Acknowledgements

There are a great number of people and institutions that participated in creating this manual. Cornell University and the University of Nebraska were instrumental in providing support for this project. Much of the material was based on the ***Best Practices for Nuisance Wildlife Control Operators***, by Paul Curtis, Jill Schultz, Lynn Braband and the New York Department of Environmental Conservation. Addition support came from the regional IPM centers and the New York State Integrated Pest Management Program.

Much of the species information came from the ***Prevention and Control of Wildlife Damage***, edited by Scott Hygnstrom et all. Numerous people have worked on editing, updating and improving this material. A special thanks and acknowledgement goes to Stephen Vantassel, Jan Hygnstrom, and Kirsten Smith. The conservation and management of wildlife is a community effort and we thank all individuals and institutions that work together to improve the humane and fair resolution of human-wildlife conflicts.

Disclaimer

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

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 around the Home and Garden is designed to help anyone manage wildlife problems by proposing solutions based on the principles of **integrated pest management** (IPM). Homeowners, Master Gardeners, farmers, golf course managers, park and landscape managers, will all find the information useful.

This book covers the basic knowledge needed to effectively deal with a variety of wildlife issues. It focuses on techniques appropriate for people without a state license. For the most part, only methods suitable for non-professionals dealing with human-wildlife conflicts have been included. Fortunately, anyone who needs to resolve wildlife conflicts can follow the fundamental principles of wildlife damage management (WDM) using IPM for birds and mammals.

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. Safety practices should be followed. You will need knowledge of the biology, habitats, signs, and damage caused by various species. Be sure to review the species information after the training modules.

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.

A high level of skill and knowledge often is necessary to effectively and safely manage some species. Do not hesitate to contact a professional Wildlife Control Operator (WCO) if the damage situation is complex or if safety issues exist. If you have concerns about your ability to handle a wildlife problem with appropriate care and diligence, do not hesitate to hire a qualified WCO.

Many states require professional certification for animal removal and transport, and the use of regulated toxicants, or some type of permit for trapping and removal. To find a WCO in your area, check your local yellow pages or the internet. Some states require licensing of WCOs, so you also may check with your state wildlife agency to obtain a list of licensed individuals. Like any service provider, you should interview WCOs thoroughly before hiring to ensure that the solutions they suggest are agreeable and meet with your expectations.

The professional version of this training program is the *Wildlife Control Core Principles and Wildlife Species Information* by the **National Wildlife Control Training Program (NWCTP)**, from which this manual was adapted (http://NWCTP.com). The NWCTP was created 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.

Animal Control and Wildlife Damage Management around the Home and Garden is based on materials developed with support and funding from the US Department of Agriculture - Integrated Pest Management Program.

Introduction

Figure 1. Opossum. Photo by Jason Reger

This manual provides methods for managing wildlife damage, based on research, for a variety of different species using the latest control techniques within a framework of Integrated Pest Management (IPM). We offer strategies for a variety of human-wildlife conflicts.

The information in this book is suitable for most states in North America although state and local laws vary greatly. The training modules recognize the diversity of activities and complex decisions involved with managing wildlife pests and is organized so that users can find information quickly. The focus is on training the backyard professional with information and methods needed to solve most human-wildlife conflicts

Several important topics are addressed, including animal control techniques, safety, wildlife diseases, animal biology, legal issues, and euthanasia. We 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 homeowners 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 book 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 non-target 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. In many states, it is illegal to transport animals without a license, and in many cases, relocation of an animal is illegal as well.

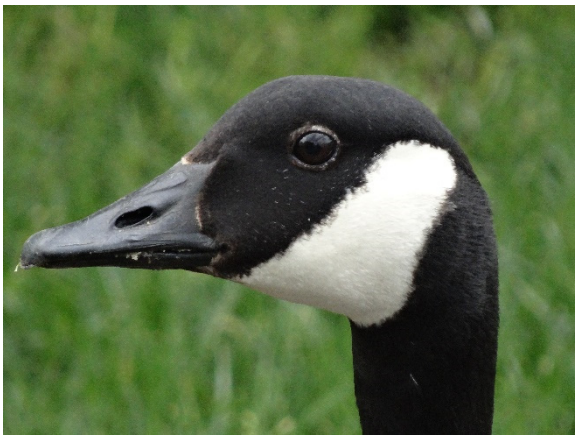


Figure 2. Canada Goose. Photo by unknown

Pest identification is a critical component of WDM. Those who want to deal with wildlife control should be able to identify the common mammal and bird pests in both urban and agricultural environments. It also is important to identify the species by its tracks, sign, and types of damage (Figure 3). It is helpful to understand whether the species is native or invasive, as legal requirements for management may vary. Information on common wildlife species is included in this manual.

Figure 3. Sign of vole activity in winter. Photo by Jan Hygnstrom.

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, local predators, and activity cycles will help in the creation of a successful management plan for the problem species. It is usually better to deal with the reasons (food and shelter) that caused the wildlife to become a nuisance rather than to lethally control the animal after it has settled into your home.

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 (Figure 4). If you have concerns about your ability to handle a certain task, we suggest hiring a professional.

Figure 4. Leather gloves provide protection when working with wildlife. Photo by Jan Hygnstrom.

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 and control 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 non-target 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 wildlife pest management that relies on a combination of common-sense practices. The 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 control methods, allows 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 non-agricultural 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 trapping or other lethal controls. 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 5).

Figure 5. The four steps of IPM in WDM.

1 - 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. Sighting an animal in the back yard 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.

2 - Identify and Monitor Problem Animals

Only a few species require control. Many wildlife species are harmless, and some are even beneficial. A WDM program accurately identifies problem animals and monitors their activity so that appropriate control decisions can be made. Accurate identification (Figure 6) 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 non-target animals will be impacted.

Figure 6. Look for tracks to be aware of what wildlife is in the vicinity. Photo by Jan Hygnstrom.

3 - Prevention

As a first line of pest management, 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, long-term 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 netting (Figure 7), fencing, or setting up the garden in a controlled space, such as a yard patrolled by a dog. Removing food attractants, such as spilled birdseed, pet food, and compost, 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.

Figure 7. Net placed over blueberries are a simple way to protect fruit from birds. Photo by Jan Hygnstrom.

4 - 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, including exclusion (Figure 8), repellents, or the use of one-way doors. If further monitoring, sightings, and action thresholds indicate that these methods are not working, then additional approaches should be used. These could include trapping and removal of wildlife, or judicious use of toxicants. Lethal control methods are often a last resort.

Homeowners need WDM Training

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 netting and fencing, 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 only as far along the IPM continuum as needed to resolve a conflict.

Figure 8. Exclusion by fencing is a valuable tool for the home landscape. Photo by Jan Hygnstrom.

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 your state Cooperative Extension Service or Master Gardener Program for assistance.

Wildlife Damage Management around the Home and Garden is designed to convey the basic knowledge needed to perform wildlife life control and wildlife damage management.

Check out the professional version of this program at http://WildlifeControlTraining.com.

Principles of Wildlife Damage Management

This section covers the basic principles of **wildlife damage management** (WDM), such as key definitions, important objectives, and social and ethical considerations. The goal of a wildlife control professional is to manage the wildlife damage rather than just control the wildlife.

Introduction

Wildlife is an important resource in the US. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 87.5 million US residents fished, hunted, or watched wildlife in 2006. They spent over $122 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 (Figure 1). However, some wildlife species do well in the landscapes we create and cause conflicts with humans.

Figure 1. Chipmunk eating seeds. Public domain photo.

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

Human-wildlife conflicts are typically caused by three common reasons.

- **Economic** – personal and social costs associated with damage to crops and property.
- **Safety** –wildlife attacks, vehicle collisions, personal comfort and transmitted diseases.
- **Nuisance** –noise, defecation, odors, chewing, burrowing, 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 (clothing, rugs, curtains) 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, car and airplane collisions, wildlife attacks, animal diseases (e.g., tick-borne

disease associated with deer and field mice); and

3. become a nuisance (e.g., geese on golf courses, skunks under a deck, and fear of snakes).

Objectives of WDM

The objectives of WDM are to:

- **reduce damage to a tolerable level,**
- **use methods that are low-risk for people and the environment, and**
- **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. Landowners have many options for implementing wildlife damage management strategies.

Homeowners should set reasonable wildlife management goals. Be respectful and considerate when other people explain their negative feelings about an animal. Recognize that some situations are not really problems, and therefore don't need a solution (Figure 1 and 2).

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 that situation from recurring.

Act legally and morally

Is the animal protected? Is a permit required to remove or contain it? Is certification needed to deal with the problem? Homeowners experiencing wildlife damage may be under severe stress and suffering high economic losses, which could lead them to consider 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 poisoning non-target animals such as neighborhood pets, or cause unnecessary suffering. Use the techniques most appropriate for solving the problem. Do no use any techniques beyond what you believe are legal, reasonable, moral, or safe.

WDM Considerations

Look for practical solutions to human-wildlife conflicts

Figure 2. Raccoons on a deck are looking for food.

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 long-term. 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 wildlife problems and to determine potential solutions. Some problems may be very complex and require you to coordinate costs, timelines, and legal requirements. Practicing wildlife damage management requires focus and discipline, just like many other professions. You must be capable of the following:

- **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 some individual species are given at the end of 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 supported 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, or the prudent use of toxicants.

Habitat modification

The number of animals the land can sustain can be reduced by decreasing the resources necessary for population growth.

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 long-term solution. Exclusion techniques range from simply sealing entry holes on buildings to installing bird exclusion devices and animal-proof fences. Although exclusion initially may cost more than trapping, it provides a long-term solution to prevent future 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 (Figure 3), audible, a combination of the two, or biological.

Figure 3. This frightening device is meant to scare Canada geese from a track and field area. Photo by Jan Hygnstrom.

The effectiveness of the technique greatly depends on how motivated animals are to access the protected location or food sources. If food is scarce, they will be highly motivated to get to a food source, even if a repellent or frightening device is used. 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 at 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 4). For example, a person may have a chipmunk problem in a yard. Four chipmunks are trapped and removed, yet several weeks later the problem is back. The action was effective, as the chipmunks residing on the property were removed. Unfortunately, other chipmunks moved in from neighboring properties (the reservoir) and occupied the habitat previously used by the chipmunks that were removed.

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 long-term 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.

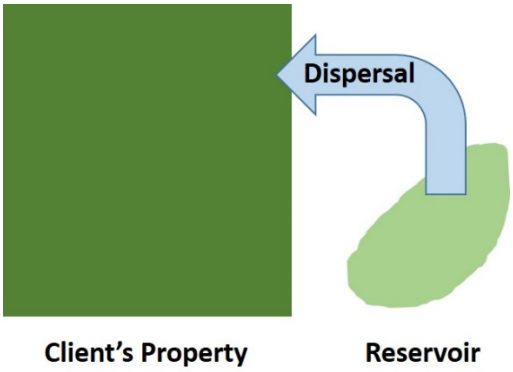


Figure 4. Problem animals introduced due to dispersal. Image by Jan Hygnstrom.

Public Perceptions

Will predators solve the problem?

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 are not stable. They 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.

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 what you can do. Homeowners should focus 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. Building owners 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 non-target animals likely will be taken as well.

Figure 5. Although often recommended, cats are not very effective for control of rodents. Image in Public Domain.

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 (like 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:

- urbanization creates new shelter such as decks, attics, and chimneys;
- urbanization provides food for animals through bird feeders, trash cans, compost piles, fruit trees, and pet dishes;
- environmental legislation has allowed some wildlife populations to rebound; and
- 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:

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

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 neighbors and local authorities. In addition, you must be knowledgeable of species biology, legal requirements, and ethical considerations.

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

Physical Safety

The purpose of this module is to provide information to prevent injuries associated with wildlife damage management (WDM). It can be dangerous, and hazards may arise from animal bites and scratches, diseases, tools, and work environments. Wildlife can be dangerous and unpredictable (Figure 1). If you are not comfortable employing a wildlife control strategy, call a professional. Many control strategies end in euthanizing an animal. Be careful of all dangers of wildlife control.

Figure 1. A snapping turtle can inflict a painful bite if not handled carefully. Photo by Jan Hygnstrom.

Risks Associated with WDM

Wildlife damage management is physically demanding and may expose you to a wide variety of threats to your physical well-being.

Risks related to WDM are associated with:

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

The physical environment refers to dangers such as drop offs (Figure 2), 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 2. 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

Wear the appropriate clothing for comfort, ease of movement, as well as protection.

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

Leather gloves (Figure 3) 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. We recommend that you always wear gloves while performing any wildlife control activity.

Figure 3. Plastic and leather gloves are essential safety items. Photo by University of Nebraska.

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

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 4) with a N100 particulate filter certified by the National Institute for Occupational Safety and Health (NIOSH). This respirator will be sufficient for most general inspections and work in sheds and basements.

Use a full-face mask respirator in crawl spaces, attics, or when the risk of airborne dust is high. Consult Occupational Health and Safety Administration information at http://OSHA.gov for the latest guidelines on use of respirators.

Figure 4. 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 with 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 (Figure 5) if biologically hazardous dust, aerosolized feces, or other potential contaminants are present.

Figure 5. A full-face mask provides eye protection as well as respiratory protection. Photo by Jan Hygnstrom.

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 into 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 an animal is 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 a catch pole, snake tongs, or cat grasper. When there appears to be a choice between getting bitten and allowing the animal to escape, let the animal get away.

Ladders

The term “ladder” will refer to all devices used to reach elevated or descended distances. Choose ladders rated 1 or 1A for industrial use. You should have a 6- to 8-foot stepladder for entering attic crawl spaces, a 14- to 18-foot ladder for one-story structures, and a 28- to 32-foot ladder for two-story structures.

Basic Ladder Safety

Choose the correct ladder for the situation. Ensure each ladder is rated for the total amount of weight it will bear when in use. Several options are available, including step ladders, extension ladders, platform ladders, and mechanical lifts. If you will be on a roof, you may need to use fall-protection equipment.

Check all ladders for damage and defects before each use. Ladders should not be bent. They should not have splinters, damaged welds, or loose or damaged parts. The rubber fittings on the feet of a ladder should be in good condition. If they are not, replace them. Check stabilizers and levelers. Replace unsafe parts with parts approved by the ladder manufacturer. If you are in doubt about the integrity of a ladder, mark it as unsafe and properly dispose of it.

Never stand on the top 3 rungs of a ladder. All steps and rungs should be clean and free of debris or other items that could cause slips. Never lean or reach to the side; your shirt pockets should not extend beyond the sides of the ladder.

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.

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 do not come 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 to Know

- **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.

Figure 2. Blacklegged ticks (male left; female before feeding, center; and female after feeding, right) can transmit the agent of Lyme and other diseases. Photo by unknown.

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).

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 working:

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, 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 for the day:

1. clean any equipment you used,
2. remove work clothing and wash separately, and
3. wash carefully 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.

Figure 3. Regular hand washing can prevent most fecal-orally transmitted diseases. Photo in public domain.

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
Bites or scratches • Rabies (**mammal bites or scratches**) • West Nile virus (**mosquito bites**) • Lyme disease (**tick bites**) • Hantavirus (**can transmitted by rodent bites**) **Boldface type** indicates a common way that people catch that disease.	**Mammal bites or scratches** • Get rabies pre-exposure vaccination and keep it current • Wear suitable gloves when handling animals • Use a restraining device (catch pole) • Capture animals in traps • Avoid contact with animal's mouth and saliva • Shower soon after work, every day **Mosquito or tick bites** • Wear loose-fitting, light-colored clothing (harder to bite through and easier to see small ticks) • Use insect repellent (DEET or Permethrin) • Tuck pant legs into socks (keeps ticks from crawling into pant legs) • Check yourself for ticks frequently; remove any you find
Inhalation of disease organism • Histoplasmosis • Hantavirus	• Wear an appropriate and properly fitted respirator, disposable clothing, goggles, gloves, and hood • Ventilate the area if possible • Dampen contaminated materials, wipe with wet sponge • Spray contaminated area or dead animals with disinfectant (10% bleach/water mix) • Schedule job for cool, damp weather
Contaminated hand or glove touches mouth, eyes, or nose • Raccoon roundworm (**mouth**) • Toxoplasmosis (**mouth**) • Rabies (**infected saliva enters through the mouth, eyes, nose, or breaks in the skin**) • Hantavirus (**mouth, eyes, or nose**)	• Wear a proper respirator, disposable clothing, latex or nitrile gloves • Wash hands thoroughly with soap and water, especially before eating, drinking, or smoking • Avoid contact between hands and face

Disease organism enters wound • Rabies • Hantavirus	• Protect wounds with bandages if practical • Wear gloves or clothing that covers wound • Check wounds and keep them clean
Eat contaminated food or put contaminated object into mouth • Raccoon roundworm (**contaminated object**) • Toxoplasmosis (**contaminated meat or object**) • Hantavirus (**contaminated food or water)**	• Wash your hands thoroughly after outdoor activities and especially before eating, drinking, or smoking • Cook meat thoroughly
Handle infected animal or contaminated equipment • Mange	• Wear gloves • Minimize contact with mangy animal by using restraining devices • Minimize contact with contaminated clothing and equipment • Dry clothing with high heat to kill mites

Disinfect all used traps or replace them. If you must work in high-risk areas, wear rubber gloves. Gloves are especially important when you handle animals, traps, or other exposed items. Before removing the gloves, wash your hands in disinfectant and then in soap and water. Then, remove the gloves and thoroughly wash your hands with soap and water.

Figure 5. To minimize exposure to airborne diseases, clean and disinfect infested areas.

Rabies

Rabies is a disease that affects the nervous system of animals and humans. It is caused by a virus present in the saliva and brain/spinal cord of infected animals. The virus is usually transmitted to other animals or humans either by the bite of a rabid animal or by contact with infected saliva.

Only mammals are susceptible to rabies. The disease mainly affects bats and furbearers in the US, especially skunks (Figure 6), raccoons, foxes, and coyotes. Rabbits and most rodents rarely are diagnosed with the disease.

Figure 6. Skunks are carriers of rabies.
Photo by Jan Hygnstrom.

Site Inspection

A thorough site inspection is the foundation of effective wildlife damage management (WDM). We discuss it because you cannot control what you have not identified correctly. This section discusses how to perform a site inspection as well as the skills and equipment needed.

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.

Throughout the inspection, try to answer these three questions:

- What is the nature of the problem, and is it truly a problem?
- How can the problem be resolved?
- 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. Inspections are like detective work.

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 in 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.

Figure 1. A pocket-sized digital camera is a valuable tool. Photo by Jan Hygnstrom.

6. **A notebook** is essential to record findings. Don't rely on your memory.

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. The *Species Information* following the training modules has 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 a WDM inspection, 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. At first, the effort may be tiring, 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. 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? Provide specific details.
2. Have you 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 are blamed for crop damage that was done by other animals.
3. How long has the problem been occurring?
4. How severe is the problem? Can you quantify the extent of the damage? This helps put the problem in perspective.
5. What time of day does the problem occur? Does the damage occur during the night, day, or at dusk or dawn?
6. Have any actions been taken to resolve the problem? What were those actions? Did those actions have any effect?

Step 2 - Site Visit

As you approach the location, consider the neighborhood and the habitat it contains.

- Are wooded areas nearby?
- Is a stream or body of water nearby?
- Where would wildlife live and eat?

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.

Use the following questions to help narrow down your list of suspects.

- Is the damage below ground? Consider moles and voles.
- Is the damage at ground level? Consider beavers, chipmunks, raccoons, skunks, tree squirrels, voles, and woodchucks,
- Is the damage within one foot of the ground surface? Consider deer, rabbits, raccoons, and woodchucks.

- Is the damage occurring more than one foot off the ground? Consider birds, deer, tree squirrels, raccoons, opossums, and woodpeckers.

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

Disappearance – The plant 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 rabbit. Note the clean cut. Photo by UNL.

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. Vole runway in grass. Photo by Jan Hygnstrom.

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 (Fig. 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 WCO or other expert view what you are seeing. Here are a few tips.

1. Set your camera at a high resolution.

2. Provide scale. Set a ruler or standard-sized object in the frame to show how large or small the sign is.

3. Take wide-angle photos of the area to help the viewer see the context surrounding the sign.

4. 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.

Consider sounds and odors, 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 8). If it is illuminated (Figure 9), then the structure is reflecting light back to you and a hole is not present.

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

When trying 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.

Figure 8. The dark spot is a suspected entry point for bats. In figure 9 light is reflecting off a board showing that entry is blocked. Photos by Stephen M. Vantassel.

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.

Attics

1. Wear PPE and practice safe attic entry.
2. With a spotlight, look along the eave line. Check the vents for mosquito netting or window screen. Is the material intact?
3. Look at the insulation. Do you notice droppings? Are some areas disturbed? Are there trails where the insulation has been packed down? Remove some insulation to reveal the ceiling and check for droppings.
4. Does light enter the attic? Light could indicate holes where wildlife might enter.

Crawl Spaces

1. Wear PPE and practice safe entry.
2. With a bright light, look along the sill plate.
3. Look at the insulation. Do you notice droppings? Are some areas disturbed?
4. Inspect stored boxes and materials. Are they damaged?
5. Turn off your light. Is any light entering the space?

Basements

1. Wear PPE and practice safe entry.
2. With a bright light, look along the sill plate. You may need a ladder.
3. If you can see insulation (Figure 18), do you notice droppings? Are some areas disturbed?
4. Inspect stored boxes and materials. Are they damaged?
5. Look above ceiling tiles for droppings, acorns, seeds, and other signs of wildlife.
6. Pay special attention to areas that are remote, or near sources of heat or water.

Wildlife Control 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.

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 non-lethal 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.

Methods for Wildlife Damage Management

- 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 long-term WDM. Keep in mind, however, that changes in the habitat to hinder one species may encourage population growth in others.

Typical habitat modifications include:

- modifying bird feeders to reduce the spilled seed from reaching the ground,
- cutting back bushes and trees to reduce cover and access to structures, and
- removing vegetation near a building foundation (Figure 1), and eliminating brush, woodpiles, and any other potential living spaces for wildlife.
- Securing soffits, foundations and decks.

Figure 1. Stone or crushed rock can modify habitat around a building to reduce the availability of food, water, shelter, and access. Photo by Jan Hygnstrom.

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 long-term solutions to difficult wildlife conflicts. Unfortunately, some modifications can be expensive. When long-term 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 long-term, 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. 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 non-chemical means. Frightening devices fall into four categories: visual, audio, audio-visual, and biological. Wildlife often quickly habituate (become accustomed) to frightening devices, except, perhaps, biological frightening.

Figure 2. An owl effigy could scare rabbits from a yard or garden. Photo by Jan Hygnstrom.

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. 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.

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 (active during the day) birds and red lasers work on nocturnal (active at night) 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 produce a noisy boom that is suitable only for rural settings. Distress calls (Figure 4) 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. This device broadcasts distress calls to frighten birds. Photo by Jan Hygnstrom.

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.

Repellents

Repellents are chemicals that deter animal activity through, pain, fear, touch, or aversive conditioning. In most states, someone 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.

Toxicants

For more information, see Module 7, Repellents and 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 non-target 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 (RUPs). The RUPs carry more risk to human health and the environment.

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

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 the toxicants section - Module 7.

Shooting

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

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 most homeowners. 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.

Figure 6. Shotguns and rifles are important tools for WDM. Photo by University of Nebraska.

Although shooting may be common in rural areas, many states and communities have laws or ordinances that regulate the discharge of firearms. For example, in New York, it is illegal to discharge a bow within 150 feet for a vertical bow, 250 feet for a crossbow, or a firearm within 500 feet of a building without landowner 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 state wildlife agency 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 homeowners use cage and box traps for the majority of their trapping.

Use of a cage or box trap offers many advantages. For example, you can see what you have captured and then can release non-target 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.

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

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 non-target animals. For example, raccoons like sweet baits. Using them will reduce captures of cats, skunks, opossums, and other animals that are attracted to fish-based baits.

Always have a plan for what to do with a captured animal before you start trapping. In many states such as New York, it is illegal to transport live nuisance wildlife off of your property without a permit or license. Regulations may limit the distance some species (e.g., vectors of rabies such as raccoons, skunks, and foxes) can be moved to reduce the spread of disease. Some states limit the movement of any captured wildlife species. Humane euthanasia of wildlife, an alternative to relocation, often is difficult in urban areas without specialized equipment. Training and experience are needed to catch, handle, and euthanize animals humanely. Many states require onsite euthanization of common nuisance wildlife unless the animal is immediately released back on the property.

Additional information on trapping 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.

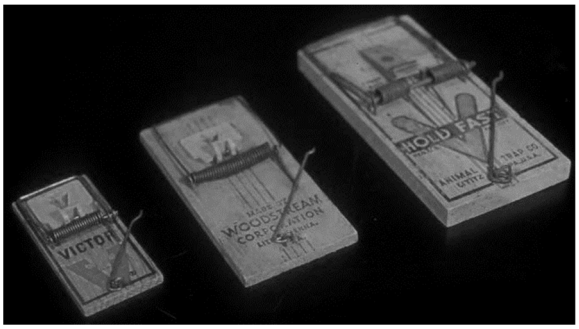


Figure 8. Mouse- and rat-sized snap traps come in expanded (left and middle) and narrow triggers (right). Photo by University of Nebraska.

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. 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.

Figure 9. Clothes pin or clamshell mouse trap. Photo by Jan Hygnstrom.

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 a chipmunk. 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 Co.

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. These materials are not available in all states and may require specialized training, permits, or a pesticide applicator's license for use.

Many wildlife species are long-lived and there are very few examples where long-term 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.

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 to low enough levels to meet landowner expectations. Even though house cats may be good "mousers" (Figure 10), they cannot effectively control high populations of rodents, and they may take non-target species such as songbirds and other small mammals.

Figure 10. Cats may have more of an impact on bird populations than rodent populations. Photo in Creative Commons.

Exclusion

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, shelter, and water, which mean things like poultry and pet food, decks and attics, and containers of water. This method is both a type of **habitat modification** and a form of **damage prevention**. It is one of the few methods to stop a human-wildlife conflict before it starts.

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 non-target animals or people. Third, exclusion provides immediate, long-term, and often complete protection.

Unfortunately, exclusion also has several disadvantages. Frequently, many people consider exclusion to be too costly, particularly when large areas need protection (Figure 1). Before you reject exclusion, consider the value of exclusion over the long-term.

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

In addition to cost, a second disadvantage with exclusion is the perception that it disrupts the beauty of the landscape. A well-maintained wooden fence can be quite attractive, however, and even add to a home's value. In addition, exclusion often can be made less obtrusive. For example, shrub plantings can conceal fences.

When Considering Exclusion

Know the animal

Effective exclusion requires awareness of an animal's behavior and physical capabilities. 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. Generally, an entire structure must be secured to prevent access by climbing animals, but only up to 4 feet to prevent access by those that cannot climb. Exclusion of birds requires consideration of the entire building, especially perching and nesting locations. Different animals require different approaches to exclusion.

Caution

Whenever using exclusion, 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 the sticks aside (Figure 2).

Figure 2. Place dry sticks in front of openings to determine whether animals are using them. Photos by Stephen M. Vantassel.

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.

Exclusion for Specific Situations

The type of exclusion to use depends on what is being protected, the type of wildlife you are trying to exclude, the economic cost of the solution, and its long-term benefits.

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.

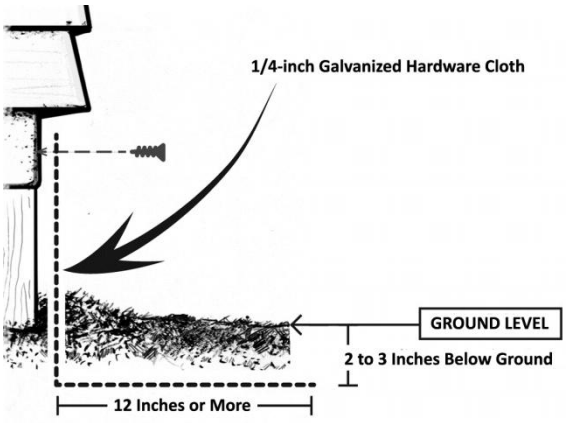


Figure 3. Trench screen installed to protect a crawl space. Image by Michael S. Heller.

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.

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

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.

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. Non-electric barriers prevent access to many species and have the added benefit of low maintenance (Figure 5). Add electric wires to the outside of non-electric barriers to stop climbing animals such as raccoons and squirrels.

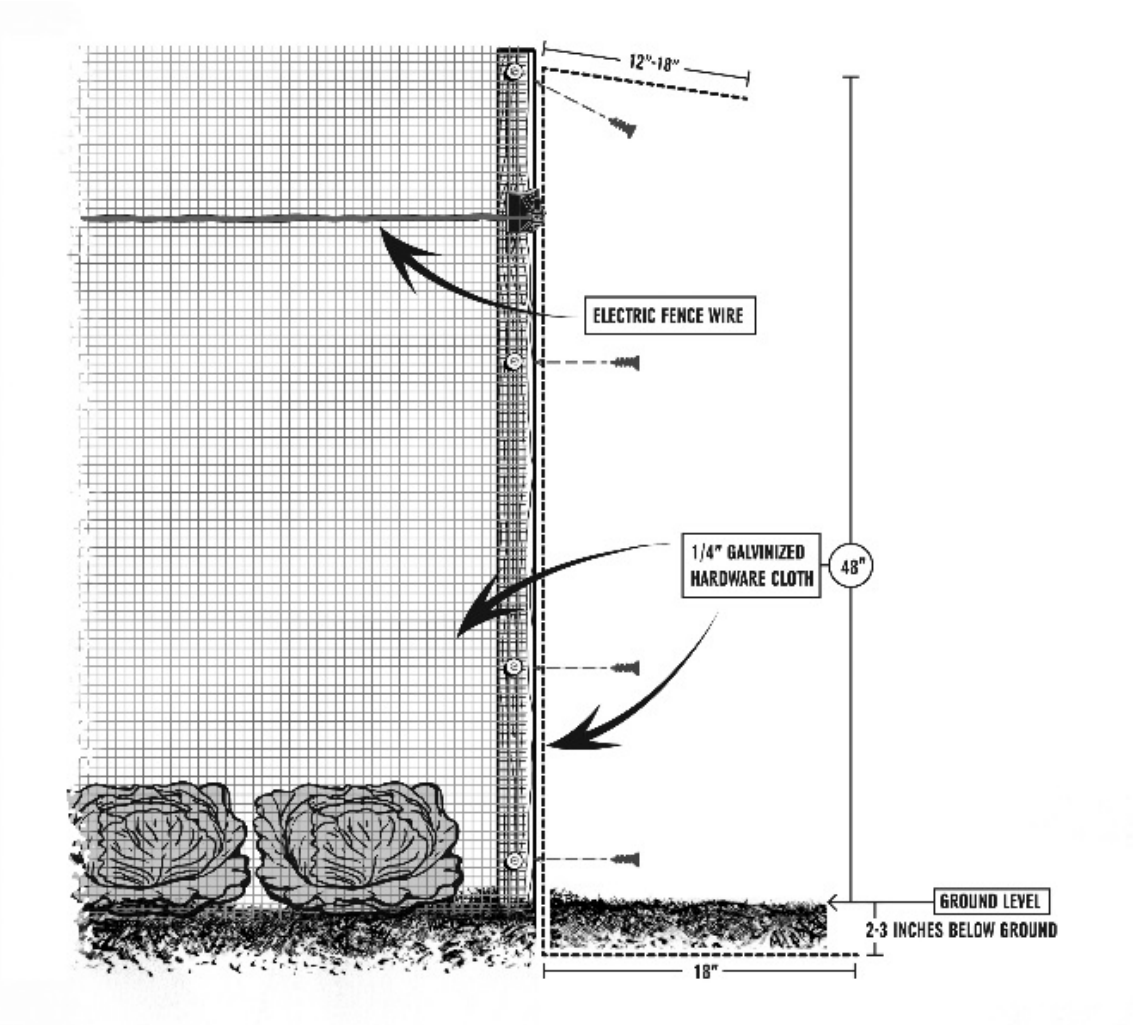


Figure 5. Wire mesh fence with added electric wires prevent animals from burrowing or climbing into a garden. Image by Michael S. Heller.

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

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 non-electric 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.

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.

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 Unknown.

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.

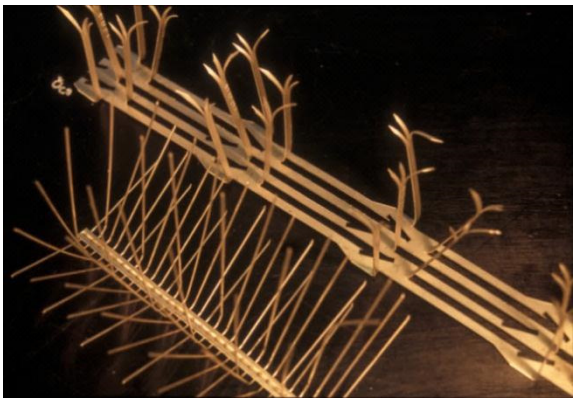


Figure 7. Cat Claw® (upper) and Nixalite® spikes (lower) are two of the many models of non-electric ledge products.

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 can prevent bird access to sensitive areas or trees. Photo by unknown.

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.

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

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: Deterring Nuisance Wildlife from Bird Feeders" at http://extensionpublications.unl.edu/assets/pdf/ec1783.pdf.

Protecting window wells

Many people are not aware that wildlife can become trapped in window wells that are 4 inches deep or more. Use window well covers 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

Holes and Openings

A thorough site inspection is necessary for any exclusion technique to be effective. All potential entry points must be located. Rats need slightly more than a ½-inch gap to enter; mice need slightly more than a ¼-inch gap. Do not ignore small crevices, as gnawing rodents can enlarge them quickly.

Screen, plug, or secure openings, but only after you are certain that animals are not using them. When uncertain about whether animals are using an opening, plug it with rolled up newspaper and monitor it for at least 3 consecutive days of fair, warm weather (Figures 2a to 2c). If the

newspaper is untouched after 3 days, it is reasonable to assume that the opening is no longer in use. Do not use this method if bats may be present.

Next, consider whether a potential opening may be filled or if it must be screened. If airflow is needed, use a screen. If the gap can be filled, several options are available.

Secure holes up to ½ inch in diameter with caulk or other sealant. Sealants have greater elasticity than caulks and are preferable where movement in the substrate is expected, such as joints. Gaps larger than ½ inch require a backer to help hold the sealant. Backer rod, Copper Stuf-it™, and Xcluder™ have the flexibility to be wedged in crevices. They also provide enough structure to support the sealant as it dries.

Caulks and sealants come in several formulations. When selecting a caulk or sealant, choose the one that is appropriate for the substrate, exposure to weather, and aesthetics. It is common for WCOs to carry several formulations of sealant.

Fill large openings, such as holes made by squirrels, first with expanding foam or other insulation to prevent leakage of air. It is thought that by inhibiting air movement and potential heat loss, animals will be less attracted to the structure as a possible nest or den site. After sealing the hole(s), install a gnaw-resistant barrier over the gap to prevent entry (Table 1).

For openings less than ¾ inches in diameter that cannot be secured by other means, wedge copper or stainless steel wool tightly into the gap. Coarse steel wool will work temporarily, but eventually will rust. Never rely on expanding foam alone to secure an opening.

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 may 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. Chimney cap

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 (NWCOA) 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.

Vents

Consult state regulations before modifying vents. Vents require special care because they must allow air flow. As a rule, metal screening is best placed on the exterior of a vent so that mosquito netting may be protected from damage. Screen with a mesh size less than ½- x ½-inch may significantly reduce airflow.

Roof and attic vents are best secured from the outside to prevent animal entry. Professionally manufactured screens (stainless steel and galvanized; are available.

Repellents and Toxicants

This section addresses many of the issues and concerns regarding repellents and toxicants that are used when dealing with human-wildlife conflicts. In most cases, a pesticide applicator's license may be needed to use vertebrate repellents and pesticides.

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 (weeds).

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.

Non-target species or **non-targets** – wildlife, livestock, pets, and people that 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 non-target 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 have 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 manufactured (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 unknown.

Regulations

The registration and use of most pesticides is regulated by EPA through the authorization of the Federal Fungicide, Insecticide, and Rodenticide Act (FIFRA). Rules and regulations enforced by 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 many states, anyone using 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 may be purchased and used only by people with a certified applicator's 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 non-targets because rodents cannot move the toxicant easily.

In general, pesticide applicator must be certified whenever applying a RUP commercially or on someone else's property. In some states, applying even a GUP commercially requires the applicator to be certified.

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 areas that have been properly prepared to protect the surface from stains, and used for a short time. Repellent caulks usually are applied indoors.

Figure 2. Two brands of polybutene-based caulks used to deter wildlife. Photo by unknown.

Finally, repellents using aversive conditioning are quite different in that the reaction of target animals is delayed. Animals first eat the product, and feel sick after a few hours. 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 a repellent 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. Repellents often must be reapplied after rain, or to protect new growth on a plant.

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.

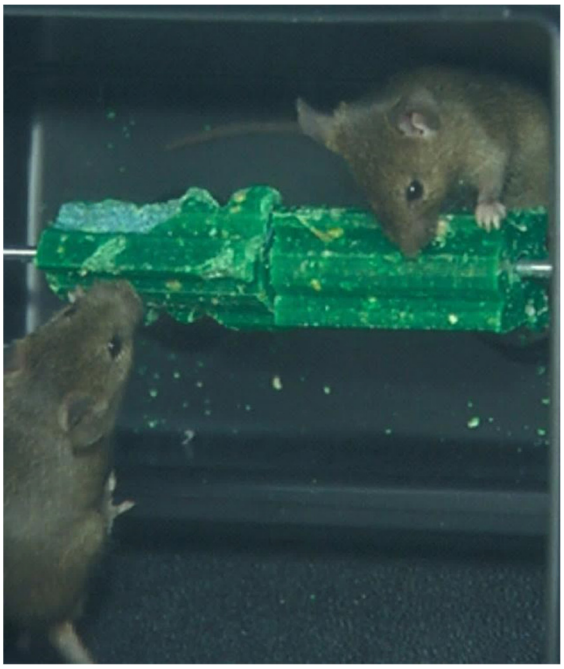


Figure 3. Toxicants in the form of bait blocks with bait stations are used to control house mice and Norway rats. Photo by unknown.

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_3). Selection of the appropriate toxicant 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.

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 people are aware of potential threats to health and safety. The safety of non-targets, including people, pets, livestock, and wildlife always must be a primary factor when considering the use of toxicants.

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 non-target 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.

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 a respirator, eye protection, and protective suit. 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.

Figure 5. Sample EPA label for a rodent toxicant containing the active ingredient difethialone.
Courtesy of Liphatech,® Inc.

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 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 given. 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 agency in your state 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 effectiveness on target species, and safety for non-targets. 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, length of exposure, sex and age of the animal, and other factors.

The toxicity of a pesticide is measured by its LD_{50} (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_{50} is given as the dose per unit of body weight, such as milligrams per kilogram (mg/kg). A pesticide with a lower LD_{50} 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_{50} of 10 mg/kg in rats, is highly toxic and far more hazardous than an anticoagulant such as warfarin that has an LD_{50} 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 non-targets. 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. Non-target animals have to consume a considerable amount of anticoagulant bait to experience immediate negative effects. In addition, vitamin K_1 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 non-targets

are present. Apply baits only in tamper-resistant, locking bait boxes that prevent access by non-target species. If not applied correctly, non-target animals are at risk. Animals that die from anticoagulant exposure often show signs of bleeding near their mouth or anus (Figure 6).

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

Anticoagulants may pose hazards for non-target 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.

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

- Avoid using them where pets, livestock, children, and other non-targets are present.
- Use the toxicant with the lowest hazard (i.e., a high LD_{50}) that still will be effective.
- Apply toxicants in tamper-resistant bait boxes (bait stations) designed to protect bait against weather and access by children and other non-targets (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). In some situations, use of a bait box is required; read the product label.
- Remove dead and impaired rodents found during daily inspections.
- 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 non-target animals.

As part of EPA's 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.

Figure 7. Bait stations for rodents, showing bait block placement on the right. The metal wire key unlocks the bait station. Photo by unknown.

Bait stations are useful because they:

- protect bait from moisture and dust,
- provide a protected place for rodents to feed,
- keep non-target animals and children away from hazardous bait,

- allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to non-targets,
- 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.

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 non-target 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 (Figure 8) are GUPs, and may be used for woodchucks.

Figure 8. Always read the label to determine the site to which a pesticide may be applied legally. This product may be used on lawns, parks, golf courses, rangeland, reforested areas, etc., but NOT in under, or near buildings, homes, porches, or any structures because of the fire risk.

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.

Summary

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.

Trapping

Trapping involves the use of mechanical devices that capture animals without the person being present. Trapping is one of the most common and effective methods that landowners use for managing wildlife damage because traps save time. Traps work when you are not present and can be used in different locations and with different baits and lures.

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. The term "**live trap**" is 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).

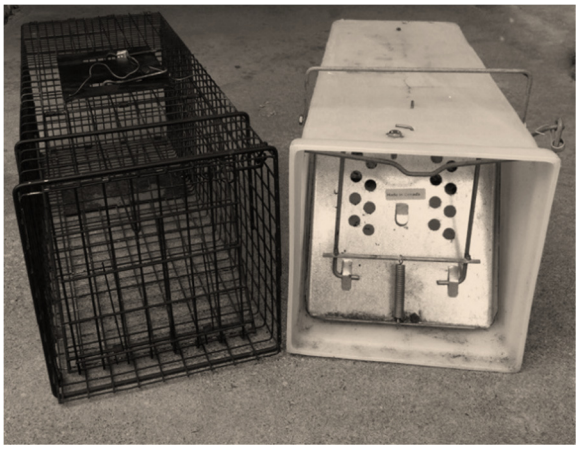


Figure 1. Cage trap (left), box trap (right). Photos by Stephen M. Vantassel.

Types of Cage & Box Traps

Manufacturers produce cage traps (Figure 2) and box traps with different features.

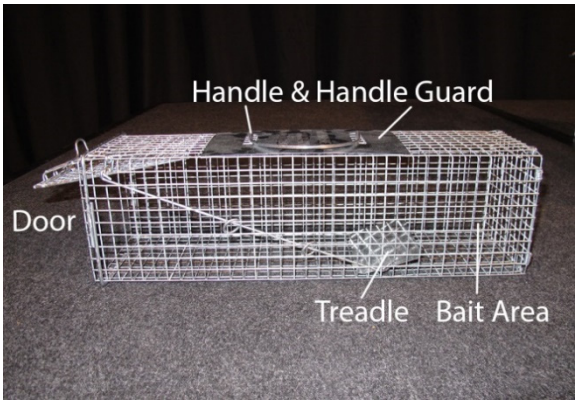


Figure 2. Main parts of a single-door cage trap. Photo by Stephen M. Vantassel.

This section will discuss a few of the more important ones.

- **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.

- **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 openings at both ends, giving the appearance of a tunnel to an animal.

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. Non-target animals can be released easily by gently rolling the trap over on its top. The disadvantage is that a trapped animal sometimes rolls the trap over and escapes 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.

Traps for Homeowners vs. Professionals

Manufacturers make 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 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.

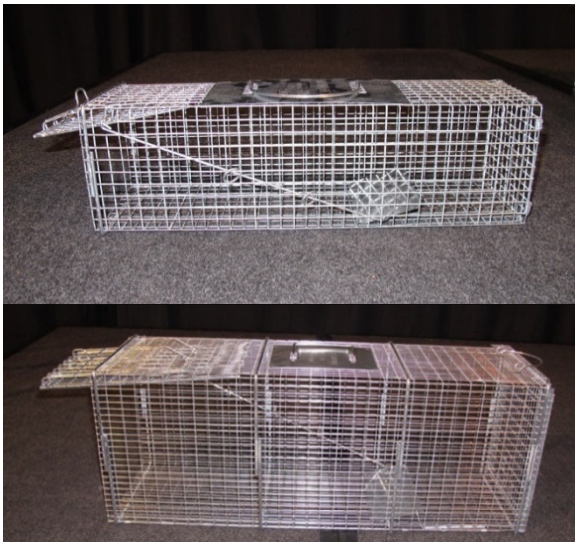


Figure 3a (top). A retail-grade squirrel trap. Photo by Woodstream Corp. Figure 3b (bottom). A professional-grade raccoon trap. Notice that the professional trap has smaller gaps in the mesh. Photo by Stephen M. Vantassel.

Effective Use of Traps

The apparent simplicity of cage and box trapping is deceiving. While setting cage or box traps is not complicated, effective trapping involves attention to details for improving capture success. Improper baiting or trap location can make animals trap shy and more difficult to capture.

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 non-targets because smaller sizes make it hard for larger animals to enter.

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 pulled a cord and wood 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 several traps when trying to capture squirrel-sized and larger animals. 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 with 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 professional 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).

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.

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

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 non-target 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 non-targets. 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. Some states (e.g., New York), do not allow landowners to move problem wildlife from their property. **A WCO license or state permit may be required for live transport of wildlife. Some states require onsite euthanization of common nuisance wildlife unless immediately released on the same property.**

Enclosed Foothold Traps

Several types of enclosed foothold traps are highly selective for raccoons and opossums, which have small feet and long legs. Enclosed footholds have a small hole, with a trigger fairly deep within the enclosure. They are anchored and placed in the ground with baits that are attractive to raccoons, such as marshmallows, jam, honey, or anise. Place the bait in the bottom of the trap, below the trigger. Larger animals cannot get their feet through the opening and smaller animals cannot reach the trigger. When a raccoon attempts to remove the bait from the device, the trap is triggered and a small spring arm captures the foot. Enclosed foothold traps are specific for raccoons and opossums.

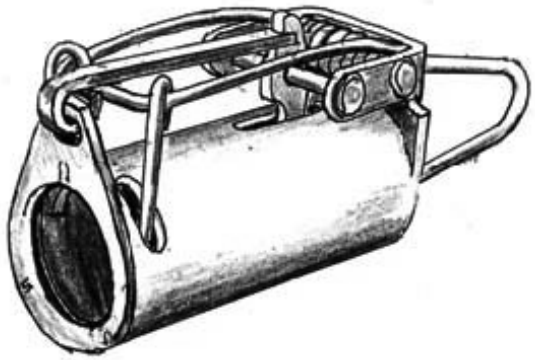


Figure 10. Lil' Griz™ Foothold Trap. Image courtesy of IAFWA.

Animal Handling

This module discusses how to handle animals and the treatment of wildlife while under the direct control of a person, trap (Figure 1), or other control method. Handling animals can be dangerous and must be done with skill and competency.

Figure 1. Check traps daily so that trapped animals can be handled quickly. Photo by Jan Hygnstrom.

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 make sure 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 that humane trapping requires 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.

Animal Removal

Catch Poles

Catch poles, also known as snare, noose, or restraint poles, should be high quality with an instant open feature that immediately loosens the noose when activated. While it is important to ensure the animal remains firmly under control, cinching a noose around the neck or chest of an animal could kill the animal. Always treat animals with respect and have concern for their stress and suffering. Have a cage trap ready before you use a catch pole to minimize the time the animal remains in the noose.

Hand Nets

Hand nets, also known as landing nets, simplify animal capture by making it unnecessary to place a noose around the head of an animal. Choose a size that will fit diagonally into a raccoon-sized cage or box trap. This allows you to release the animal by simply inserting the animal, net and all, into the trap. Most animals will get out of the net by themselves. Monitor the animal out of public view as it escapes the net, being sure to remove the net and close the trap door completely after the animal is free from the net.

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.

Loose Animals

One of the most challenging situations during WDM is the capture and removal of an animal that is loose in a room. It may be difficult and you often have to do it in view of the client. If possible, do not have clients in the area where you are working, for the safety of both you and the client. Animals are unpredictable and the presence of additional people creates greater anxiety for all.

Some tips for catching a loose animal:

1. Limit the movement of the animal by closing gates, doors, windows, and other openings.
2. Determine if the animal must be captured immediately or if setting traps may be appropriate.
3. Wear heavy leather gloves to protect yourself from scratches and bites, and to provide protection from diseases and parasites.
4. Prepare for the worst. An animal caught in a catch pole may urinate and defecate. Place a large piece of cardboard under an upright trap to catch this debris. Prepare clients with what to expect.
5. Ask whether anyone might have had contact with the animal. If so, rabies testing or treatment may be required.

Disposing of animals

Depending on state laws, three options are available for disposal of captured animals: on-site release (**relocation**), **translocation**, or **euthanasia**. Be aware that states and localities may have different definitions for the terms relocation and translocation, or may use different terms. Make sure you know the requirements for your area. In most states it is not legal to move animals to public or private lands without explicit written permission.

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. It is illegal in many states.

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. Also

some states (e.g., New York), do not allow landowners to move problem wildlife from their property. 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. Species that are more communal and less territorial, such as rabbits, voles, opossums, snakes, and birds, are better candidates for translocation.
State regulations may place restrictions on the release of rabies-vector species (e.g., raccoons, foxes, and skunks, Figure 2). Always check your state regulations before moving any species to another location.

Figure 2. Raccoons may carry rabies, so special precautions must be taken when dealing with them. Photo by Havahart.

If translocation is the chosen and legal option for handling an animal, consider the following recommendations.

1. Release animals in accordance with state laws. Consult with the landowner and obtain written permission in advance of release.

2. Without handling the animal, inspect it to ensure that is does not have debilitating injuries or show signs of illness. Only release animals that appear healthy.

3. Release animals in habitat suitable for the species.

4. Release animals at times that will provide the greatest opportunity for survival, especially in respect to diurnal and nocturnal activity.

5. Release animals a sufficient distance from the capture location to minimize returns. Use natural barriers (e.g., rivers) and human barriers (e.g., highways) to reduce the return of wildlife.

The following are suggested minimum distances.

- chipmunk-sized animals - 2 miles
- skunks and opossums - 10 miles
- raccoons - 20 miles

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 3).

Figure 3. 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 leave it overnight.

4. 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 on a box trap or during cold weather.

Handling Snakes

Snakes require more specific handling information and skills than other wildlife. Handling snakes illegal in some states, so check regulations.

Figure 4. Handling venomous snakes such as rattlesnakes is best left to a professional. Photo by Jan Hygnstrom.

1. Whenever possible, use snake tongs to handle snakes (Figure 4). Most people are not experienced enough to distinguish non-venomous from venomous snakes. Even a non-venomous snake can inflict a painful bite requiring medical treatment. 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 a snake.

2. Hold a snake behind the head to avoid being bitten (Figure 5); 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.

3. 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.

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

Figure 5. Proper hand-hold of a non-venomous snake. Photo by Stephen M. Vantassel.

Euthanasia

In some states, laws or regulations require euthanasia of captured nuisance animals. If the potential for disease transmission is high, euthanasia is the preferred option. 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. Organizations such as the National Wildlife Control Operators Association and The Wildlife Society are working on guidelines for humane euthanasia in field settings. The next section has more information on euthanasia.

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.

Terms to Know

Distress - Pain or suffering. Distress implies external and usually temporary physical or mental strain and stress.

Euthanasia - good death ("eu" = good; "thanasia" = death), referring to techniques used to kill an animal as quickly and painlessly as possible.

Humane - A practice or product that causes no unnecessary pain or stress for an animal.

Suffering - A highly unpleasant emotional or physical response. Suffering implies conscious endurance of pain or distress

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 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 still may 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 (Figure 1). Although the trap's 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.

Figure 1. A snap trap can cause a quick death for a mouse. Photo by Jan Hygnstrom.

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 an animal before and during efforts to kill it. Failure to follow this advice may result in a great deal of scrutiny and unwanted attention. All wildlife is protected from indiscriminate killing.

Disposition of Injured Wildlife

Wild animals that are captured, injured, and unfit, that could be released in accordance with state, county, or city regulations should be euthanized or humanely killed. Even if a wildlife rehabilitator is an option, there are laws governing the transportation of sick and injured wildlife. Check your state and local laws BEFORE you begin any control program for known problem species.

Euthanasia Techniques

Capture Methods vs. Euthanasia vs Humane Killing

It is important to distinguish between capture methods and euthanasia. For example, the use of a body-gripping trap to control a muskrat is a capture method, not a euthanasia technique. The trap will kill the muskrat quickly and humanely, but its primary function is to capture the target animal. In the same respect, shooting a free-ranging deer that is injured is now considered "humane killing" by the AVMA.

Euthanasia only refers to the deliberate death of an animal that is killed under the direct control of a person, either instantly or while unconscious.

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 American Veterinary Medical Association (AVMA). The method requires a chamber in which CO_2 replaces the available oxygen. With this method, the animal can be euthanized without injection, handling, or transfer.

Figure 2. A cage trap enclosed in a carbon-dioxide euthanasia chamber constructed with Plexiglas®. Photo by Stephen M. Vantassel.

Carbon dioxide (CO_2) 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 2) is essential. They can be purchased from various supply companies or constructed on your own.

Shooting

Personnel should be trained in the safe use of firearms and the anatomy of the species involved. We recommend that only professionals be involved in euthanizing animals by shooting. Shooting is a common and useful control method for trained professionals. State and local laws often restrict firearm discharge in non-rural areas.

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 their state wildlife agency 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:

- aboveground,
- belowground, single-use burial area,
- belowground, repeated-use burial area,
- incineration, and
- 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 3). Ticks and fleas present a health risk as they leave the dead carcass in search of a new host.

Figure 3. 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 to recycle 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 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. 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.

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.

Hiring A Professional

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 section will help you determine if you need the services of a professional.

When to Contact a WCO

Professionals can provide expert advice and competent wildlife control services. The reasons to contact a professional fall into three general categories: legal issues, safety concerns, and other, often, species related concerns.

Figure 1. Typical WCO service vehicle.
Photo by Stephen M. Vantassel.

Legal issues

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

- Any animal species identified as threatened or endangered by your state or the federal government. This will require permits and the help of a licensed WCO. This will be rare, as most wildlife species that become a nuisance are abundant.
- When the problem animal is a bird, except for house sparrows, pigeons, and starlings. Nearly all other birds have protected status.
- Situations involving domesticated species, such as livestock, dogs, and cats. However, in some states (e.g., New York), the WCO license only covers wildlife, and does not include domesticated species.
- If you want the animal transported alive off of your property. Some states (e.g., New York), do not allow landowners to move problem wildlife from their property (this requires a WCO license for transport). Also, movement of rabies-vector species (e.g., raccoons) may be restricted.

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 contracting 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

Everyone knows that quality and expertise can vary greatly among service providers. A Yellow Page ad or website does not guarantee the company is legal or qualified. This situation is even more common in the field of wildlife damage management (WDM) because in several states, the WCO industry has few government regulations, and requires no professional training or certification.

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 between these professions (Table 1).

Table 1. Responsibilities of professionals that deal with wildlife and wildlife damage management.

	Pest Control Operator (PCO)	Wildlife Control Operator (WCO)	Fur Trapper	Animal Control Operator (ACO)
Regulatory agency	Department of Agriculture or Environmental Conservation	Department of Natural Resources, Game and Fish, or Environmental Conservation	Department of Natural Resources, Game and Fish, or Environmental Conservation	City and County Government
Manage	Invertebrates, rats, mice, urban birds	Vertebrate animals, including rats, mice, urban birds, and furbearers	Furbearers	Domestic species, dogs, cats
Extent of regulation	Highly regulated	Some regulation, but not all clearly stated and quite variable	Clearly-defined state regulations	Highly regulated, often a municipal worker
Control methods	Pesticides and some traps	Traps, direct capture, transport	Traps	Traps and nets
Number of visits	Monthly	Multiple visits until the problem is resolved	Daily visits until harvest rate drops or season ends	Often single and routine patrols
Equipment	Step ladders	Assorted ladders	No ladders	No ladders
Time with Client	Regular visits	One-time service	Seasonal	One-time visit
Payment	By client	By client	By fur buyer	Taxes and fees

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, problem animal controller, and vertebrate pest 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?

Unfortunately, many states lack meaningful standards that individuals must meet before obtaining a WCO license. Often a person only needs to pass a simple exam or take a trapper education course to be licensed. Some states require no training or exam before granting licenses. With such low entry requirements, consumers should not assume that people offering to do WCO work are qualified to perform the service. Many people in the animal control industry started as trappers and hunters. Professional wildlife damage management and the resolution of human-wildlife conflicts takes training similar to the sections of this manual.

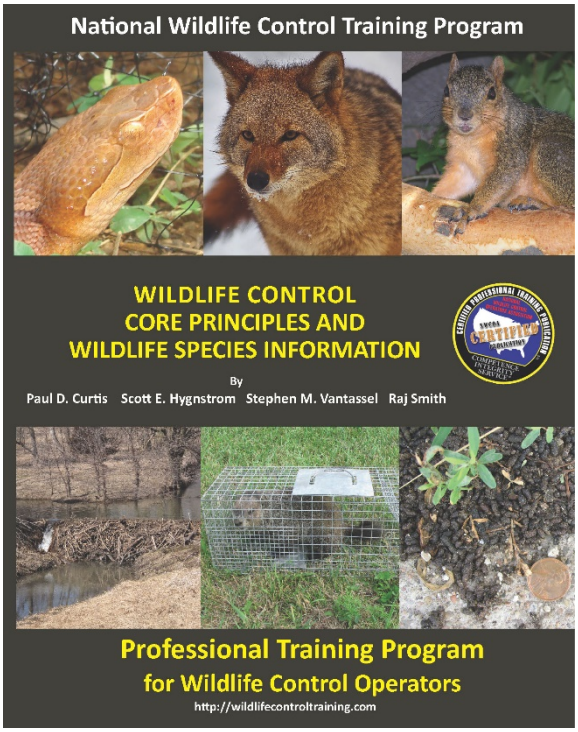
We suggest that consumers ask the following questions of the WCO, and get recommendations from others before hiring a WCO.

- Consult with your state's Conservation Officers and state wildlife agency staff. Ask them who they recommend in your area. Some states (e.g., New York) have lists of licensed WCO professionals who have taken a certification exam.
- Is the WCO licensed or certified? Not all states require licenses, so check with your state wildlife agency before asking a WCO. 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. Some of the certifications available to those working with wildlife are listed here.

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 training manual from the **National Wildlife Control Training Program: *Wildlife Core Principles and Wildlife Species Information.*** More information on the training program can be found at http://WildlifeControlTraining.com. The BWCO seeks to establish minimum competency for WCO work. Some states (e.g., Delaware, New York, Virginia, North Carolina, Oklahoma, Tennessee, Oregon) have adopted the National Wildlife Control Training Program for licensing its wildlife control operators.



Cover of the NWCTP Training Program Manual

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 NWCOA.com.

Bat Standards Compliant (BSC). Individuals obtaining the BSC certification 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 services for 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 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 of the year, prices may be lower due to a reduced demand for services.*

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, it is important think about the ethical aspects of WDM.

Introduction

It is important to know the current status of laws at the state and national level. 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. In many cases, homeowners have specific rights when dealing with nuisance wildlife but it is best to check if you have the legal ability to trap or euthanize an animal.

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. **Wildlife and natural resources agencies,**
2. **Departments of Agriculture,**
3. **Pesticide Review Boards, and**
4. **Departments 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 on-line 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 (Figure 1). 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.

Figure 1. Whooping cranes are listed as an endangered species. Photo by USFWS.

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 non-target 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. For example, in New York State, the Environmental Conservation Law states, “Red-winged blackbirds, common grackles, and cowbirds destroying any crop may be killed during the months of June, July, August, September and October by the owner of the crop or property on which it is growing or by any person in his employ.” Local laws may limit the types of treatments (e.g., pyrotechnics or firearms) that can be used for managing birds. Check local and state laws before attempting to manage any bird species (Figure 2).

Figure 2. Control of migratory birds, such as waterfowl, require special permits. Photo by Jan Hygnstrom.

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. Review OSHA standards and training requirements, especially those on safe practices in confined spaces and the use of respirators (Figure 3) if WDM efforts will involve these.

Figure 3. Use of a respirator may be important for safety. Photo by Jan Hygnstrom.

State Laws and Regulations

In general, state laws and regulations add restrictions to federal laws. They cannot be less restrictive. States typically classify wildlife in the following ways.

1. **Game species** that 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. **Non-game species** are not harvested, and no open seasons are available. Most non-game 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.

Non-target Animals

In general, a non-target animal is an individual or species that is incidentally captured or taken. In general, non-target animals are released from the location from which they are taken. If the species is a rabies vector (e.g., raccoon, skunk, or fox), some states require it to be euthanized, or limit transport distances.

The legal situation becomes more unclear when the non-target 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. Most states do not clarify the legal status of feral cats, so work with the local animal shelter if you've captured a

feral domestic animal. 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.

Social Ethics for Wildlife

Ethics are the principles that guide the way we perform activities. Your behavior is motivated by your values. In short, every action demonstrates an ethical standard, but many people will judge your humane and ethical treatment of the wildlife you capture and euthanize. Drowning animals is not a humane way to kill them.

Your effort to manage wildlife damage must follow the highest ethical and humane practices because the public holds wildlife in high regard. Wildlife is important and has the respect we give to all living animals. 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 property by acknowledging their inherent value and dignity. Be empathetic and respectful of other people and the animals you work with, and you likely reduce human-wildlife conflicts.

Conclusion

Many wildlife control decisions are clearly right or wrong, others depend on the situation. People are emphatic of their rights over animals when they feel threatened. People disagree over a specific course of action that resolves the conflict, but consider whether you can defend your wildlife damage management solution. Lethal control or wildlife is controversial. 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

Wildlife professionals follow the following nine principles. Consider which of these principles apply to your behavior.

1. Follow all state and federal laws and regulations related to Wildlife Damage Management.
2. Behave in a professional manner. Exemplify honesty, integrity, and commitment to the goal of or resolving human-wildlife conflict.
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 clients and wildlife 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 nuisance wildlife to find more humane solutions.

Wildlife Species Information

To manage wildlife damage effectively, you must have good information on the species involved. Understanding the biology and habitat of the problem animal allows a person to use methods effectively to control or eliminate the unwanted behavior, conflict, or the animal itself.

The following section highlights problems caused by common species of wildlife, and management methods for dealing with the damage they cause. These fact sheets are meant to serve as a guide for you while in the field. These research-based profiles will help you resolve human-wildlife conflicts.

A high level of skill and knowledge are needed to control wildlife damage effectively and safely. You will need to know 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. Do not hesitate to contact other professional WCOs or state wildlife agencies if the damage situation is complex, or if safety issues exist. If you have concerns about your ability to handle a wildlife problem with appropriate care and diligence, do not hesitate to work with other qualified professionals.

Situations Involving Protected Wildlife May Require Additional Permits

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. Some species are protected by federal law, such as Canada geese, gulls, hawks, robins, and woodpeckers. States protect game and furbearer species, such as white-tailed deer, cottontail rabbits, wild turkeys, raccoons, and foxes. In addition, species that are endangered and threatened are protected by both federal and state laws. Many states require professional certification for animal removal and transport, and the use of regulated toxicants. Some require a permit for trapping and removal of certain wildlife species, especially game animals and protected species.

Even professionals can't just pack their truck and hit the road when a customer calls with a complaint about one of these species because they either are managed by a state agency or are federally protected. You may need to secure permits — perhaps at both the federal and state levels — before using certain control techniques. The focus of this section is on those species that routinely cause conflicts with people in the US.

Federally Protected Wildlife

Endangered species (on the national list), threatened species (national list), and migratory birds are all federally protected wildlife.

In most states, WCOs cannot, under any circumstances, handle an endangered or threatened species. No way, no how.

You must take special care to make sure that activities intended to control other species do not accidentally harm an endangered or threatened species. Here's what to do. First, review the lists of endangered and threatened species to see if any are found where you work. Go to the US Fish and Wildlife Service Endangered Species Online Bulletin (http://www.fws.gov/endangered/species/index.html) and click on your state to see the most up-to-date list. Learn how to identify those species. Then take special precautions, especially if applying pesticides or setting traps.

Migratory birds that most commonly cause conflicts with people include the American crow, Canada geese, gulls, double-crested cormorants,

and woodpeckers. The Migratory Bird Treaty Act protects these birds, their feathers, nests, and eggs. You may not take, possess, or transport a migratory bird without permits from the US Fish and Wildlife Service (50 CFR Depredation Permit).

Bird Control

Methods that require state and federal permits include:

- any attempt to capture, relocate, injure, or kill migratory birds (except for those waterfowl species which may be taken during the hunting season by those with a state hunting license, a federal waterfowl hunting stamp, and Harvest Information Program (HIP) registration).
- any attempt to destroy eggs of migratory birds.
- any attempt to destroy nests of migratory birds that currently have eggs or young within them.

On April 15, 2003, the US Fish and Wildlife Service changed its policy regarding the nests of migratory birds to allow for the destruction of nests that lack eggs or young—as long as those nests are not protected by other laws, such as bald eagles, golden eagles, and other endangered and threatened birds.

Although this policy change now makes it possible (in some cases) to destroy an unoccupied nest, make sure you do not violate the Migratory Bird Treaty Act by accidentally taking eggs or birds. For example, it can be difficult to tell if eggs are in the nest of a ground-nesting or cavity-nesting species, such as a bank swallow.

Legal methods that do not require state or federal depredation permits include harassment, exclusion, habitat modification, and the use of repellents, unless you're dealing with a bird that currently is nesting or has dependent young, for which you would need a permit. If you have any questions, contact your state wildlife agency. Their staff can offer advice about management strategies and information about necessary permits.

Identify the Pest

To manage a pest effectively, you must be able to identify it. You must also understand its life cycle, habitat, and behavior. Identification, however, is often difficult. Many mammals are nocturnal or crepuscular and may rarely be visible during the day. Your only clue may be the damage itself.

The most practical way to identify a pest is by examining the damage site. Often the damage from one animal is distinguishable from that of another. For example, deer tear off plant parts while rabbits clip parts off cleanly. Groundhog damage usually occurs close to its burrows. Among predators, killing and eating styles differ by species and may help you identify the culprit. Signs like tooth marks, feces, hair, and tracks are also helpful.

Identifying the damage-causing species takes knowledge, perseverance, and keen observation. The more you know about potential pests and the damage they cause, the more easily you can pinpoint their identity and control their actions.

In the following text, we discuss some of the mammal species that most frequently cause human-wildlife conflicts. This includes a description of each species, the damage it causes, its habitat, behavior, and life cycle and damage prevention and control methods.

Controlling Problem Mammals

There are many ways to manage mammal that are causing human-wildlife conflicts. Many methods are specific to certain pests in particular situations. Usually, a combination of these methods achieves the best control. Review the sections on Wildlife Control Methods and Animal Handling. If using a pesticide, be sure to read the

label and review the section on the use of toxicants.

Controlling Bird Pests

As with mammals, there are many ways to manage pest birds. The goal is to choose the safest, least harmful option that gives effective control. To do this, you must have a solid understanding of the life cycles and habits of the nuisance birds. You must also know which control methods are effective and available to control specific pest birds.

Some techniques used to manage birds are similar to those used for mammals. However, birds have some unusual features. For example, few birds can smell. Olfactory repellents, therefore, do not work on birds. A good understanding of workable techniques will help you choose a successful control strategy.

Chemical registrations and use patterns change. Any specific pesticides mentioned may no longer be registered for use at the time you read this manual.

Always read the most recent label when selecting and using a pesticide.

Develop a Management Plan

First, study the birds in the problem area. Observe both pest birds and non-target birds. Study them early in the morning, at midday, and again in the evening. This will tell you how many birds and what species are present. It is important to note what the birds are doing. Are they nesting, feeding, roosting, or loafing? Are they adults or juveniles? Are they resident birds, or are they migrating? Where do they eat and drink? What is attracting them to the area?

Next, make some decisions. Answers to the following questions will help you develop a responsible and effective control plan.

Are the birds a nuisance? Are they causing physical damage? Do they pose a health risk? Is exclusion or habitat modification possible? Are these actions practical? Are there effective repellents for the target pest and site? If the birds disperse, where will they go? If the birds have eaten a toxic bait, where will they die? Will non-target species be at risk if avicides are used? What are the legal and public relations considerations?

As you draw up your plan, remember that **all migratory birds are protected by the federal Migratory Bird Treaty Act.** You may not take these birds or their nests without a permit. In some cases, only officials working with a federal wildlife management agency qualify for such a permit. Be especially cautious when destroying the eggs of pest birds. If you destroy the eggs of protected birds by mistake, you may be liable for prosecution under the Migratory Bird Treaty Act. The US Fish and Wildlife Service issues migratory bird depredation permits.

Bats

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Little brown bat (*Myotis lucifugus*). Photo by Bat Conservation International (BCI).

Figure 2. Big brown bat (*Eptesicus fuscus*). Photo by BCI.

Understanding Bats

Conflicts

Bats may enter the living space where they can pose a disease risk. In addition, their droppings and urine can contaminate and deface surfaces.

Legal Status

Familiarity with the appropriate federal and state laws should precede any nuisance management activities. The lethal control of bats, even when a proven potential danger to humans exists, is often subjected to careful scrutiny and interagency coordination. Some states have laws that specifically mention bats, either providing or denying protection. Others have legislation that applies to bats only by interpretation because bats may be considered nongame wildlife or indigenous state mammals. Some species 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.

Identification

Bats are the only mammals that can truly 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. Among the 40 species of bats found north of Mexico, 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 the northeast are colonial and include little brown bats (*Myotis lucifugus*, Figure 1), and big brown bats (*Eptesicus fuscus*, Figure 2).

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 photos of the bats discussed herein can be found at Bat Conservation International and the University of Michigan's Animal Diversity Website.

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

Physical Description

Little brown bats have glossy fur that can be dark-brown, golden-brown, reddish, or olive-brown. The fur on the belly is lighter than the fur on their back. Wings and membranes between the legs are dark brown or black, and have almost no hair. Little brown bats have small ears and large hind feet. The hind foot has hairs that extend past the toes. These bats are tiny, weighing between 2/10 and ½ ounce. They are between 2½ and 4 inches long, and have a wingspan between 8½ and 10½ inches. Females are larger than males, especially during the winter.

Just as with the little brown bat, 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 ½ to $^{5}/_{8}$ ounce.

Species Range

Little brown and big brown bats are found throughout the northeast. 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 estimates that more than 5 million bats have died from contracting WNS.

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. 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.

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).

General Biology

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 the northeast, 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 the northeast should be able to fly by mid-August.

Nesting/Denning Cover

Pregnant females usually congregate in building attics or bat boxes. High temperatures are needed for rapid development of their young. Bats do not build nests.

Behavior

Bats prepare for winter around the first frost. Big brown and little 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. Big brown bats in the northeastern US 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 the northeast 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.

The diet of little brown bats includes mayflies, midges, mosquitoes, caddis flies, moths, and beetles. An individual can consume insects equal to ⅓ its body weight in ½ hour of foraging. 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.

How to Identify Damage

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 in the northeast are insectivorous, their droppings are easily distinguished from droppings of small rodents. Bat droppings tend to be segmented, and elongated (Figure 3). 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).

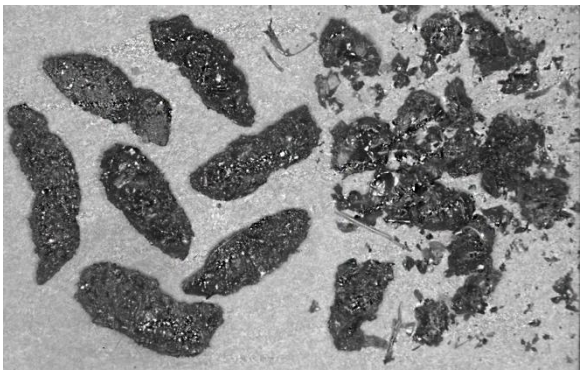


Figure 3. Bat guano (whole, left; crushed, right) looks similar to mouse droppings except for the shiny speckles and susceptibility to crumble. Photo by UNL.

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 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 ⅜-inch wire mesh to reduce access by bats. Never secure an opening unless you are 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 ¼ x 1½ inches and openings ⅝- x ⅞-inch or greater. Bats use some of the same holes in buildings through which heat or cooled air is lost.

Install one-way doors on holes that are actively used by bats to enter or exit the structure. Timing is important to reduce the risk of separating adults from flightless young. In the northeast, 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 ¼-inch mesh will create a check-valve and exclude bats. Tubes, such as the Batcone® (Figure 4), 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 4. Batcone• by Westchester Wildlife.

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.

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 space between a door bottom and the threshold or around windows.

Treat attic and basement doors whenever the 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. Little brown and big brown bats respond to their own distress cries, but not to the cries of other species.

Repellents

No repellents are registered for use on bats.

Toxicants

No toxicants are registered for use on bats.

Shooting

Shooting bats is not practical and is illegal in many states.

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 obtain the lift needed to fly away.

Translocation

If legal in your state, drive at least 20 miles and release bats in an area with abundant insects, such as near lakes and ponds. Effectiveness of this method is questionable, as many bats often migrate hundreds of miles between summer and winter roosts.

Euthanasia

A carbon dioxide chamber is an excellent way to euthanize bats. It will not invalidate rabies testing if such testing is required.

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Figure 1. American beaver (Castor canadensis). Photo by Ralph Arvesen.

Understanding Beavers

Conflicts

Most beaver (*Castor canadensis*) conflicts are associated with dam-building and flooding, or feeding damage and cutting of valuable trees. Usually beaver conflicts 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

The legal status of beavers varies among states. In some states, beavers are protected except during furbearer seasons. In other seasons, they are classified as pests, and may be taken whenever they cause damage. Beavers generally are not considered pests until economic loss is extensive. Consult your state regulations for additional information related to beaver management.

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 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, and a few over 100 pounds.

Species Range

Beavers are found throughout most of North America, and are abundant in the northeast.

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

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 3 or 4 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 4 to 8 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 tend to increase as beavers prepare for freezing winter temperatures. In northern areas, 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. Some beavers girdle pines and sweetgums for the sap that seeps from the wound. Poplar and aspen are preferred food trees. 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.

Cut trees or mud slides along pond and stream edges provide evidence of recent beaver activity.

Figure 3. Beaver damage can be easy to identify. Photo by Jan R. Hygnstrom.

How to Identify Damage

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 long-term 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. They 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 cause flooding of 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, and thousands of acres of cropland and commercial forests have been flooded by beavers. 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. Some states may require permits to remove beaver dams.

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 moving up or down stream.

Install flow pipes only when:

1. landowners 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.

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.

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.

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. Protect the tree bark from the ground to a height of 4 feet. Stir the mixture frequently to keep the sand in solution. The color of the paint is a personal preference. 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

Hire a professional if shooting is the best management solution. In many suburban areas, firearms may not be discharged within 500 feet of neighboring dwellings without a permit.

Trapping

The use of traps often is the most effective, practical, and environmentally safe method for control. Several methods and types of traps are effective for beavers, depending on the situation. The effectiveness of any trap type 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 large watersheds with several colonies. Traps should be checked daily.

Use a walking staff when wading in ponds to locate deep holes, runs, or trails. Use of a walking stick will prevent stepping into water over waders or hip boots in winter, and help locate venomous snakes in the summer. It is not uncommon to find runs and entrances to lodges or dens 2 to 3 feet below the rest of the bottom of the impoundment in older ponds and bottomland swamps where beavers are common.

Foothold Traps

Double-spring foothold traps are very effective when used properly. Use at least No. 3 double long-spring, coil spring, or traps of equivalent spread and strength (Figure 4). Use a drowning-set attachment with all foothold traps for beaver.

Figure 4. Number 4 double-long spring trap.
Photo by Dallas Virchow.

As a trap is tripped, the beaver will head for the water. Use a weight to hold the beaver underwater so it drowns. Some trappers stake the wire in deep water to accomplish drowning. If drowning sets are not used, beavers likely will escape and become trap-shy.

Body-gripping Traps

The Conibear® No. 330 is an effective and easy-to-use trap for catching beaver (Figure 5). When properly set, conibear-style traps will kill the beaver that has been captured. They are equally effective in deep and shallow water. Additional useful equipment includes an axe, hatchet (or large cutting tool), hip boots or waders, wire, and wire cutters.

Figure 5. Conibear-style trap set in a beaver run set half-submerged with trigger on the bottom jaws.
Photo by Stephen M. Vantassel.

Disposition

Relocation

Relocation of beavers only is feasible for rescues.

Translocation

Translocation should be used only when recommended by your state wildlife agency staff.

Euthanasia

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

Fruit-Eating Birds

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Figure 1. European starling (*Sturnus vulgaris*).
Image by unknown.

Understanding Fruit-eating Birds

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 Migratory Bird Treaty Act. Under the Act, birds cannot be killed without a federal permit. Exceptions include the European starling and house sparrow, which are invasive, exotic species, and are unprotected.

In some cases, American 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."

States may require permits for the control of crows, and may regulate the method of take.

Regulations or interpretation of rules regarding depredation may vary among states, and state or local laws may prohibit certain activities for control, such as shooting or trapping. Check with local wildlife officials for specific rules and regulations before initiating lethal control.

Figure 2. American robin (*Turdus migratorius*).
Image by unknown.

Identification

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

Fruit-eating birds are widely distributed in North America. Again, 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 incidence of bird droppings on fruit in an orchard is often low and washing fruit may be an option. Droppings on stored fruit in buildings, however, may pose a problem.

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

General Biology

Reproduction

Breeding behavior varies considerably by species. For example, starlings nest in cavities, both human-made and natural. Other songbirds usually nest in trees or shrubs to avoid ground predators. Check 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.

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. Some devices reproduce distress calls in an attempt to scare birds from crops. Fruit-eating birds usually are small, and often consume fruit while perched. Therefore, tracks are seldom seen.

How to Identify Damage

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.

Damage to cherry crop. Photo by Paul Curtis

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 an entire row (Figure 3), or side panels of nets can be secured to the trellis wires.

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

Frightening Devices

Frightening devices can be effective for short-term dispersal of birds from fruit crops.

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

A combination of several frightening techniques used together may work better than a single technique. Strips of Mylar® tape or scary-eye balloons (Figure 4) may be helpful in some cases. Supplement frightening techniques with lethal control of starlings by shooting, where permitted, to improve effectiveness.

Birds usually learn whether a device presents real danger or not, and they may quickly habituate to stationary effigies. Vary the location, intensity, and types of frightening devices to improve their effectiveness.

Figure 5. Hawk model and an acoustic device intended to frighten 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. Hawk models are suspended on tall poles with fishing line to allow them to move freely in the wind.

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

Several devices on the market use distress calls to deter birds from crops (Figure 6). 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 6. Device using both bird distress calls and raptor calls to deter birds from fruit crops.
Image by Paul D. Curtis.

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 your pesticide labels to determine which formulations are available for specific bird species and crops in your state.

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 Migratory Bird Treaty Act. The US Fish and Wildlife Service (USFWS) and state wildlife agencies 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). Twelve-gauge shotguns set at full choke with No. 7½ shot works well within 40 yards. Permits may require the use of non-toxic steel shot so that lead pellets don't become lodged in fruit. 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.

Disposition

Relocation

Release of starlings is not recommended. Other bird species should be released where captured.

Translocation

Translocation of starlings is not recommended.

Euthanasia

Euthanize starlings with carbon dioxide or cervical dislocation.

Disposal

Check your local and state regulations regarding disposal of carcasses.

Unprotected Birds

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Male house sparrow (*Passer domesticus*). Photo in Public Domain.

Figure 2. European starling (*Sturnus vulgaris*). Photo by unknown.

Understanding Birds

Conflicts

House sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), and pigeons (*Columba livia*) are non-native 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

The Migratory Bird Treaty Act does not protect these species because they are not native to the US. However, some states and communities may restrict management. 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 non-target species.

Figure 3. Pigeon (*Columba livia*). Photo by Erin Bauer.

Identification

Unprotected birds include the house sparrow, European starling, and pigeon, also known as the rock dove.

Physical Description

House sparrows are the smallest of the unprotected birds at about 6½ inches long and weighing 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 are robin-sized, short-tailed black birds about 8½ inches long, and weigh

about 3 ounces. Plumage color changes with gender and season (Figure 2). 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 color on their 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 3 species, at about 12 inches long, and weigh 12 to 17 ounces. They typically 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 the northeast, especially where there are people and 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

Female house sparrows lay 3 to 9 eggs in a single clutch, and may nest twice a year beginning in early April. Female starlings lay 4 to 6 eggs per clutch and can also nest twice a year. Pigeons mate year-round, but most of their 5 to 6 broods produced annually are raised during the spring and summer, when temperatures are above freezing. Females usually lay 2 eggs per clutch.

Figure 4. Nest of a house sparrow.
Photo by Stephen M. Vantassel.

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).

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 (Fig. 6).

Habitat

All three species use habitats in both urban and rural areas.

Figure 6. Pigeon nest with 2 eggs.
Photo by Stephen M. Vantassel.

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.

Figure 3 . Starling droppings on a sidewalk.
Photo by Stephen M. Vantassel.

How to Identify Damage

Damage to Landscapes

Starlings can damage turf when foraging for insects. Sidewalks covered with bird droppings are aesthetically unpleasing (Figure 7).

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 feeding 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). Secure the services of a certified arborist for pruning

landscape trees. Contact an electric company if trees are near power lines.

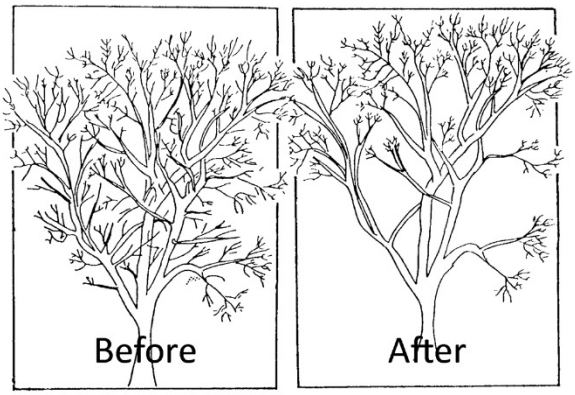

Figure 4. Prune branches to help reduce attractiveness of trees to birds. Image by Prevention and Control of Wildlife Damage (PCWD).

Exclusion

Nets with ½-inch mesh (Figure 9) will prevent birds from gaining access to a location. The use of nets is labor intensive, but often is the best way to prevent birds from accessing rafters and building frontage with many ledges. Zippers allow nets to be used in areas where access is needed, such as doorways and lights.

Figure 5. Nets are used to prevent birds from accessing a porch. Photo by Unknown.

Ledge products prevent birds from roosting on flat surfaces. The non-electric products include spikes (Figure 10), wires, coils, 45° angle inserts, and specialty products.

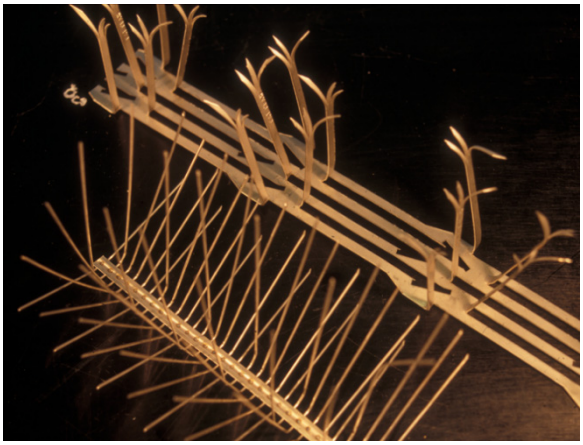

Figure 6. Nixalite® (bottom) and CatClaw® (top) are spiked products used to prevent bird roosting on ledges. Photo by Unknown.

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 7. 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.

Figure 8. Scary-eye balloons move in the wind and frighten birds. Photo by Jan R. Hygnstrom.

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. Some states consider starter pistols that project pyrotechnics to be firearms.

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 is a chemical frightening agent for birds. Professionals may use tactile repellents and fogging applicators to deter birds from warehouses and other large buildings.

Shooting

Populations of problem birds 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. Shooting is usually limited in urban areas.

Trapping

Traps (Figure 13) 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 single-capture devices (Figure 14), to multiple-catch traps capable of capturing dozens of birds. Place 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 9. Pigeon traps. Photo by Stephen M. Vantassel.

Nest-style traps can be effective for sparrows and starlings inside structures.

Other Methods

Nest and Egg Removal

The nests of house sparrows and pigeons are conspicuous, and often can be removed easily to reduce reproduction in these problem species. Nests of starlings typically are in cavities and are much less obvious. The nests, eggs, young, and adults of these species are not protected by federal law. Use a ladder or a long pole with a hook at the end to reach nests that are high off

the ground. Always use caution when setting and climbing ladders and reaching for nests, especially near overhead wires. To avoid contact with nest mites and lice, use 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. Most pest birds are quick to rebuild nests, often in the same location, so block access to the nest site or be persistent and prepared to remove nests and eggs repeatedly from spring through fall.

Lone Bird in Structure

Birds sometimes get inside buildings and are unable or unwilling to leave. These situations can be quite difficult to resolve, particularly when in a public place such as big-box stores and supermarkets. If possible, restrict the area where the bird can fly. Birds tend to fly toward light, so darken the area except for the exit to encourage a bird to fly the right direction. The use of hand nets may work, but the bird is often able to fly around it. Mist nests can be very effective but require regular monitoring to prevent bird deaths. In many circumstances, trapping or shooting will be the only viable options.

Disposition

Relocation

In rescue situations (e.g., from chimneys or basements), birds can be released on-site, provided the entrance has been secured properly.

Translocation

Translocation of pigeons is not recommended because of their homing ability. Pigeons can fly hundreds of miles and return to the original flock. Translocation of sparrows and starlings is not practical or recommended.

Euthanasia

Carbon dioxide is the preferred method of euthanasia. Cervical dislocation or chest compression are other options for people with training or experience.

Euthanasia

Carbon dioxide is the preferred method of euthanasia. All birds expire relatively quickly in a carbon-dioxide environment. Cervical dislocation is another option for euthanasia for staff with training and experience. Grasp the bird firmly in one arm, and with the other grasp its head between thumb and index finger. Pull and twist in a quick jerk to break the neck.

Disposal

Check your state and local regulations regarding disposal of carcasses.

Black Bears

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Black bear (*Ursus americanus*).
Photo by Scott E. Hygnstrom.

Objectives

1. Explain key elements of bear biology that are important for their control.
2. Effectively communicate the options for the control of bears.
3. Describe how to avoid damage by bears.
4. Identify the risks involved with controlling bears.

Species Overview

Conflicts

Black bears (*Ursus americanus*) may damage bird feeders, bee hives, and crops, as well as raid trash cans and dumps. On occasion, they will enter buildings and vehicles in search of food. If a bear has entered a structure, immediately contact your local police agency. Black bears may travel many miles in early summer seeking food and prior to breeding season. They may end up in suburban areas such as parks and school yards. If a bear is treed in an urban area, keep people and pets away, and let the bear leave on its own if possible. Darting and translocation of a bear is high risk for both the bear and agency staff.

Legal Status

Black bears are protected by federal and state laws and regulations throughout their range.

Identification

Black bears (Figure 1) are the smallest and most widely distributed of the three species of bears in North America. They are the only bear species in the northeast. Bears are massive, strong animals.

Physical Description

Black bears that live east of the Mississippi River are predominantly black, and some may have a light blaze on their chest. In the Rocky Mountains and westward, shades of brown, cinnamon, and blond are common. The head is moderately-sized with a straight profile and tapering nose. The ears are relatively small, rounded, and erect. The tail is short (3 to 6 inches) and inconspicuous. Each foot has five curved claws, about 1-inch long, that do not retract. Bears walk with a shuffling gait but can be quite agile and quick.

Health and Safety Concerns

Bears suffer from a variety of internal and external parasites, some of which may be transmitted to humans. Zoonotic diseases include the worm responsible for trichinellosis, and the protozoan that causes toxoplasmosis. Surveys have revealed that a small percentage of bears contract tularemia, brucellosis, and leptospirosis. Few bears have tested positive for rabies.

Although black bears generally avoid humans, they have attacked people. However, encounters are rarely fatal. Always respect bears and keep a safe distance. If a bear starts to approach, shout and wave your arms to scare the animal.

General Biology

Reproduction

Black bears become sexually mature at about 3½ years of age, but some females may not breed until their fourth year or later. Black bears breed during the summer, usually in late June or early July. Males travel extensively in search of receptive females, and mating individuals do not form pair bonds. Rival males may fight one another, and unreceptive females may fight with males. Dominant females may suppress breeding activities of females that are subordinate.

After mating, the fertilized egg does not implant immediately, but remains unattached in the uterus until fall. Females in good condition usually produce 2 or 3 cubs that weigh 7 to 12 ounces at birth. Bears in urban areas with subsidized food have had up to 5 cubs in a single litter.

Females give birth between late December and early February while they are in their dens. After giving birth, the sow may continue torpor (winter sleep) while the cubs are awake and nursing. Females that are lactating do not come into estrus, so females generally breed every other year. Only females care for young. Males sometimes kill and eat cubs.

Cubs are weaned in late summer, but usually stay close to their mother throughout their first year. After the breeding season, females and their yearlings may travel together for a few weeks. The cubs leave the mother when the female comes into her next estrus.

Nesting/Denning Cover

Sites for dens are quite variable and include piles of rocks or brush, excavations, hollow trees, and structures made by humans. The den floor may be covered with grass and leaves, or left bare. Many dens are at ground level under fallen trees, or sometimes even decks.

Behavior

Black bears typically are nocturnal, although occasionally they are active during the day. In the South, black bears tend to be active year-round. In northern areas, black bears undergo a period of torpor during winter, which they spend in their dens. During torpor, individuals may remain in their dens for 5 to 7 months (late October to early April), foregoing food, water, and elimination.

The home range of a black bear depends on the type and quality of habitat, and the sex and age of the bear. In mountainous regions, bears encounter a variety of habitats by moving up or down in elevation. Where the terrain is flat, bears typically range more widely in search of resources. Most adult females have well-defined home ranges of 5 to 20 square miles. Ranges of adult males are several times larger.

Habitat

Black bears frequent heavily forested areas, including large swamps and mountainous regions. Black bears depend on forests for food, water, cover, and space. Mixed-hardwood forests interspersed with streams and swamps are typical habitats for bears. Black bear populations have their highest growth rates in eastern deciduous forests, where there is a variety and abundance of foods, especially near urban areas.

Food Habits

Black bears are omnivorous and forage on a wide variety of plants and animals. Their diet typically is determined by the seasonal availability of food. About 80% of their diet is plant material, and typical foods include grasses, berries, nuts, tubers, inner bark, insects, small mammals, eggs, carrion, and garbage (Figure 2). Shortages of food occasionally occur in northern ranges when mast crops (berries and nuts) fail. At those times, bears travel more widely in search of food. Human encounters with bears are more frequent during such years, as are complaints of damage to crops and losses of livestock.

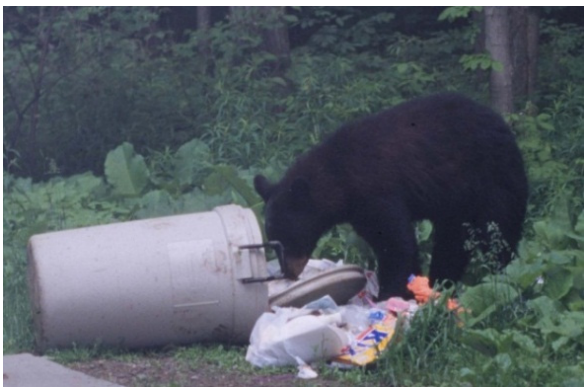

Figure 2. Black bear feeding on trash. Image provided by Gary R. Goff.

Voice, Sounds, Tracks, and Signs

Bears normally are silent when traveling. They emit grunts with young, and may blow and click their teeth if they are upset. Females use loud, staggered grunts to threaten unwanted males. Bears utter moans when subordinate to others.

Tracks of bears are recognized by their shape and size (Figure 3). The heel rarely shows in the track of a front foot. Front feet average 4½ inches in length and 4 inches in width. Rear feet are 7 x 3½ inches. Scat of black bears varies in color and consistency, depending on diet. Well-formed scat averages 2½ inches in diameter, and 5 to 12 inches in length.

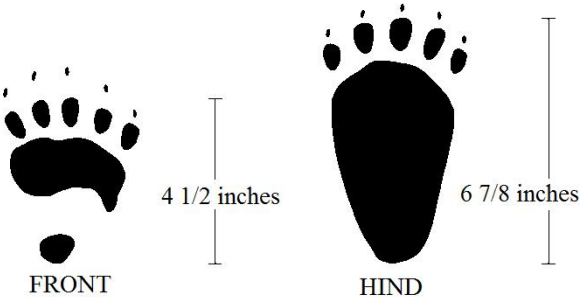

Figure 3. Tracks of a black bear. Image by Dee Ebbeka.

How to Identify Damage

Damage to Landscapes

Bears can cause extensive damage to trees, especially in second-growth forests, by feeding on the inner bark, or clawing the bark to leave territorial markings. Black bears damage orchards by breaking trees and branches in attempts to reach fruit. They often will return to an orchard nightly. Due to repeated damage to orchards, and trees with broken limbs, losses often are economically significant.

Damage to Crops and Livestock

Black bears damage field crops such as corn, and occasionally alfalfa or oats. Large, localized areas of broken, smashed stalks show where bears have fed in cornfields. Bears eat the entire cob, whereas raccoons strip the ears from the stalks and chew the kernels from the ears. Black bears prefer corn in the milk stage.

Few black bears kill livestock but the behavior, once developed, usually persists. The severity of predation by black bears usually makes solving the problem urgent for those who suffer damage. If bears are suspected, check the carcass for deep tooth marks (about ½-inch in diameter) on the neck directly behind the ears. On large animals, look for large claw marks (½ inch between individual marks) on the shoulders and sides. After an animal is killed, a black bear typically will open the body cavity and remove the internal organs. A black bear will eat the liver and other vital organs first, followed by the hindquarters. Udders of lactating females often are consumed.

Predation by bears should be distinguished from attacks by coyotes or dogs. Coyotes typically attack the throat of their prey. Dogs chase their prey, often slashing the hind legs and mutilating the animal. Tooth marks on the back of the neck usually are not found on kills made by coyotes and dogs. In addition, claw marks are less prominent on kills by coyotes or dogs, if visible at all.

Livestock behave differently when attacked by bears. Sheep tend to bunch when they are approached, and three or more often will be killed in a small area. Cattle tend to scatter when a bear approaches. Bears usually kill a single animal. Hogs evade bears in the open, and more often are killed when they are confined. Horses rarely are killed by bears, but they do get clawed on the sides.

When a bear makes a kill, it usually returns to the site at dusk. Bears prefer to feed alone. If an animal is killed in the open, the bear may drag it

into the woods or brush, and cover the remains with leaves, grass, soil, and forest debris. The bear will return periodically to the cache to feed on the decomposing carcass.

Black bears destroy beehives (Figure 4). Damage to beehives includes broken and scattered combs and hives, with claw and tooth marks. Hair, tracks, scat, and other sign may be found in the immediate area. A bear usually will use the same path to return every night until all of the brood, comb, and honey are eaten.

Figure 4. Beehives damaged by a bear.
Photo by Paul D. Curtis.

Damage to Structures

Black bears can damage homes and vehicles when searching for food. Black bears also will scavenge in garbage cans, break in and demolish the interiors of cabins, damage bird feeders, and raid campsites and food caches.

Damage Prevention and Control Methods

Habitat Modification

Prevention is the best approach to handling damage by black bears. Sanitation and proper management of garbage are essential. You should store food, organic waste, and other attractants in bear-proof containers. Use garbage cans for nonfood items only, and place food waste in bear-proof garbage receptacles (Figure 5). Pick up garbage regularly, and place garbage at the curb the morning of pick up rather than the night before. Reduce access to landfills through fencing, and bury refuse daily.

Eliminate garbage and carcass dumps. Surround dumpsters with electric fences. Only feed birds during winter, when bears are denning. Plant crops (e.g., corn, oats, fruit) away from forest edges if possible. Pick and remove all dropped fruit from orchards.

Prohibit all feeding of bears. If possible, locate campgrounds, campsites, and hiking trails in areas that are not frequented by bears. If feasible, clear hiking trails to provide a minimum viewing distance of 50 yards down the trail. Avoid bear feeding and denning areas.

Black bears can tear open doors, rip holes in siding, and break glass windows to gain access to food stored inside cabins, tents, and other structures. Use solid frame construction, ¾-inch plywood sheeting, and strong, tight-fitting shutters and doors. Steel plating is more impervious than wood.

Figure 5. Bear-proof trash can.
Photo by Stephen M. Vantassel.

Place beehives on a flat or low-sloping garage roof. Add extra roof braces as two hives full of honey can weigh 800 pounds or more. Another technique is to place hives on an 8- X 40-foot flatbed trailer, and surround it with a 3-strand electric fence. Although expensive, this method makes hives less vulnerable to bear damage and makes moving them very easy.

Exclusion

Confine livestock in buildings and pens at night, especially during lambing or calving seasons. Remove and dispose of carcasses by deep burial. Place livestock pens and beehives away from wooded areas or protective cover, and surround them with electric fences.

Fences have proven effective in deterring bears from landfills, apiaries, cabins, and other high-value properties. Fences, however, may be relatively expensive. Consider the extent, duration, and cost of damage. Many fence designs have been used with varying degrees of success. Electric chargers increase the effectiveness of fences.

One person can easily and quickly install an electric polytape fence (Figure 6). It is economical and dependable for low to moderate pressure from bears. The fence consists of four strands of electric polytape that are attached to posts with insulators.

Figure 6. Installation of a polytape fence to protect a beehive. Photo by Jan Hygnstrom.

Materials that are required to make an electric polytape fence (Figure 7) include:

- 200-yard roll of polytape,
- 12, 4-foot fence rods ($^5/_{16}$-inch diameter),
- 48 insulators or clips,
- 4 gate handles,
- 12-volt fence charger,
- 12-volt deep cycle battery, and
- herbicides.

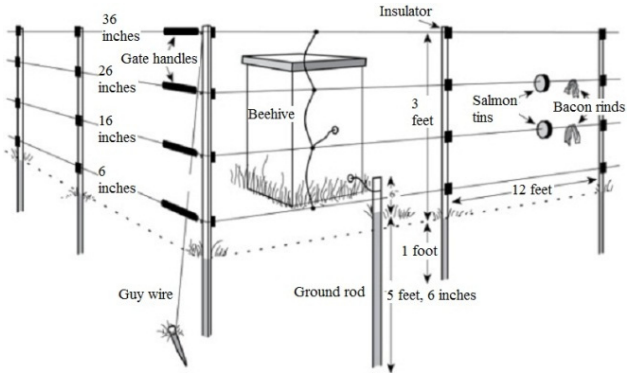

Figure 7. Electric polytape portable fence. Image by Prevention and Control of Wildlife Damage (PCWD).

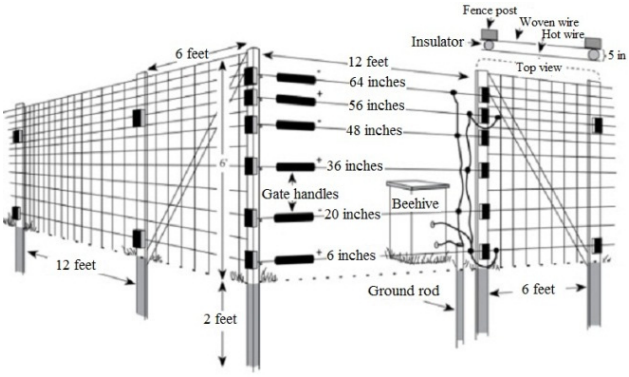

Figure 8. Woven-wire permanent fence. Image by PCWD.

To install the fence, drive four corner posts one foot into the ground, and attach a guy wire. Clip vegetation in a 15-inch-wide strip under the fence and apply an herbicide (use pesticides carefully near bees). Attach insulators on the inside of corner posts and stretch the polytape from the four posts at intervals of 6, 16, 26, and 36 inches aboveground. Hand-tighten the polytape and join the ends with square knots. Drive the remaining posts into the ground at 12-foot intervals, attach insulators on the outside of the line posts, and insert polytape.

A welded-wire, permanent fence (Figure 8) is durable and expensive, and used where there is high pressure from bears. Two people can install it in about 8 hours. The fence consists of heavy, 5-foot woven-wire, supported by wooden posts, and ringed by two additional electrified wires.

Materials required to construct a woven-wire permanent fence include:

- 50-yard roll of 5-foot-high, woven-wire with 6-inch mesh,
- 150-yard roll of high-tensile (14-gauge) smooth wire,
- 24, 8-foot treated wooden posts,
- 40 insulators (screw-in types),
- 2-pound box of 1½-inch fence staples,
- 6 gate handles,
- 12-volt fence charger,
- 12-volt deep cycle battery, and
- herbicides.

To install the fence, set posts 6 to 12 feet apart in 2-foot-deep holes. Align the four corner posts at 5º angles from the vertical. Brace the corner and gate posts from the inside with H-braces or posts set at 45º angles. Clear the vegetation in a 15-inch-wide strip under the fence and apply herbicide. Place one length of welded wire vertically into position and staple the end to a corner post. Pull the entire length of wire taut with a vehicle and staple the welded wire to the line posts. Continue until all sides, except the gate opening, are fenced. Fasten two strands of high-tensile wire to insulators positioned 5 inches away from the welded wire, at intervals of 6 and 56 inches above ground level.

For a 12-foot gate opening, attach three strands of high-tensile wire to insulators on the gateposts. Space the wires at 6, 36, and 56 inches above the ground. Connect them to the two strands that were previously strung around the fence; these will be connected to the positive terminal of the fence charger. Attach three more wires to gatepost insulators 20, 48, and 64 inches above the level of the ground; these will be connected together and to the ground rod. Fit insulated gate handles to the free ends of all six gate wires.

To energize electric fences, use a 110-volt outlet, or 12-volt deep cell (marine) battery connected to a high-output fence charger. If there is sufficient sunlight, consider using a solar charger (Figure 9). Place the charger and battery in a case to protect them against weather and theft. Drive a ground rod 5 to 7 feet into the ground, preferably into moist soil. In dry soil, multiple ground rods may be needed. Connect the ground terminal of the charger to the ground rod with a wire and ground clamp. Connect the positive fence terminal to the fence with a short piece of fence wire. Use connectors to ensure good contact.

Figure 9. A solar-powered charger can provide electricity for a fence. Photo by Jan Hygnstrom.

Electric fences must deliver an effective shock to repel bears. Lure bears into licking or sniffing the wire and getting shocked by attaching attractants (peanut butter on strips of aluminum foil) to the fence. Increase grounding, especially in dry, sandy soil, by laying grounded chicken wire around the outside perimeter of the fence.

Check the voltage of the fence each week: it should carry at least 3,000 volts. To protect against voltage loss, keep the battery and charger dry and their connections free of corrosion. Make certain all connections are secure and check for faulty insulators that might cause arcing between the wire and post. Each month, check the tension of the fence and refresh attractants. Always recharge batteries during the day so that the fence is energized at night.

Frightening Devices

Habituated bears that are conditioned to food can be very dangerous. Do not use any frightening method that would threaten a bear and elicit an attack. If a frightening technique does not cause the bear to flee in a few seconds, stop and try a different method, provided you are in a safe location.

Repellents

Capsaicin spray (Figure has been tested and used effectively on black bears in close quarters and threatening encounters. The range for most products is less than 30 feet, so capsaicin is only effective in close encounters. Do not spray capsaicin on objects or in areas in an attempt to repel bears, as the spray actually may attract them. When using capsaicin spray, make sure that you are upwind of the target so that you do not suffer from the effects.

Figure 10. Pepper spray is an option for protection when in bear country. Photo by Sharon O. Skipton.

Toxicants

No toxicants are registered for the control of black bears.

Shooting

As last resort, shooting is effective for dealing with a black bear that poses an immediate threat to safety. Permits are required in most states to shoot bears. To increase the probability of removing the individual causing the problems, shooting should be done at the site where damage has occurred. Shooting is best left to a professional or law enforcement.

Trapping

Several traps are available for capturing bears. Due to the legal and technical issues involved with bear trapping, it is necessary to consult with your state wildlife agency. This work is best left to professionals.

Disposition

Relocation

Relocation of black bears is not recommended unless the situation involves a rescue.

Translocation

Any capture and translocation of bears usually is conducted by a state or federal wildlife agency. This is time consuming and expensive, and is used as a last resort for problem bears, prior to lethal removal.

Translocation of bears has a mixed record of success. Bears that have been trapped and are to be released should be transported at least 50 miles from the capture site, preferably across a substantial geographic barrier, such as a large river or mountain range, and released in a remote area with suitable wooded habitat. Some bears have returned from as far as 120 miles from the release site. A bear that causes problems should be released only once. If it causes subsequent problems, it should be euthanized.

Translocation often is combined with aversive conditioning. Bears transported in culvert traps can be shot with rubber buckshot or gel-scram paintballs when released.

Euthanasia

If necessary, bears should be euthanized by shooting or chemical induction.

Canada Geese

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Canada goose (*Branta canadensis*). Photo in Public Domain.

Understanding Canada Geese

Conflicts

Canada geese damage turf through their feeding and excrement. Parks, athletic fields, and golf courses often are damaged by goose flocks. Feathers and feces may also foul water, and excessive grazing may result in shoreline erosion. Geese also 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 (non-migratory geese that may inhabit areas throughout the year), are protected by federal and state laws and regulations that govern the capture, handling, or killing of Canada geese, including disturbance of nests and eggs. Permits are required for most control activities other than hazing. Contact your state wildlife agency for more detailed information.

Identification

Canada geese (Figure 1) are a valuable natural resource that provide 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.

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 (Figure 2). 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, there are few cases of human illnesses that are attributed to goose feces.

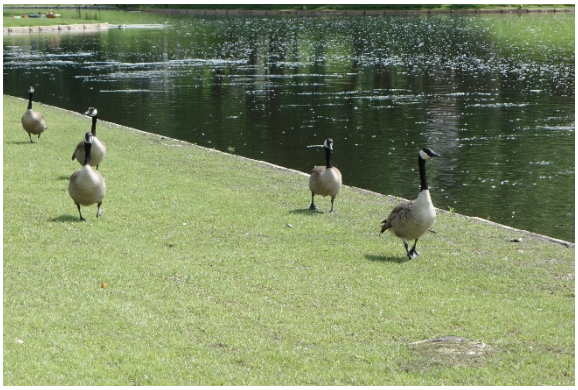

Figure 2. Canada geese may pose a health hazard in parks and residential areas. Photo by Jan Hygnstrom.

General Biology

Reproduction

Geese form life-long pair bonds, but if a member of a pair dies, the other will mate again. Families migrate together, stay together in the winter, and return to the same area for nesting each year.

The annual life cycle of a goose begins in late winter, when adult pairs return to nesting areas in late February or March, or as soon as ice melts. During a 1- to 2-week time span, a goose lays 5 to 6 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 hatching, 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 non-breeding 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 over-winter. 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. Droppings are green when geese are eating grasses (Figure 3). Tracks are easy to find in soft soils or sand (Fig. 4).

Figure 3. Fresh dropping of a Canada goose.
Photo by Stephen M. Vantassel.

How to Identify Damage

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 (Figure 5). Erosion may be a problem on the banks of pond.

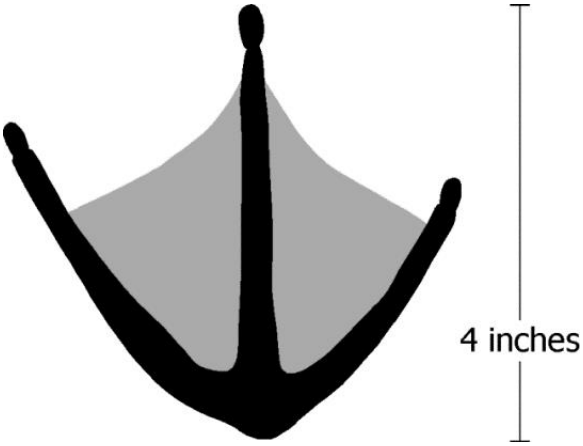

Figure 4. Track of a Canada goose. Image by Dee Ebbeka

Figure 5. Continuous feeding by geese can ruin vegetation in an area. Photo by Jan R. Hygnstrom.

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 fescues. Allow the grass to grow tall, and avoid fertilizing to reduce 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 wires. Secure each wire 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 wires, attach brightly colored rope, flagging, or other markers to make the wires more visible.

Grid-wire 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 wires 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 can 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. Frequently relocate stationary devices to avoid acclimation by geese. Geese quickly learn whether something poses a real danger, and they quickly habituate to most devices. When the birds become habituated, the devices lose effectiveness.

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 6) attempt to portray visual threats to geese. Effigies with moving or flapping parts are more effective than non-moving ones. Reposition effigies every few days.

Figure 6. An effigy of a canine predator may frighten geese. Photo by Jan R. Hygnstrom.

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.

Mylar-style tape reflects sunlight to produce a flashing effect and may be an effective short-term deterrent for geese (Figure 7). 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 at the points of attachment to prevent tearing by the wind.

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.

Remote controlled boats have been successful for hazing geese (Figure 8). 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.

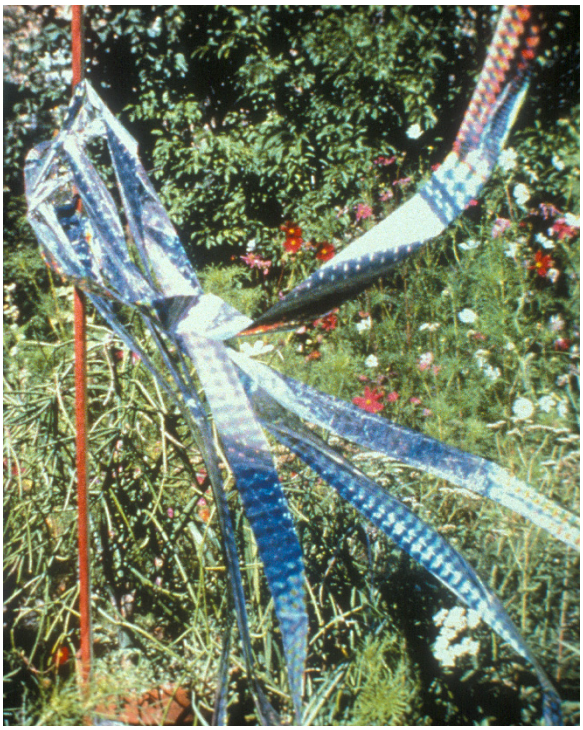

Figure 7. Irri-tape® is Mylar® tape that can be attached to poles to scare geese. Photo by Bird-X, Inc.

Figure 8. Remote controlled motorboats can be an effective way to haze geese. Photo by S. Vantassel.

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.

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.

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.

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 may only 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.

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. There are several commercial products and formulations 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 require that people register on-line 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 your state wildlife agency.

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. Some geese that are translocated return to the location of capture by the following summer. Translocation may increase the risk of spreading diseases to wildlife in other areas.

Euthanasia

Federal permits are required to kill Canada geese. Geese are easily euthanized with carbon dioxide. Geese also may be euthanized by cervical dislocation, which requires training, strength, and skill.

Chipmunks

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Eastern chipmunk (*Tamias striatus*). Photo by Tom Tetzner, US Fish and Wildlife Service (USFWS).

Understanding Chipmunks

Conflicts

Eastern chipmunks (*Tamias striatus*) feed on garden vegetables and flowers. They dig burrows that can disrupt patios, stone walls, and sidewalks. Occasionally they enter structures.

Legal Status

Chipmunks may be protected by regulations in some states. Most states allow landowners to capture and kill chipmunks when they are causing, or about to cause damage.

Identification

The eastern chipmunk (Figure 1) is a common, native species in the northeastern US. They spend most of their time on the ground, and when startled, run with their tails upright.

Physical Description

Eastern chipmunks are 5 to 6 inches long and weigh 3 ounces. Two tan, and five black longitudinal stripes occur on the back, and two tan and two brown stripes occur on each side of the face. The stripes end at the rump. The tail is 3 to 4 inches long and hairy.

Species Ranges

Eastern chipmunks occur throughout the northeastern US.

Health and Safety Concerns

Chipmunks are not important carriers of diseases harmful to humans. Chipmunks and other rodents serve as a reservoir for Lyme disease.

General Biology

Reproduction

Eastern chipmunks mature within a year, and mate twice per year, during early spring and summer through early fall. They have a 31-day gestation period. Two to five young are born in April or May, and again in August or October.

Nesting/Denning Cover

Chipmunk burrows are often well hidden near objects or buildings (e.g., stumps, wood piles, brush piles, stone walls, and basement or garage foundations). The burrow entrance usually is about 2 inches in diameter. No obvious mounds of soil occur around the entrance. The main tunnel typically is 20 to 30 feet in length. Burrow systems normally include a nesting chamber, 1 or 2 food storage chambers, various side pockets connected to the main tunnel, and separate escape tunnels.

Behavior

With the onset of cold weather, chipmunks are inactive from late fall through winter. They do not enter a deep hibernation, and rely on the cache of food stored in their burrow. Some individuals become active on warm, sunny days during winter. Most chipmunks emerge from torpor by early March. Chipmunks generally are solitary, except during courtship, or when rearing young.

Habitat

Eastern chipmunks live in deciduous forests, and prefer areas with rocky or shrubby protective cover. They often are present in parks and backyards. Home ranges of chipmunks may be up to ½ acre, but adults only defend a territory about 50 feet around the entrance of their burrow. Densities of eastern chipmunks may be as high as 10 animals per acre if sufficient food and cover are available.

Food Habits

Chipmunks primarily eat nuts, berries, seeds, mushrooms, insects, and carrion (Figure 2). Chipmunks cache food in their burrows throughout the year. By storing and scattering seeds, they promote the growth of various plants. Chipmunks also prey on bird nestlings and eggs.

Figure 2. Seeds are a favorite food for chipmunks. Photo by Jan Hygnstrom.

Voice, Sounds, Tracks, and Signs

Chipmunks have a sharp "chuck-chuck-chuck" call. Their warning call is a high pitched "wee," which commonly is heard when they feel threatened.

Chipmunks usually are quite noticeable, as they are active during daylight hours. It is rare to find tracks of chipmunks (Figure 3).

How to Identify Damage

Damage to Landscapes

Most damage by chipmunks occurs in home landscapes where vegetables are damaged, or birdseed and flowers are eaten. Chipmunks do little damage to lawns.

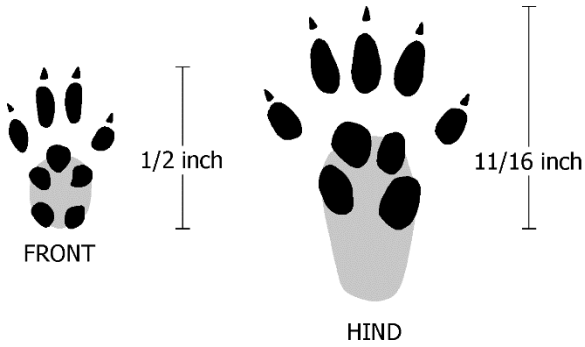

Figure 3. Tracks of an eastern chipmunk. Image by Dee Ebbeka.

Damage to Crops and Livestock

Chipmunks pose a minimal threat to crops, livestock, and pets.

Damage to Structures

When chipmunks are present in large numbers, they can cause structural damage by burrowing under patios, stairs, retention walls, and foundations. Their burrows can damage pool liners. Their digging may undermine retaining walls and cause collapse. Chipmunks typically enter buildings along the sill plate, through dryer vents, along the roof line, and under siding.

Damage Prevention and Control Methods

Habitat Modification

Homeowners should use bird feeders that capture fallen seed to reduce the amount that reaches the ground.

Stack firewood away from buildings to deter burrowing near homes. Avoid planting landscape features (e.g., ground cover, trees, and shrubs) that connect wooded areas with the foundations of homes. Remove stone walls, or fill gaps and holes with mortar.

Exclusion

Use wire-mesh hardware cloth to exclude chipmunks from flower beds. Cover seeds and bulbs with ¼-inch-mesh hardware cloth and remove when the bulbs germinate. Otherwise,

cover the bed with wire mesh large enough for the flowers to grow.

Keep chipmunks out of structures with hardware cloth topped with sheet metal. Use hardware cloth, Copper Stuff-Fit, or Xcluder™ to close openings before they gain entry.

For active burrows, wait until the animals are out and away, fill the holes with soil, and cover them with rocks or other heavy objects.

Frightening Devices

No devices are effective at frightening chipmunks.

Repellents

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.

Fox or coyote urine is registered for repelling animals from lawns and gardens. Follow all label instructions. There is little research to evaluate the effectiveness of repellents for deterring chipmunks.

Toxicants

Chlorophacinone is registered for the control of chipmunks in some states. There may be Special Local Needs 24(c) registrations for site-specific use of toxic baits for chipmunk control.

Shooting

Check with your state wildlife agency for restrictions or permits required to shoot chipmunks. Shooting chipmunks may reduce the local population if the shooter is persistent. Use air rifles, .22-caliber rifles, or shotguns with No. 7½ shot. Local or state laws may limit discharge of firearms in suburban areas.

Trapping

Trapping is practical for eliminating chipmunks in areas less than one acre. To determine the number of traps needed, quickly scan the site, count the number of chipmunks and multiply by 3. Follow-up trapping may be required to remove animals that emigrate from the surrounding area. Set all traps in areas where damage is occurring, next to active burrows, or on active runways.

Cage traps (Figure 5) for chipmunks should be at least 3 x 3 x 10 inches with fine mesh (¼-inch). Use peanut butter or pieces of fruit, vegetables, nut meats, or sunflower seeds as bait. Place bait in the back of the trap to avoid attracting birds.

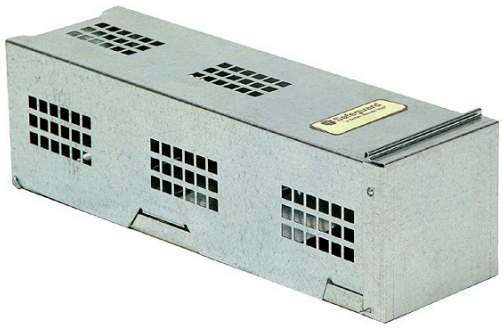

Figure 5. Safeguard® 53070 rodent trap.
Image by Safeguard®.

Rat-sized snap-traps can be used to kill chipmunks. Place traps under inverted wooden boxes with a 2-inch hole cut in each end, or use rat-sized bait stations to reduce capture of non-target animals. Conceal snap traps that are set against structures by leaning boards over them.

Disposition

Relocation

Relocation of chipmunks is not feasible except in rescue situations.

Translocation

Translocation is not recommended for chipmunks. If legal in your state, release chipmunks at least 3 miles from their capture site. Avoid translocating chipmunks in late summer, as this will separate them from their winter food cache.

Euthanasia

Carbon dioxide is an appropriate method of euthanasia for chipmunks.

Coyotes

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Coyote (*Canis latrans*). Photo by unknown.

Species Overview

Conflicts

Coyotes can prey on waterfowl and livestock, and may attack pets (especially small dogs). In rare instances, they will attack people. Coyotes may carry rabies, so if a person or pet is bitten or scratched, consult your local health department. Food-habituated coyotes are more likely to come into contact with people and create problems.

Legal Status

The legal status of coyotes (*Canis latrans*) varies depending on state and local laws. In most western states coyotes are classified as predators, and can be hunted throughout the year, regardless of whether they are causing damage to livestock. In the northeast, coyotes are protected game animals and/or furbearers, and may be hunted only during specific seasons with specific methods. Always review state regulations before initiating coyote control.

Identification

The coyote (Figure 1) is a member of the dog family. Historically, coyotes were most common on the Great Plains, but their range has spread eastward since the 1920s. They are now found throughout most of the United States.

Physical Description

Coyotes resemble small German shepherd dogs with erect, pointed ears, a slender muzzle, and black-tipped, bushy tail. They may vary greatly in size, color, and appearance. Many coyotes are brown-gray with a light gray- or cream-colored belly. Overall color varies greatly from nearly black, to red, to nearly white in some individuals and populations. Most individuals have dark guard hairs over the back and tail. Differences in coloration may be due partially to past hybridization with wolves. In western states, adult male coyotes weigh 25 to 45 pounds, and females 22 to 35 pounds. In eastern states, coyotes are larger, with males averaging 45 and females 30 pounds.

Health and Safety Concerns

Coyotes typically are not considered a threat to humans, although several documented attacks have occurred, including a few that resulted in death. Children are at the greatest risk. Researchers have created an ascending scale that may be useful in evaluating the likelihood of attacks by coyotes in some situations. The risk of an attack increases as you progress from the first to the last item on the list.

1. Is there an increase in numbers of coyotes on streets and in yards at night?
2. Is there an increase in numbers of coyotes approaching adults or taking pets at night?
3. Are coyotes observed early in the morning and late in the afternoon on streets and in parks and yards?
4. Are coyotes observed chasing or taking pets during the daytime?
5. Do coyotes attack and take pets on leash or in proximity to their owners?
6. Do coyotes chase joggers, bicyclists, or other adults?

7. Are coyotes seen in and around play areas, school grounds, and parks during the day?
8. Do coyotes act aggressively toward adults during mid-day?

Coyotes suffer from various diseases, including distemper, hepatitis, parvovirus, heartworm, and demodectic and sarcoptic mange, caused by parasitic mites, Figure 2.

Figure 2. Coyote with mange. Note the substantial loss of hair. Photo by John Consolini.

Rabies and tularemia also occur, and may be transmitted to other animals and humans. Coyotes also harbor numerous parasites including mites, ticks, fleas, worms, and flukes. Rabid coyotes may be very aggressive, so if a person or pet is bitten or scratched, consult your local health department.

General Biology

Reproduction

Coyotes become sexually mature in about 12 months. They usually breed between January and March and produce one litter per year. Gestation lasts approximately 63 days. Females sometimes breed during the winter following their birth, particularly if food is plentiful. Average litter size is 5 to 7 pups, although a litter of 13 has been reported. Pups frequently are moved between multiple dens if the family group is disturbed.

On rare occasions, more than one litter may occupy a single den, which may be from two females that are mated to a single male. Adult male and female coyotes bring food to their young for several weeks.

Pups begin emerging from the den by 3 weeks of age, and within 2 months, will follow adults to hunt or feed on carrion. Pups normally are weaned by 6 weeks of age. The adults and pups usually remain together until early winter, when pups become independent. Occasionally, pups are found in groups until breeding begins. Pups may disperse 50 miles or more from their natal home ranges.

Nesting/Denning Cover

Coyotes bed in sheltered areas, but may seek shelter underground during severe weather or when closely pursued. Dens usually are used for raising young. Coyotes often will dig or enlarge holes dug by smaller animals. Dens vary from 3 to 50 feet long and may have several entrances. Dens usually are found in protected, concealed areas (e.g., steep banks, crevices in rocks, sinkholes, and underbrush), typically less than a mile from water.

Behavior

Coyotes bear young in the spring and raise them through the summer, a process that demands an increase in food for both the mother and young. The peak in reported coyote complaints often occurs in mid-summer. Conflicts may also increase during late fall or winter, when young coyotes disperse from their home ranges and establish new territories.

Coyotes are most active at night and in early morning during hot summer weather. Daytime activity is more likely during the mating and breeding seasons, during periods of low human activity, and cool weather. Coyotes commonly hunt as singles or in pairs. Extensive travel is common during hunting forays. If food is plentiful, coyotes will hunt in the same area regularly. They occasionally bury (cache) remains of food for consumption at another time.

Coyotes are adaptable, and can do well in very urban areas. Recent research has demonstrated that coyotes are compensatory breeders, meaning that they increase reproduction and immigration in response to human-induced killing of coyotes. Mortality is highest during the first year of life, and few coyotes survive for more than 5 years in the wild.

Habitat

Coyotes exist in virtually every type of habitat in North America. Coyotes live in deserts, swamps, tundra, grasslands, brush, and dense forests. They may live at altitudes below sea level, on mountains, and all intermediate altitudes. Coyotes are abundant near urban and suburban areas such as Los Angeles, Pasadena, Phoenix, Denver, New York City, and Chicago.

Food Habits

Coyotes are opportunistic feeders that hunt the prey species that are most abundant in their territory. Common food items include carrion, rodents, ungulates, insects, livestock, and poultry. Coyotes are omnivores, but eat mostly meat during winter and spring. During late summer and fall, more than half of their diet may consist of plant material. Coyotes readily eat fruits such as watermelons (Figure 3), persimmons, and berries. Coyotes may exploit food associated with humans, including garbage and pet food.

Figure 3. Coyote damage to watermelons. Photo by the University of Nebraska-Lincoln (UNL).

Voice, Sounds, Tracks, and Signs

Coyotes are very sociable and use vocalizations to communicate. Coyotes mostly vocalize with a bark or a flat howl, both of which have many variations. Other sounds include a yip, warble, laugh, and irregular howl. Two coyotes that are howling together can give the impression of many more, which may lead to a skewed estimate of the size of the population in a given area. Coyotes in urban areas do not always vocalize.

Tracks of coyotes can be difficult to distinguish from those of a domestic dog (Figure 4). Coyote tracks, however, tend to be narrower and the nails point toward the middle of the track. In contrast, the tracks of domestic dogs tend to splay.

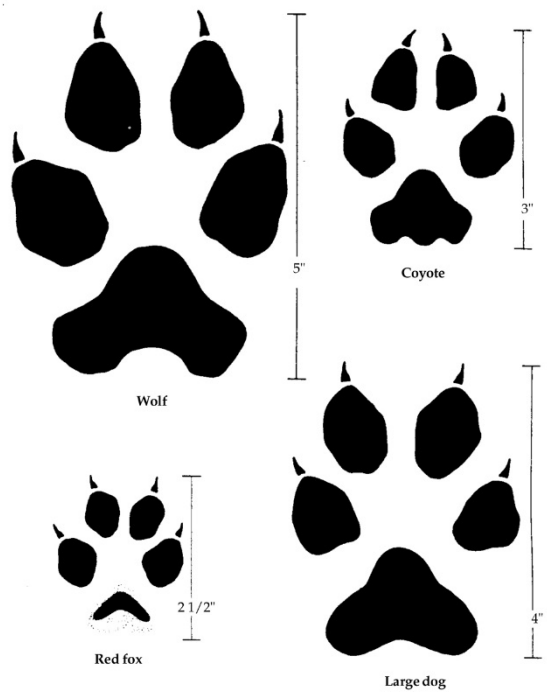

Figure 4. Footprints of canine predators. Image by Prevention and Control of Wildlife Damage (PCWD).

How to Identify Damage

Damage to Landscapes

Coyotes are not known to cause landscape damage.

Damage to Crops and Livestock

Coyotes may damage watermelons. They also will eat fallen and rotting fruit, and may bite plastic maple tubing or irrigation lines.

Livestock predation by coyotes is generally more severe during spring and summer, when coyotes are rearing young. While coyotes frequently are blamed for losses of domestic animals, they often will scavenge animals that were killed by other means. The observation of droppings and tracks of coyotes near a carcass is not sufficient to prove predation by coyotes. Once a coyote has killed

livestock, it probably will continue to do so if given the opportunity.

Damage to Structures

Coyotes are not known to damage structures.

Damage Prevention and Control Methods

The focus of management should be on preventing damage, and targeting individual coyotes that cause conflicts. It is neither necessary nor practical to kill all coyotes. Use a variety of methods to manage damage as no single method is effective in every situation. Success usually involves an integrated approach that combines removing food attractants with effective lethal removal of individual offending animals.

Habitat Modification

Habitats change in some areas depending on the season and the growth of crops. In general, areas that are more open are less likely to have problems with coyote predation.

Piles of junk located near farms are good habitat for rabbits and other prey, and may bring coyotes into proximity with livestock. Eliminate sources of cover and food to make yards and landscapes less attractive to coyotes.

Eliminate intentional and unintentional feeding of coyotes. Bury livestock carcasses, as carcass dumps are attractive food sources for coyotes. Do not allow small pets outdoors unsupervised, especially at night.

Exclusion

Most coyotes readily cross over, under, or through conventional fences for livestock, or those in residential areas. The response of a coyote to a fence is influenced by various factors, including the experience and motivation of the coyote. Total exclusion, especially from large areas, is unlikely. Some coyotes learn to dig under or climb over fences of almost any size.

Net-wire fences in good repair can deter many coyotes from entering a field or pasture. Horizontal spacing of the mesh should be less than 6 inches, and vertical spacing less than 4 inches. Coyotes can be discouraged from digging under a fence by a barbed wire placed at ground level or with a buried wire apron. A fence should be at least 5½ feet high to discourage coyotes from jumping over it (Fig.5).

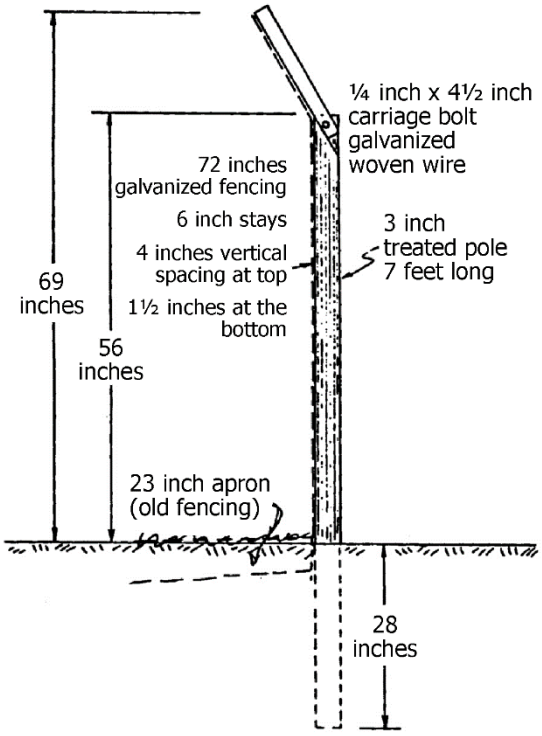

Figure 5. Barrier fence with wire-overhang and buried apron. Image by PCWD.

The success of fences ranges from poor to excellent. Fences are most likely to be cost-effective where predation is high, there is potential for a high stocking rate, or electric modification of existing fences can be used.

The amount of labor and the techniques for installation vary with each type of fence. High-tensile wire fences require bracing at corners and over long spans. Electric fences are easiest to install on flat, even terrain. Labor to install a high-tensile, electric fence may be 40% to 50% less than for a conventional fence for livestock. The amount of labor required to keep electric fences functional can be significant.

Another option is electric modification of existing fences. Where existing fences are in good condition, the addition of wires can significantly improve the ability of the fence to discourage predators and its effectiveness for controlling livestock (Figure 6).

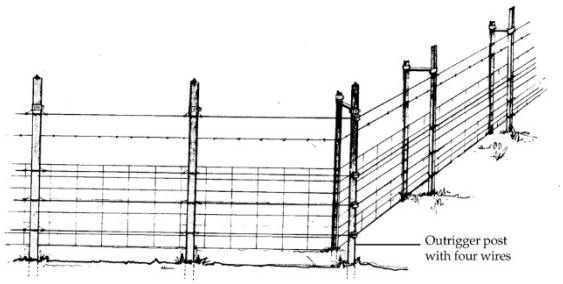

Figure 6. Woven-wire fence for livestock that has been modified with electrified wire. Image by PCWD.

A charged trip wire placed 6 to 8 inches above the ground and 8 to 10 inches outside the fence often is effective in preventing coyotes from digging and crawling under. This addition to an existing fence often is the most economical way to fortify a fence against coyotes.

The advent of safe, high-energy chargers has led to the development of portable electric fences. Most are constructed with thin strands of wire that run through polyethylene ribbon (polytape) and ribbon (polywire). Both are available in single and multiple wire rolls, or as mesh fencing. Portable electric fences allow for the setup of temporary pens to hold livestock at night, or during activities to control predators. Animals that are not accustomed to being fenced may be difficult to contain in a portable electric fence.

Consider modifying chain link and other non-electric fences. Coyotes normally do not jump 6-foot fences. Instead, they grab the top of the fence and pull themselves over (Figure 7).

The Coyote Roller™ (Figure 8) is marketed as a device to prevent coyotes from climbing fences. The spinning action of Coyote Roller's™ prevents coyotes from gaining a foothold. The Coyote Roller™ is suitable for fences at least 6 feet tall. The fences must be secured to the ground to prevent coyotes from digging underneath.

Figure 7. Coyotes are capable of climbing chain link fences. Photo by Ron Case.

Figure 8. The Coyote Roller™ installed on top of chain link and solid fences. Image by Coyote Roller, Inc.

Frightening Devices

Devices that frighten coyotes are useful for short periods of time. Avoid habituation and increase the effectiveness by varying the position, appearance, duration, or frequency of the stimuli, or use them in combinations.

Some devices provide both audio and visual stimuli to frighten coyotes out of an area. Combinations of lights and noisemakers are common. The Electronic Guard incorporates a strobe light and siren that are activated by a light sensor to turn on at dusk and off at dawn. One Electronic Guard can effectively deter coyotes from a 20-acre area of pasture.

Yelling, waving arms, throwing things, blowing whistles, or other hazing may temporarily frighten coyotes in residential areas. Be sure the coyote makes eye contact with you to ensure that the coyote understands humans are a threat. Harass or chase coyotes until they are out of sight to reinforce fear of humans. To be effective, these techniques must be widespread, consistent, and combined with removal of food sources.

Repellents

No repellents are registered by EPA for the control of coyotes.

Toxicants

No oral toxicants are registered for coyotes in the northeastern US.

Carbon monoxide is an effective fumigant for dens and was recently re-registered by the EPA. Gas cartridges produce carbon monoxide, carbon dioxide, and other noxious gases when ignited. They are registered by the EPA for control of coyotes in dens only. State pesticide regulations vary, so check with your wildlife agency before using den fumigants.

Shooting

Shooting is best left to professionals. In many urban areas, firearms may not be discharged within 500 feet of neighboring dwellings without permission. Permits are required in many eastern states to kill problem coyotes.

Trapping

Many people oppose trapping, especially in urban situations. The most common objections include the perception that traps are cruel and inhumane, and concern over catching non-target animals, especially pets. When used properly, traps are effective, selective, and safe, especially when used by an experienced trapper. For best and quickest results, have an experienced professional perform trapping. As for shooting, permits or licenses are required in many eastern states to kill problem coyotes.

Disposition

Relocation

Relocation of coyotes is suitable only for rescues.

Translocation

Translocation of coyotes is not practical in most situations, nor legal in some states.

Euthanasia

A .22-caliber rim-fire shot to the head is a good method for euthanasia of coyotes, if allowed in your municipality. Do not shoot a coyote in the head if it must be tested for rabies.

Carbon dioxide also is an appropriate method used by professionals. Use a snare-pole to control the coyote, and transfer the animal from the trap into a suitable CO_2 chamber.

Crows

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 10. American crow (*Corvus brachyrhynchos*). Image courtesy of Wildlife Control Consultant, LLC.

Understanding Crows

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 also feed on the eggs and young of other birds.

Legal Status

Crows are protected by the Migratory Bird Treaty Act. Under the Act, 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."

State wildlife agencies may require permits for crow control, and may regulate the method of take. 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 state wildlife officials for specific rules and regulations before initiating control.

Identification

The American crow (Figure 1) is the most common species of crow in North America. In the northeast, they may be confused with fish crows (*Corvus ossifragus*). The fish crow has a more nasal call than American crows. Northern ravens (*C. corax*) also 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. Fish crows are slightly smaller than American crows, but appear similar in the field.

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.

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 breathe 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. Fish crows also can contract WNV, but have a higher rate of survival.

General Biology

Reproduction

American crows are capable of breeding after 2 years. Crows nest in February to May in the northeast. Mates appear to remain together throughout the year, at least in non-migratory 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 4 to 6 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 4 or 5 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. Crows flying to 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 ⅓ 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 of 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 call of fish crows is a short, nasal “ca,” “car,” or “ca-ha.”

The gregarious behavior of crows accompanied by frequent vocalizations allow for easy identification. Tracks may be found in soft soils (Figure 3).

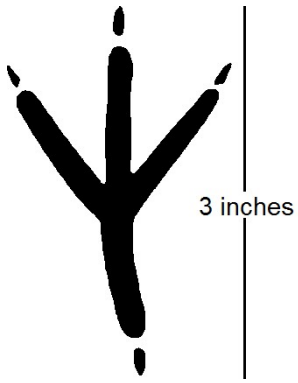

Figure 3. Track of an American crow. Image by Dee Ebbeka.

How to Identify Damage

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.

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 ⅓ 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. Secure trashcans and dumpsters, and remove carrion.

Exclusion

Exclusion, generally, 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. Strips of aluminum or cloth, or aluminum pie pans may be tied to the wires, but have mixed results. Lines appear to represent an obstacle that is difficult for a flying bird to see, especially when rapid escape may be necessary. 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.

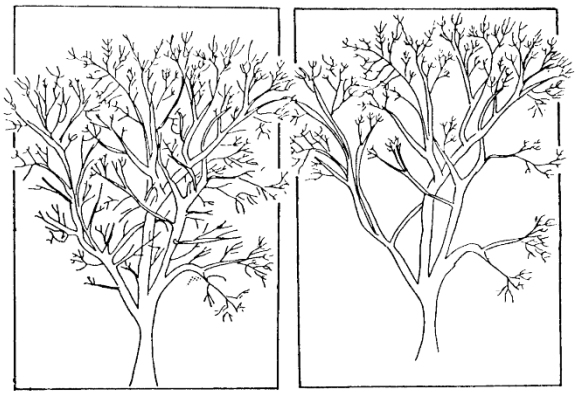

Figure 4. Thin branches to reduce roosting cover for crows. Image by PCWD.

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.

Ultrasonic sounds (high frequency, above 20 kHz) are not effective in frightening crows and most other birds. Strips of Mylar® tape hung in roost trees may be helpful in urban areas.

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 (LRAD) 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).

Fertility Control

No methods are available for use on crows.

Toxicants

No toxicants are registered for controlling crows.

Shooting

Crows are protected by the Migratory Bird Treaty Act. The US Fish and Wildlife Service (USFWS) and state wildlife agencies may issue permits to shoot crows. Check your local and state regulations before shooting crows. Twelve-gauge shotguns set at full choke with No. 6 shot work 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. 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 Migratory Bird Treaty Act. The USFWS and state wildlife agencies 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 for rescues.

Translocation

Translocation of crows is not recommended.

Euthanasia

Euthanize crows with carbon dioxide or cervical dislocation.

Deer

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Figure 1. Female white-tailed deer (*Odocoileus virginianus*). Photo by Greg Clements.

Understanding Deer

Conflicts

Despite their economic and aesthetic values, white-tailed deer (*Odocoileus virginianus*) 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, such as Lyme disease.

Legal Status

White-tailed deer are protected year-round in all states. Where severe or persistent damage occurs, states may issue depredation or nuisance permits to allow shooting of deer at times other than legal hunting seasons. Regulations vary on the necessary permits and on disposal of dead animals. The popularity of deer as game animals and the need to curb poaching have led to the development of severe penalties for illegal possession. As a rule, lethal control of deer cannot be initiated before consulting your state wildlife agency. Some states provide technical assistance or compensation for damage by deer.

Identification

White-tailed deer (Figure 1) are found throughout the northeastern US. The volume of literature on the ecology and management of deer exceeds that for any other species of wildlife. We recommend *Biology and Management of White-tailed Deer* by Hewitt (2011) as the best single reference.

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 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.

Health and Safety Concerns

Deer-vehicle collisions are their 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 a 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 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

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 2 or 3 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

In northern areas, deer gather or “yard up” in dense cover for the winter. They may move up to 100 miles from a summer range to a winter yard. They have a home range of several hundred acres that varies with season, sex, and quality of habitat. 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 forest. 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 the northeast, deer densities may exceed 150 animals per square mile in suburban areas with patches of forest habitat or park lands. This could be 4 to 5 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. When deer are in the area, deer trails, tracks, and scat are usually easy to find (Figure 3.)

Figure 3. Deer scat. Photo by Jan Hygnstrom.

How to Identify Damage

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 United States.

Damage to Crops and Livestock

Deer may cause damage to a wide variety of row and forage crops (Figure 4), 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. Deer also are susceptible to the virus that cause epizootic hemorrhagic disease and bluetongue in cattle. On occasion, deer attack dogs.

Figure 4. Young corn plants are a favorite food for deer. Photo by Jan Hygnstrom.

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

Some state-funded programs offer subsidies for materials for damage control, or direct compensation for losses resulting from damage by deer. These subsidy programs tend to be more common in western states than in the northeast. Such programs can be very costly but probably are necessary where large deer herds are maintained in agricultural landscapes. Individual states vary greatly in their degree of financial and technical assistance for deer damage management. Consult your state wildlife agency for information.

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 (Figure 5) 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.

Figure 5. A woven-wire fence may be worth the investment for a high value crop such as a vineyard. Photo by Jan Hygnstrom.

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 the northeast, 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 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. Deer fertility control does little to reduce densities of overabundant deer in the short term as urban deer may live 10 or more years. Contact your state wildlife agency for information.

Toxicants

No toxicants are registered for the control of white-tailed deer.

Shooting

Shooting through regulated sport and managed hunting during fall and winter can help maintain or reduce deer densities. Depredation or nuisance deer permits are available from some state wildlife agencies during non-hunting 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

Deer trapping is conducted by professionals, and may be used in conjunction with an urban deer 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. Most states currently do not allow translocation of deer. Also, deer are abundant in many eastern states, and there are few places to release deer where conflicts can be avoided.

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 firearms discharge. For more information, see the National Wildlife Control Training Program.

House Mice

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

Figure 1. House mouse (*Mus musculus*). Photo by US Department of Health and Human Services-National Institutes of Health.

Understanding House Mice

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 non-native species, house mice are not protected by 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 include our native deer, white-footed, 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 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 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

Litters of 5 or 6 young are born 19 to 21 days after mating. Newborn house mice are hairless and their eyes are closed. Young grow rapidly, and after two 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 three 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 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 $^{1}/_{10}^{th}$ 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 $^{1}/_{2}$ 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.

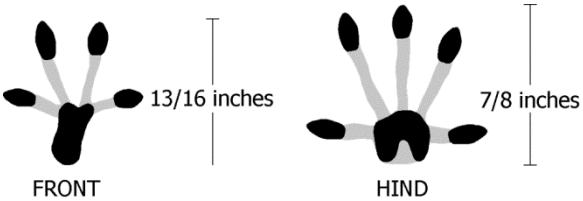

Figure 2. Tracks of a house mouse. Image by Dee Ebbeka.

Tracks, including footprints and marks from tails, may be seen on dusty surfaces or in mud (Figure 2). 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).

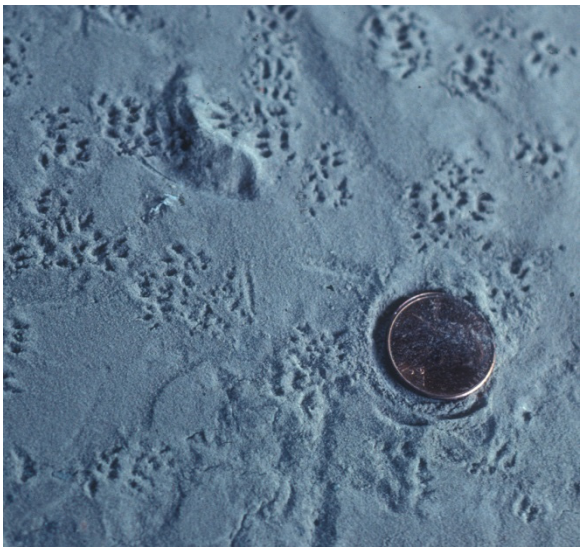

Figure 3. Tracks of house mice in flour. Photo by Ron Case.

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 ¼ inch long, whereas those of cockroaches usually are $^1/_8$ to ¼ 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 $^1/_{32}$ inch, and those of Norway rats are $^1/_{16}$ inch in diameter. Fresh accumulations of wood shavings, insulation, and other materials that have been gnawed indicate infestations that are active. Entry holes of mice are less than 1½ 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.

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.

How to Identify Damage

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 can quickly cause extensive damage to insulation inside walls and attics (Figure 4).

Figure 4. Insulation that has been damaged by house mice. Photo by Robert M. Timm.

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.

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, however, permit easier detection of sign, increase effectiveness of traps and bait by reducing 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-it 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.

Figure 5. Xcluder® fabric placed in a crevice on the foundation. Photo by Stephen M. Vantassel.

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.

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

Most states require having a commercial pesticide applicator license before applying rodenticides as a business service. 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).

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.

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)

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 non-target 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.

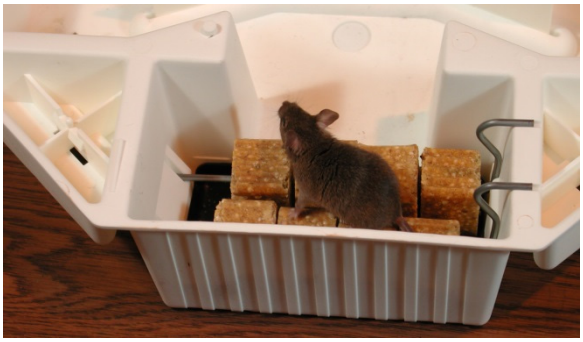

Figure 6. Mouse on bait blocks secured inside a bait station. Photo by Liphatech®.

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:

- protect bait from moisture and dust,
- provide a protected place for rodents to feed,
- keep non-target animals and children away from hazardous bait,
- allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to non-targets,
- prevent accidental spilling of bait.

Types of Bait Stations - Bait stations (boxes) made of plastic, cardboard, or metal are available (Figure 7) in sizes for rats and mice.

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.

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.

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

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 non-target 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 his or her 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 they 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 pieces of marshmallows, hot dog, bacon, or nutmeat tied securely to the trigger. Non-allergenic 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 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 non-target animals can come in contact them. Non-target 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

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. Some dogs and cats will catch and kill mice, but pets generally do not control large populations. 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 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.

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.

Moles

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Figure 1. Star-nosed mole (*Condylura cristata).* Photo by unknown.

Understanding Moles

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 most states.

Identification

Moles are small mammals that spend most of their lives underground. They feed primarily on soil-borne insects, grubs, and earthworms that they encounter while tunneling beneath the surface. The star-nosed mole (*Condylura cristata,* Figure 1*)* is the most common and widespread mole in the northeastern US. Eastern moles (*Scalopus aquaticus*) and hairy-tailed moles (*Parascalops breweri*) also may be common.

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.

Star-nosed moles typically are 6 to 8 inches long and weigh about 2 ounces. Their fur is blackish-brown. They have a long thick tail, 44 teeth, and a ring of 22 pink, fleshy tentacles at the tip of their snout (Figure 1).

Figure 11. View of an eastern mole (*Scalopus aquaticus*) on its back, showing its tail, hind feet, enlarged front feet, and pointed nose. Photo by University of Nebraska-Lincoln.

Species Range

Star-nosed moles are common throughout the northeastern US, and share much of the same range as the hairy-tailed mole. Eastern moles occur in southern New England, New York, and the eastern US.

Health and Safety Concerns

No human health or safety concerns are associated with moles.

General Biology

Reproduction

The mole gestation period is about 42 days. A litter of 3 to 5 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 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 insects, grubs, and worms. 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.

How to Identify Damage

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.

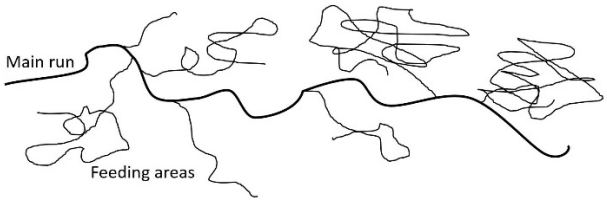

Figure 3. Main run and feeding areas for a mole.

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).

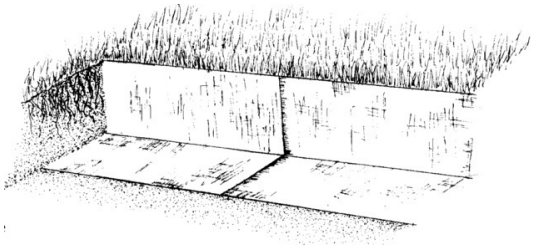

Figure 4. Fence to exclude moles. Image by Prevention and Control of Wildlife Damage (PCWD).

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. This product may not be registered in all northeastern states.

Gopher purge (*Euphorbia lathyris,* Figure 5), 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.

Figure 5. Mole plant is not recommended as it is toxic to people, invasive, and has not been proven to be effective. Photo by pixabay.com Creative Commons.

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. Tomcat® 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. In some states, such burrow fumigants may be available only to certified applicators.

Shooting

Shooting is not a practical control for moles.

Trapping

The most successful and practical method for controlling moles is trapping. Several styles of mole traps are on the market (Figure 6). 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.

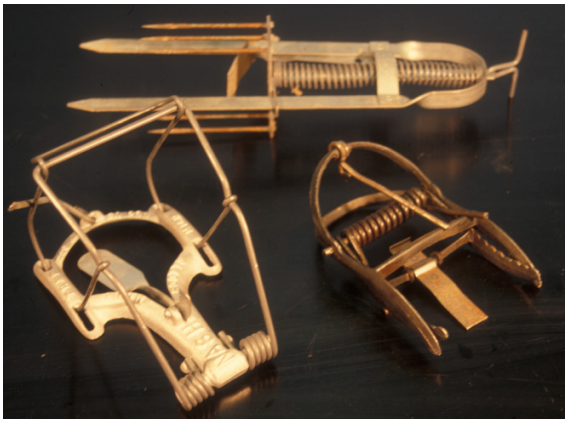

Figure 6. Traps for moles, listed in clockwise from the top: Victor® (harpoon), Out O' Sight® (scissor-jawed) and Nash® (choker loop). Photo by UNL.

Disposition

Relocation and Translocation

Relocation and translocation are not practical.

Euthanasia

Use carbon dioxide to euthanize moles, if necessary.

Opossums

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Figure 1. Opossum (*Didelphis virginiana*) with young. Photo by Jason Reger.

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

Laws and regulations that protect opossums vary among states. In most states they are furbearers, with open seasons for hunting or trapping. Check with your state and local authorities for options in dealing with opossums.

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. In northern climates, however, tail length may be shorter due to frostbite. 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.

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

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 7 to 8. 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 3.5 miles per hour, and escape predators by entering burrows, climbing trees (Figure 2), 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.

Figure 2. Opossums escape canine predators by climbing trees. Photo by Jan R. Hygnstrom.

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, wooded to open fields. Opossums prefer environments near streams or swamps. They 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. Opossums may 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.

How to Identify Damage

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 major 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 typically they 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 non-food 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 single door, or 7 x 7 x 24 double-door) are preferred for capturing opossums. Use cat food, fruit, or marshmallows as bait. Body-gripping traps (Nos. 160 or 220) and foothold traps (Nos. 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 grasp 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.

Disposition

Relocation

Relocation of opossums is appropriate for rescues. Release the opossum into cover away from roads and where people live.

Translocation

If translocation of opossums is legal in your state, transport them at least 5 miles away from the capture site, and release them into suitable habitat.

Euthanasia

Carbon dioxide gas is the most appropriate technique to euthanize opossums. Opossums also can be humanely killed with a gunshot to the head, if it is legal and safe in your area.

Rabbits

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Figure 1. Eastern cotton-tailed rabbit (*Sylvilagus floridanus*). Photo by Gareth Rasberry

Understanding Rabbits

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

In most states, cotton-tailed rabbits are classified as game animals and are protected. Some states allow property owners to trap or shoot rabbits outside the normal hunting season on their own property if the animals are causing damage. Check with your state and local authorities for options in dealing with cottontails.

Identification

The eastern cotton-tailed rabbit (Figure 1) occurs throughout much of the northeastern US. The snowshoe hare (*Lepus americanus*) occurs in the more mountainous regions of the northeast with deeper snowfall. This module will focus on the eastern cottontail, as it 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 in length, and weigh 2 to 4 pounds.

Species Range

The range of eastern cotton-tailed rabbits extends from southern New England along the Canadian border westward throughout much of the eastern US.

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

Rabbits generally live 12 to 15 months, and only 1 in 100 lives 3 years. Typically, a female produces 2 to 3 litters annually, with 5 to 6 young per litter, in the northeastern US. 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.

Figure 3. Unprotected trees can be severely girdled by rabbits. Photo by Stephen M. Vantassel.

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 *Euonymous*, dogwood, and roses.

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. 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.

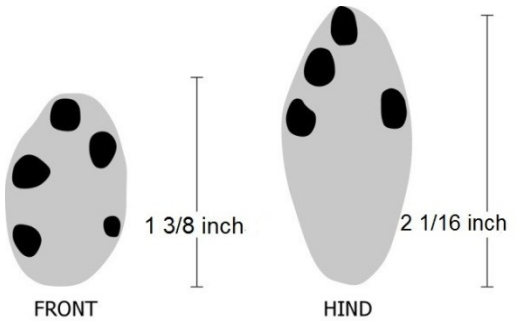

Figure 4. Tracks of an eastern cottontail rabbit. Image by Dee Ebbeka.

How to Identify Damage

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.

Figure 6. Droppings of rabbits in winter tend to be filled with remnants of fibrous plant material.
Photo by Jan R Hygnstrom.

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 are 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 are almost never found far from protective escape cover (Figure 7).

Figure 7. Remove brush piles to reduce habitat for rabbits.
Photo by Jan R. Hygnstrom.

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 state 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 suitable only in rescue situations.

Translocation

If state regulations allow translocation, release rabbits in suitable habitat in rural areas several miles from where they were trapped. As with trapping, state permits may be needed to transport rabbits. Do not release rabbits where they may create a problem for someone else.

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.

Raccoons

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
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Figure 1. Raccoon (*Procyon lotor*). Photo by Greg Clements.

Understanding Raccoons

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 are protected furbearers in most states with seasons established for running dogs, hunting, and trapping. Most states have provisions for landowners to control furbearers that are damaging their property. Check with your state wildlife agency before using any lethal control methods.

Identification

Raccoons, also called “coons,” are native to the northeastern US, 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 (Figure 1).

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 the northeastern US 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. Raccoons are the primary vector species for rabies in the northeastern US.

Raccoon roundworm (*Baylisasacris 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

Raccoons mainly breed in February or March. Gestation lasts about 63 days. Most litters are born in April or May. Average litter size is 3 to 5 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 the 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, 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 are frequently 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). Latrines, where raccoons regularly defecate (Figure 3), tend to be in areas open to the sky such as roofs, sand boxes, and fallen trees.

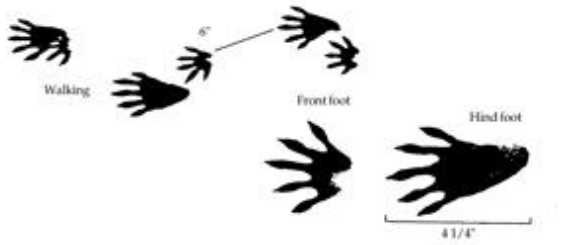

Figure 2. Five long rear toes and "hand-like" front prints are characteristic of raccoon tracks. Image by Prevention and Control of Wildlife Damage (PCWD).

Figure 3. Latrine of a raccoon. Photo by Stephen M. Vantassel.

How to Identify Damage

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 may damage 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 being 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 mesh-wire 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.

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 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 that 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 long-term 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 treed raccoons if shot placement is restricted to the head. Otherwise, use a shotgun with No. 6 shot, if legal in your state. Shooting is prohibited in most towns and cities. Check with state 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 Traps

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 non-target 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.

Figure 9. A raccoon captured in two foot-encapsulating traps.

Foot-encapsulating Traps

Dog-proof, foot-encapsulating traps (Figure 9) can be very effective for catching raccoons in urban areas. These type of traps will reduce non-target captures common with cage traps. There are several commercial brands of these traps available, and they all restrain raccoons by the foot in a similar way.

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

Raccoons can be released on-site if it is legal in your state. Try to release them where they will not run into traffic or cause other disturbances. 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 is not recommended for raccoons. Survival rates are low for transported raccoons, and they may move up to 25 miles from their release site to return to their home area. It is illegal to translocate raccoons in many states because of the risk of transmitting rabies and other diseases.

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 raccoons in the head if rabies testing is required.

Disposal

Dispose of raccoons by deep burial or incineration. Consult your state regulations regarding disposal of carcasses.

Norway Rats

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Norway rat (*Rattus norvegicus*). Photo by US Department of Health and Human Services-Public Health Service.

Understanding Rats

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 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 the contiguous 48 states, Alaska, and Hawaii. They generally are found at lower elevations but may occur wherever humans live.

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, these rats may bite infants and adults who are unable to defend themselves.

General Biology

Reproduction

Females produce 3 to 6 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.

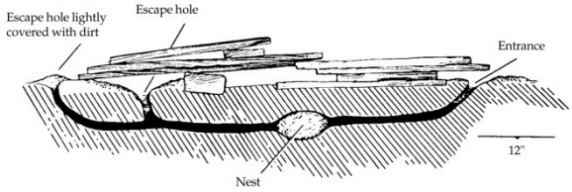

Figure 2. Diagram of a den of a Norway rat. Image by the Prevention and Control of Wildlife Damage.

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 and 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 ½ 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.

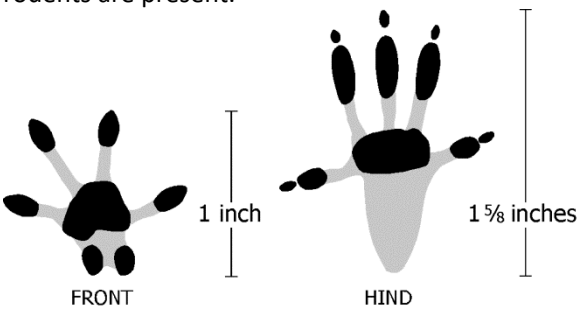

Figure 3. Tracks of the Norway rat. Image by Dee Ebbeka.

Droppings may be found along runways, in feeding areas, and near shelters (Figure 4). Scat may be up to ¾ inch long and ¼ 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 hairs of rats 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.

How to Identify Damage

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.

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.

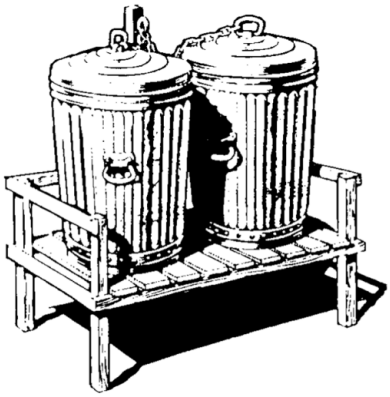

Figure 7. Galvanized garbage cans on an elevated platform. Image by PCWD.

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

Most states require having a commercial pesticide applicator license before applying rodenticides as a business service. 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 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 non-target 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 EPA's 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:

- protect bait from moisture and dust,
- provide a protected place for rodents to feed,
- keep non-target animals and children away from hazardous bait,
- allow placement of baits in locations where it otherwise would be difficult because of weather or potential hazards to non-targets, and
- prevent accidental spilling of bait.

Types of Bait Stations - Use rat-sized bait boxes made of plastic, card-board, or metal (Figure 6).

Figure 6. 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.

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.

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

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 non-target 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

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 toxicants not advised. It 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 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. Place traps across obvious runways or where runs are confined. Expanded-trigger traps set directly on travel routes may catch rats immediately. 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 7a and 7b). Expanded-trigger snap-traps typically have less bait losses and twice the capture rate of the narrow-trigger versions.

Figure 7a. Metal (thin) trigger snap trap (top) and plastic expanded trigger (bottom). Photo by Stephen M. Vantassel

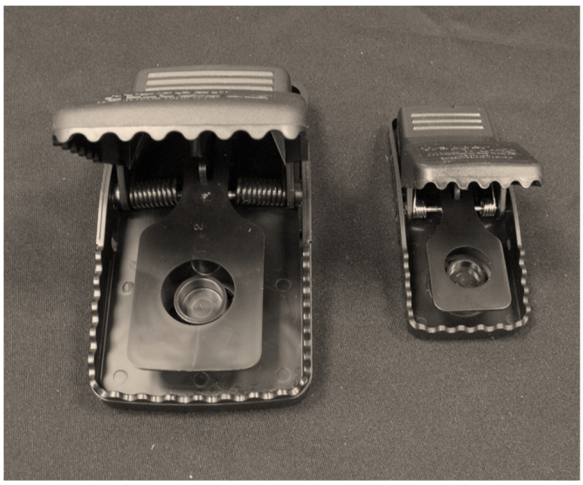

Figure 7b. Clamshell-style traps (rat left, mouse right). Photo by Stephen M. Vantassel.

Follow these guidelines to improve your success:

1. use plenty of traps,
2. place traps where rats are traveling, such as along walls,
3. position traps with the trigger facing the wall so that rats will pass directly over the trigger,
4. leave traps unset for several days to help rats become accustomed to them,

5. refresh and replace bait as needed,

6. use a combination of baited and blind (unbaited) sets,

7. use appropriate bait (e.g., pieces of hot dog, bacon, pepperoni, or nutmeat tied securely to the trigger; peanut butter; marshmallows; or commercially-available non-allergenic baits),

8. avoid placing traps directly in front of holes to reduce refusals, and

9. place traps inside bait stations, under slanted boards, or in areas that are difficult to access to reduce likelihood of capturing non-target animals.

Cage Traps

Wire-mesh cage traps such as the National®, Tomahawk®, and Havahart® can be used to capture rats. Wire funnel-entrance traps also have been used to capture rats. The animals must be euthanized unless released on the property.

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 non-target animals may be captured. Non-targets can be released by applying vegetable oil to the glue. Glueboards lose effectiveness in areas that are dusty, unless they are covered.

Other Methods

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. However, pets rarely will control populations of Norway rats. Around most structures, Norway rats can find places to hide and rear their young out of the reach of predators. Cats increase the 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 invasive to the US, so 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.

Skunks

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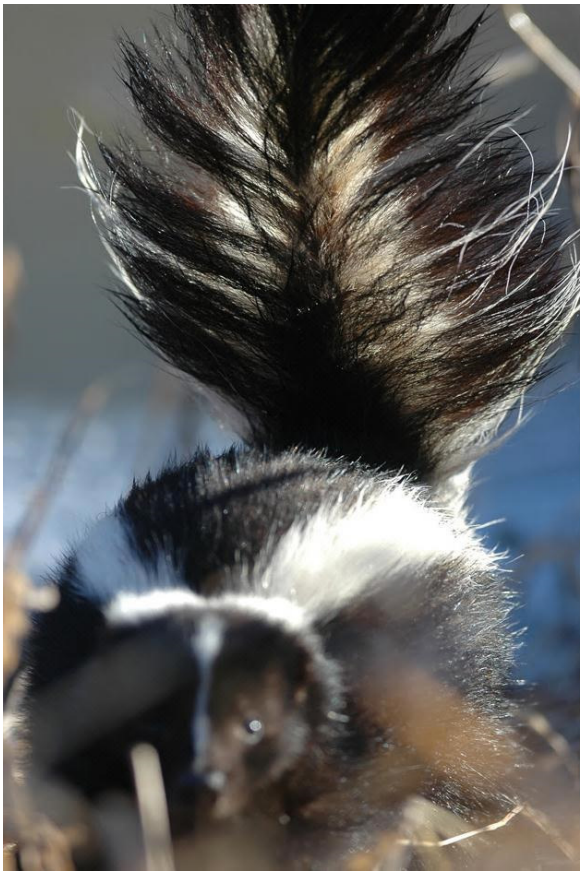

Figure 1. Eastern striped skunk (*Mephitis mephitis*). Photo by Greg Clements.

Understanding Skunks

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 not protected by law in some states. However, they are protected furbearers or non-game species in others. Check with state wildlife officials before removing any skunks.

Identification

Striped skunks are members of the weasel family. Most are black with white stripes the length of the body (Figure 1), and are easily recognized by most people. However, coat color is quite variable, and skunks may range from nearly all black, to all white.

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.

Striped skunks are about the size of an ordinary house cat, up to 29 inches long and weighing about 8 pounds.

Species Range

Striped skunks are common throughout the US in both rural and suburban areas. It is found in every state except Alaska and Hawaii.

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

Adult skunks begin breeding in late January. Gestation usually is 7 to 10 weeks, and litters commonly consist of 4 to 6 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. A female that does not wish to mate with a particular male will typically 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, and open lands bordering forests. Often, skunks inhabit 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.

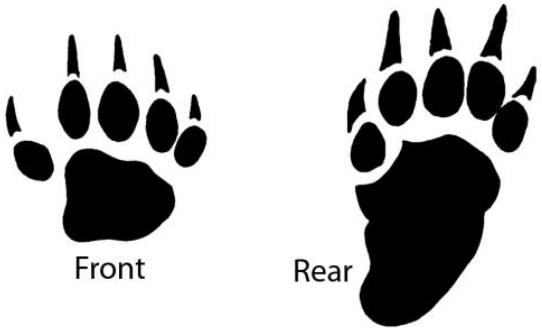

Figure 2. Tracks of a striped skunk. Image by PCWD.

Droppings of skunks often can be identified by the undigested insect parts they contain. Droppings are ¼ to ½ 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.

How to Identify Damage

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.

Figure 3. Damage by skunks in turf. Photo by Javier Gil.

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.

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 attractiveness of an area to skunks. Skunks prefer cover, and debris-filled areas provide excellent hunting grounds. Properly dispose of garbage or other food sources that will attract skunks. Skunks are often 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 (Figure 4). 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 ¼-inch mesh fences 2 inches below the ground, and extend the mesh out perpendicular from the location being protected at least 12 inches (Figure 4).

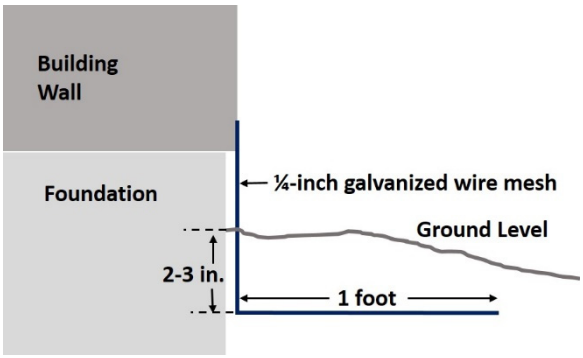

Figure 4. Diagram of below-ground exclusion fencing. Image by Jan Hygnstrom.

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 one-way door and secure the opening.

Figure 5. One-way door over the entrance to a den of a skunk. The thin vertical sticks in the back will be knocked over if an animal moves through. Photo by S. 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 non-target 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, use a .22-caliber rifle, or shotgun with No. 6 shot.

Trapping

Skunks can be captured with cage or box traps located 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 ¼ cup baking soda, 1 quart of 3% hydrogen peroxide, 1 teaspoon of dish soap, and 1 gallon of water. Rinse with water. Avoid getting the mixture in eyes.

If a skunk is suspected of being rabid, it should be humanely killed, while avoiding a shot 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

When rescuing skunks from window wells and garages, on-site release is the preferred option. Residents and neighbors should 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

Translocation of skunks is not advised because they may transmit rabies. In some situations, translocation may be restricted, so check state and local regulations.

Euthanasia

Carbon dioxide is the preferred euthanasia method for skunks. Skunks are tolerant to CO_2, 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.

Tree Squirrels

Prepared by the **National Wildlife Control Training Program.** WildlifeControlTraining.com
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Figure 1. Eastern gray squirrel (*Sciurus carolinensis*). Photo by unknown.

Understanding Squirrels

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. People who feed birds often lose seed, and feeders are damaged by squirrels.

Legal Status

Fox and gray squirrels are usually classified as game animals. Flying squirrels are often fully protected as non-game wildlife. Red squirrels may be unprotected in some states. Check with your state wildlife agency to determine the legal status of squirrels in your area.

Identification

In this chapter, tree squirrels are divided into three groups:

1. large tree squirrels, including the eastern gray squirrel (*Sciurus carolinensis*) and fox squirrel (*Sciurus niger*);
2. small tree squirrels, including the red squirrel (*Tamiasciurus hudsonicus*); and
3. flying squirrels, including the southern flying squirrel (*Glaucomys volans*) and northern flying squirrel (*Glaucomys sabrinus*).

Physical Description

Eastern gray squirrels (Figure 1) typically are gray, but have some variation in color. Black individuals are common in northern parts of their range. Local populations of white gray squirrels are found in upstate New York and other localities. White gray squirrels are not albino. They have gray on the back of their heads, necks, or shoulders. Fox squirrels typically are orange-brown, but color varies greatly from all black to silver gray.

Red squirrels are red-brown above with white under parts. They have small ear tufts and often have a black stripe separating the dark upper color from the light belly.

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. The two species of flying squirrels that occur in the northeastern US are very similar in appearance.

Eastern gray squirrels are 16 to 20 inches long and they weigh 1¼ to 1¾ pounds. Red squirrels are considerably smaller. They are 10 to 15 inches

long and weigh ⅓ to ⅔ pounds. Flying squirrels are 8 to 12 inches long.

Species Range

Eastern gray squirrels are found throughout much of the eastern US and often are abundant in both urban and rural areas. Red squirrels are a more northern species that are found throughout most of the northeastern US. The ranges of the two species of flying squirrels overlap in the northeast.

Health and Safety Concerns

Squirrels chew on electrical wires, and that may 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

Gray 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. Gray 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 2. Leaf nest of a tree squirrel. Photo by Jan Hygnstrom.

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

Gray squirrels typically occupy any woodlot with mast-producing hardwoods. They also are common in cities, especially in and around parks. Red squirrels prefer mixed-hardwood and conifer forests. 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 types of food storage used by squirrels. Gray squirrels scatter cache, which means they store individual acorns or other seeds in different areas around their home range. Red squirrels store food in one place. It is not uncommon to find trash-bag-sized piles of conifer cones stored by red squirrels inside attics or gutters, or in piles at the base of a tree.

Gray 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 often observed in mud, soft soil, and snow (Figure 4).

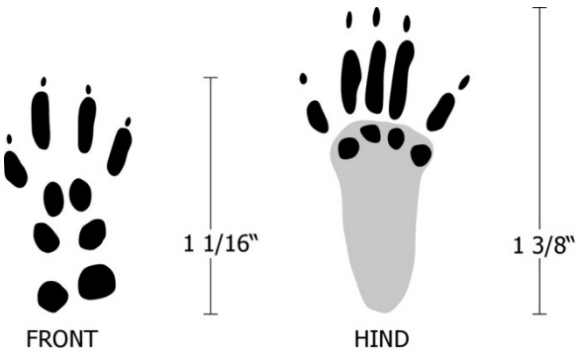

Figure 4. Tracks of a red squirrel. They are similar in structure to gray and fox squirrels. Image by Dee Ebbeka.

How to Identify Damage

Damage to Landscapes

Squirrels may damage lawns or planting beds by burying or digging up nuts. They chew bark and clip twigs on ornamental trees or shrubs planted in yards (especially maples). 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.

Squirrels occasionally damage trees by chewing and stripping bark from branches and trunks. They also eat conifer cones and nip twigs.

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. Red and gray squirrels chew the bark of various orchard trees.

Squirrels do not pose a threat to livestock.

Damage to Structures

Gray squirrels typically gnaw holes the size of a baseball (Figure 5) in wooden structures. Holes of red squirrels are golf ball-sized, and those of flying squirrels are the size of a quarter.

Squirrels often travel on power lines and short out transformers. They gnaw on wires, enter buildings, and build nests in attics. They chew holes through tubing used in maple syrup production. Feces of flying squirrels mixed with urine can cause stains (Figure 6).

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 and panes trying to escape. Carpets and other fabrics can be chewed and destroyed.

Figure 5. Hole from a gray squirrel. Photo by S. Vantassel.

Figure 6. Urine and feces below an attic vent where flying squirrels were exiting the home. Photo by S. Vantassel.

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 (Figure 7), 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 sunflower seeds or corn.

Figure 7. Even bird feeders marketed as squirrel proof may not deter them. Photo by Jan R. Hygnstrom.

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. 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.

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 it is illegal in many states.

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 shotgun with No. 6 shot. Firearms cannot be discharged in many urban areas due to discharge regulations. Gray and fox squirrels are game animals in most states, and lethal control may require a permit. Often state regulations allow homeowners to take (kill) squirrels causing property damage. If there is any question, check with your state wildlife agency.

Trapping

Gray and fox squirrels are classified as game species in most states, so trapping permits may be required from your state wildlife agency. 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

Avoid translocation of tree squirrels because of the stress placed on both transported and resident squirrels, and concerns regarding the disease transmission. Many states do not allow the translocation of squirrels. Check with your state wildlife agency.

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.

Venomous and Non-venomous Snakes

Prepared by the **National Wildlife Control Training Program.** WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Northern water snake (*Nerodia sipedon*), a non-venomous snake. Photo by Jack H. Hecht/LMS Engineers.

Understanding Snakes

Conflicts

Non-venomous snakes are usually harmless and cause no damage, yet many people are afraid of any snake. Occasionally, venomous snakes bite pets or livestock, causing physical damage and, on rare occasions, loss of life. A person may be bitten by a venomous snake, but this is uncommon in the northeastern US. A bite from a venomous snake requires immediate medical attention.

Legal Status

Snakes are considered nongame wildlife and are protected by law in most states, unless they are about to cause damage to people or property. Never indiscriminately kill snakes. Some species are listed as endangered or threatened on federal and state endangered species lists. For example, the Eastern Massasauga rattlesnake (*Sistrurus catenatus*) is federally endangered in New York State.

Identification

About 150 species of snakes occur in North America, of which over 90% are non-venomous (Figure 1). All native snakes are beneficial to the environment, and are protected wildlife laws in many states. Timber rattlesnakes (*Crotalus horridus*) and northern copperheads (*Agkistrodon contortrix*) are venomous snakes native to some parts of the northeastern US. Consult a reptile field guide for detailed descriptions and range maps for different snake species.

Physical Description

Snakes are specialized animals with elongated bodies and no legs. They have no ears or eyelids, but transparent scales cover the eyes. A snake has a long, forked tongue, which aids the sense of smell. The tongue picks up particles from odors and inserts them into a 2-holed organ (the Jacobson's Organ), in the roof of the mouth.

The two halves of the lower jaw are not fused, but are connected by a ligament. This allows snakes to swallow food much larger than their head size. 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. Snakes eat little or no food during times of decreased activity.

Color usually is not a main characteristic used to identify snakes. Coloration can vary greatly by area, genetic variation, and age of the snake. Features described below are used for identifying snakes.

1. The keel is a ridge that runs along the middle of each scale in some snakes. Like the keel of a boat, the ridge may be pronounced, less pronounced, or absent. Rub a finger across the width of the skin of the snake skin to feel for the presence of a keel.

2. Inspect the vent. Check if the scale that covers the vent is divided or single.

3. Unlike color, patterns can be helpful for identifying snakes, although in some species, the pattern of juveniles differs considerably from adults. Identify whether the snake has stripes, blotches, or solid coloration.

4. The distance from the snout to vent may be helpful but can be misleading in small snakes.

5. The number of scales across the width of the snake may help identify the snake.

6. Check if the head scales are large or small.

Pit Vipers versus Non-venomous Snakes

Several characteristics can be used to distinguish between pit vipers (venomous) and non-venomous snakes. All pit vipers have a deep pit on each side of the head, midway between the eye and nostril. Non-venomous snakes do not have pits.

On the underside of the tail of pit vipers, scales typically (but not always) go all the way across in one row (Figure 2). On the underside of the tail of most non-venomous snakes, scales are in two rows from the vent to the tip of the tail. The shed skin of a snake shows the same characteristics. Because exceptions to the rule exist, do not use this technique to conclusively differentiate between venomous and non-venomous snakes.

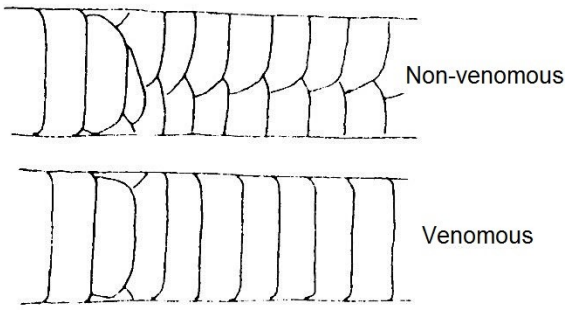

Figure 2. Typical scale patterns between the vent and the tip of the tail for venomous and non-venomous snakes. Image by Prevention and Control of Wildlife Damage (PCWD).

The pupil of a non-venomous snake is perfectly round (Figure 3). The pupil of a pit viper is vertically egg-shaped. In very bright light, the pupil may be a vertical line due to extreme contraction to shut out light.

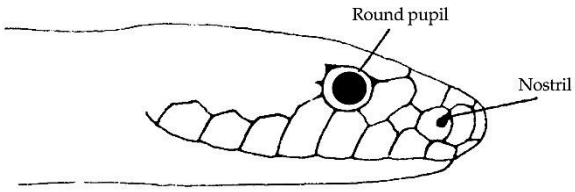

Figure 3. Non-venomous snakes have round pupils and no pit between the eye and the nostril. Image by PCWD.

Species Range

Consult snake field guides for information on the range of a specific species. State-specific guides to snakes also can be very helpful.

Health and Safety Concerns

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, it usually is due to the snake 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 non-native 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 northeast, the risk is increasing as they 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 non-venomous snake will not harm the long-term health of the victim. Some individuals have been bitten several thousand times by handling non-venomous snakes, and suffered no adverse reaction. They only required basic first aid for any of the bites.

Non-venomous snakes cause harm by frightening people who are unfamiliar with them, and possible infection from a bite, just as with any break in the skin. A bite from a non-venomous snake should be treated as any other minor flesh wound. Clean the area and treat it with an antiseptic.

A bite from a venomous snake usually results in 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 non-venomous snake, or the bite did not contain venom (a dry bite). Over ½ of rattlesnake bites lack venom. Snakes dispense venom to capture and digest prey, and have little interest in people. Most snake bites occur in the suburbs. The following statistics offer a breakdown of snake bite occurrences in the US:

- reported bites in US is ~7,000 per year,
- 65% are from rattlesnakes,
- 55% to 60% resulted in no venom injected, and
- 50% of the people were handling snakes.

The probability of a bite from a snake being fatal in US is 0.002%. Typical victims are white males between the ages of 18 to 40 who have been handling a snake. In about ¼ of these cases, alcohol was involved.

First Aid for a Venomous Snake Bite

First, 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.

Seek medical care immediately. Call 911 and transport the victim to the closest hospital. 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.

Remove constrictive clothing and jewelry. Swelling will prevent such articles from being removed and can result in a tourniquet action. 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.

General Biology

Reproduction

Snakes typically mate in the spring. Depending on the species, female snakes may lay eggs, retain membrane-covered eggs inside the body during incubation, or give birth to live young. Eggs hatch and young are born in late June through early fall depending on latitude and species. Young copperheads and rattlesnakes are retained in the body of the female during incubation. They are born within a transparent egg sack during late summer or early fall. Juveniles of venomous species are just as venomous as adults.

Nesting/Denning Cover

Snakes do not nest. They seek locations for protection and thermoregulation. For example, a sun-exposed rock provides warmth on cool mornings, and a rock wall provides protection and cool temperatures during hot weather.

Underground dens or 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. In most cases, snakes will move away when approached. When cornered, snakes react with a variety of defensive tactics that vary by species. Defensive tactics include playing dead on their back, hissing, opening the mouth in a menacing manner, coiling, emitting an odorous fluid from the vent, striking, and biting.

Habitat

Most species of snakes have specific habitat requirements. 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. Rat snakes primarily eat rats, mice, chipmunks, bird eggs, and baby birds. King snakes eat other snakes, rodents, and young birds. Some snakes (e.g., green snakes), primarily eat insects. Northern red-bellied snakes and Eastern worm snakes eat earthworms, slugs, and salamanders. Water snakes primarily eat fish, frogs, and tadpoles.

Voice, Sounds, Tracks, and Signs

Some snakes, such as bull snakes, may hiss in such a manner that it sounds like a rattlesnake. Hognose snakes will puff. Many snakes shake their tails, which can sound like a rattle.

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.

How to Identify Damage

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 help reduce populations of insects and rodents, and usually are considered beneficial.

Damage to Crops and Livestock

Some snakes eat eggs and young birds. A classic sign of snake presence is the daily disappearance of eggs from nests. 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

Reduce food sources, including populations of rodents, fish, and invertebrates. Keep vegetation closely mowed. Remove bushes, shrubs, rocks, boards, firewood, and debris lying close to the ground. Alter sites that provide habitat and protected basking locations.

Exclusion

Seal all openings ¼ inch and larger with mortar, ⅛-inch hardware cloth, sheet metal, Copper Stuf-fit, or Xcluder™. A snake-proof fence, or boundary made from lava rocks may be effective for excluding snakes from an area.

Frightening Devices

Frightening devices are not applicable for snakes.

Repellents

Several snake repellents have been promoted and are registered by EPA. However, none have 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 local firearm discharge regulations.

Other Methods

Place piles of damp burlap bags or towels where snakes have been seen. Use a hook to check beneath the piles, and snake tongs to capture snakes that are present.

Disposition

Relocation

Relocation is appropriate when snakes are being rescued, or when exclusion likely will prevent their return.

Translocation

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. Translocation is illegal in many states without a permit. 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. It is illegal to handle or kill snakes in New York State as they are protected wildlife.

Use caution with venomous snakes as the venom remains potent following death.

Voles

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Figure 1. Meadow vole (*Microtus pennsylvanicus*). Photo by Stephen M. Vantassel.

Understanding Voles

Conflicts

Meadow voles (*Microtus pennsylvanicus*) and pine voles (*Microtus pinetorum*) may damage garden plants, flower bulbs, and girdle tree bark. Runways and tunnels can ruin lawns, golf courses, and ground covers. Meadow voles usually cause plant damage above ground. Pine voles are more fossorial (live underground) and frequently girdle plant root systems.

Legal Status

Voles are non-game mammals and can be controlled whenever they are causing damage. Contact your state wildlife agency for details regarding regulations.

Identification

Voles (Figure 1), also called meadow mice or field mice, are New World rodents. They are distinct from common woodland mice (*Peromyscus* spp.) and Old World house mice (*Mus musculus*). Twenty-three species of voles occupy the US, four of which are present in the northeastern US. Voles tend to have small, inconspicuous ears and eyes when compared to mice.

Look at tail length to distinguish between meadow and pine voles. If the tail length is longer than the length of the hind foot, it is a meadow vole. If the tail length is shorter than the length of the hind foot, it is a pine vole. It is important to distinguish between these two common species because of differences in behavior.

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.

Meadow voles (*M. pennsylvanicus*) have a total length is 5½ to 7½ inches. The fur is gray to yellow-brown and obscured by black-tipped hairs. Northern subspecies may have red in their fur. Underparts are gray, sometimes washed with silver or buff. The tail is bicolored.

Pine voles (*M. pinetorum*) have a total length of 4 to 6 inches. 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.

Yellownose voles (*M. montanus*) are 6 to 7 inches in total length. The fur on the body is grayish brown and the nose is yellow.

Boreal redback voles (*Clethrionomys gapperi*) are 4 to 6½ inches in total length. The fur on most is gray, with a reddish back.

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

Voles may breed throughout the year, but most commonly in spring and summer. Voles typically have 1 to 5 litters per year. Litter sizes range from 1 to 11, but the average is 3 to 6. 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 belowground. 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 ¼ 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 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 the northeastern US. 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.

How to Identify Damage

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 ⅛ inch wide, ⅜ inch long, and 1/16 inch or more deep. Marks made by gnawing by rabbits are larger and not distinct. Rabbits neatly clip branches at a 45° 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. Seeding 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 long-term.

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. 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 non-target animal access 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 activity of voles is observed, such as near runways and burrow openings. Bait them with apple slices, the vole's favorite food. Traps are more effective if they have overhead cover such as a piece of wood or roofing shingle about one foot square.

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.

Woodchucks

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Figure1. Woodchuck (*Marmota monax*) Photo in public domain.

Understanding Woodchucks

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 considered either small game animals, or are unprotected in most states. Check your state wildlife regulations.

Identification

Woodchucks (*Marmota monax*, 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. Their 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 eastern and central North America.

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

Woodchucks breed in March and April. One litter of 2 to 6 young (usually 4), 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 are 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, roadsides, 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 (Fig. 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.

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.

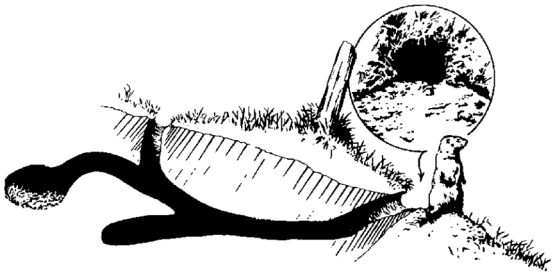

Figure 2. Schematic of a woodchuck den. Structure varies by location. Image by Prevention and Control of Wildlife Damage (PCWD).

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 “phew,” 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 and frequently obscure tracks of the front feet (Figure 3). Tracks may be found in sandy areas Woodchucks deposit scat underground, making it a rare find.

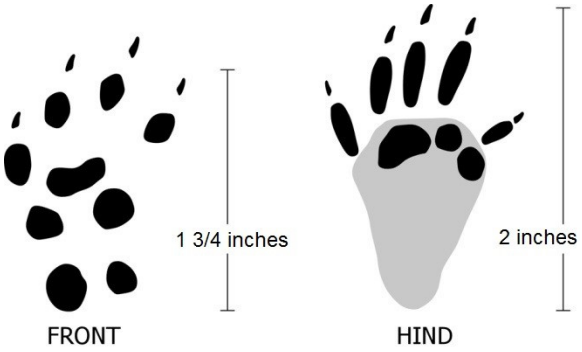

Figure 3. Tracks of a woodchuck. Image by Dee Ebbeka.

How to Identify Damage

Damage to Landscapes

Woodchucks can cause significant damage to crops such as beans, lettuce, peas, carrots, cabbage, clover, and plantain. Trees 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.

Damage to Crops and Livestock

Woodchucks can damage vegetables, ornamentals, nursery trees, fruit trees, and forage crops such as alfalfa and clover. They are often a major problem for home gardeners. 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 or hoses, and wires.

Figure 4. Damage to a fruit tree by woodchucks. Photo by Robert K. Swihart.

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; gardeners 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 double-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 states have regulations prohibiting such sets in urban areas or near public trails.

Other Methods

Woodchucks can be flooded out of dens and into nets. 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.

Euthanasia

A .22-caliber firearm in the hands of an experienced shooter is a good option, where shooting is allowed. The shot should be from close range and directed to the head. Follow rules of firearm safety at all times. Woodchucks also can be euthanized by carbon dioxide gas.

Disposition

Relocation and Translocation

Relocation is not recommended unless the woodchuck is being rescued.

Translocation is not recommended unless the woodchuck is being rescued.

Woodpeckers

Prepared by the National Wildlife Control Training Program. WildlifeControlTraining.com
Research-based, certified wildlife control training programs to solve human – wildlife conflicts.

Figure 1. Male downy woodpecker (*Picoides pubescens*). Photo in Public Domain.

Figure 2. Yellow-bellied sapsucker (*Sphyrapicus ruber*). Photo by unknown.

Understanding Woodpeckers

Conflicts

Woodpeckers can damage wood siding and soffits on structures. They also may cause economic losses to utility companies due to cavities in wooden power-line poles. The weakened poles could snap in high winds. Their springtime, territorial "drumming" on wooden or metal objects can be an annoyance to people during early morning.

Legal Status

All species of woodpeckers are classified as migratory nongame birds and are protected by the Federal Migratory Bird Treaty Act.

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 relevant state wildlife agency 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. Downy (*Picoides pubescens*, Figure 1*)*, hairy (*Picoides villosus*), and pileated (*Dryocopus pileatus*) woodpeckers most often are involved in damaging homes or other wooden, human-made structures in the northeast. Yellow-bellied sapsuckers (*Sphyrapicus ruber*, Figure 2) may cause resin wells and damage valuable ornamental trees, especially during fall migration. Red-bellied (*Melanerpes carolinus*) and red-headed (*Melanerpes erythrocephalus*) woodpeckers, and northern flickers (*Colaptes auratus*) may be common in some areas, but are less often involved with damage situations.

Although woodpeckers become a nuisance in some situations, 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

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 3 to 8 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. Red-headed and pileated woodpeckers favor dead trees (Figure 3).

Figure 3. The large holes on a dead tree indicate the work of a pileated woodpecker. Photo by Jan Hygnstrom.

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 are dependent 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. Red-bellied woodpeckers occupy habitat similar to that of red-headed woodpeckers, as well as openings in mature forests, wooded wetlands, and large trees in open pastures. 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. Pileated woodpeckers are common in mature and extensive forests.

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.

How to Identify Damage

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 (Figure 4). 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 sloughed. 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.

Figure 4. Severe sapsucker damage can stress a tree. Photo by Jan Hygnstrom.

Vegetable matter constitutes 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. Control actions to protect commercial crops are rarely 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 may also be damaged. Damage to a building typically involves only 1 or 2 birds, but may involve up to 6 or 8 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.

Plastic tubes that are used to collect maple sap are sometimes damaged by woodpeckers. In some regions, drilling in utility poles by pileated woodpeckers has necessitated frequent and costly replacement of weakened poles. Similar 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 next 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 pesticide registered for use in your state 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. Note 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 only suitable in rescue situations.

Translocation

Given the mobility of birds, translocation of woodpeckers is only suitable 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.

Questions and Answers for Wildlife Damage Management

What is Integrated Wildlife Damage Management?

Integrated wildlife damage management involves the timely use of a variety of cost-effective, environmentally safe, and socially acceptable methods to reduce human-wildlife conflicts to a tolerable level.

What are 2 ways to prevent orphaning wildlife?

The best way to prevent orphaning is to convince your customers to wait until the young are mobile before removing, repelling, or excluding the family from the site. If that's unacceptable, you can try to capture and remove both the female and all of her young and hope that she will retrieve them and continue to care for them.

People categorize wildlife damage prevention and control methods in a number of ways. What are 4 damage prevention and control methods based on traditional pest control methods?

Cultural, mechanical, biological, and chemical.

What is cultural control? Give some examples.

Cultural control involves changing human habits (sanitation, work practices, or cleaning and garbage pickup schedules) to create an uninviting or unfavorable environment for pests. Habitat modification, such as trimming tree limbs, removing sources or water, varying the type of crop or timing of planting are cultural controls.

What is mechanical control? Give some examples.

Mechanical control uses scare and harassment tools, barriers, tactile repellents, or mechanical devices to control wildlife pests. Fencing, trapping, propane canons and other scare devices, and shooting are examples of mechanical controls.

What is biological control? Give some examples.

Biological control is the use of living organisms (disease agents, parasites and predators), or natural processes (e.g., fertility control) to manage wildlife damage.

What is chemical control? Give some examples.

Chemical control involves applying pesticides to repel, frighten, or kill a pest. These chemicals include rodenticides (control rodents), avicides (control birds), and frightening agents.

Another way to categorize wildlife damage and prevention methods is to put them into broad categories. What are 8 broad categories?

1. Habitat Modification (Cultural Control)
2. Exclusion (Mechanical Control)
3. Frightening Devices (Mechanical and Biological Control)
4. Repellents (Chemical and Biological Control)
5. Toxicants (Chemical Control)
6. Shooting (Mechanical Control)
7. Traps (Mechanical Control)
8. Other Methods

Habitat modification affects 3 necessities must animals have to survive. What are they?

All animals need water, food, and shelter.

What are the downsides to habitat management?

Changes to habitat to reduce the carrying capacity for one species, however, may encourage population growth in another species.

Unfortunately, some habitat modifications can be expensive, so expect some client resistance.

What are some examples of exclusion?

- Nets can exclude birds from important crops and buildings and have become a more reasonable solution to complex bird problems.
- Screens and barricades exclude wildlife from entering crawl spaces and buildings.
- Fences prevent ground-dwelling animals from gaining access to landscapes like fields, gardens, airports, and structures such as decks, porches, buildings.
- Covers, caps, and screens prevent wildlife from entering specific structures such as chimneys.
- Crevice sealers include materials such as caulk, foam, mortar, and fabric to fill cracks, crevices, and openings to prevent animals from entering structures.
- Cone guards keep pests away from birdfeeders and nest boxes on poles.
- Rollers are long, cylindrical wheels with supports on each end, mounted on peaks of roofs, signs, ledges, and other narrow locations where birds loaf. Birds land on the rollers and fall off.

What are frightening devices? List 4 types.

These harassment tools scare wildlife from a location through non-chemical means. Frightening devices fall into 4 categories: visual, audio, audio-visual, and biological.

True or False. Birds can be hazed in their nesting area during the nesting season.

False. Birds cannot be hazed in their nesting areas during the nesting season because of the Migratory Bird Treaty Act.

How do visual frightening devices work? Give examples.

Visual devices use sight to frighten wildlife.

Visual frightening devices include scarecrows, effigies (e.g., plastic owls), scary-eye balloons, and Mylar® tape.

What type of visual frightening devices are least effective?

Stationary visual frightening devices are the least effective, as birds tend to habituate to them in a few days.

Geese and crows can be dispersed from a night-time roost by using what visual frightening device?

Geese and crows can be dispersed from a night-time roost by pointing a spotlight, laser pointer, or high-intensity laser at them.

What are some examples of audio frightening devices?

Audio devices include propane cannons and distress calls.

What extra steps should be taken when using audio frightening devices?

Check local ordinances and consider the effects on the neighbors before using any noisemakers.

What are audio-visual frightening devices?

Audio-visual devices use sight and sound to frighten wildlife, and include pyrotechnics (bangers, screamers, shell crackers, and propane canons).

What is an example of a biological control using fright?

Guard animals such as dogs and llamas sometimes are used to protect livestock, especially sheep, from predators.

What are repellents?

Repellents are chemicals that deter animal activity through, pain, fear, touch, or aversive conditioning.

List examples of repellents and how they work.

Capsaicin is an active ingredient that causes pain to animals that eat it. Coyote urine may cause herbivores to flee due to fear. The sticky material used in polybutene-based bird repellents is a tactile repellent. Finally, aversive conditioning is the mode of action of Flight Control™. Geese that consume grass sprayed with anthraquinone, the active ingredient in Flight Control™, quickly learn that treated grass causes nausea and avoid eating the grass in the future.

What are 3 reasons that repellents may need to be reapplied?

Repellents may have to be reapplied after rainfall, to protect new plant growth, or because they lose effectiveness over time.

What are toxicants, and what are some examples?

Toxicants are chemical compounds used to kill problem animals. These chemicals include rodenticides, avicides, and lethal frightening agents. Toxicants also include toxic baits often used to control pest birds such as starlings (an avicide).

How can the effectiveness of a toxicant be increased?

Toxicants should be used with other control methods, such as habitat modification and exclusion, to increase their effectiveness.

What are some non-target animals that could be harmed by toxicants?

Considerable care must be used to minimize risks to non-target animals, including wildlife, livestock, pets, and people.

What equipment is often used when shooting is selected as the damage control method?

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

On what species of animals is shooting appropriate?

Shooting is appropriate for use with medium to large mammals (squirrel-sized and larger), birds, and reptiles.

What are extra considerations when using shooting to control wildlife damage?

Shooting requires training and skill. 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 (NRA).

What is a benefit of using trapping to control wildlife damage?

Traps are devices that can capture wildlife without the WCO being present.

What are 6 types of live traps?

Live traps include cage traps, box traps, multiple-capture traps, foothold traps, nets, cable-restraints, and a variety of bird traps.

What are some advantages of using live traps?

You can see what you have caught and demonstrate success to the client. It prevents animals from dying in inaccessible locations, which is a hazard of using toxicants. With live-trapping, you avoid the foul odor caused by decay that could attract other pests and is a nuisance itself. In most cases, if you are using a live trap you can release animals that are caught accidentally.

What are some disadvantages to using live traps?

It usually is labor-intensive and you may capture the wrong animal. If a live trap is used improperly, an animal may die in it from lack of food or water; from weather extremes ranging from heat in summer to cold in winter; or from attacks by wildlife, pets, or people.

What is the difference between a cage trap and a box trap?

Cage traps often are made of wire while box traps are made of solid material.

What are foothold traps?

Foothold traps are live traps and, as the name suggests, are designed to capture an animal by the foot.

What animals are foothold traps most efficient to trap?

Footholds can be used in land sets, water sets (in streams, lakes), and under ice. They are the most efficient tools for catching coyotes and foxes and often are important for trapping raccoons, beavers, muskrats, and nutria during wildlife control activities.

True or False. Mouse and rat snap traps are examples of body-gripping traps.

True. The familiar mouse trap is a form of body-gripping trap.

What modifications have been made to the traditional snap trap to make them more effective?

Snap traps with expanded triggers and the clamshell design 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.

What is the benefit to using a multiple-capture trap?

Multiple-capture traps can catch more than one animal without having to be reset.

How often should one check a live trap?

Check live traps at least once daily so that animals are not stressed for more than 24 hours or exposed to extreme temperatures.

What is the key to successful mole trapping?

The key to successful trapping of moles is to identify active tunnels. Look for ridges, molehills, dead grass, and soft spots in the lawn. Prepare the site and set the trap according to the instructions given for the trap. If there is no activity after a few days, move the trap.

Why are snap traps preferred over glue boards in many cases?

Snap traps often are more effective than glue boards and are more humane, although setting them does take more effort.

How can you increase your success in trapping birds?

To increase your chance of success, habituate birds to the trap. First, put out some bird seed (shelled corn for pigeons) or other appropriate bait to habituate birds to feeding in the area.

What baits are attractive to raccoons, but not cats?

Marshmallows and sardines attract raccoons but marshmallows will not entice cats, so marshmallows are safer if you must trap where cats are free roaming. Cats are attracted to fat and protein-based baits, so choose sweet baits to reduce the likelihood of attracting cats.

What is the purpose of a lure?

Lures can help bring the target animal to your trap.

What are 3 categories of lures? Give examples of each.

Lures tend to be liquid and fall into 3 categories: food-based, gland-based, and curiosity. Lures are concentrated odors and may be detected by wildlife from great distances. Food-based lures trigger hunger. They are subdivided into sugary baits called "sweet baits," or oil and protein baits called "meat baits." Gland-based lures trigger sexual or territorial behavior. Urine is a gland-based lure. Curiosity lures are odors that likely are unfamiliar to the animal, yet attractive enough to cause the animal to investigate.

What equipment is useful for direct capture?

Gloves, however, we do not recommend grabbing wildlife using only gloves, except when dealing with juveniles

A catch pole is a versatile tool for the capture and restraint of animals. It is a long stick with a noose on one end.

Snake tongs are useful for grabbing snakes and a snake hook can be used to pin the head of a snake to the ground.

Capture nets, to be distinguished from nets used in exclusion, are available in varying designs such as throw nets, hoop nets, and mist nets.

Chemical agents can be used to immobilize animals so they are unable to escape a human that approaches. Products such as alpha-chlorolose, ketamine, and telazol typically are available only to state wildlife agency, USDA-APHIS-Wildlife Services (WS), veterinary, and academic personnel. Purchase and use of the drugs requires federal and state licenses.

Why is one form of biological control, the use of a disease, to manage a target population rarely used?

Control with diseases is rarely used due to the risk of unexpected consequences.

What is fertility control? What is one example?

It is essentially birth control for wildlife. Eggs can be "addled" so that they cannot hatch by oiling, puncturing, or shaking. Egg addling often is used to manage resident Canada geese in troublesome nesting areas. Federal permits are required.

What is a last step to perform after using a wildlife damage control method?

Check and evaluate your work to become a better WCO. No matter how often you do it, you can still learn something new.

Evaluations help you to improve your control techniques and your business planning.