UW EXTENSION

# Category 907H: Wyoming Industrial, Institutional, Structural and Health-Related Pest Control: Birds

For commercial applicators

## Acknowledgments

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**Wyoming Industrial, Institutional, Structural and Health-Related Pest Control: Birds**
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by Jeff Edwards

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## Preparation for your Exam

The reader preparing to take the Wyoming Commercial Pesticide Applicator Exam for category 907H, Bird Control, is encouraged to 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.

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 - Category 907H - 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 birds.

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 is available electronically through University of Nebraska-Lincoln (UNL) NebGuides (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 publication 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

### Introduction

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 manual 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.

## Assessing damage

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

### Introduction

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.

## 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, jack rabbits, 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

### Introduction

When persons consider 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, (see Grains Commonly Used in Rodent Baits). 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 percent of a test population. From this established quantity of toxicant, a LD100 is determined, which is the amount of toxicant necessary to kill 100 percent 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 2½ 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.

You may be required to visit the EPA BULLETINS LIVE! Two website and find details concerning product use in your specific area. Bulletin information can be access using this link; http://www.epa.gov/oppfead1/endanger/bulletins.htm

## 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/I) 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 1-½ 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 ½ hour 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 ½ hour.

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 yoming statutes as predacious 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 predacious 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 Commission 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, parathypoid, pullorum, salmonellosis, transmissible gastroenteritis, tuberculosis, various encephalitis viruses, vibriosis, and yersinosis), internal parasites (acariasis, 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 "predacious 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 predacious 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) com, 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.

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# Appendix A. Wyoming Statute 23-1-101: Definitions of wildlife.

(a) As used in this act:

(i) "Big game animal" means antelope, bighorn sheep, deer, elk, moose or mountain goat;

(ii) "Exotic species" means any wild animals, including amphibians, reptiles, mollusks, crustaceans or birds not found in a wild, free or unconfined status in Wyoming;

(iii) "Furbearing animal" means badger, beaver, bobcat, marten, mink, muskrat or weasel;

(iv) "Game bird" means grouse, partridge, pheasant, ptarmigan, quail, wild turkey and migratory game birds;

(v) "Game fish" means bass, catfish, crappie, grayling, burbot, northern pike, perch, salmon, sauger, sunfish, trout, walleye or whitefish unless the species is otherwise designated by the commission in specific waters through rule and regulation;

(vi) "Migratory game bird" means all migratory game birds defined and protected under federal law;

(vii) "Predacious bird" means English sparrow and starling;

(viii) "Predatory animal" means:

(A) Coyote, jackrabbit, porcupine, raccoon, red fox, skunk or stray cat; and

(B) Until the date gray wolves are removed from the list of experimental nonessential population, endangered species or threatened species in Wyoming as provided by W.S. 23-1-108, "predatory animal" includes wolves. After that date, "predatory animal" shall include any gray wolf within areas of the state where the state of Wyoming has jurisdiction for wildlife management, but not within an area of the state in which the gray wolf is:

(I) Designated as a trophy game animal under subdivision (xii)(B)(I) or (II) of this subsection.

(II) Repealed by Laws 2012, ch. 25, 2.

(ix) "Protected animal" means black-footed ferret, fisher, lynx, otter, pika or wolverine;

(x) "Protected bird" means migratory birds as defined and protected under federal law;

(xi) "Small game animal" means cottontail rabbit or snowshoe hare, and fox, grey and red squirrels;

(xii) "Trophy game animal" means:

(A) Black bear, grizzly bear or mountain lion; and

(B) From and after the date gray wolves are removed from the list of experimental nonessential population, endangered species or threatened species in Wyoming as provided by W.S. 23-1-108:

(I) "Trophy game animal" shall include any gray wolf within those tracts of

land within the following described area: northwest Wyoming beginning at the junction of Wyoming Highway 120 and the Wyoming-Montana state line; southerly along Wyoming Highway 120 to the Greybull River; southwesterly up said river to the Wood River; southwesterly up said river to the Shoshone National Forest boundary; southerly along said boundary to the Wind River Indian Reservation boundary; westerly, then southerly along said boundary to the Continental Divide; southeasterly along said divide to the Middle Fork of Boulder Creek; westerly down said creek to Boulder Creek; westerly down said creek to the Bridger-Teton National Forest boundary; northwesterly along said boundary to its intersection with U.S. Highway 189-191; northwesterly along said highway to the intersection with U.S. Highway 26-89-191; northerly along said highway to Wyoming Highway 22 in the town of Jackson; westerly along said highway to the Wyoming-Idaho state line; north along said state line to the southern boundary of Yellowstone National Park; east and north along said boundary to the Wyoming-Montana state line; then east along said state line to Wyoming Highway 120;

(II) "Trophy game animal" shall include any gray wolf located, from October 15 through the last day of February in the subsequent year, within the following described area: beginning at the boundary described in subdivision (B)(I) of this paragraph, where the Bridger-Teton National Forest boundary intersects U.S. Highway 189-191 at Hoback Rim; westerly and then southerly along said forest boundary to its intersection with USFS Road 10125 (McDougal Gap Road); westerly along said road to USFS Road 10138 (Grey's River Road); southerly along said road to Sheep Creek; westerly down said creek to Grey's River; southwesterly up said river to Bear Creek; southwesterly up said creek to the hydrographic divide between Bear Creek and Willow Creek; west from said divide to USFS Road 10080 (Willow Creek Road); northwesterly along said road to Lincoln County Road 123; southerly along said road to USFS Road 10081 (Grover Park Road); southerly then westerly along said road to Lincoln County Road 172; westerly along said road to the junction with Wyoming Highway 237; westerly along said highway to Wyoming Highway 238; southerly along said highway to Lincoln County Road 134; westerly along said road to the Wyoming-Idaho state line; north along said state line to Wyoming Highway 22 where the boundary described in this subdivision will rejoin the boundary described in subdivision (B)(I) of this paragraph.

(xiii) "Wildlife" means all wild mammals, birds, fish, amphibians, reptiles, crustaceans and mollusks, and wild bison designated by the Wyoming game and fish commission and the Wyoming livestock board within Wyoming.

# Appendix B: Descriptions of vertebrate pesticides[1]

## ALUMINUM PHOSPHIDE

### Chemical name
Aluminum phosphide

### Trade names
Phostoxin®, Delta®, Rotox®, Gastoxin®, PhosTek®

### Use
A fumigant for certain burrowing rodents and moles, it is also used to control insects in stored products.

### History
Aluminum phosphide was introduced as a fumigant for stored products in the early 1930s by Dr. Werner Freyberg, Chemische Fabrik. It being formulated into molded tablets or pellets is a rather recent development. This material was registered for mammal control in 1981, although the compound has been used for this purpose in some other countries for a much longer time.

### Properties
Aluminum phosphide form dark gray or yellowish crystals. For mammal control, it is formulated into 3-g tablets or 600-mg pellets. A typical formulation contains 56% to 57% active ingredient plus 26% ammonium carbamate, 3% paraffin, and 14% to 15% aluminum oxide. Aluminum phosphide reacts with atmospheric moisture to release phosphine ($PH_3$) gas, the active ingredient. Phosphine is colorless and has a slight carbide-like odor. At some concentrations it is flammable or explosive. In formulations that contain ammonium carbamate, this compound hydrolyzes to release C02 and ammonia. Aluminum phosphide should be stored in its original metal container until used.

### Toxicity
Phosphine gas is a potent mammalian toxicant. At a concentration of 1,000 ppm, it is lethal to humans after a few breaths. At 400 ppm, it is lethal in 30 minutesa. It is immediately dangerous to life or health at 200 ppmb. At a concentration of 1 ppm, it can be lethal to some rats within 24 hoursc. [aSpencer 1981,bBerg 1983,cLewis 1979].

## ANTICOAGULANTS

### Chemical name
See below.

### Trade names
See below.

### Use
Anticoagulants are a group of widely used rodenticides; an estimated 95% of all commensal rodent control is conducted with anticoagulants. They are separated into two functional groups, first-generation and second-generation anticoagulants. Those of the second generation have the ability to control warfarin-resistant rats and house mice, and they are also considered single-feeding anticoagulants. First-generation anticoagulants are also used for the control of certain field rodents, including ground squirrels, pocket gophers, and voles. Some field rodent and rabbit registrations are specific to local

1 Compiled by Robert M. Timm. *Description of Active Ingredients. Prevention and Control of Wildlife Damage - 1994*. Cooperative Extension Division, University of Nebraska, Lincoln. Pages G-23 - G-60.

needs of various states, and they are extensively used to protect agricultural crops and forest trees. At present, none of the second-generation anticoagulants are registered for control of field rodents or rabbits.

### History

Warfarin, the first anticoagulant rodenticide, had its beginning in 1943 when Dr. Karl Paul Link and his coworkers of the Biochemistry Department, University of Wisconsin, were attempting to determine the cause of "Sweet Clover Disease" in cattle. Moldy sweet clover hay was found to contain a powerful anticoagulant. The first result of the research was the development of dicumarol, which is used to prevent the formation of blood clots in humans. Dr. Link's staff continued the line of research and synthesized warfarin (Compound 42), which is a much more potent anticoagulant than dicumarol. In April 1948, J.A. O'Connor described the first successful use of an anticoagulant compound, dicoumarin, for controlling rats under field conditions.

Pindone, coumafuryl, and valone soon followed warfarin on the market, with diphacinone and chlorophacinone marketed somewhat later. The last two compounds were, by far, more toxic than the earlier materials; hence, the concentration in baits was reduced by some fivefold. Of the earlier anticoagulants, coumafuryl (Fumarin®) and valone (PMPR) are no longer marketed.

The second-generation anticoagulants, bromadiolone and brodifacoum, were developed some years later specifically to combat warfarin resistance. The newest of the second-generation anticoagulants, difethialone, has been in development for a number of years and is nearing registration in the United States.

### Characteristics

Anticoagulants used as rodenticides are chemically separated into two general groups: the hydroxycoumarins (such as warfarin) and the indandiones (pindone, valone, diphacinone, and chlorophacinone). The second-generation materials (bromadiolone, brodifacoum, and difethialone) are closely akin to the hydroxycoumarin group.

All first-generation anticoagulants, also known as multiple-dose rodenticides, relied on their cumulative toxic effect. They were substantially more toxic if consumed in small doses over a period of several days than if consumed in one large amount (for instance, the 5-day cumulative LD50 is substantially lower than the acute LD50). The baits are formulated so rodents have to feed a minimum of 3 to 5 days before a lethal dose is achieved; death follows after several additional days.

To achieve this multiple feeding, the bait must be made available on a continuous basis until the desired control is reached. Prior to the development of anticoagulants, all rodenticides were acute (single dose) materials; hence, the introduction of warfarin required a whole new concept of bait application. Bait trays or bait boxes had to be designed to hold substantial amounts of baits and strategically located so all rodents in an area had access to ample bait for repeated feedings until death.

Bromadiolone, brodifacoum, and difethialone, all second-generation materials, are much more potent, with relatively low acute LD50s for rodents, making them effective for the control of warfarin-resistant rats and mice. When formulated at their current concentrations, they have the ability to kill a high percentage of the rodent population in a single feeding, hence their designation as a single-feeding anticoagulants. The effects of these compounds are also cumulative and will result in death after several feedings of even small amounts.

As in the case of all anticoagulants, death is delayed for several days following the ingestion of a lethal dose. This delayed action has a decided safety advantage because it provides time to administer the antidote and save pets, livestock, and of course, people who may have accidentally ingested the bait. Vitamin K1 is the antidote for anticoagulants and, if administered soon enough after intake, can reverse the action of the anticoagulant. Diphacinone, chlorophacinone, and all of the second-generation materials persist in animals and will often require prolonged veterinary or medical treatment.

The slow action of anticoagulant baits has another great advantage in that the target animal is unable to associate its illness with the bait eaten. Bait shyness or toxicant shyness does not occur.

More of the anticoagulant baits used today are commercial ready-to-use baits; very few individuals prepare their own baits from concentrates as they commonly did 20 years ago. Ready-to-use bait increases the cost of rodent control but avoids past problems of incorrect bait concentrations and poor bait formulation, which often led to poor control.

Some anticoagulants are available as tracking powders and others as sodium salts that are water-soluble, allowing their use as water baits.

In the early 1960s, the practice began of mixing anticoagulant grain baits with melted paraffin and molding it into cans or cartons to form block-type paraffin baits. These became commercially available a few years later and were promoted for sewer rat control or for other rodent-infested areas with moisture and high humidity. Now there are molded or extruded paraffin-type baits made from most of the current anticoagulants. Block-type baits have several advantages: they confine multiple feedings of bait into one unit; if permitted by the label, they can be placed in strategic locations where bait boxes with loose grain or pelleted bait would be difficult to place; and bait deterioration from insects and molds is retarded.

### Anticoagulant resistance

The resistance of rats to warfarin was first noted in Scotland in 1958, some years following its repeated use. Shortly thereafter, anticoagulant resistance was identified in rats and house mice in other European countries. It was identified somewhat later in the United States, where it has since been demonstrated in many regions and major cities. All three species of commensal rodents are implicated. Resistance arises from genetic mutation or recombination, sometimes of a single gene, and levels of resistance vary among individual animals. A high degree of resistance will render control with warfarin virtually impossible. Rats and mice that are resistant to warfarin also show some resistance to all first generation anticoagulants. Where resistance is apparent, switch to a second generation anticoagulant or to another rodenticide with a different mode of action.

Whether resistance will eventually extend to all second-generation anticoagulants remains to be seen; some isolated instances of resistance to bromadiolone have been reported.

### Pharmacology

All anticoagulants have two actions; they reduce the clotting ability of the blood and cause damage to the capillaries (tiny blood vessels). The rate of blood clotting gradually decreases and blood loss leads to an apparently painless death.

Animals killed by anticoagulants often have no color in the skin, muscles, or viscera. Evidence of hemorrhage may be found in any part of the body, but usually only in one location. The blood that remains in the heart and vessels is very thin and forms a poor clot or no clot. The animal exhibits increasing weakness though appetite and body weight are not specifically affected. Hematoma (a

local swelling or tumor filled with blood) formation beneath the skin is often more common than free hemorrhage.

Repeated daily doses of the anticoagulants greatly increases their effective toxicity. Feeding does not have to be on consecutive days, but several feedings should occur within a 10-day interval with no longer than 48 hours between feedings. Plenty of bait must be made available at all times to achieve adequate control.

### Toxicity

The susceptibility to anticoagulants varies considerably among species and among anticoagulants. For this reason, generalizing often leads to erroneous conclusions. Since all anticoagulants are cumulative in toxicity, they have the ability to kill any warm-blooded animal if consumed in sufficient amounts for a long enough period. Materials with the highest toxicity and the longest half-lives present the greatest lethal potential with fewer feedings.

Compounds with the longest half-lives need not be consumed daily; a lapse of several days between feedings will not alter the outcome.

Many drugs increase the effects of anticoagulants; among these are the broad-spectrum antibiotics, the barbiturates, and the salicylates. Observations of rats treated with chlordane and DDT show the opposite effect; they stimulate the metabolism of warfarin, thus decreasing its toxicity. Susceptibility to anticoagulants seems to increase with age.

Anticoagulants tend to accumulate in the liver and gradually dissipate over a period of time, depending on the initial accumulations and successive doses. Where large doses of anticoagulants are ingested, substantial amounts may pass through the animal unassimilated.

Precautions should be taken to prevent children, pets, and livestock from gaining access directly to anticoagulant bait. Baits should be placed in areas inaccessible to nontarget animals or in tamper-resistant bait stations. A single substantial ingestion of diphacinone, chlorophacinone, or any of the second-generation anticoagulants baits may, for example, place a dog in jeopardy, requiring veterinary attention. When used according to label instructions, there is little potential hazard to nontarget species.

Secondary hazard associated with predator or scavenger animals consuming rodent carcasses is minimal in commensal rodent control. It can be of somewhat greater concern when anticoagulants are used for field rodent control. Occasionally a farm dog is known to consume fresh vole or ground squirrel carcasses over several days and begin to show signs of anticoagulant intoxication. With quick and proper veterinary attention, the dog can usually be saved. Although secondary poisoning has been demonstrated in the laboratory for various species, its occurrence in the wild appears very low, with few documented cases where use recommendations were followed.

## AVITROL

### Chemical name

4-aminopyridine

### Trade name

Avitrol®

### Use

Avitrol® is a bird management chemical registered for use as a flock-frightening repellent. It is usually formulated as a grain bait. Treated bait is diluted with untreated bait so only a few birds in a flock ingest a treated particle of bait. Affected birds emit distress cries and/or perform visual displays that

often frighten the other birds in the flock, causing them to leave.

Avitrol® has been used for feral pigeons, house sparrows, and for certain blackbirds and cowbirds in and around structures. In agricultural situations, crows, starlings, grackles, cowbirds, and blackbirds are most frequently the targeted species.

Avitrol® products are for use by or under the supervision of government agencies or certified control operators. Avitrol® is not for sale to the public.

### History

Avitrol® is the registered trademark of the Avitrol Corporation for the chemical 4-aminopyridine. The synthesis of this chemical was first reported in 1931, and its unique action on birds was reported in 1964 by Goodhue. Its utility for controlling damage by birds in some situations was demonstrated in 1965 by Goodhue and Baumgartner.

### Characteristics

4-aminopyridine is a white crystalline, odorless, water-soluble material. It is stable in light and melts at 159°C.

### Pharmacology

Avitrol® is an acutely toxic substituted pyridine that affects the nervous system in a manner similar to that of organophosphates and carbamates; however, Avitrol® is not a cholinesterase inhibitor. In most bird species, a lethal dose of Avitrol® is necessary to produce distress behavior.

### Toxicity

Birds and mammals appear equally sensitive to Avitrol® intoxication. LD50 values are generally less than 10 mg/kg. Birds ingesting the material become disoriented, emit distress calls, and exhibit erratic flight, tremors, and convulsions before death. Distress usually begins in about 15 minutes and last 20 to 30 minutes in most species. Some species, such as pigeons, do not emit distress calls.

In mammals, the following symptoms are produced: hyper-excitability, salivation, tremors, muscular incoordination, convulsions, cardiac or respiratory arrest, and death. Initial effects are usually noted in 10 to 15 minutes and death often occurs 15 minutes to 4 hours later. Occasionally, the tremor and/or convulsive stages are accompanied by audible vocalizations produced by strong, involuntary contractions of the diaphragm.

Documented reports of secondary poisoning following Avitrol® use have been very limited. When birds are offered undiluted Avitrol® baits, there may be potential hazards to dogs, cats, and raptors that consume unassimilated Avitrol® in gut contents. In field use, only individual scavengers such as magpies and crows appear to have been impacted.

## GAS CARTRIDGES

### Chemical components

Variable, depending upon type of gas cartridge.

### Trade names

US Department of Agriculture Gas Cartridge, Giant Destroyer® Smoke'Em®, GopherGasser®, Dexol Gasser®, and others.

### Use

Gas cartridges are incendiary devices designed to give off carbon monoxide and other poisonous gases and smoke when ignited. They are used to fumigate burrows of certain rodents and other mammals (coyotes, skunks).

### History

Gas cartridges were developed by the former Bureau of Biological Survey more than 70 years

ago. One type is manufactured and supplied by the Pocatello Supply Depot, USDA-APHIS-Animal Damage Control, Pocatello, Idaho. Other types were developed and are manufactured and sold by private commercial establishments.

### Properties

The current USDA gas cartridge was developed for control of woodchucks, ground squirrels, prairie dogs, and pocket gophers. It contains sodium nitrate, charcoal, and inert ingredients. A similar cartridge was developed and registered by USDA for fumigating coyote and skunk dens. Most gas cartridges are made of cardboard or paper and are ignited with a fuse. Care should be taken to avoid fire hazards at locations of use. Dry grasses, and methane or natural gas, which may be present in or around structures, can make using gas cartridges a potential fire hazard.

### Pharmacology

Gas cartridges give off smoke and toxic gases when ignited. Carbon monoxide gas is a major product. In humans, the first stage of carbon monoxide poisoning produces a feeling of tightness across the forehead, headache, throbbing at the temples, dizziness, weariness, nausea, vomiting, collapse, and unconsciousness. In the second stage, the blood pressure falls, muscular control is lost, intermittent convulsions may occur, and the victim's breathing becomes shallower, slower, and finally stops. Presumably, carbon monoxide acts similarly on other animals.

### Toxicity

Two hundred parts per million of carbon monoxide in inhaled air may produce symptoms of poisoning in a few hours, and 1,000 ppm can cause unconsciousness in 1 hour and death in 4 hours.

## METHYL ANTHRANILATE

### Chemical names

Methyl anthranilate, o-aminobenzoic acid methyl ester, o-carbomethoxyaniline

### Trade name

ReJeX-iT®

### Use

Because methyl anthranilate is broadly (if not universally) repellent to birds, it has many potential applications. The development of several of these applications has begun, and the formal registration of a few is imminent. The manufacturer (PMC Specialties Group) anticipates the registration of methyl anthranilate as a bird repellent additive to standing water at airports. The company also anticipates registration of methyl anthranilate as a bird repellent additive to Concover® (Newastecon, Inc.), a product designed as a thin cover for landfill operations. Gulls and crows refuse to forage in areas sprayed with Concover®/methyl anthranilate.

### History

Methyl anthranilate is a GRAS (Generally Recognized As Safe) food flavoring that is approved by the Food and Drug Administration as an additive to both human foods and livestock feeds. This chemical occurs naturally and is the characteristic odor of Concord grapes. The major US producer is PMC Specialties Group. The company synthesizes the chemical as a precursor ingredient for the manufacture of calcium and sodium saccharin.

The first publication on the bird repellency of methyl anthranilate appeared in Poultry Science (Kare and Pick 1960). The following year, methyl anthranilate was patented as a bird repellent. For reasons still not completely understood, methyl anthranilate is a chemical irritant to birds, much as ammonia, formaldehyde, and black pepper are irritants to mammals. Every avian species

tested to date, including laughing gulls, ring-billed gulls, starlings, sparrows, waxwings, red-winged blackbirds, grackles, cowbirds, mallards, Canada geese, snow geese, crows, chickens, guinea fowl, pheasants, bobwhite quail, and turkeys will avoid normally preferred foods when these foods are adulterated with methyl anthranilate at concentrations ranging from 0.5% to 1.0% by weight.

### Properties

Methyl anthranilate at room temperature is an oily, yellowish liquid. It has a fruity or grape-like odor and occurs in neoli, ylang-ylang, bergamot, jasmine, other essential oils, and in grape juice. It can be obtained synthetically by esterifying anthranilic acid with CH30H in the presence of HCL. Methyl anthranilate is only slightly soluble in water but is freely soluble in alcohol or ether. It has a boiling point of 256°C, a melting point of 24°C, and a specific gravity of 1.168. It has a vapor pressure of 1 mm at 20°C.

### Pharmacology

According to the Materials Data Safety Sheet, the pure substance may be harmful if inhaled, ingested, or absorbed through the skin. The vapor or mist from the concentrated compound can be irritating to the eyes, mucous membranes, and upper respiratory tract. It can cause skin irritation.

### Toxicity

Methyl anthranilate is not fundamentally toxic to mammals or birds. It may, however, be moderately toxic to fish.

## STARLICIDE

### Chemical name

3-chloro-p-toluidine hydrochloride

### Other names

3-chloro-4-methyl benzylnamine hydrochloride, CPTH, DRC-1339

### Use

Starlicide® is a slow-acting avicide registered for the control of starlings, blackbirds, pigeons, gulls, ravens, crows, and magpies.

### History

This chemical, originally coded DRC-1339 and evaluated by the Denver Wildlife Research Center, was found to be an excellent toxicant for starlings and blackbirds when formulated as a Starlicide® pellet. It received federal registration in 1967 for feedlot uses. Starlicide® is manufactured and distributed by the Purina Mills Company. Registration of a DRC-1339 concentrate has been maintained by USDA-APHIS for use against starlings, blackbirds, and gulls, with additional approvals granted for use against pigeons in 1992 and against ravens, crows, and magpies in 1993. Use of the DRC-1339 concentrate is restricted to USDA-APHIS personnel.

### Properties

The technical compound is a pale yellow, crystalline solid material very soluble in water and other highly polar solvents; it sublimes at 220°C. If formulated with many grains, potency of the compound may decline significantly when stored. Commercial Starlicide® pellets retain their potency for 6 to 12 months.

### Pharmacology

Starlicide® is a slow-acting and apparently painless toxicant in birds and mammals. In sensitive bird and mammal species, death results primarily from uremia (a buildup of uric acid in the blood). Death occurs without convulsions or spasms and is the result of generalized circulatory impairment in the liver and kidney, and congestion of the major organs. At death, victims' feathers are usually

fluffed and their feet tucked inside the feathers of the lower breast.

In most mammals and nonsensitive birds, death results from methemoglobinenimia (a buildup of methemoglobin in the blood). Mammals become listless and comatose before death.

Birds and mammals appear to metabolize or excrete Starlicide® completely within a matter of hours, and the excreted metabolites are nontoxic to birds and mammals. Because the Starlicide® and its metabolites are excreted while birds are still alive, there is no secondary toxicity to any scavengers eating dead birds.

### Toxicity

In birds, the average time between ingestion and death is 36 to 60 hours, depending on the amount ingested. Even when the lethal dose level is exceeded many times, death still takes many hours. Death occurs in 3 to 12 hours in most mammals.

The toxicity of Starlicide® varies considerably between bird species. Starlings, blackbirds, and crows are among the most sensitive birds; house sparrows and hawks are nonsensitive. Mammals are generally not sensitive to the toxic effects of Starlicide®.

## STRYCHNINE

### Chemical Name

2,4a,5,5a,7,8,15, l5a,l5b,l 5c-dechydro-4,6-methano-6H, l4H-indolo (3,2,l-ij)oxepino(2,3,4-de) pyrrolo(2,3- h)quinolin- 14-one

### Use

Strychnine is a widely used toxicant registered for use in controlling certain rodent and depredating bird species. In the past, strychnine was commonly used for controlling rodents, depredating birds, and mammals such as skunks and coyotes. Above-ground uses were halted by court action in 1988, but it remains registered and used below-ground for control of pocket gophers and, in some states, other species.

### History

Strychnine is one of the alkaloids processed from raw dried ripe seed of Strychnos nux vomica, a small tree native to India, North Australia, Vietnam, and Ceylon. This alkaloid was discovered by Pelletier and Caventon in 1817. There is 2.0% to 2.7% total alkaloid found in the seeds, which were used to kill dogs, cats, and birds in Europe at least as early as 1640.

### Properties

Strychnine, a white crystalline powder, is available in an alkaloid form; the sulfate form previously used is no longer registered. Strychnine has a bitter taste. It is almost entirely insoluble in water and very stable (unless exposed to heat and light); however, it is subject to acid-salt formation, which renders it water soluble and subject to leaching in acid soils.

### Pharmacology

Strychnine acts the quickest of the commonly used rodenticides. It is not stored in body tissues nor absorbed through normal intact skin. It has a very slight odor, very high toxicity, and acts somewhat variably on target animals. Strychnine enters the blood very rapidly and acts on the central nervous system. The time of action depends on whether the stomach is empty or full and the nature of the food present. Animals with little in their stomachs react more quickly to strychnine than those that have fed recently. Symptoms may appear from 5 to 30 minutes after ingestion.

Intoxicated animals have frequent tetanic convulsions interspersed with quiescent periods. Ultimately these convulsions lead to death through

respiratory failure. Strychnine is not assimilated into tissues or bone; however, residues in the gastrointestinal tract of animals poisoned with lethal doses are known to be potentially hazardous if the gastrointestinal tract is consumed. With its current below-ground application pattern, secondary poisoning is unlikely.

### Toxicity

LD50 values range between a low of O.70, 0.75 and 1.5 mg/kg for coyotes, desert kit foxes, and black-tailed prairie dogs, respectively, and 16.0 mg/kg for chukar partridge and 24.7 mg/kg for ring-necked pheasants. LD50s for mallards, Canada geese, golden eagles, and house sparrows fall within an approximate range of 3.0 to 5.0 mg/kg.

Livestock are about as sensitive to strychnine as rats. Horses, hogs, geese, and ducks show no hesitation in eating strychnine baits. Cattle and sheep are more reluctant to accept baits. Gallinaceous game birds and most domestic poultry, however, are less susceptible to strychnine than most rodents.

### Antidote

The use of general antidotes is feasible and often successful if treatment is initiated soon after exposure. Sodium pentobarbital and sodium amytal both act to reduce the severity of convulsions in humans (see J. Am. Med. Assoc. 100:548-551). Emetics such as 1% to 2% tannic acid are useful but should only be used after the convulsive stage is past. Prompt administration of methocarbamol is useful in treating poisoned dogs. Prognosis: if the patient lives for 24 hours, he or she probably will recover.

## ZINC PHOSPHIDE

### Chemical name

Zinc phosphide

### Use

Zinc phosphide, at concentrations of O.75% to 2.00/o on grain, fruit, or vegetable baits, has been used successfully against such species as meadow mice, ground squirrels, prairie dogs, and Norway rats. In some areas, zinc phosphide baits have been partially or completely rejected by ground squirrels and meadow mice and at times control has been erratic.

### History

Zinc phosphide appears to have been first synthesized by Marggral in 1740 and was first used as a rodenticide by the Italians in 1911. Extensive use of zinc phosphide in the United States did not occur until 1942, when the availability of strychnine became uncertain due to the war.

### Properties

Zinc phosphide is a heavy, finely ground gray-black powder that is practically insoluble in water and alcohol. When exposed to moisture, it decomposes slowly and releases phosphine gas ($PH_3$). Phosphine, which is highly flammable, may be generated rapidly if the material comes in contact with diluted acids. Zinc phosphide concentrate is a stable material when kept dry and hermetically sealed.

Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic-like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. For many uses of zinc phosphide formulated on grain or grain-based baits, prebaiting is recommended or necessary for achieving good bait acceptance.

In general, zinc phosphide is less toxic than Compound 1080 or strychnine and is slower-acting than either of these compounds.

There is only a small amount of deterioration of zinc phosphide on baits due to the evolution of phosphine gas; dry baits must be considered to be toxic indefinitely and must be used accordingly. Lecithin-mineral oil, added to zinc phosphide to adhere it to grain bait, offers protection against moisture, and may increase its stability. Under field conditions, zinc phosphide baits may remain toxic for several months until baits are eroded by weathering, the carrier decomposes, or the grain is removed by insects. Physical erosion does not seem to occur rapidly. In one instance, zinc phosphide-treated bait exposed in the field for 2 to 3 months and subject to 10 to 12 inches (25 to 30 cm) of rain continued to maintain some toxicity.

When zinc phosphide is dusted onto wet baits, such as meats or cubed fresh fruits and vegetables, it breaks down within a few days and the baits soon lose their attractiveness.

In soil, zinc phosphide breaks down rapidly to phosphine, which is either released into the atmosphere or converted to phosphates and zinc complexes.

Translocation of phosphine gas has been demonstrated, but it is rapidly converted to harmless phosphates. There is no evidence that hazards exist via this route when grain baits are used in growing vegetables.

### Pharmacology

When zinc phosphide comes into contact with dilute acids in the stomach, phosphine ($PH_3$) is released. It is this substance that probably causes death. Animals that ingest lethal amounts of bait usually succumb overnight with terminal symptoms of convulsions, paralysis, coma, and death from asphyxia. If death is prolonged for several days, intoxication occurs that is similar to intoxication with yellow phosphorous, in which the liver is heavily damaged. The surface of the liver will be spotted and discolored. Prolonged exposure to phosphine can produce chronic phosphorous poisoning.

Early symptoms of zinc phosphide poisoning are nausea, vomiting (yielding black stomach contents and the smell of phosphine), abdominal pain, chest tightness, excitement, and a feeling of coldness. In fatal cases, there is liver, kidney, and heart damage. The time between ingestion and death is frequently about 30 hours. Victims who are alive after 3 days are said to recover completely. Mild poisoning from breathing minute amounts of phosphine gas can be mistaken for food poisoning because of the diarrhea and stomach pains produced.

Zinc phosphide-poisoned rats show no signs of distress until a short terminal death agony occurs. They typically die in a prone position with their legs and tails outstretched.

Because zinc phosphide is not stored in muscle or other tissues of poisoned animals, there is no secondary poisoning with this rodenticide. The bait, however, remains toxic up to several days in the gut of a dead rodent. Other animals can be poisoned if they eat enough of the gut contents of rodents recently killed with zinc phosphide.

### Toxicity

Zinc phosphide is poisonous to some degree to all animals. Supposed safety factors such as the odor and dark color may be of little deterrence in situations. As little as a teaspoonful of bait containing zinc phosphide could cause toxic symptoms in a child to whom the color and odor may not be disagreeable. Around dwellings, bait should be exposed only in situations that will

prevent pets and children from coming into contact with it.

Use extreme care in handling zinc phosphide concentrate and treated bait. If zinc phosphide baits are prepared in the open air, phosphide generated from the moist bait offers little hazard. When quantities of bait are prepared within a bait mixing plant, safeguards against continued exposure to low concentrations of phosphide must be taken. Zinc phosphide dust created by the preparation or handling of baits is also hazardous. Personnel working indoors should wear appropriate respirators and work under exhaust fans. Zinc phosphide baits should not be mixed or distributed with the bare hands. Oils, liquid or semisolid, are used in some preparations. Because phosphorous is soluble in certain fatty oils, it may be absorbed in small amounts through the skin. Continued exposure to phosphorous absorption may result in toxic manifestations at some later time. Rubber or synthetic gloves are preferable when handling dry zinc phosphide bait formulations but cotton or leather gloves are acceptable.

Zinc phosphide can be used for rat control on almost any food product; however, it (or any other acute toxicant) should not be used on bait materials recognizable as food in the home environment. Do not use on such foods as tomatoes, apples, oranges, or bread, unless they are made unrecognizable by rolling or cubing them.

# Appendix C: Definitions

**Acceptance**: Refers to the palatability of baits and toxicants.

**Acclimation**: Process of adaptation by an individual organism to a new situation.

**Acute Rodenticide**: A chemical that only requires a single dose to kill the target animal.

**Adaptation**: The fitness of an organism within its genetic structure for its environment, or the process (acclimation) by which it becomes fit.

**Adult**: Sexually mature; an animal that has or is capable of contributing new individuals to a population.

**Age Composition**: The arrangement of age classes in a population, which describes the relative strengths of the age classes. Synonym, age structure.

**Aggressive Behavior**: Includes both combat and aggressive display to drive the stimulus object away or otherwise modify it by intimidating, injuring, or even killing it.

**Agonistic Behavior**: Aggressive behavior associated with conflict or fighting between two individuals.

**Animal Unit**: A measure for converting types of animals to the forage resources, based on the equivalent of the forage required by a mature cow of about 1,000 pounds.

**Anticoagulants**: Compounds that reduce the clotting ability of blood. Vitamin K is usually an antidote for anticoagulant poisoning.

**Avicides**: Usually a lethal agent used to destroy birds, but also refers to other materials or means of repelling or mitigating birds.

**Bait Extender**: An edible or non-edible material added to increase the bait's bulk to dilute the concentration, or make the bait easier to handle.

**Balance of Nature**: The relationship of the population densities of the diverse species of organisms that make up an ecologic community.

**Biological Control of Vertebrates**: An attempt to reduce the population density of a pest species (i.e., increase mortality, reduce natality, or cause a significant emigration), either by increasing predation, manipulating the conditions of the habitat, introducing or stimulating epizootics (diseases), or by the application of antifertility agents.

**Bait Shyness**: A learned aversion to both toxicant and food items of a toxic bait.

**Buffer Crops**: Crops deliberately planted to take the feeding pressure of vertebrate pests off more valuable crops.

**Buffer Species**: An animal species constituting food for predators to the benefit of game or domestic stock; a comparatively undesirable animal species that lessens or neutralizes the effects of predators on a desirable species.

**Carnivore**: An animal whose principal diet is meat.

**Carrying Capacity**: The maximum density of a particular species of animal that can be maintained in a given ecosystem on a sustained basis without deteriorating the habitat, i.e., the number of

individuals that a habitat can maintain in a healthy condition.

**Chemical Toxicant**: Any chemical substance, which, when ingested, inhaled, or absorbed, or when applied to, or injected into the body in relatively small amounts, may cause significant bodily malfunction, injury, or death to animals or man by its chemical action.

**Chemosterilant**: A chemical substance that causes sterilization or prevents effective production.

**Chronic Rodenticide**: A chemical that may require more than one dose to kill the target animal. Many of the available anticoagulant rodenticides fall into this category.

**Climax**: A community in a state of relative ecologic equilibrium with its habitat because it is no longer in process of further successional changes. Climatic climax is an equilibrium with the general climate. Edaphic climax is modified by substrate where topography, soil, or water are such that the climatic climax cannot develop.

**Conservation**: The maintenance of a species at a desired level and/or the perpetuation (not preservation per se) and wise use of natural resources and conservative use of non-renewable resources, such as natural gas, oil, and minerals.

**Cumulative Poison**: A chemical that is not excreted from the body and causes damage over a period of time resulting in death.

**Cyclic**: A population with great variation between high and low densities (excluding seasonal fluctuations), that occur with cyclic regularity.

**Deprivation**: Withholding food, water, sexual contact, etc.

**Ecology**: Derived from the Greek oikos, meaning house or place to live. A branch of biology that is concerned with organisms in relation to environment.

**Economic Control**: The reduction or maintenance of a pest density below the economic-injury level, or any attempt to reduce a pest population to the economic threshold.

**Economic Threshold**: The density at which control measures should be determined to provide the necessary time to initiate control to prevent an increasing pest population from reaching the economic-injury level.

**Ecosystem**: It includes an ecological community (of organisms) together with its habitat (climate and physical features of the environment).

**Endangered Species**: A species whose prospects for survival and reproduction are in immediate jeopardy due to loss of habitat, change in habitat, over-exploitation, predation, competition, or disease.

**Endemic**: A disease caused by an indigenous pathogen.

**Environment**: All the organic and inorganic features that surround and affect a particular organism or group of organisms, i.e., both the biotic and physical factors of the habitat.

**Eradicate**: Often used to imply the local extermination of a species (best stated as local eradication).

**Exotic**: An organism that is not native to the region in which it is found.

**Extinction**: The disappearance of a species, due to the remaining individuals of that species being incapable of maintaining a viable population.

**Feral**: An organism that has escaped from cultivation or domestication and is established in a wild state.

**Food Chain**: A sequence of species within a community, each member of which serves a food for the species next higher in the chain.

**Fur Bearer**: Any animal sought for its fur.

**Game Management**: The art of making land produce a sustained crop of wild game for recreational purposes.

**Graminivorous**: An animal that eats grass.

**Habitat**: It is the environmental situation (usually only climate and physical features of the environment) in which or on which any community, species, or individual lives.

**Herbivore**: An animal whose principal diet is plants.

**Home Range**: The area over which an individual animal habitually travels while engaged in its daily activities.

**Immunity**: Following repeated exposures to pesticides, drugs, or pathogens, the organism acquires the ability to resist the agent or infection.

**Indicators**: Indicator species of plants or animals often recur again and again in widely separated ecosystems of similar types and serve as an indicator of certain general characteristics of the environment.

**Integrated Control**: Is a management system which, within the area of associated environments and population dynamics of the pest species, uses all suitable techniques and methods in as compatible a manner as possible to maintain pest populations at levels below those causing economic injury.

**Invasions**: Spread of a species into a community where it was not formerly represented.

**LD50**: the amount of a chemical necessary to kill 50% of a population. Usually expressed in milligrams of toxicant per kilogram of body weight, (mg/kg).

**LD100**: the amount of toxicant needed to kill 100% of a population. Usually expressed in milligrams of toxicant per kilogram of body weight, (mg/kg). LD100 means that a chemical is highly toxic.

**Learning**: The process that produces change in individual behavior as the result of experience.

**Life Cycle**: The stages an organism passes through from the fertilized egg to death.

**Limiting Factors**: Any environmental factor that limits the distribution and/or the size of a population.

**Marginal Habitat**: Where individuals or populations live a tenuous existence and seldom successfully reproduce.

**Multiple Use**: Harmonious use of land for more than one of the following purposes: grazing of livestock, wildlife production, recreation, watershed, and timber production; but not necessarily the combination of uses that will yield the highest economic return or unit output.

**Natality**: Birth rate.

**Natural Control**: The maintenance of a more or less fluctuating population density with certain definable upper and lower limits over a period of time by the combined actions of abiotic and biotic elements of the environment.

**Niche**: The portion of the habitat the species concerned occupies for shelter, for breeding sites, and for other activities; the food that it eats, and all the other features of the ecosystem that it utilizes.

**Non-Cumulative Poison**: A chemical that is excreted from the body over a relatively short period of time.

**Omnivore**: An animal whose principal diet is meat and plants.

**Overpopulation**: A population level that the habitat cannot sustain indefinitely.

**Pesticide**: A substance or mixture of substances intended for destroying, repelling, or mitigating any vertebrate or invertebrate pest or preventing the species from becoming a pest.

**Placebo**: An inactive substance; in a test bait that contains all the same ingredients except the toxic or test material.

**Plague**:

1. A drastic increase in the population and "outbreak" as a plague of mice or locusts.

2. Commonly used in reference to the disease, bubonic plague, caused by Yesinia (Pasteurella pestis).

**Pollution**: Environmental (air, water, land, cities, etc.) contamination.

**Polyandry**: The mating of a single female with several males.

**Polygamy**: The mating of one male with several females.

**Predacide**: Chemical substance used to poison predators.

**Predatory Animal**: Any mammal, bird, or reptile that habitually preys on other animals.

**Primary Poisoning**: Poisoning of the target species by the direct effect of toxicants causing sickness, pathological changes, or death resulting from ingestion or absorption.

**Raptor**: A bird of prey.

**Rodenticide**: A pesticide applied as a bait, dust, or fumigant, to destroy or repel rodents and other animals, such as moles, rabbits, and hares.

**Secondary Poisoning Effect**: The result attributable to a chemical toxicant which, after being ingested, inhaled, or absorbed by or into, or when applied to or injected into a mammal, bird, or reptile, is retained in its tissue, or otherwise retained in such a manner and quantity the tissue itself or retaining part, if thereafter ingested by man or animal, produces the effects of a chemical toxicant.

**Selective Pesticide**: A pesticide which, while killing the pest individuals, spares much or most of the other fauna, including beneficial species, either through differential toxic action or through the manner in which the pesticide is used, (formulation, dosage, timing, etc.).

**Scavenger**: An animal that feeds principally on carrion (dead animals) or garbage.

**Social Behavior**: Activities elicited by other members of the same species, but in some cases of another species, that have some effect on other individuals.

**Species**: A group of interbreeding populations (actually or potentially) reproductively isolated from other such groups.

**Succession**: The replacement of one community by another.

**Synergistic Effects**: Where the degree of control achieved by a combination of methods exceeds the sum of the independent effects of each method.

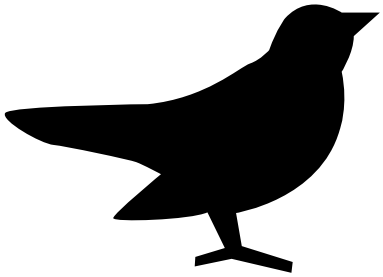
**Territory**: That portion of a home range that is defended against trespass by other members of the same species.

**Tolerance**: An organism's ability to endure a pesticide or drug without ill effect; for example, the state of the innate resistance or acquired immunity.

**Trap Night**: Used to express the ratio of individuals captured, depending on the number of traps and length of time they were set. One trap night equals one trap set for one night.

**Vertebrate Control Objectives**: To accomplish the desired effect with a maximum of safety to man and to forms of life useful or of neutral value to him, and that it be carried out with a minimum of disturbance to the biotic community. It is the alleviation of the problem to a tolerable level, not the destruction of vertebrates.

**Vertebrate Pest**: Any native or introduced, wild, or feral species of vertebrate animal that is currently troublesome locally or over a wide area, to one or more persons, either by being a health hazard, a general nuisance, or by destroying food, fiber, or natural resources. A pest to one person may at the same time have aesthetic or recreational value to others.



**Category 907H**
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