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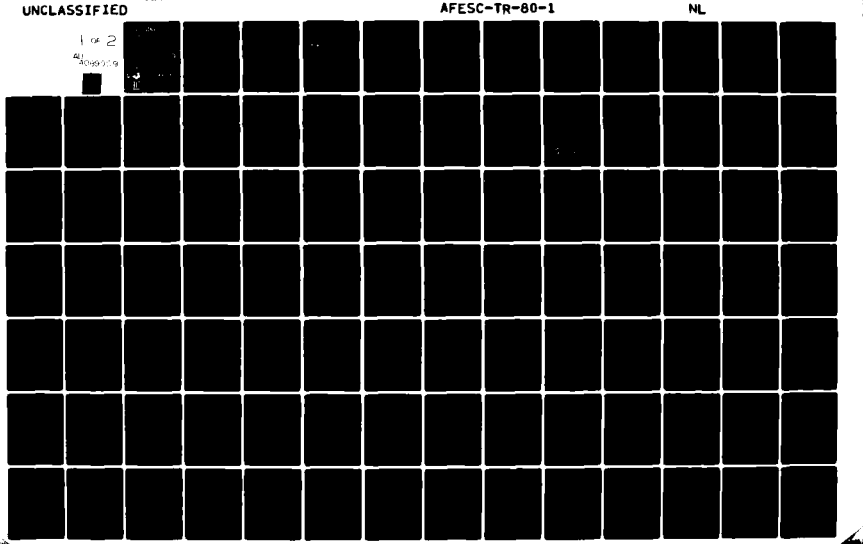

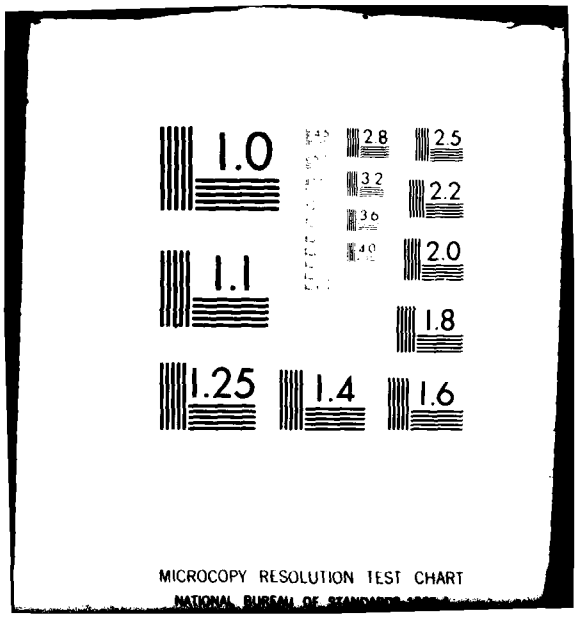
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HANDBOOK ON BIRD MANAGEMENT AND CONTROL

VINCENT J. LUCID
ROY S. SLACK
TERRESTRIAL ENVIRONMENTAL SPECIALIST INC.
PHOENIX, NEW YORK 13135

MARCH 1980

FINAL REPORT
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This handbook was prepared to provide detailed information to Air Force pest managers on hazardous and pest bird control. It discusses bird control in hangars, on airfields, and at other base locations. A systematic approach for surveying and determining control methods for bird problems is provided, and legal aspects of bird control are discussed. Chapters two (2) through eight (8) have review questions to help the pest manager evaluate his proficiency in each subject area.

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A slide/tape presentation was prepared corresponding with information in this handbook. Copies are available for loan from Major Command Entomologists and the Air Force Engineering and Services Center.

PREFACE

This report was performed under Program Element 91212F, AFESC JON DEVN008. This report was reviewed by the Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This report has been reviewed and is approved.

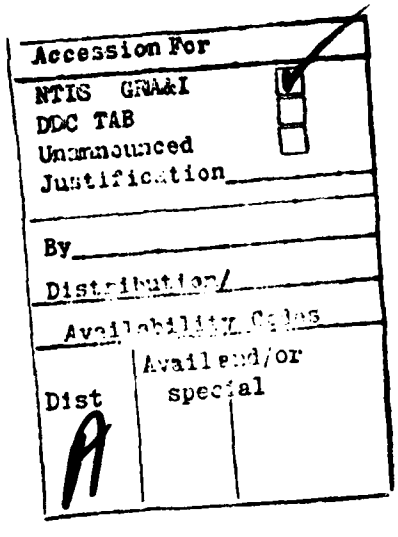
Jeffrey J Short

JEFFREY J. SHORT, Captain, USAF
BASH Reduction Team Leader

William M. Kornman

WILLIAM M. KORNMAN
Chief, Natural Resources Division

BOYD T. BOFFIE, III, Lt Colonel, USAF
Director of Environmental Planning



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CHAPTER ONE OVERVIEW

Chapter One introduces the Pest Manager (PM) to problems between man and birds, types of damage caused by birds, and general terms applicable to the PM.

Chapter Objective:

1. Identify and explain general terms used in bird management.

Key Words and Terms:

Pest birds

Bird damage

Bird management

Bird damage control

Bird/aircraft strike hazard

CHAPTER 1. INTRODUCTION TO BIRD MANAGEMENT AND CONTROL

1.1. INTRODUCTION

Each year the U. S. Air Force loses millions of dollars and hundreds of work-hours in maintenance time because of damage to aircraft and equipment caused by birds. These losses result from bird strikes to aircraft and from bird droppings and nesting materials in and around air base structures and equipment. The seriousness of this problem and the potential health hazards caused by birds in certain situations require pest bird management procedures for each airdrome environment.

In early 1969 the Air Force began a research and development program to reduce the bird and aircraft strike hazard. In 1975, emphasis changed to field assistance and practical application of bird control methods. This program has been aimed at increasing flight safety and reducing the repair costs caused by birds. The Air Force Bird/Aircraft Strike Hazard (BASH) Team of the Air Force Engineering and Services Center (formerly the Air Force Civil Engineering Center) has analyzed the pest bird problem at a number of air bases and has made considerable progress in reducing the bird strike hazard. It has become apparent, however, that regular control of pest bird problems by base personnel could prevent many bird problems from developing into emergency situations.

Bird control in the airdrome environment can be a complex problem. However, simple procedures often can be started and continued on a regular basis to greatly reduce pest bird problems. This manual provides background information needed by a base Pest Manager (PM) to contain or eliminate real or potential pest bird problems. Each PM should read the entire manual to understand basic principles of bird biology, as they affect bird control and to choose the most appropriate control technique for the situation at hand (Chapter 5).

1.2. MAN AND BIRDS

People have always been fascinated with birds, particularly with their ability to fly. This fascination did not lead to an understanding of birds and their importance until recent times. Even when birds were recognized as an important food source, we hunted some species so extensively that we contributed to their elimination. Our failure to understand the role that birds play in nature has also destroyed their habitat and damaged the environment to the extent that some species have been totally eradicated, while others are near extinction. At the same time, some species have either benefited from habitat changes or have adapted to living near humans. Many of these species multiplied, and some that were formerly limited in their range are now found nearly worldwide.

As the importance of birds became apparent and we began to understand our impact upon birds and their populations, the protection and management of birds gained new emphasis. Laws, treaties and regulations were established to protect birds and to ensure that they would be maintained as important natural resources. At first these laws concerned only game species, but now almost all of the birds in North America are protected by a number of laws, treaties, and regulations (Chapter 7). The PM must be aware of the legal protection that has been given to birds. Any bird control program must comply with applicable regulations and should be coordinated with the appropriate local, state, and federal wildlife authorities.

1.3. DEFINITIONS

1.3.1. INTRODUCTION

Effective bird management requires an understanding of some basic terms and concepts. Several of the more important concepts are defined in this section. Additional definitions are in the glossary (Appendix A).

1.3.2. PEST BIRD

Bird species cannot be categorized as good or bad. A given bird may be beneficial or injurious to man's interests depending upon its activities at a specific time and place. The term "pest bird" refers to an individual, flock, or population causing economic damage or creating a health or safety hazard by its activities at a given time and place. Certain species may become involved in hazardous or damaging situations more frequently than others because of their behavior patterns or habitat requirements.

1.3.3. BIRD DAMAGE

Bird damage results when material or equipment is damaged as a result of bird activities. This is an economic problem that costs money and work-hours to repair or replace Air Force property. There is a distinct difference between a bird nuisance and bird damage. For example, a few noisy house sparrows around an office building may appear to be a problem, but may only be an annoyance to workers. Bird damage occurs when the sparrows build nests in the building, leaving corrosive droppings or holes in screening. (Thus, the determination of economic damage should be made before beginning any pest bird control program.)

1.3.4. BIRD HAZARD

A bird hazard exists when birds represent a potential threat to health or safety. The PM is even more concerned about

bird hazards than bird damage. In and near an airdrome the bird/aircraft strike hazard is frequently serious, and reducing this hazard becomes the most important task of the PM.

1.3.5. BIRD MANAGEMENT

Bird management depends upon changing the characteristics and interactions of birds, habitat, and man to achieve human goals. It refers to everything man does deliberately to affect birds, whether to encourage or discourage them from a given area, or to increase or decrease their populations.

1.3.6. BIRD DAMAGE CONTROL

Bird damage control seeks to reduce the potential for damage caused by birds. Bird hazard control attempts to reduce the health or safety hazard potential. The term "bird control" sometimes includes the control of both damage and hazards. The objective, however, is to reduce the damage and the hazards that birds can cause, rather than to control the birds. This can be done in several ways including, but not limited to, direct control procedures.

1.4. BIRD HAZARDS TO AIRCRAFT

Birds can be hazardous to aircraft in several ways. The effects of nesting materials and bird droppings upon the performance of engines or other aircraft parts can threaten aircraft operation. Aircraft collisions with birds are the most serious problem. Bird strikes (contact between a bird and a moving aircraft) cause losses of lives and equipment, with even minor bird strikes resulting in thousands of dollars in annual repair costs. Bird strike hazards can also interrupt base missions.

Bird/aircraft strike problems can occur during the take-off, enroute or landing phases of flight and are particularly hazardous during the low-level phase. The hazards during take-off and landing are the main concern of the PM. Therefore, control of bird activity on or near the airfield is his or her responsibility.

The magnitude of bird/aircraft strike hazards and the resultant losses are discussed in Chapter 4. This will help in more fully understanding the importance of bird management and control in the airdrome environment.

CHAPTER TWO OVERVIEW

Chapter Two provides information on bird biology and behavior. Various characteristics of different bird species are given.

Chapter Objectives:

1. Recognize environmental factors affecting bird territoriality.

2. Identify bird habits which cause conflicts with man.

3. Identify migratory routes and flocking characteristics of migratory birds.

4. Identify feeding habits of various bird species.

Key Words and Terms:

Bird habitat	Migration
Territoriality	Flocking
Nesting	Roosting
Vocalizations	Feeding
Distress/alarm calls	Habituation
Auditory repulsion	

CHAPTER 2. BIRD BIOLOGY AND BEHAVIOR

2.1. INTRODUCTION

Feathers are the characteristic that sets birds apart from all other animals. Different species of birds, however, vary greatly in size, shape, color and behavior. Although other animals such as bats and insects can fly, flight is strongly associated with birds. Some birds, like the Ostrich and the penguins, do not fly, but most birds throughout the world are excellent fliers. This often affects our ability to control pest birds. Birds also have many behavioral characteristics that make their control very different from controlling other pest animals. This chapter will discuss the behavioral characteristics and patterns that are important to the PM.

2.2. BIRD HABITAT

Each bird species has habitat requirements which determine where the bird will nest, roost, feed, etc. Pest bird problems often result from environmental situations which produce attractive habitat for large bird populations of a single species (e.g., a building with abundant roosting area for pigeons), or habitat that attracts large bird populations of different species (e.g., carelessly harvested grain crops attracting large flocks of blackbirds and Starlings). Marshes, pine plantations, grasslands, and wooded areas are examples of natural habitats. Buildings with accessible girders, short grass on an airfield and ornamental trees planted close together are examples of man-made habitats. The PM must learn to recognize these conditions. The advice of local wildlife authorities or state and federal agencies can often be helpful in assessing these situations.

2.3. TERRITORIALITY

Most birds defend an area against other individuals of their species or other species during some season of the year. Usually males defend a breeding territory during the nesting season. The area may vary from several square miles for large birds of prey to a few square feet for colonial nesting birds such as gulls or terns. The breeding territory may guarantee essential cover, nesting materials, and food supplies. It also limits the number of birds that will nest in a given area and reduces interference among birds during the nesting season. Territorial behavior can be a problem for the PM because this behavior disperses birds during the breeding season, thus affecting control techniques. Birds are also difficult to chase away from their nesting territory, thus reducing the effectiveness of repulsion techniques.

Some species also defend territories for feeding, roosting, and winter life. Blackbirds with a spring breeding territory of

several hundred square feet may defend a winter roosting territory of just several square inches in a large communal roost. This tendency to form large winter flocks instead of maintaining the more spread-out territories of the breeding season causes some species to become a pest problem.

2.4 NESTING

Each bird has requirements that determine where it will nest. Some species have flexible nesting requirements while other species require much more specific types of nesting habitat. For example, well-known birds such as the House Sparrow, Domestic Pigeon, and Starling build nests of twigs, grasses, and other materials in a wide variety of places. The exact materials used in nest construction can vary widely. These birds often nest inside buildings and under eaves. Starlings and House Sparrows nest within crevices on signs, outdoor lights, or other man-made structures. In the airdrome environment the PM should be particularly aware of House Sparrows and Starlings. Their habit of nesting in crevices or small enclosed areas can present particular problems. They may enter empty fuel cells when aircraft panels are removed for maintenance and will often nest within aircraft engines, air conditioning duct inlets, and landing gear wheel wells. These birds can build a nest in only a day or two and deposit substantial amounts of nesting material in a matter of hours. Starlings and House Sparrows also nest in building structures and equipment. Fires have resulted from nests in hangar heaters, and large electrical transformers have failed because bird nests have blocked off cooling airflow, causing the transformers to overheat. Nesting materials can thus result in operational failure of aircraft or other equipment.

Other species with more restrictive requirements are often not as widely distributed as the Starling, Domestic Pigeon, and House Sparrow. Some of these birds may require a particular type of tree or other structure for nesting or a particular substance to build their nest. Generally, birds with more restrictive nesting requirements are more narrowly distributed or less abundant. A knowledge of the general nesting requirements of potential pest species is valuable to the PM. For example, birds that nest in tall grass, such as meadowlarks and pheasants, may be problems on airfields. One source of such information is A Field Guide to Birds' Nests (Houghton Mifflin Co., Boston, 1975). If nesting birds create a pest problem, the solution may be to eliminate or alter the nesting habitat.

2.5. BIRD VOCALIZATIONS

2.5.1. SONGS AND DISPLAYS

Bird songs serve several purposes. During the nesting season, males sing to attract a mate and to announce to other

males that a territory has been established. Bird songs vary from elaborate vocal displays with musical quality to simple whistles or single notes. Other sounds made by birds are generally referred to as calls or call notes. Males may also sing or use other vocalizations to announce winter territories. A bird species can often be identified by the recognition of its song or call notes.

Some species have other ways to attract a mate or announce that they are defending a territory. Loud hammering by woodpeckers on objects such as tin roofs, aluminum downspouts, or wood siding is a courtship display that can be a nuisance or cause economic damage. Woodpeckers hammering and probing while feeding can also cause problems. Ruffed Grouse and Greater Prairie Chickens create drumming noises with their wings or air sacs along the neck. Often such displays, as well as bird songs, are given from specific areas, that is, drumming or booming grounds or song perches. The removal of song perches, the elimination or modification of the objects used by woodpeckers, or the establishment of alternative drumming or booming grounds may provide better solutions than attempting to totally repel a pest bird from an area.

2.5.2. DISTRESS AND ALARM CALLS

Two vocalizations particularly important to the PM are distress calls and alarm calls made by many species such as gulls, blackbirds, and Starlings. Birds emit distress calls when harmed or frightened. This call would be given if a bird were captured by a predator. Alarm calls are produced by birds upon sighting a predator or otherwise becoming alarmed. These calls alert other birds to a source of danger. Chapter 5 discusses how these calls can be used to control pest birds.

2.6. MIGRATION

Migration is the movement of birds between breeding and wintering grounds. Each fall, birds move to their wintering grounds and return in spring to the breeding grounds. Migration can vary from movements from a mountainous area down into a valley to movements of thousands of miles. Many common birds that nest in the northern United States and Canada migrate to the southern United States, Mexico, or Central and South America to spend the winter. The greatest number of birds leave the breeding grounds during September and October and return during April and May.

Many factors influence the pathways that birds take during migration. While birds undoubtedly pass over almost every portion of the United States, large numbers of migrant birds pass through specific areas called flyways. Because migration is influenced by weather, terrain, large water bodies, and other factors, cer-

Figure 1. The Atlantic Flyway.

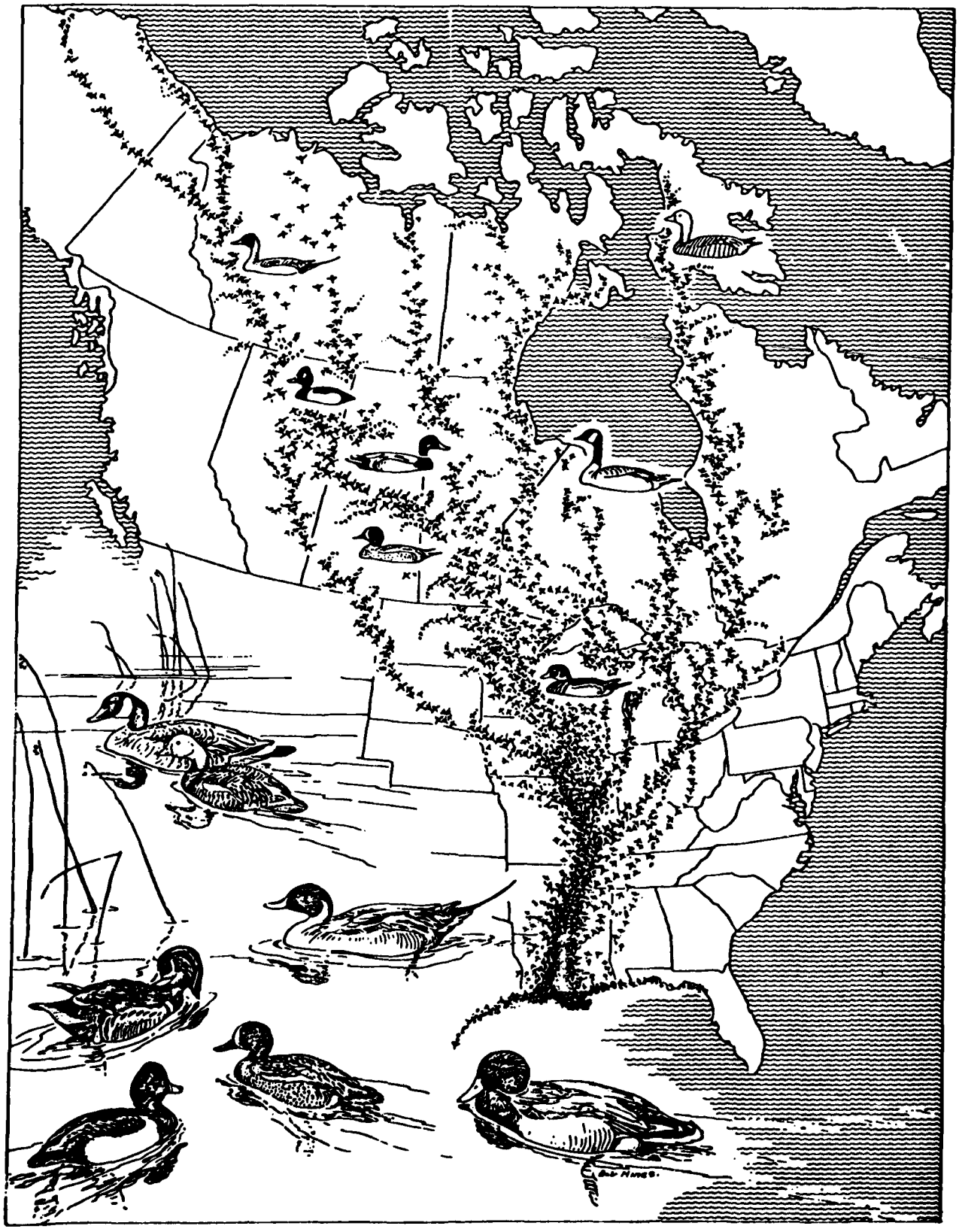

Figure 2. The Mississippi Flyway.

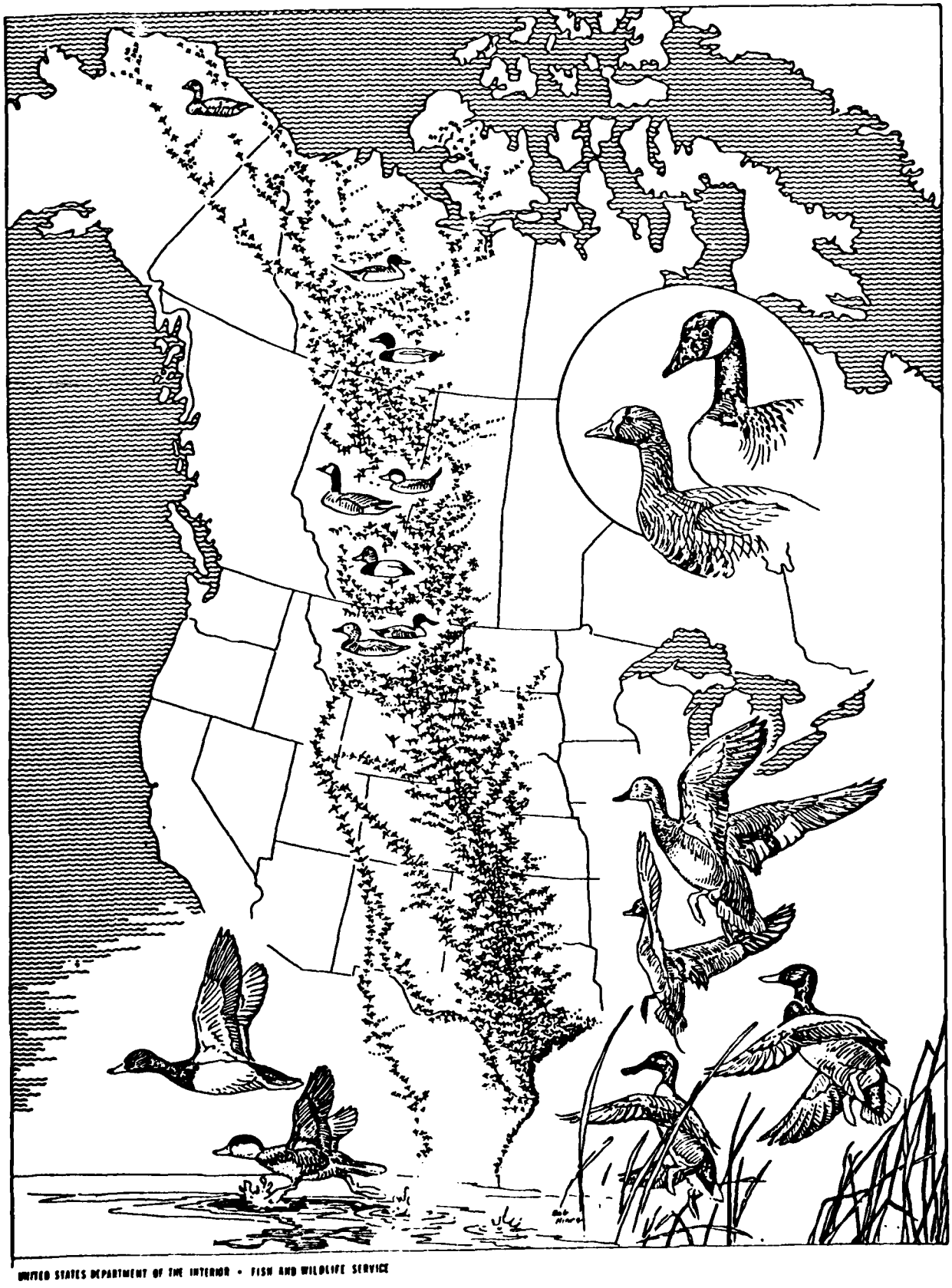

Figure 3. The Central Flyway.

Figure 4. The Pacific Flyway.

tain flyways are heavily used, particularly in the fall migration. Both the Atlantic and Pacific coastlines are major flyways with large numbers of birds following these coastlines during their southern movements. Two other major flyways exist. The Mississippi Flyway follows the Mississippi River, and many birds from the Great Lakes area and the interior of Canada follow this one. The Central Flyway generally follows the prairies which slope gently eastward from the Rocky Mountains. Many birds from the western interior portions of the United States and Canada follow this flyway. Figures 1 through 4 show how these flyways are situated and how birds are funneled into these flyways.

Bird migration is particularly important to the PM. A general knowledge of the routes and duration of migration may be important in the assessment of a pest bird control problem. The PM may have to determine if a problem is short-term such as might be caused by birds passing through on migration. These birds could be gone before a control procedure is initiated.

2.7. FLOCKING

Most species of birds in North America will form flocks at some time during the year. A flock is a group of birds composed of either a number of individuals of a single species or a number of species. The larger flocks are usually found during the non-breeding seasons, particularly fall and winter.

The social or spatial organization of bird flocks varies greatly and can be important to the PM. Some species form highly organized flocks in which the birds act as a unit. In these flocks social interaction is important. These flocks may be organized as compact groups or groups that fly in regular formations, or they may be more loosely organized. Other flocks may simply be aggregations of birds that occupy an area with little social interaction between the members of the flock.

Flocking characteristics will influence the success of some pest control methods described in Chapter 5. A trapping or repelling technique may yield good results with a small flock that is highly organized both spatially and socially because the flock acts as a unit. The same technique may have limited success against very large or loosely organized flocks because it may affect only a small number of individuals. For example, the PM may effectively chase a Starling flock from a building with auditory repulsion techniques such as loud noises and recorded alarm or distress calls since a Starling flock is spatially and socially organized. The flock would be repelled as a unit. However, the same technique may not work as well for pigeons or House Sparrows because the flocking tendency is not as strong for these species. Pigeons are also strongly territorial, which further reduces the effectiveness of auditory repulsion tech-

niques on this species. In general, auditory repulsion techniques are not recommended for pigeons and House Sparrows; even if all individuals are repelled, they will likely return singly to re-form the flock.

2.8. ROOSTING

A roost is where birds congregate at night, in bad weather, or other times when they are not feeding. The PM will usually be concerned with birds that roost in large flocks. Gulls that roost on the ground during the day or night can become pest problems as can large flocks of blackbirds, swallows, or other small birds that usually roost in large concentrations during the night. The areas where birds such as gulls, ducks, and geese roost during daylight hours when they are inactive are called loafing areas. The type of habitat chosen for roosting depends upon the habitat preference of the birds.

The roost site usually provides protection from weather and predators. Plantings, such as ornamental evergreens around buildings, often provide shelters and become roosting sites. Short grass on the airfield offers the birds protection from predators by allowing an unobstructed field of vision. Such situations can often be controlled with appropriate grounds maintenance procedures. Even if the roosting site is some distance away from potential bird strike hazards, the pathway birds use to enter or leave the roost may create a problem. In such a case, reducing the attractiveness of the roost site is more effective than trying to alter the routes that birds use to enter or leave the roost.

Species that typically roost on or in man-made structures are of particular concern. Domestic Pigeons, Starlings, and House Sparrows find suitable roosting areas on ledges, rafters, and other structures that give them protection from harsh weather and predators. The latter two species will also roost or nest in enclosures of aircraft. Whenever possible the PM should reduce the attractiveness of such roosting areas to these birds.

2.9. FEEDING

If a food source is directly related to bird control problems, control of the food source may be easier and more effective than direct control of the birds. A source of information that may be helpful is American Wildlife and Plants: A Guide to Wildlife Food Habits (Dover Publications, New York, 1961).

Food and feeding habits of birds vary with species, season, and availability of particular food items. Several terms describe birds according to the type of food that they consume. An insectivorous bird, such as a swallow, feeds primarily upon

insects. Carnivorous birds, such as hawks or owls, are meat-eaters, feeding mainly upon other birds, mammals, reptiles, amphibians or fish. A herbivorous bird, such as a dove, feeds upon plant material. A herbivore that feeds mainly upon seeds and grains is often referred to as granivorous. Many species are omnivorous; that is, they feed on both plant and animal foods. The Common Crow and Starling are good examples of omnivores. Crows consume fruits, grains, insects, young birds or bird eggs, reptiles, frogs, small mammals, carrion and discarded human food. The Starling, which feeds upon insects, fruits, grains, and seeds, is also known for feeding on garbage in and around towns and cities. Gulls are also a well-known omnivorous species.

Several of these terms may apply to a single species depending upon time of year or food availability. For example, during the nesting season the diet of Red-winged Blackbirds consists largely of insects while during the winter months they are granivorous. If weed seed availability is good, Red-winged Blackbirds consume large quantities of ragweed, bristle-grass, panicgrass, or other seeds during the summer. This feeding habit makes these birds beneficial to farmers during the summer months. In addition to weed seeds, however, they often consume large quantities of corn, oats, wheat, sunflowers, barley, and rice, thus becoming farm pests.

Some species are referred to as scavengers. These birds feed on the remains of plants and animals. Carrion eaters such as vultures are scavengers, as are those omnivores that feed upon dead plants and animals and upon garbage. Gulls and crows associated with garbage dumps and landfills are scavengers and can become serious pests when dumps and landfills are located near airfields.

Feeding flocks or individual birds may pose a bird/aircraft strike hazard. Species that feed on the ground, among vegetation, or on bodies of water may pose a problem as they move to and from a feeding area. Aerial feeders such as swallows can present a pest bird problem when feeding in the airdrome environment. Terns, kingfishers, Ospreys and kestrels can pose a problem because they often hunt their prey by flying or hovering over a feeding area. Knowing the feeding habits of birds may be helpful in determining if a food source is the direct cause of the problem.

The PM must carefully determine if a pest bird species is feeding, since methods used to control feeding flocks may be quite different than those used to control roosting flocks. By direct observation the PM should be able to determine whether a bird or a flock of birds is feeding, roosting, loafing, or nesting.

2.10. LEARNING

2.10.1. INTRODUCTION

Another important concept of bird behavior is the ability of birds to learn. Learning results from experience, practice, trial and error. For example, a bird may learn to find food at a certain location through experience; that is, the bird has found food at that location in the past. Furthermore, through practice or through trial and error, the bird may learn how to remove food from a container at that location. Bird species differ in their ability to learn.

2.10.2. HABITUATION

Habituation is a type of learning defined as the declining response to a simple stimulus because no reward or punishment is associated with the stimulus. Simply, the bird gets so accustomed to a specific condition that it no longer reacts to that condition. A bird initially frightened away by the presence of a human may soon become tame if the presence of the human (the stimulus) does not result in any danger.

Habituation is extremely important to the PM because it can affect many pest control methods. At first, devices used to repel birds with sharp, loud noises are often quite effective. The birds react to the loud noise and are frightened away. After some time, however, the birds' reaction to the noise decreases because they do not associate the noise with any punishment. As discussed in Chapter 5, using repulsion techniques in conjunction with occasional real danger (such as live ammunition) can prevent birds from becoming habituated to a particular technique.

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REVIEW EXERCISE

1. An area that is defended by a bird is referred to as:

   a) cover.

   b) territory.

   c) colony.

   d) habitat.

2. Nesting materials used by birds:

   a) are the same for all species.

   b) vary widely.

   c) consist only of twigs and sticks.

   d) are of no concern to a PM.

3. Which of the following is <u>not</u> a reason for bird vocalization or "noise making"?

   a) to attract a mate

   b) to attract other males of the species

   c) to announce establishment of a winter territory

   d) to announce establishment of a summer territory

4. Two vocalizations that may be particularly important in bird control are:

   a) mating songs and alarm calls.

   b) alarm calls and distress calls.

   c) drumming and alarm calls.

   d) distress calls and mating songs.

5. The major flyways used during migration are:

   a) Atlantic, Central and Pacific.

   b) Atlantic, Rocky Mountain, and Pacific.

   c) Atlantic, Mississippi, Central, and Pacific.

   d) Atlantic, Great Lakes, Central, and Pacific.

6. A group of birds composed of a single species or a number of species is a:

   a) colony.

   b) nesting group.

   c) flock.

   d) non-breeding group.

7. The area where birds roost during daylight hours are called:

   a) roosting areas.

   b) resting sites.

   c) loafing areas.

   d) feeding sites.

8. In which of the following situations would auditory repulsion techniques have the most effect?

   a) repelling House Sparrows from a building

   b) repelling Starlings from a building

   c) repelling House Sparrows and Starlings from a building

   d) repelling Starlings and Domestic Pigeons from a building

9. Which of the following most accurately depicts the feeding habits of the bird species indicated?

   a) Swallows: herbivorous and insectivorous

   b) Starlings: herbivorous and granivorous

   c) Gulls: omnivorous

   d) Hawks: omnivorous

10. Birds that feed upon dead plants and animals are referred to as:

    a) omnivores.

    b) scavengers.

    c) granivores.

    d) herbivorous.

11. Learning is a result of:

    a) trial and error, observation, and practice.

    b) observation, practice, and experience.

    c) practice, experience, and trial and error.

    d) practice, trial and error, and observing.

12. Habituation results in:

    a) birds being frightened by distress calls.

    b) birds reacting to the sight of dead birds by flying away.

    c) birds learning that distress calls or noise makers represent no real danger.

    d) birds learning that a shotgun blast can cause harm.

13. A bird can become tame through the process of:

    a) socialization.

    b) aggregation.

    c) habituation.

    d) acclimatization.

14. Migration is defined as the movement of birds to and from:

    a) breeding and nesting grounds.

    b) breeding and wintering grounds.

    c) nesting and feeding grounds.

    d) winter and summer grounds.

15. The nesting territory of birds:

a) is an area of a few square inches.

b) is defended only against members of other species.

c) may vary in size depending on the species.

d) is the same as the winter roosting territory.

16. The breeding territory of a bird provides:

a) cover.

b) nesting materials.

c) food.

d) all the above.

e) A and B.

17. Vocalizations emitted by birds when being harmed or handled are called:

a) alarm calls.

b) distress calls.

c) drumming.

d) hazard notes.

18. A vocalization produced by birds upon sighting a source of danger is known as:

a) alert call.

b) alarm call.

c) distress call.

d) repulsion call.

19. Large concentrations of birds around an air base in spring or fall:

a) will be a bird strike hazard all year long.

b) may be only a temporary pest problem.

c) are of no concern to the PM due to migration.

d) are nesting and should not be disturbed.

20. Habituation is an important concept to the PM because:

a) it can affect the efficiency of a bird control technique.

b) it is completely different from learning.

c) the PM can never prevent it from occurring.

d) it enhances the learning and instinctive capability of a bird species.

CHAPTER THREE OVERVIEW

Chapter Three introduces the PM to bird identification methods, taxonomy, and identification characteristics of some common pest birds.

Chapter Objectives:

1. Recognize field marks commonly used in making bird identification.

2. Recognize anatomical parts of birds.

3. Match topographical characteristics to a particular bird species.

Key Words and Terms:

Field marks

Bird topography

Bird taxonomy

CHAPTER 3. BIRD IDENTIFICATION

3.1. INTRODUCTION

Proper identification of a bird species or group of birds is important. Without proper identification, the wrong method might be selected in pest bird control. This chapter will help the PM learn how to use field marks and a field guide to correctly identify birds.

3.2. FIELD MARKS

Field marks are the important external characteristics used by the PM to identify birds in the field. This chapter illustrates some of the important external anatomy or topographical features the PM needs to know. These characteristics will be discussed in detail in the following section of this chapter.

The PM should have a pair of field glasses and one of several field guides for bird identification. The most commonly used sources are Birds of North America (Golden Press, New York, 1966) and A Field Guide to the Birds or A Field Guide to Western Birds (Houghton Mifflin, Boston, 1947 and 1961, respectively). Bird identification using these guides requires the user to note field marks of the birds in question. The PM should record such characteristics as the general color pattern, wing markings, facial patterns, breast color and pattern, and tail markings. General body size as well as shape and size of the bill, wings, and tail are important characteristics. Posture, flight patterns, and habitat should also be noted. When recording characteristics such as body size, the PM can describe the size in relation to another more familiar bird (e.g., "crow-sized", "smaller than a robin", etc.)

Since many birds change their plumage pattern from the winter to breeding season, different field marks may be needed to identify a given species at different times of the year. Young and adult birds, and male and female birds of the same species also often have different field marks. The field guides previously listed will help the PM to identify species regardless of time of year, age, or sex.

It may sometimes be sufficient to identify a group of species with similar habits as the cause of a pest bird problem. For example, identifying large mixed flocks of blackbirds which may include Starlings, Cowbirds and blackbirds or identifying mixed flocks of gulls may be ample for the PM's needs. In most cases, however, species identification is preferable, and in many instances it is required.

3.3. TOPOGRAPHY OF A BIRD

3.3.1. INTRODUCTION

The PM must become familiar with terms used to describe the field marks for bird identification. The major terms describing the topography of birds are discussed in this section.

The body of a bird can be divided into logical sections: head, trunk, wings, and tail. Each of these sections has a number of parts with which the PM must be familiar, since these terms are commonly used in field guides.

3.3.2. HEAD

As illustrated in Figure 5, the head of a bird includes the neck, bill, forehead, crown, nape, lores, chin, and throat. The bill or beak is often the most notable structure on a bird. By noting the size and shape of a bird's bill, the PM can learn a great deal about the bird, including the type of food that the bird eats and its mode of feeding.

When the PM uses the mode of feeding to aid in the identification of a bird, bill characteristics will be important. The PM must always observe if the bill is long, short, hooked, curved, wider than it is high, or distinctive in any other way (Figure 6). The shape of the bill indicates whether the bird feeds by: 1) probing, as would be indicated by the tubular bills of sandpipers, 2) tearing, as would be indicated by the hooked bill of a hawk, or 3) seed-eating as would be indicated by the strong conical-shaped bills of many sparrows.

In some birds the upper portion of the bill has a prominent fleshy base. This structure is called the cere and is found on birds such as hawks, pigeons, and doves (Figure 6). The presence of this structure may help to identify bird specimens.

Figure 5 shows how the dorsal (top) portion of the head and neck is divided into the forehead, crown, and nape. The portion of the head between the base of the bill and an imaginary line between the eyes is the forehead. The top of the head to the base of the skull is the crown. The nape or hindneck is the portion of the neck that lies between the crown and the back.

The sides and undersides of the head have four major divisions. The lores are small areas located behind the base of the bill and anterior to (in front of) the eyes. The side of the head from the base of the lower portion of the bill to just behind the eye is the cheek. The chin is the small area that lies between the forks of the base of the lower half of the bill, and the portion of the neck below this area is the throat.

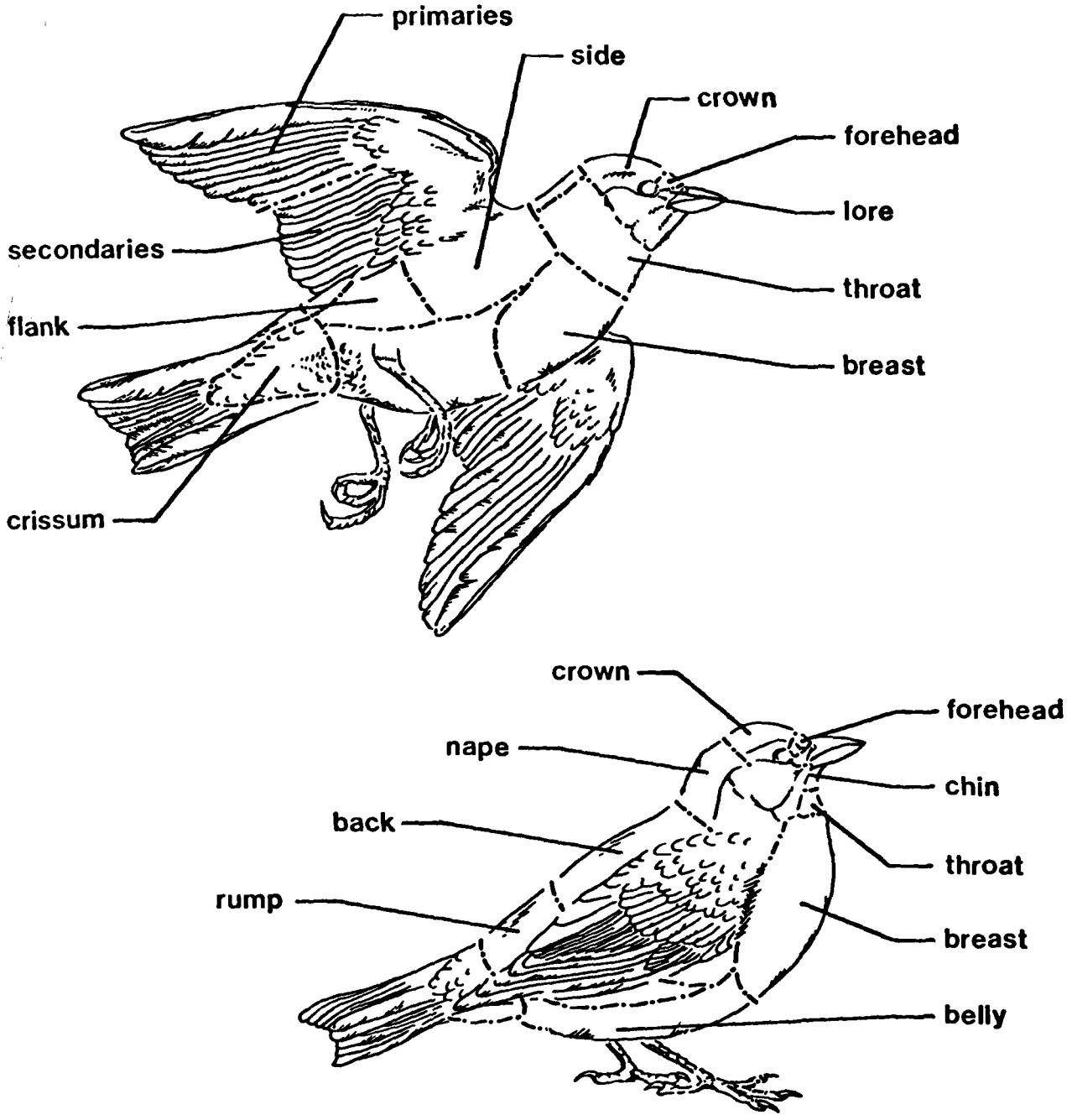

Figure 5. Topography of a bird.

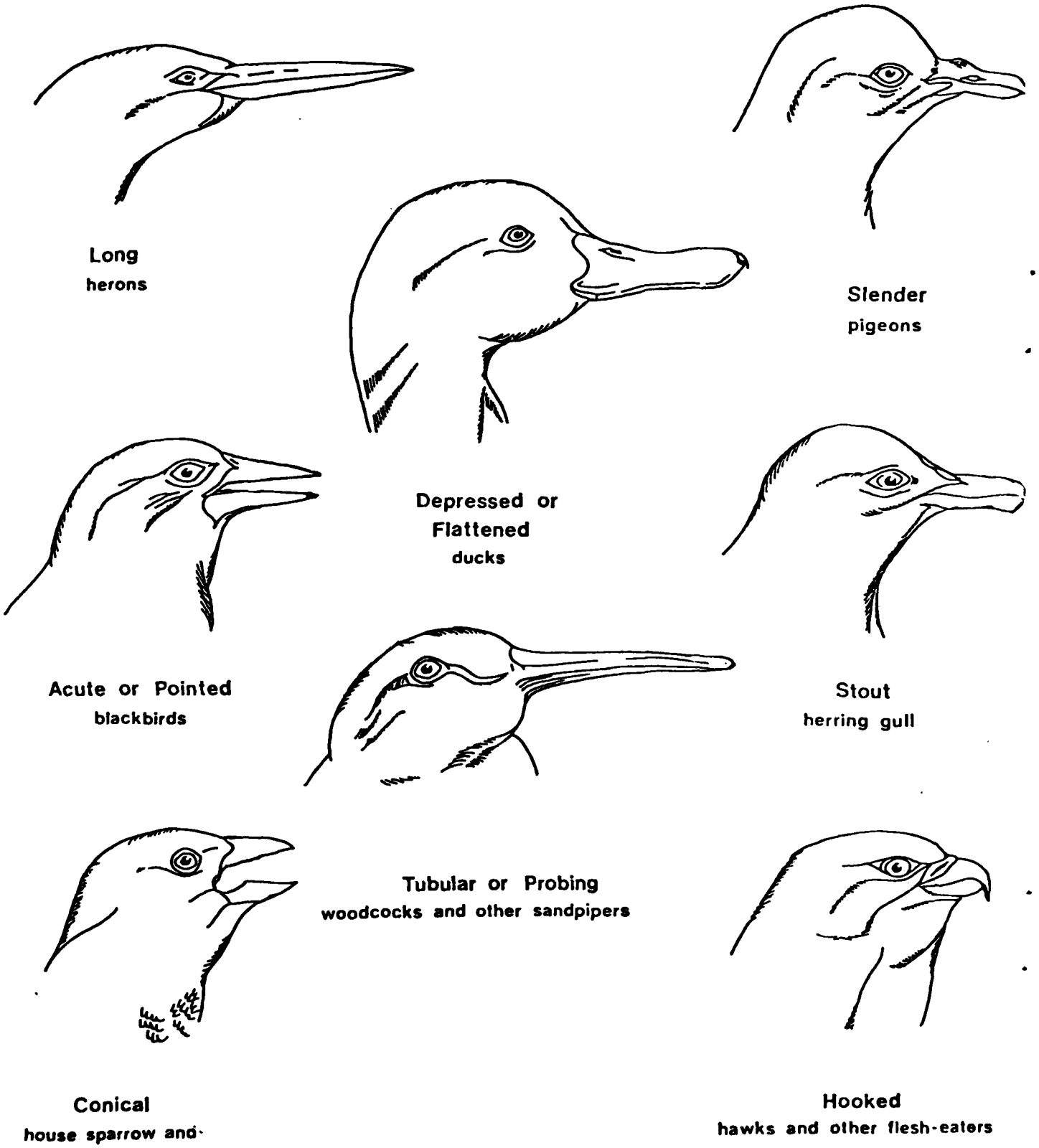

Figure 6. Typical bird bill shapes.

3.3.3. TRUNK

The upper portion of the body or trunk is divided into the back and the rump. The back is the anterior two-thirds of the upper portion of the trunk. The rump is the remaining area extending from the back to the base of the tail.

The under part of the bird's trunk is divided into the breast, abdomen, sides, and flanks. The sides and flanks are the areas just under the wings. The breast is the anterior rounded portion of the underside, while the abdomen or belly is the flatter portion around and between the legs of the bird.

3.3.4. WINGS

Although the wing feathers of a bird are divided into many groups, only a few feather groups or wing areas are used repeatedly in bird identification. These feathers or areas include the primaries, secondaries, speculum, coverts, scapulars, and wing linings. The flight feathers are composed of the primary and secondary feathers. The primary feathers are those longer feathers composing the end of the wing which allow the bird to fly forward. These feathers are attached to the manus (hand) of the bird. The secondary feathers are the inner flight feathers and are mainly responsible for lift, acting with the forward portion of the wing much like an airplane wing. These feathers are attached to the ulna (forearm) of the wing. Often the secondary feathers of birds such as ducks have a color-patterned area known as the speculum.

The majority of the smaller feathers on the wing are known as coverts. Covert feathers overlie the base of the primaries and secondaries and cover the remainder of the wing. The feathers of the shoulder area are covert feathers known as the scapulars.

A few other characteristics of the wing are sometimes used as field marks. The wing lining consists of the covert feathers on the underside of the wing. On the upper surface of the wing, the edges of the scapulars or a row of coverts are often tipped with a color that is different from the surrounding feathers and will appear as wing bars as the bird is sitting. A wing stripe can also be seen in some birds when the bases of the secondary and/or primary feathers are lighter in color than the tips of the feathers.

Noting the shape of a bird's wing can also help identify a species. Figure 7 illustrates typical wing shapes.

3.3.5. TAIL

The tail of a bird consists of the prominent tail feathers and the tail coverts. The large, conspicuous flight

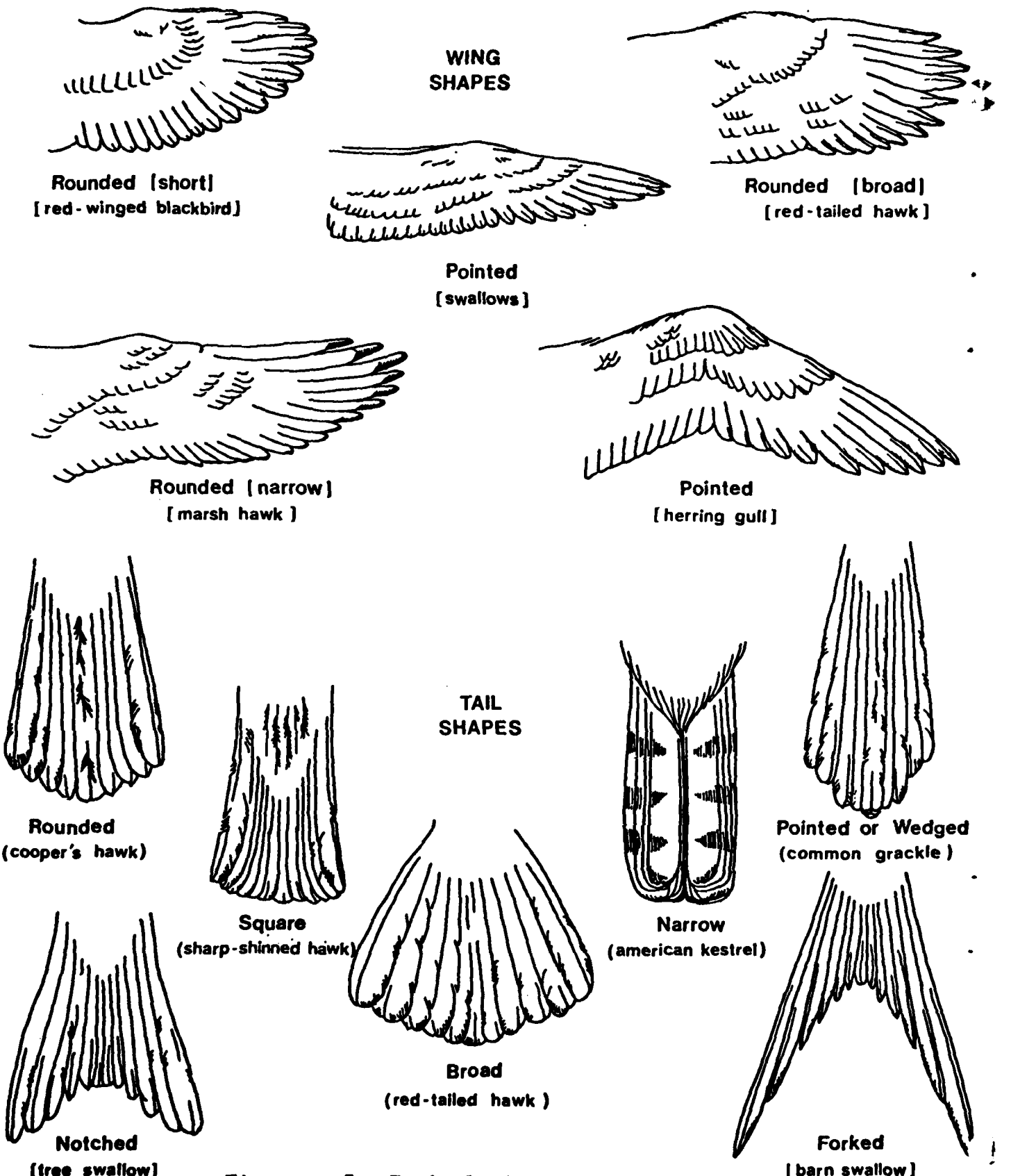

Figure 7. Typical wing and tail shapes.

feathers of the tail are used as a rudder to steer and when spread act as a brake to slow the bird's flight. Tail shapes vary and can be used as identifying characters (Figure 7). Some birds may have colored spots near the tips of the outermost tail feathers, and these tail spots are often used as field marks. The upper-tail coverts lie above the base of the tail feathers and are not easily distinguished from the rump. The under-tail coverts are located at the base of the underside of the tail and are known collectively as the crissum (Figure 5).

3.3.6. LEGS AND FEET

Noting the shape, size and color of birds' legs and feet can be useful in field identification of some larger birds. Although these structures are sometimes difficult to determine as field marks on smaller birds, the legs and feet help identify in-hand birds. Scale and webbing patterns, shape of leg cross-sections, toe placement, and the shape of the nail or claw are all important identifying characters. Often bird remains can be identified using only the foot of the bird.

3.4. TAXONOMY OF BIRDS

The classification of plants, animals and minerals according to their natural relationships is called taxonomy. All living things are classified according to physical characteristics, and each organism is grouped with others that share similar characteristics. The various levels of classification are: kingdom, phylum, class, order, family, genus, and species. Both the Plant Kingdom and the Animal Kingdom include a number of phyla, each of which includes a number of classes, etc. Because all birds have feathers and wings and are warm-blooded, they are grouped into the Class Aves, which is in the Phylum Chordata of the Animal Kingdom.

Each order of birds within the Class Aves contains related families that share important characters (often skeletal or other internal anatomy). The families within each order also contain groups of birds that share some important taxonomic character or a number of characters. For example, ducks, geese, and swans belong to the Family Anatidae. The Family Anatidae is in the Order Anseriformes along with a group of lesser known birds called the screamers (Family Anhimidae) which are only found in South America. The largest order of birds is Passeriformes, which are known as the perching birds or songbirds. This order contains 67 families including most of the commonly known bird families such as blackbirds, crows and jays, Starlings, wood warblers, finches and sparrows.

Families are composed of smaller related groups called genera (singular genus). A genus contains closely related species groups. The genus name is always the first name in a bird's

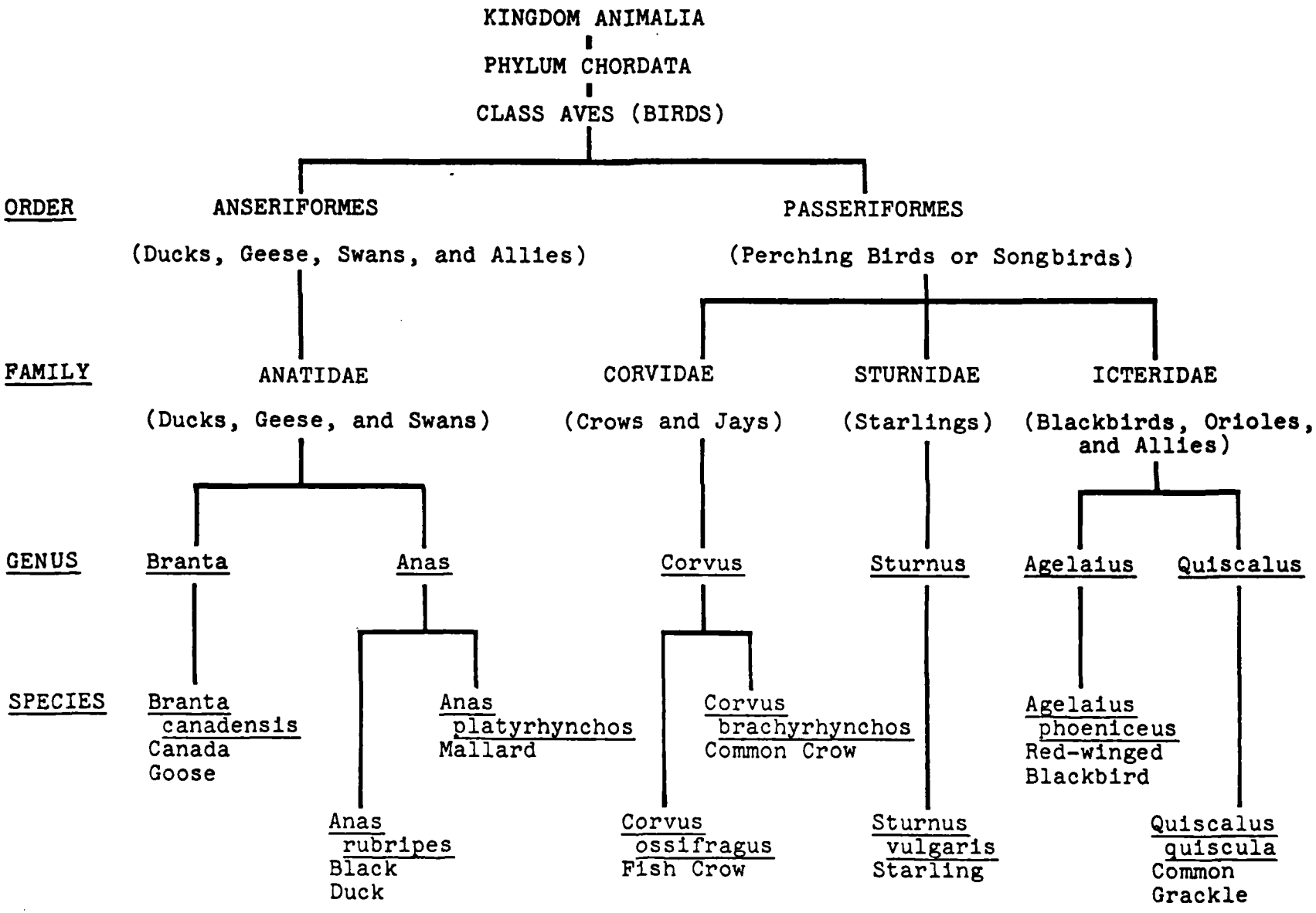

Figure 8. Taxonomic relationships of eight common bird species.

scientific or Latin name. For example, the Common Crow (Corvus brachyrhynchos) and the Fish Crow (Corvus ossifragus) are separate species, both in the Genus Corvus. These two birds are in the Family Corvidae with other birds such as the Blue Jay (Cyanocitta cristata) which is in another genus (Cyanocitta).

Figure 8 illustrates the taxonomic relation of several common birds that belong to two of the 20 orders of birds found in North America. An understanding of the general scheme of taxonomy is important to the PM. Most field guides that the PM might use to identify a bird are organized according to taxonomic relationships. Therefore, closely related birds are grouped together in the field guide, and the orders of birds are usually placed in taxonomic sequence within a field guide. We will find groups such as loons, herons, and ducks near the beginning and the songbirds at the end. A general knowledge of avian taxonomy will aid in the use of any field guide.

3.5. USE OF THE FIELD GUIDE

The effective use of a field guide depends greatly on the PM's familiarity with its organization. Do not wait until the need arises to properly identify a bird or group of birds. The field guide's format, the sequence with which the bird families are presented and some of the major field marks and characteristics associated with these families should be reviewed and understood before application becomes necessary.

The PM should be able to determine the family, or at least the order, to which a bird belongs. This does not require the PM to name the family or order; instead, he/she must be able to locate it within the field guide. Once familiar with the field guide, the PM must practice using it in the field. This is the only way to become proficient in its use.

Once the PM has determined the bird family or order to which an individual bird belongs, he or she can begin to identify the birds in question. A field guide such as Birds of North America (Golden Press, New York, 1966) provides much information, and the user should consider all of the available information. In addition to the field marks prominently displayed in the pictures, range maps, descriptions, habitat preferences and behavioral characters should be noted. Often these observations will be necessary to identify birds, especially when several species have very similar field marks.

3.6. IMPORTANCE OF IDENTIFICATION

Because of differences in habitat requirements and behavior, various groups and species of birds create different types of pest problems. Birds differ in their responses to a given control measure. An effective technique for one species may be

useless, or even illegal, for controlling another. Thus it is extremely important to properly identify the birds causing the problem (the target species) before beginning any management or control measures. Proper identification of non-target species that may be affected is also necessary to evaluate the potential for undesirable consequences of a bird control measure.

3.7. SOME COMMON PEST BIRDS

3.7.1. INTRODUCTION

This section briefly describes some common species and groups that frequently cause damage or hazards. The PM must be familiar with these birds and must become aware of the times of the year they may be found at his or her installation. The PM must consult the field guide for range maps and other information concerning these species.

3.7.2. GULLS

Gulls are a group of large shorebirds with long pointed wings, usually square tails, strong hooked bills, and webbed feet. Many species are similar in appearance, and field identification requires practice. The PM should carefully note field marks such as leg color, color patterns on back, head, and wing tips, and the size of the bird relative to a known species.

3.7.3. DOMESTIC PIGEON OR ROCK DOVE

The Domestic Pigeon is a common bird of towns, cities, farmyards and other areas. The species is not native to North America. Pigeons in North America vary greatly in color and even in size. Various color patterns of gray, black, white and brown are common. Most types are plump birds with pointed wings and a square tail. Additional information on the Domestic Pigeon is presented in Section 8.4.

3.7.4. HOUSE SPARROW

Often called the English Sparrow, this small weaver finch (not a true sparrow) was introduced from Europe into North America. Adult males have a gray crown, black chin and upper throat, light gray lower breast and belly, white cheek, and brown back and wings. Females and immature birds are dull brown with a tan stripe above the eye. This species is strongly associated with buildings and other man-made structures. Section 8.4 contains additional information on the House Sparrow.

3.7.5. STARLING

Another introduced species, the Starling is somewhat similar to the blackbirds with which it often roosts and flocks.

Spring birds have a bright yellow bill and a green and purple iridescence to their dark plumage. In fall the adult plumage becomes spotted with white, and the bill turns dark gray. The short tail and pointed wings are good field marks, especially for the drab, gray, immature birds. Further details on the Starling may be found in Section 8.4.

3.7.6. RED-WINGED BLACKBIRD

The adult male Red-winged Blackbird is readily identified by the bright red covert feathers edged in yellow on a totally black body. Females are brown, heavily streaked and spotted. Immature males are patterned like the female, although a trace of a reddish-orange wing patch is often evident.

3.7.7. COMMON GRACKLE

Two color phases (Purple and Bronzed) of this species of blackbird are often shown in field guides. The long wedge-shaped tail is the best field mark for this black-bodied bird with a purple, green, or bronze iridescence to its plumage. Females are less iridescent than males, and juvenile birds are a uniform dull brown.

3.7.8. OTHER BLACKBIRDS

Several other blackbird species are often found in blackbird flocks or roosts that present a pest situation. The PM should be able to identify the Brown-headed Cowbird, Rusty Blackbird, Brewer's Blackbird, and Yellow-headed Blackbird if they occur near his/her base.

3.7.9. SPARROWS

The term sparrow is applied to a group of small finches, many of which are very similar in appearance. The PM must be particularly aware of the behavioral differences associated with native sparrows and House Sparrows, as the latter are much more common as pests. When identifying native North American sparrows, field marks such as crown color and pattern, presence of eye stripes and wing bars, breast coloration, shape of tail, habitat observed in, and natural range are very helpful.

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REVIEW EXERCISE

1. The top of a bird's head is called the:

   a) nape.

   b) lore.

   c) crown.

   d) skull.

2. Which of the following is <u>not</u> associated with the head of a bird?

   a) lore

   b) crissum

   c) nape

   d) cere

3. Which group of terms identifies bill shapes useful in identifying birds?

   a) probing, insect eating, and seed eating

   b) probing, insecting eating, and tearing

   c) probing, tearing, and seed eating

   d) tearing, seed eating, and insect eating

4. The longer flight feathers composing the end of the wings are the:

   a) primaries.

   b) secondaries.

   c) scapulars.

   d) coverts.

5. The speculum of a duck's wing is part of the:

   a) primary feathers.

   b) tail coverts.

   c) secondary feathers.

   d) scapulars.

6. Birds are identified in the field by observing:

   a) behavior.

   b) field marks.

   c) habitat.

   d) all of the above.

   e) a and c above.

7. Which group of terms refers to color patterns on feathers?

   a) wing stripe

   b) speculum

   c) wing bar

   d) tail spots

   e) all of the above

8. The covert feathers of the shoulder area are called:

   a) scapulars.

   b) primaries.

   c) speculars.

   d) secondaries.

9. The PM should practice identifying birds:

   a) whenever he/she can.

   b) that are most common in the area.

   c) after a strike occurs.

   d) as they feed or loaf.

10. If two birds belong to the same family, they must also belong to the same:

   a) order.

   b) species.

   c) genus.

11. If two birds are in the same genus, they must be in the same:

   a) family and species.

   b) family and order.

   c) species and order.

   d) species and class.

12. If the scientific names of two birds are Parus bicolor and Parus atricapillus, they are in:

   a) different families.

   b) the same genus, different species.

   c) the same species, different genus.

   d) the same species, genus, and family.

13. Which group of leg and foot characteristics help identify a "bird-in-hand"?

   a) scale patterns, webbing patterns, and color patterns

   b) scale patterns, webbing patterns, and claw shapes

   c) color patterns, scale patterns, and claw shapes

   d) color patterns, webbing patterns, and claw shapes

14. Which of the following lists is in the proper taxonomic sequence?

a) class, order, family, genus, species

b) species, family, genus, class, order

c) family, class, order, genus, species

d) class, genus, order, family, species

15. The most numerous order of birds is:

a) Anatiformes - ducks, geese, and swans.

b) Passeriformes - songbirds or perching birds.

c) Falconiformes - buzzards, hawks, eagles.

d) Corvidae - crows, jays.

16-20. Match the description in Column B with the bird in Column A:

Column A	Column B
____16. Rock Dove	a. grey crown, black cheek and upper throat (adult male)
____17. Starlings	b. long, wedge-shaped tail, black body, purple, green, or bronze iridescence to its plumage
____18. House Sparrows	c. vary greatly in color and size; various color patterns of grey, black, white, and bronze are common
____19. Red-winged Blackbirds	d. pointed wings, square tail, and webbed feet
____20. Common Crackle	e. spring birds have a bright yellow bill and a green/purple iridescence

f. females are brown, heavily streaked, and spotted

CHAPTER FOUR OVERVIEW

Chapter Four discusses health, damage, and economic aspects of hazardous and pest birds. Bird-borne diseases, prevention of infection, the bird/aircraft strike problem, and other damaging aspects of birds are discussed.

Chapter Objectives:

1. Identify economic, hazardous, and other aspects of bird problems.

2. Determine conditions conducive to the spread of bird-borne diseases.

3. Associate bird-borne diseases with statements regarding their characteristics.

Key Words and Terms:

Histoplasmosis

Psittacosis

Encephalitis

Building and equipment decontamination

Disinfectant

CHAPTER 4. HEALTH, DAMAGE, AND ECONOMIC ASPECTS

4.1. INTRODUCTION

Birds in the airdrome environment can be a hazard to human health and safety and can result in loss and damage to Air Force property including aircraft. This chapter discusses these aspects and a number of other economic aspects the PM should consider. The PM should realize how routine pest bird control, particularly with Domestic Pigeons, Starlings, and House Sparrows, can reduce most of the hazards mentioned in this chapter.

4.2. HEALTH HAZARDS

4.2.1. INTRODUCTION

Birds can be associated with several diseases. They can transmit disease to humans and animals by becoming a reservoir for disease organisms, by transmitting organisms into the air or through their droppings, or by serving as intermediate hosts for disease organisms. Among the better known diseases are histoplasmosis, psittacosis, and encephalitis, although nearly 100 diseases are alleged to have been transmitted to man by birds.

4.2.2. HISTOPLASMOSIS

Histoplasmosis is caused by a fungus, Histoplasma capsulatum. The disease is worldwide in distribution, but it is more common in certain geographical areas such as the Mississippi River Valley region and other river valleys in the eastern and southeastern United States. The disease is contracted by inhaling the organism which is present in soils. It thrives in soils enriched by bird droppings. Histoplasmosis usually results in benign lesions of the lungs caused by an infection which often shows no symptoms. However, in advanced stages the disease can be fatal. The National Center for Health Statistics recorded nearly 600 deaths from histoplasmosis between 1966 and 1975, an average of 59 deaths per year.

The PM should be aware of the increased potential for the spread of histoplasmosis that exists in certain situations. When species such as Domestic Pigeons, Starlings, and House Sparrows roost near areas where people work, the potential for histoplasmosis increases. The histoplasmosis spores are usually spread when soils enriched by bird droppings are disturbed. For example, construction near active or unused bird roosts can expose workers to the disease. The PM should give special attention to these situations and include control measures in any pest management program.

4.2.3. PSITTACOSIS

Psittacosis, often called ornithosis or parrot fever, is caused by a rickettsial-like organism called a Bedsonia. The name ornithosis was applied after the disease was found in many wild non-psittacine (non-parrot) birds. This disease is distributed throughout the world wherever birds are found. Inhaling dust containing infective particles from bird droppings, feathers, bird bodies, and nasal secretions is a common source of human infection. The Public Health Services reported over 2000 confirmed cases and 111 deaths from psittacosis between 1930 and 1960. The disease is actually more common than these figures indicate because several cases may go unreported.

During recent years, researchers have found that birds such as pigeons often transmit the disease. Pigeons have been responsible for a number of outbreaks of the disease in New York, Massachusetts, Minnesota, and California. The disease has often been traced to pigeons that nest or roost on or in buildings where people work. Wild birds can also spread the organism to commercially raised chickens, ducks, and turkeys which die quickly after showing only brief signs of illness.

4.2.4. ENCEPHALITIS

Encephalitis is one of the more serious diseases associated with birds. A number of encephalitis viruses are carried by birds (the primary hosts) and can be transmitted to people and horses by arthropod vectors, mainly mosquitoes and ticks. The viruses for Western Equine Encephalitis, Eastern Equine Encephalitis, St. Louis Equine Encephalitis, and several other encephalitides have been isolated in birds.

These viruses attack the central nervous system, and the mortality rate during outbreaks is often high. An epidemic of Eastern Equine Encephalitis in Louisiana in 1947 resulted in 90 percent mortality in 14,000 infected horses and killed 9 people. St. Louis Equine Encephalitis is not as deadly as Eastern Equine or Western Equine Encephalitis, but the mortality during outbreaks has been as high as 11 percent. From 1966 to 1975, the National Center for Health Statistics reported about 3,600 deaths from acute encephalitis infections.

Birds host a variety of other diseases that can be transmitted to man. Human infection is usually caused by the transmittal of the disease organism by an arthropod vector or through inhalation or ingestion of contaminated air, water, or food. The potential for such diseases is highest where large numbers of birds congregate, roost or nest.

4.3. GUARDING AGAINST INFECTION

4.3.1. PERSONAL HYGIENE

The PM must guard against personal infection, particularly when handling birds or working in areas where birds have congregated. Gloves must always be worn whenever handling live or dead birds. When working in roosting areas, enclosed areas, or any area where bird droppings are prevalent, the PM should wear rubber boots and gloves. To prevent infection by inhalation in such areas, a protective mask must be worn; disposable masks are recommended. Immediately after the operation, the PM must shower and wash his/her clothes and all equipment in hot water with a strong soap.

4.3.2. DECONTAMINATION OF BUILDINGS AND EQUIPMENT

The removal or exclusion of pest species such as Starlings, pigeons, and House Sparrows from a building area using the methods described in Chapter 5 may eliminate the introduction of new disease organisms into the area. The PM must also eliminate existing potential sources of infection. Wash roosting and nesting sites thoroughly with a detergent disinfectant to eliminate infective agents. Such areas can also be disinfected with a 3 percent Formalin solution, and this is recommended if the presence of histoplasmosis organisms is suspected. Consult the base bioenvironmental engineer to determine if bird-borne diseases are present in bird droppings or in the soil where they are found. He or she can also provide advice on specific disinfectant procedures.

4.3.3. SANITARY DISPOSAL OF BIRDS

If the PM must handle dead birds, strict precautions are needed to preclude the spread of infectious materials. Gloves must always be worn. The feathers of any dead birds should be thoroughly wetted with a detergent disinfectant prior to handling. This step will immobilize lice and mites and help prevent the spread of airborne infective particles. Such specimens must be placed inside plastic bags or other such containers before transport to any other area. Dispose of specimens by incineration.

4.4. BIRD STRIKE DAMAGE IN THE AIR FORCE

4.4.1. INTRODUCTION

Contact between a moving aircraft and a bird is called a bird strike. The first recorded loss of human life caused by a bird strike occurred in 1912. As aircraft speeds increased, bird strikes became a serious problem to the U.S. Air Force. From 1966 to 1976 the number of reported bird strikes ranged from 300 to

400 per year. Bird strikes were only reported when the incident resulted in damage requiring repair to the aircraft before its next flight or when a Safety Officer reported the incident as a significant hazard to the aircraft or crew. At least two-thirds of the bird strikes are probably not reported because they do not meet the above criteria; thus the actual number of USAF bird strikes is probably closer to 1000 per year.

4.4.2. BIRD STRIKE LOSSES

Between 1970 and 1976, the average dollar loss from bird/aircraft collisions was over $10 million per year. The seriousness of the problem is further indicated by the loss of two lives and destruction of ten aircraft as a result of collisions with birds between 1966 and 1976.

A considerable portion of the aircraft loss and damage is caused by birds striking aircraft windscreens or canopies. Such impacts account for more than half of the aircraft that are destroyed by bird strikes and approximately 40 percent of all accidents. The PM should note that about half of all bird strikes, and 42 percent of the bird collisions with aircraft windscreens and canopies, occur during take-off and landing. Appropriate bird control in the airdrome environment can significantly reduce these incidents.

The PM must realize that damage to aircraft is not caused only by large birds. While collisions with birds such as swans, hawks and vultures have caused damage and loss of aircraft, collisions and engine ingestions of much smaller birds such as Starlings and swallows have also resulted in damage and loss of aircraft and lives. Additional information on bird strikes is available from the Directorate of Environmental Planning (DEVN), Air Force Engineering and Services Center, Tyndall AFB, FL 32403.

4.5. OTHER DAMAGE DUE TO BIRDS

While bird strikes account for most of the dollar losses caused by birds, other situations also cause concern. Bird droppings and nesting materials can damage equipment and supplies, particularly around hangars, warehouses, and other buildings. Birds can also damage agricultural crops, trees, and ornamental shrubs. Even small groups of birds can damage shade trees by eating buds during spring.

Inside aircraft hangars, birds enter engine housings and can accumulate a considerable volume of nesting material within a matter of hours. Engines, idle for repair, are prime targets. Nesting material can cause jet engines to fail by clogging intakes, and static and rotating blades can be significantly damaged by nesting material. Such problems are usually associated with House Sparrows and Starlings that enter hangars.

Birds that nest in buildings or on equipment also present fire hazards if their nests are built around or near electrical wiring and switching boxes. Even if nests are not in a situation to cause fires, electrical failures can arise from birds shorting electrical systems or as a result of the corrosive effects of bird droppings on wires or wire insulation.

Bird droppings within buildings are not only unpleasant but can result in substantial economic loss. Bird droppings corrode many metals and can cause serious damage if allowed to fall into dismantled engines or if allowed to build up on other equipment. In warehouses and other storage buildings, bird droppings on supplies often render them unusable or result in costly cleanup.

The PM must consider routine control of pest species, particularly pigeons, Starlings and House Sparrows as necessary to reduce hazards and prevent damage. These species should be eliminated to the greatest extent possible in the airdrome environment. Use the approach described in Chapter 5 and employ regular control methods to prevent their reintroduction.

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REVIEW EXERCISE

Match the following diseases with the statements listed in 1-6:

a) Histoplasmosis

b) Psittacosis

c) Encephalitis

___1. Distribution is very common in river valleys of the southeastern part of the US.

___2. Attacks the central nervous system and has a high mortality rate.

___3. Has been traced to pigeons that occupy or roost on buildings.

___4. Birds are the primary host of this arthropod-borne disease.

___5. This is a fungal disease.

___6. This is found primarily in soil enriched by bird droppings.

7. Both histoplasmosis and psittacosis are commonly contacted by:

a) bites of house flies.

b) bites from any insect vector.

c) inhalation of contaminated dust or particles.

d) wading in contaminated ponds.

8. Almost half of all bird strikes occur during:

a) engine warm-up.

b) take-off and landing.

c) high altitude flight.

d) all the above.

9. About half of the bird strikes that result in aircraft loss:

   a) involve the aircraft wings.

   b) involve loss of rudder control.

   c) involve windscreen or canopy collisions.

   d) are due to poor pilot avoidance.

10. Who should the PM contact for advice on disinfectant procedures for buildings?

   a) Environmental Protection Agency

   b) Occupational Safety and Health Administration

   c) Bioenvironmental Engineer

   d) MAJCOM Pest Management Professional

11. Correct steps for insuring that the PM does not become infected with disease organisms include:

   a) showering immediately following any pest control operation.

   b) washing clothes in strong soap and hot water immediately following any pest control operation.

   c) washing equipment, boots, and rubber gloves in hot, soapy water.

   d) all of the above.

12. Wetting dead birds with a detergent disinfectant before handling:

   a) is intended to rinse off loose feathers.

   b) is not really necessary.

   c) replaces the need for plastic bags or other such containers.

   d) will immobilize lice and mites and prevent the spread of infective, airborne particles.

13. Bird droppings can cause considerable problems because:

a) they can be contaminated with disease organisms.

b) they can be corrosive to metal engine parts.

c) they can foul and ruin supplies.

d) all of the above.

14. Nesting materials can:

a) result in engine failure due to engine ingestion.

b) can represent a fire hazard within buildings.

c) can clog or result in malfunction of necessary equipment.

d) all of the above.

e) A and B above.

CHAPTER FIVE OVERVIEW

Chapter Five discusses management techniques for controlling hazardous and pest birds. Information in previous chapters is applied here to help the PM choose an acceptable, effective bird management technique.

NOTE: The PM is discouraged from turning directly to this chapter to seek a quick "cure-all" for bird management problems. Previous chapters should be thoroughly studied to provide the necessary background for performing bird management functions.

Chapter Objectives:

1. Identify the control categories of bird management functions.

2. Determine when a given control method should be used against a particular bird species.

3. Identify basic facts regarding bird control techniques.

Key Words and Terms:

Altering the concept

Altering the situation

Exclusion

Repulsion

Removal/Reduction

CHAPTER 5. MANAGEMENT TECHNIQUES

5.1 INTRODUCTION TO THE FIVE CATEGORIES OF TECHNIQUES

Damage and hazard control techniques fall into five general categories or approaches. In order of preference, these approaches are:

A. Altering the Concept

B. Altering the Situation

C. Exclusion

D. Repulsion

E. Removal or Reduction

Altering the Concept involves making a complete assessment of the situation at hand and deciding whether active management is required. The birds may merely be a nuisance or a transient problem caused by migration, with no active management program required. The costs of a management program might also exceed those of the damage being caused.

Altering the Situation involves changing the timing or procedure of mission operations to avoid conflicts with birds. Also included in this category is habitat modification. This includes elimination or reduction of bird habitat (food, water, roost or nest sites, perches) near the airfield and is the most permanent solution to many pest bird problems.

Exclusion means preventing birds from gaining physical access to an area where they can create a problem, such as roosting or nesting in buildings. Some exclusion techniques are actually habitat modification when nesting or roosting sites are eliminated. Exclusion is most effective when considered during design and construction of new structures, but techniques are available to exclude birds from existing structures.

Repulsion is simply scaring birds away. Many devices and techniques have been designed to repel birds. Techniques used for birds on airfields are usually visual (sight), tactile (touch) and auditory (hearing). In addition, one chemical is considered a psychological repellent. When using auditory repulsion (the type most commonly used to prevent strike hazards) the keys to success are diversity and intensity.

Removal or Reduction techniques attempt direct population control by capture or killing. As a general rule, this approach is rarely effective. Even if a large proportion of the flock is

removed (a difficult task), other birds will eventually move in to replace them if the original environmental attraction remains. Killing birds is also likely to result in adverse public reaction (Chapter 8). Nevertheless, there are instances when habitat modification, exclusion, or repulsion are not viable approaches, and direct population reduction is appropriate.

For each specific bird problem, the PM should think through these five categories in turn, with an awareness of the variety of techniques available in each category. Each successive approach (A through E) should be rejected only if no acceptable technique, that is likely to be successful, exists within that approach for the specific problem at hand. Table 1 is a guide to the active management techniques that apply to some common damage and hazard situations. Implement the specific management methods by following the procedures outlined in this chapter. With experience, the PM will learn to immediately identify the best techniques for a given problem.

5.2. SPECIFIC TECHNIQUES

5.2.1. ALTERING THE CONCEPT

5.2.1.1. No Problem/No Action

General Description. Suspected bird damage situations should always be carefully evaluated. If no problem is verified, no control actions are required.

Applicability. "No Action" is appropriate if close examination reveals that no economic damage, health hazard, or safety hazard exists (see Chapter 1 for further discussion). For example, someone may report large numbers of birds at a certain locality. If an investigation determines that the presence of birds does not conflict with mission activities, no control action is required. All birds around buildings are not necessarily pests. Furthermore, birds that are considered pests by some people may be considered desirable by others.

Materials and Procedures. No materials are required. Procedures for conducting an evaluation of suspected potential or actual pest situations are discussed in Chapter 6, "Surveying a Bird Management Problem."

Advantages. No time or expense is incurred in efforts to change a situation that does not represent a problem. Birds and habitat will not be needlessly disturbed or destroyed.

Disadvantages. Situations may exist where a problem could develop at a later time when it may be more difficult to control. Th PM may have difficulty convincing others that no

TABLE 1

GUIDE TO ACTIVE* BIRD MANAGEMENT TECHNIQUES

Species	Situation	Potential Control Measures (in the order to be considered	Reference No.
Pigeons	Around buildings	Design and construction	5.2.3.1.
		Screening or netting	5.2.3.2.
		Sharp projections	5.2.3.3.
		Sticky repellents	5.2.5.2.
		Water hoses	5.2.5.3.
		Avitrol	5.2.8.1.
		Pigeon trap	5.2.9.2.
		Shooting	5.2.11.1.
House Sparrows	Around buildings	Design and construction	5.2.3.1.
		Screening and netting	5.2.3.2.
		Sharp projections	5.2.3.3.
		Sticky repellents	5.2.5.2.
		Water hoses	5.2.5.3.
		Avitrol	5.2.8.1.
		Modified Austalian crow trap	5.2.9.3.
		Commercial live trap	5.2.9.1.
		Nest box trap	5.2.9.4.
Starlings	Roosting in or on buildings	Design and construction	5.2.3.1.
		Screening or netting	5.2.3.2.
		Sharp projections	5.2.3.3.
		Sticky repellents	5.2.5.2.
		Distress/alarm calls	5.2.4.1.
		Electronically produced noises	5.2.4.2.
		Bird bombs	5.2.4.3.
Starlings	Nesting around buildings	Design and construction	5.2.3.1.
		Screening or netting	5.2.3.2.
		Sharp projections	5.2.3.3.
		Sticky repellents	5.2.5.2.
		Nest-box trap	5.2.9.4.

*Altering the concept and using advoidance measures, which are not listed, should be considered (if applicable) prior to an active bird management program.

TABLE 1 (Cont.)

GUIDE TO ACTIVE* BIRD MANAGEMENT TECHNIQUES

Species	Situation	Potential Control Measures (in the order to be considered	Reference No.
Starlings	Feeding situations	Elimination of food source	5.2.2.3.
		Distress/alarm calls	5.2.4.1.
		Electronically produced noises	5.2.4.2.
		Airbursts, scare-cartridges, bird bombs	5.2.4.3.
		Automatic exploders	5.2.4.4.
		Rope firecrackers	5.2.4.5.
		Avitrol	5.2.8.1.
		Modified Australian crow trap	5.2.9.3.
		Commercial live traps	5.2.9.1.
		Starlicide	5.2.10.2.
Blackbirds and/or Starlings	Roosting in trees	Elimination of roosting sites	5.2.2.5.
		Distress/alarm calls	5.2.4.1.
		Electronically produced noises	5.2.4.2.
		Airbursts, scare-cartridges, bird bombs	5.2.4.3.
		Automatic exploders	5.2.4.4.
		Sticky repellents	5.2.5.2.
		Wetting agents	5.2.11.3.
Gulls	Loafing on airfields	Elimination of roosting sites	5.2.2.5.
		Elimination of food sources	5.2.2.3.
		Elimination of water sources	5.2.2.4.
		Distress/alarm calls	5.2.4.1.
		Electronically produced noises	5.2.4.2.
		Airbursts or scare-cartridges, bird bombs	5.2.4.3.
		Automatic exploders	5.2.4.4.

TABLE 1 (Cont.)

GUIDE TO ACTIVE* BIRD MANAGEMENT TECHNIQUES

Species	Situation	Potential Control Measures (in the order to be considered	Reference No.
Gulls	Feeding on or near airfield	Elimination of food source	5.2.2.3.
		Distress/alarm calls	5.2.4.1.
		Electronically produced noises	5.2.4.2.
		Airbursts or scare-cartridges, bird bombs	5.2.4.3.
		Automatic exploders	5.2.4.4.
Other water birds	Creating strike hazard near airfield	Elimination of water source	5.2.2.4.
		Elimination of food source	5.2.2.3.
		Netting or wire	5.2.3.2
		Airbursts, scare cartridges, bird bombs	5.2.4.3.
		Automatic exploders	5.2.4.4.
		Rope firecrackers	5.2.4.5.
		Shooting (waterfowl hunting)	5.2.11.1.
Birds of prey	Creating strike hazard near airfield	Elimination of food source	5.2.2.3.
		Elimination of nesting, roosting, or perching sites	5.2.2.5.
		Sharp projections	5.2.3.3.
		Sticky repellents	5.2.5.2.
		Raptor traps	5.2.9.5.
Other land birds	Creating strike hazard near airfield	Elimination of food source	5.2.2.3.
		Elimination of nesting, roosting, or perching sites	5.2.2.5.

problem actually exists. The potential consequences of a possible error in judgment should be considered.

Restrictions on Use. There are no legal restrictions. The health and safety aspects of an error in judgment or the potential for the situation evolving into a problem may restrict the use of this "no action" alternative.

5.2.1.2. Tolerance

General Description. Tolerance of a bird problem means simply repairing the damage caused rather than attempting to control the birds.

Applicability. Tolerance may be the most appropriate action for damage situations that occur infrequently or only affect easily replaceable materials. If the expense of preventing the damage would be greater than the cost of replacing or cleaning the material or equipment affected, this approach should be considered.

Materials and Procedures. The materials depend upon the specific situation at hand. Periodic examination is required to evaluate the damage. Estimates should be made of material and manpower costs associated with tolerance compared to those of an active control procedure. Carefully evaluate hidden costs such as possible interference with mission activities during the time required to clean and replace materials. The problem should be documented (Chapter 6). Cumulative costs may warrant the expenditure of funds for a one-time solution of the problem.

Advantage. Tolerance can be the least expensive solution to a minor bird damage problem. Other control procedures are not guaranteed to be 100 percent successful.

Disadvantages. While some control procedures may require only one application, maintenance and replacement may need to be repeated. Hidden costs may also be associated with tolerance of a problem. Certain damage problems may get worse if control procedures are not begun.

Restrictions on Use. Tolerance is not a viable alternative if health or safety hazards are possible.

5.2.2. ALTERING THE SITUATION

5.2.2.1. Changing Mission Activities

General Description. Changing mission activities consists of modifying procedures to avoid or reduce a potential conflict between birds and aircraft.

Applicability. Changing mission activities applies to many types of situations, particularly those of a temporary nature (e.g., the presence of large numbers of migratory birds).

Materials and Procedures. After evaluating the circumstances of a potential hazard in a particular situation (Chapter 6), one can select the types of changes in mission activities that may solve a particular problem. Two or more specific recommendations may be combined, depending upon the severity of the problem at hand. The PM should identify the circumstances of the conflicts between birds and flight operations and coordinate possible changes in flight operations with the base Flight Safety Officer. The Flight Safety Officer can recommend changes in operational procedures to the appropriate organization.

Providing pilots with information on birds is one way to alter the situation by changing mission activities. Pilots can be alerted to hazardous bird areas by posting information in Base Operations and by tower/pilot communication. Pilots can be informed of the numbers, location and altitude of birds in the same manner they are informed of severe weather conditions.

Changes in operational procedures have been recommended in certain instances by the Bird/Aircraft Strike Hazard (BASH) Team of the Air Force Engineering and Services Center. These include: restricting the use of certain runways, only allowing full-stop landings, avoiding long final approaches, reducing approach and climb-out speeds, restricting formation rejoins on departure, and raising radar vectoring altitudes. The technique of scheduling flights to avoid hazardous situations is discussed in para. 5.2.2.2., "Flight Scheduling".

A Bird Hazard Working Group (BHWG) should be created with members from Flying Safety, Director of Operations, Flight Facilities, Base Operations and Civil Engineering. Ideally, the BHWG should be a sub-committee of an existing group such as the Air Traffic Control Board, Safety Council or a similar group. The group should review the local flying operation and determine modifications needed to reduce bird hazards and make pilots more aware of the hazards. The BHWG should:

1. Define the local bird problem and possible changes in procedures to avoid the birds.

2. Develop a plan to implement avoidance procedures.

3. Define responsibilities for various aspects of bird control.

4. Inform aircrews of procedural changes to be initiated.

5. Prepare briefings, posters, etc., for educating aircrews on bird strike hazards.

6. Review and modify procedures and recommendations to improve the base's BASH reduction program.

To inform pilots of bird densities which require temporary operational changes, the term BIRD WATCH should be used. Similar to a weather MET WATCH, BIRD WATCH alerts aircrews to possible flight hazards due to increased bird activity. Pilots are then prepared to begin alternate procedures for bird avoidance as established by the BHWG. Such procedures as full stop landings only, diversions, and delays in departure may be considered appropriate for the particular threat.

Different bird densities may require varying degrees of caution. Terms such as BIRD WATCH GREEN, YELLOW or RED may be used to communicate the changing nature of bird hazards to pilots. For example, BIRD WATCH GREEN denotes normal operating conditions. BIRD WATCH YELLOW may mean high bird densities in locations which represent a probable hazard to safe flying operations, and specific procedures for avoidance should be implemented. BIRD WATCH RED may indicate that extremely high concentrations of birds are present on the airfield and constitute an immediate hazard to aircraft, and that procedures to divert are in effect until the birds are dispersed.

Advantages. Changing mission activities is safe, effective, and sometimes the only viable solution to a bird hazard.

Disadvantages. A change in mission activities may be very difficult to begin and organize. The PM may not have the required authority to initiate such changes. The cost of interruption of mission activities can be very high.

Restrictions on Use. Existing procedural regulations and mission objectives may limit the nature and extent of modifications.

5.2.2.2. Flight Scheduling

General Description. Bird strike hazards can be reduced by scheduling flights to avoid those times of the day or night when birds are most active near the installation.

Applicability. Flight scheduling is particularly applicable to the avoidance of night-migrating waterfowl and songbirds, and to the avoidance of blackbirds or Starlings arriving at a roost at sunset or departing at dawn.

Materials and Procedures. A survey should be conducted as described in Chapter 6. Identify the types of birds, the

nature of their activities, and their locations and movements throughout the day. Determine the feasibility of flight scheduling to avoid the birds by counting the numbers of birds present at various times of the day and plotting this information on a graph (Figure 9). For example, to obtain an estimate of the number of birds present at a given location between 0800 and 0900, conduct a count at 0830. The objective is not to obtain exact counts of actual numbers present, but to obtain a relative measure of abundance. Thus, count the number of individuals observed during a predetermined interval, say 3 minutes. This makes it possible to measure the abundance of birds that are only moving through an area.

It may help to make separate graphs for each location, as well as a composite showing average numbers for all counting locations. This information could suggest that flights be scheduled to avoid certain areas at certain times of the day, instead of rescheduling flights entirely.

A typical situation is where flights can be scheduled to avoid winter bird roosts near sunset or sunrise when the birds are coming and going. Another example would be scheduling night sorties during the months from September to November and from March to May to avoid the peak migratory seasons. Waterfowl counts conducted at local wildlife refuges can be used to determine the weeks of peak waterfowl migration in an area. Additional information on peak migration can be obtained from local bird watching clubs, state wildlife offices, and published literature.

If flight scheduling appears to be a viable solution, the PM should suggest it to operations personnel and use the prepared graphs to illustrate the temporary nature of the problem.

Advantages. Flight scheduling is frequently the safest means of avoiding a bird hazard. For night migrating birds which are beyond the control of the PM, it may be the only effective means.

Disadvantages. It may be difficult to schedule flights without interfering with mission requirements. Interruption of mission activities can be costly and can degrade readiness.

Restrictions on Use. Changes in flight scheduling are restricted by mission requirements.

5.2.2.3. Elimination of Food Sources

General Description. If birds are attracted by a food source, removal of the food source will result in fewer birds in the area. Various techniques are used depending on the situation.

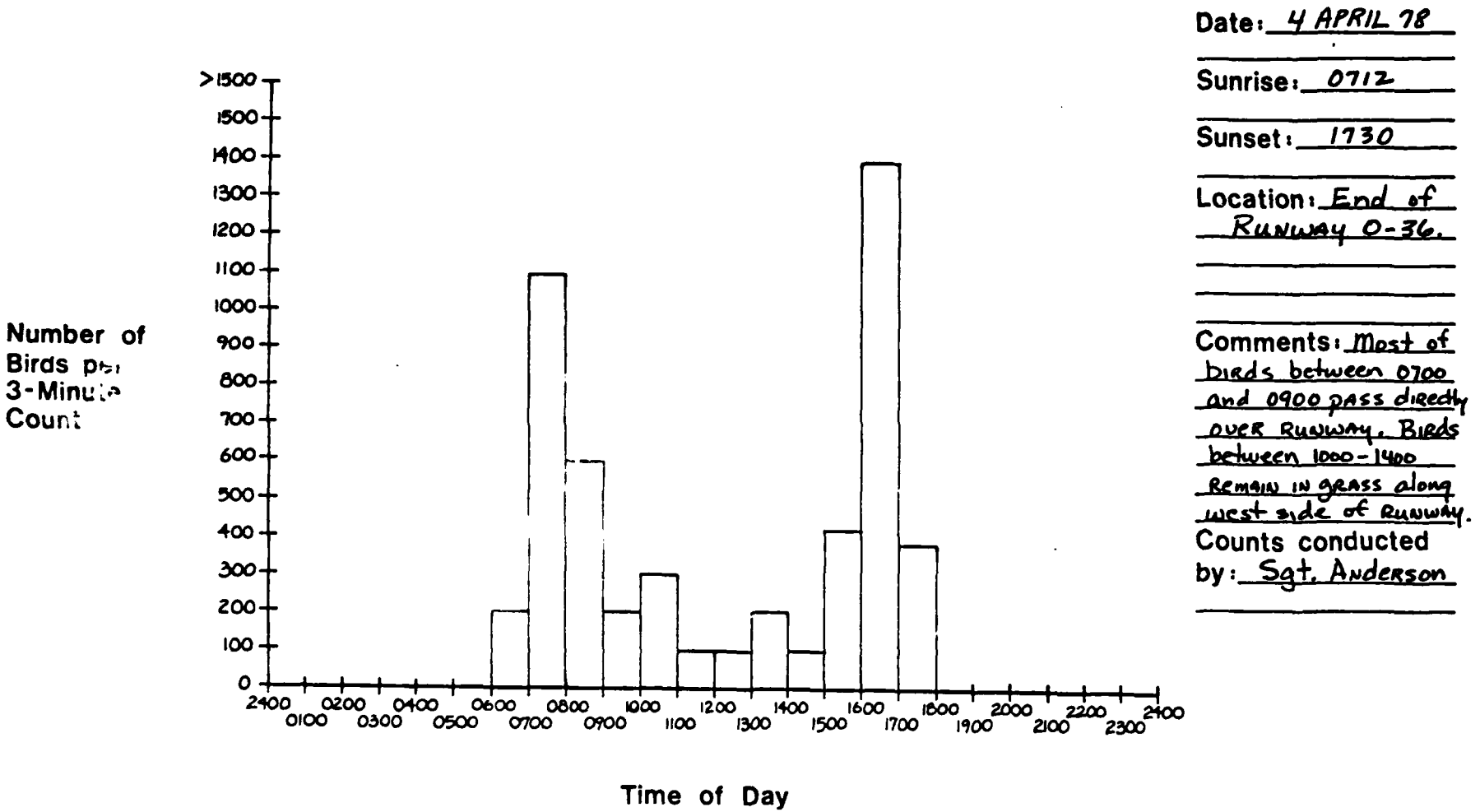

Figure 9. Sample graph used to determine the feasibility of scheduling flights to avoid a bird strike hazard.

Applicability. In many cases food is the major attraction for birds. Some typical examples and potential methods of eliminating these sources of food are listed below:

a. Exposed garbage at landfills attracts scavengers such as gulls, crows, and Starlings. If a landfill is properly operated, with refuse being continuously covered with soil, large numbers of birds should not be attracted. The PM can encourge proper landfill operations. If necessary landfills causing serious bird strike hazards should be closed, and the refuse covered permanently. Garbage around buildings should be eliminated or kept in covered containers to preclude attracting pest birds such as Starlings and pigeons.

Weed seeds in grassy areas attract many birds, such as Mourning Doves and Horned Larks. The amount of weed seeds produced can be reduced by mowing operations or by regular application of herbicides. For areas that cannot be mowed, controlled burning is an alternative. Safe burning requires predictable weather conditions and considerable skill and should only be performed by experienced personnel. Further discussion of vegetation control is included in para. 5.2.2.5., "Elimination of Nesting, Roosting, and Perching Sites" and Herbicide Manual for Non-Cropland Weeds (AFM 91-19, Aug 1970).

Insects in grassy areas attract many types of birds including Cattle Egrets and meadowlarks. Proper timing of mowing operations to avoid exposure of insects at times of heavy runway use may keep insect populations in check without creating a strike hazard. If necessary, insects can be controlled by spraying. Methods of insect control may be found in the Military Entomology Operational Handbook (AFM 96-16, Dec. 1971).

b. Earthworms attract birds such as American Robins to short-grass areas. Following a rain, scavengers such as gulls may be attracted to runways to feed upon earthworms. Runways can be swept clean of earthworms with runway sweepers.

c. Rodent populations in grassy areas may attract raptors (hawks and owls). Keeping the grass mowed short will eliminate the rodent habitat and in turn reduce the food source that attracts the raptors. As explained in para. 5.2.2.5., grass height of 8-12 inches (20-30 cm) is recommended to discourage birds that prefer shorter grass for roosting without attracting large numbers of rodents and birds that prefer taller grass.

d. Carrion-eating birds (such as vultures, crows, and gulls) may be attracted by dead animals on

the airfield. This food source can be reduced by frequent inspection, removal and proper disposal of the carcasses.

e. Fruit (e.g., berries) produced by trees, shrubs, and vines, including ornamental plantings, may attract birds such as swallows, warblers, or Starlings. This food source can be eliminated entirely by removing the fruit-bearing vegetation. With ornamental plantings, it may be preferable to exclude the birds by netting (para. 5.2.3.2.) during the fruiting time. Growth inhibitors can be used before fruiting to reduce food supply.

f. Agricultural land near an airfield can create a bird/aircraft strike hazard by attracting large numbers of birds to a food source. For example, flocks of blackbirds may be attracted by grain crops or by waste grain following harvest. Another type of hazardous situation may be created when plowing or mowing exposes worms, grubs, and flying insects which attract birds. Such problems may be beyond the immediate control of the PM. If the land is government-owned, the problem may be solved by not leasing for agricultural purposes or by stipulating in the lease agreement that grain crops not be grown. Local farmers can be encouraged to plow the fields after harvest to reduce the attractiveness of waste grain to birds.

Materials and Procedures. The materials and procedures required to eliminate food sources will depend upon the particular situation. The situations are too varied to permit a detailed discussion of all procedures. The previous section includes a general discussion of procedures. Information on available materials and procedures may be obtained from the base Pavements and Grounds Section.

Food sources such as weed seeds, insects, and small mammals are all associated with open areas of grass, the prevalent habitat type at air bases. Additional details on control procedures for grassy areas are included in paragraph 5.2.2.5., "Elimination of Nesting, Roosting, and Perching Sites".

Advantages. Removal of food sources solves many pest bird situations at their origin. Techniques involving sanitation procedures may also solve rodent pest problems. Operations such as mowing are a regular part of grounds maintenance and may be easily modified to control a pest bird problem.

Disadvantages. Removal of food sources, like other habitat management practices, can be costly and time consuming. In some situations the benefits may not be immediately apparent. Some problems may be beyond the immediate control of the PM. Each specific technique has disadvantages. For example, if grass is cut too short, it may attract gulls to loaf in the area. The mowing operations may temporarily attract birds by exposing

insects. Chemical insect control may have undesirable environmental effects or cause public relations problems.

Restrictions on Use. Permits may be required for certain techniques such as chemical applications and controlled burning. Applicable federal and state regulations, as well as local ordinances, must be investigated (para. 7.2.5. and sect. 7.3.).

5.2.2.4. Elimination of Water Sources

General Description. If birds are attracted by a source of water, removal of the source will result in fewer birds in the area. Various techniques are used depending upon the particular situation.

Applicability. Low areas or clogged drainage ditches may collect water, attracting waterfowl, gulls or smaller shorebirds. Elimination of such temporary water sources will reduce the attractiveness of the area to birds considered to be potential strike hazards. If permanent ponds create a strike hazard, draining and filling may be necessary. Exclusion by netting or wire (para. 5.2.3.2.) is an alternative to draining and filling.

Materials and Procedures. Low areas that collect water can be eliminated by installing covered tile drains or by filling and regrading. Drainage ditches can be replaced by buried drainpipe. All ditches, drains, and culverts should be unclogged. Open drainage ditches should be cleared at regular intervals.

Advantages. Elimination of water sources solves the problem at its origin and is a permanent solution, except that periodic maintenance of drainage systems is required. Breeding areas for insects are also eliminated by removing sources of water.

Disadvantages. Major filling operations or installation of drainage pipes and culverts is costly. Draining and filling permanent ponds is impractical, unless a very serious bird strike potential exists.

Restrictions on Use. Ponds, streams, marshes, and swamps are often strictly regulated by law. Appropriate local and state permits may be required before such sources of water can be altered or eliminated (sect. 7.3.)

5.2.2.5. Elimination of Nesting, Roosting, and Perching Sites

General Description. If birds are attracted by the vegetation cover (or the openness) of an area, a reduction in the cover (or openness) provided will reduce the number of birds

attracted by this type of habitat. In some circumstances, removal of favored perching sites will also discourage birds from frequenting an area.

Applicability. Crows, Starlings, and blackbirds that roost in trees can often be discouraged from using the roosting site by topping or thinning (i.e., pruning) the trees. Birds roosting in tall reeds (i.e., blackbirds or swallows) can be discouraged by cutting the reeds to a shorter height. Birds (e.g., meadowlarks) that roost or nest in tall grass can be discouraged from an area by mowing the grass short. For areas that cannot be mowed, controlled burning is an alternative. If gulls loaf in open areas of short grass, they can be discouraged by allowing the grass to grow to a height which will obstruct their vision and make it difficult for them to spread their wings freely. Removal of dead snags on which hawks frequently perch may discourage these birds from frequenting the area.

Materials and Procedures. Equipment required consists of suitable mowers or saws, depending upon the situation. Safety equipment (eye protection and hard hats) is also required for tree thinning operations. For controlled burning, equipment, such as drip torches, is required to start the fire, while brush rakes, fire brooms, and backpack pumps are needed to control it.

Intensive pruning discourages birds from roosting in trees. A sparse tree canopy provides few perching sites and little protection. More branches should be removed than would normally be removed in residential pruning. In one known case in Texas, removal of approximately one-third of the canopy was 100 percent effective in discouraging several species of blackbirds, Starlings, and American Robins from roosting in live oaks. In instances where birds such as crows roost in tall trees, topping the trees to a height of 20-30 feet (6-9 m) may be effective. A more drastic measure would be the complete or nearly complete removal of the trees.

Tall reeds (such as the common reed, Phragmites) where birds roost can be cut back with machetes or mowers. This will reduce the use of reeds as blackbird or swallow roosting habitats.

Grass height in open areas can be controlled by mowing to eliminate nesting or roosting habitat. To compromise between short grass that is attractive to gulls and long grass that attracts other birds, maintenance at a height of 8-12 inches (20-30 cm) is recommended. If mowing operations expose insects that attract birds, it may be preferable to mow at times when runways are not being used heavily by aircraft such as at night or on weekends.

Controlled burning requires predictable weather conditions. Safe burning requires considerable skill and should only be performed by experienced personnel.

Snags or other perches being used by hawks can be identified by direct observation. These snags can then be cut down. For other perches, such as antennas or other structures, tactile repellents should be considered (para. 5.2.5.).

Advantages. Elimination of nesting, roosting, and perching sites solves a pest bird problem at its origin. Habitat modification is likely to be more effective than repulsion techniques. Allowing grass to grow taller will reduce grounds maintenance costs including maintenance costs for equipment.

Disadvantages. Removal or thinning of roosts may only result in the birds moving to nearby sites. Careful maintenance of grass is required. Short grass in open areas may attract gulls for loafing. Mowing grass too short can replace one pest situation with another, perhaps creating a more serious problem. Allowing it to grow too long may result in an increase in other birds as well as small mammals that attract raptors. Tall grass is sometimes considered unsightly. Mowing operations may attract birds temporarily by exposing insects. As with other methods of habitat manipulation, some of these control procedures can be costly in terms of manpower required.

Restrictions on Use. Habitat modification techniques that may result in the disturbance or harassment of protected species will require appropriate permits (para. 7.2.5.). For example, active raptor nests are protected by federal law. Therefore, trees containing such nests cannot be cut down without a permit. The use of controlled burning also requires appropriate permits.

5.2.3. EXCLUSION

5.2.3.1. Design and Construction

General Description. The design of structures is frequently responsible for their attractiveness to Domestic Pigeons, Starlings, and House Sparrows. Design modifications or additional construction to eliminate roosting and nesting locations can provide effective bird control.

Applicability. Unfortunately the PM may not have an opportunity to comment on structure design during the planning stages. However, additional construction may be feasible to modify features of structures that attract roosting or nesting birds. For example, open eaves of a building may be boxed to prevent access. Flaws in building construction causing cracks or crevices that attract Starlings or House Sparrows can be sealed with boards, bricks, or mortar.

Materials and Procedures. The building materials needed will depend upon the particular design modifications

required. Boards, bricks, mortar, or sheet metal are frequently appropriate. Screening, as discussed in para. 5.2.3.2., should be considered as an alternative. Cavities being used by birds can be located by looking for accumulations of bird droppings, protruding nest materials, or by careful observation of birds. Birds may be reluctant to enter a nesting cavity if an observer is nearby, so the PM should use field glasses and watch from a distance. When the problem areas have been identified, select the appropriate building material, remove existing nests (para. 5.2.11.2.), and seal off the opening. Eliminate ledges used as perching locations by installing angled board, a piece of sheet metal or a row of bricks.

Advantages. Design modification is a permanent method of pest bird exclusion. Unless conducted during actual nesting, it is not likely to cause an adverse public reaction and is thus a socially acceptable means of preventing protected species, such as robins or swallows, from nesting on structures in the future.

Disadvantages. Design modification may require considerable manpower and materials initially, but results are permanent. Care should be taken to avoid interfering with functional design characteristics. For example, ventilators should be screened rather than entirely sealed.

Restrictions on Use. Permits are required to disturb the nests of protected species (para. 7.2.5.). Carefully comply with applicable building codes or specifications.

5.2.3.2. Screens/Nets/Wires

General Description. Exclusion by means of screens, nets, or wires consists of installing materials that will prevent the physcial access of birds to areas were they roost, nest, or feed.

Applicability. Screening or netting is frequently used to prevent pigeons, Starlings, or House Sparrows from roosting or nesting in or on buildings or other structures. Ventilation holes can be screened to exclude Starlings and House Sparrows. Chimneys can be covered with screening. Netting or criss-crossed wire has been used to exclude birds from drainage ditches or other water areas that attract waterfowl, gulls, or other birds. Screening has been used to exclude birds such as Starlings and gulls from filter beds and settling tanks of sewage treatment facilities.

Pigeons and Starlings can sometimes be discouraged from hangars or warehouses by suspending netting from the top of the large doorways. The birds may be reluctant to fly low enough to enter under the netting. This technique is not effective against House Sparrows, nor has it been scientifically tested, so the

maximum ground clearance that will be effective and the probability of success are unknown.

Netting is also used in agricultural situations to prevent bird depredation of fruit crops. Similarly, netting can be used to prevent the attraction of birds to certain vines, shrubs, or trees that have been planted for ornamental or gardening purposes.

Materials and Procedures. The materials and procedures will depend upon the particular pest situation at hand. To exclude birds from relatively small areas, 1/2 inch (1-1.5 cm) mesh screening is recommended. To enclose larger areas, such as an aircraft hangar superstructure or to partially screen large doorways, nylon or polyethylene netting can be used. This netting is available in large rolls from commercial suppliers (Appendix E). Several materials can be used to cover fruit trees or vines, including acrylic fiber webbing and plastic netting.

As with other control techniques, the PM must first survey the situation (Chapter 6). Be sure to identify all the areas which must be screened: the birds may choose alternative perches or nest sites unless all suitable locations are made inaccessible. Scare away adult birds and remove all nests, eggs, and young before sealing off an area.

To control pigeons, Starlings, and House Sparrows in buildings such as aircraft hangars, the PM should follow the procedure outlined in the Consultation Report: Grissom AFB Hangar 200 (Air Force Civil Engineering Center, Tyndall AFB, 1976).

1. Clean the hangar with high pressure water. Deicing booms may be used to wash down girders and remove nests. Ensure that all electrical power to the building is turned off to eliminate the shock hazard.

2. Scrape beams where droppings have accumulated before washing.

3. Spray with disinfectant where nests are removed. Dispose of nests by incineration.

4. Wash hangar floors and treat with disinfectant. Incinerate all dead birds.

5. Replace insulation and glue it down. Spot weld 1/2 inch (1-1.5 cm.) mesh screening to door bracings completely enclosing the insulation. Ensure that the screening does not touch the insulation to prevent birds from pulling insulation fibers through the mesh.

6. Screen off all nesting and resting areas, such as edges of runs, ducts, and conduit races, spaces between the wall

and utility runs, and around heating units. Suspend netting as required to enclose larger areas.

Do not underestimate the ability of Starlings or House Sparrows to fit through openings that seem smaller than the birds themselves. Use screening or netting with small mesh and apply it to all openings that could permit access. Strong material is required because weak screening (such as window screen material) can be easily broken, expecially by Starlings. Exclusion is expensive and labor-intensive, but costs will be reduced by choosing a sufficiently strong material the first time and applying it in the most appropriate locations. Follow-up inspection may indicate additional locations where application is required. If netting is hung to discourage pigeons from entering through large doors, the netting should be suspended as low to the ground as possible without interfering with doorway use. The maximum ground clearance that will be effective may vary with the situation.

The technique of criss-crossing wire across water bodies requires the use of heavy gauge wire (at least 10 gauge) to minimize the potential for injury to birds. Nylon monofilament line of 50-100 lb (23-45 kg) test can be substituted for wire. Posts should be placed about 6 feet (2 m) apart on each side of the body of water, alternating the positions of the posts with those on the opposite site. Wire is then strung in a zig-zag manner across the water at approximately 12 to 18 inches (30-45 cm) above the high water line. This technique is effective against large birds only.

Advantages. If properly installed, screening or netting is a permanent solution to a pest bird problem, although periodic inspection and maintenance are required. Exclusion of birds is socially acceptable and should not cause a public relations problem. Netting and screening are appropriate means of excluding protected species.

Disadvantages. Exclusion by mechanical means may involve large initial expenses for materials and labor. Partial netting over doorways may interfere with the movement of large vehicles or equipment. The effectiveness of this technique is uncertain.

Restrictions on Use. Excluding birds by screening or netting is not legally restricted.

5.2.3.3. Sharp Projections

General Description. Sharp projections, wires, or spikes can be used as barriers and repellents to perching birds on buildings and other structures.

Applicability. These devices can effectively prevent any bird from perching on ledges or other surfaces. A sample application is shown in Figure 10. They are most commonly installed to discourage pigeons, Starlings, and House Sparrows from structures. Sharp spikes have also been successfully used to prevent raptors from perching on runway marker lights.

Materials and Procedures. These devices are commercially available in strip form under several brand names. Installation materials (clips, fasteners, wire ties, and adhesive), as appropriate for particular installation requirements, are also available from the same suppliers (Appendix E). Different designs of projection material are available for large birds such as gulls or pigeons, and for smaller birds, such as Starlings or House Sparrows.

This material can be installed on ledges, rafters, window sills or other locations where birds might roost, loaf or nest. Wide surfaces may require two or more parallel rows of the material. Detailed instructions on the appropriate type of adhesive or fastener, as well as recommended spacing, are available from the suppliers. Determine the appropriate locations for this material by observing birds directly or by noting heavy concentrations of droppings.

Advantages. Sharp projections are an effective and permanent means of excluding or repelling birds from ledges, rafters, and other structures.

Disadvantages. In certain situations the large amount of material required may render this an impractical technique. High cost is another significant factor.

Restrictions on Use. Because of the sharp spikes, these devices cannot be used in accessible areas where a safety hazard might result.

5.2.4. AUDITORY REPULSION

5.2.4.1. Recorded Distress/Alarm Calls

General Description. This bioacoustic technique consists of using a loud-speaker and cassette tape player to broadcast a recording of actual distress or alarm calls of the same bird species to frighten away flocks of birds.

Applicability. Distress or alarm calls are highly recommended for dispersing flocks of gulls from an airfield. In the Air Force, this is their primary use. This technique is also frequently effective in dispersing blackbirds or Starlings from roosts in trees or Starlings roosting in hangars. Distress or alarm calls can also be used in many other situations, if tapes

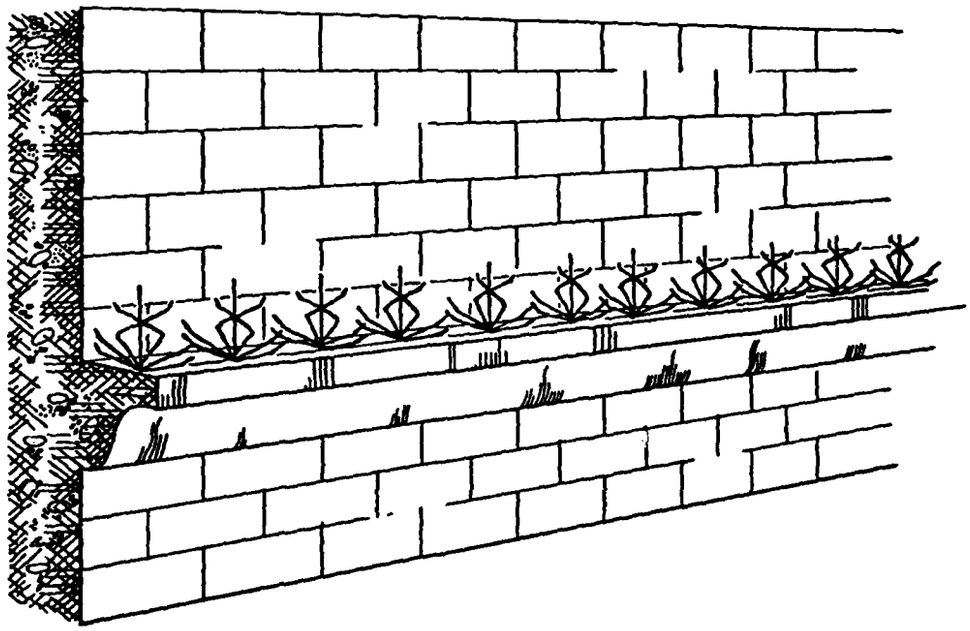

Figure 10. Sample application of sharp projections.

are available for the species that is causing the pest situation. Repulsion techniques are most effective with transient birds and are more effective with roosting or loafing birds than with those that are nesting. Auditory repulsion is not recommended for pigeons or House Sparrows (sect. 2.7.).

Materials and Procedures. Equipment consists of a vehicle from which to broadcast the calls, sound equipment (tape player with amplifier and loud-speaker), and the appropriate cassette tape recordings for the pest species. The loud-speaker can be mounted on the vehicle. The sound equipment must play the tapes loudly and with good fidelity. A system capable of 30-50 watts power without distortion to produce 90-110 dB (several feet in front of the speaker) and a frequency response of up to at least 20,000 Hz is recommended. This equipment is covered in Table of Allowances 483. The system can be powered directly by the vehicle through the cigarette lighter, using an AC/DC transformer. Recorded tapes of distress/alarm calls for various species can be obtained from the Air Force Engineering and Services Center, Tyndall AFB, Florida. If available, alarm calls are usually preferable to distress calls, because some birds are dispersed more readily by alarm calls.

As with other repulsion techniques, it is best to start a control program before the birds establish the habit of using the area. If the birds already frequent the area, observe their usual movement pattern. It is easier to herd them along accustomed flight patterns than to disperse them at random.

Proper identification of the birds is even more important than with other repulsion techniques, because many birds respond only to distress or alarm calls of their own species. Even gulls should be identified to species before a tape is selected. In mixed flocks, the dispersal of one species will sometimes but not always disperse the other species.

For loafing gulls, drive the vehicle to within 100-200 yards (90-180 m) of the birds. Note the wind direction because sound carries farther downwind. If birds are roosting in trees, it will be necessary to get even closer, because the trees will muffle the sound of the recording. In hangars, the sound may echo making it unrecognizable to the birds. Try different locations within the hangar; it may be desirable to move the speaker up to ceiling level. At tree roosts and loafing areas, play the tape from different locations.

To keep birds from habituating to this control technique, play the tape as little as possible and never allow it to run continuously. For gulls, play the tape 10-20 seconds if necessary. Two or three attempts should be sufficient. If the birds do not fly up and disperse after the third attempt, it is unlikely that they will be influenced by the distress call.

Do not allow the tape to continue running, because this will persuade the birds that they are not in danger, and they will ignore the tapes. Frequently the birds rise up and fly toward the loudspeaker when the distress call is used. Sometimes they circle for a short time over the source of the distress call and then fly away. At other times they may circle the vehicle and spiral higher and higher, creating a hazard to aircraft. Pyrotechnics should then be exploded among the birds to speed their departure.

For Starlings or blackbirds at roosts, the technique should be applied when the birds are arriving at the roost. Play the tape 15-30 seconds at a time for a total of only a few minutes during this period. Apply the technique for four to seven successive nights. Recorded distress or alarm calls can be reinforced with airbursts or scare cartridges (para. 5.2.4.3.), or live ammunition (para. 5.2.11.1.). This will help convince the birds that a danger is present, and they will be more likely to heed the recorded calls and disperse.

Advantages. In many situations, this is probably the most effective repulsion technique available. If the technique is properly applied, habituation is not as likely to occur as with other techniques. Except for the reinforcing measures, no other supplies are required. The birds are not physically harmed by the distress or alarm calls. This method entails no fire hazard (as with pyrotechnics), no soiling problems (as with sticky repellents), and no chemical residues (as with toxicants).

Disadvantages. Circling gulls may create an immediate strike hazard until completely dispersed. High background noise levels will reduce the probability of success by impeding the birds' ability to hear the recording. Echoes and distortion of the calls when played inside a hangar or between buildings may reduce effectiveness. The recordings are disturbing to some people. The initial expense for equipment is fairly high, and continuous manpower is required. As with any repulsion method, roosting birds that are moved may become a problem elsewhere. Repulsion alone will not permanently solve a problem; habitat changes should also be made.

Restrictions on Use. Playing recorded distress/alarm calls is harassment and cannot be used on protected species without a permit. If live ammunition is used as reinforcement, depredation permits are also required for protected species, including gulls (para. 7.2.5.).

5.2.4.2. Electronically Produced Noises.

General Description. Electronically produced noises which simulate bird calls can be broadcast by loud-speaker in the same manner as recorded distress/alarm calls (para. 5.2.4.1.) to repel birds. Ultra-high frequency sounds (ultrasonics), which

cannot be heard by humans, are not recommended for bird control because their effectiveness is questionable.

Applicability. Like recorded calls, electronically produced noises can repel flocking birds (e.g., blackbirds, Starlings, gulls) from feeding and roosting situations with varying degrees of success. Auditory repulsion techniques are not recommended for pigeons or House Sparrows (sect. 2.7.). Electronic noises have been used in enclosed areas such as hangars and in open and wooded areas.

Materials and Procedures. Electronic bird repulsion systems are available from commercial suppliers (Appendix E). Several models are available: low power for enclosed or small areas and high power for larger, open areas. They can be played from a vehicle or permanently installed, but mobile units are more effective and can cover a larger area. If installed, several stationary speakers or a rotating (or partially rotating) speaker is recommended so that the direction of the broadcast can be varied. The systems can be operated manually or automatically. A timer can be used to turn the system on for a few seconds every several minutes. A photocell can activate or deactivate it at dawn and dusk. The use of electronic systems is similar to broadcasting recorded distress/alarm calls. To increase effectiveness, the location of mobile units should be changed frequently. In a small area, high volumes are not necessary, as long as the birds can hear the sound. Because the noises can be very irritating to people, unnecessarily high noise intensity should be avoided.

Like recorded calls, the effectiveness of this technique can be increased by using it in combination with other techniques such as airbursts (para. 5.2.4.3.), automatic exploders (para. 5.2.4.4.), or live ammunition (para. 5.2.11.1.). Birds may exhibit a delayed response, perhaps being attracted at first or acting curious toward the noise before taking flight. Repulsion programs should begin before a pattern has been established for the season, and the sounds should be played as birds arrive at a feeding or roosting area. Persistence is often required.

Advantages. Many variations of noises can be produced by the same equipment. Tapes of calls for various species are not required. Different combinations of noises may repel more than one species at the same time. Experimentation with different noise is possible.

Disadvantages. Many electronically produced noises will be ineffective unless some biologially meaningful message (such as "alarm") is conveyed to the birds. For this reason, the use of actual recordings of distress/alarm calls, if available, is preferable to electronic simulations. The initial cost of

the equipment is high. The noises produced can be very irritating to people. The base bioenvironmental engineer should be asked to assess the noise hazard potential and to make recommendations.

Restrictions on Use. This technique constitutes harassment and cannot be used on protected species without a permit (para. 7.2.5.).

5.2.4.3. M-74 Airbursts, Scare Cartridges, and Bird Bombs

General Description. M-74 (M-74A1) Airbursts are explosive charges fired from an M-1 pyrotechnic pistol (flare gun). Scare cartridges are 12-gauge shotgun shells that propel a second charge instead of pellets. The propelling charge of airbursts and scare cartridges ignites the fuse on the second charge and projects the charge about 100 yards (90 m), where it explodes with a loud noise and a flash of light. Bird bombs are similar in principle, but are fired from a special pistol with a small powder cartridge, and have a shorter range of about 30-40 yards (27-37 m).

Applicability. Airbursts and scare cartridges are fired into the air to repel flocks of birds such as blackbirds, Starlings, crows, gulls or waterfowl. Bird bombs are also fired into the air but are used in situations where a shorter range is needed, i.e., to prevent birds from entering an aircraft hangar to roost. These pyrotechnics can be used in conjunction with distress/alarm calls (para. 5.2.4.1.) to repel birds coming in to roost (blackbirds and Starlings) or to discourage gulls from loafing in the vicinity of runways. These techniques are seldom effective for pigeons or House Sparrows (sect. 2.7.).

Materials and Procedures. Procedures for ordering M-74 Airbursts (Airburst, Projectile, Simulator NSN: 1370-00-028-6007, DOD Code: L366) may be obtained from the Munitions Supply Office, Security Police Squadron (supply account code FK) on each base. Also, Technical Order 11A-1-46, Fire Fighting Guidance, Transportation and Storage Management Data and Ammunition Complete Round Chart contains information on shipping, storing, and handling the airbursts. An M-1 pyrotechnic pistol (NSN: 1095-00-726-5657) is required to fire the airbursts. Scare cartridges and bird bombs are available from commercial suppliers (Appendix E). Bird bombs are fired from special pistols designed for this purpose and are available from the commercial supplier. Scare cartridges can be fired only from 12-gauge shotguns with no choke or an open choke barrel. A choke-bore shotgun will slow the projectile, possibly resulting in explosions inside the barrel. Users must wear goggles, gloves, and ear protection. Dispose of empty casings properly. If discarded on the airfield, they may be picked up by birds and dropped on the runway where they can be ingested by an engine. For the same reason,

unexploded projectiles must be recovered. When unexploded projectiles occur, Explosive Ordnance Disposal (EOD) personnel must be contacted to dispose of the explosives.

When pyrotechnic devices are used without other repulsion techniques, birds may habituate to the noise, reducing the effect. This tendency can be reduced by occasionally using live ammunition with the pyrotechnics to show the birds that a hazard is present (para. 5.2.4.1.). Pyrotechnic devices are most effectively used in conjunction with recorded distress or alarm calls (para. 5.2.4.1.). This reduces the potential for habituation to either technique.

The keys to success are diversity and intensity. Fire the airbursts or scare cartridges at irregular intervals and combine their use with other repulsion techniques. When attempting to disperse a roost, provide daily harassment (as the birds arrive) for a period of 3 to 7 days. It is easier to turn birds back when they are approaching a roost than to scare them out of a roosting area after they have settled.

Advantages. The intital cost for materials is fairly low. Airbursts, scare cartridges, or bird bombs are often an effective method of repulsion, at least for a short time and increase in effectiveness when used in conjunction with other techniques.

Disadvantages. When used as the sole method of repulsion, the birds may habituate rapidly. It is difficult to predict whether these pyrotechnic devices will be effective in a particular situation. Development of military specifications for scare cartridges was not complete when this handbook was published. Therefore, a temporary problem in purchasing and storing the cartridge may be encountered.

Restrictions on Use. The exploding charge represents a fire hazard. These devices should not be fired over dry vegetation. Authorization for munitions is found in AFR 67-1 (4 November 1974), Vol. I, Part One, Chap. 20, para. 72b, c. AFM 66-1, (1 November 1975), Vol. VI, Chap 1, para. 1-24d(a) concerns receipt of munitions. Permits may be required (para. 7.2.5. and sect. 7.3.). AFR 127-100 also requires that two BC fire extinguishers be present whenever pyrotechnics are transported.

5.2.4.4. Automatic Exploders

General Description. Automatic exploders, sometimes called gas cannons, produce loud noises (similar to those of a 12-gauge shotgun) at regular intervals.

Applicability. Automatic exploders can be used in conjunction with other control methods to frighten birds away from

airfields or hangars. They are mainly for open situations. These exploders are reported to be particularly effective for waterfowl but have also been used (with varying degrees of success) for gulls, blackbirds, Starlings, crows and other birds in both feeding and roosting situations. They should be most effective on those species that are regularly hunted and thus are likely to associate the noise with gunfire. Auditory repulsion techniques are generally not effective for pigeons or House Sparrows (sect. 2.7.).

Materials and Procedures. Table of Alowances 483 lists a propane operated scareaway gun (NSN 3740-01-037-9325) for bird dispersal. This model operates from liquid propane, which is ignited by a flint that sparks when struck by the firing mechanism. The timing of explosions is determined by gas pressure.

Exploders should be used in combination with other control techniques. Live ammunition or airbursts will help keep the birds from becoming accustomed to the noise of the exploders. Where birds are strongly attracted to an area, explosions at 1-2 minute intervals can be tested for effectiveness. One cannon can repel birds from an area of approximately 10 acres (4 ha). Several exploders will usually be required in most airdrome situations. The effectiveness is increased if the cannons are pointed downwind. The location should be changed frequently, perhaps every hour, but at least daily. If this is not done, the birds will soon ignore the noise. For ease of movement, the exploders can be mounted on a vehicle. While in operation, the mechanism should be checked periodically.

Repulsion should begin when birds begin feeding or roosting in an area. This is more likely to be successful than starting a program after a pattern has become established for the season. It is even better if the program can be started before the birds' estimated arrival time, based on experience from previous years.

Advantages. This technique is not harmful to birds. Gas cannons have a low operating cost compared to shotguns or airbursts.

Disadvantages. The automatically controlled explosions may cause a flock to rise while an aircraft is passing, creating an immediate strike hazard. Another problem is that birds eventually become accustomed to the noise, especially if the devices are not moved frequently. The loud noise may annoy people working in the area. The sound can carry several miles across water, possibly annoying local residents. The initial cost is fairly high. A safety hazard is associated with the flammable gas.

Restrictions on Use. Because of the explosive gas, the use of automatic exploders may be restricted in certain areas

where a safety hazard could result. Permits may be required (para. 7.2.4. and sect. 7.3.).

5.2.4.5. Rope Firecrackers

General Description. This device consists of a series of powerful firecrackers attached by their fuses at intervals along a cotton rope, which is ignited while suspended. The rope burns slowly, causing the firecrackers to drop and explode. Timing is controlled by the spacing of the firecrackers along the rope.

Applicability. Rope firecrackers discourage blackbirds, Starlings, crows, waterfowl, and other birds from feeding areas. They can be used in combination with other techniques at blackbird and Starling roosts. Auditory repulsion techniques are generally not effective for pigeons or House Sparrows (para. 2.7.).

Materials and Procedures. Preassembled rope firecrackers can be obtained from commercial suppliers (Appendix E). However, the user loses the advantage of determining the intervals of explosions to suit the particular situation. Fuse rope can also be purchased from commercial suppliers to be fitted with flash salutes (bulldogs), cherry bombs, or other powerful firecrackers at the desired intervals. Cotton rope of 5/16 or 3/8 inch diameter (8-10 mm) with three or four strands can also be used. Rope should be wrapped with twine above and below the cutting location to prevent the strands from unravelling when cut. Treating the rope with saltpeter will increase the burning speed almost twofold.

Rope firecrackers can withstand fog and drizzle but should be protected from rain by a device such as a stovepipe with an elbow at the top, an inverted apple crate or a canvas shelter. Wire baskets should be placed beneath the suspended assembly to reduce the fire hazard when the firecrackers fall and explode.

Firecrackers should be spaced on the rope to assure that explosions will occur most frequently during periods of highest bird activity. For example, firecrackers should explode at five minute intervals for the first hour in the morning, progressively increasing the interval to one-half hour during midday.

Depending upon the weather and other factors (such as tightness of twisting of rope strands) 5/16 inch (8 mm), rope can be expected to burn at a rate of about 1 inch (25 mm) every 7 to 10 minutes. Thus, 4 feet (1.2 m) of rope should burn 6 to 8 hours, and firecrackers spaced 1 inch (25 mm) apart will explode every 7 to 10 minutes.

The most efficient number and location of assemblies will vary with the particular situation. In an open field one assembly may effectively repel birds from an area of about 5 acres (2 ha) or more. The largest area of effectiveness can be obtained by suspending the rope firecrackers by a pulley arrangement from a pole from which the firecrackers can drop into a wire basket or onto a wooden platform located above ground vegetation.

Advantages. Rope firecrackers require a minimum of labor and initial cost. Once constructed and suspended, the devices are automatic.

Disadvantages. There is a fire hazard, and precautions must be taken to minimize it. Locations of firecracker assemblies should be clearly marked to minimize the safety hazard to other workers in the area. If access is not controlled, vandalism can be a problem. As with any scare devices, birds may become habituated to the explosions, resulting in diminished effectiveness with time.

Restrictions on Use. Many states and municipalities prohibit the sale, transportation, or use of fireworks without a permit. Applicable local regulations should be investigated by contacting the base Office of the Staff Judge Advocate (Sect. 7.3.). In certain situations, the fire and safety hazards may preclude the use of this technique.

5.2.4.6. Live Ammunition

General Description. Live ammunition can be used to scare or to kill birds, and therefore can be used as a repulsion or reduction technique. See para. 5.2.11.1 for a detailed discussion.

5.2.5. TACTILE REPULSION

5.2.5.1. Sharp Projections

General Description. Sharp projections, wires, or spikes can be used as barriers or to repel perching birds on buildings and other structures. See para. 5.2.3.3. for a detailed discussion.

5.2.5.2. Sticky Repellent (Polybutenes)

General Description. Sticky materials are used to keep birds from perching on surfaces. In addition to discomfort caused by feeling the material, some materials produce a mild burning sensation.

Applicability. Sticky repellents are commonly used to discourage pigeons and Starlings from perching on beams, ledges,

window sills, roof peaks, and other building features. The ability of House Sparrows to cling to small perches makes successful application more difficult than for the larger species. Larger areas, such as entire roof tops can be treated with liquid material. Liquid repellent has been sprayed on small trees. Sticky material has also be used to discourage hawks and owls from perching on runway markers, antennas, radar reflectors and top edges of towers.

Materials and Procedures. Repellent substances are referred to as polybutene repellents and are available from commercial suppliers in various forms under several brand names (Appendix E). For most applications (such as beams, ledges, and roof peaks) cartridges for caulking guns are the most practical means of application. The substance is applied in a continuous strip 1/2 inch (10-15 mm) from the edge of all roosting surfaces. Zig-zag or parallel strips are used to cover wide perching areas. For example, on larger "I" beams, an additional bead is required midway between the two edges. Treatment should start from the ceiling and progress downward. One case of eight cartridges will treat approximately 80 linear feet (24 m). To estimate the quantity of repellent required, count the number of edges to be treated and multiply by the length of the beams.

For very limited areas, such as an occasional window sill or air conditioner, sticky repellent is available in small tubes and aerosol cans. Liquid repellents can be used to cover large areas, such as entire roof tops. These can be applied by power or hand sprayers. Spray applications should be accompanied by caulking gun application on the favored perching areas. When spraying the interior of a hangar, always use drop cloths to keep the spray from coating the floor and any equipment present. Another repellent material can be applied to buildings as a paste with a brush or trowel to form a soft film that is not sticky.

Locate all the favored perching areas. Clean the surface to be treated, and follow the instructions on the container of the repellent material to be used. Detailed application instructions are available from the manufacturers of some substances. An undercoating may be desirable before application to porous surfaces. To minimize potential staining, or to facilitate removal, the cartridge-dispensed substances can be applied on top of waterproof duct tape.

Advantages. If properly applied in appropriate locations, these substances can provide effective bird control without causing public relations problems.

Disadvantages. The effectiveness of this type of repellent is not permanent. One treatment usually lasts about a year, but sometimes will remain effective for several years. Some repellents are reported to last over 3 years. Substances

may get brittle in cold weather, and some melt and run in hot weather, perhaps defacing the building. Substances may stain wooden buildings. These repellents soon become ineffective in dusty areas. Sticky substances can be difficult to remove unless applied over tape. Effectiveness varies considerably with different types. Materials and applications are costly.

Restrictions on Use. Practical limitations are discussed under Disadvantages. There are no legal restrictions to use of this repellent material on buildings. These substances should not be used where a safety hazard to personnel might result.

5.2.5.3. Water Hoses

General Description. Hoses can be used to apply heavy streams of water to repel roosting birds.

Applicability. Streams of water can be used in some situations for pigeons roosting on buildings or House Sparrows in ivy. The technique has also been used for other species in roosting situations, such as swallows in reeds.

Materials and Procedures. Fire hoses or garden hoses can be used to apply the stream of water. If fire hoses are used, the pressure should be carefully controlled. Persistence is required. Applications should be made at dusk on three-four successive days or until birds fail to return.

Advantages. This technique uses equipment that is often already available.

Disadvantages. The birds that are repelled may simply roost in another suitable area nearby. Too much water pressure can cause damage to vegetation or windows. Other water damage can often be more severe than the damage caused by the birds.

Restrictions on Use. Protected species cannot be harassed without a permit (para. 7.2.5.). The practical aspects of discharging volumes of water restrict the situations in which water hoses can be used.

5.2.6. VISUAL REPULSION

5.2.6.1. General Discussion

Many visual frightening devices have been used in attempts to repel birds. These include: scarecrows, imitation snakes, two-faced owl dummies, models and mounts of hawks and other birds, bird corpses, trained falcons (para. 5.2.6.2.), moving novelties of many kinds, flashing and revolving lights, floodlights, flashing or whirling pieces of metal, windwheels,

balloons, flags, masses of dangling thread, streamers, salted herring on strings, Roman candles, puffs of smoke, non-exploding rockets, radio-controlled model aircraft, and even purple grass.

With the exception of trained falcons, these visual repulsion techniques will not be described in any detail in this handbook. In general, visual frightening devices are not effective, mainly because birds habituate rapidly to their presence. Although attempts have been made to develop effective techniques and to prevent or delay habituation to visual repulsion devices, most are not effective or dependable enough to recommend.

5.2.6.2. Falconry

General Descripton. Falconry as a bird control technique refers to the use of trained birds of prey (raptors) to clear birds from airfields.

Applicability. Falcons have been used in other countries as part of bird control programs that included other control techniques. Details of falconry programs in other countries may be found in Bird Hazards to Aircraft (Clark, Irwin & Co., Toronto, 1976). However, falconry is not considered practical and is not recommended. Much of the success of programs that include falconry may be attributed to the high degree of motivation on the part of the PM. This motivation is best applied to other control techniques that are recommended in this manual. The BASH Team is investigating the use of falconry in unusual circumstances where other techniques are unsuccessful.

Advantages. Falconry scares birds from airfields in good weather during daylight hours and does not cause habituation.

Disadvantages. Falconry is very costly, time-consuming and requires several highly skilled full-time personnel and a dependable supply of trained raptors. Falcons cannot be used in bad weather or darkness and when being flown often create a bird strike hazard themselves.

Restrictions on Use. Raptors are protected by federal law and cannot be captured for any purpose without a permit (para. 7.2.5.). Falconers must be licensed. The possession of hawks or owls for any purpose requires a license. Installations considering the use of falconry should consult the BASH Team.

5.2.7. TASTE/ODOR REPULSION

5.2.7.1. General Discussion

Repellent chemicals are presently available to treat agricultural seeds and sprouts to repel birds and prevent econo-

mic damage. These repellents will not be discussed in this handbook because their use is not directly applicable to pest problems in the airdrome environment. This type of repulsion is mentioned here so the PM will be aware of such chemicals when discussing bird control techniques with local farmers.

Taste/odor repulsion techniques which have been used in attempts to discourage birds from roosting or nesting include burning sulfur or smudge materials and the application of naphthalene (moth balls). Such methods are considered impractical and are not recommended.

5.2.8. PSYCHOLOGICAL REPULSION

5.2.8.1. Avitrol (4-Aminopyridine)

General Description. When birds eat bait which has been treated with this toxic chemical, they react erratically, exhibit abnormal behavior and give distress calls. This frightens the rest of the flock away from the area.

Applicability. Avitrol is currently registered for use by authorized personnel as a repellent for gulls, Starlings, blackbirds (including Common Crackles and cowbirds), crows, House Sparrows, and pigeons. Since bait must be eaten, this technique only applies to situations where birds are feeding or can be encouraged to feed by means of pre-baiting. Although pigeons react less than other species, this technique is recommended for their control, because it is more effective for pigeons than is auditory repulsion.

Although Avitrol has been used successfully to repel gulls from airfields, it is not recommended in such situations because the birds attracted by prebaiting may create a serious strike hazard. However, Avitrol can be used to disperse gulls from landfills in the vicinity of airfields. Avitrol is not recommended for the control of Starling roosts, because Starlings will not generally feed in the vicinity of their roost. In feeding situations, however, Avitrol is quite effective against Starlings. This technique is frequently more effective with large flocks of birds than with smaller ones.

Materials and Procedures. "Avitrol" is a Phillips Petroleum Company trademark for the chemical 4-aminopyridine. Various types of grain treated with the chemical, as well as untreated grain of the same type for pre-baiting, are available from commerical suppliers (Appendix E). Different concentrations and types of treated bait are registered for different use. For pigeons, using whole corn minimizes the hazard to smaller, non-target species that will not eat whole kernels. For House Sparrows, treated mixed grain or fine corn chops (cracked corn) can be used. Treated corn chops (double strength) are usually

accepted by Starlings in feeding situations. For gulls at landfills, powered concentrate of Avitrol can be applied to bread.

Pre-baiting is the most important part of the control program, even in situations where birds are already feeding in the area. The birds must become accustomed to eating the same type of food and in the same location as the treated bait that will be used. Do not pre-bait in an area where protected non-target species are feeding or will be attracted. Non-target species that do not eat grain (e.g., American Robins, Mockingbirds, Purple Martins) do not pose a problem. If it is necessary to pre-bait in a location where the birds are not already feeding (such as hangar roof), a longer pre-baiting period is required. It is advisable to allow two weeks for pre-baiting although several days may be sufficient if good acceptance is obtained.

If possible, bait off the ground. This will minimize exposure to people, pets, and some non-target species (e.g., Mourning Doves). A flat rooftop is a good location to pre-bait for pigeons. Elevated feeders can be constructed for House Sparrows.

Pre-baiting accomplishes several objectives. The PM learns the feeding habits of both target and non-target birds. Pre-baiting locations where protected species are attracted can be discontinued before using treated bait. Also, the target birds get accustomed to being fed and will readily take the treated bait when it is substituted for the untreated bait. For pigeons, it is advisable to put out the feed at the same time each day. A break in the pattern will result in a setback to the pre-baiting program. Plenty of bait should be on hand, so that the supply does not run out before total acceptance is obtained.

After a feeding pattern has been established, immediately substitute treated bait for the untreated. When handling treated bait, gloves must be worn. Label instructions must be carefully followed. After handling treated bait, the applicator must change clothes and wash thoroughly. Pick up downed birds and dispose of them by burning. Clean up and dispose of excess bait and empty containers in the same manner. Personnel must not be exposed to fumes or smoke.

Only a portion of the flock needs to ingest treated bait, so it must be blended with untreated bait of the same type. The higher the concentration of treated bait, the more birds will be killed. For example, a mixture of 30 parts untreated to 1 part treated (30:1) may repel flocks of pigeons with little mortality. Use of mixtures of 10:1 or 5:1 constitutes reduction rather than repulsion, for many birds will be poisoned. The average amount of blended bait needed per treatment is 3-4 pounds (1.4-1.8 kg) for pigeons and about 1 pound (0.5 kg) for House

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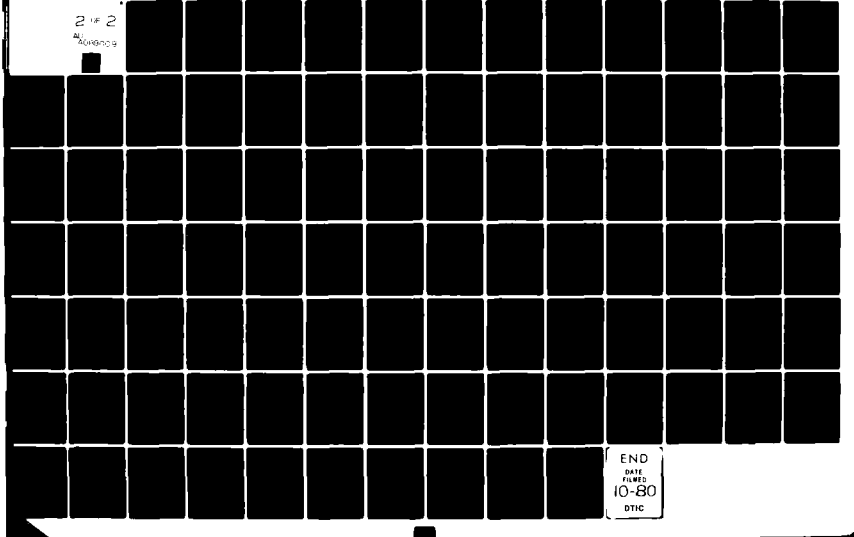

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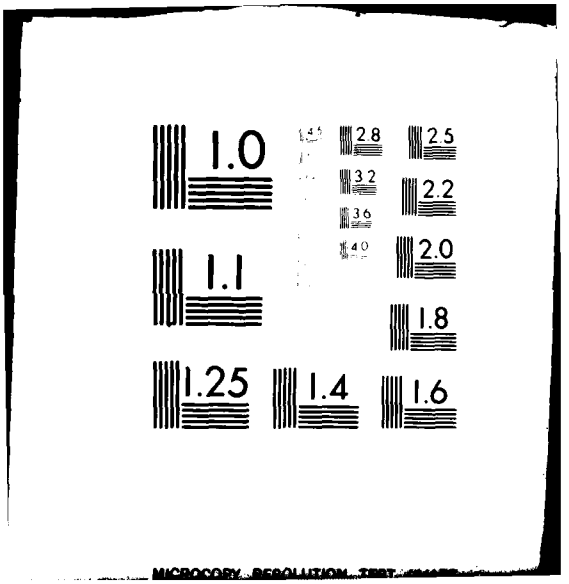
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MICROCOPY RESOLUTION TEST

Sparrows. Daily treatment over a period of several weeks at increasingly higher concentrations may be required. One hundred percent repulsion of either pigeons or House Sparrows cannot be expected. A regular maintenance program may be required to keep the populations at acceptable levels.

For gulls at landfills, cut standard slices of bread into 12 sections. Treat only one-tenth of the sections (i.e., a 10:1 ratio) with Avitrol concentrate by shaking in a plastic bag. After pre-baiting, broadcast the untreated bread and space the treated bread throughout the area. A typical application for 5000 gulls is 240 untreated pieces (20 cut-up slices of bread) and 24 treated pieces (3 pieces at each of 8 widely separated stations). One-half of this amount in any one feeding area is sufficient for smaller flocks. Repeated applications and site maintenance may be required for continued control.

Repulsion (or even reduction) is not a permanent solution to a pest bird problem. If feasible, either exclusion or habitat manipulation is still recommended to solve the problem at its source and prevent recurrence.

Advantages. Although the individuals that ingest the chemical will probably be killed, most of the flock is unharmed. Avitrol is safer to handle than other toxicants, because only the diluted chemical or bait is usually handled by the applicator.

Disadvantages. At least some individual birds are killed. There is often some danger to non-target species. The possibility of secondary poisoning must be considered. Avitrol is a poison and must be carefully handled; contact with the skin must be avoided. It also requires careful storage and disposal by burning or burial. As with all poisons, improper use is dangerous to the PM and other personnel in the area.

Repulsion is not a permanent solution to a pest bird problem. Unless techniques such as habitat manipulation or exclusion are used to prevent the situation from recurring, applications may need to be repeated.

Restrictions on Use. Avitrol should be handled only by trained personnel who are properly licensed and certified. U.S. Fish and Wildlife Service personnel should be consulted before starting a management program using this chemical. Permits are required for use on protected species, including gulls (para. 7.2.5.). When used for non-protected species, bait should not be exposed where it may be taken by protected species. It cannot be used where streams or ponds may be contaminated by the chemical being transported by runoff (i.e., drainage of rainwater).

5.2.9. REMOVAL/REDUCTION BY CAPTURE

5.2.9.1. Commerical Live Traps

General Description. Traps designed to capture birds unharmed are available in a variety of designs from commercial suppliers. Birds are attracted by bait, perhaps in combinatien with live decoys. Captured birds can be killed by gassing or, preferably, transported for release elsewhere.

Applicability. Commerical live-traps can be used to capture Domestic Pigeons, Starlings, or House Sparrows. Trapping is not practical over large areas or where large populations are present, but considerable numbers of pest birds can be removed from limited areas with persistent effort. If birds are not feeding, they may be encouraged by pre-baiting. Birds are more easily attracted to bait in winter because natural food is less available. Starlings, however, do not usually feed near their roosts.

Materials and Procedures. Traps of many designs are available from commercial suppliers. Some of these are listed in Appendix E. Each trap is designed to capture a particular species. The designs include swinging-bob pigeon traps (similar to those described in 5.2.9.2.), funnel traps for pigeons, center-drop traps for Starlings and House Sparrows (like small modified Australian crow traps, para 5.2.9.3.), funnel traps for House Sparrows, and some novel designs. Many models capture dozens of birds at once, and some have multiple chambers to increase their capacity and prevent escape.

Traps should be placed where they will not be disturbed. They should be baited (inside and around the trap) with a food preferred by the species sought and provided with an ample water supply. Pigeons can be attracted by whole corn, House Sparrows by finely cracked corn, and Starlings by cracked corn, peanut butter or apples.

Traps must be checked daily. Several calm, healthy birds left in the trap to serve as decoys will often increase efficiency. Protected species should be handled carefully and immediately released. Non-protected birds causing a pest problem should be released at least 40 miles (64 km) away. The trap can be covered with a tarpaulin (after removal of protected species and decoys), and the birds killed by gas through a hose connected to the exhaust pipe of a vehicle. Dead birds must be incinerated.

Advantages. Live-trapping and release is a socially acceptable means of removing birds. Even if pest birds are killed by gassing, live-trapping is less likely to cause a public relations problem than poisoning. Protected species can usually be released unharmed although frantic birds may be injured in the trap.

Disadvantages. Live-trapping is expensive and time consuming, because it requires considerable persistence to be effective even on relatively small populations in limited areas. Removal is not a permanent solution to a pest problem, as other birds will move in to fill the available habitat. Therefore, eliminating the habitat is the preferred solution.

Restrictions on Use. There are no federal regulations restricting the capture of pigeons, Starlings, and House Sparrows. Some local regulations, if applicable, may require permits (sect. 7.3.). Trapping locations and type of bait should be chosen to prevent the capture of protected species. The capture of protected species requires a permit from the U.S. Department of Interior (para. 7.2.5.).

5.2.9.2. Pigeon Traps

General Description. A pigeon trap consists of a screened enclosure with an entrance through which birds are lured by bait and live decoys. The entrance door is made of lightweight rods (called bobs) that only swing inward, thus preventing the birds from leaving the enclosure.

Applicability. Trapping reduces the numbers of pigeons feeding, roosting, or nesting around buildings.

Materials and Procedures. Pigeon traps can be constructed of wood or meshed wire, with entrance bobs made of aluminum or steel wire or wooden dowels. Figure 11 illustrates a low-profile trap. Pre-constructed individual bobs or bobs in a frame can be obtained from commercial suppliers (Appendix E), as can completely assembled traps of various styles.

Place the traps near feeding or roosting locations, but where they will not be disturbed; a flat rooftop is often a good location. Observe the pigeons' feeding habits to determine suitable trapping locations; for example, if they are feeding in open fields, place the traps in a field. If the birds have been feeding near the runway, do not pre-bait and trap in this area. Instead try to lure the pigeons to an area away from the runway. Post signs advising people to remain clear of the trapping area.

For bait, use preferred food such as cracked corn or other grain. Spread some bait around the door of the trap, and put an ample supply of bait and water inside. Tie the bobs open and pre-bait for two weeks to lure the pigeons to the food source and allow them to become accustomed to entering the traps.

After the pre-baiting period, untie the bobs to activate traps. During several weeks of operation, check the traps daily. At each check, remove captured birds to await transport and release, leave two or three healthy birds as decoys, and reple-

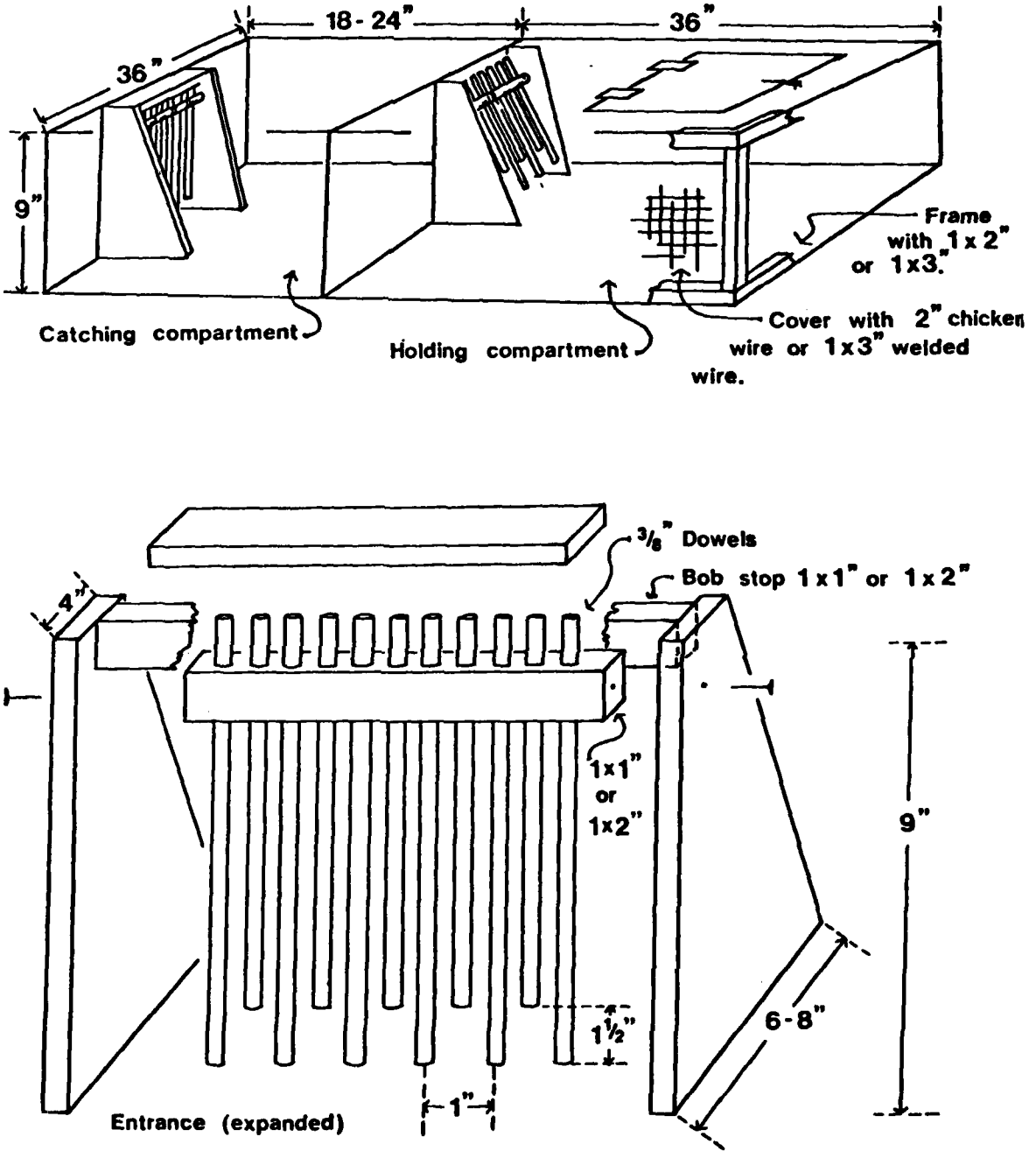


Figure 11. Plans for a low profile pigeon trap. (From an illustration by D. Clark in Kreps, Proc. 6th Vertebrate Pest Control Conference, 1974).

nish food and water as necessary. If too many birds are left in the trap, all bait will be consumed and few other birds will be attracted. Try to leave the same individuals as decoys each time so that they will become tame. Leaving birds with distinctive color patterns will facilitate identification; bright-colored birds also seem to be more effective decoys than the duller blue-gray birds.

A portable holding cage may be constructed for transporting the captured birds. Mark these birds with Indigo Red dye to allow recognition of birds returning to the area. Transport birds to an appropriate area at least 40 miles (64 km) from the base and release. If any marked birds return to the traps or the affected building, dispose of them in a humanitarian manner as directed by the hospital commander.

After several weeks of trapping, another pre-baiting period is recommended, followed by several weeks of trapping. If trapping is unsuccessful, the birds must be destroyed (para. 5.2.10. and para. 5.2.11.).

Advantages. Pigeons with leg bands or non-target species such as Mourning Doves can be released unharmed (sect. 7.5.). Trapping does not involve the hazards associated with toxic chemicals. Fairly large numbers of birds can be captured and removed during proper trapping programs.

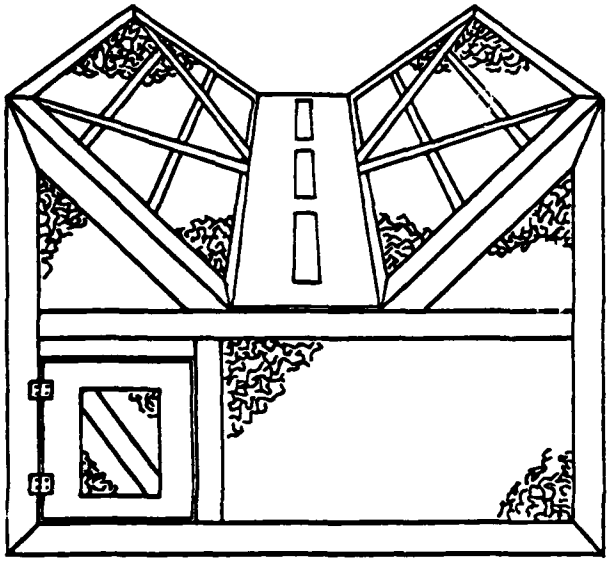
Disadvantages. At best, trapping will remove only 75-80 percent of the resident pigeons in any area. Results are not rapid and considerable effort is required. Removal is not a permanent solution to the pest bird problem, because other birds will move in if the source of attraction remains (sect. 5.1.).

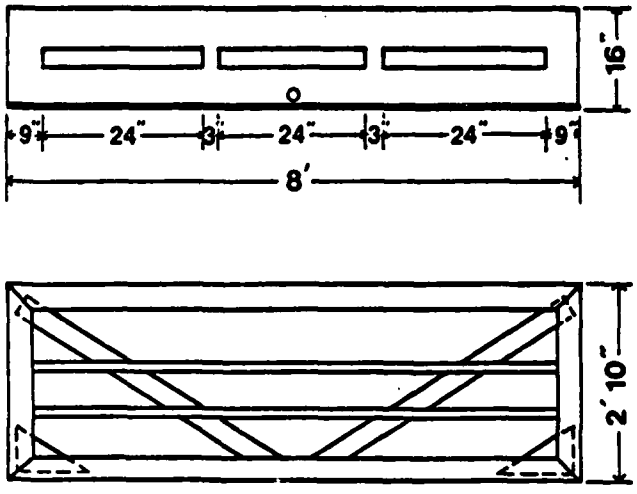
Restrictions on Use. Pigeons are not federally protected, so there are no legal restrictions on the capture of pigeons by live-trapping in most localities. In some areas, however, all birds including pigeons are protected by local regulations (sect. 7.3.). The PM should contact the Base Office of the Staff Judge Advocate to determine permit requirements.

5.2.9.3. Modified Australian Crow Trap

General Description. Also known as the center-drop trap, the modified Australian crow trap captures birds unharmed by luring them with bait and live decoys. The principle is that birds drop through an opening at the bottom on the V-shaped top of the trap (Figure 12) to take the bait. When attempting to leave, they go up into the ends of the "V" instead of back through the entrance slots.

Applicability. This trap is an effective means of capturing Starlings, House Sparrows, blackbirds, and other problem





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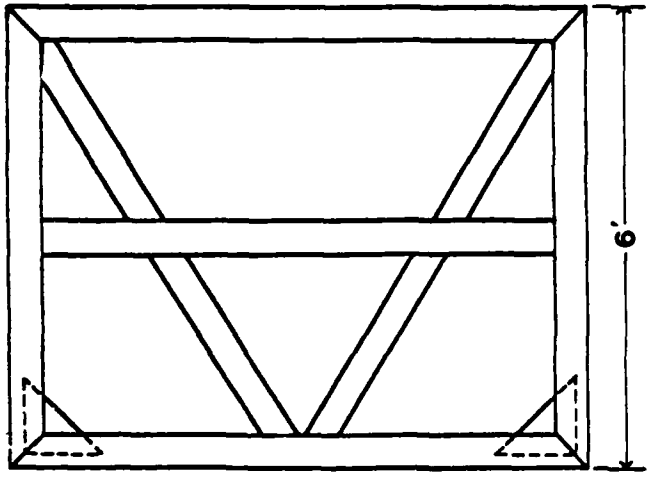
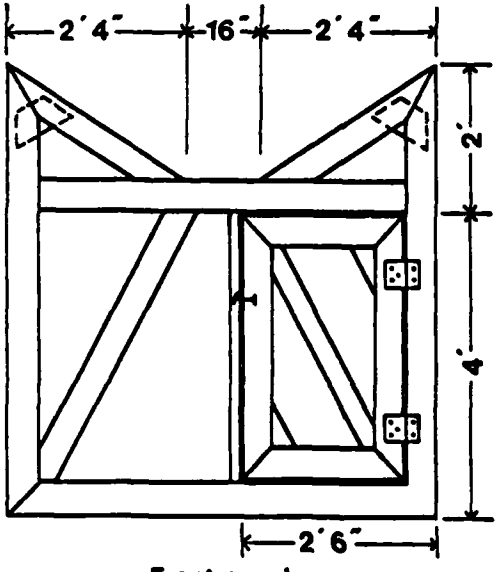


Side panel (make two)



Front panel
Rear panel (omit door)

Figure 12. Plans for a modified Australian crow trap (USFWS).

birds in an area of limited size. The design illustrated in Figure 12 was developed for Starling control in orchards, but the trap has many other applications. It is very successful when used around buildings and other man-made structures and provides an appropriate means of capturing protected songbirds.

Materials and Procedures. Traps should be at least 8 feet (2.4 m) long, 6 feet (1.8 m) wide, and 6 feet (1.8 m) high, and even larger if practical. To ensure effectiveness and prevent escape, the 1.75 inch width (4.4 cm) of the entrance slots and 9 inch (23 cm) minimum clearance at both ends are critical (Figure 12). The following materials are required for construction of one trap, according to the plans shown in Figure 12:

1 in mesh chicken wire - 40 ft x 6 ft

15 pieces lumber - 1 in x 4 in x 8 ft

25 pieces lumber - 1 in x 4 in x 6 ft

4 pieces lumber - 1 in x 1 in x 8 ft

1 piece exterior plywood - 1/2 in x 16 in x 8 ft

2 hinges

2 lbs. staples

Disassembly for moving or storage is easier if sections are bolted together rather than nailed.

Place traps in the open rather than under trees. For Starlings (as well as many other birds), the traps can be baited with rotting apples (one or two boxes), finely cracked corn, or feed pellets. Try to bait with a food that the birds are accustomed to eating. If one trap location or type of bait is unsuccessful, try another.

The trap will be most effective if decoy birds (10 to 12) are kept in the trap. It may be necessary to capture the first decoys by some other means. Provide the decoys with fresh water. Two suitable water containers can be created by splitting an old rubber tire down the middle. Traps should be tended regularly.

Advantages. The modified Australian crow trap is probably the best live trap yet devised, simple and effective. Protected species can usually be released unharmed, while non-protected species can be killed or transported and released.

Disadvantages. Trapping large populations of Starlings or other birds is impractical. It may be necessary to capture

decoy birds by other means. The traps are large and may require disassembly before moving or storage.

Restrictions on Use. Trapping permits may be required. To capture protected species, a permit is required from the U.S. Department of Interior (para 7.2.5.).

5.2.9.4. Nest-box Trap

General Description. This trap looks like a bird house. When a bird enters the box to investigate, its weight tips a device that drops it into a bag attached to the bottom of the trap. The trap is then automatically reset for another capture.

Applicability. Nest-box traps are used to reduce local numbers of Starlings or House Sparrows during their breeding season.

Materials and Procedures. Nest box traps come in several different designs. Plans for a trap designed to capture House Sparrows are shown in Figure 13. For Starlings, the opening should be made 2 inches (5 cm) instead of the 1 1/2 inches (4 cm) used for House Sparrows. When constructing the trap, the front wall should be put on last and fastened by screws instead of nails to make repairs easier. Glue pieces of hay and feathers to the back of the chamber. Use a tightly woven sack to receive the birds as they are captured. Place the trap on the side of a building or on a pole where the sack can hang freely and be easily reached with the use of a ladder. The elimination of existing nesting sites by means of exclusion (para. 5.2.3.) may increase the effectiveness of the traps.

Advantages. In a limited area, nest-box traps can effectively remove House Sparrows or Starlings. Live-trapping is a humane method and does not involve the hazards associated with chemical repellents or poisons.

Disadvantates. Nest-box traps will probably not eliminate all the pest birds in any area. A continuous trapping program is required. Large-scale trapping programs for common pest species are generally considered impractical. These traps are effective only during the breeding season.

Restrictions on Use. In most areas there are no legal restrictions on the use of nest-box traps to capture House Sparrows or Starlings (para. 7.2.5. and sect. 7.3.). However, this trap should not be used in areas where protected species (e.g., chickadees, bluebirds) are likely to be captured.

5.2.9.5. Raptor Traps

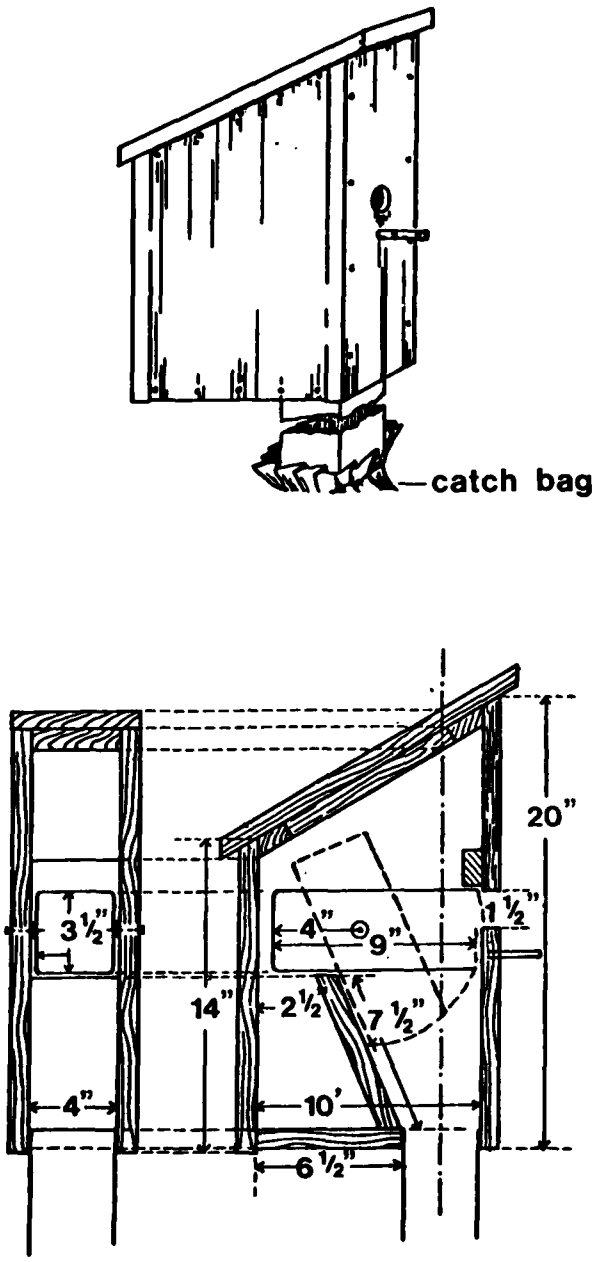


Figure 13. Nest-box trap for House Sparrows.
(From U. S. Fish and Wildlife Service)

General Description. A number of trap designs are available to capture raptors (hawks or owls). Two of the more common designs are the Verbail Pole Trap and the Bal-Chatri. The Verbail snares birds of prey by the feet when they perch atop a pole. The Bal-Chatri uses nooses to entangle the feet of raptors that are attracted by live bait in a cage.

Applicability. If hawks or owls create a strike hazard and cannot be discouraged from frequenting the area by other means such as elimination of their food supply (para. 5.2.2.3.), removal of perches (para. 5.2.2.5.), or putting sticky repellent (para. 5.2.5.2.) or spikes (para. 5.2.3.3.) on the perches, it is possible to trap them alive and release them elsewhere.

Materials and Procedures. A raptor trapping program can only be conducted with the cooperation of the U.S. Fish and Wildlife Service. Fish and Wildlife Service personnel will provide the traps or the specific information necessary for construction. Verbail traps were once manufactured commercially but are no longer available.

Verbail traps are set on top of posts. The raptor attempts to perch on the post, landing on a trigger plate which causes a spring to loop a cord around the bird's feet. The Fish and Wildlife Service also uses other types of pole traps specially adapted to capture birds of prey.

The Bal-Chatri is a cage constructed of hardware cloth with the top covered by a number of slip-knot nooses of monofilament nylon (fishing line). Different sizes of traps are used for different raptors. A live lure such as a mouse, Starling or House Sparrow (or perhaps a rabbit, chicken, or pigeon for owls) is placed inside the cage. A raptor landing on the cage gets its feet tangled in the nooses.

Raptor traps should be observed continuously or checked very frequently so that birds can be removed before they are injured. Captured birds should be transported for release at least 20 or 30 miles (32-48 km) away to keep them from returning.

Advantages. Trapping has no advantages over habitat modification (para. 5.2.2.) or tactile repulsion (para. 5.2.5.) techniques for discouraging raptors. The Bal-Chatri has several advantages in comparison to other raptor traps; specifically, it is simple, portable, easier to construct than the Verbail traps, and there is little danger of accidentally killing the birds.

Disadvantages. Trapping programs require considerable manpower and persistence. Other raptors may move in to replace those removed. Habitat modification (mowing to eliminate the

habitat of the prey animals which attract the raptors, removal of perches) or use of tactile repellents on the perches are better, more permanent solutions to a strike hazard caused by raptors.

Restrictions on Use. Raptors are protected by federal law and permits are required to capture them (para. 7.2.5.). Raptor trapping programs must be conductd with the cooperation of the U.S. Fish and Wildlife Service.

5.2.9.6. Netting

General Description. Birds can be captured by various types of nets including cannon nets, mist nets and floodlight traps. The cannon net use rockets or mortar projectiles to carry a large, light net over a flock of birds attracted by bait. Mist nets are made of fine black nylon thread (like a hairnet) that is virtually invisible when set against a dark background. The mist net is strung between two upright poles to capture birds in flight. The floodlight trap is a huge funnel-shaped net (supported by a frame) into which roosting birds can be driven. The funnel narrows down to a tent, lit by floodlights, which functions as a holding chamber.

Applicability. The cannon net was designed to capture waterfowl but has also been used in other applications. Mist nets will capture small birds such as House Sparrows if the nets can be located to obstruct the birds' normal flight path. The floodlight trap was designed to capture Starlings and blackbirds at their night roosts. Except in special circumstances, netting techniques are not likely to remove enough of the local population to be considered practical for bird control.

Materials and Procedures. If the PM feels a particular pest situation warrants the use of a netting technique, the U.S. Fish and Wildlife Service should be contacted. This organization can supply information on the availability of cannon nets or floodlight traps in a given locality. Mist nets are commercially available from suppliers of bird-banding materials (Appendix E). Fish and Wildlife Service personnel will also cooperate with the PM in a control program using these techniques.

Advantages. These netting techniques permit the capture of birds when other trapping techniques may be ineffective.

Disadvantages. Usually these techniques will not catch enough birds to effectively control a pest problem. Their use is limited and not practical for most Air Force bases.

Restrictions on Use. Federal permits are required (para. 7.2.5.). Netting programs should only be conducted with the cooperation of the U.S. Fish and Wildlife Service.

5.2.10. REMOVAL/REDUCTION BY POISONING

5.2.10.1. General Discussion

Killing birds with poison or other means should only be used as a last resort. Poisoning birds can result in bad public relations (Chapter 8) or present a hazard to personnel and protected species. Killing is not a permanent means of solving a pest bird problem. Other birds will move in to occupy the available habitat.

The previously described techniques of altering the concept, altering the situation (especially habitat manipulation), exclusion and repulsion are all preferable to reduction techniques such as poisoning. However, in some situations other approaches are not practical, and a toxic chemical is needed. Avitrol used in low concentrations to minimize mortality as described in 5.2.8.1., is recommended whenever feasible. If it is necessary to kill the birds, rather than to merely repel them, or if rapid results are mandatory, poisons can be used. Only poisons registered by the Environmental Protection Agency (EPA) specifically for birds may be used. Furthermore, Executive Order 11643 bans the use of some poisons on federal property (para. 7.2.4.). Unauthorized poisons are unlikely to be effective or may present a severe hazard to personnel. For one or more of the above reasons, strychnine, thallium sulfate, and poison perches (containing Fenthion or Endrin) are not recommended. Poisons that might be considered for use by the PM are "Avitrol" and "Compound DRC-1339", which is sold under the tradename "Starlicide". These poisons are described in the following sections.

5.2.10.1. Avitrol (4-Aminopryidine)

General Description. Avitrol is a toxic chemical used to treat bait. When treated bait is mixed with untreated bait in low concentrations, it can be used as a psychological repellent (para. 5.2.8.1.). In higher concentrations, it is used as a poison.

Applicability. Avitrol can be used as a poison for Domestic Pigeons and House Sparrows in situations where rapid results are required, non-target species are not present, and the occurrence of dead birds in the surrounding area is not likely to cause an adverse public reaction.

Materials and Procedures. The materials and procedures are the same as for use of Avitrol as a repellent, as described in para. 5.2.8.1. Pre-baiting is the most important part of the program. The only difference in use is that more treated bait is used, so that more birds are affected and each bird ingests more treated bait. For example, pigeons can be

by using 5:1 mixtures of treated whole corn instead of the
end used when low mortality is desired. For House
s, the straight concentrate of treated mixed grains or
ops (0.5 percent 4-aminopyridine) can be used if rapid
are needed, whereas a 10:1 mix of untreated to treated
normally used for repulsion. When using this toxicant in
centration, proper handling, bait placement, and clean-up
al.

Advantages. Avitrol used in high concentrations to
e birds achieves more rapid results than when used as a
nt.

Disadvantages. High concentrations increase hazards
onnel and protected species. Dead birds must be located
perly disposed of. Birds may fly considerable distances
being affected. Poisoning birds is unpopular and may
n adverse public reaction.

Restrictions on Use. Avitrol should be handled by
personnel who are properly licensed and certified. U.S.
d Wildlife Service personnel should be consulted before
g a management program using this chemical. Permits are
d in some localities for use on unprotected species (para.
and sect. 7.3.). When used for non-protected species,
ould not be exposed where it may be taken by protected
. It cannot be used where streams or ponds may be con-
ed by the chemical being transported by runoff (i.e.,
e of rainwater).

3. Starlicide (3, chloro-p-toluidine hydrochloride or Compound DRC-1339)

General Description. Feed pellets treated with this
hemical are marketed under the trade name "Starlicide",
s used to poison Starlings and blackbirds at livestock and
feedlots.

Applicability. This poison is registered for use only on
gs and blackbirds at livestock and poultry feedlots. If
s near an air base are attracting birds that are creating
e hazard or if a large proportion of a roosting flock is
at a particular feedlot, this control method may be
iate.

Materials and Procedures. The chemical "3, chloro-p-
ne hydrochloride" was tested as a bird poison by the
Wildlife Research Center of the U.S. Fish and Wildlife
, and it was given the code name Compound DRC-1339. The
ially available product, marketed by Ralston-Purina
and sold only to professionals, consists of feed pellets
with the poison. "Starlicide" is the registered trade-

mark of this product, and the 0.1 percent mixture is called "Starlicide Complete".

A feeding trough 4 feet (1.2 m) long, 12 inches (30 cm) wide and 3 inches (8 cm) deep can be constructed, or the bait can be placed in plastic pans. Pre-baiting with untreated feed pellets may be necessary to get the birds accustomed to feeding on pellets in the trough or pans. Bait can also be broadcast on dry or frozen ground, but this increases the chance that protected species will be affected. Pre-bait for at least several days or until good acceptance is obtained. If protected species feed on the bait, discontinue the program or try pre-baiting in a different location. When the Starlings or blackbirds are regularly feeding on the untreated bait, replace it with the treated mixture. No more than 20 lbs per acre (22.4 kg per ha) should be used for large feedlots, i.e., those over 10 acres (4 ha), or more than 50 lbs per acre (56 kg per ha) for small lots. The poison may take up to about 48 hours to take effect, and birds never die less than 3 hours after ingestion.

Gloves must be worn when handling treated bait. Excess bait and dead birds must be recovered and destroyed by incineration. The bait must be placed where it is inaccessible to poultry or livestock, and label instructions must be carefully followed.

Advantages. Starlicide is less toxic to mammals than Avitrol. It is less toxic to light-colored birds than to dark birds (such as Starlings) so the danger to many protected species is reduced.

Disadvantages. There is always some danger that protected species may be affected. Poisoning birds is unpopular and may cause an adverse public reaction, especially since the slow-acting poison will not take effect until birds have moved to another, perhaps more populated, location.

Restrictions on Use. U.S. Fish and Wildlife Service personnel should be consulted before starting a management program using any toxicant. Poisons must be handled only by properly certified personnel. Permits are required in some localities (sect. 7.3.). Toxicants should not be used where protected species may be affected.

5.2.11. REMOVAL/REDUCTION BY OTHER LETHAL METHODS

5.2.11.1. Live Ammunition

General Description. Live ammunition can be used to scare or kill birds and can be both a repulsion or a reduction technique.

Applicability. Shooting can be used to eliminate small flocks of pest birds in limited areas. Live ammunition is also used to frighten away flocks of birds or to reinforce other techniques, such as airbursts (para. 5.2.4.3.), gas cannons (para. 5.2.4.4.) and recorded distress calls (para. 5.2.4.1.). In certain circumstances, hunting may be encouraged to control game birds such as waterfowl that may cause a strike hazard. Shooting has been attempted as a control method for gulls on airfields but has generally been ineffective for this purpose.

Materials and Procedures. The firearm and ammunition used should have sufficient power to kill quickly. However, shooting near buildings or equipment or using excessive firepower will increase the chance of damage and the hazard to personnel. For pigeons, a .22 caliber smoothbore rifle (using ammunition loaded with number 12 birdshot), a .410 caliber shotgun (using ammunition loaded with either Number 12 or Number 9 birdshot), or even a high-powered air rifle can be used. Larger bore shotguns can be effectively used in more open areas. When shooting , use the best marksmen available. A local rod and gun club or security police personnel could perform this function. A blind can be constructed on the roof of a hangar and the birds can be shot as they fly into the hangar or over the roof. Adequate safety precautions must be observed. Restrict personnel access to the area. Post guards in the hangar to ensure no personnel enter the restricted area. Remove aircraft and ground equipment from the washrack and hangar apron. Limit the firing zone to protect other buildings. If firing is directed toward the flight line, move aircraft to a safe area.

When using live ammunition to reinforce repulsion techniques, only an occasional bird need be killed. Leaving the dead bird where it is visible to the rest of the flock may increase the effectiveness of the program. However, the dead bird must be removed when the PM leaves the area to ensure scavenger birds are not attracted to the carcass. It is important to be persistent. Discontinuing a program too early may result in loss of whatever progress has been made.

Advantages. Shooting is selective in terms of the species (or individual bird) to be eliminated. In some circumstances, it may be the least expensive and most rapid technique available. Shooting will reinforce other repulsion techniques and may greatly increase their effectiveness.

Disadvantages. Like other reduction techniques, shooting (used alone) is rarely effective for population control. Other birds are likely to replace those shot. Live ammunition is hazardous to people and aircraft and may damage buildings or equipment. Shooting birds may cause an adverse public reaction.

Restrictions on Use. This technique cannot be used where firearms are restricted or in other areas where a safety

hazard may result. Federal permits are required to kill protected species including gulls and blackbirds (para 7.2.5.). State permits may also be required (sect. 7.3.).

5.2.11.2. Nest Destruction

General Description. Nests of non-protected species can be destroyed by tearing them down, if accessible. Nest destruction should immediately be followed by a permanent exclusion technique.

Applicability. Existing nests must be removed before installing material to exclude Domestic Pigeons, Starlings, or House Sparrows from nesting in or around buildings.

Materials and Procedures. Accessible nests may be torn down by a long pole with a hook attached to the end. Because birds will build new nests, repeat this procedure at two-week intervals throughout the spring and summer. Thus, after eliminating a nest, an exclusion technique should be used to prevent the birds from renesting in the same location (para. 5.2.3.).

Advantages. Nest destruction before exclusion is required to prevent foul odors from trapped birds and eggs. Nest destruction alone has no advantages, except that there is no cost for materials.

Disadvantages. Destroying eggs or young birds can result in adverse public reaction. Nest destruction without exclusion would require considerable effort and yield no lasting results. Many nests, particularly Starling nests, are difficult to reach.

Restrictions on Use. Active nests of protected species cannot be disturbed without a permit (para. 7.2.5.).

5.2.11.3. Wetting Agents (Compound PA-14 Stressing Agent or Tergitol

General Description. Wetting Agents are sprayed on birds to wash the oil off their feathers. Accompanied by water and cold temperatures, this results in death by exposure. These chemicals are also called stressing agents.

Applicability. This technique can be used only with the cooperation of the U.S. Fish and Wildlife Service for population reduction in blackbird or Starling roosts that may represent a health hazard.

Materials and Procedures. A detergent/surfactant used by the U.S. Fish and Wildlife Service is known as Compound PA-14 Stressing Agent or "Tergitol". It is sprayed on a roost on a

cold rainy evening. Generally, temperatures lower than 45°F (7°C) are required for effectiveness. Large volumes of water are required, about 3000 gallons per acre (28,000 liters per ha). Detergent concentrations of 0.1 percent are commonly used. Various means of application have been used including airplanes and helicopters, specially-constructed irrigation systems within the roost, and fire hoses from elevated platforms or cherry-pickers.

Because this method is to be used only when a health hazard is present, the PM must then decontaminate the area. Decontamination methods that can be used in buildings (Chapter 4) should not be used in natural environments. Decontamination must be coordinated with the U.S. Fish and Wildlife Service and the U.S. Public Health Service.

Advantages. If properly applied and successful, this technique can be an effective emergency measure for reducing a roosting population when a health hazard at a roost is imminent. However, there are few, if any, practical advantages over other techniques.

Disadvantages. Wetting agents are costly, difficult to apply and often unsuccessful. It is difficult to get a sufficient amount of chemical and water on a large portion of the roosting birds. It requires very specific weather conditions. If successful, non-target species will likely be killed also. Birds killed must be collected and properly destroyed. Adverse public reaction is common because many people consider this an inhumane method. The method does not eliminate contaminated droppings that are present. Because a health hazard exists decontamination is still necessary.

Restrictions on Use. Wetting agents can be used only with cooperation of the U.S. Fish and Wildlife Service and should only be attempted when habitat manipulation or repulsion techniques are unsuccessful.

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REVIEW EXERCISE

A. For each of the following tasks, indicate if the control method described is:

a) altering the concept

b) altering the situation

c) exclusion

d) repulsion

e) removal/reduction

NOTE: Some items may use more than one method.

____1. Trees in a military family housing area are thinned to eliminate roosting sites for passerines.

____2. Modified Australian crow traps are placed on top of aircraft hangars to reduce numbers of House Sparrows roosting in the hangar.

____3. At a western US installation, Burrowing Owls are inhabiting burrows from an abandoned prarie dog colony at the end of an active runway. Because of the hazard they present to aircraft, the burrows are plowed under to destroy the owls' nesting habitat.

____4. Migratory waterfowl are using a lake next to the airfield. Because of the temporary nature of the situation, no action is taken to repel the birds.

____5. Before screening is installed in a hangar superstructure to eliminate roosting sites, a shooting program with pellet guns is used to chase the birds from the superstructure.

____6. Gulls and crows are attracted to food openly disposed of in a dumpster at the installation commissary. Feeding is eliminated by placing open food waste in plastic bags before disposal.

____7. Ring-billed Gulls are using the airfield as a loafing and feeding area. The decision is made to reduce the food source by applying insecticides, using bioacoustics, and maintaining grass at 8-12 inches in height.

B. Multiple Choice.

8. Cost reduction for grounds and equipment maintenance is one benefit of:

   a) a tree-thinning program.

   b) improving airfield drainage.

   c) a grass height management program.

   d) a forestation program.

9. Which of the following control techniques solves a problem at its source?

   a) elimination by poisoning

   b) elimination by nest destruction

   c) elimination of food sources

   d) elimination of roosting sites

10. Which of the following can be used as either repulsion or reduction techniques?

   a) Avitrol and live ammunition

   b) Avitrol and DRC-1339

   c) Tergitol and live ammunition

   d) Tergitol and DRC-1339

11. If birds feed on insects exposed during airfield mowing operations, causing a strike hazard, the best solution is to:

   a) apply a suitable insecticide.

   b) apply a suitable avicide.

   c) mow grass only when clearance is given by base operations personnel.

   d) mow grass at night or on weekends.

12. Which of the following types of repulsion is not generally used on an airfield?

a) auditory

b) tactile

c) taste/odor

d) behavior

13. Habitat modification does not include removal of:

a) food.

b) water.

c) nests.

d) perches.

14. A poisoning program using Avitol to control pigeons and House Sparrows around buildings should be considered:

a) before trapping but after shooting.

b) after trapping and after screening.

c) before sticky repellants but after screening.

d) before trapping and before screening.

15. A flock of blackbirds infested with brown dog ticks is roosting in a wooded area near a Security Police dog kennel. After preventive tick control measures are taken at the kennel, which of the following provides the longest term solution to removing the birds from the trees?

a) use of automatic exploders

b) use of distress calls

c) elimination of roosting sites

d) elimination of feeding sites

CHAPTER SIX OVERVIEW

Chapter Six discusses methods of effectively surveying an installation to identify existing or potential bird management problems. A sample survey checklist is provided.

Chapter Objective:

Identify general principles of pest and hazardous bird surveys.

Key Words and Terms:

Food source

Water source

Habitat

Ecology

Building features

CHAPTER 6. SURVEYING A BIRD MANAGEMENT PROBLEM

6.1 INTRODUCTION

Before any bird problem can be effectively and efficiently controlled, it must first be identified and evaluated. For many types of pest bird problems, it is important to begin a control program while the problem is just beginning to develop or even before it begins. The PM should inspect the entire air base at least once a month throughout the year. During spring and fall, when birds are migrating through the area, daily spot checks are needed in addition to the monthly inspections.

6.2 OBJECTIVES

A primary objective of the survey is to properly identify bird species that may create damage problems or strike hazards. Bird identification, including the use of a field guide, is discussed in some detail in Chapter 3. Some species or species groups (such as gulls and blackbirds) are more likely to become involved in pest situations than other birds, and different birds will visit a given locality at different times of the year. During periodic surveys the PM should watch for the arrival of birds that may create problems. One can use past experience and good documentation to anticipate the arrival of problem birds and to be ready to begin a control program before the birds establish a pattern for the season.

The second objective of the survey is to determine if a problem exists. The presence of birds, even in large numbers, is not a problem unless the birds are creating a strike hazard, a health hazard or causing damage to buildings or equipment. If a problem exists, the PM must decide whether an active management program is needed. During migration, the birds may soon leave on their own. In other cases, the expense of a management program might exceed the cost of the damage that would result if nothing were done.

Another objective of the survey is to specifically identify the behavior patterns of the birds that are causing the damage or hazard. Bird behavior is discussed in detail in Chapter 2. The PM must determine specifically <u>what</u> the birds are doing, <u>where</u> they are doing it and <u>when</u> they are doing it. For example, are birds a problem because they feed near the runway, attempt to nest in aircraft, or roost near a housing area? These are examples of bird behaviors that may cause problems because of the location in which the birds carry out their activities. The time of day and time of year can also be important factors in the behavior patterns that must be identified during the surveys. <u>When</u> are the birds doing the feeding, nesting, or roosting that causes the problem?

CHECKLIST FOR SURVEYING A BIRD PROBLEM

Location _____

Survey Conducted by: _____

Date: _____ Time of Day: _____

Weather Conditions: _____

	Present on Base	Inspected	Comments
1. Types of Habitat			
a. Aircraft hangars	( )	( )	
b. Housing area	( )	( )	
c. Other buildings	( )	( )	
d. Landfill	( )	( )	
e. Parklike landscaped area	( )	( )	
f. Agriculture	( )	( )	
g. Runways and/or grassy field	( )	( )	
h. Brushland	( )	( )	
i. Forest	( )	( )	
j. Forest plantation	( )	( )	
k. Marsh	( )	( )	
l. Pond	( )	( )	
m. Stream or drainage ditch	( )	( )	
n. Shoreline or mudflats	( )	( )	
o. Other (specify)	( )	( )	

Table 2 (Cont.)

2. Building Features to Inspect for Evidence of Pest Birds

	Type of Evidence			
	Droppings (X)	Nest Material (X)	Birds (list species and numbers)	Comments
a. Rooftop	( )	( )		
b. Roof edges or firewalls	( )	( )		
c. Window ledges	( )	( )		
d. Other outside ledges	( )	( )		
e. Underneath eaves	( )	( )		
f. Air conditioners	( )	( )		
g. Ventilators	( )	( )		
h. Chimneys	( )	( )		
i. Gutters and downspouts	( )	( )		
j. Holes or construction flaws	( )	( )		
k. Signs	( )	( )		
l. Antennas	( )	( )		
m. Ornamental features	( )	( )		
n. Other outside features	( )	( )		
o. Beams and rafters	( )	( )		

Table 2 (Cont.)

	Type of Evidence			
	Droppings (X)	Nest Material (X)	Birds (list species and numbers)	Comments
p. Inside ledges	( )	( )		
q. Inside corners or recessed areas	( )	( )		
r. Insulation	( )	( )		
s. Other inside features (specify)	( )	( )		
t. Equipment (specify)	( )	( )		

Table 2 (Cont.)

3. Other Evidence of a Pest Bird Problem

   a. Reports or complaints. (Give details and means of verification).

   b. Birds observed loafing on or near runway. (List species and numbers).

   c. Birds observed feeding on or near runway. (List species, numbers, and food being taken).

   d. Birds crossing flight path of planes. (List species, source and destination of birds).

   e. Other. (Specify).

Table 2 (Cont.)

4. Summary of Birds Observed

Species	Numbers seen	Habitat in which seen	Activity (feeding, nesting, roosting, flying)
Pigeon			
Starling			
House Sparrow			
Protected species (list)			

Table 2 (Cont.)

5. Are any of the birds listed in (4) causing economic damage or creating a health or safety hazard?

   If so, list species and type of damage or hazard.

6. What is attracting the problem birds to the area?

   a. food
   b. water
   c. a place to nest
   d. a place to escape enemies or avoid harsh weather (includes roosting and loafing areas).
   e. A combination of the above. (Specify which).

7. How long has the problem existed?

8. What season(s) of the year is there a problem?

9. Is the problem being caused by resident birds or transient birds?

Table 2 (Cont.)

10. What time(s) of day is there a problem? (Make a graph by plotting numbers vs. time of day.)

11. Are the birds developing a pattern dependent on weather (e.g. gulls loafing on the runway in overcast weather)?

12. Does the situation warrant the time and expense of an active management program? What would probably happen if no action were taken at this time?

13. List control techniques previously applied or attempted. If unsuccessful, list reasons for failure.

Table 2. (Cont.)

14. Management approaches considered. (For each approach in turn, list reason for rejection).

a. Change the concept

b. Change the situation (including habitat manipulation)

c. Exclusion

d. Repulsion

e. Removal/Reduction

Another objective of the inspection is to analyze relationships between the birds and the airdrome environment so the PM can determine specifically what is attracting the birds that are causing the problem. Chapter 2 discusses the relationships between birds and their environment (i.e., the ecology of birds). Birds, in general, need four things: (1) food, (2) water, (3) a place to nest, and (4) a place to escape their enemies or avoid harsh weather. During the periodic surveys, the PM should determine which of these four things is attracting the problem birds. More than one factor could be important in any situation. However, quite frequently only one of these factors is the main attraction; if it can be eliminated by means of habitat manipulation, the pest problem will be solved (para. 5.2.2.).

6.3 SURVEY CHECKLIST

Table 2 is a checklist for surveying a bird problem. Copies can be made of this checklist and used during each periodic inspection. This form can be modified for use at a particular base. In addition to helping the PM identify and evaluate a pest problem and decide if active control is needed, these checklists document the inspection and should be saved for reference when future pest problems arise or when the same problem recurs.

Pest problems change with time. Therefore, it is very important to fill out both the date and time of day at the top of the checklist. Weather conditions should also be recorded because they affect the bird activities.

Item 1 on the checklist can serve two purposes. First, it lists the different types of habitats present on an air base. Second, when spot checks are conducted in addition to the periodic complete inspections, this item permits the PM to check specific areas that were inspected.

Item 2 is a list of building features that frequently are used for nesting or roosting by pigeons, Starlings or House Sparrows. For each feature, the species and number of birds seen and the presence of bird droppings or nest material can be indicated on the checklist during inspections of housing areas, hangars and other buildings. Try to sketch the situation as well as describe it in words.

Item 3 on the checklist is to document evidence of other types of potential bird damage or hazards. The PM should personally investigate complaints before beginning a control program.

Item 4 is used to record the species numbers, location and activity of birds observed during the inspection. Remember that a federal permit is required before beginning a control program that might affect any protected bird species. A map of the air

base and surrounding area showing the locations of bird concentrations and attractive habitat features, as well as the movement patterns of the birds observed, can be used to supplement data recorded on this checklist. Figure 14 is a sample bird survey form including a runway diagram (LAFB Form 0-2), which could help document bird problems.

Item 5 requires careful analysis of the situation. Is damage being caused that will cost money to repair, or is it just a nuisance situation? Is a hazard to aircraft or people being caused by the presence or activity of the birds?

For Item 6, the PM should check the ecological factor or combination of factors that attracts the birds to the particular locality where they are a problem. Careful field observation is required; do not jump to conclusions.

On Item 7 of the checklist the PM should record how long the problem has existed. Refer to checklists completed during previous inspections and ask questions of personnel who have been working in the area. The same should be done for Item 8, in which the season of the year when the problem occurs can be recorded. These last two items, as well as correct identification of the species and information obtained through consultation with state or U. S. Fish and Wildlife Service biologists, will help complete Item 9, which states whether the birds are residents or just passing through the area. This answer will help determine the need for an active management program.

Record the time of day when a problem occurs (Item 10) to help determine whether a strike hazard can be avoided by careful mission scheduling (para. 5.2.2.2.). A graph with bird numbers plotted against time of day will help evaluate this possibility (Figure 9).

Observing bird behavior in relation to weather conditions (Item 11) may help predict when a problem is likely to occur. For example, gulls may loaf on the airfield on overcast days.

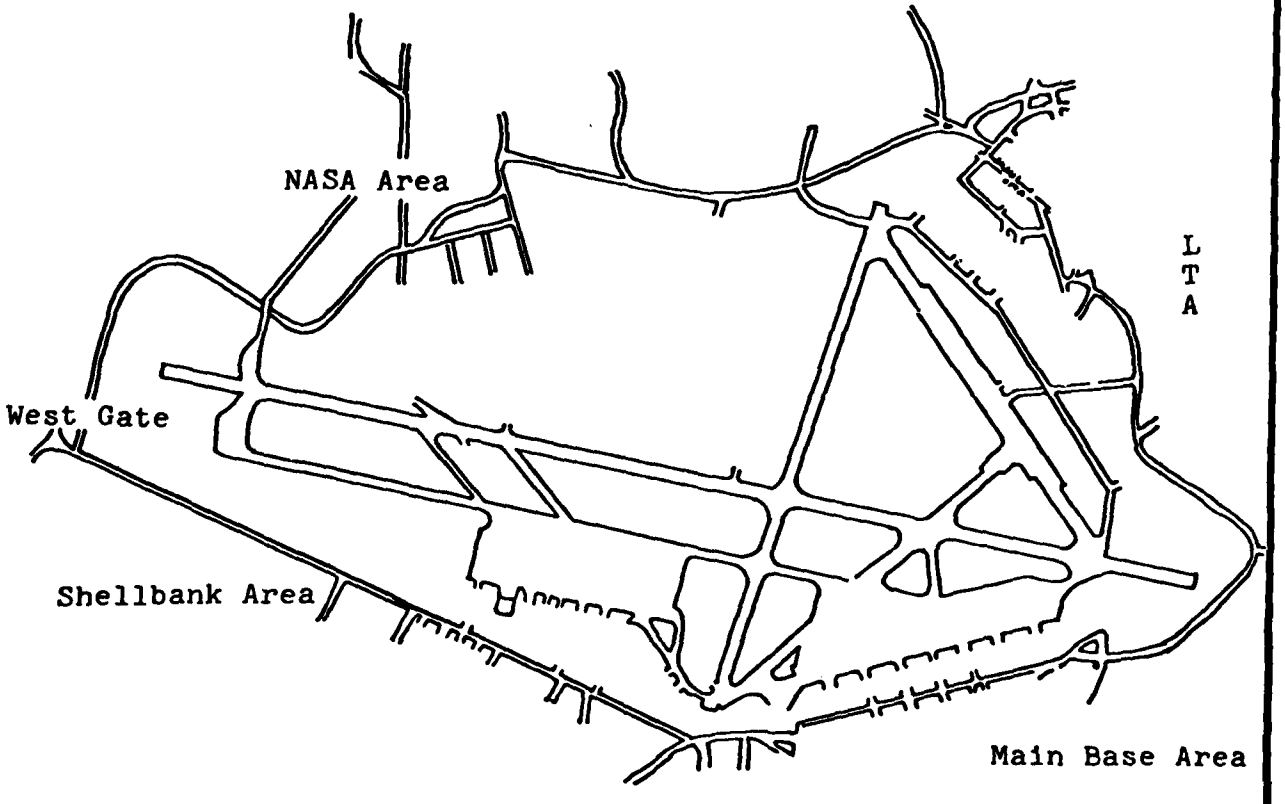
Use Item 12 to evaluate the need for an active management program. Consider the alternative of taking no action, and predict what would happen. Take all available evidence and past experience into account, and do not jump to conclusions. If you are not sure, say so, and collect more information. Consult with U. S. Fish and Wildlife Service personnel.

In Item 13, list any actions previously attempted to solve each particular bird problem and the suspected reasons for their failure if they were unsuccessful. This will permit rapid evaluation of control measures worth repeating, the proper refinement of partially successful techniques and unnecessary duplication of futile efforts.

DAILY BIRD SURVEY

DATE:	TEMPERATURE:	WIND:	CLOUDS:
TIME:	RAINING, SNOWING:	GROUND CONDITIONS:	
INITIALS:	BIRD WATCH CONDITIONS:		

BIRD CODES:
H.G. – Herring Gull
L.G. – Laughing Gull
B. – Blackbirds
R. – Raptors (Hawks, Owls, etc.)
P. – Passerines(Sparrows, Robins, etc.)
O. – Other



NO.	CONDITIONS	ACTION TAKEN	RESULTS
1.			
2.			
3.			

Figure 14. Sample bird survey form (LAFB Form O-2).

In Item 14, check each approach to management as consideration is given to it. This should be done with reference to Chapter 5, which describes the various techniques available within each of the five approaches. Consider each approach in turn, and reject only those that contain no acceptable technique for the specific problem at hand.

REVIEW EXERCISE

1. Before any bird problem can be effectively and efficiently controlled, it must first be:

    a) identified and documented.

    b) identified and evaluated.

    c) identified and described.

    d) evaluated and documented.

2. Daily spot checks are needed:

    a) during the breeding season.

    b) during migration seasons.

    c) in hangars.

    d) never.

3. The PM should be prepared to begin a control program:

    a) before a bird strike occurs.

    b) before a roost is established.

    c) before a seasonal pattern is established.

    d) after a seasonal pattern is established.

4. The primary objective of a survey is to:

    a) identify birds that may create a problem.

    b) determine whether a problem exists.

    c) identify the behavior patterns that are causing a problem.

    d) determine what is attracting the birds to the airdrome environment.

5. How often should complete installation inspection be conducted?

   a) every two weeks

   b) every month

   c) every six weeks

   d) every year

6. If the PM must use pyrotechnics, water hoses or bioacoustics to chase Starlings from trees in the evening, which of the birds' habitat requirements is he altering?

   a) food

   b) water

   c) shelter

   d) nesting materials

7. If gulls are attracted to an airfield each year in August because grasshoppers are abundant in the grass, which is the most effective, practical solution to the problem?

   a) chase the birds with pyrotechnics and distress tapes

   b) alter flying operations each year for the month of August

   c) poison the grasshoppers early in the summer

   d) shoot the gulls to convince them airfields are dangerous

8. Why is it necessary to determine whether birds observed are resident or transient?

   a) because migratory birds are protected by federal law

   b) because transient birds may soon leave the area on their own

   c) because transient birds are harder to repel than resident birds

   d) because resident birds are protected by state law

Before a bird problem can be effectively and efficiently controlled, the first step is to:

a) purchase a variety of traps.

b) obtain necessary permits to kill the birds.

c) identify and evaluate the problem.

d) initiate a preliminary control measure.

Which of the following statements is true?

a) A removal/reduction technique is always the most desirable.

b) Birds are attracted to the airdrome environment only for food and water.

c) Any bird in the airdrome environment represents a hazard to aircraft.

d) Some pest bird problems may be temporary in duration and may not justify an active control program.

Which of the following statements is <u>not</u> true?

a) Some birds may be a pest problem only during certain times of the year.

b) The types of habitat available in the airdrome environment should be carefully considered when analyzing a bird problem.

c) Buildings should be inspected as part of a pest management survey.

d) Time of day is not important when considering a bird control problem.

12. The presence of a large number of birds in the airdrome environment:

    a) does not pose a problem unless there is a strike hazard, health hazard, or damage to buildings or equipment.

    b) means a reduction program should be initiated immediately.

    c) means repulsion is the only method that would be successful.

    d) is a problem only if the birds are very large.

13. From past experience and documentation (record keeping) of previous pest problems and their solutions:

    a) the PM may be able to anticipate the arrival of particular pest species.

    b) the PM can determine previously used control methods and whether or not they were successful.

    c) the PM may be able to predict if a problem is of a temporary nature

    d) all of the above.

CHAPTER SEVEN OVERVIEW

Chapter Seven discusses legal aspects of bird control. Federal and state legislation affecting birds is discussed and recommendations are made regarding selection of the most acceptable control method from the legal point of view.

Chapter Objectives:

1. Determine when conditions require a permit to conduct bird control.

2. Identify offices to be contacted regarding bird control.

3. Determine what legal actions are required before starting a bird control program.

Key Words and Terms:

Bird banding

Endangered/threatened species

Protected/non-protected species

Animal damage control

CHAPTER 7. BIRD CONTROL AND THE LAW

7.1 INTRODUCTION

The important role of birds in the balance of nature has resulted in their protection under international treaties, federal laws, and state and local regulations. These laws protect birds from harassment and from indiscriminate killing. These regulations do not hinder the PM; rather, they establish a framework to conduct bird control operations. When birds represent a potential hazard to human life or safety or are associated with significant economic loss, federal and state agencies will permit the elimination or reduction of these problems and will often provide valuable assistance to the PM. This chapter furnishes information and background material on when and how the PM must obtain permits and establish control programs with the approval of the various governing agencies.

7.2 THE ROLE OF THE UNITED STATES GOVERNMENT

7.2.1 THE NATIONAL ENVIRONMENTAL POLICY

Major bird control programs on Air Force bases could have a significant impact on the environment. Under the National Environmental Policy Act of 1969 (NEPA), they may require the preparation of an environmental impact statement or assessment. The PM must not initiate major control efforts without consulting the base Office of the Staff Judge Advocate and the U. S. Fish and Wildlife Service.

7.2.2 MIGRATORY BIRD LEGISLATION

Most wild birds in North America are fully protected by treaties between the United States, Canada, Mexico and other countries. Many federal laws concerning wildlife exist; two of these are particularly important to the PM and are noted here. The Migratory Bird Treaty Act of 1918 implements a 1916 treaty with Canada to protect migratory birds whose welfare is a shared state and federal responsibility. It regulates the taking of migratory birds and provides penalties for violations. The treaty adopted a system of protection of migratory birds to assure preservation of species either harmless or beneficial to man. It sets dates for hunting seasons for migratory birds, prohibits hunting of insectivorous birds and permits killing of birds when they are injurious to agriculture. In 1936, a similar treaty was concluded with Mexico and was implemented by an amendment to the Migratory Bird Treaty Act. In 1972, the treaty was again amended pursuant with a treaty with Japan to include 32 additional families including birds such as eagles, hawks, owls and crows.

7.2.3 THE ENDANGERED SPECIES ACT

The Endangered Species Preservation Act of 1966 was the first U. S. endangered species legislation, although in 1940 an act had been passed specifically protecting Bald Eagles and Golden Eagles. The 1966 Act was broadened by passage of the Endangered Species Conservation Act of 1969, which was in turn superseded by the Endangered Species Act of 1973, and amended in 1978. The legislation requires the Secretary of the Interior to compile a list of Endangered Species (in danger of extinction) and Threatened Species (likely to become endangered). It includes authorization to designate Critical Habitat for those species on the list and to acquire lands to conserve them. Critical habitat refers to "...the specific areas...on which are found those physical or biological features...essential to the conservation of the species and...which may require special management considerations or protection...". In addition, it prohibits any federal action that would jeopardize the continued existence of threatened or endangered species or destroy or modify habitat considered to be critical to an endangered or threatened species. It does allow the review of disputed projects for possible exemption.

7.2.4 CHEMICALS FOR BIRD CONTROL

The only chemicals, including repellents and toxicants, that can be used for bird control are those that are registered with the U. S. Environmental Protection Agency (EPA). This registration specifies those situations and bird species for which these chemicals can be exclusively used, as well as application rates for toxic chemicals. All the substances and uses recommended in Chapter 5 are currently registered by the EPA.

In 1972, Executive Order 11643 was issued pertaining to "Environmental Safeguards on Activities for Animal Damage Control on Federal Lands". This order restricts "...the use on federal lands of chemical toxicants for the purpose of killing predatory mammals or birds...", and restricts the use"...of chemical toxicants which cause any secondary poisoning effects for the purpose of killing other mammals, birds, or reptiles". In a specific emergency situation, including cases involving "...the protection of the health or safety of human life...", the use of such toxicants can be authorized by the head of a federal agency if it has been determined that other control methods would not be effective. This Executive Order limits the types of poisons that can be used for the control of any bird species, including non-protected species. Thus, some pesticides currently registered by the Environmental Protection Agency cannot be used on air bases.

7.2.5 PROTECTED VS. NON-PROTECTED SPECIES

Starlings, House Sparrows, and Rock Doves (Domestic Pigeons) are not protected by federal law although they may be protected by state or local legislation. Blackbirds, cowbirds, grackles, and crows are protected under the Migratory Bird Treaty Act. The PM must first identify the problem species. Even if the problem species is unprotected and permits are not required for control measures, non-target protected species must not be harmed. In the event of any pest bird problem, the U. S. Fish and Wildlife Service district office should be contacted (Appendix C). These offices have information necessary to provide help with the problem at hand and recommend alternative solutions. Bird control permits for protected species are issued through the Law Enforcement Division of the Fish and Wildife Service and are required for control measures that involve harassing, capturing, or killing protected species.

7.3 STATE GOVERNMENTS

Some states require permits to control protected species and only allow use of pesticides registered in that state. Such permits and other procedural requirements (e.g., paying fees, filing reports, etc.) do not normally apply to activities of the Federal Government. However, the state natural resources agency should be contacted about any bird control program. A list of state natural resources agencies is provided in Appendix D. The PM should contact the base Office of the Staff Judge Advocate to determine local permit requirements.

Contact with appropriate state authorities is strongly recommended for a number of reasons. It is Air Force policy to abide by the substantive standards of state wildlife laws. Many states have their own lists of endangered species. These may vary greatly from federal lists. Some states will also apply special standards or criteria for a specific control technique. In addition to contacting the state agency, the PM should inform the state conservation officer for the local district of the pest control problem and the planned control procedures.

7.4 RECOMMENDED PROCEDURES

The following steps have been adapted for Air Force use from a procedure recommended by the U. S. Fish and Wildlife Service to insure that pest control programs are properly conducted:

1) Survey the problem and determine the species involved. Consider non-target species that may be affected.

2) Determine if a non-lethal method can be used to alleviate the problem.

3) Contact the base Office of the Staff Judge Advocate and local, state, and federal enforcement officials to discuss the control method that has been chosen.

4) Obtain permits.

5) Initiate the program with caution. This is particularly necessary where toxic chemicals may affect non-target species.

6) If lethal methods must be used, pick up dead birds and incinerate them as soon as possible.

7) These procedures should apply to controlling non-protected species (Domestic Pigeons, House Sparrows, and Starlings) when protected species may be affected by the program.

8) If the problem is beyond local and MAJCOM resources obtain assistance from AFESC/DEVN, Tyndall AFB, FL.

7.5 ENCOUNTERS WITH BANDED BIRDS

During pest management programs, the PM may encounter birds that have a numbered metal leg band. These bands are applied by people cooperating with the U. S. Fish and Wildlife Service, and records are kept on each bird banded in the United States, Canada, and Mexico. Banded birds should be reported to the U. S. Fish and Wildlife Service, Office of Migratory Bird Management, Bird Banding Laboratory, Laurel, Maryland 20811. As much of the following information as possible should be reported: (1) band number, (2) species, (3) sex, (4) age, (5) condition, (6) method of capture, (7) date, (8) location. Domestic Pigeons are not banded by the U. S. Fish and Wildlife Service and should not be reported.

If the banded bird is still alive, it should be released unless it represents a distinct hazard. The bird can be transported away from the airdrome environment if necessary, but state authorities must be contacted before any bird is removed from the air base property. In this case the location of the release should also be recorded.

If the banded bird is dead, the band should be removed, flattened, and included with the rest of the information before disposal of the bird. If the bird is in good condition, it should be frozen with the band left on its leg, because the Bird Banding Laboratory may wish to have the specimen deposited in a museum. The Bird Banding Laboratory should be notified that the specimen is being kept.

7.6 ENDANGERED OR THREATENED SPECIES

Although not likely, an endangered or threatened species (para. 7.2.3.) may become a pest bird, particularly large species such as Bald Eagles, Brown Pelicans and Peregrine Falcons. If such a species represents a hazard, the PM must contact the District Fish and Wildlife Service Office (Appendix C) for assistance. No control procedure that affects the animal in any manner should be used against endangered or threatened species by the PM.

If a bird is listed only on a state list of endangered or threatened species, then state wildlife officials should be contacted immediately. The PM should take no action until conferring with state officials about the specific problem. The PM should obtain a list of both state and federal endangered species from the agencies listed in Appendices C and D before conducting pest management operations.

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REVIEW EXERCISE

1. A PM plans to start a poisoning program on an airfield to repel Red-winged Blackbirds. What legal consultation should be sought before beginning the program?

    a) consultation with the squadron legal representative

    b) consultation with the base Staff Judge Advocate

    c) consultation with the Environmental Protection Agency regional office

    d) consultation with the US Fish and Wildlife Service regional office

    e) b and d above

2. Which of the following birds is not protected under federal law?

    a) European Tree Sparrow (Passer montanus)

    b) Field Sparrow (Spizella pusilla)

    c) House Sparrow (Passer domesticus)

    d) Tree Sparrow (Spizella arborea)

3. How would the PM find out if the species in number 2 above is protected under state or local law?

    a) by consulting the base State Judge Advocate

    b) by consulting the state Natural Resources Agency

    c) by consulting the state Wildlife Management Agency

    d) by consulting the state office of the US Fish and Wildlife Service

4. The Endangered Species Act of 1973

   a) provides for the prohibition of any federal action that would jeopardize an endangered or threatened species or would modify or destroy habitat considered critical to these species.

   b) allows federal activities to use repulsion techniques as the only method of bird control.

   c) is of no concern to the PM since the potential for an endangered species creating a bird strike hazard is low.

   d) prohibits any Federal action that would jeopardize the existence of an endangered species during the breeding season only.

5. The Migratory Bird Treaty Acts of 1918 and 1936 protect migratory birds in:

   a) the Atlantic and Pacific flyways.

   b) wildlife refuges and parks.

   c) the United States, Canada, and Mexico.

   d) the breeding season.

6. Using chemical toxicants on federal lands is restricted by:

   a) the Migratory Bird Treaty Act.

   b) the Endangered Species Conservation Act of 1969.

   c) the Endangered Species Preservation Act of 1966.

   d) Executive Order 11643.

7. Bird control permits for protected species are issued through:

   a) the Law Enforcement Division of the State Audubon Society.

   b) the Law Enforcement Division of the Environmental Protection Agency.

   c) the Law Enforcement Division of the US Fish and Wildlife Service.

   d) the base office of the Staff Judge Advocate.

tected under federal law include:

gs, and crows.

irds, grackles, and crows.

parrows, Starlings, and blackbirds.

parrows, and Starlings.

s, and crows.

re that all necessary permits have

to have any permits.

ngered species as he/she sees fit.

btain a permit only for shooting

e State natural resource agency

o provide valuable assistance.

their own endangered species lists
d be aware of these.

policy to abide by the substantive
te wildlife laws.

y special standards or criteria in
of a specific control technique.

atened species is encountered as a

. Fish and Wildlife Service to
he control technique being used.

ffecting the bird in any manner
U. S. Fish and Wildlife Service

lethal techniques.

nce of the bird to the Office of
anagement.

12. The PM should send any informatic
cerning banded birds to:

    a) the nearest conservation

    b) the state natural resourc

    c) the regional office of th
    Service.

    d) The Office of Migratory B
    ing Laboratory.

13. All banded birds should be report
Wildlife Service except for:

    a) ducks.

    b) blackbirds.

    c) pigeons.

    d) songbirds.

14. If a banded bird is found dead:

    a) the band should be throwr

    b) the band should be kept i
    about banded birds.

    c) the band should be flatte
    Bird Banding Laboratory.

15. A federal permit is required for
control measures?

    a) repelling gulls with airt

    b) trapping pigeons

    c) screening vents to exclud

CHAPTER EIGHT OVERVIEW

ter Eight describes factors regarding public awareness and ern about pest and hazardous bird management. Methods for mizing the possibility of an adverse public reaction in bird rol techniques are provided.

ter Objectives:

1. Determine method for publicizing bird control methods.

2. Identify situations that would cause maximum and minimum ern in the local community.

Words and Terms:

Public Affairs Office

Public relations

CHAPTER 8. BIRD CONTROL AND PUBLIC RELATIONS

8.1 INTRODUCTION

Maintaining favorable public relations toward bird control is frequently more difficult than solving the pest problem itself. The general public is quite concerned about humaneness toward animals, and controversy may result from the use of lethal control methods. Lesser public relations problems can result from the use of other techniques, such as using loud noises to repel birds (and thus disturbing people living or working nearby) and letting grass and weeds grow tall. It is important to communicate the situation to the Public Affairs Office (PA) and use the expertise of that office to preclude a public misunderstanding before a control program is begun.

Attempts to eliminate winter blackbird roosts have made annual news during recent years. Large roosts in Kentucky and Tennessee have received the most press coverage. Some of this controversy was caused by ill-conceived eradication programs using toxic chemicals and there has been considerable objection to using the wetting agent Tergitol, which causes birds to die of exposure. Such large-scale eradication programs give an extreme example of adverse public reaction towards bird control. The PM may encounter objections to any program involved with killing birds (including pigeons and other non-protected species), particularly by methods which cause slow death, such as poisons or wetting agents.

8.2 SELECTING THE LEAST OBJECTIONABLE CONTROL MEASURE

The best way to avoid a public relations problem is to choose a socially acceptable control technique. The approach to control described in Chapter 5 is designed to minimize adverse public reaction. That is, each of the five categories of management is generally more socially acceptable than the subsequent category. The most viable, least objectionable alternative must consider altering the concept, altering the situation, exclusion or repulsion, and as a last resort, reduction. There will be exceptions. For example, someone may complain that nothing is being done to control nuisance birds, even when no damage is being caused. It is seldom possible to please everyone, so the PM should choose a sound approach and be prepared to defend it. Involving state wildlife personnel in the development of the control program whenever possible will also help maintain good public relations.

Sometimes it is necessary to sacrifice efficiency for public relations by using a technique that takes longer to achieve results but is more socially acceptable than another technique. For example, using high concentrations of Avitrol can solve a pigeon problem with rapid results, but many individual birds will

be killed. A longer program using lower concentrations will solve the same problem with fewer dead birds and be less likely to cause an adverse public reaction.

8.3 COMMUNICATING WITH THE PUBLIC

Another important means of avoiding bad public relations is to keep people well-informed and prevent misconceptions concerning a bird problem and its control. This is accomplished by using the media through the base Public Affairs Office and by personal contact. Good community relations are especially important if an off-base control program becomes necessary to eliminate a strike hazard. Develop a public relations program with the PA as part of any bird control plan.

Whether providing input for a press release or casually talking with interested observers, there are some general guidelines to apply in conveying specific information about the problem and the proposed solution.

1. Describe the seriousness of the problem, including the hazard to aircraft, the possible health hazard, or the potential economic losses. Do not exaggerate the problem or try to use scare tactics; this could result in a loss of credibility. Chapter 4 contains specific information concerning the health, safety, and economic aspects of bird problems.

2. Explain the approach that was used in selecting control procedures (as described in Chapter 5) and express confidence in the decisions made. However, indicate that in dealing with pest problems, there is always a chance that even the best techniques will be unsuccessful in a given instance.

3. Describe the back-up procedures that will be used in the event of failure. The objective is to demonstrate that the entire program has been carefully thought out and that all the alternatives have been considered.

4. Prepare the public for objectionable aspects of the control procedure, such as loud noises or the necessity to kill some individual birds. Explain that special permits have been obtained for the control program.

People may ask the PM specific questions about the birds and the bird control programs. They may also ask for advice on how to control their own bird problems, such as pigeons perching on their roof or eating seed put out for smaller birds. For the latter problem suggest exclusion from the bird seed by putting it in a small hanging feeder or building a cage over the feeding tray with bars far enough apart to permit entry of only the smaller birds.

The answers to many questions about birds in general may be found in Chapter 2 (Bird Biology and Behavior) and Chapter 3 (Bird Identification). Answers to questions about the need for bird control can be found in Chapter 5 (Bird Control Measures).

8.4 INFORMATION ON NON-NATIVE SPECIES

In addition to providing information contained elsewhere in this manual, the PM may be asked questions about why certain birds become involved in pest situations and why some species are not protected by law. The PM can explain that Domestic Pigeons, Starlings and House Sparrows are not native to North America.

The Domestic Pigeon apparently developed from the Rock Dove of Europe, Asia and Africa and was introduced to this country as a domestic bird. Its rapid growth gave rise to the wild (or feral) populations. The habitat of the wild pigeons was rocky cliffs; the artificial cliffs created by buildings provide appropriate habitat for the feral pigeons. They are almost entirely dependent on the habitat humans have built, and pigeon activities frequently conflict with our interests.

Starlings were successfully introduced to Central Park in New York City in 1890 and 1891. In the absence of their natural enemies and other natural checks, they increased rapidly. By 1942 Starlings had spread across the country. This adaptable and aggressive bird has prevailed over native birds in the struggle for available habitat and has found abundant nesting and roosting sites in our cities where its presence in large numbers is likely to be objectionable. Large wintering flocks are also frequent pests at livestock and poultry feedlots.

The House Sparrow or English Sparrow was first introduced to this country in 1850 and eight pairs were released in Brooklyn, New York. Many additional birds have since been imported and transported to various locations. Actually, they do not belong to the sparrow family at all, but to a family known as Weaver Finches. Like the Starling, the House Sparrow is aggressive, has few natural enemies and has found abundant habitat in cities. Its messy habits are objectionable, and this species has outmanuevered more desirable native songbirds for the available habitat.

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Frings, H., and M. Frings. 1967. Behavioral manipulation (visual, mechanical, and acoustical). Pages 387-454 in W. W. Kilgore and R. L. Doutt, eds. Pest Control - Biological, Physical, and Selected Chemical Methods. Academic Press, New York, NY.

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Harrison, M. J., and E. R. Godsey. 1976. Bird/Aircraft Strike Hazard Survey - Langley Air Force Base, Virginia. AFCEC TM-76-4. Air Force Civil Engineering Center, Tyndall AFB, FL.

Harrison, M. J., P. R. McCracken, and C. L. Scott. 1976. Bird/Aircraft Strike Hazard Survey - Myrtle Beach Air Force Base, South Carolina. AFCEC TM-76-11. Air Force Civil Engineering Center, Tyndall AFB, FL.

Jackson, J. A. 1976. Blackbirds, scare tactics, and irresponsible legislation. Editorial. Wilson Bull. 88: 159-160.

Thearle, R. J. P. 1968. Urban bird problems. Pages 181-197 in R. K. Murton and E. N. Wright, eds. The Problems of Birds as Pests. Academic Press, New York, NY.

REVIEW EXERCISE

1. What is the best way to avoid a public relations problem in bird control?

    a) use non-lethal control methods at all times

    b) control only non-protected species

    c) use socially accepted control techniques

    d) inform the Public Affairs Office when a problem arises

2. Which of the following control measures is <u>least</u> likely to cause an adverse public reaction?

    a) screening vents to exclude House Sparrows

    b) firing airbursts to repel gulls

    c) trapping raptors and releasing them elsewhere

    d) spraying Tergitol on a blackbird roost

3. Which of the following is <u>most</u> likely to cause an adverse public reaction?

    a) excluding pigeons with screening

    b) repelling pigeons with sticky repellant

    c) repelling pigeons with Avitrol

    d) poisoning pigeons with Avitrol

4. If someone asked you how to control large numbers of pigeons perching along the peak of their house roof, which of the following would you probably recommend?

    a) shoot them

    b) trap them

    c) sticky repellent

    d) Avitrol to repel them

5. Based on your knowledge of the five categories of bird management, which of the following would have the least likelihood of causing an adverse public reaction?

   a) removing bird nests and eggs from eaves at the base commissary

   b) applying a biodegradable insecticide to the airfield to reduce food availability

   c) criss-crossing wire over a drainage ditch to reduce the attractant to waterfowl

   d) using 12-gauge scare cartridges to repel gulls from an airfield

6. The PM should use a reduction technique to eliminate a (pest) bird problem:

   a) immediately so that the problem is solved once and for all.

   b) only as a last resort.

   c) if the public is not likely to know what is happening.

   d) when a serious safety hazard exists.

7. Which of the following does <u>not</u> accurately describe the intent of a press release?

   a) to make the public aware of the problem that exists

   b) to demonstrate that the pest control program has been thought out

   c) to keep the public well-informed so that misconceptions about pest control are avoided

   d) to convince people that most birds do more harm than good.

8. Species such as the pigeon, Starling, and House Sparrow are often involved in damage situations because:

   a) people generally don't consider them pretty.

   b) they don't have pleasing songs and therefore most people don't like them.

   c) they are highly dependent upon habitats created by man and therefore live in close contact with humans.

   d) they are protected by strict federal treaties.

9. It may be helpful to point out in a press release that pigeons, Starlings, and House Sparrows:

   a) are not native to North America.

   b) are aggressive birds and have out-competed many native species.

   c) have become abundant throughout North America, particularly in large cities.

   d) all of the above.

10. In which of the following situations would good community relationships be important?

   a) when a nearby municipal landfill is being closed to eliminate a food source for gulls

   b) when blackbirds attracted by waste grain in nearby agricultural fields fly across a runway

   c) when the noise from airbursts will be heard in a residential area

   d) all of the above

CHAPTER 9. SUGGESTIONS FOR FURTHER STUDY

9.1 INTRODUCTION

Included in this chapter are reference materials that the PM can use to find more detailed information on many of the subjects covered in earlier chapters. In many cases several references of similar subject matter are listed so the PM can use whichever text is available at the library. For the highly recommended references, the PM should obtain an office copy.

9.2 ANNOTATED BIBLIOGRAPHY

9.2.1 BIRD BIOLOGY AND BEHAVIOR

Allen, A. A. 1961. The Book of Bird Life. D. Van Nostrand Co., Princeton, NJ.

This text is included here because it is a common ornithological text that is available in many public libraries. Only the sections on the classification of birds and bird communities would be of value. The book is interesting, non-technical reading.

Armstrong, E. A. 1963. A Study of Bird Song. Oxford Univ. Press, London.

This text provides a good review of bird songs and other vocalizations. Its use to the PM is limited unless a detailed knowledge of bird songs is desired.

Bellrose, F. C. 1976. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg. PA.

This text is an update of Kortright's Ducks, Geese and Swans of North America and is particularly useful if more knowledge of this group of birds is desired.

Bent, A. C. 1919-1968. Life Histories of North American Birds (23 volumes). U. S. National Museum, Washington, DC.

This series is now available as Dover Publications reprints. They may be particularly useful when a thorough knowledge of any one species is needed. It includes behavior, range, food preferences and, often, photographs of the species and its nests.

Dorst, J. 1962. The Migration of Birds. Houghton Mifflin Co., Boston, MA.

This book discusses migration and migratory patterns of birds throughout the world.

Dorst, J. 1974. The Life of Birds. Columbia Univ Press, New York, NY.

This general ornithological text (2 volumes) covers bird biology, migration, distribution and other subjects. This book is similar to any of the other general texts in its content.

Griffin, D. R. 1964. Bird Migration. Anchor Books, New York, NY.

This book, which is a review of bird migration, emphasizes how birds navigate.

Harrison, H. H. 1975. A Field Guide to Birds' Nests. Houghton Mifflin Co., Boston, MA.

This guide presents information concerning nests, eggs and nesting habitat for 285 species east of the Mississippi River. It would be particularly useful if habitat manipulation were considered to reduce a bird problem caused by nesting birds.

Headstrom, R. 1951. Birds' Nests of the West, Ives Washington New York, NY.

This book is useful for identifying bird nests in the western United States. There is an accompanying eastern volume, but the Harrison guide is more complete and recent.

Johnsgard, P. A. 1975. Waterfowl of North America. Indiana Univ. Press, Bloomington, IN.

This text is a comprehensive reference book that summarizes available information on the nearly 60 species of ducks, geese, and swans that occur in North America. This volume contains much information on waterfowl migration, identification and behavior.

Kortright, F. H. 1953. The Ducks, Geese and Swans of North America. Stackpole Books, Harrisburg, PA.

Although several similar newer books have been published on the subject, this text is still very useful to learn more about ducks, geese and swans. This book has now been updated (Bellrose 1976), but the newer version may not be available in many libraries.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1961. American Wildlife and Plants: A Guide to Wildlife Food Habits. Dover Publications, New York, NY.

This is an important reference (first published by McGraw-Hill in 1951) for use when the presence of a food source is suspected to be an important factor in a bird problem. This guide discusses the use of trees, shrubs, weeds and animals as food sources for birds and mammals.

Pettingill, O. S. 1970. Ornithology in Laboratory and Field. Burgess Publishing Co., Minneapolis, MN.

This text contains particularly good chapters concerning anatomy, behavior, migration and subjects such as songs, nests and nest building, territory, etc.

Stefferud, A., ed. 1966. Birds in Our Lives. U. S. Department of the Interior, Washington, DC

This book is a diverse collection of information on the relationships between man and birds. The articles are written in non-technical language.

Thorpe, W. H. 1961. Bird-song: The Biology of Vocal Communication and Expression in Birds. University Press, Cambridge.

If an extensive knowledge of bird vocalizations and communications is desired, this text is recommended.

Tinbergen, N. 1953. The Herring Gull's World: A Study of the Social Behavior of Birds. Collins, London.

This book is a classic and is highly recommended to anyone interested in bird biology and behavior. The PM who regularly encounters problems with gulls is specifically referred to this text to gain an understanding of gull social behavior.

Van Tyne, J., and A. J. Berger. 1976. Fundamentals of Ornithology. John Wiley and Sons, New York, NY.

This general text is an excellent source of information on bird anatomy, behavior, taxonomy and general bird biology. A synopsis (169 pages) of all the families of birds in the world is highly useful in understanding the classification system of birds.

Wallace, G. J., and H. D. Mahan. 1975. An Introduction to Ornithology. Macmillan Publishing Co., New York, NY

This book is a general ornithological text based mainly upon North American birds.

Welty, J. C. 1975. The Life of Birds. W. B. Saunders Co., Philadelphia, PA.

This is one of the most widely used books in North America concerning birds, bird biology and bird behavior. It contains broad coverage of biological facts and concepts with detailed discussions based upon various bird studies.

9.2.2 BIRD IDENTIFICATION

Peterson, R. T. 1947. A Field Guide to the Birds. Houghton Mifflin Co., Boston, MA.

This field guide is specifically for eastern birds.

Peterson, R. T. 1960. A Field Guide to the Birds of Texas. Houghton Mifflin Co., Boston, MA

This field guide is extremely useful in Texas and other southwestern states where Mexican birds may occur. Its use by the PM may be limited since such species are not likely to be pest birds.

Peterson, R. T. 1961. A Field Guide to Western Birds. Houghton Mifflin, Boston, MA.

This field guide is the counterpart to the eastern guide listed above

Pough, R. H. 1949. Audubon Land Bird Guide. Doubleday and Co., Garden City, NY.

Pough, R. H. 1951. Audubon Water Bird Guide. Doubleday and Co., Garden City, NY.

These two field guides are usable but are not recommended unless the Robbins or Peterson guides are not available.

Robbins, C. S., B. Bruun, and H. S. Zim. 1966. Birds of North America. Golden Press, New York, NY.

This field guide covers all of North America and presents illustrations, range maps, and text on the same page for each species. This guide is a necessity for the PM.

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lifornia Vertebrate Pest Committee. Proceedings of the Vertebrate Pest Conferences.

The proceedings of these conferences, held every 2 years in recent years, cover all aspects of vertebrate pest control and include many papers on bird control. Copies are available from: Vertebrate Pest Conference, Department of Wildlife and Fisheries Biology, University of California, Davis, California 95616, and also from Bowling Green State University at the address listed previously.

lark, D. O. 1975. Vertebrate Pest Control Handbook. State of California, Department of Food and Agriculture, Division of Plant Industry, Sacramento, CA.

This handbook contains practical information on pest birds and their control. Although the manual was prepared for controlling agricultural depredations, many of the techniques described are also applicable to pest problems that occur on air bases.

ltzwater, W. D. 1970. Sonic systems for bird control. Pest Control 38(11): 9-10, 12-13, 16.

This article, which also appears in the Proceedings of the Fifth Bird Control Seminar under the title "Sonic systems for controlling bird depredations," includes an understandable explanation of the underlying principles of bird repulsion by means of recorded distress/alarm calls.

rings, H., and M. Frings. 1967. Behavioral manipulation (visual, mechanical, and acoustical). Pages 387-454 in W. W. Kilgore and R. L. Doutt, eds. Pest Control - Biological, Physical, and Selected Chemical Methods.

This chapter of a broad-spectrum textbook is a comprehensive technical review of repulsion techniques that have been attempted, mainly on birds, including a review of scientific research on recorded distress/alarm calls.

oodhue, L. D., and F. M. Baumgartner. 1965. The Avitrol method of bird control. Pest Control 33(7): 16-17, 46, 48.

This article contains practical and informative details about Avitrol, which was newly developed when the article was written.

raham, F., Jr. 1976. Blackbirds - a problem that won't fly away. Audubon 78(3): 118-125.

Graham, F., Jr. 1978. Problem birds: blockbuster weapon on way. Audubon 80(2): 99-101.

The first of these articles describes the problems caused by large wintering flocks of blackbirds and the controversy over their control. The second article includes further discussion of the controversy and a review of some recent research on the problem and its control.

Harrison, M. J. 1976. Land use planning for control of birds near airports. Proc. Bowling Green State Univ. Bird Control Seminar 7: 79-82.

This publication provides an overview of problems in land use and bird control at airports.

ICAO. 1975. Airport Services Manual - Part 3, Bird Control and Reduction. First edition. International Civil Aviation Organization, Montreal, Quebec.

This publication is a comprehensive, practical handbook on the problem and control of birds at airports.

Murton, R. K., and E. N. Wright, eds. 1968. The Problems of Birds as Pests. Academic Press, New York, NY.

This volume is the proceedings of a symposium held by the Institute of Biology. One section is devoted to birds and aircraft, including articles entitled "Recent developments in bird scaring on airfields", "Modification of habitat as a means of bird control", and "Urban bird problems."

RAF. 1977. Airfield Bird Control. Directorate of Flight Safety, Royal Air Force, London.

This practical handbook on bird control was written primarily for use in the United Kingdom, but it contains information that is universally applicable.

Wingard, R. G., J. E. Sidelinger, and J. L. George. 1978. Bird Control Handbook. School of Forest Resources, Pennsylvania State Univ., University Park, PA.

This handbook contains information on pest bird species and their control. Particularly useful are sample labels for registered bird control pesticides, which present details on applicability, procedures for use, and restrictions.

APPENDIX A
GLOSSARY

Abdomen - the portion of a bird's trunk between the legs; the belly. (Para. 3.3.3.)

Airdrome - all physical facilities and features of an air base, excluding personnel. (Para. 1.3.4.)

Alarm calls - vocalizations produced by birds upon sighting a predator or other alarming circumstances. (Para. 2.5.2.)

Altering the concept - looking at an apparent bird problem in a different manner. This includes deciding not to take action because damage or hazards do not exist or because a control action would cost more than is justified. (Sect. 5.1.)

Altering the situation - avoiding conflict with birds. This includes altering mission activities (including flight schedules) and the alteration or elimination of habitat components such as food, water, perches, nest sites, or roost sites. (Sect. 5.1.)

Arthropod vector - arthropods such as ticks and mosquitoes that transmit disease-causing organisms from one animal to another or from animal to man. (Para. 4.2.4.)

Auditory repulsion - scaring birds away using noise. (Sect. 2.7. and sect. 5.1.)

Back - the anterior two-thirds of the upper portion of a bird's trunk. (Para. 3.3.3.)

Behavior - the way a bird acts. (Para. 1.3.2.)

Belly - the abdomen of a bird. (Para. 3.3.3.)

Bill - the beak of a bird. (Para. 3.3.2.)

Bioacoustics - repulsion techniques that involve the use of noises with biological meaning to birds, such as recorded or electronically simulated distress/alarm calls. (Para. 5.2.4.1.)

Bird control - bird damage control and bird hazard control. (Para. 1.3.6.)

Bird damage - economic loss caused by pest birds. (Para. 1.3.3.)

Bird damage control - bird management in which the specific goal is to minimize the potential for damage caused by birds. (Para. 1.3.6.)

Bird hazard - a danger to health or safety caused by birds. (Para. 1.3.4.)

Bird hazard control - bird management in which the specific goal is to minimize the danger caused by birds to health or safety. (Para. 1.3.6.)

Bird Hazard Working Group (BHWG) - a committee which reviews the flying operation at an air base and determines what modifications could be made to reduce bird hazards and make pilots more aware of the hazards. (Para. 5.2.2.1.)

Bird management - the art and science of changing the characteristics and interactions of birds, habitat, and man to achieve specific human goals. In general, anything done deliberately to affect birds. (Para. 1.3.5.)

Bird strike - any contact between a bird and a moving aircraft. (Sect. 1.4. and sect. 4.4.)

Bird Watch - a program for alerting aircrews to possible flight hazards due to bird activity. Bird Watch condition Green denotes normal operating conditions. Bird Watch condition Yellow means a probable hazard, and specific avoidance procedures should be implemented. Bird Watch condition Red means an immediate hazard due to high concentrations of birds on the airfield, and procedures to divert are in effect. (Para. 5.2.2.2.)

Bobs - inward-swinging rods which make up the entrance door of a pigeon trap. (Para. 5.2.9.2.)

Booming ground - an area from which displays are given by birds such as the Greater Prairie Chicken. (Para. 2.5.1.)

Breast - the anterior rounded portion of the underside of a bird's trunk. (Para. 3.3.3.)

Carnivorous - feeding on flesh. A carnivorous animal is called a carnivore. (Sect. 2.9.)

Cere - a fleshy portion at the base of the upper bill. (Para. 3.3.2.)

Cheek - the side of the head from the base of the lower portion of the bill to just behind the eye. (Para. 3.3.2.)

Chin - the small area between the forked base of the lower portion of the bill. (Para. 3.3.2.)

Class - one of the major taxonomic groupings of animals. Birds belong to the Class Aves, which separates them from all the other animals with backbones. (Para. 3.4.)

Coverts - small feathers covering the bases of the quills of the wings and tail of a bird. (Para. 3.3.4. and para. 3.5.)

Crissum - a collective term for the under tail coverts. (Para. 3.3.5.)

Critical habitat - an official designation under the Endangered Species Act of 1973. Specific areas on which are found those physical or biological features essential to the conservation of an endangered or threatened species, and which may require special management considerations or protection. (Para. 7.2.3.)

Crown - the top of the head extending from the forehead to the nape of the neck. (Para. 3.3.2.)

Damage - economic loss. (Para. 1.3.3.)

Distress calls - vocalizations emitted by birds when being harmed or handled. (Para. 2.5.2.)

Drumming grounds - an area from which displays are given by birds such as the Ruffed Grouse. (Para. 2.5.1.)

Ecology - the study of the relation of organisms to their environment. (Sect. 6.2.)

Economic - involving cost. (Para. 1.3.3.)

Encephalitis - a group of acute inflammatory viral diseases of short duration involving parts of the brain, spinal cord, and meninges and usually resulting in a high mortality rate. (Para. 7.2.3.)

Endangered species - any species (animal or plant) which is in danger of extinction throughout all or a significant portion of its range. (Para. 7.2.3.)

Exclusion - the use of materials to physically prevent birds from gaining access to an area. (Sect. 5.1.)

Family - a taxonomic grouping of animals that have similar characters. A subdivision of an order. (Sect. 3.4.)

Field marks - external characteristics that are noted in the field to allow correct species identification. (Sect. 3.2.)

Flank - the posterior (rear) portion of the side of the trunk of a bird's body. (Para. 3.3.3.)

Flock - a group of birds. (Sect. 2.7.)

Flyway - one of the major routes taken by birds during migration. The U.S. has four: the Atlantic, Mississippi, Central, and Pacific flyways. (Sect. 2.6.)

Forehead - the frontal portion of the head located behind the base of the bill to the front of the eyes and lying between the lores. (Para. 3.3.2.)

Genera - plural of genus. (Sect. 3.4.)

Genus - a division of a family that contains very closely related species. Plural - genera. (Sect. 3.4.)

Granivorous - feeding on grain or other seeds. A granivorous animal is called a granivore. (Sect. 2.9.)

Habitat - the place where a bird lives, including its feeding area, roosting area, nesting location and source of water. (Para. 1.3.2. and sect. 2.2.)

Habitat manipulation - habitat modification; for example, grass height management, tree pruning, and land grading and filling. (Sect. 5.1.)

Habitat modification - the reduction or elimination of important habitat components (food, water, perches, nesting or roosting sites) so that birds are no longer attracted to an area. Also called habitat manipulation. (Sect. 5.1.)

Habituation - a declining response to a simple stimulus, resulting from no reward or punishment being associated with the stimulus. A type of learning. (Para. 2.10.2.)

Hazard - a danger to health or safety. (Para. 1.3.4.)

Herbivorous - feeding on plants or plant matter. An herbivorous animal is called an herbivore. (Sect. 2.9.)

Histoplasmosis - a fungal disease that can affect the respiratory system and spread to other organs. (Para. 4.2.2.)

Insectivorous - feeding on insects. An insectivorous animal is called an insectivore. (Sect. 2.9.)

Kingdom - the largest taxonomic group by which organisms are classified (e.g. Plant Kingdom, Animal Kingdom). (Sect. 3.4.)

Learning - a process that results in a behavioral change. Learning can come from practice, experience or trial and error. (Para. 2.10.1.)

Loafing - roosting in the open during the daytime. (Sect. 2.8.)

Lore - the thin, small feather patch located in front of the eye and extending to the base of the upper bill (Para. 3.3.2.)

Management - see Bird management.

Met Watch - a program for alerting aircrews to bad weather conditions. (Para. 5.2.2.1.)

Migration - the movement of birds between their breeding and wintering grounds. (Sect. 2.6.)

Nape - the back portion of a bird's neck posterior to the crown and extending to the back. (Para. 3.3.2.)

Non-target species - animals, other than those causing the problem, that may be affected by a control measure. (Sect. 3.6.)

Nuisance - a situation in which birds are bothersome or annoying, but are not causing damage or creating a hazard. (Para. 1.3.3.)

Omnivorous - feeding on both animal and vegetable matter. An omnivorous animal is called an omnivore. (Sect. 2.9.)

Order - a taxonomic grouping that contains one or more families of related animals. A subdivision of a class. (Sect. 3.4.)

Ornithosis - a name given to psittacosis, when the virus is found in wild birds. (Para. 4.2.3.)

Pest bird - any bird that is causing damage or creating a hazard by its specific activity at a specific time and place. (Para. 1.3.2.)

Phylum - any of the broad basic divisions of the Plant or Animal Kingdom. (Sect. 3.4.)

Polybutene repellents - sticky chemicals applied to a surface to prevent birds from perching. (Para. 5.2.5.2.)

Primaries - the longer flight feathers on the outside, back edge of the bird's wing. (Para. 3.3.4.)

Psittacosis - a rickettsia-like disease, often called parrot fever, that attacks man and birds. (Para. 4.2.3.)

Pyrotechnics - techniques using non-lethal, noise-producing devices which simulate gunshot sounds to repel birds. (Para. 5.2.4.3.)

Removal/Reduction - the direct elimination of individual birds by capture or killing. Removal refers to the individual eliminated; reduction refers to the intended effect on the population. (Sect. 5.1.)

Repulsion - Frightening birds away from a location, including the causing of unpleasant sensations. (Sect. 5.1.)

Reservoir - any animal that carries a disease-causing organism that is transmitted by a vector. (Para. 4.2.1.)

Roost - a perching or resting place. The term can also refer to the action of perching or resting, or to a flock which occupies a perching or resting place. (Sect. 2.8.)

Rump - the posterior one-third of the dorsal (top) side of the bird's trunk. (Para. 3.3.3.)

Scapulars - the feathers on the shoulder area. (Para. 3.3.4.)

Scavenger - an animal that feeds on the remains of plants and animals. (Sect. 2.9.)

Secondaries - the flight feathers on the inside, back edge of the bird's wing. (Para. 3.3.4.)

Side - the area on a bird's trunk under the wing and in front of the flank. (Para. 3.3.3.)

Songs - vocal displays usually given by the male of a species. The song is usually repeated consistently to attract a mate or announce a territory. (Para. 2.5.1.)

Species - a group of animals or plants which possess, in common, certain distinctive characteristics, and are capable of interbreeding and reproducing these characteristics in their off spring. A subdivision of a genus (Sect. 3.4.)

Speculum - a colored patch in the secondary feathers of the wing. The speculum is a particularly useful field mark to identifying of ducks. (Para. 3.3.4.)

Stimulus - a change in the internal or external environment of an organism which evokes a response in the organism. (Para. 2.10.2.)

Stressing agents - chemicals that cause death in birds by inducing stress, such as death by exposure as caused by wetting agents. (Para. 5.2.11.3.)

Strike - see Bird strike

Tail spots - patches of color near the tips of the outermost tail feathers; a field mark used in identifying some species. (Para. 3.3.5.)

Target - the individual, population, or species of animal toward which control efforts are directed. (Sect. 3.6.)

Taxonomy - the classification of birds and other organisms according to their natural relationships. (Sect. 3.4.)

Territory - an area defended by a bird against individuals of its own or similar species. This area may be defended as a breeding territory, feeding territory, winter territory or roosting territory. (Sect. 2.3.)

Threatened species - any species which is likely to become an endangered species within the forseeable future throughout all or a significant portion of its range. (Para. 7.2.3.)

Throat - the portion of a bird's neck below the chin. (Para. 3.3.2.)

Topography - general external anatomy. A scheme by which different external parts of the body are delineated. (Sect. 3.2. and Sect. 3.3.)

Trunk - the main part of a bird's body, exclusive of the head, wings, tail, feet and legs. (Para. 3.3.3.)

Under-tail coverts - the small feathers at the base of underside of the tail, collectively called the crissum. (Para. 3.3.5.)

Upper-tail coverts - the small feathers covering the bases of the long tail feathers. (Para. 3.3.5.)

Vector - Arthropod transmittor of a disease. (Para. 4.2.4.)

Wetting agents - chemicals which are sprayed on birds to wash the oil off their feathers, resulting in death by exposure. Also called stressing agents. (Para. 5.2.11.3.)

Wing bar - a pattern on the folded wing of a bird which is used as a field mark for identification. (Para. 3.3.4.)

Wing lining - the covert feathers on the underside of the wing. (Para. 3.3.4.)

Wing stripe - a pattern on the wing of a bird, caused by the bases of the primaries or secondaries being lighter than the tips. (Para. 3.3.4.)

APPENDIX B

ANSWERS TO REVIEW EXERCISES

CHAPTER 2

1. b	6. c	11. c	16. e
2. b	7. c	12. c	17. b
3. c	8. b	13. c	18. b
4. b	9. c	14. b	19. b
5. c	10. b	15. c	20. a

CHAPTER 3

1. c	6. d	11. b	16. c
2. b	7. e	12. b	17. e
3. c	8. a	13. d	18. a
4. a	9. a	14. a	19. f
5. c	10. a	15. b	20. b

CHAPTER 4

1. a	6. a	11. d
2. c	7. c	12. d
3. b	8. b	13. d
4. c	9. c	14. d
5. a	10. c	

CHAPTER 5

1. b	6. b	11. d	
2. e	7. b,d	12. c	
3. c	8. c	13. c	
4. a	9. c	14. b	
5. c,e	10. a	15. c	

CHAPTER 6

1. b	6. c	11. d
2. b	7. c	12. b
3. a	8. b	13. d
4. a	9. c	
5. b	10. d	

CHAPTER 7

1.	e	6.	d	11.	b
2.	c	7.	c	12.	d
3.	b	8.	d	13.	a
4.	a	9.	a	14.	c
5.	c	10.	e	15.	a

CHAPTER 8

1.	c	6.	b
2.	a	7.	d
3.	d	8.	c
4.	c	9.	d
5.	b	10.	d

APPENDIX C
U.S. FISH AND WILDLIFE SERVICE DISTRICT OFFICES

ADDRESS	GEOGRAPHICAL AREAS COVERED
District 1	
U. S. Fish and Wildlife Service 813 D Street Anchorage, Alaska 99501 (907) 265-4864	Alaska
District 2	
U. S. Fish and Wildlife Service P. O. Box 3737 Portland, Oregon 97208 (503) 234-3361	Idaho, Oregon, Washington, Hawaii
District 3	
U. S. Fish and Wildlife Service Room E 2911, 2800 Cottage Way Sacramento, California 95821 (916) 484-4551	California, Nevada
District 4	
U. S. Fish and Wildlife Service P. O. Box 25486 Denver Federal Center Denver, Colorado 80225 (303) 234-2209	Colorado, Montana, Utah, Wyoming
District 5	
U. S. Fish and Wildlife Service P. O. Box 1038 301 West Lexington Avenue Independence, Missouri 64051 (816) 374-6273	Iowa, Kansas, Missouri, Nebraska, North Dakota, South Dakota

ADDRESS	GEOGRAPHICAL AREAS COVERED
District 12	
U. S. Fish and Wildlife Service 700 Rockaway Turnpike Lawrence, New York 11559 (212) 995-8613	New Jersey, New York
District 13	
U. S. Fish and Wildlife Service P. O. Box 34 Boston, Massachusetts 02101 (617) 223-2961	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

APPENDIX D

STATE NATURAL RESOURCES AGENCIES

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:or
:ment of Conservation
l Natural Resources
.stration Building
)mery, Alabama 36104
832-6361

ι

ısioner
:ment of Fish and Game
't Building
ı, Alaska 99801
465-4100

ıa

:or
ınd Fish Department
lest Greenway Road
.x, Arizona 85023
942-3000

ıas

:or
ınd Fish Commission
Rock, Arkansas 72201
[illegible]

[illegible]

Colorado

Division of Wildlife
Department of Natural
Resources
6060 Broadway
Denver, Colorado 80216
(303) 825-1192

Connecticut

Commissioner
Department of Environmental
Protection
State Office Building
165 Capitol Ave
Hartford, Connecticut 06115
(203) 566-5599

Delaware

Division of Fish and Wildlife
Department of Natural Resources
and Environmental Control
The Edward Tatnall Building
Legislative Avenue and D Street
Dover, Delaware 19901
(302) 678-4431

Florida

Director
Game and Fresh Water Fish
Commission
620 South Meridian
Tallahassee, Florida 32304
(904) 488-1960

Georgia

Game and Fish Commission
Department of Natural
Resources
270 Washington St., SW
Atlanta, Georgia 30334
(404) 656-3530

Hawaii

Director
Division of Fish and Game
Department of Land and
Natural Resources
1179 Punchbowl Street
Honolulu, Hawaii 96813
(808) 548-4000

Idaho

Director
Fish and Game Department
600 South Walnut Street
P. O. Box 25
Boise, Idaho 83707
(208) 384-3700

Illinois

Wildlife Resources Division
Department of Conservation
102 State Office Building
Springfield, Illinois 62706
(217) 782-6302

Indiana

Director
Department of Natural
Resources
608 State Office Building
Indianapolis, Indiana 46204
(317) 633-6344

Iowa

Director
State Conservation Commission
State Office Building
300 4th Street
Des Moines, Iowa 50319
(515) 281-5145

Kansas

Director
Forestry, Fish and Game
Commission
Box 1028
Pratt, Kansas 67124
(316) 672-5911

Kentucky

Commissioner
Department of Fish and
Wildlife Resources
Capital Plaza Tower
Frankfort, Kentucky 40601
(502) 564-3400

Louisiana

Director
Wildlife and Fisheries
Commission
400 Royal Street
New Orleans, Louisiana 70130
(504) 527-5126

Maine

Commissioner
Department of Inland Fisheries
and Game
State Office Building
Augusta, Maine 04330
(207) 289-2766

Maryland

Wildlife Administration
Department of Natural Resources
Tawes State Office Building
Annapolis, Maryland 21401
(301) 267-5195

Massachusetts

Director
Division of Fisheries and Wildlife
100 Cambridge Street
Boston, Massachusetts 02202
(617) 727-3180

Michigan

Director
Department of Natural Resources
Steven T. Mason Building
Lansing, Michigan 48926
(517) 373-1220

Minnesota

Commissioner
Department of Natural Resources
Centennial Office Building
658 Cedar Street
St. Paul, Minnesota 55101
(612) 296-2549

Mississippi

Director of Conservation
Game and Fish Commission
Robert E. Lee Office Building
239 N. Lamar Street, Box 451
Jackson, Mississippi 39205
(601) 354-7333

Missouri

Director
Department of Conservation
P. O. Box 180
Jefferson City, Missouri 65101
(314) 751-4115

Montana

Director
Department of Fish and Game
Mitchell Building
Helena, Montana 59601
(406) 449-2535

Nebraska

Director
Game and Parks Commission
2200 N. 33rd Street
P. O. Box 30370
Lincoln, Nebraska 68503
(402) 464-0641

Nevada

Director
Department of Fish and Game
Box 10678
Reno, Nevada 89510
(702) 784-6214

New Hampshire

Director
Fish and Game Department
34 Bridge Street
Concord, New Hampshire 03301
(606) 271-3421

New Jersey

Director
Division of Fish, Game and Shellfisheries
Department of Environmental Protection
P. O. Box 1809
Trenton, New Jersey 08625
(609) 292-2965

New Mexico

Director
Department of Game and Fish
State Capitol
Santa Fe, New Mexico 87501
(505) 827-2143

New York

Commissioner
Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233
(518) 457-3446

North Carolina

Executive Director
Wildlife Resources Commission
Albemarle Building
325 N. Salisbury Street
Raleigh, North Carolina 27611

North Dakota

Commissioner
State Game and Fish Department
2121 Lovett Avenue
Bismarck, North Dakota 58501
(701) 224-2180

Ohio

Director
Department of Natural Resources
Fountain Square
Columbus, Ohio 43224
(614) 466-3066

Oklahoma

Director
Department of Wildlife Conservation
P. O. Box 53465
Oklahoma City, Oklahoma 73105
(405) 521-3851

Oregon

Director
Department of Fish and Wildlife
P. O. Box 3503
Portland, Oregon 97208
(503) 229-5551

Pennsylvania

Executive Director
Game Commission
P. O. Box 1567
Harrisburg, Pennsylvania 17120
(717) 787-3633

Rhode Island

Chief
Division of Fish and Wildlife
Department of Natural Resources
83 Park Street
Providence, Rhode Island 02903
(401) 277-2784

South Carolina

Director
Wildlife and Marine Resources Department
1015 Main Street, Building D
Box 167
Columbia, South Carolina 29202
(803) 758-6314

South Dakota

Director
Game and Fish Division
Department of Game, Fish and Parks
Anderson Building
Pierre, South Dakota 57501
(605) 224-3381

Tennessee

Executive Director
Wildlife Resources Agency
P. O. Box 40747
Ellington Agricultural Center
Nashville, Tennessee 37220
(615) 741-1431

Texas

Executive Director
Parks and Wildlife Department
Reagan State Building
Austin, Texas 78701
(512) 475-2087

Utah

Director
Division of Wildlife Resources
1596 West North Temple
Salt Lake City, Utah 84116
(801) 533-9333

Vermont

Commissioner
Fish and Game Department
Agency of Environmental Conservation
5 Court Street
Montpelier, Vermont 05602
(802) 828-3371

Virginia

Executive Director
Commission of Game and Inland Fisheries
4010 W. Broad Street
P. O. Box 11104
Richmond, Virginia 23230
(804) 786-4974

Washington

Director
Department of Game
600 North Capitol Way
Olympia, Washington 98504
(206) 753-5700

West Virginia

Director
Department of Natural Resources
1800 Washington St., East
Charleston, West Virginia 25305
(304) 348-2754

Wisconsin

Director
Bureau of Fish and Wildlife Management
Department of Natural Resources
Box 450
Madison, Wisconsin 53701
(608) 266-2621

Wyoming

Commissioner
Game and Fish Department
Box 1589
Cheyenne, Wyoming 82001
(307) 777-7631

APPENDIX E

SUPPLIERS OF BIRD CONTROL MATERIALS

This list of suppliers is not necessarily complete. Listing does not imply endorsement of the products available from these suppliers.

SUPPLIER	PRODUCTS
Allcock Manufacturing Company/Havahart P. O. Box 551 Ossining, New York 10562	Live traps
Alpha Enterprises, Inc. 12514 Gulf Freeway Houston, Texas 77034	Shellcrackers Fuse rope and salutes for rope firecrackers
Animal Repellents, Inc. P. O. Box 999 Griffin, Georgia 30224	Netting Sticky repellents
Av-Alarm Corporation P. O. Box 2488 Santa Maria, California 93454	Electronic noise equipment
Avitrol Corporation P. O. Box 45141 7644 East 46th Street Tulsa, Oklahoma 74145	Avitrol
Baum's Castorine Company, Inc. 200 Matthew Street Rome, New York 13440	Tactile repellent
Bird-X, Inc 325 West Huron Street Chicago, Illinois 60610	Sharp projections Sticky repellent Avitrol

SUPPLIER	PRODUCTS
Bleitz Wildlife Foundation 5334 Hollywood Boulevard Hollywood, California 90027	Mist nets
A. Z. Bogert Company, Inc. 1000 East Mermaid Lane Philadelphia, Pennsylvania 19118	Sticky repellent
Brownell Net Company Moodus, Connecticut 06469	Netting
Chicopee Manufacturing Company Lumite Division Cornelia, Georgia 30531	Netting
W. V. Clow Seed Company 1081 Harkins Road Salinas, California 93901	Bird bombs
Conwed Corporation Plastics Division 770 29th Avenue, SE Minneapolis, Minnesota 55414	Netting
E. I. Du Pont de Nemours & Co. (Inc.) 1007 Market Street Wilmington, Delaware 19898	Netting
The J. E. Fricke Company 40 North Front Street Philadelphia, Pennsylvania 19106	Fuse rope for rope firecrackers
Hub States Corporation 200 North Illinois Street Indianapolis, Indiana 46202	Sticky repellent Avitrol
The Huge' Company, Inc. P. O. Box 24198 St. Louis, Missouri 63130	Sharp projections Sticky repellent Avitrol
Mustang Manufacturing Company P. O. Box 10947 Houston, Texas 767018	Live traps

SUPPLIER	PRODUCTS
National Bird Control Laboratories 7323 North Monticello Avenue Skokie, Illinois 60076	Sticky repellent
Nichols Net & Twine Company Rural Route 3, Bend Road East St. Louis, Illinois 62201	Netting Cannon nets
Nixalite Company of America 2509 Fifth Avenue Rock Island, Illinois 61201	Sharp projections
Ralston-Purina Company General Offices Checkerboard Square St. Louis, Missouri 63188 (product available from local Purina dealers)	Starlicide
Roy Vail Company Wentworth Road, Box 336 Antwerp, Ohio 45813	Live traps (for House Sparrows)
Sagen & Brown Associates West Lake Road Skaneateles, New York 13152	Live traps (for pigeons)
Sullivan's Sure Catch Traps P. O. Box 1241 Valdosta, Georgia 31601	Live traps
The Tanglefoot Company 314 Straight Avenue, SW Grand Rapids, Michigan 49502	Sticky repellent
Tomahawk Live Trap Company P. O. Box 323 Tomahawk, Wisconsin 54487	Live traps
Woodstream Corporation Animal Trap Division P. O. Box 327 Lititz, Pennsylvania 17543	Live traps

APPENDIX F

SCIENTIFIC NAMES OF BIRD SPECIES MENTIONED IN TEXT

Struthio camelus
Ostrich

Pelecanus occidentalis
Brown Pelican

Bubulcus ibis
Cattle Egret

Branta canadensis
Canada goose

Anas platyrhynchos
Mallard

Anas rubripes
Black Duck

Buteo lineatus
Red-shouldered Hawk

Aquila chrysaetos
Golden Eagle

Haliaeetus leucocephalus
Bald Eagle

Pandion haliaetus
Osprey

Falco peregrinus
Peregrine Falcon

Bonasa umbellus
Ruffed Grouse

Tympanuchus cupido
Greater Prairie Chicken

Columba livia
Rock Dove (Domestic Pigeon)

Zenaida macroura
Mourning Dove

Eremophila alpestris
Horned Lark

Progne subis
Purple Martin

Cyanocitta cristata
Blue Jay

Corvus brachyrhynchos
Common Crow

Corvus ossifragus
Fish Crow

Mimus polyglottis
Mockingbird

Turdus migratorius
American Robin

Sturnus vulgaris
Starling

Passer domesticus
House Sparrow

Xanthocephalus xanthocephalus
Yellow-headed Blackbird

Agelaius phoeniceus
Red-winged Blackbird

Euphagus carolinus
Rusty Blackbird

Euphagus cyanocephalus
Brewer's Blackbird

Quiscalus quiscula
Common Grackle

Molethrus ater
Brown-headed Cowbird

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