.edu/herpneb/> for the snakes of Nebraska.

## Health and Safety Concerns

Human-snake encounters become very common during spring and summer when snakes move about searching for mates or food, and when people spend time outdoors. Snakes that are native to North America do not hunt or attack people, although a provoked or harassed snake will defend itself. When a person is bitten, usually the snake is reacting defensively after being handled, threatened, or approached.

Never put your hands or feet into holes or other areas that you have not visually inspected. Wear leather gloves and use a snake tong or hook when capturing and handling snakes. When walking or inspecting areas where an encounter with a venomous snake is likely, wear protective leggings and always step on logs, as opposed to stepping over them without looking.

Exotic snakes present special safety issues. Exotic snakes are nonnative species that once were pets, but were released into the wild. Some exotics are extremely dangerous due to their large size and toxic venom. While few complaints regarding dangerous snakes have occurred in the Plains states, the risk is increasing as exotic snakes become more popular in the pet trade.

Snakes have few diseases that are transmissible to humans. Salmonella is rare in wild snakes versus snakes from the pet trade. The exception is water snakes that may inhabit waters with abundant waterfowl. Some snakes carry ectoparasites but most are harmless to humans. Maintain standard sanitation procedures to protect yourself from snake-borne diseases.

A bite from a nonvenomous snake will not harm the longterm health of the victim. Some people have been bitten several thousand times by handling nonvenomous snakes, and suffered no adverse reaction. They only required basic first aid for the bites. A bite from a nonvenomous snake

should be treated as any other minor flesh wound. Clean the area and treat it with an antiseptic.

Over ½ of rattlesnake bites lack venom as venomous snakes have little interest in wasting venom on a human too big for them to eat. If a bite injects venom, the victim usually experiences an almost immediate bodily reaction. Swelling, tissue turning a dark blue-black, a tingling sensation, and nausea are common reactions to snake venom. If no signs are observed or felt, the bite likely was from a nonvenomous snake, or the bite did not contain venom (a dry bite). Juveniles of venomous species are just as venomous as adults.

Bites from venomous snakes are extremely rare in the US. Of the 7,000 bites that occur annually, 50% of them occurred while the victims were handling venomous snakes. In about ¼ of these cases, alcohol was involved. *The probability of a bite from a snake being fatal in the US is 0.002%.*

### *First Aid for a Venomous Snake Bite*

In the extremely unlikely event a person is bitten by a venomous snake, use the instructions below to guide your actions.

1. Move away from the snake to avoid any further bites and keep others away from the snake. Try to keep the victim from panicking; stay as calm as possible. Panic will increase blood flow and the speed of venom travel through the bloodstream. The victim should not drink alcohol after being bitten. Alcohol dilates veins and will aid in the spread of the venom.
2. Seek medical care immediately. Call 911 and transport the victim to the nearest hospital.
3. Remove constrictive clothing and jewelry. Swelling will prevent such articles from being removed and can result in a tourniquet effect. Do not use a tourniquet or ice, as they can increase tissue damage. Do not cut the skin or

apply suction to the site of the bite. Clean the wound with water to remove residual venom on the skin and reduce the risk of infection.

4. If you are skilled at handling snakes, and the proper equipment is available (snake hook or tongs and a sealable container), capture the snake and bring it in for identification. A photograph of the snake can suffice, but stay at least two snake lengths away when taking the picture.

## General Biology, Reproduction, and Behavior Reproduction

Garter snakes, as with other snakes, mate as soon as weather conditions allow, upon emerging from hibernation in the spring. Males usually emerge first and wander around trying to locate the scent of a female. Some snow cover may remain when this occurs. When temperatures begin to increase, females emerge and immediately elicit a pheromone scent that will attract every male snake of that species in the area. These mating aggregations occur every spring. The balls of snakes found in lawns, gardens, and on rock piles consist of one female and up to a dozen males.

Once mated, the female will move off to hide and feed and the males will return to their original location. Female garter snakes will give live birth to one litter of 12 to 20 young in late summer.

The young are less than 6 inches long and thin as a stirring stick. Females offer no care and the young must fend for themselves and find food—primarily small worms, ant larvae, and termites. Over 90% of the young will die before the next spring. In the fall, it is not uncommon to find clusters of young snakes in gardens where ant nests occur.

Some species of snakes lay eggs, while others retain membrane-covered eggs inside the body during incubation. Eggs hatch and young are born in late June through early fall, depending on the species and latitude.

## Nesting/Denning Cover

Snakes do not construct nests. They seek locations for protection and thermoregulation. For example, a rock exposed to the sun provides warmth on cool mornings, and a rock wall provides protection and cool temperatures during hot weather.

Underground dens, called hibernacula, protect snakes from freezing temperatures. Snakes use hibernacula in and around structures including sump pumps, rock walls, basements, crawl spaces, and other locations that are safe from winter freezing. A single winter hibernaculum may contain multiple species and hundreds of snakes.

## Behavior

The behavior of snakes is determined more by temperature than by season. Snakes become lethargic at temperatures below 50°F. Snakes eat little or no food during times of decreased activity. Snakes are ectothermic (cold-blooded) and may eat only one meal in several weeks. Snakes may hibernate during cold weather, or aestivate during hot summer months.

In most cases, snakes will move away when approached. When cornered, snakes react with a variety of defensive tactics that vary by species. Garter snakes tend to rear up and open their mouth. Other defensive tactics used by snakes include playing dead by laying on its back, hissing, coiling, emitting an odorous fluid from the vent, striking, and biting.

## Habitat

Most species of snakes have specific habitat requirements. Garter snakes prefer retaining walls, as well as decorative gardens containing rocks or concrete components and debris piles. Some species live underground while others, such as green snakes, primarily live in trees. Generally, snakes live in cool, damp, dark areas where prey is available.

Areas around the home that are attractive to snakes include piles of firewood, old lumber piles, junk piles, flower beds with heavy mulch, gardens,

basements, shrubbery growing against foundations, barn lofts (especially where feed attracts rodents), attics in houses where rodents or bats are present, banks of streams and ponds, lawns with long grass, and abandoned lots and fields where boards, tires, and planks are present to provide cover.

## Food Habits

All snakes are predators and different species eat a variety of sizes and kinds of animals. Snakes can swallow food much larger than their head size because the two halves of the lower jaw of snakes are not fused.

Garter snakes eat earthworms, minnows, grubs, and other insects. Black rat snakes (*Scatophis obsoleta*) primarily eat rats, mice, bird eggs, and baby birds. Prairie king snakes (*Lampropeltis calligaster*) eat other snakes, rodents, and lizards. Some snakes (e.g., smooth green snake; *Liochlorophis vernalis*, primarily eat insects. Brown snakes (*Storeria dekayi*) and western worm snakes (*Carphophis vermis*) eat earthworms, slugs, and termites. Water snakes primarily eat fish, frogs, and tadpoles.

## Voice, Sounds, Tracks, and Signs

Garter snakes have no vocalizations. Some snakes, such as bull snakes (*Pituophis catenifer*), may hiss in such a manner that it sounds like a rattlesnake. Hognose snakes (*Heterodon platyrhinos*) will puff. Most snakes shake their tails, which can sound like a rattle, particularly when striking dried leaves.

Snakes rarely leave signs of their presence. It takes a careful eye to notice disturbances in soil that indicate the movement of snakes. Look in attics, crawl spaces, and outbuildings for paths in dust, drags through spider webs, as well as skins that have been shed. Shed skins tend to be 20% longer than the total length of the snake. A growing snake may shed up to four times in a single year.

## Damage Identification

Property owners typically discover the presence of snakes by direct observation or discovery of a skin. The fear of snakes is the most common conflict.

## Damage to Landscapes

Snakes do not harm landscapes or gardens. They do not dig burrows. Only bull snakes (*Pituophis catenifer sayi*) can dig and they only do this in areas where a mole or pocket gopher has softened the soil. Snakes help reduce populations of insects and rodents, and usually are considered beneficial.

## Damage to Crops and Livestock

Garter snakes cannot harm crops or livestock. Some snakes eat eggs and young birds. A classic sign of snake presence is the daily disappearance of an egg from a nest. Most mammals break several eggs and leave the shells behind. Snakes swallow eggs whole, and usually just one per day. Pets or livestock may suffer serious injuries if bitten by a venomous snake, especially if the bite occurs on the nose or face.

## Damage to Structures

Snakes do not damage structures.

## Damage Prevention and Control Methods

Most methods for snake control are inexpensive, except for snake-proof fences. It is valuable to spend time educating people about the benefits of snakes.

## Habitat Modification

Remove bushes, shrubs, large rocks, boards, firewood, and debris lying close to the ground. Alter sites that provide habitat and protected basking locations, such as by covering stone walls with concrete. Ensure that rocks or lumber for walls are tight-fitting with few areas where snakes can find refuge to decrease snake numbers. Trim plants, shrubs and bushes, and eliminate branches

that are low to the ground. Keep vegetation closely mowed. Reduce food sources, such as rodents, fish, and invertebrates.

## Exclusion

Snakes are not capable of making a hole or entry into a structure either by biting, chewing or pushing with their head. Garter snakes, however, are able to squeeze through extremely small openings. A young garter snake may enter a structure by means of a crack as narrow as  $\frac{1}{4}$  inch. Some of the most common ground level snake entry points include garage and basement doors, foundation cracks, basement window frames, around utility lines, dryer vents, outdoor water faucets, sump pump drain lines, and gaps in vinyl and metal siding. Seal all openings  $\frac{1}{4}$  inch and larger with mortar,  $\frac{1}{8}$ -inch hardware cloth, sheet metal, Copper Stuf-fit, or Xcluder™.

Apply crushed lava rock around areas to discourage snakes from entering. It is believed that the sharp edges of the rock discourage snake movement.

A snake-proof fence may be effective for excluding snakes from an area (*Figure 4*).

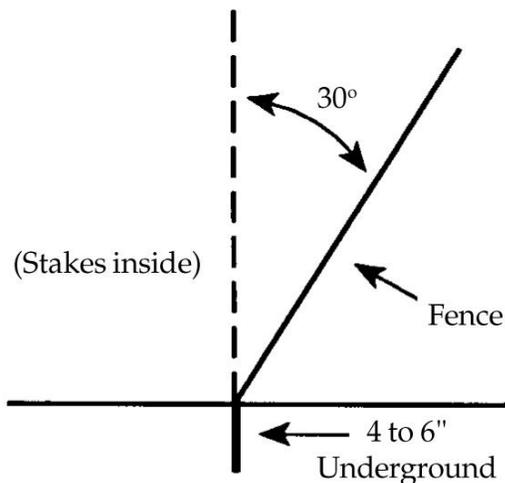


Figure 4. Side-view of a snake exclusion fence. Image by the PCWD.

## Frightening Devices

Frightening devices are not applicable for snakes.

## Repellents

Several snake repellents have been promoted and are registered by the US Environmental Protection Agency (EPA). Research on naphthalene-based repellents has shown they are ineffective at repelling snakes. Other products have not undergone extensive research to demonstrate effectiveness for real-world applications.

## Toxicants

No toxicants are registered for use on snakes.

## Shooting

Use a shotgun or small-caliber rifle to kill snakes only when health and safety are at risk. Shooting may be limited by safety concerns and local regulations on the discharging of firearms.

## Trapping

Use funnel or pitfall traps with drift fences to capture snakes. Rat-sized glue-boards or specialized glue-snake traps are effective in capturing snakes that move across them, although some consider this method to be inhumane. Apply vegetable oil on the glue to deactivate it and release the snake. Snakes that are released do not always survive as they may be injured or suffer from severe exhaustion. Check traps several times a day to improve the chances of snake survival. Reduce endangerment to nontarget animals by placing them inside structures. If placing traps outside, keep them close to the building and position a piece of plywood over the trap to reduce its visibility.

## Disposition

### Relocation

Nebraska wildlife regulations permit the relocation and release of snakes into the wild within 100 yards of the site of initial capture. Relocation is appropriate when snakes are being rescued, or when exclusion likely will prevent their return. Only snakes that are not endangered, threatened, or in need of conservation may be relocated.

## Translocation

Nebraska wildlife regulations do not allow the translocation of snakes. Translocation is not recommended, as snakes likely will lose access to their hibernaculum and habitat needed for survival. In addition, translocation increases the risk of disease transmission among populations of snakes. Consult a professional herpetologist for additional information on how to remove live snakes.

## Euthanasia

Carbon dioxide is an effective method for euthanizing snakes. Cervical decapitation also is permitted. A heavy blow to the head or neck with a hoe or shovel will kill a snake.

Use caution with venomous snakes as the venom remains potent following death.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Thirteen-lined Ground Squirrels

Prepared by the National Wildlife Control Training Program. [WildlifeControlTraining.com](http://WildlifeControlTraining.com)

Research-based, certified wildlife control training programs to solve human-wildlife conflicts.

Your source for training, animal handling and control methods, and wildlife species information.



**Figure 1.** Thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*). Photo by Stephen M. Vantassel.

## Objectives

1. Describe the biology of the thirteen-lined ground squirrel.
2. Describe how their behaviors can influence methods used for managing damage.
3. Identify signs of damage by thirteen-lined ground squirrels.
4. Explain appropriate options for managing damage.

## Species Overview

### Conflicts

Thirteen-lined ground squirrels feed on garden vegetables and flowers. They dig burrows that can disrupt patios and sidewalks. Occasionally they enter structures.

## Legal Status

Thirteen-lined ground squirrels are unprotected in Nebraska, so landowners can capture and kill them when they are causing or about to cause damage.

## Identification

The thirteen-lined ground squirrel (*Figure 1*) is a common ground-dwelling native rodent in Nebraska. They spend most of their time on the ground and when startled, carry their tails upright.

## Physical Description

The thirteen-lined ground squirrel is a slender rat-sized rodent that weighs about 8 ounces. They are about 10 inches long, including a 3-inch tail. As its name implies, 13 stripes run the length of their body. Five of the light-colored lines break up into a series of spots as they progress down the back and over the rump. Five light and four dark stripes extend along the top of the head and end between the animal's eyes. The cheeks, sides of the body, and legs are yellowish, tan, or tan with an orange cast. The chest and belly are thinly covered with light tan fur. Each front foot has four toes with long slender claws for digging. Five toes are on each hind foot. Some of the common names for this species include "thirteen-liners," "stripers," "striped ground squirrels," "striped gophers," and "gophers."

## Species Range

Thirteen-lined ground squirrels occur throughout Nebraska in grasslands and turf.

## Health and Safety Concerns

Thirteen-lined ground squirrels are not significant carriers of diseases harmful to humans.

## General Biology, Reproduction, and Behavior

### Reproduction

Thirteen-lined ground squirrels are sexually mature at 9 or 10 months of age. They mate within 2 weeks after emerging from hibernation. Both sexes are sexually active for about 2 weeks. After a gestation period of 28 days, 3 to 14 (average 10) blind, naked, toothless young are born. Only one litter is produced per female each year. The young weigh about  $\frac{1}{10}$  ounce at birth. Their stripes begin to appear after about 12 days and their eyes open after 28 to 30 days. Young are weaned after 6 to 12 weeks.

### Nesting/Denning Cover

The burrows of 13-lined ground squirrels typically have inconspicuous 2-inch diameter openings (*Figure 2*) that often are concealed by vegetation and rarely have soil scattered in front.

The main entrance plunges down 6 inches or more before angling off into a complex system of galleries and side entrances. The chamber for rearing young is about 9 inches in diameter, lined with fine dry grass, and located somewhat deeper than the main burrow system. Natural enemies include most predator species, especially hawks, badgers, weasels, foxes, coyotes, and bull snakes.

### Behavior

Thirteen-lined ground squirrels are diurnal. They come above ground when the sun is high and the temperature is above 80°F, and return to the burrow long before sundown. They rarely venture out of the burrow on damp, dark, or overcast days. They often stand upright, with front paws held close to the chest, surveying their territory. If danger threatens, they run with tail held horizontally to the nearest burrow.



**Figure 2.** Burrow of a 13-lined ground squirrel in sandy soil. Six-inch ruler on top. Photo by Stephen M. Vantassel.

Thirteen-lined ground squirrels begin hibernation in September or early October and emerge between late March and early May in the northern portions of their range. Males usually begin hibernation earlier in fall and emerge earlier in spring than females. When they hibernate, their body temperature generally is within a few degrees of the ambient air temperature.

### Habitat

Thirteen-lined ground squirrels prefer grassy areas that are cut low, such as lawns, parks, cemeteries, and sports fields. They avoid wet areas with heavy clay soils. Home ranges of 13-lined ground squirrels vary between 3 to 12 acres. Thirteen-lined ground squirrels do not defend home ranges but will defend dens. Densities of adults can reach 10 animals per acre, and increase dramatically after young are born.

### Food Habits

Thirteen-lined ground squirrels eat vegetation, the eggs and young of ground-nesting birds, earthworms, lizards, mice, and insects. During summer, insects make up nearly  $\frac{1}{2}$  of their diet. Thirteen-lined ground squirrels prefer beetles, grasshoppers, and moth larvae. They also consume seeds, green shoots, flower heads, roots, vegetables, fruits, and cereal grains. They rarely

drink water, but rather depend on the moisture contained in their food. They cache large quantities of seeds and grass. The cached food may be eaten during periods of bad weather or when other food is scarce.

## Voice, Sounds, Tracks and Signs

Thirteen-lined ground squirrels exhibit six different calls. The call that is most commonly heard is a high-pitched trill that is used to signal danger.

It is rare to find tracks of 13-lined ground squirrels (Figure 3). Ground squirrels normally are identified by entrances to dens or visual sightings.

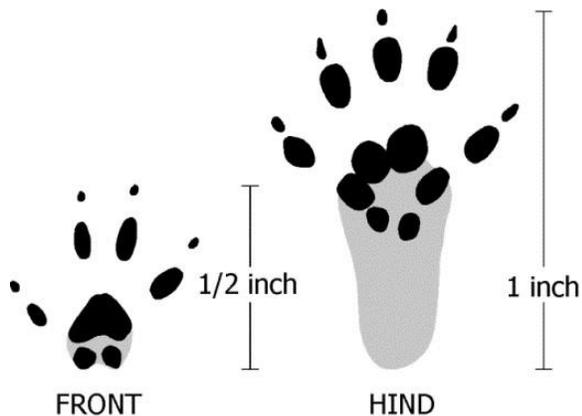


Figure 3. Tracks of a 13-lined ground squirrel. Image by Dee Ebbeka.

## Damage Identification

### Damage to Landscapes

Thirteen-lined ground squirrels feed on vegetables in gardens and often damage more than they consume.

## Damage to Crops and Livestock

Thirteen-lined ground squirrels dig up newly-planted seeds (Figure 4), consume seeds that are sprouting, clip shoots of emerging plants, and pull over wheat, barley, and oats to eat the grain.



Figure 4. Divots in the soil where 13-lined ground squirrels dug up kernels of seed corn. White pen and knife point to their respective holes. Photo by the University of Nebraska–Lincoln (UNL).

Thirteen-lined ground squirrels establish colonies in and around borders of minimum-tillage fields of corn and soybeans. They can cause significant losses when present in large numbers.

Extension agents and farmers reported losses of 20 to 80 acres annually in fields during 1989 to 1992 in Nebraska. The 13-lined ground squirrel is a minor pest in suburban areas, and a minor to moderate pest in agricultural situations. Indiana Wildlife Services considers them a major agricultural pest in no-till corn.

Do not attempt to eliminate 13-lined ground squirrels, as their predation on crop-damaging insects provides an important benefit. Try to manage populations of ground squirrels at levels where conflicts with humans are maintained at tolerable levels.

Thirteen-lined ground squirrels pose minimal threats to livestock and pets.

### Damage to Structures

Thirteen-lined ground squirrels are not known to damage structures. They may gnaw on and damage underground water lines.

## Damage Prevention and Control Methods

### Habitat Modification

Activity in fields and gardens can be discouraged by deep soil cultivation, which destroys burrows and changes the habitat. Allow grassy areas, such as road ditches, to grow as tall and as dense as possible if consistent with local land use practices. Such vegetation discourages ground squirrels but may encourage populations of other small mammals, such as voles. Plant crops before squirrels emerge from hibernation to reduce losses to seeds and seedlings.

Modify bird feeders to prevent rodents from accessing them. Use feeders that capture fallen seed to reduce the amount that reaches the ground.

### Exclusion

Exclusion is expensive and practical only in limited situations. Hardware cloth (¼-inch) can be used to exclude ground squirrels from flower beds and gardens. Cover seeds and bulbs with ¼-inch hardware cloth. The cloth itself should be covered with soil and extend at least a foot past each margin of the planting.

Thirteen-lined ground squirrels can be kept out of electrical substations or similar installations with hardware cloth topped with sheet metal. Most electrical substations and other secured installations are enclosed by chain-link fences that can be modified to exclude ground squirrels. Dig a trench 18 inches wide and 18 inches deep around the installation next to the outside of the existing fence. Install galvanized ½-inch or smaller mesh hardware cloth (6 feet wide) across the bottom and up the side of the trench nearest the existing fence, continuing 3 feet up the fence. Backfill the trench and securely attach hardware cloth to the chain-link fence. Attach a piece of sheet metal, 2 to 3 feet wide, to and above the hardware cloth. Adjust all gates to fit within ½ inch of the support post and the ground. Install cement thresholds to keep squirrels from digging under gates.

Secure exhaust vents with professionally-manufactured screens. Exhaust vents of dryers require particular care due to fire hazards.

For active burrows, wait until the animals are out and away, fill the holes with soil, and cover with a rock or other heavy object.

### Frightening Devices

No frightening devices are effective for the control of 13-lined ground squirrels.

### Repellents

Check Nebraska pesticide regulations before applying any repellent. Repellents are expensive and usually do not provide 100% reduction in damage. Thiram (75% concentration) is registered by the US Environmental Protection Agency (EPA) as a seed treatment to reduce damage to seeds by 13-lined ground squirrels. Taste repellents that contain capsaicin, Bitrex®, or ammonium soaps of fatty acids can be used to protect flower bulbs, seeds, and foliage. Multiple applications of repellents are required. Predator urine (fox or coyote) is the active ingredient in products registered for repelling animals from lawns and gardens. The repellent is to be used as a barrier. Carefully follow all instructions on the label.

### Toxicants

Zinc phosphide, formulated as pellets or grain baits, is registered for use on thirteen-lined ground squirrels. It is most effective in spring and late summer when ground squirrels are gathering seeds. Apply untreated pellets or grain as a pre-bait to encourage the squirrels to consume the treated bait quickly. Rapid consumption is necessary to decrease the likelihood of bait shyness. Apply prebait on a bright, warm, sunny day when ground squirrels are most active. Do not apply treated bait over bare ground or in areas of scant vegetation, where it can pose a direct threat to grain-eating birds. Zinc phosphide is a restricted-use pesticide and may be applied only by a certified pesticide applicator who must carefully follow all instructions on the label.

Burrow fumigants are effective for controlling ground squirrels in small areas. Fumigation may be the most humane method from mid-April to mid-June because both female ground squirrels and their young are present in the burrows. Fumigants should never be used in or around buildings, or where people, livestock, or other nontarget animals may be exposed to the gases. Treat and plug all burrows, wait 24 to 48 hours, and retreat any burrows that have been reopened. Most burrow fumigants work best when the soil moisture is high and the air temperature is above 50°F.

Aluminum phosphide tablets and pellets can be used to treat burrows of 13-lined ground squirrel in agricultural and non-cropland areas. Use of aluminum phosphide is highly regulated and a fumigation plan must be developed prior to use. Carefully read and follow all instructions on the label. Place 1 to 4 tablets, or 5 to 20 pellets, as far down into the burrow as possible. The higher rates are recommended for larger burrow systems when soil moisture is low. Seal the entrance of the burrow by packing it with crumpled newspaper and then shoveling soil over the entrance. Do not cover the tablets or pellets with soil when sealing the burrow. Aluminum phosphide is a restricted-use pesticide and may be applied only by certified pesticide applicators. Carefully follow all instructions on the label.

Gas cartridges produce carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>), and consume oxygen when applied to a closed burrow system. Gas cartridges come in different sizes; make sure the cartridge will fit into the burrow before lighting the fuse. Some cartridges include built-in fuses while others must have the fuse inserted. Kneel at the opening, light the fuse, and place the cartridge, fuse end first, as far down the burrow as possible. Place a slice of sod over the opening and cover with soil to make a tight seal. Close any openings from which smoke appears. Do not use gas cartridges near buildings or other combustible material, or during periods with prolonged dry weather, because they are a potential fire hazard.

## Shooting

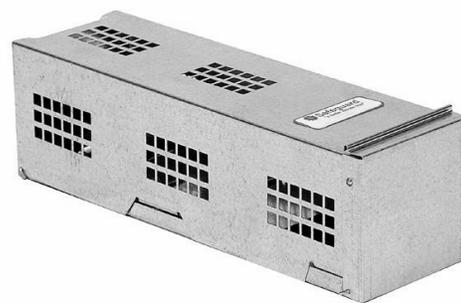
Permits are not required in Nebraska to shoot 13-lined ground squirrels, except within city limits. Shooting may effectively reduce the local population if the shooter is persistent. Use air rifles, .22-caliber rifles, or shotguns with No. 7½ shot. Follow all regulations and rules for safe firearm handling.

## Trapping

The use of traps is a practical method for eliminating ground squirrels in areas less than 1 acre. To determine the number of traps that should be used, count the number of burrows and divide by 2. After completing the initial control, more trapping may be needed to remove animals that immigrate from the surrounding area. Set all traps in areas where damage is occurring, next to active burrows or on active runways.

### Cage Traps

Cage traps (*Figure 5*) for 13-lined ground squirrels should be at least 3 x 3 x 10 inches. Cover half of the trap to provide additional shelter for the trapped animal and to keep bait out of view of tree squirrels and birds. Ensure the cover does not interfere with operation of the trap.

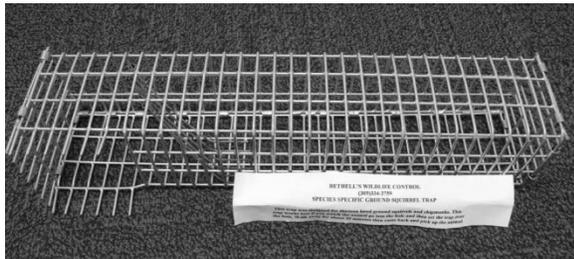


**Figure 5. Safeguard 53070 rodent trap.**  
Image by Safeguard®.

Peanut butter is a very effective bait, and is difficult for animals to remove without springing the trap. Pieces of fruit, vegetables, nut meats, or sunflower seeds also can be used as bait. Seeds may be glued to the trigger of the trap. Some

trappers place bait around the entrance of the trap, however, this tactic will attract birds. Check traps at least every 24 hours, preferably at dusk, and apply fresh bait. If more than 2 or 3 days pass without a sprung trap, move it to a new location. If the bait is taken without the trap being sprung, try using mouse-sized snap traps inside the trap. Young ground squirrels may not be big enough to spring rat-sized traps.

The Bethel ground squirrel trap (12- by 20-inch piece of ½-inch mesh) uses a one-way door to capture 13-lined ground squirrels (*Figure 6*). Before setting the trap, spend time observing the animals to determine which burrows are active. Plug any holes within 20 feet of active burrows with soil. Place the trap over the entrance of a burrow that you observed a ground squirrel entering. Ground squirrels frequently emerge from their burrows after 20 minutes. Watch the trap from a distance or check it occasionally during the day.



**Figure 6.** The Bethel ground squirrel trap is designed to be set directly over the hole, thereby forcing the squirrel to enter. Photo by Stephen M. Vantassel.

### *Body-gripping Traps*

Common rat snap traps can be used to kill ground squirrels. Restrict access to traps by nontarget animals by placing them under inverted wooden boxes with a 2-inch hole cut in each end, or use rat-sized bait stations (*Figure 7*). This will, however, reduce success of trapping. The box must allow enough clearance for the trap to operate properly.



**Figure 7.** Cut a 2-inch hole in the end of a container and paint it black. Photo by Stephen M. Vantassel.

All snap traps should be anchored to prevent squirrels from carrying them away. Conceal snap traps that are set against structures by leaning boards over them. Locate snap traps in the same manner as cage traps and secure bait to the triggers. Prebait traps for several days for large jobs or set traps immediately. Set the trigger arm so that it is sensitive and easily springs the trap. Electronic rat traps also are effective for killing 13-lined ground squirrels.

### **Other Control Methods**

Ground squirrels can be captured by pouring water down their burrow and forcing the squirrel to the surface. Use a gallon milk jug turned upside down so that opening is flush with hole. As water fills the den, the ground squirrel will climb into the container. Turn the container over and seal it with the screw-on cap. This approach requires some experience to be effective. Avoid flooding burrows that are adjacent to foundations of buildings or other underground structures that may be damaged by water.

## Disposition

### Relocation

Relocation of 13-lined ground squirrels is not feasible except in rescue situations.

### Translocation

In Nebraska, animals cannot be moved over 100 yards, so ground squirrels can only be relocated outside of structures. Ground squirrels are territorial and would not survive well without access to protective cover from predators.

## Euthanasia

Carbon dioxide is an appropriate method of euthanasia for 13-lined ground squirrels.

## Web Resources

<http://wildlifecontroltraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

# Tree Squirrels

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Figure 1. Fox squirrel (*Sciurus niger*). Photo by Jan Hygnstrom.

## Objectives

1. Identify common squirrels in Nebraska.
2. Understand squirrel biology and characteristics important for resolving conflicts.
3. Demonstrate the ability to educate clients about management options for squirrels.
4. Identify various risks involved with squirrels in and around homes.

## Species Overview

### Conflicts

Squirrels cause economic losses to homeowners, and are a nuisance to people with birdfeeders. Squirrels chew on soffits, eaves, and electrical

wires. They may nest in attics or chimneys. Squirrels often eat seed meant for birds, and feeders are damaged by squirrels.

### Legal Status

Fox and gray squirrels are classified as game species in Nebraska and thus, are protected. Southern flying squirrels are fully protected as nongame wildlife. Landowners in Nebraska can protect their own property without permits if squirrels are causing damage.

### Identification

Three species of tree squirrels are native in Nebraska: the fox squirrel (*Sciurus niger*), eastern gray squirrel (*Sciurus carolinensis*), and southern flying squirrel (*Glaucomys volans*).

### Physical Description

Fox squirrels (*Figure 1*) typically are orange-brown, but color varies greatly from black to silver gray. Fox squirrels are 16 to 20 inches long and weigh  $1\frac{1}{4}$  to  $1\frac{3}{4}$  pounds. Eastern gray squirrels typically are gray, but they have some variation in color, and are about the same size as fox squirrels. The most distinctive characteristics of flying squirrels are the broad webs of skin connecting the fore and hind legs at the wrists, large black eyes, and the distinctly flattened tail. Flying squirrels are 8 to 12 inches long and weigh  $\frac{1}{8}$  to  $\frac{3}{8}$  pounds.

### Species Range

Fox squirrels are found throughout much of Nebraska and often are abundant in wooded farmland and riparian areas, as well as urban areas. Eastern gray squirrels primarily are found in eastern Nebraska. Southern flying squirrels are

uncommon and are found only in forests in southeastern Nebraska.

## Health and Safety Concerns

Squirrels chew on electrical wires, which can cause building fires. Squirrels also may nest in chimneys, creating a fire hazard. If left long enough, squirrels can weaken rafters due to their gnawing.

Gray and fox squirrels are vulnerable to several parasites and diseases. Ticks, mange, fleas, and internal parasites are common. Squirrel hunters often notice bot fly larvae, called “wolves” or “warbles,” protruding from squirrel skin, especially before frosts. The larvae do not impair the quality of the meat, and are not known to harbor diseases dangerous to humans. The droppings of flying squirrels have been associated with murine typhus.

## General Biology, Reproduction, and Behavior

### Reproduction

Fox squirrels first breed when they are about a year old. They breed in early January, and a small percentage (maybe 10% of adult females) breeds again in mid-summer. Younger squirrels often breed only once during their first season. The gestation period is 42 to 45 days.

During the breeding season, noisy mating chases take place when one or more males pursue a female through the trees. Fox squirrels have about three young per litter. At birth they are hairless, blind, and their ears are closed. Young weigh about ½ ounce at birth, and 3 to 4 ounces at 5 weeks. At weaning, they are about half their adult weight. Young begin to explore outside the nest about the time they are weaned, at 10 to 12 weeks. Typically, about half of the squirrels in a population die each year. In the wild, squirrels over 4 years old are rare, while individuals may live 10 years in captivity.

## Nesting/Denning Cover

Tree squirrels rear young in leaf nests (*Figure 2*), tree cavities, and may use chimneys, attics, or soffits (*Figure 3*).



Figure 2. Leaf nest of a tree squirrel. Photo by Stephen M. Vantassel.



Figure 3. A pile of leafy debris serves as the nest for a gray squirrel in a building soffit. Photo by Jim Beucher of Beucher & Son.

## Behavior

Individual home ranges vary from 1 to 100 acres, depending on the season and availability of food. They often seek fruit- and nut-bearing trees and cornfields in the fall. Tender buds of maple trees are favored in the spring. During fall, squirrels may travel 50 miles or more in search of better habitat. Populations of squirrels fluctuate regularly. When population numbers are high, gray squirrels may experience mass emigrations, traveling in large numbers across the landscape, where many individuals die.

## Habitat

Fox squirrels typically occupy any woodlot near agricultural fields, especially woodlots with mast-producing hardwoods. They also are common in cities, especially in and around parks. Flying squirrels, being more arboreal (tree-dwelling), are most common in areas with large, mature hardwoods.

## Food Habits

It is important to distinguish the different behaviors of food storage used by squirrels. Fox squirrels scatter cache, which means they store individual acorns and other seeds in different areas around their home range.

Fox squirrels typically feed on mast in fall and early winter. Acorns, hickory nuts, walnuts, and a variety of fruits are favorite fall foods. Nuts often are cached for later use. In late winter and early spring, they prefer tree buds. In summer they eat fruits, berries, fungi, corn, and cultivated fruits when available. Squirrels may chew bark from a variety of trees in early spring.

Flying squirrels have similar diets, except they are the most carnivorous of all tree squirrels. They eat bird eggs and nestlings, insects, and other animal matter when available.

## Voice, Sounds, Tracks, and Signs

Squirrels emit a variety of sounds including churrs, barks, and squeals. Churrs express anger, barks act as warnings, and squeals occur when a squirrel is terrorized or in pain.

Tracks of squirrels commonly are observed in mud, soft soil, and snow (*Figure 4*).

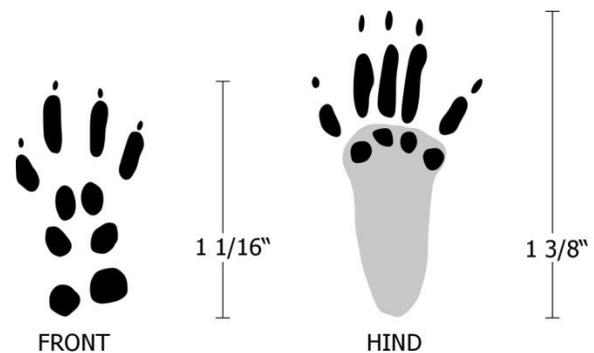


Figure 4. Tracks of a red squirrel. They are similar to but a third smaller than tracks of fox and gray squirrels. Image by Dee Ebbeka.

## Damage Identification

### Damage to Landscapes

Squirrels may damage lawns or planting beds by burying or digging up nuts. They chew bark and clip twigs on woody ornamentals planted in yards (especially maples). Squirrels occasionally damage trees by chewing and stripping bark from branches and trunks. They also eat conifer cones and nip twigs.

Squirrels often take seed at feeders intended for birds. Squirrels do not pose a threat to pets, but will consume bird eggs and nestlings. Flying squirrels are small enough to enter most birdhouses and are likely to eat nestling birds.

### Damage to Crops and Livestock

Squirrels may eat planted seeds, mature fruits, corn, and grains.

Squirrels can severely curtail nut production by eating nuts prematurely and by carrying off mature nuts. In fruit orchards, squirrels may eat blossoms and destroy ripening fruit. Gray squirrels chew the bark of various orchard trees.

Squirrels do not pose a threat to livestock.

## Damage to Structures

Fox squirrels typically gnaw holes the size of a baseball (*Figure 5*) in wooden structures. Holes of flying squirrels are the size of a quarter.



Figure 5. Hole from a tree squirrel.  
Photo by Stephen M. Vantassel.

Squirrels often travel on power lines and may short out transformers. They gnaw on wires, enter buildings, and build nests in attics. They chew holes through plastic tubing used in maple syrup production. Feces of flying squirrels mixed with urine can cause stains (*Figure 6*).



Figure 6. Urine and feces below an attic vent where flying squirrels were exiting the home.  
Photo by Stephen M. Vantassel.

Squirrels may enter buildings through uncapped chimneys and cause substantial damage. If a squirrel gets trapped in a seasonal cabin during winter, it may chew window framing trying to escape. Carpets and other fabrics can be chewed and destroyed.

Squirrels also may try to nest on chimney dampers, especially in areas with few mature trees with nesting cavities. This creates a fire hazard when the stove or fireplace is first used in the fall.

## Damage Prevention and Control Methods

For landowners experiencing long-standing conflicts with tree squirrels, it is helpful to use a variety of cost-effective methods to control the damage.

### Habitat Modification

Trim limbs and trees 6 to 8 feet away from buildings to prevent squirrels from jumping onto roofs. In yards where squirrels cause problems at bird feeders, modify bird feeders with baffles to prevent foraging by squirrels at the feeder itself. Add a hopper to collect spilled seed and prevent feeding on the ground. Use milo or millet seed, as these small, hard seeds are less attractive to squirrels than sunflowers or corn.

### Exclusion

Prevent squirrels from traveling on wires by installing 2-foot sections of lightweight 2- to 3-inch diameter plastic pipe. Slit the pipe lengthwise, spread it open, and place it over the wire. The pipe will rotate on the wire and cause traveling squirrels to tumble. Critter Guard® has created a device to stop squirrels from crossing wires. **Never** install wire guards on or near electrical lines. Only professional electricians and employees of power companies should handle power lines.

Prevent squirrels from climbing isolated trees or utility poles by encircling them with a 2-foot-wide collar of sheet metal 6 feet above the ground (Figure 7). Consult the local power company before installing anything on a power pole. Attach metal bands using encircling wires held together with springs to allow for tree growth.



Figure 7. A tree trunk wrapped with aluminum flashing may prevent squirrels from climbing.

Photo by Stephen M. Vantassel.

Close openings to buildings with heavy-gauge, ½-inch wire mesh or aluminum flashing. Wire-mesh fences topped with electrified wires may keep squirrels out of gardens or small orchards.

## Frightening Devices

No frightening devices have been proven effective, although strobe lights in attics have shown some promise.

## Repellents

We do not recommend the use of moth balls (naphthalene) to repel squirrels because the chemical can cause severe distress to people. This is an off-label use, and is illegal in Nebraska.

Ro-pel® is a taste repellent that can be applied to seeds, bulbs, flowers, trees, shrubs, poles, fences, siding, and outdoor furniture. Effectiveness varies greatly, as rodents typically are not deterred by bitter tastes. Another taste repellent, capsaicin, is registered for use on tubing and equipment used to collect maple sap.

Polybutenes are sticky materials that can be applied to buildings, railings, downspouts, and other areas to keep squirrels from climbing. Polybutenes can be messy, and can stain building finishes. A pre-application of masking tape is recommended. These products are best used to stop gnawing damage indoors. Outdoors, they quickly become covered with dust and dirt and lose effectiveness.

## Toxicants

No toxicants are registered for the control of tree squirrels.

## Shooting

Offending squirrels can be controlled using a .22-caliber rifle or a shotgun with No. 6 shot. Firearms cannot be discharged in many urban areas due to discharge regulations. Fox and gray squirrels are game animals in Nebraska and lethal control may require a permit. Nebraska regulations allow homeowners to take (kill) squirrels causing property damage. If there is any question, check with Nebraska Game and Parks Commission (NGPC).

## Trapping

Gray and fox squirrels are classified as game species in Nebraska, so trapping permits may be required from NGPC. Place traps near den holes or on travel routes. Do not rely on bait to overcome poor location of traps. Most traps will be placed off the ground, so make sure they are secured to something solid. Use at least three traps for gray and fox squirrels, and five or more for smaller squirrels. Remove competing food sources such as bird feeders.

## Disposition

### Relocation

In rescue situations, such as from chimneys or basements, consider on-site release of squirrels, provided the entrance to the structure has been secured.

### Translocation

Translocation puts considerable stress on both transported and resident squirrels. In addition, many are concerned about the potential for transmitting diseases. In Nebraska, animals cannot be moved over 100 yards, so tree squirrels can only be relocated outside of structures.

## Euthanasia

Carbon dioxide is the preferred method of euthanasia for tree squirrels. Squirrels expire relatively quickly in carbon dioxide chambers. Shooting is also a good method for larger squirrels if it is safe and legal in your area.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://Critterguard.org>

<http://extension.org>

# Voles

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Figure 1. Meadow vole (*Microtus pennsylvanicus*). Photo by Stephen M. Vantassel.

## Objectives

1. Identify common vole species and distinguish them from moles.
2. Communicate to clients the options for the management of vole damage.
3. Explain mistakes that typically are made during the management of vole damage.

## Species Overview

### Conflicts

Voles (*Microtus spp.*) can damage garden plants, flower bulbs, and girdle trees by chewing the bark. Runways and tunnels can ruin lawns, golf courses, and ground covers. Prairie voles (*M. ochrogaster*) and meadow voles (*M. pennsylvanicus*, *Figure 1*) usually cause plant damage above ground. Pine voles (*M. pinetorum*) are more fossorial (live underground) and frequently girdle plant roots.

## Legal Status

Voles are nongame mammals and can be controlled whenever they are causing damage.

## Identification

Voles (*Figure 1*), also called meadow mice or field mice, are small New World rodents. Voles have relatively small and inconspicuous ears and eyes and short tails, compared to native mice.

## Physical Description

Voles are compact animals with stocky bodies, short legs, and short tails. The eyes are small and the ears are not very visible. Voles usually are brown or gray, although many color variations exist. Tentative identification of an individual can be made using the information provided in this chapter. For positive identification, use a field guide or contact an expert.

**Prairie voles** are 5 to 7 inches in total length. The fur on the body is a grizzled brownish-gray. Underparts are whitish or yellowish. The tail is relatively short.

**Meadow voles** have a total length of 5½ to 7½ inches. The fur is gray to yellow-brown and obscured by black-tipped hairs. Underparts are gray, sometimes washed with silver or buff. The tail is bicolored.

**Pine voles** are 4 to 6 inches in total length. The brown fur is soft and dense. Underparts are gray, mixed with some yellow to cinnamon. The tail is barely bicolored or uniform in color.

## Species Range

The prairie vole thrives in drier conditions than the meadow and pine voles. Thus, they are found throughout Nebraska. The meadow vole is found mostly in northeastern Nebraska and the pine vole is limited to the southeastern tip of the state.

## Health and Safety Concerns

Voles pose no major hazard to public health because of their infrequent contact with humans. They may carry diseases such as plague (*Yersinia pestis*) and tularemia (*Francisilla tularensis*). Ectoparasites such as mites and ticks feed on voles. Use protective gloves when handling voles.

## General Biology, Reproduction, and Behavior

### Reproduction

Voles may breed throughout the year, but most commonly in spring and summer. Voles typically have one to five litters per year. Litter sizes range from 1 to 11, but the average is three to six. The gestation period is about 21 days. Young are weaned by the time they are 21 days old, and mature in about 35 days. Females can breed as soon as they reach maturity. The lifespan of a vole is short, ranging from 2 to 16 months.

Population levels generally peak every 2 to 5 years, although cycles are not predictable. During population irruptions, densities of voles have risen to 4,000 voles per acre! A density of several hundred voles per acre is common in good habitat, such as orchards or shrubby meadows. Dispersal, food quality, climate, predation, physiological stress, and genetics influence the population levels.

### Nesting/Denning Cover

Meadow voles usually establish nests above ground, or in shallow depressions. Pine voles typically establish complex burrow systems down to 4 feet below ground. For this reason, pine voles

tend to prefer loose, sandy or loam soils, and avoid heavy, wetter clay soils.

## Behavior

Voles are active day and night, year-round. They do not hibernate. Home ranges usually are  $\frac{1}{4}$  acre or less but vary with season, population density, habitat, food supply, and other factors. Voles construct many tunnels and surface runways with numerous entrances to a burrow. A single burrow system may contain a social group with several adults and young.

## Habitat

Voles occupy a wide variety of habitats. They prefer areas with heavy ground cover of grasses, forbs, and plant litter. Voles use habitats modified by humans such as orchards, windbreaks, and cultivated fields, especially when vole populations are high. Meadow voles prefer wet meadows and shrub land habitats in northeastern Nebraska. Pine voles prefer heavy ground cover along forest edges, abandoned fields, and orchards.

## Food Habits

Voles eat a variety of plants, most frequently grasses and forbs. In late summer and fall they store seeds, tubers, bulbs, and rhizomes. They primarily eat bark during winter, and will eat crops during spring and summer, especially when densities of voles are high. Occasionally they eat snails, insects, and the remains of animals.

## Voice, Sounds, Tracks, and Signs

Pine voles make a high pitched noise that may serve as a warning signal.

## Damage Identification

The most easily identifiable sign of meadow voles is an extensive surface runway system (*Figure 2*) with several openings to burrows. Runways are 1 to 2 inches wide. Vegetation near well-traveled runways may be clipped close to the ground. Feces and small pieces of vegetation are found in runways.

Pine voles do not use surface runways. Instead they build an extensive system of underground tunnels.



Figure 2. Trails cut into the grass and soil. Photo by the University of Nebraska–Lincoln (UNL).

## Damage to Landscapes

Voles can damage lawns, golf courses, and ground covers with their tunnels and runways.

Voles can cause extensive damage to orchards, ornamentals, and tree plantings through girdling, usually in late fall and winter (*Figure 3*). Marks from girdling and gnawing alone are not necessarily indicative of damage by voles because other animals, such as rabbits, may cause similar damage. Marks of voles are about  $\frac{1}{8}$  inch wide,  $\frac{3}{8}$  inch long, and  $\frac{1}{16}$  inch or more deep. Marks made by gnawing by rabbits are larger and not distinct. Rabbits neatly clip branches at a  $45^\circ$  angle. Examine the damage and accompanying signs (feces, tracks, and burrow systems) to identify the animal causing the damage. Much of the damage to tree bark occurs under the protection of snow cover. Voles will girdle trees as high as the deepest winter snowfall.



Figure 3. Seedling girdled by voles. Photo by UNL.

## Damage to Crops and Livestock

Voles may damage and destroy field crops, such as corn, soybeans, alfalfa, clover, potatoes, and sugar beets. Runways and tunnels of voles interfere with crop irrigation by displacing water and causing soil erosion.

Voles do not pose a direct threat to animals, but may consume and contaminate stored feed.

## Damage to Structures

Voles occasionally invade structures but usually present little threat. Voles often will enter buildings or greenhouses near suitable habitat during the first snowfall seeking warmth and potential food plants. Damage to stored plants in greenhouses can be substantial and costly.

## Damage Prevention and Control Methods

The control of voles may not appear to be justified in comparison to the damage, but the “ounce of prevention” rule often applies. Preventive measures that are costly up front may be the most economical options in the longterm.

Timely control of voles is important. Their populations can increase rapidly, so it is important to monitor their population levels where damage is a concern. Voles do not hibernate and can be controlled whenever damage reaches levels that are intolerable. In field settings, it is important to reduce vole populations in fall before the first snowfall. Once snow covers the ground, options for vole control are limited and difficult.

### Habitat Modification

Remove or modify bird feeders to reduce spillage. Eliminate ground cover with either repeated close mowing or herbicides. Cultivate soil to destroy burrows and reduce cover. Mow grasses and other vegetation to less than 2 inches in height.

Voles are attracted to many types of natural and synthetic mulches, and weed prevention mats. The overhead cover provides excellent protection for their runways and creates ideal breeding conditions. If vole problems occur frequently, remove mulch and expose bare soil. About the only mulches that will not support a vole tunnel system are coarse stone, or large chunks of pine bark. Voles will tunnel underneath shredded pine bark.

### Exclusion

Use wire cages to protect trees and ornamental plants. Trench cages into the ground at least 2 inches, or surround them with coarse stone. Cages must be higher than the deepest anticipated snow depth during winter, or voles will climb over the top and girdle the trees. Plastic tree wraps are less effective because they tend to break down in UV light, and may unfurl in high winds, exposing tree bark.

### Frightening Devices

No devices are effective in frightening voles.

### Repellents

Registered repellents for voles include capsaicin, and thiram. Fox and coyote urine are available either as a liquid or powder, although their effectiveness is uncertain. Follow all label and application instructions.

### Toxicants

Registered toxicants include zinc phosphide and anticoagulants (e.g., chlorophacinone). Most products are restricted use pesticides (RUPs) and may only be applied by certified applicators. Follow label directions carefully. Use of T-tube bait stations will reduce access of nontarget animals to toxic baits. Toxic baits should be used as a last resort if exclusion or habitat modification has failed to reduce damage to tolerable levels.

### Shooting

Shooting is not practical or effective for managing voles.

### Trapping

Mouse snap traps, box traps (Sherman-type), and multiple-catch traps are effective for capturing voles. Set traps where vole activity is observed, such as near runways and burrow openings. Bait them with apple slices, the vole’s favorite food. Place baited traps under cover to prevent injury to nontarget animals such as birds.

### Other Methods

Provide perches in large agricultural areas for raptors that may feed on voles. Although raptors and other predators may take many voles, their impact is usually not enough to reduce vole population growth, especially during a population irruption.

## Disposition

### Relocation

Relocation of voles is not recommended.

### Translocation

Translocation of voles is not recommended.

### Euthanasia

Voles can be euthanized with carbon dioxide gas or by cervical dislocation.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Woodchucks

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Figure1. Woodchuck (*Marmota monax*) in a tree.  
Photo by Bamyers99.

## Objectives

1. Explain how woodchuck behavior impacts management.
2. Communicate options for damage management to clients.
3. Describe some risks posed by woodchucks.

## Species Overview

### Conflicts

Woodchucks may damage vegetables in gardens, strip fruit from tree limbs, and damage or kill trees. Woodchuck burrows may undermine building foundations and be a hazard for field equipment or livestock.

### Legal Status

Woodchucks are unprotected in Nebraska and can be controlled if they are causing or about to cause damage.

## Identification

Woodchucks (*Figure 1*) are large members of the squirrel family and are closely related to other species of marmots in North America. They also are known as ground hogs and whistle pigs.

## Physical Description

Woodchucks usually are grizzled gray-brown from head to toe. Its compact, chunky body is supported by short strong legs. The forefeet have long, curved claws that are well adapted for digging burrows. The tail is short, furred, and dark brown. As with other rodents, woodchucks have yellow-white, chisel-like incisor teeth. The eyes, ears, and nose are located toward the top of the head, allowing the animal to remain concealed in its burrow while checking for danger over the rim of the burrow opening.

Both sexes are similar in appearance, but males are slightly larger. Woodchucks weigh 5 to 10 pounds. The total length of the head and body averages 16 to 20 inches, and the tail is 4 to 7 inches long.

## Species Range

Woodchucks occur throughout the eastern and central US. In Nebraska, they are most often found in eastern agricultural and urban areas.

## Health and Safety Concerns

Woodchucks occasionally scare homeowners by aggressive displays known as bluff charges. Healthy woodchucks will flee from people, although woodchucks will defend themselves when cornered. Pets and children should not approach woodchucks. Although rare, woodchucks may be infected with rabies, tularemia, and hepatitis. A variety of

ectoparasites, including ticks, that are disease vectors also infest woodchucks.

Dens may cause safety issues for pedestrians and wheeled vehicles, particularly on hillsides.

## General Biology, Reproduction, and Behavior

### Reproduction

Woodchucks breed in March and April. One litter of two to six young (usually four), is produced each year, after a gestation period of about 32 days. Young are born blind and hairless, and weaned by late June or early July. They leave the nest soon after they are weaned. Young frequently occupy dens or burrows that have been abandoned. New burrows that appear during late summer usually are dug by older woodchucks.

The lifespan of a woodchuck is 3 to 6 years.

### Nesting/Denning Cover

Woodchucks commonly place burrows in fields and pastures, at the base of trees, and along fence rows, stone walls, and building foundations. The burrow serves as home to the woodchuck for mating, weaning young, hibernating, and protection. Woodchucks maintain sanitary den sites and burrow systems, and replace nest materials frequently. A burrow or den system is used for several seasons. The system is irregular and may be extensive. Burrows may be 5 feet deep, and 8 to 66 feet long (*Figure 2*).

A woodchuck burrow has a large mound of excavated earth at the main entrance, called a porch. The main opening typically is 10 to 12 inches in diameter. Many burrows have two or more entrances. The secondary entrances are dug from below the ground, and do not have mounds of earth beside them, making them difficult to locate. The secondary entrances provide an escape to or away from the den when pursued by predators. Burrows not in use by woodchucks provide habitat for rabbits, weasels, and other wildlife.

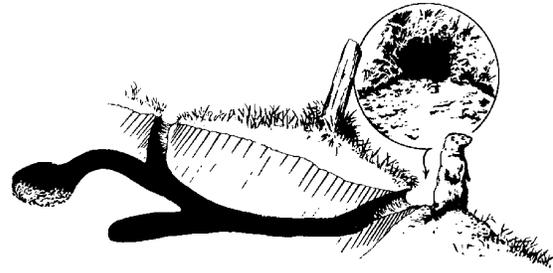


Figure 2. Schematic of a woodchuck den. Structure varies by location. Image by Prevention and Control of Wildlife Damage (PCWD).

### Behavior

Woodchucks enter true hibernation near the end of October or early November, and continue until late February and March. In northern latitudes, hibernation generally starts earlier and ends later. Males usually come out of hibernation before females and sub-adults, and may travel long distances in search of a mate.

Woodchucks usually range 50 to 150 feet from their dens during the daytime. This may vary during the mating season and depend on the availability of food. Woodchucks primarily are active during daylight. They sometimes bask in the sun during the warmest periods of the day and may doze on fence posts, stone walls, large rocks, or fallen logs close to the entrance of their burrow. Woodchucks are good climbers, and are sometimes seen in lower tree branches.

### Habitat

In general, woodchucks prefer open farmland, edges of crop fields and orchards, and wooded or brushy areas.

### Food Habits

Woodchucks forage most heavily in the early morning and evening. They primarily are herbivores and feed on a variety of vegetables, grasses, and legumes. Preferred foods include soybeans, beans, peas, carrot tops, alfalfa, clover, and grasses.

## Voice, Sounds, Tracks, and Signs

When startled, a woodchuck may emit a shrill whistle or alarm, proceeded by a low, abrupt “pew,” and followed by a low, rapid warble that sounds like “tchuck, tchuck.” The woodchuck makes this call when startled at its burrow entrance. Tooth popping and chattering may indicate that a bite is eminent.

Woodchucks can be identified by observing individuals during the day, and by finding den entrances. The presence of flies may signify an active den. Den holes average 10 to 12 inches in diameter with excavated soil in front of the main entrance.

The hind feet of a woodchuck are 2 to 3 inches long (*Figure 3*) and frequently obscure tracks of the front feet. Tracks may be found in sandy areas

Woodchucks deposit scat underground, making it a rare find.

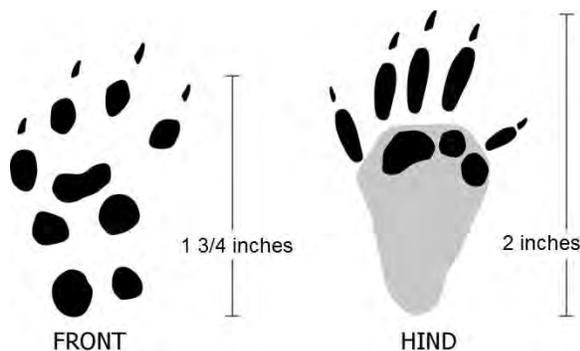


Figure 3. Tracks of a woodchuck. Image by Dee Ebbeka.

## Damage Identification

### Damage to Landscapes

Woodchucks can damage vegetables; they are often a major problem for home gardeners. Trees and ornamentals may be severely damaged or killed by chewing and territorial marking (*Figure 4*). Woodchucks may strip apples or cherries from trees in the vicinity of dens. Woodchucks readily climb fruit trees, causing damage to limbs and fruit. Broken limbs of fruit trees can be mistaken for damage by raccoons.



Figure 4. Damage to a fruit tree by woodchucks. Photo by Robert K. Swihart.

### Damage to Crops and Livestock

Woodchucks can cause significant damage to crops such as beans, lettuce, peas, carrots, cabbage, clover, and plantain. Woodchucks can damage nursery trees, fruit trees, and forage crops such as alfalfa and clover. Woodchucks are not a threat to livestock.

### Damage to Structures

Woodchuck burrows undermine foundations of buildings, pools, and sidewalks. Woodchucks chew on wood and may gnaw on pipes, irrigation lines, hoses, and wires.

## Damage Prevention and Control Methods

### Habitat Modification

Close sheds and make them tight to prevent entry by woodchucks. Remove piles of rock, wood, and brush that may be attractive den sites. Keep fields and ditch banks mowed to expose woodchucks to predators.

### Exclusion

Surround gardens with a 3-foot-high, wire-mesh fence with a 9- to 12-inch overhang. Bury a skirt of

wire that extends 2 inches underground and 18 inches out from the vertical fence to prevent digging. Use single- or double-strand electric fences less than 8 inches aboveground where legal.

## Frightening Devices

Dogs can frighten woodchucks from an area.

## Repellents

Fox urine is registered as a repellent for woodchucks, although its effectiveness has not been studied. Follow all label requirements; clients may not want to apply urine to food crops.

## Toxicants

Gas cartridges are fumigants registered for the control of burrowing rodents, including woodchucks. Follow label instructions carefully, as gas cartridges pose a fire hazard, and should not be used near buildings.

## Shooting

A .22-caliber rifle or shotgun with No. 4 shot, in the hands of an experienced shooter, can eliminate problem woodchucks. Shooting may be limited in urban areas due to discharge regulations. Although shooting may remove a problem woodchuck, research has shown that empty burrows quickly may be reoccupied during the growing season.

## Trapping

Use a cage or box trap, such as a 10- x 12- x 32-inch single-door, or a 9- x 9- x 32-inch two-door trap for woodchucks. Bait cage traps with apples or other fruits.

An experienced trapper could use the appropriately sized Conibear® or foothold trap to remove a woodchuck efficiently. However, some communities have regulations that prohibit such sets. Check with the NGPC for more information.

## Other Methods

Woodchucks can be flooded out of dens and into nets, although be careful using this method near buildings. Plug all burrow openings that can be found, except for the main entrance. Stretch a 2- x 2-inch mesh net loosely over the opening, and run water into the main entrance through a garden hose. Be prepared to euthanize the netted woodchuck, or move it into a transfer cage.

## Disposition

### Relocation

Relocation is not recommended unless the woodchuck is being rescued.

### Translocation

Captured animals can only be transported up to 100 yards to ensure increased humaneness and reduced spread of disease.

### Euthanasia

Where shooting is allowed, an experienced shooter with a .22 caliber firearm is a good option. Direct a shot to the head from close range. Don't shoot the head if the animal is to be tested for rabies. Follow rules of firearm safety at all times. Woodchucks also can be euthanized by carbon dioxide gas.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

# Woodpeckers

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Figure 1. Female downy woodpecker (*Picoides pubescens*). Photo by Stephen M. Vantassel.

## Objectives

1. Explain key elements about the biology of woodpeckers that are important for managing the damage they cause.
2. Explain options for managing damage caused by woodpeckers.

## Species Overview

### Conflicts

Woodpeckers can damage wood siding and soffits on structures. They also may cause economic losses to utility companies due to cavities in wooden poles. The weakened poles could snap in high winds. Woodpeckers' springtime, territorial "drumming" on wooden or metal objects can be annoying to people during the early morning.



Figure 2. Yellow-bellied sapsucker (*Sphyrapicus ruber*). Photo by William H. Majoros.

### Legal Status

All species of woodpeckers are classified as migratory nongame birds and are protected by the Federal Migratory Bird Treaty Act (MBTA).

When warranted, woodpeckers can be killed, but only under a depredation permit issued by the

Law Enforcement Division of the US Fish and Wildlife Service (USFWS). Authorization by the Nebraska Game and Parks Commission also may be required before lethal control methods are initiated.

Sound justification must be present for the issuance of depredation permits. Hazing woodpeckers does not require a permit.

## Identification

Woodpeckers are found throughout the US. In Nebraska, the most common species include the downy (*Figure 1*), hairy (*Picoides villosus*), and red-headed (*Melanerpes erythrocephalus*) woodpeckers; yellow-bellied sapsucker (*Figure 2*); and the northern flicker (*Colaptes auratus*). Woodpeckers become a nuisance and cause damage to structures in some situations. They also they provide valuable ecological services. Woodpeckers consume substantial numbers of insects, some of which are agricultural and forest pests. They are remarkable, intriguing animals to observe.

## Physical Description

Woodpeckers have sharp pointed beaks for excavating holes into wood, and long tongues to dislodge insects. The stiff tail feathers serve as a prop when climbing vertical surfaces. Each foot has two talons that face forward and two that face backward, enabling the birds to cling to trees and vertical wooden structures. Woodpeckers usually are 7 to 15 inches in length.

Adult males of most species have a pattern of black, white, and red. Females are similar, but most lack red markings. Northern flickers are light brown with black and white stripes on the back, yellow or red under-wing, with a black crescent on the breast, and a grey hood with a red crescent.

## Species Range

Range depends on species. Consult a bird field guide for more information.

## Health and Safety Concerns

Woodpeckers are not known to be a significant disease risk for humans or domestic animals.

## General Biology, Reproduction, and Behavior

### Reproduction

Clutch size and other characteristics vary with species. Most species have one brood per year, but red-bellied woodpeckers may have up to three broods. Typical clutch size is three to eight eggs, with an incubation period of approximately 11 to 12 days. The nestling period often lasts 18 to 30 days, depending on the species. Egg color is usually white. Consult a bird field guide for more information.

### Nesting/Denning Cover

Woodpeckers nest in cavities in trees or structures. Nest cavities are hollowed out areas below and perpendicular to the entrance. Cavities may be chiseled into tree trunks, branches, or structures, or may be natural or pre-existing cavities. Both sexes may help excavate the nest cavity, and sleep in it throughout the year.

Some species, such as downy and hairy woodpeckers, excavate new cavities each year. Others, such as northern flickers, return to the same cavity annually. Some species, such as yellow-bellied sapsuckers, prefer to excavate cavities in live trees, while red-headed woodpeckers favor dead trees.

### Behavior

Some species, such as northern flickers, yellow-bellied sapsuckers, and red-headed woodpeckers are migratory. Most woodpeckers live year-round in the same area in small social groups.

### Habitat

Woodpeckers depend on trees for shelter and food, and generally are found in or on the edge of wooded areas.

Red-headed woodpeckers reside in areas of low elevation along stream courses, or in open country with extensive grasslands and small woodlots. Yellow-bellied sapsuckers are found in heavily forested areas. Downy and hairy woodpeckers are widespread and common in almost any habitat where deciduous trees occur and are common suburban residents. The northern flicker is common in habitats ranging from city parks to heavily forested areas, although it has experienced significant declines in recent years.

## Food Habits

Most woodpeckers feed primarily on tree-living or wood-boring insects, but may feed on a variety of other insects including ants, wasps, and bees found on trees. Northern flickers commonly feed on ants they gather from the ground. Many woodpeckers also feed on berries, fruit, nuts and seeds, particularly when insects are not available.

Yellow-bellied sapsuckers feed on sap that oozes from horizontal rows of small holes they drill into tree trunks. Their tongues are shorter and have fine, hair-like processes on the tip that help collect sap. Sap also serves as a trap from which insects can be harvested.

## Voice, Sounds, Tracks, and Signs

Each species of woodpecker has characteristic calls. They also use a rhythmic pecking sequence to make their presence known. Referred to as “drumming,” pecking establishes territories and apparently attracts or signals mates. Both sexes drum by striking their bills against a hollow or dried branch or other hollow or resonant objects.

## Damage Identification

### Damage to Landscapes

Sapsuckers bore a series of parallel rows of ¼- to ⅜-inch holes, closely spaced in the bark of healthy trees, and use their tongues to remove the sap. Sapsuckers usually feed on just a few ornamental or fruit trees, while nearby trees of the same species may be untouched. Continued pecking will enlarge holes and large patches of bark may be

removed or slough off. The girdling of limbs and trunks may kill trees. Wounds of attacked trees may attract insects, porcupines, and tree squirrels. Wounds from feeding also serve as entrances for diseases and wood-decaying organisms. Wood-staining fungi and bacteria may enter the wounds and cause a grade defect called “bird peck” that lowers the value of hardwoods.

Vegetable matter makes up much of the diet of some woodpeckers. Native and cultivated fruits and nuts play an important role in their diet.

### Damage to Crops and Livestock

Birds involved in orchard depredation often are so few in number that damage is limited only to a small percentage of the crop. Rarely are control actions to protect commercial crops necessary. A crop of isolated backyard fruit or nut trees may, however, be severely reduced.

Some woodpeckers will kill young birds and eggs. Occasionally, woodpeckers drill into and devastate beehives.

### Damage to Structures

Damage by woodpeckers is easily identified by the pounding noise and excavated holes. Damage to buildings is a relatively infrequent problem nationwide, but may be widespread regionally or locally. Houses or buildings with wooden exteriors near wooded areas or in rural wooded settings most likely will suffer pecking damage, although structures with synthetic siding also may be damaged. Damage to a building typically involves only one or two birds, but may involve up to six or eight individuals during a season. Most damage occurs from February through June, which corresponds with the breeding season and territory establishment, and again in the fall during dispersal and establishment of new territories.

Holes may be drilled into wood siding, eaves, window frames, and trim boards. Woodpeckers prefer cedar and redwood siding, but will damage pine, fir, cypress, and others when available. Natural or stained wood surfaces are preferred over painted wood. New houses often are primary

targets. Rustic-appearing, channeled plywood with cedar or redwood veneers are particularly vulnerable to damage. Woodpeckers also have been found to damage plastic used for rooftop solar heating and electric panels.

Imperfections in the layers of intercore plywood exposed by the vertical grooves may harbor insects. Woodpeckers often break these core gaps, leaving characteristic narrow horizontal damage patterns in their search for insects. If a suitable cavity results from feeding, it also may be used for roosting or nesting.

Woodpecker damage to wooden fence posts can be a serious problem for some farmers and ranchers.

## Nuisance

Drumming on the sides of houses, chimneys, and eaves, especially during spring, can be annoying to people during early morning. Sometimes woodpeckers will drum on other metal objects, such as signs or gutters.

## Damage Prevention and Control Methods

Damage by woodpeckers should be addressed as soon as it appears.

## Habitat Modification

Remove dead trees. Construct buildings with woodpecker-resistant siding. Application of insecticides to reduce insect populations may provide indirect control by removing the food source. Providing suet as an alternative food or nest boxes as alternative roost cavities has shown poor results for reducing damage by hairy and downy woodpeckers.

## Exclusion

Exclude woodpeckers by covering susceptible areas with nets or metal barriers. Repair damage quickly.

## Frightening Devices

Devices with recorded distress calls of woodpeckers and hawk predator calls failed to reduce damage to buildings in a recent study.

Visual strips of Irri-Tape™ or Mylar® tape suspended on cords along the faces of buildings with woodpecker holes deterred birds and reduced new incidences of pecking damage.

## Repellents

Polybutenes are sticky gels that can be applied to vertical structures to repel woodpeckers, but they may discolor siding. Methyl anthranilate (ReJex-it™) may be sprayed on siding to repel woodpeckers if the damage is caused by feeding activity. Check pesticides registered for use in Nebraska and follow label requirements.

## Toxicants

No toxicants are registered for use on woodpeckers.

## Shooting

A .177-and .22-caliber rifle, or shotgun with size 7½ shot, are effective. Proper federal and state permits must be acquired. Many communities or states have laws restricting firearm discharge in suburban areas.

## Trapping

A rat snap trap mounted vertically on damaged siding with the trigger down and baited with nutmeats or suet can be used to kill woodpeckers. Proper federal and state permits must be acquired.

## Disposition

### Relocation

Given the mobility of birds, relocation of woodpeckers is suitable only in rescue situations.

## Translocation

Given the mobility of birds, translocation of woodpeckers is suitable only in rescue situations.

## Euthanasia

Lethal control of woodpeckers requires federal and state permits. Carbon dioxide gas and cervical dislocation are appropriate techniques for the euthanasia of birds.

## Web Resources

<http://WildlifeControlTraining.com>

<http://icwdm.org/>

<http://wildlifecontrol.info>

<http://extension.org>

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# Glossary

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**Active ingredient** The chemical compound that affects an organism's behavior or biology.

**Agent** An organism or entity (bacterium, virus, fungus) that causes disease.

**Anticoagulant** A toxicant that kills an animal by interfering with clotting of the blood (warfarin, diphacinone).

**Bait** Food-based materials that animals find attractive to eat.

**Baited set** A trap set with food or lures to attract a target animal into the set.

**Banger (bird bombs)** An explosive cartridge that makes a loud bang to repel birds.

**Barbiturate** A group of drugs that sedate and can kill animals.

**Best management practice (BMP)** An effective method for solving a human-wildlife conflict that also minimizes risks to the environment and human health and well-being.

**Biological carrying capacity** The maximum number of individuals of a given population that an environment can sustain without longterm impacts to the environment.

**Biological control** The use of living organisms (disease agents and parasites) or natural processes (e.g., fertility control) to manage wildlife damage.

**Bird bomb** See "banger."

**Bird spikes** Mechanical devices with sharp projections intended to repel birds from landing on surfaces such as building ledges.

**Blind set** A trap placed without bait in an area where a target animal is likely to travel.

**Body-gripping trap** Any trap designed to catch and subsequently kill an animal by snapping the spine with a blow to the back of the neck.

**Box trap** A trap made of solid material (often plastic or metal) that captures an animal entirely within the trap.

**Cable-restraint** A trap consisting of a woven-wire cable that, when tightened around the neck or body of an animal, physically restrains it.

**Cage trap** A trap made from wire mesh that captures an animal entirely within the trap.

**Carbon dioxide (CO<sub>2</sub>) chamber** An enclosed space into which CO<sub>2</sub> gas is added at a controlled rate to euthanize an animal.

**Carnivore** An animal that primarily eats meat.

**Catch pole (snare pole)** A device with an adjustable loop of cable used to capture and restrain an animal.

**Cervical dislocation** A form of euthanasia in which the cervical vertebrae are separated and spinal cord disrupted.

**Copulation** The act of sexual intercourse.

**Cracker** See "shell cracker."

**Damper** The metal plate that controls the size of the opening between a fireplace and chimney to regulate exhaust.

**Decapitation** A form of euthanasia in which the head is cut quickly from the body, primarily used for birds that are too large for cervical dislocation and sometimes for snakes.

**Depredation permit** A permit issued by state and federal government wildlife agencies that allows the use of approved wildlife control techniques on protected wildlife or game species.

**Direct capture** The technique of obtaining control of an animal without the use of traps.

**Diurnal** Active during daylight hours.

**Droppings** See “feces” and “scat.”

**Ectoparasite** A parasite that lives outside the body of its host.

**Edge** The zone between two or more adjacent habitats.

**Endoparasite** A parasite that lives inside the body of its host.

**Environmental Protection Agency (EPA)** A federal agency that establishes and enforces rules to protect the environment. It also regulates pesticide labels, registration, and certification.

**Euthanasia** A humane method of killing that provides as painless a death as possible by causing rapid unconsciousness and rapid death.

**Exclusion** Techniques and products that prevent wildlife from entering an area.

**Exsanguination** A form of euthanasia, known as “bleeding out,” that entails the cutting of major blood vessels to rapidly drain blood from an animal.

**Feces** Solid waste eliminated through the digestive system of an animal.

**Feral** An individual of a domesticated species that lives and behaves as a wild animal.

**Firearm** A device that fires a projectile, using an explosive charge, force of a spring, air, or other gas as a propellant. Includes shotguns, rifles, hand guns, and air rifles.

**Foothold trap** Refers to a variety of traps that restrain an animal by holding the foot. They may be used as live or lethal traps.

**Fossorial** An animal that burrows underground.

**Frightening device** Typically, a nonchemical tool designed to cause animals to avoid areas through the use of fear.

**Fumigant** A toxicant that is inhaled by a target species.

**Game species** Wildlife that may be hunted, trapped, or fished in appropriate seasons.

**Gestation** The length of a pregnancy or the amount of time between conception and birth.

**General use pesticide (GUP)** A relatively low-risk chemical that is regulated by the EPA whose use does not require a license and is sold over-the-counter.

**Habitat** An area that provides an animal its home and its food, water, and shelter.

**Herbivore** An animal that primarily eats vegetation.

**Hibernaculum** Site where snakes hibernate during the winter.

**Home range** The area in which an animal lives, hunts, and breeds throughout its life.

**Host** An organism that sustains a parasite or a disease agent and is negatively affected.

**Humane** A practice or product that causes no unnecessary pain or stress for an animal.

**Hunting** Pursuing, shooting, killing, or capturing wildlife.

**Integrated pest management (IPM)** An environmentally-responsible approach to pest management that involves the timely use of a variety of cost-effective methods to reduce damage to a tolerable level.

**Integrated wildlife damage management (IWDM)** A strategy for resolving conflicts between humans and wildlife while reducing risks to people and wildlife without longterm harm to the environment.

**Lethal blow** A blow to the head of a captured animal which is used to render unconsciousness and a humane death.

**Live trap** A trap that is designed to capture an animal without killing it.

**Louver** A framed ventilation opening that is covered with horizontal slats, usually located in an attic wall.

**Lure** Typically an odorous liquid used to attract animals to a trap set.

**Microtine** A family of small mammals belonging to the subfamily *Microtinae* that includes lemmings, voles, and muskrats.

**Migration** The movement of animals from one area to another and back.

**Migratory Bird Treaty Act (MBTA)** The federal law that protects all species of birds that migrate and are not feral, exotic, or state resident game species.

**Nestling** A young bird that is in the nest under the care of its parents or other adults.

**Niche** The role that an animal plays in its environment.

**Nocturnal** Active during the night.

**Non-anticoagulant** A toxicant that kills animals by means other than interfering with the clotting of blood.

**Nongame species** Wildlife that are protected and not hunted, trapped, or harvested in any way.

**Nontarget animal** An individual or species that is not sought after in a wildlife control process.

**Noseburn** The loss of skin on the nose of an animal, typically through the constant pushing of the snout through the wire of a cage trap.

**Occupational Safety and Health Administration (OSHA)** A federal agency that provides rules for

worker safety, investigates complaints, and enforces compliance.

**Omnivore** An animal that eats plant, animal, and other materials.

**Opportunist** An animal that is adaptive and takes advantage of many things in its environment for food, water, and shelter.

**Ordinance** A rule established by a local or municipal government.

**Parasite** An organism that feeds on another organism (the host) and is detrimental to the host.

**Pesticide** Any substance designed to prevent, destroy, repel, or mitigate any pest.

**Porcupine wire** See “Bird spikes.”

**Personal Protective Equipment (PPE)** Gear worn to protect people from pesticides, contaminants, and mechanical injury (boots, gloves, goggles, respirators).

**Positive set placement** Positioning a trap in front of a hole such that only animals exiting or entering the hole are caught.

**Predator** An animal that obtains nourishment by killing and eating other animals.

**Propane cannon** A mechanical device that makes a loud explosion to repel birds by igniting a small amount of propane.

**Prophylaxis** To try to prevent something from happening. Usually a treatment, such as a vaccine, that protects someone from a disease.

**Pyrotechnics** Frightening devices that use explosive charges similar to fireworks, such as screamers, bangers, and shell crackers.

**Regulation** A rule created by an agency that interprets and applies a law or statute.

**Relocation** Moving an animal from the site of capture and releasing it within its home range.

**Repellents** Chemicals used to cause animals to avoid a given location due to pain, fear, touch, and conditioned aversion.

**Reservoir** Organisms that sustain disease agents, but are not negatively affected.

**Restricted use pesticide (RUP)** A relatively high-risk chemical that is regulated by the EPA, the use of which requires a certification or license.

**Scat** See “feces.”

**Scavenger** An animal that obtains its nourishment by eating dead and decaying animals.

**Screamer** A pyrotechnic device that makes a long, drawn out whistle to repel birds.

**Set** The location and positioning of a trap, bait, and lure (if any) to capture an animal.

**Shell cracker (cracker)** A pyrotechnic device propelled from a shotgun that explodes to repel birds.

**Sill plate** The board on the top of a foundation wall that connects to a house wall.

**Smoke shelf** The flat area inside a chimney behind the damper.

**Social carrying capacity (SCC)** The number of animals that a person or community will tolerate in a given area.

**Soffit** The framed-in and covered section of a building beneath the eaves.

**Species-specific trap** A trap designed to reduce capture of nontargets.

**Statute** A law created by an act of the state legislature or US congress.

**Stun** Delivery of a “blow to the head” of a captured animal to render it unconscious so another killing method can be used safely. Stunning may be intended as the primary killing

method, in which case it is usually referred to as a “lethal blow.”

**Taking/take** Pursuing, shooting, hunting, killing, capturing, trapping, snaring, and netting wildlife and all lesser acts such as disturbing, harrying, or worrying; or placing, setting, drawing, or using any net or other device commonly used to take any such animal.

**Target animal** The specific individual or species that is sought after in a wildlife control process.

**Territory** An exclusive area that often is vigorously defended by an animal for a certain time.

**Translocation** Movement of an animal from a site of capture and release to a location outside its home range.

**Trapping** Taking, killing, and capturing wildlife with traps, deadfalls, and other devices commonly used to take wildlife.

**Vaccination** Introduction of a disease agent (typically a modified virus) to stimulate an immunological response and produce antibodies that will help to ward off illness caused by the disease agent.

**Vector** An organism that carries and transmits a disease agent to an animal.

**Weaning** The period when a mammal transitions from feeding on its mother’s milk to consuming solid food.

**Wildlife Control Operator (WCO)** A professional who handles wildlife complaints for clients.

**Wildlife damage management (WDM)** The process of dealing with vertebrates that cause damage, threaten health and safety, and cause a nuisance.

**Zoonose** A disease originating from wildlife that can be transmitted to humans, also referred to as a zoonotic disease.

## Master Gardener Worksheets

Name \_\_\_\_\_

Date Started \_\_\_\_\_

Date Completed \_\_\_\_\_

State \_\_\_\_\_

Organization \_\_\_\_\_

What are your reasons for learning wildlife control training for Master Gardeners?

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Have you performed any wildlife damage management prior to taking this course? Please describe your areas of expertise and/or interest.

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What species have you worked with? What species would you like to learn more about?

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**After you complete each module of the training program, please fill in the following information:**

### Module 1: Principles of Wildlife Damage Management

List the four WDM strategies:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

What are the three objectives of WDM?

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

## Module 2: Physical Safety

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What three methods should be used to handle a captured animal?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

What are some common pieces of safety equipment?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

## Module 3: Wildlife Diseases

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What are the causes of many common zoonotic diseases?

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List some of the most common zoonotic diseases:

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## Module 4: Site Inspection

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What three questions does a site inspection answer?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Briefly describe the inspection process.

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### Module 5: Wildlife Control Methods

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What are the primary control methods of WDM?

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### Module 6: Exclusion

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Describe some exclusion methods.

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### Module 7: Toxicants

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What are some of the most important safety considerations when using pesticides?

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Why are toxicants potentially hazardous to nontarget species?

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### Module 8: Trapping

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Describe the three types of sets used for trapping.

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### Module 9: Animal Handling

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What is the difference between relocation and translocation?

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What are the tools used in the handling of animals?

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## Module 10: Euthanasia

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What is the difference between capture methods and euthanasia techniques?

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How is animal death confirmed?

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List several euthanasia techniques:

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## Module 11: Hiring a Professional

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How do you identify a client's needs and wishes?

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Why is it so important to explain control options to a client?

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When should you call a wildlife control professional?

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## Module 12: Legal and Ethical Principles

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Who is responsible for regulating the control of wildlife?

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Describe a few of the principles of WDM.

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