

Wyoming Agricultural
Pest Control:
Categories 909E, 909H, 909I
Rodents, Birds and Small Vertebrates

For government applicators



Acknowledgments

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Wyoming Agricultural Pest Control: Categories 909E, 909H, 909I

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Preparation for Your Exam

If you are preparing to take any of the Wyoming Commercial Pesticide Applicator Exam(s) for categories 909 E, H or I, review this manual several times. Please read and respond to the learning objectives that correspond to each of the manual sections for which you plan on taking exams.

Exam questions may come from any section of this manual — this includes the definitions and appendices; however, when focusing on a specific subcategory of 909, the questions in the exam will be weighted to cover mainly this material in the manual.

It is important that you take note of the following:

- You may bring a basic hand-held calculator with you to use during the exam (cell phones and other communication devices are prohibited — **you will be failed** if using your cell phone during the exam).
- Exams are closed book. You will not be allowed to refer to any notes, manuals, or other unauthorized training materials during the exam.
- You must pass each category with a 70% or better to be issued a license.
- Exams can be taken at any University of Wyoming County Extension office — please call your local Extension office to make an appointment.

Section 1 - Introduction

LEARNING OBJECTIVES

After completing the following section, you should be able to:

- A. Be able to explain why it is important in some situations to manage rodents and other vertebrates.
- B. Explain the four points of assessing vertebrate damage.
- C. Understand and describe the diseases that are vectored by vertebrates.
- D. Identify and understand the control tactics for a variety of vertebrate pests.
- E. Describe what causes bait shyness.
- F. Understand the Federal requirements for baiting rodents and how it impacts the record keeping and program documentation.

PREFACE

Small mammalian pests in normal situations are considered a minor nuisance; however, populations of these pests are often cyclical, and many hungry mouths can have significant impact on well-managed turf and kill ornamental trees and shrubs. Small mammalian activities can also negatively affect irrigation, interrupt electrical supply, and crop production. They also have the potential to transmit diseases to livestock and humans.

Small animal control tactics have experienced few recent improvements. The majority of the information presented below has been taken from university publications available through a variety of means. Most of the material was published originally in the mid 1990s with revisions made in the 2010s. One of the compilations for small animal control, *The Handbook: Prevention and Control of Wildlife Damage*, is available electronically at http://digitalcommons.unl.edu/icwdmhandbook/?utm_source=digitalcommons.unl.edu%2Ficwdmhandbook%2F22&utm_medium=PDF&utm_campaign=PDFCoverPages.

The information presented below has been designed for two purposes:

1. To provide necessary information to persons interested in becoming a certified private or commercial applicator of pesticides used in wildlife damage control.
2. To serve as a resource manual in providing information in the control of wildlife commonly found in Wyoming.



The material in this section can be used as a comprehensive reference of North American vertebrate species that can cause economic damage to resources or become a nuisance at various times and places. The information is intended for use by extension agents and specialists, wildlife biologists, animal control officers, public health personnel, pest control operators, teachers and students of wildlife biology, and others who deal with wildlife damage problems.

Wildlife damage management is an essential part of contemporary wildlife management. This material is a condensation of current, research-based information on wildlife that cause problems and the control of damage that they cause. While the material emphasizes prevention of damage as being desirable when possible, it does not neglect the necessity of population reduction in cases where animals must be removed to solve problems. This publication stresses an integrated approach to damage management and includes treatment of materials and techniques such as exclusion, habitat modification, repellents, frightening stimuli, toxicants, fumigants, trapping, shooting, and others. All of the major vertebrate pesticides currently federally registered are included.

The Wyoming Department of Agriculture recognizes many products other than those listed may be commonly used, legally registered, and distributed by firms not mentioned. In addition, the applicator must keep in mind that many products may be canceled, their uses restricted, or new products developed at any time. Users of these products are encouraged to check with the appropriate federal, state, or county authorities for updated information.

The mention of specific pesticide product manufacturers and distributors listed herein is supplied with the understanding that no discrimination is intended and no endorsement

of any product is implied by the Wyoming Department of Agriculture or the University of Wyoming.

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INTRODUCTION

Wildlife management is often thought of in terms of protecting, enhancing, and nurturing wildlife populations and the habitat needed for their well-being. However, many species at one time or another require management actions to reduce conflicts with people or with other wildlife species. Examples include an airport manager modifying habitats to reduce gull activity near runways, a forester poisoning pocket gophers to increase tree seedling survival in a reforestation project, or a biologist trapping an abundant predator or competing species to enhance survival of an endangered species.

Wildlife damage control is an increasingly important part of the wildlife management profession because of expanding human populations and intensified land-use practices. Concurrent with this is the growing need to reduce wildlife-people conflicts, public attitudes, and environmental regulations restricting use of some of the traditional tools of control such as toxicants and traps. Agencies and individuals carrying out control programs are being more carefully scrutinized to ensure their actions are justified, environmentally safe, and in the public interest. Wildlife damage control activities must be based on sound economic, ecological,

and sociological principles and carried out as a positive, necessary component of overall wildlife management programs.

Wildlife damage control programs can be thought of as having four parts:

1. Problem identification; refers to determining the species and numbers of animals causing the problem, the amount of loss or nature of the conflict, and other biological and social factors related to the problem.
2. Ecology of the problem species; refers to understanding the life history of the species, especially in relation to the conflict.
3. Control methods application; refers to taking the information gained from parts 1 and 2 to develop an appropriate management program to alleviate or reduce the conflict.
4. Evaluation of control. Allows an assessment of the reduction in damage in relation to cost and impact of the control on target and non-target populations and the environment.

Increasingly, emphasis is being placed on integrated pest management whereby several control methods are combined and coordinated with other management practices in use at that time.

ASSESSING DAMAGE

The objective of any responsible rodent or predator control program is not to eliminate the target species, but to reduce the population to below injurious levels. Reducing the population may be

necessary in some situations to alleviate wildlife damage, while at other times, removal of the problem animal may be the correct solution.

Control personnel should be aware of values placed on wild animals by persons not affected with wildlife damage. Non-affected persons often object to any type of control activities. A concept promoted by some organizations and individuals is to preserve all wildlife in the interest of conservation. However, at times this concept may actually work against the desired results. Control personnel must remember this concept when considering control activities, as the wildlife values of the non-affected party are generally different than those of the affected party.

The animal species covered in this section are **vertebrates**. Vertebrates, simply stated, have a jointed spinal column (vertebrate) and include fish, amphibians, reptiles, birds, and mammals. A vertebrate pest is any native or introduced, wild or feral, non-human vertebrate animal that is currently troublesome to one or more persons in a particular situation or over a large area, either by being a health hazard, a general nuisance, by destroying food, fiber, natural resources, or damaging monetary or aesthetic items of value to man.

Any animal that may currently be a pest to one or more persons may at the same time be desirable or of neutral interest to someone else. Examples can include birds, tree squirrels and deer.

Judgment as to the propriety of controlling vertebrate pests is a relative matter. A homeowner usually will not tolerate the presence of a single rodent, snake or other animal that he may consider a pest; whereas a farmer or rancher usually does not object to most of these same species unless they become so numerous as to cause him economic loss. Damage to habitat and economic



loss will occur if necessary pest control measures are not carried out. A good management system will employ integrated control, which is a system that uses all suitable techniques and methods in a compatible manner to maintain pest animals at levels below those causing economic or habitat.

The Assessment

Before implementing a control program an assessment or evaluation should be made for each situation. This assessment is necessary to be successful in reducing damage without endangering non-target animals, for which several factors should be considered.

1. **Problem identification and verification of the pest causing damage.** The first thing to do in any pest control program is to accurately define the problem including the amount of loss or nature of the conflict, the species doing the actual damage and the number of animals causing the damage. Proper identification of the pest is imperative in conducting successful control. Wrong identification will lead to wasted money and time as many species have similar damage-causing characteristics. When physical evidence is present, the experienced person usually does not have any difficulty in identifying the animal or animals responsible for the damage. Situations will arise where evidence may be difficult to find, and when found may be inconclusive to the observer. When this occurs, it may be advisable to consult other people who are more knowledgeable in properly identifying the pest.
2. **Ecology of the pest species.** To properly control any pest, the control personnel must have knowledge and understanding of the life cycle of the target animal(s), especially in relation to the damage being caused. By knowing the life cycle, the control personnel may be able to select the proper control measure and time its application to be the most successful in controlling the pest.
3. **Selection of control methods and application.** After the control personnel have made the proper identification of the pest and understand its ecology, the correct control method and its application may be made to reduce or alleviate the damage. Proper timing of control is often necessary in controlling the target pest. Preventive and protective control is often overlooked by those being affected, causing added expense and the need for extended control measures. In some situations, the habitat can be altered making it undesirable for the pest species; in others, the food supply may be removed or reduced. There are many situations when these non-lethal control measures will not be applicable, but they should be considered.
4. **Evaluation of control.** The evaluation of control is an assessment of the reduction in damage in relation to the cost and impact of control. By taking this final step and evaluating the results, the control personnel may take the appropriate measures in the future to alleviate or reduce the damage prior to implementing control methods that may be more costly and time consuming. In addition, the control personnel in assessing their methods, can make the necessary changes to be more successful in the future.

WILDLIFE DISEASES AND HUMANS

Diseases of wildlife can cause significant illness and death to individual animals and can significantly affect wildlife populations. Wildlife species can also serve as natural hosts for certain diseases that affect humans (zoonosis). The disease agents or parasites that cause these zoonotic diseases can be contracted from wildlife directly by bites or contamination, or indirectly through the bite or arthropod vectors such as mosquitoes, ticks, fleas, and mites that have previously fed on an infected animal. These zoonotic diseases are primarily diseases acquired within a specific locality, and secondarily, diseases of occupation and a vocation. Biologists, field assistants, hunters, and other individuals who work directly with wildlife have an increased risk of acquiring these diseases directly from animal hosts or their ectoparasites. Plague, tularemia, and leptospirosis have been acquired in the handling and skinning of rodents, rabbits, and carnivores. Humans have usually acquired diseases like Colorado tick fever, Rocky Mountain spotted fever, and Lyme disease because they have spent time in optimal habitats of disease vectors and hosts. Some general precautions should be taken to reduce risks of exposure and prevent infection.

General precautions

Use extreme caution when approaching or handling a wild animal that looks sick or abnormal to guard against those diseases contracted directly from wildlife. Procedures for basic personal hygiene and cleanliness of equipment are important for any activity but become a matter of major health concern when handling animals or their products that could be infected with disease agents. Some of the important precautions are:

1. Wear protective clothing, particularly disposable rubber or plastic gloves, when dissecting or skinning wild animals.
2. Scrub the work area, knives, other tools, and reusable gloves with soap or detergent followed by disinfection with diluted household bleach.
3. Avoid eating and drinking while handling or skinning animals and wash hands thoroughly when finished.
4. Safely dispose of carcasses and tissues as well as any contaminated disposable items like plastic gloves.
5. Cook meat from wild game thoroughly before eating.
6. Contact a physician if you become sick following exposure to a wild animal or its ectoparasites. Inform the physician of your possible exposure to a zoonotic disease.

Precautions against acquiring fungal diseases, especially histoplasmosis, should be taken when working in high-risk sites that contain contaminated soil or accumulations of animal feces; for example, under large bird roosts or in buildings or caves containing bat colonies. Wear protective masks to reduce or prevent the inhalation of fungal spores.

Protection from vector-borne diseases in high-risk areas involves personal measures such as using mosquito or tick repellents, wearing special clothing, or simply tucking pant cuffs into socks to increase the chance of finding crawling ticks before they attach. Additional preventive methods include checking your clothing and body and your pets for ticks and removing the ticks promptly after returning from infested sites. If possible, avoid tick-infested areas or locations with intense mosquito activity during the transmission season. Reduce outdoor exposure to mosquitoes especially in early



evening hours to diminish the risk of infection with mosquito-borne diseases.

Equally important preventive measures are knowledge of the diseases present in the general area and the specific habitats and times of year that present the greatest risk of exposure. Knowledge of and recognition of the early symptoms of the diseases and the conditions of exposure are essential in preventing severe illness. Also important are medical evaluation and treatment with proper antibiotics; for example, if you become ill following some field activity in a known plague-endemic area and you recognize the early symptoms of the disease, seeking medical care and informing the attending physician of your possible exposure to plague will aid in the correct treatment of your illness and reduce the risk of complications or even death.

In addition to taking personal precautions, risk of acquiring vector-borne diseases can be reduced in specific locations through area-wide applications of insecticides to control mosquito or flea vectors or acaricides to control tick vectors. Reduction in host populations (for example, rodents) and their ectoparasites (fleas or ticks) may be needed to control transmission of such diseases as plague or Lyme disease. Vaccination of wildlife hosts as a means of reducing zoonotic diseases is being investigated and may soon be available for diseases like rabies.

Conclusion

Wildlife workers tend to ignore the risks associated with handling wildlife species and working in natural environments. Diseases of wildlife or diseases present in their habitats can infect humans and some can cause serious illness or even death. Becoming aware of the potential diseases present and taking precautions to decrease exposure will greatly reduce chances of becoming infected with one of these diseases.

You can prevent infection with zoonotic diseases and reduce the seriousness of an illness by observing the following recommendations:

1. Become aware of which zoonotic diseases are present in your area and their clinical symptoms.
2. Obtain any pre-exposure vaccinations that are available, particularly for rabies.
3. Take personal precautions to reduce exposure to disease agents and vectors such as ticks, mosquitoes, and fleas.
4. Practice good sanitation procedures when handling or processing animals or their products.
5. If you become ill, promptly seek proper medical treatment and inform the physician about possible exposures.

Table 10.1. Some important wildlife diseases that affect humans.

Disease	Agent	Method of transmission	Wildlife host	Type of human illness/symptoms
Direct				
Rabies	virus	Animal Bite, aerosol	Striped skunk, raccoon, fox, bats, other mammals	Paralysis, convulsions, coma, death
Hantavirus	virus	Animal Bite, aerosol	Deer mice, other wild and commensal rodents	Fever, headache, muscle aches, nausea, vomiting, back pain, respiratory syndrome
Leptospirosis	bacteria	Urine, contamination ingestion	Urbanized wild rodents: rabbit, fox, skunk, raccoon, opossum, deer	Fever; jaundice; neurological pain; pain in abdomen, joints or muscles; nausea; may be fatal
Brucellosis	bacteria	Contamination ingestion	Hoofed animals, predators (coyotes, wolves)	Intermittent fever, chills, headache, weakness, weight loss
Rat-bite Fever	bacteria	Rodent bite	Commensal rodents	Abrupt onset with chills and fever, headache, muscle ache, rash on legs and arms, arthritis
Salmonellosis	bacteria	Ingestion of food contaminated by feces from infected animals	Rodents, swine, cattle, birds, poultry, pet turtles	Sudden onset of headache, fever, abdominal pain, nausea, diarrhea, vomiting
Ornithosis	chlamydia	Inhalation of contaminated air	Fowl	Fever, chills, headache, muscle pain, loss of appetite, sweating, pneumonia
Histoplasmosis	fungus	Inhalation of spores	None — grows in soil under bird and bat roosts	Mild fever, flu-like illness, pneumonia, hepatitis, endocarditis, death
Cryptococcosis	fungus	Inhalation is suspected	None — grows in droppings in pigeon nests	Meningitis, lung, liver and bone infection, skin lesions or ulcers.
Trichonosis	nematode	Ingestion of under or uncooked meat containing larval cysts	Swine, bear, wild and domestic carnivores, wild and domestic rodents	Nonspecific gastroenteritis, loss of appetite, nausea, swollen eyelids, fever, chills, muscle aches
Ascarid roundworm	nematode	Ingestion of nematode eggs (from fecal contamination)	Raccoon	Larval stage invades and damages organs, including the brain
Direct and Indirect				
Plague	bacteria	Contamination from skinning animals, flea bites	Wild rodents (prairie dogs, ground and tree squirrels, chipmunks) rabbits, carnivores.	Fever, headache, severe discomfort, shaking, chills, pain in groin and armpits (swollen lymph nodes), death



Disease	Agent	Method of transmission	Wildlife host	Type of human illness/symptoms
Tularemia	bacteria	Contamination from skinning animals, ticks, insect bites	Wild rodents, hares, rabbits, carnivore, birds, hoofed animals	Mild illness to severe meningitis, pneumonia, ulcer at inoculation site, swollen lymph nodes, death
Indirect: Tick-borne				
Colorado tick fever	virus	Tick	Wild rodents, hares, rabbits, marmots, carnivores	High fever, headache, muscle ache, lethargy, biphasic symptoms
Rocky Mountain spotted fever	rickettsia	Tick	Wild rodents, hares, rabbits, carnivores, birds	Rapid onset, fever, headache, muscle ache, nausea, vomiting, abdominal pain, rash, loss of muscle control, death
Ehrlichiosis	rickettsia	Tick	Unknown — possibly dogs and other carnivores	Fever, headache, nausea, vomiting, muscle ache, fleeting rash
Lyme disease	bacteria	Tick	Wild rodents, raccoon, deer, rabbits, birds	Skin lesions, fever, headache, fatigue, muscle ache, stiff neck, cardiac and neurological manifestations, arthritis
Relapsing fever	bacteria	Tick	Wild rodents who make their homes in old cabins or caves	Rapid onset, severe headache, muscle weakness, rigor, joint pain, recurring fever
Babesiosis	protozoa	Tick	Wild rodents	Gradual onset. Loss of appetite, fever, sweating, fatigue, muscle aches, prolonged anemia, can be fatal
Indirect: Mosquito-borne				
St. Louis encephalitis	virus	Mosquito	Mostly birds, some rodents	Fever, headache, musculoskeletal aches, malaise, low fatality
Eastern equine encephalitis	virus	Mosquito	Birds, bats	Fever, intense headache, nausea, vomiting, muscle aches, confusion, coma, high fatality
Western equine encephalitis	virus	Mosquito	Birds, jackrabbits, rodents	Fever, headache, nausea, vomiting, malaise, loss of appetite, convulsion, low fatality
California encephalitis	virus	Mosquito	Eastern chipmunk, tree squirrel, red fox, deer mouse	Fever, irritability, headache, nausea, vomiting, loss of muscle control, confusion, come low fatality.
Indirect: Flea-borne				
Typhus (murine)	rickettsia	Rat flea	Domestic rats, wild rodents, opossum	Fever, severe headache, chills, general pains, possible skin rash

USE OF TOXICANTS

When considering controlling pest animals through the use of toxicants, it is important to acquaint all affected parties with the intent of the control program including effectiveness, safety, and approximate cost.

Additionally, local officials in the proposed control area should be contacted and control plans discussed in detail prior to implementation. Local officials can include weed and pest supervisors and University of Wyoming Extension agents who are familiar with current control technology and can assist, advise, and coordinate the control program.

Label requirements may also mandate that additional agencies that are involved with controlling pest animals be contacted. These agencies can include the Wyoming Department of Agriculture, Wyoming Game & Fish Department, U.S. Forest Service, Bureau of Land Management, and the U.S. Fish and Wildlife Service.

Toxicology

Toxicology is a science that deals with poisons and their effects upon the target animals. Applicators of toxic materials such as those used in rodent control should have a basic understanding of how individual toxins effect target animals and be able to understand the terms used in describing the established lethal quantities or dosage rates of specific toxins for individual animal species.

Toxic substances are often incorporated in or on a food commonly attractive to the target animal species. This food is referred to as a bait, and is also the prepared formulation which contains the toxicant. When toxic materials are developed, laboratory tests are conducted to determine the effective quantity of concentration of toxic material necessary in a prepared formulation to control a specific pest.

The term used to describe the toxicity of a particular pesticide to specific animals is the Lethal Dose (LD). A LD₅₀ is the amount of concentration of the toxicant necessary to kill 50% of a test population. From this established quantity of toxicant, a LD₁₀₀ is determined, which is the amount of toxicant necessary to kill 100% of a population. A concentration of toxicant for field application would be that amount that would provide control at LD₁₀₀.

An LD₅₀ or an LD₁₀₀ is expressed as the quantity of the toxin in milligrams lethal to an animal of a specific body weight, expressed in kilograms (mg/kg). Immature or smaller animals are usually more susceptible to toxins than larger or adult animals; a larger quantity of the toxin is normally necessary to control adult animals. When the LD₅₀ or LD₁₀₀ of toxic materials are provided for an animal species, the range usually given covers the minimum and maximum limits of bodyweight of each species. An example of a specific LD₁₀₀, for a species, would be 1.0-2.0 mg/kg. The LD₁₀₀ provides assurance the concentration of the toxicant is sufficient to control the largest and/or most resistant animals that may be found in any given population.

Grains commonly used in rodent baits

Three grains, barley, wheat and oats, have been found most useful and successful as carriers of rodent toxicants.

Wheat is commonly used for bait in gopher and house mouse control. Barley and oats are used in various forms for the control of other rodents and jackrabbits. These grains may be used whole or may be mechanically altered to improve their effectiveness and lessen their attractiveness to birds. There are specific terms used to describe mechanical alteration, and these terms are often incorporated in the description of bait formulas.



Whole grains

Whole grains are those that have not been mechanically altered. The hull remains in the case of barley and oats.

Rolled grains

The term lightly-rolled whole barley, wheat, and oats indicates these grains have been processed by steam rolling to provide a somewhat flattened grain. Barley and oats processed for stock feed are normally rolled so the grain is flat or crushed. These are generally not satisfactory for use in rodent control formulas. Crimped whole oats, barley, and wheat are very lightly rolled. For example, crimped barley is not over 2-1/2 times normal width.

Hulled grains

Barley with the hulls removed is known as hulled or potted barley. The term potted is taken from the name of the machines (potting machines) used in removing the hulls. Oat groats refers to oats from which the hulls have been removed. A squirrel oat groat is a light rolled oat groat. Oat grits, a product commonly used in chicken feeds, is prepared by hammer milling so small particles result. The product is also called steel cut oat groats.

Color additives used in rodent baits

Adding colored dyes and pigments to toxic rodent baits is based upon the following reasons:

1. To protect seed-eating birds through the application of a physiological principle, which indicates some species of diurnal birds distinguish and show an aversion to certain colors when these are applied to food, while lower animals, including rodents, do not.
2. To prevent possible accidental human consumption and to reduce the hazard of baits being diverted to livestock feed.
3. To aid in bait identification purposes, including the times when the bait is in storage and while being used in the field.
4. To aid in bait preparation by the manufacturer to assure thorough mixing, as indicated by the uniformity of color additives in the finished product.
5. The dyes and pigments that are used in baits have been selected to reduce as much as possible nonacceptance of the bait by the target pest due to an imparted taste, texture, odor, and color of the finished product.

Safety precautions

Toxicants used in vertebrate pest control can be handled and used safely if the proper precautions are taken. All toxic baits, such as rodenticides, and the application equipment should be clearly marked and labeled "Poison" and stamped with skull and crossbones. It is extremely important for the applicator to avoid inhaling dust from the baits and skin contamination while handling and using these products.

Respirators or dust masks, rubber gloves, and aprons should be worn to avoid such exposures. In addition, the applicator should not allow the hands or application equipment to contact the face. Eating, drinking, chewing tobacco or gum and smoking should be prohibited during the use of these products. The hands and any clothing worn during the handling and application should always be washed with soap and water after using the products.

All pesticide products should be stored in a locked room or building separate of human habitations and livestock feed, when not in use, and clearly marked with signs warning others that pesticides are stored there. Do not leave poison baits where they will

be accessible to children, irresponsible persons, or animals.

Endangered species labeling

Most pesticide products registered for use have specific label prohibitions against exposure where endangered species may be adversely affected. The taking of an endangered species by the use of a pesticide constitutes several state and federal offenses, including violation of the Endangered Species Act and using pesticide product inconsistent with its labeling.

Species that may be adversely affected in Wyoming include grizzly bears, gray wolves, black-footed ferrets, whooping cranes, Prebles meadow jumping mouse, and Wyoming toads. Applicators need to read, understand, and comply with all product labeling prior to use.

Specific information on endangered species requirements is available from the Wyoming Game & Fish Department, or from the U.S. Fish and Wildlife Service, Endangered Species Specialist, in Cheyenne at 307-772-2374.

Visit the EPA's endangered species website, <https://www.epa.gov/endangered-species>, and find details concerning product use in your specific area.

Section 2 - Category 909E - Rodent Control

LEARNING OBJECTIVES

After completing the following section, you should be able to:

- A. Be able to explain why it is important in some situations to manage rodents and other vertebrates.
- B. Explain the four points of assessing vertebrate damage.
- C. Understand and describe the diseases that are vectored by vertebrates.
- D. Identify and understand the control tactics for a variety of vertebrate pests.
- E. Describe what causes bait shyness.
- F. Understand the Federal requirements for baiting rodents and how it impacts the record keeping and program documentation.

RODENTS

Rodents are considered gnawing mammals distinguished by strong constantly growing incisors and no canine teeth. They constitute the largest order of mammals. Generally considered prey animals for many predators and can become a problem when in close proximity to humans. Rodents can contaminate grain, spread disease, and destroy property.

POCKET GOPHERS

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation* as non-game wildlife and may be taken (without permit) during the calendar year in the entire state.

See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 9. Mammals* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Generally not practical. Small mesh wire fence may provide protection for ornamental trees and shrubs or flowerbeds. Plastic netting protects seedlings.

Cultural methods — Damage resistant varieties of alfalfa. Crop rotation; grain buffer crops; control of tap-rooted forbs; flood irrigation; plant naturally resistant varieties of seedlings.

Repellents — Synthetic predator odors are all of questionable benefit. There is no data available

to suggest that the use of castor bean oil acts as a repellent.

Toxicants — Baits — Chlorophacinone; Diphacinone; Zinc Phosphide; Strychnine alkaloid (below ground use only). The following forms are available: 0.35% Strychnine Milo & 0.5% Strychnine Steam Rolled Oats — for use in hand probes and the burrow builder; 0.5% Strychnine Oat Groats.

Note: For information on using hand probes or the mechanical burrow builder, contact the Wyoming Department of Agriculture.

Fumigants — Carbon monoxide from engine exhaust. Others are not considered very effective, but some are used: aluminum phosphide and gas cartridges.

Trapping — Various specialized gopher kill traps. Common spring or pan trap (sizes No. 0 and No. 1).

Shooting — Not practical.

Other — Buried irrigation pipe or electrical cables can be protected with cylindrical pipe having an outside diameter of at least 2.9 inches (7.4 cm). Surrounding a buried cable with 6 to 8 inches (15 to 20 cm) of coarse gravel, 1 inch [2.5 cm] in diameter may provide some protection.

Damage and damage identification

Several mammals, most common are the Richardson ground squirrel, thirteen-lined ground squirrel, vole and the mole, are sometimes confused with pocket gophers because of variations in common local terminology, or in the similarity of behavioral characteristics. In addition, in the southeastern United States, pocket gophers are called “salamanders,” (derived from the term sandy moulder), while the term gopher refers to a tortoise. Pocket gophers can be distinguished from the other mammals by their telltale signs as well

as by their appearance. Pocket gophers leave soil mounds on the surface of the ground. The mounds are usually fan-shaped and tunnel entrances are plugged, keeping various intruders out of burrows.

Damage caused by gophers includes: destruction of underground utility cables and irrigation pipe; direct consumption and smothering of forage by earthen mounds; and change in species composition on rangelands by providing seedbeds (mounds) for invading annual plants. Gophers damage trees by stem girdling and clipping, root pruning, and possibly root exposure caused by burrowing. Gopher mounds dull and plug sickle bar mowers when harvesting hay or alfalfa, and silt brought to the surface as mounds is more likely to erode. In irrigated areas, gopher tunnels can channel water runoff, causing loss of surface irrigation water. Gopher tunnels in ditch banks and earthen dams can weaken these structures, causing water loss by seepage and piping through a bank or the complete loss of or washout of a canal bank. The presence of gophers also increases the likelihood of badger activity, which can also cause considerable damage.

DEER MICE

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation* as non-game wildlife and may be taken (without permit) during the calendar year in the entire state.

See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 9. Mammals* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Rodent-proof construction will exclude mice from buildings and other structures. Use hardware cloth (1/4-inch [0.6 cm] mesh) or similar materials to exclude mice from garden seedbeds.

Habitat modification — Store food items left in cabins or other infrequently used buildings in rodent-proof containers. Store furniture cushions, drawers, and other items in infrequently used buildings in ways that reduce nesting sites.

Frightening — Not effective.

Toxicants — Anticoagulants; zinc phosphide.

Fumigants — None are registered.

Trapping — Snap, box-type (Sherman), or automatic multiple-catch traps.

Other methods — Alternative feeding — Experiments suggest application of sunflower seed may significantly reduce consumption of conifer seed in forest reseeded operations, although the tests have not been followed to regeneration.

Damage and damage identification

The principal problem caused by deer mice is their tendency to enter homes, cabins, and other structures that are not rodent-proof. Here they build nests, store food, and can cause considerable damage to upholstered furniture, mattresses, clothing, paper, or other materials they find suitable for their nest-building activities. Nests, droppings, and other signs left by these mice are similar to those of house mice. Deer mice have a greater tendency to cache food supplies, such as acorns, seeds, or nuts, than do house mice. Deer mice are uncommon in urban or suburban residential areas unless there is considerable open space (fields, parks) nearby.

Deer mice occasionally dig up and consume newly planted seeds in gardens, flowerbeds, and field borders. Their excellent sense of smell makes them highly efficient at locating and digging up buried seed. Formerly, much reforestation was attempted by direct seeding of clear-cut areas, but seed predation by deer mice and other rodents and birds, caused frequent failure in the regeneration. For this reason, to reestablish Douglas fir and other commercial timber species today, it is often necessary to hand-plant seedlings, despite the increased expense of this method.

In the early 1990s, the deer mouse (*P. maniculatus*) was first implicated as a potential reservoir of a type of hantavirus responsible for an adult respiratory distress syndrome, leading to several deaths in the Four Corners area of the United States. Subsequent isolations of the virus thought responsible for this illness have been made from several Western states, including Wyoming. The source of the disease is thought to be through human contact with urine, feces, or saliva from infected rodents.

PORCUPINES

Classification and legal status in Wyoming

Classified as a “predatory animal” under Wyoming Game & Fish Commission statutes and are not protected.

Damage prevention and control methods

Exclusion — Fences (small areas). Tree trunk guards.

Cultural methods — Encourage closed-canopy forest stands.

Repellents — None are registered. Some wood preservatives may incidentally repel porcupines.

Toxicants — None are registered.

Fumigants — None are registered.

Trapping — Steel leg hold trap (No. 2 or 3), body-gripping (Conibear®) trap (No. 220 or 330), or box trap.

Shooting — Day shooting and spotlighting are effective where legal.

Other methods — Encourage natural predators.

Damage and damage identification

Clipped twigs on fresh snow, tracks, and gnawing on trees are useful means of damage identification. Trees are often deformed from partial girdling. Porcupines clip twigs and branches that fall to the ground or onto snow and often provide food for deer and other mammals. The considerable secondary effects of their feeding come from exposing the tree sapwood to attack by disease, insects, and birds. This exposure is important to many species of wildlife because diseased or hollow trees provide shelter and nest sites.

Porcupines occasionally will cause considerable losses by damaging fruits, sweet corn, alfalfa, and small grains. They chew on hand tools and other wood objects while seeking salt. They destroy siding on cabins when seeking plywood resins.

Porcupines offer a considerable threat to dogs, which never seem to learn to avoid them. Domestic stock occasionally will nuzzle a porcupine and may be fatally injured if quills are not removed promptly.

PRAIRIE DOGS

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation* as non-game wildlife and may be taken (without permit) during the calendar year in the entire state. The prairie dog is also a “designated pest” under the Wyoming Department of Agriculture, Weed & Pest Control Act statutes, http://www.wyoweed.org/images/Designated_List.pdf.

Damage prevention and control methods

Exclusion — Wire mesh fences can be installed but they are usually not practical or cost-effective. Visual barriers of suspended burlap, windrowed pine trees, or snow fence may be effective.

Cultural methods — Modify grazing practices on mixed and mid-grass rangelands to exclude or inhibit prairie dogs. Cultivate, irrigate, and establish tall crops to discourage prairie dog use.

Frightening — No methods are effective.

Repellents — None are registered.

Toxicants — Zinc phosphide. Note: Zinc phosphide baits require pre-baiting and used when green forage is not available to be effective. When baiting for prairie dogs, you must visit and follow instructions on the EPA Bulletins Live! Website <http://www.epa.gov/oppfead1/endanger/bulletins.htm>. Further instructions for use will be included on the product label.

Anticoagulants — Chlorophacinone; diphacinone.

Fumigants — Aluminum phosphide. Gas Cartridges.

Trapping — Box traps, snares, or Conibear® No. 110 (body gripping) traps or equivalent.

Shooting — Shooting with .22 rimfire or larger rifles.

Other methods — Several home remedies have been used, but most are unsafe and are not cost-effective.

Damage and damage identification

Several independent studies have produced inconsistent results regarding the impacts of prairie dogs on livestock production. The impacts are difficult to determine and depend on several factors, such as the site conditions, weather, current and historic plant communities, number of prairie dogs, size and age of prairie dog towns, and the intensity of site use by livestock and other grazers. Prairie dogs feed on many of the same grasses and forbs that livestock feed on. Annual dietary overlap ranges from 64% to 90%. Prairie dogs often begin feeding on pastures and rangeland earlier in spring than cattle and clip plants closer to the ground. Up to 10% of the aboveground vegetation may be destroyed due to their burrowing and mound-building activities. Overall, prairie dogs may remove 18% to 90% of the available forage through their activities.

The species composition of pastures occupied by prairie dogs may change dramatically. Prairie dog activities encourage shortgrass species, perennials, forbs, and species that are resistant to grazing. Annual plants are selected against because they are usually clipped before they can produce seed. Several of the succeeding plant species are less palatable to livestock than the grasses they replace.

Other studies, however, indicate prairie dogs may have little or no significant effect on livestock production. One research project in Oklahoma revealed there were no differences in annual weight gains between steers using pastures inhabited by prairie dogs and steers in pastures without prairie dogs. Reduced forage availability in prairie dog

towns may be partially compensated for by the increased palatability and crude protein of plants that are stimulated by grazing. In addition, prairie dogs sometimes clip and/or eat plants that are toxic to livestock. Bison, elk, and pronghorns appear to prefer feeding in prairie dog colonies over non-colonized grassland.

Prairie dog burrows increase soil erosion and are a potential threat to livestock, machinery, and horses with riders. Damage may also occur to ditch banks, impoundments, field trails, and roads.

Prairie dogs are susceptible to several diseases, including plague, a severe infectious disease caused by the bacterium *Yersinia pestis*. Plague, which is often fatal to humans and prairie dogs, is most often transmitted by the bite of an infected flea. Although plague has been reported throughout the western United States, it is uncommon. Symptoms in humans include swollen and tender lymph nodes, chills, and fever. The disease is curable if diagnosed and treated in its early stages. It is important the public be aware of the disease and avoid close contact with prairie dogs and other rodents. Public health is a primary concern regarding prairie dog colonies that are in close proximity to residential areas and schoolyards.

GROUND SQUIRRELS

Species: Franklin, Richardson, Columbian, Washington, and Townsend.

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation* as non-game wildlife and may be taken (without permit) during the calendar year in the entire state. The ground squirrel is also a “designated pest” under the Wyoming Department of Agriculture,

Weed & Pest Control Act statutes, http://www.wyoweed.org/images/Designated_List.pdf.

Damage prevention and control methods

Exclusion — Limited usefulness.

Cultural methods — Flood irrigation, forage removal, crop rotation, and summer fallow may reduce populations and limit spread.

Repellents — None are registered.

Toxicants — Zinc phosphide. Chlorophacinone. Diphacinone. Note: Not all toxicants are registered for use in every state. Check registration labels for limitations within each state.

Fumigants — Aluminum phosphide. Gas cartridges.

Trapping — Box, burrow-entrance, or leghold traps.

Shooting — Limited usefulness.

Damage and damage identification

High populations of ground squirrels may pose a serious pest problem. The squirrels compete with livestock for forage; destroy food crops, golf courses, and lawns; and can be reservoirs for diseases such as plague. Their burrow systems have been known to weaken and collapse ditch banks and canals, undermine foundations, and alter irrigation systems. The mounds of soil excavated from their burrows not only cover and kill vegetation, but damage haying machinery. In addition, some ground squirrels prey on the eggs and young of ground-nesting birds or climb trees in the spring to feed on new shoots and buds in orchards.

Ground squirrels are more destructive than prairie dogs because they occur in larger numbers and over more diverse terrain. To be truly effective in

controlling ground squirrels, cooperative efforts between landowners must be implemented, as the ground squirrel will quickly re-invade from areas that have not been treated.

TREE SQUIRRELS

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 11: Upland Game Bird and Small Game Hunting Seasons* as a “Small Game Animal,” requiring a license to take tree squirrels. For more information https://wgfd.wyo.gov/Regulations/Regulation-PDFs/REGULATIONS_CH11.

Damage prevention and control methods

Exclusion — Install sheet metal bands on isolated trees to prevent damage to developing nuts, fruit, and bark. Close external openings to buildings to stop damage to building interiors. Place an 18-inch (46 cm) section of 4-inch (10 cm) diameter plastic pipe or a one-way door over openings to allow squirrels to leave and prevent them from returning. Plastic tubes on wires may prevent access to buildings.

Cultural methods — Remove selected trees or their branches to prevent access to structures.

Repellents — Naphthalene (moth balls), Ro-pel, capsaicin, and polybutenes are registered for controlling tree squirrels.

Toxicants — None are registered.

Fumigants — None are registered.

Trapping — Leghold, box, cage, rat snap traps, or box choker traps.

Shooting — Effective where firearms are permitted. Use a shotgun with No. 6 shot or a .22-caliber rifle.

Damage and damage identification

Squirrels may occasionally damage forest trees by chewing bark from branches and trunks. Pine squirrels damage Ponderosa pine, jack pine, and paper birch. Tree squirrels may eat cones and nip twigs to the extent they interfere with natural reseedling of important forest trees. This is a particular problem in Ponderosa pine forests where pine squirrels may remove 60%–80% of the cones in poor to fair seed years. In forest seed orchards, such squirrel damage interferes with commercial seed production.

In nut orchards, squirrels can severely curtail production by eating nuts prematurely and by carrying off mature nuts. Pine, gray, and fox squirrels may chew bark of various orchard trees.

In residential areas, squirrels sometimes travel power lines and short out transformers. They gnaw on wires, enter buildings, and build nests in attics. They frequently chew holes through pipelines used in maple syrup production.

Squirrels occasionally damage lawns by burying or searching for and digging up nuts. They will chew bark and clip twigs on ornamental trees or shrubbery planted in yards. Often, squirrels take food at feeders intended for birds. Sometimes they chew to enlarge openings of bird houses and then enter to eat nestling songbirds. Flying squirrels are small enough to enter most bird houses and are especially likely to eat nesting birds.

In gardens, squirrels may eat planted seeds, mature fruits, or grains such as corn.

VOLES

Classification and legal status in Wyoming

Most vole species in Wyoming are Classified under the *Wyoming Game & Fish Commission Chapter 52:*

Non-game Wildlife Regulation as non-game wildlife and may be taken (without permit) during the calendar year in the entire state.

See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 9. Mammals* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Recommended to protect trees, ornamental plants, and small areas.

Habitat modification — Eliminating ground cover reduces populations. Soil cultivation destroys burrows and reduces cover.

Frightening — Not effective.

Repellents — Effectiveness uncertain.

Toxicants — Zinc phosphide. Anticoagulants (registered in most states).

Fumigants — Not usually effective.

Trapping — Mouse snap traps or live traps (Sherman or box-type traps).

Shooting — Not practical or effective.

Damage and damage identification

Voles may cause extensive damage to orchards, ornamentals, and tree plantings due to their girdling of seedlings and mature trees. Girdling damage usually occurs in fall and winter. Field crops (for example, alfalfa, clover, grain, potatoes, and sugar beets) may be damaged or completely destroyed by voles. Voles eat crops and also damage them when they build extensive runway and tunnel systems. These systems interfere with crop irrigation by displacing water and causing levees

and checks to wash out. Voles also can ruin lawns, golf courses, and ground covers.

Girdling and gnaw marks alone are not necessarily indicative of the presence of voles, since other animals, such as rabbits, may cause similar damage. Vole girdling can be differentiated from girdling by other animals by the non-uniform gnaw marks. They occur at various angles and in irregular patches. Marks are about 1/8-inch (0.3 cm) wide, 3/8-inch (1.0 cm) long, and 1/16-inch (0.2 cm) or more deep. Rabbit gnaw marks are larger and not distinct. Rabbits neatly clip branches with oblique clean cuts. Examine girdling damage and accompanying signs (feces, tracks, and burrow systems) to identify the animal causing the damage.

The most easily identifiable sign of voles is an extensive surface runway system with numerous burrow openings. Runways are 1–2 inches (2.5–5 cm) in width. Vegetation near well-traveled runways may be clipped close to the ground. Feces and small pieces of vegetation are found in the runways.

The pine vole does not use surface runways. It builds an extensive system of underground tunnels. The surface runways of long-tailed voles are not as extensive as those of most other voles.

Voles pose no major public health hazard because of their infrequent contact with humans; however, they are capable of carrying disease organisms, such as plague (*Yersinia pestis*) and tularemia (*Francisilla tularensis*). Be careful and use protective clothing when handling voles.

WOODRATS (PACKRATS)

Classification and legal status in Wyoming

Woodrats are classified as non-game animals. In most states, they can be taken (controlled) when they threaten or damage property. Check with your

local wildlife or agriculture department for laws and regulations specific to your area.

Damage prevention and control methods

Exclusion — Is the most effective method of eliminating damage. Woodrats may be excluded from buildings. No hole larger than 1/2-inch (1.3 cm) should be left unsealed. Make sure doors, windows, and screens fit tightly. If gnawing is a problem, edges can be covered with sheet metal. Coarse steel wool, wire screen, and lightweight sheet metal are excellent materials for plugging gaps and holes.

Repellents — No woodrat repellents, registered by the EPA.

Toxicants — Available for woodrat control include anticoagulants and zinc phosphide, registered under Special Local Needs 24(c) provisions. Registered products vary among states. When using toxic baits, follow label instructions carefully. Chorphacinone or diphacinone have also proven effective.

Trapping — Woodrats show little fear of new objects in their environment and are easily trapped. Baited snap traps, cage traps, burrow entrance traps, and glue boards are effective.

Damage and damage identification

Populations generally are fairly dispersed, but economic damage to agricultural crops can occur in limited areas. Agricultural damage results when woodrats clip small twigs and branches and when they debark citrus and other fruit trees and seedling and sapling conifers, especially redwoods. Loss of trees can occur.

Woodrats are sometimes a nuisance around cabins, outbuildings, and other infrequently used structures or vehicles. As the name packrat implies, they have a tendency to pack away small objects such as jewelry, cooking and eating utensils, can

tabs, and other items. At times, this behavior can become a nuisance to backpackers and others. More seriously, woodrats may also shred upholstered furniture and mattresses for lining nests, and may take up residence in parked vehicles, gnawing on wires and other mechanical components.

Woodrats can be an important factor in the transmission of certain diseases, most notably plague, where this disease occurs. Dead or dying woodrats should not be handled.

KANGAROO RATS

Classification and legal status in Wyoming

Legal Status: Most kangaroo rats are considered non-game animals and are not protected by state game laws. Certain local subspecies may be protected by regulations regarding threatened and endangered species. Consult local authorities to determine their legal status before applying controls.

Damage prevention and control methods

Exclusion — Is most often accomplished by the construction of rat-proof fences and gates around the area to be protected. Most kangaroo rats can be excluded by 1/2-inch (1.3-cm) mesh hardware cloth, 30 to 36 inches (75 to 90 cm) high. The bottom 6 inches (15 cm) should be turned outward and buried at least 12 inches (30 cm) in the ground. Exclusion may be practical for small areas of high-value crops, such as gardens, but is impractical and too expensive for larger acreages.

Cultural methods — Alfalfa, corn, sorghum, and other grains are the most likely crops to be damaged by kangaroo rats. When possible, planting should be done in early spring before kangaroo rats become active to prevent loss of seeds. Less palatable crops should be planted along field edges that are near areas infested with kangaroo rats.

High kangaroo rat numbers most often occur on rangelands that have been subjected to overuse by livestock.

Repellents — There are no registered repellents for kangaroo rats.

Toxicants — Zinc phosphide. At present, 2% zinc phosphide bait is federally registered. Carefully read and follow all label instructions.

Fumigants — There are no fumigants registered specifically for kangaroo rats. Aluminum phosphide and gas cartridges are registered for “burrowing rodents such as woodchucks, prairie dogs, gophers, and ground squirrels.”

Trapping — **Live traps.** Trapping with box-type (wire cage) traps can be successful in a small area when a small number of kangaroo rats are causing problems. These traps can be baited successfully with various grains, oatmeal, oatmeal and peanut butter, and other baits. Do not release kangaroo rats in areas where landowners do not want them. **Snap traps:** Trapping with snap traps is probably the most efficient and humane method for kangaroo rats.

Other methods — Flooding.

Damage and damage identification

Kangaroo rats are nocturnal and harvest seeds and seed heads of mainly grass species. They are larder hoarders, meaning they collect food, store it, and feed on it during the winter. They can significantly reduce a pasture’s ability to reseed itself and can impact the grazing quality of grass pasture. They can also dig up and consume newly planted vegetable seeds. Burrows are quite extensive and can be mistaken for gopher damage. They are extremely sensitive to temperature changes and will seal burrow opening with soil during the heat of the day.

Section 3 - Category 909H - Bird Control

LEARNING OBJECTIVES

After completing the following section, you should be able to:

- A. Be able to explain why it is important in some situations to manage rodents and other vertebrates.
- B. Explain the four points of assessing vertebrate damage.
- C. Understand and describe the diseases that are vectored by vertebrates.
- D. Identify and understand the control tactics for a variety of vertebrate pests.
- E. Describe what causes bait shyness.
- F. Understand the Federal requirements for baiting rodents and how it impacts the record keeping and program documentation.

BIRDS

Federal acts and bills related to bird damage control

The following federal acts and bills should be referenced prior to the implementation of any bird damage control program:

- USFWS Title 50, Code of Federal Regulations, Part 21, *Migratory Bird Permits*. Revised 9/14/89. 37 pp.
- *Migratory Bird Treaty Act*. (16 USC 703-711). Sec. 703: Taking, killing, or possessing migratory birds unlawful. Sec. 704: Determination as to when and how migratory birds may be taken, killed, or possessed.
- *Endangered Species Act of 1973*. (As amended by P.L. 94-325, June 30, 1976; P.L. 94359, July 12, 1976;
- P.L. 95-212, December 19, 1977; P.L. 95-632, November 10, 1978; and P.L. 96-159, December 28, 1979)
- FWS/LE Law 8, Revised 6/25/84. 36 pp.
- USFWS SO CFR Part 17. *Endangered and Threatened Wildlife and Plants*. FWS/LE Enf 4-Reg-17. (Revised 1/1/89). 69 pp.
- USFWS SO CFR Part 10. *General Provisions*. FWS/LE Enf 4-Reg-10. 15 pp.

INTRODUCTION

Birds, especially migratory birds, provide enjoyment and recreation for many and greatly enhance the quality of our lives. These colorful components of natural ecosystems are often studied, viewed, photographed, hunted, and otherwise enjoyed.



Unfortunately, bird activities sometimes conflict with human interests. Birds may predate agricultural crops, create health hazards, and compete for limited resources with other more favorable wildlife species. The management of bird populations or the manipulation of bird habitats to minimize such conflicts is an important aspect of wildlife management. Problems associated with large concentrations of birds can often be reduced through techniques of dispersal or relocation of such concentrations.

DISPERSAL TECHNIQUES

Two general approaches to dispersing bird concentrations will be discussed in this section:

1. Environmental or habitat modifications that either exclude or repel birds or make an area less attractive, and
2. The use of frightening devices.

Habitat modifications

Habitat modifications include a myriad of activities that can make habitats less attractive to birds. Thinning or pruning of vegetation to remove protective cover can discourage birds from roosting. Most deciduous trees can withstand removal of up to one-third of their limbs and leaf surface without causing problems. Adverse effects are minimized during the dormant season. Thinning often enhances commercial timber production. Dramatic changes are not always necessary; however, sometimes subtle changes are effective in making an area unattractive to birds and causing bird concentrations to disperse or relocate to a place where they will not cause problems. Bird dispersal resulting from habitat modifications usually produces a more lasting effect than other methods and is less expensive in the long run.

Frightening devices

The use of frightening devices can be extremely effective in manipulating bird concentrations. The keys to a successful operation are timing, persistence, organization, and diversity. Useful frightening devices include broadcast alarm and distress calls, pyrotechnics, exploders, and other miscellaneous auditory and visual frightening devices. No single technique can be depended upon to solve the problem. Numerous techniques must be integrated into a frightening program.

Electronic devices. Recorded alarm and distress calls of birds are very effective in frightening many species of birds and are useful in both rural and urban situations. The calls are amplified and broadcast. Periodically move the broadcast units to enhance the effectiveness of such calls. If stationary units must be used, increase the volume to achieve greater responses. Electronically produced sounds such as Bird-X, AV-ALARM, or other sound generators will frighten birds but are usually not as effective as amplified recorded bird calls. This should not discourage their use, however. The greater the variety and disruptiveness of sounds, the more effective the method will be as a repellent.

Pyrotechnics. Pyrotechnic devices have long been employed in bird frightening programs. Safe and cautious use of these devices should be emphasized. The 12-gauge exploding shells (shell crackers) are very effective. They are useful in a variety of situations because of their long range. Fire shell crackers from the hip (to protect the eyes) from single-barrel, open bore shotguns and check the barrel after each round to be sure no obstruction remains. Some types of 12-gauge exploding shells are corrosive, requiring that the gun be cleaned after each use to prevent rusting. Though more expensive, smokeless powder shells will reduce maintenance.

Pyrotechnics should be stored, transported, and used in conformance with laws, regulations, and ordinances.

Several devices are fired from 15-mm or 17-mm pistols are used to frighten birds. For the most part, they cover a shorter range than the 12-gauge devices. They are known by many brand names but are usually called “bangers” if they explode, and “screamers” if they do not. Both types should be used together for optimal results. Noises up in the air near the birds are much more effective than those on the ground. The use of a shotgun with live ammunition is one of the most available but least effective means of frightening birds. Shotgun fire, however, may increase the effectiveness of other frightening devices. Live shotgun shells should not be included in a frightening program unless there is certainty no birds will be crippled and later serve as live decoys. Also, live ammunition creates safety problems in urban areas and is often illegal. Rifles (.22 caliber) fired from elevated locations are effective where they can be used safely.

Rope firecrackers are an inexpensive way to create unattended sound. The fuses of large firecrackers (known as fuse-rope salutes or agricultural explosive devices) are inserted through 5/16- or 3/8-inch (8-or 9.5-mm) cotton rope. As the rope burns, the fuses are ignited. The time between explosions can be regulated by the spacing of the firecrackers in the rope. The ability to vary the intervals is an asset since birds can become accustomed to explosions at regular intervals. Burning speed of the rope can be increased by soaking it overnight in a saltpeter solution of 3 ounces per quart (85 g/l) of water and allowing it to dry. Since the burning speed of the rope is also affected by humidity and wind speed, it is wise to time the burning of a test section of the rope beforehand. Because of the fire hazard associated with this device, it is a good idea to suspend it over a barrel, or make other fire prevention provisions.

Exploders. Automatic LP gas exploders are another source of unattended sound. It is important to elevate these devices above the level of the surrounding vegetation. Mobility is an asset and will increase their effectiveness, as will changing the interval between explosions.

Other frightening materials. Other frightening devices include chemicals such as Avitrol® and a great variety of whirling novelties and flashing lights, as well as innovative techniques such as smoke, water sprays, devices to shake roosting vegetation, tethered balloons, hawk silhouettes, and others. While all of these, even the traditionally used scarecrow (human effigies), can be useful in specific situations, they are only supplementary to a basic, well-organized bird frightening program. Combining different devices such as human effigies (visual) and exploders (auditory) produce better results than either device used separately.

Bird dispersal operations

Again, the keys to successful bird dispersal are timing, persistence, organization, and diversity. The timing of a frightening program is critical. Birds are much more apt to leave a roost site they have occupied for a brief period of time than one they have used for many nights. Prompt action greatly reduces the time and effort required to successfully relocate the birds. As restlessness associated with migration increases, birds will become more responsive to frightening devices and less effort is required to move them. When migration is imminent, the birds' natural instincts will augment dispersal activities.

Whether dealing with rural or urban concentrations, someone should be in charge of the entire operation and carefully organize all dispersal activities. The more diverse the techniques and mobility of the operation, the more effective it will be. Once initiated, the program must be continued each day until success is achieved.



The recommended procedure for dealing with an urban blackbird/starling roost is given below. Many of these principles apply to other bird problems as well.

Urban roost relocation procedure

Willing and effective cooperation among numerous agencies, organizations, and individuals is necessary to undertake a successful bird frightening program in an urban area. Different levels of government have different legal responsibilities for this work. The best approach is a cooperative effort with the most knowledgeable and interested individual coordinating the program.

Public relations efforts should precede an urban bird-frightening effort. Federal, state, and/or local officials should explain to the public the reasons for attempting to relocate the birds. Announcements should continue during the operation and a final report should be made through mass media. These public relations efforts will facilitate public understanding and support of the program. They will also provide an opportunity to solicit citizen involvement. This help will be needed when the birds scatter all over town after one or two nights of frightening. Traffic control in the vicinity of the roost is essential. Consequently, police involvement and that of other city officials is necessary.

The public should be informed that the birds may move to a site less suitable than the one they left and that, if disturbed in the new roost site, they are likely to return to the original site. Sometimes, it is wise to provide protection for a new, acceptable roost site once selected by the birds. One can predict with some certainty blackbirds and starlings will move to one of their primary staging areas if that area contains sufficient roosting habitat. Fortunately, if the birds occupy roost sites where they still create problems, a continuation of the frightening program can more easily cause

them to move to yet another site. With each successive move, the birds become more and more responsive to the frightening devices. Habituation is uncommon in properly conducted programs, especially if sufficient diversity of techniques and mobility of equipment is maintained.

Birds are much easier to frighten while they are flying. Once they have perched, a measure of security is provided by the protective vegetation and they become more difficult to frighten. Dispersal activities should end when birds stop moving after sunset. A continuation of frightening will only condition birds to the sounds and reduce responses in the future. With blackbird/starling roosts, all equipment and personnel should be prepared to begin frightening at least 1-1/2 hours before dark. The frightening program should commence as soon as the first birds are viewed. Early morning frightening is also effective. This requires only about 30 minutes and should begin when the first bird movement occurs within the roost, which may be prior to daylight. This movement precedes normal roost exodus time by about 30 minutes.

On the first night of a bird-roost frightening program, routes for mobile units should be planned and shooters of exploding shells should be placed so as to build a wall of sound around the roost site and saturate the roost with sound. Shooters should be cautioned to ration their ammunition so they do not run out before dark. The response of the birds is predictable. As flight lines attempt to enter the roost site in late afternoon, they will be repelled by the frightening effort. A wall of birds about 1/4 mile (0.4 km) from the roost site will mill and circle almost until dark. At that time, virtually all of the birds will come into the roost site, no matter what frightening methods are employed.

By the second and third nights of the frightening program, flexibility will be necessary in adapting

dispersal techniques to the birds' behavior. As larger numbers of birds are repelled from the original roost site, they will attempt to establish numerous temporary roosts. Mobile units armed with pyrotechnics and broadcast alarm and distress calls should be prepared to move to these areas, disturb the birds, and send them out of town. Frightening efforts by residents should be encouraged through mass media. Efforts must continue each morning and evening in spite of weather conditions. Complete success is usually achieved by the fourth or fifth night.

A bird-frightening program can be used to deal with an immediate bird problem, but it can also be an educational tool that prepares individuals or municipalities to deal with future problems in an effective manner. Those interested in resolving the problem should bear part of the financial burden of the bird-frightening program. This requirement will immediately eliminate imagined bird problems. When a city or individual is willing to pay a part of the bill for a bird frightening operation, it is obvious a genuine problem exists.

Summary

Large concentrations of birds sometimes conflict with human interests. Birds can be easily dispersed by means of habitat manipulation or various auditory and visual frightening devices. Timing, persistence, organization, and diversity are the keys to effective bird dispersal programs. The proper use of frightening devices can effectively deal with potential health and/or safety hazards, depredation, and other nuisances caused by birds.

PIGEONS (ROCK DOVES)

Classification and legal status in Wyoming

Classified under the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation* as non-game wildlife and may be taken as provided

for in the appropriate federal laws. Feral pigeons are not protected by federal law, but may be protected within municipalities.

See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 6. Birds* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Screen eaves, vents, windows, doors, and other openings with 1/4-inch (0.6-cm) mesh hardware cloth. Change angle of roosting ledge to 45° or more. Install porcupine wires (Cat Claw™, Nixalite™), ECOPIC™, or Bird Barrier™ to roosting sites. Construct parallel or grid-wire (line) systems.

Habitat modification — Eliminate food supply. Discourage people from feeding pigeons in public areas. Clean up spilled grain around elevators, feed mills, and rail car clean-out areas. Eliminate standing water.

Frightening — Visual and auditory frightening devices are usually not effective over long periods of time. Avitrol® (a chemical frightening agent).

Repellents — **tactile:** Various nontoxic, sticky substances (4-The Birds™, Hotfoot™, Tanglefoot™, Roost No More™, and BirdProof™).

Odor: Naphthalene flakes.

Toxicants — **oral:** DRC-1339, used under supervision of USDA-APHIS-Wildlife Services only. Avitrol®, depends on bait concentration.

Fumigants — Generally not practical.

Trapping — Several live trap designs are effective.

Shooting — Where legal.



Other control methods — Nest removal.

Damage and damage identification

Pigeon droppings deface and accelerate the deterioration of buildings and increase the cost of maintenance. Large amounts of droppings may kill vegetation and produce an objectionable odor. Pigeon manure deposited on park benches, statues, cars, and unwary pedestrians is aesthetically displeasing. Around grain handling facilities, pigeons consume and contaminate large quantities of food destined for human or livestock consumption.

Pigeons may carry and spread diseases to people and livestock through their droppings. They are known to carry or transmit pigeon ornithosis, encephalitis, Newcastle disease, cryptococcosis, toxoplasmosis, salmonella food poisoning, and several other diseases. Additionally, under the right conditions, pigeon manure may harbor airborne spores of the causal agent of histoplasmosis, a systemic fungus disease that can infect humans.

The ectoparasites of pigeons include various species of fleas, lice, mites, ticks, and other biting insects, some of which readily bite people. Some insects that inhabit the nests of pigeons are also fabric pests and/or pantry pests. The northern fowl mite found on pigeons is an important poultry pest.

Pigeons around airports can also be a threat to human safety because of potential bird-aircraft collisions and are considered a medium priority hazard to jet aircraft by the U.S. Air Force.

HOUSE OR ENGLISH SPARROWS

Classification and legal status in Wyoming

House or English Sparrows are classified under Wyoming statutes as predaceous birds allowing for control of these birds in the entire state at any time

during the calendar year. In addition, it is also legal to destroy the nest and eggs of predaceous birds. Federal law does not protect House or English sparrows because they are an introduced species. Many listings for various other species of sparrows are classified under the *Wyoming Game & Fish Chapter 52 Regulations* as non-game wildlife and may or may not be protected under federal law.

See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 6. Birds* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Block entrances larger than 3/4-inch. Design new buildings or alter old ones to eliminate roosting and nesting places. Install plastic bird netting or overhead lines to protect high-value crops.

Cultural methods — Remove roosting sites. Plant bird resistant varieties.

Frightening — Fireworks, alarm calls, exploders. Scarecrows, motorized hawks, balloons, kites. 4-Aminopyridine (Avitrol®).

Repellents — Capsicum. Polybutenes. Sharp metal projections (Nixalite® and Cat Claw®).

Trapping — Funnel, automatic, and triggered traps. Mist nets.

Shooting — Air guns and small firearms. Dust shot and BB caps.

Other methods — Nest destruction. Predators.

Damage and damage identification

House sparrows consume grains in fields and in storage. They do not move great distances into grain fields, preferring to stay close to the

shelter of hedgerows. Localized damage can be considerable since sparrows often feed in large numbers over a small area. Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits. They interfere with the production of livestock, particularly poultry, by consuming and contaminating feed. Because they live in such close association with humans, they are a factor in dissemination of diseases (chlamydiosis, coccidiosis, erysipeloid, Newcastle's, paratyphoid, pullorum, salmonellosis, transmissible gastroenteritis, tuberculosis, various encephalitis viruses, vibriosis, and yersinosis), internal parasites (acarasis, schistosomiasis, taeniasis, toxoplasmosis, and trichomoniasis), and household pests (bed bugs, carpet beetles, clothes moths, fleas, lice, mites, and ticks).

In grain storage facilities, fecal contamination probably results in as much monetary loss as does the actual consumption of grain. House sparrow droppings and feathers create janitorial problems as well as hazardous, unsanitary, and odoriferous situations inside and outside of buildings and sidewalks under roosting areas. Damage can also be caused by the pecking of rigid foam insulation inside buildings. The bulky, flammable nests of house sparrows are a potential fire hazard. The chattering of the flock on a roost is an annoyance to nearby human residents.

Nestlings are primarily fed insects, some of which are beneficial and some harmful to humans. Adult house sparrows compete with native, insectivorous birds. Martins and bluebirds, in particular, have been crowded out by sparrows that drive them away and destroy their eggs and young. House sparrows generally compete with native species for favored nest sites.

EUROPEAN STARLING

Classification and legal status in Wyoming

Starlings are classified under Wyoming statutes as “predaceous birds” allowing for control of these birds in the entire state at any time during the calendar year. In addition, it is also legal to destroy the nest and eggs of predaceous birds. Federal law does not afford protection to starlings.

Damage prevention and control methods

Exclusion — Close all openings larger than 1 inch. Place covering at 45° angle on ledges. Porcupine wires on ledges or rafters. Netting to prevent roosting on building beams or to protect fruit crops. PVC or rubber strips to cover door openings; netting where frequent access is not needed.

Cultural methods and habitat modification

— Reduce availability of food and water at livestock facilities: remove spilled grain and standing water; use bird proof feeders and storage facilities; feed livestock in open sheds; where appropriate, feed in late afternoon or at night; lower water level in waterers. Modify roost sites by closing buildings; exclude from roost areas with netting (for example, under roof beams); modify specific perch sites. For tree roosts, prune branches of specific trees or thin trees from groves.

Frightening — Frightening devices include recorded distress or alarm calls, various sound-producing devices, chemical frightening agents (Avitrol®), lights, and bright objects. Use with fruit crops and starling roosts. Also useful at livestock facilities in warm climates and at facilities located near major roosts.

Repellents — Soft sticky materials (polybutenes) discourage roosting on ledges. Starling repellent is under development: methyl anthranilate (grape flavoring). If successful, it may be useful for protecting fruit and as a livestock feed additive.



Toxicants — Starlicide (USDA Wildlife Service only licensed applicant): toxic bait for use around livestock facilities and, in some situations, at roost sites. **Toxic perches:** can be useful for certain industrial and other structural roost situations.

Fumigants — None are registered.

Trapping — Nest-box traps, for use during nesting season. Decoy traps may be useful around orchards or livestock facilities. Proper care for trap and decoy birds is necessary.

Shooting — Helpful as a dispersal or frightening technique. Not effective in reducing overall starling numbers.

Damage and damage identification

Starlings are frequently considered pests because of the problems they cause, especially at livestock facilities and near urban roosts. Starlings may selectively eat the high protein supplements often added to livestock rations.

Starlings may also be responsible for transferring disease from one livestock facility to another. This is of particular concern to swine producers. Tests have shown that the transmissible gastroenteritis virus (TGE) can pass through the digestive tract of a starling and be infectious in the starling feces. Researchers, however, have also found healthy swine in lots with infected starlings. This indicates that even infected starlings may not always transmit the disease, especially if starling interaction with pigs is minimized. TGE may also be transmitted on boots or vehicles, by stray animals, or by infected swine added to the herd. Although starlings may be involved in the spread of other livestock diseases, their role in transmission of these diseases is not yet understood. Starlings can cause other damage by consuming cultivated fruits such as grapes, peaches, blueberries, strawberries, figs, apples, and cherries. They

were recently found to damage ripening (milk stage) corn, a problem primarily associated with blackbirds. In some areas, starlings pull sprouting grains, particularly winter wheat, and eat the planted seed. Starlings may damage turf on golf courses as they probe for grubs, but the frequency and extent of such damage is not well documented.

The growing urbanization of wintering starling flocks seeking warmth and shelter for roosting may have serious consequences. Large roosts that occur in buildings, industrial structures, or, along with blackbird species, in trees near homes, are a problem in both rural and urban sites because of health concerns, filth, noise, and odor. In addition, slippery accumulations of droppings pose safety hazards at industrial structures, and the acidity of droppings is corrosive.

Starling and blackbird roosts near airports pose an aircraft safety hazard because of the potential for birds to be ingested into jet engines, resulting in aircraft damage or loss and, at times, in human injuries. In 1960, an Electra aircraft in Boston collided with a flock of starlings soon after takeoff, resulting in a crash landing and 62 fatalities. Although only about 6% of bird-aircraft strikes are associated with starlings or blackbirds, these species represent a substantial management challenge at airports.

One of the more serious health concerns is the fungal respiratory disease histoplasmosis. The fungus *Histoplasma capsulatum* may grow in the soils beneath bird roosts, and spores become airborne in dry weather, particularly when the site is disturbed. Although most cases of histoplasmosis are mild or even unnoticed, this disease can, in rare cases, cause blindness and/or death. Individuals who are weakened by other health conditions or who do not have endemic immunity are at greater risk from histoplasmosis.

Starlings also compete with native cavity-nesting birds such as bluebirds, flickers, and other woodpeckers, purple martins, and wood ducks for nest sites. One report showed that, where nest cavities were limited, starlings had severe impacts on local populations of native cavity-nesting species. One author has speculated that competition with starlings may cause shifts in red-bellied woodpecker (*Melanerpes carolinus*) nesting from urban habitats to rural forested areas where starling competition is less.



Section 4 - Category 909I - Vertebrate Pest Control

LEARNING OBJECTIVES

After completing the following section, you should be able to:

- A. Be able to explain why it is important in some situations to manage rodents and other vertebrates.
- B. Explain the four points of assessing vertebrate damage.
- C. Understand and describe the diseases that are vectored by vertebrates.
- D. Identify and understand the control tactics for a variety of vertebrate pests.
- E. Describe what causes bait shyness.
- F. Understand the Federal requirements for baiting rodents and how it impacts the record keeping and program documentation.

FOXES

Classification and legal status in Wyoming

Red fox are classified as predators and may be taken at any time within the entire state, whether or not they are causing damage.

Gray fox are classified under the Wyoming Game & Fish Commission regulations as non-game wildlife, but may not be taken unless the following conditions exist:

1. It is determined to be unavoidable and does not result from conduct with lack of reasonable care, or
2. It results from control measures approved by the Wyoming Game & Fish Commission as necessary to address public health concerns. See the *Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 4. Taking of Non-game Wildlife* at https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf for additional information.

Damage prevention and control methods

Exclusion — Net wire fence. Electric fence.

Cultural methods — Protect livestock and poultry during most vulnerable periods (for example, shed lambing, farrowing pigs in protective enclosures).

Frightening — Flashing lights and exploders may provide temporary protection. Well-trained livestock guarding dogs may be effective in some situations.

Repellents — None are registered for livestock protection.

Toxicants — M-44 sodium cyanide mechanical ejection device. The M-44 is registered for use in Wyoming and is labeled for both red and gray fox. Contact the Wyoming Department of Agriculture for more information.

Fumigants — Gas cartridges for den fumigation, where registered.

Trapping — Steel leghold, cage, or box traps, or snares.

Shooting — Predator calling techniques, aerial hunting is available by permit through the Wyoming Department of Agriculture.

Other methods — Den hunting — Remove young foxes from dens to reduce predation by adults.

Damage and damage identification

Foxes may cause serious problems for poultry producers. Turkeys raised in large range pens are subject to damage by foxes. Losses may be heavy in small farm flocks of chickens, ducks, and geese. Young pigs, lambs, and small pets are also killed by foxes. Damage can be difficult to detect because the prey is usually carried from the kill site to a den site or uneaten parts are buried. Foxes usually attack the throat of young livestock, but some kill by inflicting multiple bites to the neck and back. Foxes do not have the size or strength to hold adult livestock or to crush the skull and large bones of their prey. They generally prefer the viscera and often begin feeding through an entry behind the ribs. Foxes will also scavenge carcasses, making the actual cause of death difficult to determine.

Pheasants, waterfowl, other game birds, and small game mammals are also preyed upon by foxes. At times, fox predation may be a significant mortality

factor for upland and wetland birds, including some endangered species.

Rabies outbreaks are most prevalent among red foxes in southeastern Canada and occasionally in the eastern United States. The incidence of rabies in foxes has declined substantially since the mid-1960s for unexplained reasons. In 1990, there were only 197 reported cases of fox rabies in the United States as compared to 1,821 for raccoons and 1,579 for skunks. Rabid foxes are a threat to humans, domestic animals, and wildlife.

SKUNKS

Classification and legal status in Wyoming

Classified as predators and may be taken at any time within the entire state, no license required.

Damage prevention and control methods

Exclusion — **Buildings:** close cellar and outside basement and crawl space doors; seal and cover all openings including window wells and pits. **Poultry yards:** install wire mesh fences. **Beehives:** elevate and install aluminum guards.

Habitat modification — Removal of garbage, debris, and lumber piles.

Frightening — Lights and sounds are of limited value.

Repellents — Some home remedies such as moth balls or flakes or ammonia solution may be useful, but no repellents are registered.

Toxicants — None are registered.

Fumigants — Denning gas cartridges, (available from the Wyoming Department of Agriculture).

Trapping — Box or leghold trap.



Shooting — Practical only when animals are far from residential areas.

Other methods — Skunk removal. Odor removal.

Damage and damage identification

Skunks become a nuisance when their burrowing and feeding habits conflict with humans. They may burrow under porches or buildings by entering foundation openings. Garbage or refuse left outdoors may be disturbed by skunks. Skunks may damage beehives by attempting to feed on bees. Occasionally, they feed on corn, eating only the lower ears. If the cornstalk is knocked over, however, raccoons are more likely the cause of the damage. Damage to the upper ears of corn is indicative of birds, deer, or squirrels. Skunks dig holes in lawns, golf courses, and gardens while searching for insect grubs found in the soil. Digging normally appears as small, 3- to 4-inch (7- to 10-cm) cone-shaped holes or patches of up-turned earth. Several other animals, including domestic dogs, also dig in lawns.

Skunks occasionally kill poultry and eat eggs. They normally do not climb fences to get poultry. By contrast, rats, weasels, mink, and raccoons regularly climb fences. If skunks gain access, they will normally feed on the eggs and occasionally kill one or two 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 will often severely mutilate poultry. Tracks may be used to identify the animal causing damage. Both the hind and forefeet of skunks have five toes. In some cases, the fifth toe may not be obvious. Claw marks are usually visible, but the heels of the forefeet normally are not. The hind feet tracks are approximately 2-1/2 inches long (6.3 cm). Skunk droppings can often be identified by the undigested insect parts they contain. Droppings are 1/4 to 1/2 inch (6 to 13 mm) in diameter and 1 to 2 inches (2/5 to 5 cm) long.

Odor is not always a reliable indicator of the presence or absence of skunks. Sometimes dogs, cats, or other animals that have been sprayed by skunks move under houses and make owners mistakenly think skunks are present.

Skunks are the primary carriers of rabies in Wyoming. When rabies outbreaks occur, the ease with which rabid animals can be contacted increases. Rabid skunks are prime vectors for the spread of the virus. Avoid overly aggressive skunks that approach without hesitation. Any skunk showing abnormal behavior, such as daytime activity, may be rabid and should be treated with caution. Report suspicious behavior to local animal control authorities.

To prepare and secure a skunk for rabies testing, the animal should be shot in the body, taking care not to hit the head. The head should then be removed and submitted to the State Veterinary laboratory for analysis. Proper protective precautions should be exercised, (i.e., wearing of protective gloves) when preparing the animal for testing as the rabies virus is contagious.

BATS

Classification and legal status in Wyoming

See Wyoming Game & Fish Commission regulations for additional information.

Damage prevention and control methods

Exclusion — Polypropylene netting check-valves simplify getting bats out. Quality bat-proofing permanently excludes bats. Initiate control before young are born or after they are able to fly.

Repellents — Naphthalene: limited efficacy. Illumination. Air drafts/ventilation. Ultrasonic devices: not effective, some even attract bats. Sticky deterrents: limited efficacy.

Toxicants — None are registered.

Trapping — Available, but unnecessarily complicated compared to exclusion and bat-proofing.

Other methods — Sanitation and cleanup. Artificial roosts.

Removal of occasional bat intruders — When no bite or contact has occurred, help the bat escape (otherwise submit it for rabies testing).

Conservation and public education — Information itself functions as a management technique.

Damage and damage identification

Bat Presence. Bats often fly about swimming pools, from which they drink or catch insects. White light (with an ultraviolet component), commonly used for porch lights, building illumination, street and parking lot lights, may attract flying insects, which in turn attract bats. Unfortunately, the mere presence of a bat outdoors is sometimes beyond the tolerance of some uninformed people. Information is a good remedy for such situations.

Bats commonly enter buildings through openings associated with the roof edge and valleys, eaves, apex of the gable, chimney, attic or roof vent, dormers, and siding. Other openings may be found under loose-fitting doors, around windows, gaps around various conduits (wiring, plumbing, air conditioning) that pass through walls, and through utility vents.

Bats are able to squeeze through narrow slits and cracks. For purposes of bat management, one should pay attention to any gap of approximately $1/4 \times 1-1/2$ inches (0.6×3.8 cm) or a $5/8 \times 7/8$ inch ($1/6 \times 2.2$ cm) hole. Such openings must be

considered potential entries for at least the smaller species, such as the little brown bat. The smaller species require an opening no wider than $3/8$ inch (0.95 cm), that is, a hole the diameter of a U.S. 10-cent coin (Greenhall 1982). Openings of these dimensions are not uncommon in older wood frame structures where boards have shrunk, warped, or otherwise become loosened.

The discovery of one or two bats in a house is a frequent problem. If unused chimneys are selected for summer roosts, bats may fall or crawl through the open damper into the house. Sometimes bats may appear in a room, then disappear by crawling under a door to another room, hallway, or closet. They may also disappear behind curtains, wall hangings, bookcases, under beds, into waste baskets, and so forth. Locating and removing individual bats from living quarters can be laborious but is important. If all else fails, wait until dusk then the bat may appear once again as it attempts to find an exit.

Roosting sites. Bats use roosting niches that are indoors (human dwellings, out-buildings, livestock quarters, warehouses), semi-enclosed (loading docks, entrance foyers), partially sheltered (porches, carports, pavilions, highway underpasses, bridges), and open structural areas (window shutters, signs). Active bats in and on buildings can have several economic and aesthetic effects, often intertwined with public health issues (Frantz, 1988). Unusual roosting areas include wells, sewers, and graveyard crypts. Before considering control measures, verify that bats are actually the cause of the problem.

Rub marks. Surface areas on walls, under loose woodwork, between bricks, and around other bat entryways often have a smooth, polished appearance. The stained area is slightly sticky, may contain a few bat hairs, and is yellow-brown to blackish brown in color. The smooth gloss of these



rub marks is due to oils from fur and other bodily secretions mixed with dust, deposited there as many animals pass repeatedly for a long period over the same surface. Openings marked in this way have been used heavily by bats.

Noise. Disturbing sounds may be heard from vocalizations and grooming, scratching, crawling, or climbing in attics, under eaves, behind walls, and between floors. Bats become particularly noisy on hot days in attics, before leaving the roost at dusk, and upon returning at dawn. Note that rustling sounds in chimneys may be caused by birds or raccoons and scratching and thumping sounds in attics and behind walls may indicate rats, mice, or squirrels.

Guano and urine. Fecal pellets indicate the presence of animals and are found on attic floors, in wall recesses, and outside the house at its base. Fecal pellets along and inside walls may indicate the presence of mice, rats, or even roaches. Since most house bats north of Mexico are insectivorous, their droppings are easily distinguished from those of small rodents. Bat droppings tend to be segmented, elongated, and easily crumbled. When crushed, they become powdery and reveal shiny bits of undigested insect remains. In contrast, mice and rat droppings tend to taper, are unsegmented, are harder and more fibrous, and do not become powdery when crushed (unless extremely aged).

The droppings of some birds and lizards may occasionally be found along with those of bats. However, bat droppings never contain the white chalky material characteristic of the feces of these other animals.

Bat excrement produces an unpleasant odor as it decomposes in attics, wall spaces, and other voids. The pungent, musty, acrid odor can often be detected from outside a building containing a large or long-term colony. Similar odor problems

occur when animals die in inaccessible locations. The odor also attracts arthropods, which may later invade other areas of a building.

Bat guano may provide a growth medium for microorganisms, some of which are pathogenic (histoplasmosis, for example) to humans. Guano accumulations may fill spaces between walls, floors, and ceilings. It may create a safety hazard on floors, step, and ladders, and may even collapse ceilings. Accumulations also result in the staining of ceilings, soffits, and siding, producing unsightly and unsanitary conditions.

Bats also urinate and defecate in flight, causing multiple spotting and staining on sides of buildings, windows, patio furniture, automobiles, and other objects at and near entry/exit holes or beneath roosts. Bat excrement may also contaminate stored food, commercial products, and work surfaces.

Bat urine readily crystallizes at room temperature. In warm conditions under roofs exposed to sun and on chimney walls, the urine evaporates so quickly it crystallizes in great accumulations. Boards and beams saturated with urine acquire a whitish, powder-like coating. With large numbers of bats, thick and hard stalactites and stalagmites of crystallized bat urine are occasionally formed.

Although the fresh urine of a single bat is relatively odorless, that of any moderate-sized colony is obvious, and the odor increases during damp weather. Over a long period of time, urine may cause mild wood deterioration (Frantz and Trimarchi 1984). As the urine saturates the surfaces of dry wood beams and crystallizes, the wood fibers expand and separate. These fibers then are torn loose by the bats crawling over such surfaces, resulting in wood fibers being mixed with guano accumulations underneath.

The close proximity of bat roosts to human living quarters can result in excreta, animal dander, fragments of arthropods, and various microorganisms entering air ducts as well as falling onto the unfortunate residents below. Such contaminants can result in airborne particles of public health significance (Frantz 1988).

Ectoparasites and other arthropods. Several arthropods (fungivores, detritivores, predators, and bat ectoparasites) are often associated with colonies of bats in buildings. Their diversity depends upon the number of bats, age, and quantity of excreta deposits, and season. Some arthropods contribute to the decomposition of guano and insect remnants but may also become a pest of stored goods and/or a nuisance within the living quarters. Bat ectoparasites (ticks, mites, fleas, and bugs) rarely attack humans or pets and quickly die in the absence of bats. Ectoparasites may become a nuisance, following exclusion of large numbers of bats from a well-established roost site. Fumigation with insecticides may be required.

Rabies. Bats are distinct from most vertebrate pests that inhabit human dwellings because of the potential for transmitting rabies. Bats are not asymptomatic carriers of rabies. After an incubation period of 2 weeks to 6 months, they become ill with the disease for as long as 10 days. During this latter period, a rabid bat's behavior is generally not normal. It may be found active during the daytime or on the ground incapable of flying. Most human exposures are the result of accidental or careless handling of grounded bats. Even less frequently, bats in this stage of illness may be involved in unprovoked attacks on people or pets (Brass, per. commun.; Trimarchi et al. 1979). It is during this stage the rabid bat is capable of transmitting the disease by biting another mammal. As the disease progresses, the bat becomes increasingly paralyzed and dies as a result of the infection. The virus in the carcass is reported

to remain infectious until decomposition is well advanced.

MOLES

Classification and legal status in Wyoming

Consult Wyoming Game & Fish Commission regulations for additional information.

Damage prevention and control methods

Exclusion — Generally not practical, except in very small, high-value areas where an above-ground and underground barrier (sheet metal, brick, wood, concrete) might restrict moles.

Cultural methods — Packing the soil destroys burrows, and sometimes moles if done in early morning or late evening. Reduction in soil moisture and food source removal by the use of insecticides discourages moles and generally results in lower populations.

Frightening — Ineffective.

Repellents — None are registered.

Toxicants — None are registered.

Fumigants — Aluminum phosphide. Gas cartridges.

Trapping (most effective control method) — Out O' Sight® Trap, bayonet or harpoon trap (Victor® Mole Trap), easy-set mole eliminator, cinch mole trap, Death-Klutch gopher trap.

Shooting — Not practical.

Damage and damage identification

Moles remove many damaging insects and grubs from lawns and gardens; however, their burrowing habits disfigure lawns and parks, destroy flower



beds, tear up the roots of grasses, and create havoc in small garden plots.

It is important to properly identify the kind of animal causing damage before setting out to control the damage. Moles, voles, and pocket gophers are often found in the same location, and their damage is often confused. Control methods differ for the two species.

Moles leave volcano-shaped hills that are often made up of clods of soil. The mole hills are pushed up from the deep tunnels and may be 2 to 24 inches (5 to 60 cm) tall. The number of mole hills is not a measure of the number of moles in a given area. Surface tunnels or ridges are indicative of mole activity.

Pocket gopher mounds are generally kidney-shaped and made of finely sifted and cloddy soil. Generally, gophers leave larger mounds than moles. Gopher mounds are often built in a line, indicative of a deeper tunnel system.

COTTONTAIL AND JACKRABBITS

Classification and legal status in Wyoming

Cottontail Rabbits: Classified under Wyoming Game & Fish Commission statutes as a “Small Game Animal,” requiring a license to take cottontail rabbit. Contact the Wyoming Game & Fish Commission for additional information.

Cottontails in rural areas spend their entire lives on a few acres; in urban areas, they may not venture far from a single backyard. Since jackrabbits reside in open rangelands, they may need to travel several miles from their dens to areas containing their preferred food.

Jackrabbits: Classified as predators and may be taken at any time in the entire state, no license required.

Economic importance

Rabbits can cause damage any time of the year. During spring, rabbits prefer young, growing vegetation, like tulips, garden vegetables (carrots, peas, beans, lettuce, beets), clover and turfgrass. In winter, rabbits gnaw through the tender bark of young trees and shrubs to eat the green, inner bark.

Prevention and control of damage

The presence of rabbits does not always result in economic damage to plants. Most 2- to 3-foot high shrubs can survive having most of the 1- and 2-year-old twigs removed. However, the desirable bud, flower, or fruit development may be impaired. The key to effective and economical rabbit control is being able to predict and intercept damage with methods that are relative to the predicted loss in value.

Exclusion — A 1-inch mesh fence of poultry netting (chicken wire) works well to protect gardens and perennial flower beds from rabbit damage. Bury the bottom edge of the fence about 4 inches below the ground to prevent rabbits, particularly jackrabbits, from digging under it. The buried portion should be flared outward from the protected area to better prevent digging.

Nurseries, tree farms, and other large areas can be protected with a double-strand electric fence or electrified plastic-net fence. Place electric wires at 3 to 4 inches and at 8 to 12 inches above the ground. Consult local regulations before installing electric fences.

To protect individual trees, place cylinders of black plastic drain tile, cut to length and slit down one side, around the trunks. Poultry netting supported by stakes can be placed around the trunks of young

trees and shrubs. Shrub stems growing through the netting will become susceptible to damage by rabbits.

Habitat modification and plant selection —

Reduce harborage for rabbits by removing brush piles and tall weeds, particularly those near new windbreaks. Mow or spray to remove vegetation within 3 to 4 feet of recently planted trees and shrubs. Some trees and shrubs may need protection for as long as 10 years before they become mature enough to discourage rabbit feeding. Conversely, to guard against jackrabbit damage, encourage taller and denser vegetation.

Among herbaceous plants, preferred species within the rose and lily families are preferred. Horticulturists and others have compiled the following partial list of species most often eaten by rabbits.

Most often eaten:

- Annuals and Perennials
 - Aster
 - Coneflower
 - Hosta
 - Hybrid lily — Asiatic, Oriental
 - Impatiens — Young flowers on young plants
 - Pansy
 - Phlox
 - Rudbeckia
 - Tulip
- Shrubs and Young Trees
 - *Acer* spp. (maples)
 - *Amelanchier* spp. (serviceberry, juneberry)
 - *Aronia* spp. (black chokeberry, red chokeberry)
 - *Carpinus* spp. (ironwood)
 - *Cornus* spp. (dogwood)

- *Euonymus* spp. (burning bush, wahoo)
- *Gleditsia* spp. (honeylocust)
- *Hydrangea quercifolia* (oakleaf hydrangea)
- *Tilia* spp. (linden)
- *Malus* spp., (apples, flowering crabapples)
- *Rubus* spp. (raspberries and related brambles)
- *Sorbus* spp. (mountain ash)
- *Spiraea* spp. (spirea)
- *Pinus strobus* (Eastern white pine)
- *Populus* spp. (willow, poplar, cottonwood)
- *Prunus* spp. (plum, cherry, almond, peach)
- *Rhus* spp. (sumac)
- *Rosa* spp. (rose)
- *Quercus* spp. (oaks)

Plants with strong aromas and/or dense hair are typically avoided by rabbits. Some tree species rarely damaged by rabbits include black walnut, juniper, spruce, and fir. Be aware you cannot depend on rabbit-resistant plants if winter conditions are severe and food sources are limited.

Frightening devices — Scarecrows, owl, or snake effigies, spinning aluminum pie pans, and glass jars of water have been used to frighten rabbits. Commercial, water-driven scarecrows with motion detectors that spray water when movement occurs near them are available. Dogs confined by fences, tethers, or long leashes may help frighten rabbits away. In general, frightening devices may be limited in range to a few feet and provide short-lived protection because rabbits become used to them.

Repellents — Most rabbit repellents aren't registered for use on plants destined for human consumption. Repellents fall into two categories: taste and odor.



- **Taste repellents** attempt to make the plant less palatable for rabbits and are typically applied directly to the plant. Examples are those containing capsaicin or hot pepper extract (Deer-off™, Get Away™, Scoot™, Shotgun™). Their effectiveness tends to be short-lived and requires reapplication after sprinkler irrigation, rain, or new growth occurs. The duration and effectiveness of some repellents can be extended by mixing them with an antitranspirant, such as VaporGuard™ or Wiltpruf™.
- **Odor repellents** keep rabbits away from an area by fear or foul smell. A wide variety of active ingredients are used, including: ammonium or potassium salts of soaps (M-pede™; Ro-Pel™), eggs (DeFence®), thiram (Spotrete™), zinc dimethyldithiocarbamate (Earl May® Rabbit Scat), predator urine (Shake-Away™), or garlic (Sweeny's® Deer & Rabbit Repellent). They are typically applied to soil in the perimeter area and/or on plant foliage to repel rabbits.

Check the label for proper application rate, method, and site before applying any repellent.

Because daffodils are poisonous to rabbits, plant them in place of tulips to ensure reliable, spring-blooming bulbs.

Toxicants — No toxicants are registered for rabbits.

Trapping or shooting — Both trapping and shooting can temporarily reduce local rabbit populations.

Integrated pest management — A combination of methods usually best controls rabbit damage, and the methods selected depend on the situation. For a windbreak in a rural area, the best combination of methods may be to plant older, less-browsed species of trees, to add a different species each year, and then apply a commercial repellent with a spreader-sticker. A spreader-sticker is a product added to the repellent to increase duration and effectiveness of the repellent. Antitranspirants are excellent spreader-stickers. Ivory Liquid (add 1 teaspoon per gallon of mixed repellent) also acts as a spreader-sticker. Apply repellents several times during the winter during the first few years of tree growth.

For the gardener, the best approach may be to build a rabbit-proof fence to guard young sprouting plants. For perennial flower beds, the best approach may be to use motion-activated water sprays or a vigilant dog to scare rabbits. Homeowners might also resort to a low, aesthetic plastic-mesh fence as flower blossoms emerge.

For young trees and shrubs in a backyard, methods of control include low fences around clusters of plants, individual tree guards, or tree guards incorporated with chemical repellents.

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Resources

- Disease and Pests series, <https://apsjournals.apsnet.org/>
- Endangered species requirements, Wyoming Game & Fish Department, or from the U.S. Fish and Wildlife Service, Endangered Species Specialist, in Cheyenne at 307-772-2374.
- EPA Bulletins Live!, <http://www.epa.gov/oppfead1/endanger/bulletins.htm>.
- Guide to Weed Management, <https://marketplace.unl.edu/extension/extpubs/ec130.html>
- Protecting Endangered Species from Pesticides, <https://www.epa.gov/endangered-species>
- The Handbook: Prevention and Control of Wildlife Damage, http://digitalcommons.unl.edu/icwdmhandbook/?utm_source=digitalcommons.unl.edu%2Ficwdmhandbook%2F22&utm_medium=PDF&utm_campaign=PDFCoverPages
- University of Wyoming Extension, www.uwyo.edu/uwe
- Upland Game Bird and Small Game Hunting Seasons, https://wgfd.wyo.gov/Regulations/Regulation-PDFs/REGULATIONS_CH11
- Wyoming bee hive locations, <http://wyagric.state.wy.us/divisions/ts/sections-a-programs/plant-industry>
- Wyoming Department of Agriculture, Weed & Pest Control Act statutes, http://www.wyoweed.org/images/Designated_List.pdf
- Wyoming Game & Fish Commission Chapter 52: Non-game Wildlife Regulation, Section 9. Mammals, https://wgfd.wyo.gov/Regulations/Regulation-PDFs/Regulations_Ch52.pdf
- Wyoming Pesticide Safety Education Program and Wyoming pesticide applicator information, <https://uwyoextension.org/psep/>

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