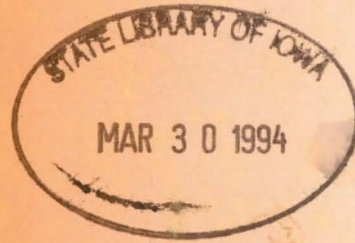


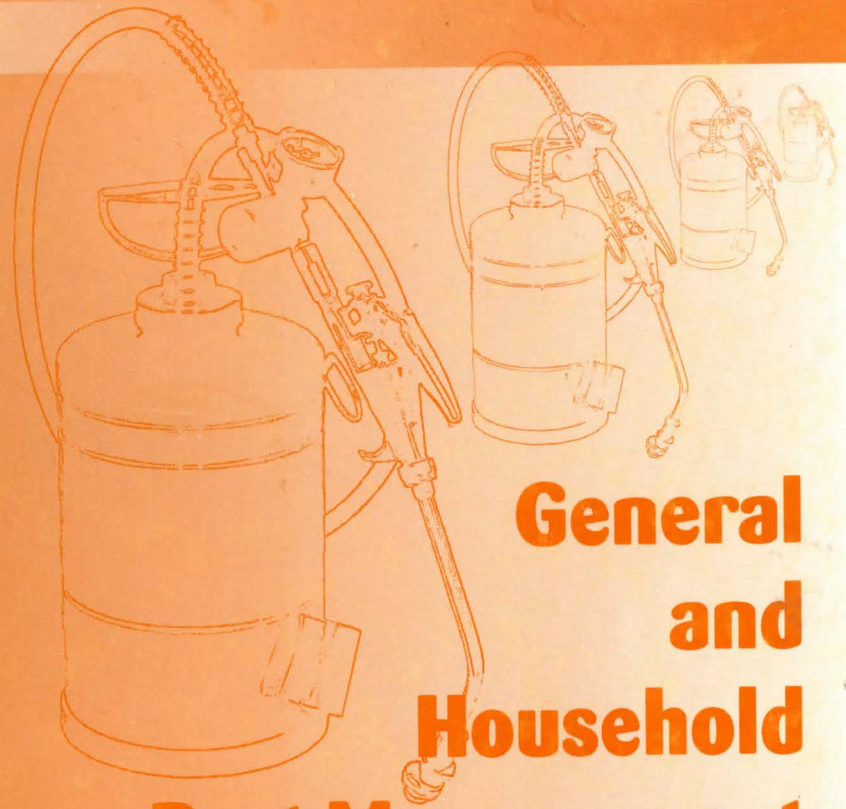
S
544.3
.J8
C74
no.19
rev
1993

Iowa Commercial Pesticide Applicator Manual



Category

7A



General and Household Pest Management

IOWA STATE UNIVERSITY
University Extension

Ames, Iowa

CS-19 | Revised December 1993

File: Pest Management

E

... and justice for all

The Iowa Cooperative Extension Service's programs and policies are consistent with pertinent federal and state laws and regulations on nondiscrimination regarding race, color, national origin, religion, sex, age, and disability.

Cooperative Extension Service, Iowa State University of Science and Technology and the United States Department of Agriculture cooperating. Robert M. Anderson, Jr., director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.

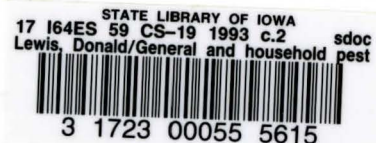


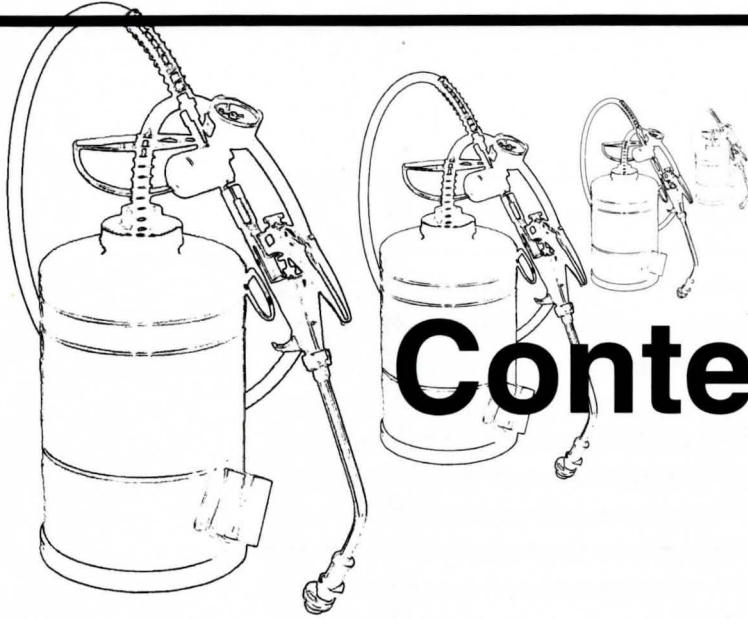
Iowa Commercial Pesticide Applicator Manual

General and Household Pest Management

Category 7A

Prepared by Donald Lewis, Iowa State University Extension entomologist





Contents ❖

Acknowledgments	3
Introduction	3
Integrated Pest Management	5
Monitoring or inspection	5
Identification	6
Treatment	6
Pesticide Safety	6
Applicator safety	7
Environmental safety	7
Customer and public safety	7
Equipment maintenance and calibration	8
Cockroaches	9
Types of cockroaches	9
Cockroach management	10
Ants	11
Ant management	12
Flies and gnats	15
Types of flies	15
Fly management	16
Stored-food pests	17
Management of insects in stored foods	19
Stored product and fabric pests	20
Carpet beetles	20
Clothes moths	21
Stored product and fabric pest management	21
Accidental invaders	22
Other arthropod pests	25
Spiders	25
Foreign grain beetle	26
Silverfish and firebrats	26
Booklice	27
House centipede	27

Biting and stinging pests	27
Fleas	27
Flea management	28
Ticks	29
Mosquitoes	29
Bees and wasps	29
Types of bees	30
Bat bugs and bed bugs	30
Human lice	31
Delusory parasitosis	32
Vertebrate pests	33
Rats	33
Control and management	35
Mice	39
Control and management	41
Birds	44
Pigeons	44
Starlings	45
House sparrows	46
Health hazards associated with birds	46
Legal considerations	47
Tools and methods for managing birds	47
Bats	49
Tree squirrels	51
Snakes	52
Skunks, raccoons, and opossums	52



Acknowledgments

Information in this manual was adapted from the following: *Structural Pest Management*, Minnesota Extension Service, University of Minnesota; edited by James Cink and Phillip Harein; *Structural Pest Control*, 2nd edition, University of Wisconsin, by Phil Pellitteri and others; and *Urban Integrated Pest Management, A Guide for Commercial Applicators*, US-EPA 735-B-92-001.



Introduction

This manual has been developed for individuals preparing to become certified in Iowa as Commercial Pesticide Applicators in category 7A, General and Household Pest Management. Persons likely to utilize this manual include commercial and institutional pest control operators, food plant sanitarians, and others responsible for the management and elimination of cockroaches and other household pests.

Applicators providing service for structural pests such as termites, carpenter ants, and powderpost beetles are required to be certified in Category 7B, Structural Pest Management.

This manual supplements the general information contained in the *Iowa Core Manual*. Your preparation for certification requires use of both manuals.



This manual has been developed for individuals preparing to become certified in Iowa as Commercial Pesticide Applicators in category 7A, General and Household Pest Management.

This project has been funded by the Iowa Department of
Agriculture and Land Stewardship through a grant from
the U.S. Environmental Protection Agency.



Integrated Pest Management

The pesticide applicator training program is not an endorsement of pesticides as the method of choice in controlling household pest problems. In fact, **Integrated Pest Management (IPM)**, as defined in the *Iowa Core Manual* and described in this manual, is believed to be the most effective way to control pests.

IPM is an information-based management system. Successful application of IPM requires the pest control operator to have a thorough understanding of the following points:

- the pests that are likely to be found
- pest life cycles and habits
- reasons pests exist and flourish where they do
- effective and legal means to manage pests

Household integrated pest management is also known as **urban pest management**. The definition of pest management of household pests is the same as the more highly evolved and widely implemented concept of IPM in agriculture and horticulture. That is, we are looking at a process that systematically uses all appropriate pest control processes (cultural, mechanical, biological and chemical) in an environmentally compatible and economically feasible manner to maintain pest populations below tolerable levels (See the *Iowa Core Manual*).

However, urban pest management is different from agricultural IPM in several important aspects. First, "tolerable damage" in agricultural IPM is an economic calculation called the **injury level** or **threshold**. Pests are tolerated, often in

large numbers, as long as the cost of damage is less than the cost of control. In contrast, urban pest management thresholds are related to aesthetics, personal taste, comfort, and public health. In general, pest presence is not tolerated; that is, **injury thresholds** (called **aesthetic injury levels**) are zero. Sampling or monitoring under such a constraint is aimed at detection of any pests and not a measurement of the number of pests present.

Secondly, urban pest management stresses integration of non-chemical and chemical management procedures. These are used with a thorough understanding of a pest's biology and ecological relationships within its environment to achieve pest prevention and control.

Monitoring or inspection

Urban pest management places an emphasis on monitoring for the arrival or presence of pests. Early detection of pest problems is important so prevention or elimination actions can take place in a timely fashion. Pest detection requires a well-planned inspection or monitoring system. Monitoring requires that you know what to look for; (that is, identifying the various stages or symptoms of the common pests), where to look, and when the different stages are likely to be present. Pests do not infest uniformly; training and experience in conducting inspections are important for successful location of infested areas.

Several monitoring techniques and tools are available to the pest control industry. These include visual inspection for signs of infestation (pests, cast skins, damage, droppings, or tracks), "flushing" agents, sticky traps, pheromone traps, electrocutor traps, product sampling, and



Urban pest management uses all appropriate pest control processes to maintain pest populations below tolerable levels.

others. Pest-specific inspection/detection techniques will be included throughout this manual.

Identification

Pest management requires positive and accurate identification of pests. The correct identification makes it possible to learn and use information about pest biology and habits to help you efficiently manage the pests. This might include knowledge about potential points of entry, likely harborage or shelter areas, or alternative pesticide formulations and methods of application that will make your work more successful.

Treatment

The actual choice of pest control techniques you use will vary with each situation. Treatment will usually be a combination of methods, including sanitation and habitat modification, other cultural and mechanical factors, and pesticides as appropriate for the situation. Examples of the most common pest management options include:

- cultural methods
 - sanitation and cleanliness (removing food sources and harborages)
 - structural modification (eliminating harborages)
- mechanical methods
 - traps, glue boards, barriers, screens, preventing pest access
- biological control
 - predators, parasites, pathogens, (limited usefulness in urban pest management, though research in biological controls is continuing)
- chemical controls
 - fogging, crack and crevice treatment, spot treatment, baiting

If you chose to use a pesticide, select a product that has label directions for the intended use. Match the labeled site, pest, and other considerations to your situation. Important performance considerations of the various pesticides include:

- mode of action
 - contact
 - residual
 - growth regulator
- formulation
- treatment surface
 - porous or nonporous
 - staining potential
 - alkalinity (bare concrete)
- residual life expectancy (dependent on formulation & surface)
- phytotoxicity
- available equipment
- visual appearance of objectionable residues
- flammability when used near open flames or heat sources
- electrical conductivity
- pest life cycle or timing



Pesticide safety

The application of pesticides for household pest control involves risks to the environment, the customer, and the applicator. However, the hazard of household pest control is very low when modern pesticides are properly used by conscientious, well-trained applicators. Most problems with pesticides result from misuse, and these problems can be avoided by reading and following label directions, understanding pesticides and their uses, and using common sense.

◆
The application of pesticides for household pest control involves risks to the environment, the customer, and the applicator.

Applicator safety

Handling pesticides always presents some risk of exposure to the pesticide applicator. The relative hazard varies with the toxicity of the pesticide, the formulation, the work being done, the method of application, the location, and for outdoor applications, the weather. Personal protective clothing and equipment was discussed in your *Iowa Core Manual*. Review that material and your pesticide labels to determine the appropriate use of coveralls, aprons, gloves, goggles, boots, and respirators or gas masks for your situation.

Never eat, drink, or smoke when handling, mixing, or applying pesticides. Wash your hands thoroughly when you finish application.

Environmental safety

Broadly defined, environment is all of our physical, chemical, and biological surroundings. This definition would include soil, water, air and all species of plants, animals, and microorganisms. Obviously, this broad definition includes the customer and their families, pets, the residential or commercial structure, and its furnishings. Pesticides have the potential to cause direct, indirect, or long-term adverse effects on any of these and other components of the environment.

Environmental safety most commonly focuses on groundwater contamination, safe pesticide storage, unintentional effects to nontarget animals, and emergencies such as spills, fires, and accidents. Minimizing pesticide waste and safe, proper pesticide and container disposal are additional concerns. Review these topics in your *Iowa Core Manual*.

Outdoor treatments are, obviously, more likely to result in environmental contamination. Spray or runoff must not contaminate rivers, ponds, or lakes. Use extra caution when treating areas where pets or wildlife might be harmed by the pesticide.

Customer and public safety

Safe application of pesticides requires a careful, thorough reading and understanding of the pesticide label. The label directions generally give necessary considerations for safe pesticide application.

Most pesticide poisonings involve very small children. Extra care should be taken in storing, measuring, and applying pesticides where children are present. Check the label for directions if people, pets, or specific items are to be removed prior to application. The applicator should also be specific in instructing customers when to reenter the premises and what precautions to take. At the minimum, people and pets should not return to treated areas until the spray has dried or the dust has settled and the area has been completely ventilated.

Your basic concern is to minimize people's exposure to the pesticides you apply. This is especially important for persons on the premises who are sensitive to chemicals, ill, elderly, disabled, or pregnant.

Use special care in sensitive areas such as kitchens and food-handling establishments. Food, feed, and food-handling surfaces and equipment must not be contaminated with your pesticide. If food handling equipment or surfaces such as counters are treated, such as when fogging, these must be thoroughly washed

◆
Your basic concern is to minimize people's exposure to the pesticides you apply.

before food preparation is resumed. Remember to remove birds, cats, dogs, and other pets and to remove or cover aquariums prior to treatment.



Equipment maintenance and calibration

Several different types of equipment are available to the Pest Control Operator (PCO) for applying space and residual treatments. Matching the appropriate equipment to the specific job is an important decision for each application. Carefully follow all directions and precautions provided by the manufacturer of the equipment you are using.

The most commonly used equipment in urban pest control includes:

- hand held compressed air sprayers
- power sprayers
- pressurized canned insecticides
- aerosol and fog generators
- dusters (hand or power)
- bait stations or boxes
- traps

Equipment must be kept in a well-maintained condition to avoid expensive and embarrassing problems of on-the-job equipment failure. Check all application equipment frequently and regularly, particularly for leaking hoses and connections, plugged or worn nozzles, and dirty or worn gaskets. The small compressed air sprayers most commonly used in pest control are very easily and economically maintained. Replacement parts are inexpensive and spare parts should be kept available so the equipment can be kept in first-class condition.

Equipment must be properly and frequently cleaned to maintain efficiency and professional appearance. Probably the most important part of sprayer maintenance is keeping the spray tank clean. Remember to clean the outside of the tank. A clean sprayer is unlikely to contaminate a space occupied by humans or food, if it is temporarily left in a room, and a clean tank does not expose the applicator. If a pest control sprayer is used daily, it should be cleaned thoroughly once a week. A sprayer used only occasionally should be cleaned after every use.

Thoroughly clean all mixing and loading equipment immediately after use. Cleaning should be done in a designated area where exposure can be controlled and hazardous materials contained. Remember to wear proper protective clothing and gloves during cleanup; residues remaining on equipment can be absorbed through the skin.

Equipment calibration before pesticide application allows you to apply precisely the labeled amount of pesticide to the target site. Mixing the right amount of pesticide and water (or other carrier) to achieve the labeled rate is the first step. Applying the proper amount of formulation to a given area can be achieved by following the principles outlined in the *Iowa Core Manual*. Read and follow all label instructions as well as other directions provided by the pesticide manufacturer and distributor.

◆
Calibration allows you to apply precisely the labeled amount of pesticide to the target site.



Cockroaches

Cockroaches are the most abundant and troublesome pest in many buildings and homes. Though there are approximately 3,500 different species of cockroaches in the world, most are tropical insects. Only four species are commonly found indoors throughout the United States.

Each species of cockroach varies in appearance and habits, however, all are generally flat, oval, and tan, brown, or black. Their head is flexed downward when they are at rest and is concealed by a large shield-like plate called the **pronotum**. They have very long, thread-like antennae, large compound eyes, and chewing mouthparts.

Cockroaches are nocturnal (most active at night) and stay in the dark whenever possible. They hide during the daylight hours in gaps, cracks, crevices and other tight places where their bodies can touch surfaces both above and below. They are highly gregarious (preferring to move in or form a group) and large numbers may occur within a small space (though they do not construct a "nest" as such). Cockroaches are general feeders and will survive on a wide variety of foods. They prefer starches and carbohydrates, but will consume any food of people or pets.

Cockroaches may be carried into buildings in boxes and beverage cases, and with groceries. In apartments and larger buildings, they readily migrate from one room to another along water pipes and utility lines, or through cracks in the walls. Some species may enter structures from outdoors or come in through sewer lines.

The stages in the simple life cycle of a cockroach are egg, nymph, and adult. The eggs are enclosed in a capsule of 14 to 40 eggs, depending on species. Nymphs look like the adults, but are smaller and have no wings. Their life cycle is from 1 to 12 months.

Types of cockroaches

The types of cockroaches commonly found indoors in Iowa are characterized below.

German cockroach, Fig. 1

- adults are about ½ inch long
- tan with two dark stripes running lengthwise on the pronotum
- probably the most common household insect pest
- common in kitchens and bathrooms; remains close to food and water sources
- very high reproductive potential; 4 to 8 egg capsules per female with 30 to 40 eggs per capsule
- the egg capsule is carried by the female until the eggs are ready to hatch
- has developed resistance to certain insecticides

American cockroach, Fig. 2

- adult about 1½ inches long, largest of the common cockroaches
- reddish brown; margins of pronotum lighter
- prefers warm, moist areas such as basements, sewers, and steam heat tunnels
- 12 to 24 egg capsules produced per female with 14 to 16 eggs per capsule
- egg capsules are dropped in out-of-the-way places one day after they are formed

Life size



Fig. 1. German cockroach

Life size

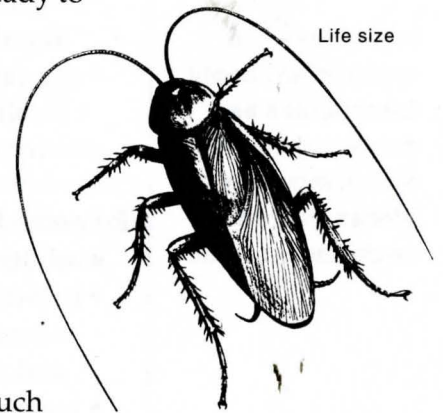


Fig. 2. American cockroach



Life size



Male



Female

Fig. 3. Oriental cockroach

Oriental cockroach, Fig. 3

- about 1 inch long as an adult
- shiny black or very dark brown
- female has very small wings; wings of the male cover about $\frac{3}{4}$ of the abdomen
- often found in damp places, such as basements
- may live outdoors during the summer months and move from building to building
- female produces 8 egg capsules of about 16 eggs each
- egg capsules are placed in protected locations within 1 day of their completion

Brownbanded cockroach, Fig. 4

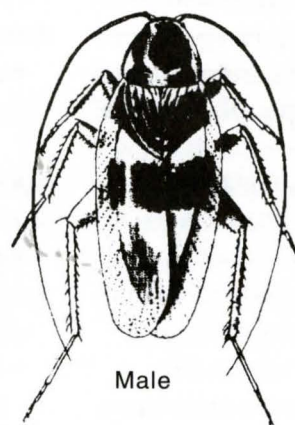
- adults are $\frac{1}{2}$ to $\frac{3}{4}$ inches long
- brown with two lighter bands across the base of the wings and abdomen
- may infest an entire building; less confined than other cockroaches to areas of food and water. Common in harborages above floor level
- female may produce 14 egg cases with 13-18 eggs per case

Cockroach management

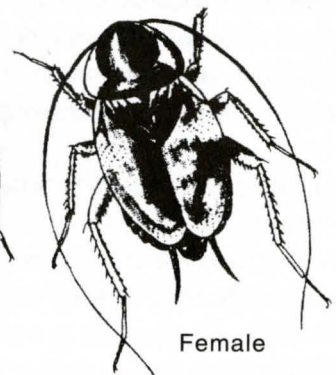
Management of cockroaches requires attention to all nonchemical and chemical control alternatives. Removing available food and water and changing structures to eliminate hiding places are essential in obtaining satisfactory cockroach management, though neither, if used alone, will eliminate cockroaches. Practical habitat alterations include building maintenance to repair defects such as loose baseboards and moldings, applying caulk around pipes and other wall penetrations, reducing clutter, and stopping water leaks.

Inspection is an important part of cockroach management. A flashlight, hand mirror, and magnifying hand lens can be used to detect cockroaches, harborages, droppings, or egg cases. Cockroach problem areas should be noted on your service record or building floor plan as a way to follow problems over time and for clearer communication with clients. Traps can be used as a monitoring method for cockroach detection. Traps will indicate pest presence and population size, but not exact sources.

In kitchens and living areas, apply insecticides as crack and crevice or spot treat-

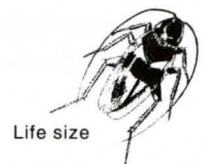


Male



Female

Fig. 4. Brownbanded cockroach



Life size

◆
In kitchens and living areas, apply insecticides as crack and crevice or spot treatments to places where the cockroaches hide.

ments to places where the cockroaches hide. Residual insecticide label directions specify crack and crevice treatment be used in commercial food-handling areas. As the name implies, a crack and crevice treatment is the application of a small amount of insecticide directly into the cracks and crevices (Fig. 5).

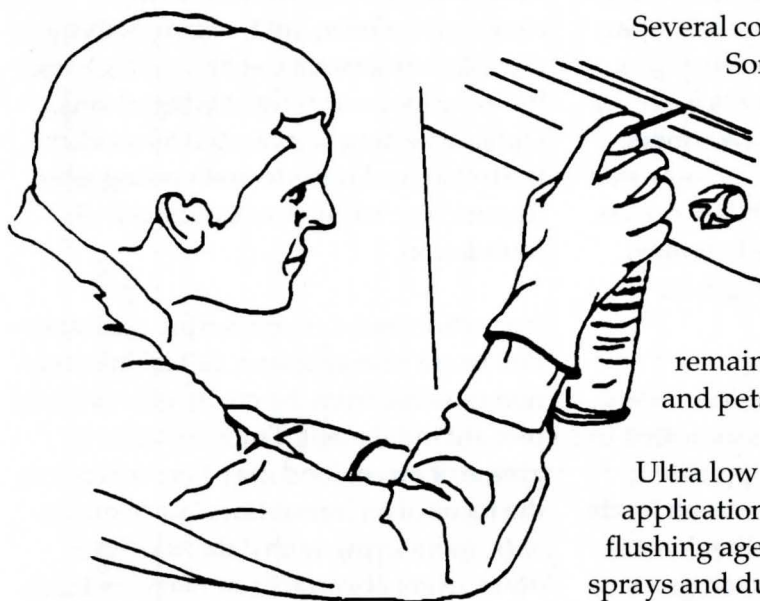


Fig. 5. Crack and crevice cockroach treatment.

These treatment sites would include expansion joints, openings to wall voids or hollow spaces, narrow openings along or beneath appliances or equipment, and hollow equipment legs and bases. A pinstream nozzle or a nozzle extension tube will be required to perform a crack and crevice treatment so that there is no insecticide applied on exposed surfaces.

A spot treatment involves limited surface application to small areas (less than two square feet) where pests hide or live. Some residual insecticide labels permit spot treatment in food handling areas, but this should not be understood as clearance to make a general or "baseboard" treatment.

Sprays, dusts, and baits are available for cockroach treatment. Dusts should be carefully blown into places difficult to reach where they will remain undisturbed. Sprays are generally used in areas where dust residues would be unsightly and where dust application is otherwise inappropriate.

Several cockroach baits are available. Some can be used in food handling establishments if label directions are followed. It is critical to make sure bait granules do not contaminate food or food-handling surfaces and that baits remain inaccessible to children and pets.

Ultra low volume (ULV) and aerosol application of contact sprays and flushing agents supplement residual sprays and dusts. Use them alone when the label prohibits the use of residuals.



Ants

Ants are among the most common pests in and around the home. They may build nests in the soil, under concrete slabs, stones or boards, adjacent to foundation walls, in the walls of the house, or in decaying wood or other cavities.

The activities of most ants are more annoying than harmful. Even the carpenter ant, which can cause considerable structural damage, is more often an annoyance than a home-wrecker. The biggest problem with ants comes when they invade the home in search of food. Although they may contaminate food,

◆
The activities of most ants are more annoying than harmful.

they become pests simply by their presence.

The stages in the life cycle of an ant are egg, larva, pupa, and adult. Ants are social insects and live in colonies with three distinct adult castes: queens, males, and workers. Most of the members of the colony are wingless workers. They forage for food; care for eggs, larvae and pupae; and enlarge and defend the colony site. Winged male and female adults leave well-established colonies as **swarmers**. The winged swarmers are often confused with swarming termites, but they can be distinguished by differences in wings, antennae, and "waist." See Fig. 6 for comparisons.

Ant management

Effective and efficient control of most household ants requires locating the nest. Ant nests may be located either inside or outside of structures. Common nest locations are given in Table 1. Indications of an indoor nest site include consistent ant foraging over a long period of time, nest materials (e.g. wood shavings) observed indoors, ant foraging activity during the winter, foragers in a high rise building, or swarming of winged ants. Outside nesting is indicated by worker trails that lead outside and nesting sites (mounds or infested wood) next to the foundation.

Inspection and data-gathering are important to ant management. Get all information possible from the client, observe, and plot ant movement. Traps baited with grease or sweet food may help determine the focus of an infestation. For pharaoh ants, monitoring with dabs of jelly or other sweet attractant (on masking tape) is necessary to locate small, isolated colonies and to determine where toxic bait treatments should be placed.

Some ant species can be discouraged by caulking wall penetrations such as utility lines and by keeping doors, windows, and screens tight. Repairing water leaks and maintaining food sanitation and cleanliness are also important.

When pesticide application is necessary, eliminating colonies by treating nesting sites is the primary goal. Insecticide sprays, dusts, or granules (for soil nests) can be used according to label directions. Access to wall void nests may require removal of moldings or drilling of small injection holes.

Ants eat a wide variety of foods as indicated in Table 1 (opposite page). Common foods include other insects, seeds, nectar, greases, sugars, and honeydew (excretion of plant sap-feeding insects such as aphids). Food is gathered by foraging workers and carried to the nest for sharing with other members of the colony. Some ant species appear to just wander

randomly, others trail each other precisely from colony to food source and back. Ants communicate with each other, especially along foraging trails, by means of **pheromones**.

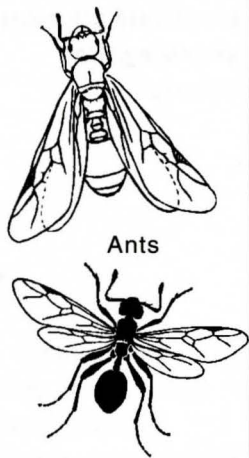


Fig. 6. Comparison of winged ants and termites
Ants: wings of different sizes; antennae "elbowed"; pinched "waist."
Termites: wings of equal size; antennae straight; no pinched "waist."

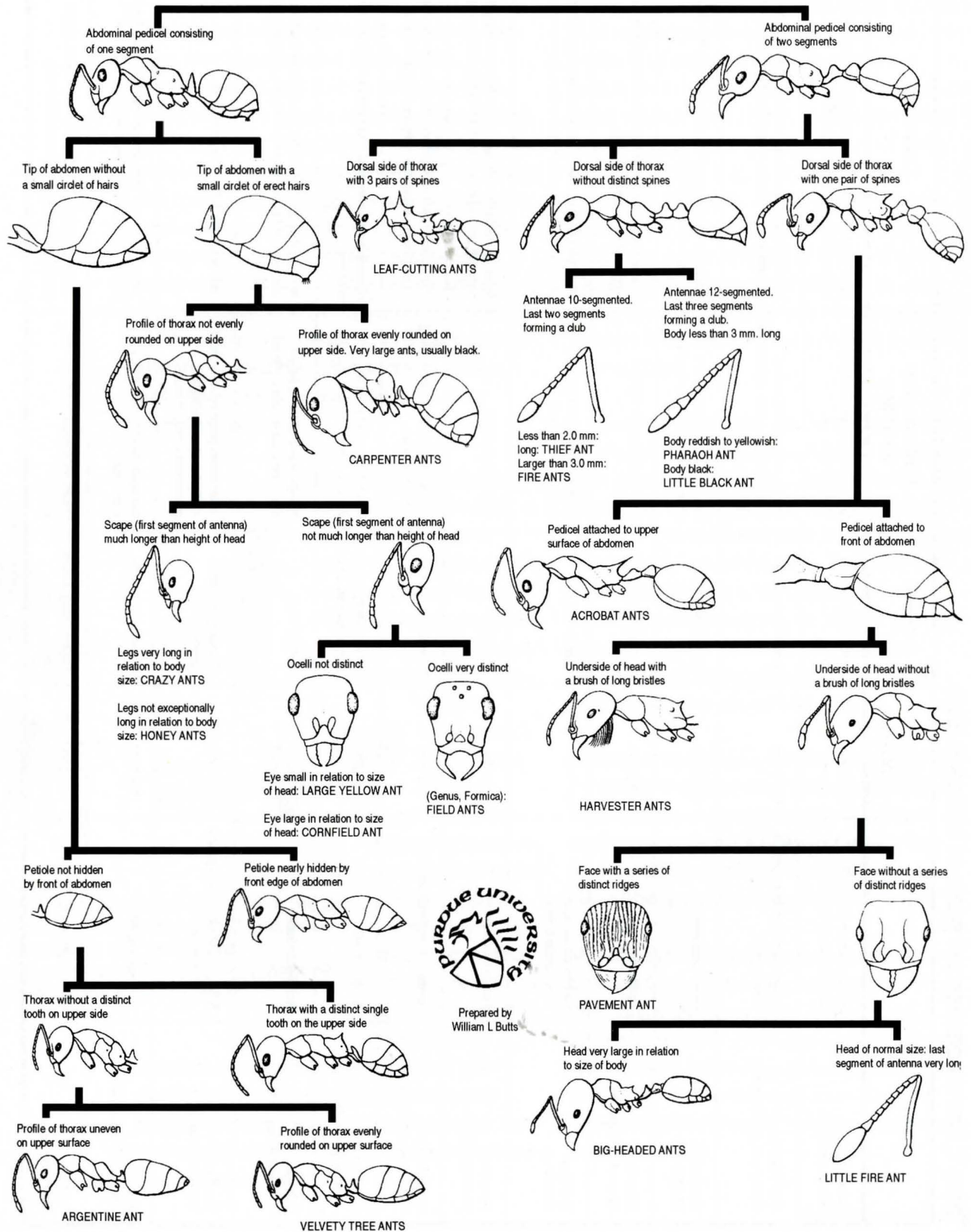
Continued on p. 15

Table 1. Some common ant pests of homes in Iowa.

Name	Color	Size of Worker	Foods	Common Nest Locations	Comments
Acrobat Ants <i>Crematogaster</i> spp.	Yellowish brown to black; abdomen usually darker	2.5 to 4mm	Sweets, meat, grease	Decayed wood; under stones; behind house veneers.	Heart shaped abdomen often raised above thorax; will sting and bite; invades homes for food only occasionally
Black Carpenter Ant <i>Camponotus pennsylvanicus</i>	Usually black but may be partially reddish brown	6 to 12 mm	Sweets, meat, grease	Partially decayed wood; natural cavities in wood or other objects either inside or outside.	Doesn't eat wood but hollows it out to form cavity for nest. Sawdust and other debris kicked from nest often marks nest entrance.
Cornfield Ant <i>Lasius alienus</i>	Brown to blackish	2 to 2.5mm	Sweets, meat	Rotten wood; under stones and sidewalks; in the soil in open areas.	Normally outdoors where it may produce many small mounds in the lawn; a common picnic ant.
Crazy Ant <i>Paratrechina longicornis</i>	Dark brown	2 to 2.5mm	Sweets, meats, grease	Small crevices inside buildings.	Has long legs and antennae and tends to run aimlessly about, accounting for its common name.
Field Ants <i>Formica</i> spp.	Red, brown, black, or combinations of these	3 to 7mm	Sweets, meats	Outdoors in the soil along fences, sidewalks, flower beds.	There are several species in this group that are normally outdoors and only occasionally enter homes for food. Some are mound builders.
Honey Ant <i>Prenolepis imparis</i>	Light to dark brown	3 to 4 mm	Sweets	In soil in shady areas.	Some individuals feed until their abdomens become greatly distended and they in turn feed other individuals by regurgitation.
Larger Yellow Ant <i>Acanthomyops interjectus</i>	Yellowish to reddish brown	4.5 to 5mm	Sweets	Old logs; stumps; under stones; along house foundation.	When crushed, give off a pleasant citronella odor. Are often confused with termites when they swarm adjacent to houses.
Little Black Ant <i>Monomorium minimum</i>	Shiny, jet black	1.5 to 2mm	Sweets, meats, grease, fruit, vegetables, bread	Rotten wood; under rocks, in masonry, in soil.	Normally nests outdoors but readily adapts to the household situation.
Odorous House Ant <i>Tapinoma sessile</i>	Brownish to black	2 to 3 mm	Sweets, meats	Beneath boards or stones outside; almost anywhere outside the house.	When crushed, give off foul odor. Invade homes especially during rainy weather that washes away honeydew, which is their primary food.
Pavement Ant <i>Tetramorium caespitum</i>	Brown to blackish brown; legs and antennae paler	2.5 to 4 mm	Grease, seeds, meat, sweets	Under stones, pavement, sidewalks; adjacent to house foundation; occasionally in walls of house.	Head and thorax furrowed by parallel lines.
Pharaoh Ant <i>Monomorium pharaonis</i>	Light yellow to red	1.5 to 2 mm	Sweets meat, grease	Wall voids; behind baseboards; other small voids.	Very large colonies. Often pests in hospitals and will feed on human wounds. Colonies often break up into several colonies.
Thief Ant <i>Solenopsis molesta</i>	Yellow to dirty brown	1 to 1.5 mm	Grease, meats, sweets, seeds	Cracks and crevices of cabinets and walls.	One of our smallest ants. Often lives in the nests of larger ants, stealing and feeding on the larvae of the hosts.

Adapted from University of Missouri-Columbia Extension Guide G7392, "Ants." By Darryl Sanders, Extension Entomologist.

Fig. 7. Pictorial key to common household ant workers.



If you cannot locate the nest site by observing ant activity or following their path or trail from the nest to the food, a surface residual spray can be applied to surfaces where ants crawl. Only workers are killed by this treatment and retreatment may be necessary. Be careful not to contaminate food, utensils, or food-handling surfaces.

Baits may be used effectively for ants that are strong trail makers. Ready-to-use baits are available and must be applied according to label directions. Some baits may require modification to be attractive to a particular species of ants. Again, read and follow label instructions after identifying the type of ant present and confirming its preferred food from the ant table. Grease ants, for example, are not attracted to sugar syrup baits, but will be attracted to baits mixed with vegetable oils, shortening, peanut butter, etc.

The pharaoh ant is particularly difficult to control. Conventional spraying will often cause the colony to break up into several smaller colonies that relocate, thus increasing the problem. Baiting with an insect growth regulator or toxicant bait is the effective way of controlling this pest. It is important to use a monitoring and baiting program from the beginning rather than start with spray. Ant identification is, therefore, especially important. See the key to ants, Figure 7, on the opposite page.



Flies and gnats

Several types of flies may be found in and around homes. Some of these are invaders from outdoors while a few are produced indoors in specific situations. The

flies mentioned below are annoying and a possible indication of unsanitary or unpleasant conditions, but are harmless except for the slight chance of mechanical transmission of disease pathogens. These flies do not bite, sting, or feed on house furnishings.

Flies have a complete life cycle of four stages; egg, larva (often called a **maggot**), pupa, and adult. Flies have very specific requirements for egg-laying sites where the larvae will develop.

Types of flies

House fly, Fig. 8

- ¼ inch long
- dull grayish thorax with lengthwise dark stripes and a dark, dull abdomen
- eggs are laid, and larvae develop in moist organic material such as garbage, manure, and other wastes

Cluster fly

- an accidental invader that enters buildings in the fall (September-October) while seeking hibernation sites. In nature, hibernation sites are under bark, in hollow trees, and other sheltered locations
- slightly larger than the house fly and more sluggish
- hibernating flies hide inside attics and walls but enter rooms on warm fall and winter days through window pulley holes, around baseboards and moldings or other small openings
- flies warmed by heat from the furnace or sun buzz around and collect in large numbers in light fixtures and at windows
- larvae develop outdoors only, as parasites inside earthworms

◆
Flies have a complete life cycle of four stages; egg, larva (often called a maggot), pupa, and adult.



Life size

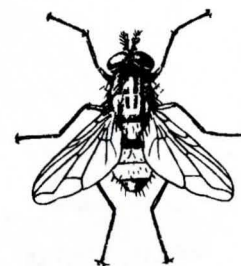


Fig. 8. House fly

◆
Sanitation is the primary control method for most household flies.

Blow flies, bottle flies and flesh flies

- bottle flies have a shiny green or blue body and are slightly larger than a house fly
- flesh flies are much larger than house flies, and are gray with three dark stripes on the thorax and black checkerboard pattern on the abdomen
- breed in garbage or decaying animals (such as birds, squirrels or rodents that became trapped in the chimney or wall and died)
- large, cream colored maggots may appear when they wander from the carcass and will be followed in 7 to 10 days by the adult flies

Fruit flies, Fig. 9

- also known as vinegar fly, pumice fly or the genus name, *Drosophila*
- very small; only $\frac{1}{16}$ to $\frac{1}{8}$ inch long
- brownish body with alternating light and dark stripes on the abdomen and red eyes
 - egg laying and larval growth occur on overripe fruit, but more commonly in the home, breeding sites are trash cans or the slime that forms in slow-running drains and around slow plumbing leaks.

Drain flies

- also known as sewer flies, filter flies or moth flies
- body and wings appear fuzzy or hairy
- black body is about $\frac{1}{4}$ inch long
- when the fly is at rest, the wings are held flat over the body and form a triangular or heart shape
- primary breeding site is the film or layer of slime that accumulates inside slow-moving drains, although other constantly-moist

accumulations of organic matter will suffice

Fungus gnats

- slender, delicate mosquito-like flies $\frac{3}{16}$ inch long
- larvae develop in moist soil (usually over-watered houseplants) and feed on decaying organic matter
- identifiable by the slender "Y" or "U" shaped marking at the outer edge of the wing

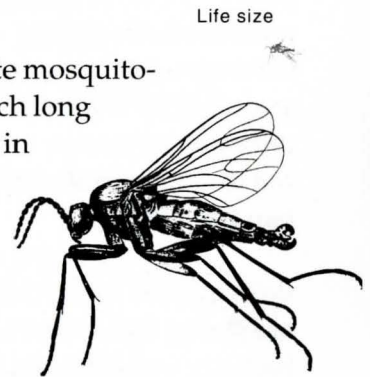


Fig. 10. Fungus gnat

Fly management

Sanitation to eliminate breeding sites is the primary control method for most household flies. This includes disposal of excrement, garbage, animal carcasses, proper storage of waste materials, and adequate drainage. Look for fly sources in and around infested buildings and practice sanitation in the areas where flies are a problem.

Eliminating fruit flies and drain flies usually involves mechanical cleaning of drains with a stiff brush, correcting plumbing leaks and periodic cleaning of water holding items such as the pan under the self-defrosting refrigerator. Insecticides and drain cleaners do not work in eliminating the slime above the water line where these flies breed. The most common means of fly entry is through open doors. Regularly check exclusion methods to see that they are being maintained. Doors, windows, and screens should be tight-fitting and in good repair to prevent fly entry. Caulk and tighten around all openings such as

Life size

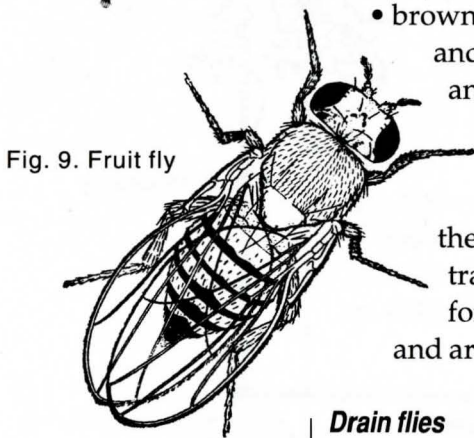


Fig. 9. Fruit fly

doors and windows, plumbing entries, ventilators, and eaves.

Commercial businesses may need to consider air doors, air curtains, and other exclusion devices. Check to see that automatic door closers are being maintained. Electric light traps have been used successfully in many fly control programs. Carefully follow manufacturer's directions for trap use. Place traps and maintain according to directions.

Insecticide sprays may temporarily reduce the number of flies, but will not eradicate a problem. Space sprays provide very brief control. Residual sprays or dusts in resting sites or entry points can be helpful, especially outdoor sprays in mid-September to prevent entry by cluster flies. Fly baits must be used with caution to avoid accidental poisoning.



Stored-food pests

Nearly all food products may be attacked by one or more of the many insects collectively referred to as **pantry pests**. They eat or contaminate the products and may make them unfit for human consumption.

Infestations can occur at every point between origin and final use, including while grain is still in the field or being stored by the farmer or elevator, while raw commodities are being processed into food, while food is being warehoused, transported and retailed, and when being stored in the home.

The common stored-food pests are beetles and moths. Both groups of insects have a complete life cycle of four stages;

egg, larva, pupa, and adult. All stages are present in stored foods, though adults commonly leave the infested products and move about inside a home or business. Beetles or moths may be seen a considerable distance from their source. Beetles infesting food can be distinguished by referral to Fig. 11 on the next page.

Indian meal moth, Fig. 12

- the most common of stored food insect pests
- ½ inch long, off-white caterpillars infest stored foods and spin webbing on the surface of the food where they feed
- larvae are commonly seen on the walls and ceilings near heavily infested products
- commonly infested foods are cereal products, dried beans, nuts, dried fruits, chocolate, bird seed, and dry pet food
- adult moths have a ¾-inch wing spread
- wings are characteristically two-toned with the half next to the body tan or gray and the outer portion reddish brown

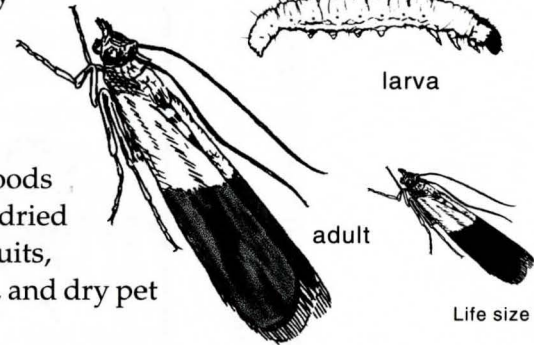


Fig. 12. Indian meal moth

Red flour beetle, Fig. 13

- much more common in Iowa than confused flour beetle
- reddish-brown shiny, flattened, oval beetle about ⅛ inch long
- larvae are ¼ inch, with a long, slender body; creamy white with a brown head and a dark two-pointed fork on tip of last body segment. The small size allows entry into closed containers

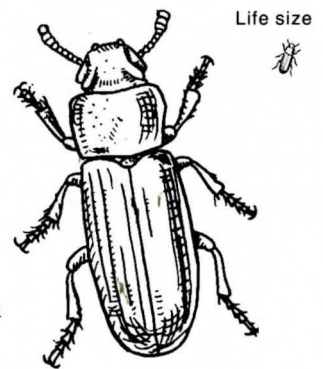
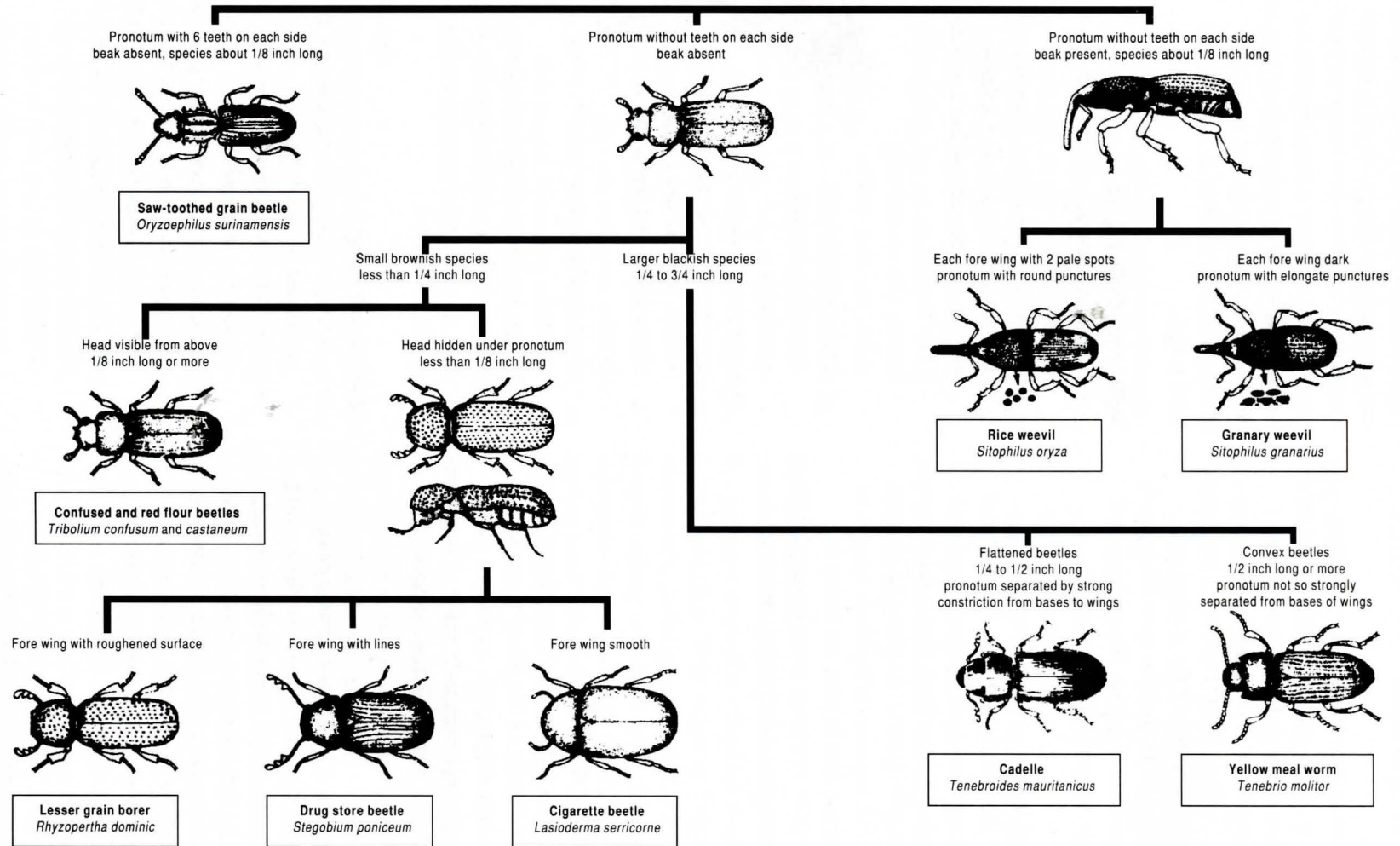


Fig. 13. Red flour beetle

continued on p. 19

Fig. 11. Key to some species of beetles commonly associated with stored foods.

Harry D. Pratt



- common in cereal products, seeds, nuts, dried fruits, and spices

Sawtoothed grain beetle, Fig. 14

- 1/10 inch long, slender, flat, and brown
- easy to identify because of the six sawtooth-like projections on each side of the thorax
- attacks all food of plant origin, especially grain and grain products, nuts, candies, dried fruits, and spices

Cigarette beetle, Fig. 15

- oval, brownish-red beetle with a hump-backed appearance and a downward pointed head
- 1/10 inch long
- found in a variety of plant products including seeds, grains, dried fruits, spices, pet food, and dried plants such as straw flowers or preserved plant specimens

Drugstore beetle

- similar to the cigarette beetle but with lines made of tiny punctures on the wing covers
- named for its ability to attack stored pharmaceutical materials

Rice weevil

- a snout beetle 3/16 inches long
- reddish brown to black with four light yellow spots on the wing covers
- eggs are laid inside whole grain kernels where the larvae develop
- these internal feeders of whole grain are not found in grain products or stored foods

Granary weevil

- similar to the rice weevil but without the yellowish spots on the wings

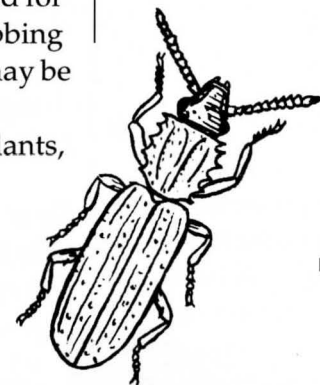
Management of insects in stored foods

Control of stored food insects requires locating and eliminating infested food items. The products mentioned with each pest should be checked and inspected for beetles, larvae or caterpillars, or webbing on the surface. Stored food insects may be in unopened boxes or containers, in cracks and gaps of manufacturing plants, warehouses and equipment, and in spilled product.

Inspection is a major part of eliminating stored food pests. A strong flashlight is required. A knife or spatula, hand lens, and mirror will be useful. Check for pests, cast skins, and tracks in spilled product or dust. Pheromone traps are now available for most stored product pests and should be used where routine inspections are made. In processing and storage facilities, keep detailed written inspection records and report pest activity, management, or maintenance recommendations.

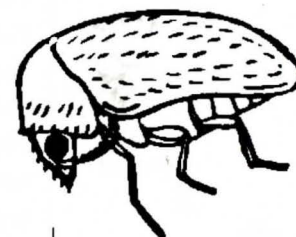
Discard infested materials. Sanitation is the primary method of population reduction where infested stored products are found. Cupboards, shelves, and machinery in the infestation area should be emptied and thoroughly vacuum cleaned. This will pick up any insects that may have wandered away from the infested items and also any spilled food that may be harboring more. Food plants must have a good, ongoing, cleaning program to prevent problems.

A light spray of a labeled insecticide can be applied being very careful not to contaminate foods. Spraying alone is not an effective substitute for locating and eliminating the source of the insects and cleaning the area.



Life size

Fig. 14. Sawtoothed grain beetle



Life size

Fig. 15. Cigarette beetle

Stored food insects can be prevented by inspecting incoming food materials, following strict sanitation procedures through regular and thorough cleaning, and stock rotation of food items in storage. Caulking cracks and closing passageways, screening doors and windows, and using air doors or curtains will also reduce pest introduction.

Homeowners may prefer to store susceptible foods in glass or heavy plastic containers or in the refrigerator or freezer for approximately a month after the source of the infestation is eliminated as a precaution against reinfestation. When they are convinced the infestation has been eradicated they can return foods to the cupboards.

generally scavengers and may feed on a variety of products of both plant and animal origin. The most damaging carpet beetles feed on animal products such as woolen and silk textiles, leather, furs, and skins. These scavengers are also abundant on dead animal carcasses and dead insects such as flies, boxelder bugs, and others that may have accumulated in house walls or attics.

Cabinet beetles are dermestids that prefer cereal grain products and are occasionally a pantry pest. Carpet beetles present in foods are there by accident except when in high protein, animal-based foods such as dried cheese found in packaged food products.

Common carpet beetles include:

Black carpet beetle, Fig. 16

- 1/8 to 3/16 inch long and oblong oval in shape
- black or dark brown and coated with short hair for a satin texture
- larvae are up to 1/2 inch, reddish to golden brown and tapered or carrot shaped
- larvae have a tuft of long hair at the tip of the abdomen

Varied carpet beetle, Fig. 17

- 1/8 inch long and nearly round
- black, but covered with yellow, brown and white scales in a mottled pattern
- larvae are 1/4 inch long and colored with alternating rings of light and dark brown stripes across the body
- larva are wider in the middle than at the ends
- tail end is covered with three dense tufts of bristles

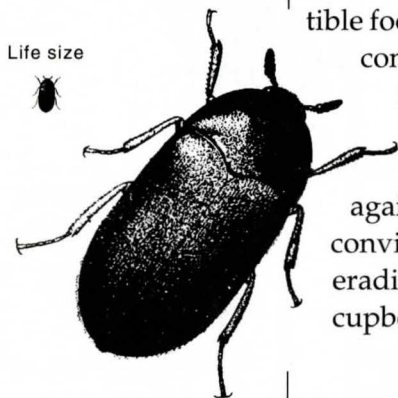


Fig. 16. Black carpet beetle



Stored product and fabric pests

Fabric pests—carpet beetles and clothes moths—develop as scavengers, consuming feathers, fur, and hide of dead animals outdoors. These insects feed primarily on high protein, animal-based textiles and products made of wool, furs, feathers, and hair. Infestations are common in boxes of old clothing, overstuffed furniture, woolen carpets, and piano felt. Both beetles and moths have a complete life cycle of four stages; egg, larva, pupa and adult. The larval stage causes the damage while the presence of adults in an area may be the first sign of infestation.

Carpet beetles

The carpet, larder, and hide beetles are collectively referred to as **dermestids**, a name derived from their taxonomic family name, *Dermestidae*. Dermestids are

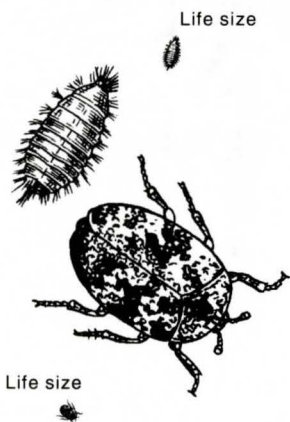


Fig. 17. Varied carpet beetle

Larder beetle

- is larger than the carpet beetles but closely related and similar
- a scavenger that feeds on high protein foods, such as dead insects
- adult is ¼ to ⅜ inch, black with a prominent tan band across the middle
- larvae are ½ inch; brown or black; slightly fuzzy; and have prominent curved spines on tip of abdomen

Clothes moths

The adult clothes moths are rarely seen. They are secretive, very small, and not attracted to lights. They scuttle in folds of textiles when disturbed. When small moths are persistently encountered in homes, they are more likely to be Indian meal moths.

Casemaking clothes moth

- only ¼ inch long at rest
- head and front wings are dusty brown with 3 small dots on each front wing
- larvae are ½ inch long, white or cream colored
- larvae construct a portable case of silk and bits of fiber

Webbing clothes moth

- similar size and appearance except wings are golden buff with no spots
- ½ inch long white larvae spin feeding tunnels of silk on fabric surface as they feed

Stored product and fabric pest management

Control of stored product and fabric pests should focus on eliminating the insects by cleaning or destroying infested items (clothing, food products, etc.). Discard or clean wool or fur products. Dry cleaning

kills clothes moths and removes food and perspiration stains necessary for caterpillar survival. There is a greater likelihood that furs or woolens in long-term home storage will be infested than those that are used seasonally. Cleaned fur, feather and woolen products should be stored in tight chests or garment bags. Storage areas should be thoroughly vacuum cleaned on a regular basis.

Often the source of carpet beetles may be unknown, difficult to find or there may be more than a single source. In that case a general treatment may be needed. After inspecting likely sources have the areas where dermestid beetles have been found thoroughly vacuum cleaned, paying particular attention to cracks and crevices.

Spot treatment or crack and crevice treatment with a labeled residual insecticide is appropriate for dermestid infestations. Treatment should be lightly applied to those surfaces upon which the insects are likely to crawl, such as along the edges of carpeting, in closets, and behind radiators, baseboards, and moldings. Baseboard spraying, fogging, and broad area treatments are generally ineffective and waste insecticide.

Long-term prevention of dermestid beetles should include thorough, frequent and regular cleaning to prevent accumulation of lint, hair, and other carpet beetle food materials. Close attention should be given to radiators and registers, corners, cracks, and other hard to reach places.

Clothes moth management is similar to that described for carpet beetles. Moth proofing of woolen clothing is available from dry cleaners but Pest Control Operator's should never spray any

◆
Spot treatment or crack and crevice treatment is appropriate for dermestid infestation.

insecticide on clothing. As with carpet beetles, contact sprays are available for exposed adults and larvae in carpets and sprayable furniture, but residual insecticides applied to cracks and crevices will not prevent or eliminate infestations in clothing.

Pesticide applications often have limited effect against accidental invaders, but are routinely done out of desperation. Pesticides can be applied to invader habitats according to label directions but some habitats, such as under mulch, may be difficult or impossible to thoroughly treat. Perimeter sprays on and adjacent to foundations are also available, but may be of limited benefit.

◆
Accidental invaders wander into houses and buildings by accident with no attraction or foresight.



Accidental invaders

The term "accidental invader" includes those pests which may occur in buildings at some stage of their life cycle, but which do not usually complete the entire life cycle within the building. They are also called **occasional invaders** because they do not regularly occur inside. They are uniformly disliked even though they are

harmless and usually cause no harm to buildings, furniture, or occupants.

Accidental invaders wander into houses and buildings by accident with no attraction or foresight.

Invasion is often triggered by migration from a nearby, heavily populated habitat.

Since accidental invaders originate outdoors, exclusion techniques to prevent their entry are preferred to indoor treatments that control them after they are inside. Exclusion techniques include sealing cracks and gaps in foundations, siding and around chimneys, windows and doors. Use well-maintained and tight-fitting windows, doors, and screens. Habitat modification is sometimes of partial success in managing accidental invaders and is suggested below as appropriate.

Boxelder bug, Fig. 18

The common boxelder bug is perhaps the best known of the accidental invaders and is frequently a nuisance in and around homes from fall through early spring. The adult bugs overwinter in protected places such as houses, other buildings, wood piles and underneath rocks, boards, leaves, loose bark, and so forth.

Adult boxelder bugs are:

- ½ inch long
- elongated-oval in shape and pointed at both ends
- black with red lines on the thorax and red outlines on the wings

The boxelder bug has a gradual or simple metamorphosis and the nymphs are:

- bright red
- similar in shape to the adults
- much smaller than adult — ⅓ to ⅔ inch long
- found on host plants where they feed on tree sap

The boxelder bug has two generations each summer. The populations vary tremendously from place to place and from year to year, mostly because of weather. Populations are highest when spring weather is very warm and mid-summer weather is very dry (such as 1989). Boxelder bug nymphs develop on several species of trees, including

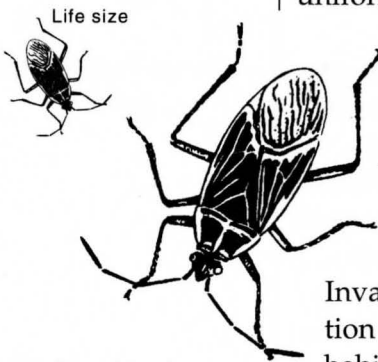


Fig. 18. Boxelder bug

boxelder and maple. Boxelder trees are a chief source of the bugs, but not the only source. Adults seeking overwintering sites in the fall congregate in large masses on the south and west sides of buildings, trees, and rocks. Like other accidental invaders, they enter the building through cracks and spaces under siding, in the foundation or around window and door frames. Once inside the wall voids, they crawl into rooms of the house when warmed by heat from the furnace or sun.

Exclusion techniques, such as screening or sealing cracks and other entrances into the building, are important because control is very difficult after boxelder bugs have entered the home. Caulk around entry points on the house foundation and door and window facings.

Pesticides have limited effect, but can be used to some benefit to prevent entry. Soapy water sprays offer a safe, effective control when applied directly to the congregating bugs, and is a control worth suggesting to homeowners. There is no residual control from soap sprays and very frequent, repeat application will be necessary. Wettable powder and microencapsulated insecticides have the most preventive effect and can be applied to tree trunks and foundations when migrating bugs are first noticed accumulating on the house sides.

A vacuum cleaner is useful for controlling bugs that have entered the home. Residual insecticides show little if any benefit in stopping bugs that emerge from within house walls. Contact sprays can be used by the homeowner for control of exposed bugs.

Attic flies

The term "attic" fly is used to refer collectively to the different species of flies that

spend the winter hibernating in house attics and walls. The predominate species in Iowa with this behavior are the cluster flies and face flies (pp. 13 and 14).

Cluster flies are discussed earlier in this manual. They wander into houses by accident while searching for a place to hibernate through the winter in the same manner as boxelder bugs and other accidental invaders.

Face flies are the familiar, large flies seen around the eyes and mouths of cattle in the summer. These flies breed in fresh cow manure and have two or more generations per summer. They overwinter as adults, often in houses near feed lots and cattle pastures.

Crickets

Black field crickets and reddish-brown, humpbacked camel cricks are common occasional invaders. Both are more annoying than harmful although some damage to fabrics, clothes, and curtains is attributable to autumn invasion of large numbers of field crickets. Exclusion is the best prevention along with cleaning up breeding and hiding places near the building. Outdoor residual sprays or granules are frequently of short-term benefit in reducing accidental invasion.

Wood cockroaches

Wood cockroaches are similar in appearance to the household cockroaches, but they live outdoors exclusively. They live in rotted logs, tree stumps, hollow trees, and under the loose bark of dead trees and firewood. They are primarily a problem in mid-spring when the males are especially active and are attracted to lights. The males fly, whereas the females cannot.

◆
Wood cockroaches are similar in appearance to the household cockroaches but they live outdoors exclusively.

Life size

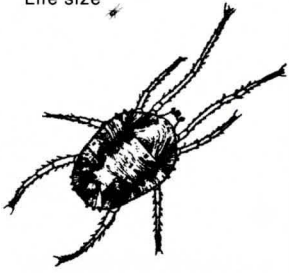


Fig. 19. Clover mite

◆
The clover mite is an annoying household invader from lush turfgrass.

Once indoors, wood roaches wander about during the daytime and do not hide in usual cockroach harborages. Usually they die within a few days because of insufficient moisture. Wood roaches do not reproduce or establish indoors, and their presence is only an annoyance.

Wood roaches can be identified by the following characteristics:

- dark brown to straw brown color
- about 1 inch long
- prominent white stripes on edges of thorax and front portion of wings
- wings of female cover half of abdomen
- wings of male extend slightly beyond tip of abdomen
- more slender shape than household cockroaches of this length

Wood cockroaches are frequently carried in with firewood or they crawl or fly in after being attracted to lights. Exclusion techniques, caulking and tight screening, may be of some benefit. Outside lighting should be reduced or regulated during periods of abundance. Outdoor perimeter applications of insecticide may help, but indoor treatments are of no benefit.

Ground beetles

There are hundreds of species of ground beetles. Many are very common and often abundant Iowa. They are beneficial as predators on other insects and cause no damage.

Ground beetles are highly variable, but in general are:

- $\frac{1}{4}$ to 1 inch long
- usually shiny black, though a few are brown or green

Under situations of persistent invasion, control is the same as mentioned in the introduction to accidental invaders.

Clover mite, Fig. 19

The clover mite is an annoying household invader that migrates indoors in the spring from lush turfgrasses close to foundation walls. Large numbers of clover mites are seen on window sills, walls, counters and curtains when migration is abundant. Populations are largest in new, lush lawns of well-fertilized grass where the landscape plants are not yet well-established.

Clover mites are:

- $\frac{1}{16}$ inch long
- bright to dark red
- easily crushed when wiped or touched and leave a red streak
- recognized by their size, habit, and very long front legs

Clover mite control should emphasize reducing outdoor populations and keeping mites from getting indoors. A bare strip 18 to 24 inches wide along foundation walls and covered with mulch may help, or even better is to plant shrubs next to the house and mulch the soil around the plantings. Caulk building cracks and gaps and install weather stripping around windows, doors, and electrical outlets.

Pesticides can be used for mite control outside and is usually done after mite invasion is underway. Thorough treatment to and along the foundation is usually effective, though application must reach the soil surface. Treatment to a larger portion of the lawn is sometimes necessary for long-lasting control. Iowa applicators are required to post treatment notification signs in residential areas if the treated area extends more than six feet from the house.

Indoor treatment may be made for immediate relief from mites already inside. It is

important to vacuum mites to avoid streaking and staining.

Millipedes, Fig. 20

- are gray or dark brown cylindrical worms; ½ to 1½ inches long
- have two pairs of short legs on each segment
- curl or coil up in a spiral when disturbed

Millipedes are common on the forest floor, in compost piles, under dead leaves, in heavily mulched areas, and in farm fields in the government reserve or set-aside program. When millipedes leave their natural habitats, they crawl over lawns and sidewalks and may invade buildings in large numbers. They cause no damage. Prevent invasion by removing leaves and compost around buildings and by sealing cracks in foundation walls and around doors, basement windows, crawl spaces, and vents. Spraying a perimeter strip around the foundation is helpful in control though a very large barrier may be necessary. Repeat applications may be required during periods of heavy migration.

Sowbugs and pillbugs

Sowbugs and pillbugs are common outdoor arthropods that occasionally wander into houses. They are land crustaceans that develop in constantly moist habitats similar to those of millipedes. They are harmless and feed only on fungi and decaying vegetable matter.

Recognition characteristics include:

- oval body ½ inch long and gray to brown in color
- seven pairs of legs concealed on the underside
- top side with overlapping plates creating an appearance similar to a miniature armadillo

Pillbugs can roll into a tight, pill-like ball; sowbugs cannot. Sowbug and pillbug controls are the same as for millipedes.



Other arthropod pests

Arthropoda is the name of the phylum that contains the insects and their close relatives such as spiders, mites, and ticks. Several arthropods are common urban pests that may be annoying or cause damage within a home, business, or institution.

Spiders

Spiders are the most common arthropod seen by homeowners, but one that few people consider a serious pest. A spider develops from an egg into an immature spider that may molt several times before becoming an adult.

The black widow and the brown recluse (fiddleback) are the only two spiders that may seriously injure humans. Neither spider bites unless provoked. The female black widow is shiny black and distinctively marked with a red or yellow spot on the underside of the body, sometimes in the form of an "hourglass." This spider lives under rocks and boards and in or around buildings. It is only rarely reported in southern Iowa.

Brown recluse spider, Fig. 21

The brown recluse spider is tan to brown with a dark brown fiddle-shaped pattern on the front half of its back. It is usually found in buildings, such as barns, sheds, garages, and houses that are dry, littered, undisturbed and contain insects that serve as food.

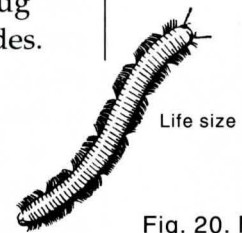


Fig. 20. Millipede

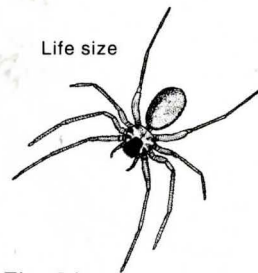
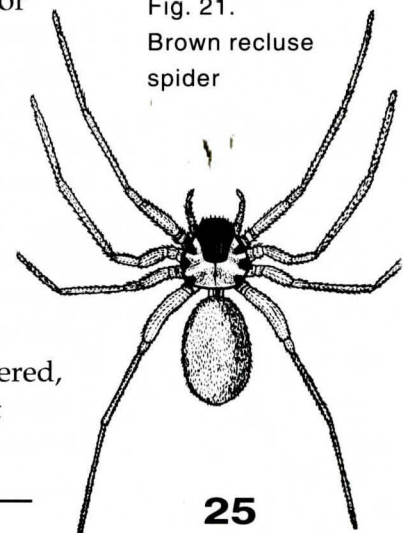


Fig. 21. Brown recluse spider



More common than the poisonous spiders are the common accidental invaders such as wolf spiders, jumping spiders, and grass spiders. These may be alarming or disagreeable but are not dangerous.

Control spiders by controlling insects that serve as food, and by regular and thorough cleaning of webs and spider harborage. Direct pesticide sprays or dusts at hiding areas such as cracks and crevices.

Foreign grain beetle

The foreign grain beetle is a common and abundant insect during late summer and fall. They feed on molds and fungi, and not on grain as the name would imply, but are often found in damp or spoiled grain and are common in grain storage facilities.

Foreign grain beetles can be identified by the following characteristics:

- very small, reddish-brown beetles $\frac{1}{16}$ inch in length
- only one-half the size of the better-known red flour beetle
- two rounded lobes or projections on the front corners of the thorax are visible when magnified with a hand lens

Foreign grain beetles are not a pest of stored foods. Beetles present indoors may originate anywhere outdoors where molds and fungi occur. They are strong fliers and are attracted to lights, and may enter homes through screens, cracks and crevices, or around windows and doors.

The most severe infestations of foreign grain beetles occur in newly-constructed houses. They originate inside walls where molds are growing on lumber that was exposed to moisture before or during construction. They continue to emerge

from the new house walls for an extended period until the house completely dries out.

Foreign grain beetles are a nuisance and annoyance but do not harm anything within the home. They cannot bite or sting and do not attack plants, furniture, or the house structure. Problems with this pest are usually self-limiting as the seasons change and as moisture trapped in new houses dries out naturally.

Beetles inside the home can be vacuumed or swept up and discarded. Insecticide fogs give only temporary control of exposed beetles. Crack and crevice application of residual insecticides has provided limited benefit in the past.

Silverfish and firebrats, Fig. 22

Silverfish and firebrats are wingless insects about $\frac{1}{2}$ inch long as adults. They have three long "bristletails" at the end of their body and two long antennae in front. They have a distinctive slender, tapered body covered with shiny silver scales (silverfish) or mottled dark gray scales (firebrat).

Unlike other insects, silverfish and firebrat adults continue to molt when full grown. They feed on stored foods, paper, and almost anything containing proteins or carbohydrates. In general, they shun light and prefer dark, undisturbed sites. The silverfish is favored by conditions of high humidity, while the firebrats prefer warm temperatures.

Eliminating moisture by repairing leaks, increasing ventilation or using fans and dehumidifiers may be of benefit. Use crack and crevice applications of registered insecticides in areas of infestation. Fogs only control exposed silverfish and

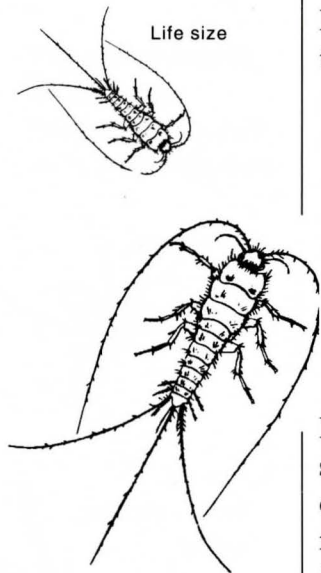


Fig. 22. Silverfish

are only of use for immediate reduction of large populations.

Booklice, Fig. 23

Booklice (psocids) are very small ($\frac{1}{20}$ to $\frac{1}{10}$ inch), light-colored insects that may be found indoors and out. They are restricted to damp places in or around stored foods and books and in crawl spaces. They feed on molds and fungi. They do little damage and are pests by being present, often in tremendous numbers. They can be serious pests for manufacturers of food products and containers.

Control booklice by removing moisture and food sources. Directed sprays and aerosols are effective in control.

House centipede, Fig. 24

Centipedes are wormlike, many-segmented arthropods with one pair of legs attached to each segment and one pair of long antennae. The centipede commonly found indoors is known as the house centipede. These fast-running creatures can be recognized by the following characteristics:

- up to $1\frac{1}{2}$ inches long; brown to grayish yellow with three dark stripes on top
- 15 pairs of long threadlike legs encircled by dark and white bands

In spite of their ecological benefit, most people are repulsed or frightened by centipedes and insist they be controlled. House centipedes can be found both indoors and outdoors in damp places such as cellars, closets, bathrooms, unexcavated areas under the house, and beneath the bark of firewood. They frequently become trapped in bathtubs, sinks, and lavatories but do not come up

through drain pipes. They are harmless to people and beneficial because they feed on small insects and spiders.

Control by frequently cleaning habitats such as undisturbed storage areas where centipedes originate. Residual insecticides can be applied to hiding places such as cracks, crevices and corners in crawl spaces, basement, and storage areas. Dusts work well in dry locations; if the area is damp, apply a light residual spray. Centipedes discovered outdoors should not be controlled.



Biting and stinging pests

Many insects, such as fleas, ticks, and mosquitoes feed directly upon people and other warm-blooded animals. In addition to their bloodsucking activities, they can carry disease-causing organisms from one animal to another or to humans.

Fleas, Fig. 25

The most important flea species in dwellings is the cat flea which feeds on a variety of hosts, including cats, dogs, rodents, and humans. The secret to successful flea management is understanding the life cycle. Fleas have a complete life cycle of four stages: egg, larva, pupa, and adult.

Adult female fleas lay up to several hundred eggs. Though laid while the flea is on the host, these eggs usually drop off the host and develop in pet-resting areas.

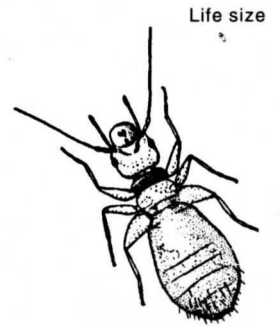


Fig. 23. Booklouse

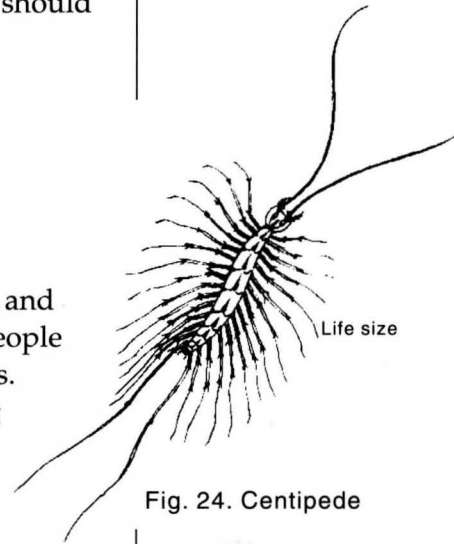


Fig. 24. Centipede

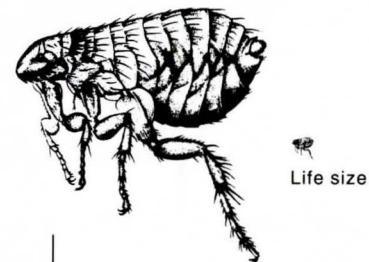


Fig. 25. Cat flea

Flea larvae, Fig. 26

Flea larvae are tiny, wormlike insects. Identifying characteristics are:

- only 1/8 inch long
- whitish to almost transparent
- small, brown head
- legless
- sparsely covered with long, fine hair

Life size

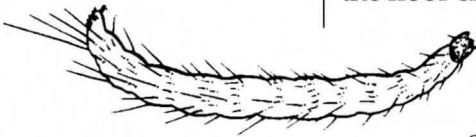


Fig. 26. Cat flea larva

The larvae live in carpets, pet bedding or the floor cracks in areas where the pets rest. They do not live on the host and do not suck blood from the host. They feed on organic debris, especially specks of dried blood that are passed in the feces of the adult fleas that do suck blood from the pet. After one week to several months, depending on environmental conditions, flea larvae spin a loose white silken cocoon and pupate within.

The flea pupa lasts only a week to 10 days before transforming into an immobile form called the **preadult**. The preadult form may remain in the cocoon for months until stimulated to emerge by favorable conditions of vibrations from pet or human activity, carbon dioxide being exhaled by a warm-blooded animal, or a sufficient number of warm, humid days.

The adult flea is ready to feed (Fig. 27) as soon as it leaves the cocoon. They obtain all of their nourishment from the host animal. They feed by biting and sucking blood, sometimes daily, for two or three weeks. The fleas inject saliva when they feed that causes irritation.

Scratching and itching by the host dislodges eggs and feces from the pet's hair that drop to

the floor or ground. Corkscrew shaped strings of dry blood are present in areas

where pets spend considerable time, and may be noticed during inspections for flea activity.

Flea management

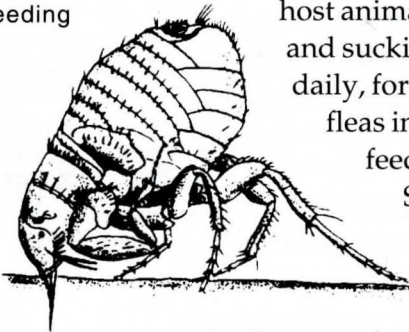
Flea management should include an inspection of the home and an interview with the home owners to determine "hot spots" of flea activity, and pet bedding or sleeping areas. Areas of flea abundance and other potential harborage areas should be vacuum cleaned as thoroughly as possible. Thorough and daily vacuuming may eliminate low to moderate flea populations. Pet bedding should be thoroughly cleaned, laundered, or discarded.

Pets should be treated by the pet owner or a veterinarian. Available treatments include sprays, dusts, shampoos, and dips. Flea collars may help but are generally the least effective treatment. Similarly, ultrasonic devices that are heavily advertised as flea deterrents are useless. Fleas do not react to ultrasound and there is no utility for ultrasonic devices in a flea management program.

Surface and crack and crevice sprays are routinely applied for flea control. Both broadcast and spot treatments are useful in killing flea larvae and adults that come in contact with the sprays. Thorough application is essential to reach concealed areas, such as under furniture. This is why fogging alone is often ineffective.

Apply sprays as an even, fine spray under low pressure, or follow manufacturer's application instructions. Over-wetting carpets must be avoided. Do not allow pets or children on treated carpet while it is wet. Ventilation, power fans, or dehumidifiers may be helpful during very humid weather when carpets dry slowly.

Fig. 27.
Cat flea feeding



Several effective insecticides are available for adult flea control. In addition, **insect growth regulators** (IGRs) are very effective at long-term reduction of flea populations by interrupting normal development of the flea between the larval and adult stages. IGRs have long residues, but are nontoxic to people and pets and work well in a residential treatment program.

Ticks

A number of ticks are parasites of people and other animals. The stages in the life cycle of a tick are egg, six legged larva, nymph, and adult.

Brown dog tick, Fig. 28

The brown dog tick is a common household pest that may be found on many animals, although the main host is the dog. This tick will become a household resident by dropping off the host after feeding and concealing itself in any available crack or crevice such as behind moldings, window frames, and in furniture.

This tick is difficult to control because of its many potential hiding places. Eggs may hatch over a period of up to five months. Hiding places may need to be sprayed at monthly intervals to eliminate this tick. The owner or a veterinarian should treat dogs, using dips, sprays, or dusts.

American dog tick

The American dog tick is also known as the wood tick. This is the species commonly picked up when hiking through wooded areas. It is seldom a problem in homes except when ticks fall off infested dogs. Wood ticks cannot complete their life cycle indoors and indoor insecticide treatments are not justified. Tick sprays, shampoos, dips, and repellents are

available from veterinarians and pet supply stores.

Mosquitoes

Mosquitoes are well-known biting pests found almost anywhere outdoors. Only adult female mosquitoes feed on blood. Mosquitoes have a complete life cycle. Eggs may be laid on water or in areas which later will be flooded, depending on the species. The larvae are found only in water and feed on organic matter found in standing water. The pupae are also found in water.

Effective mosquito control requires community-wide efforts, including elimination of mosquito breeding sites.

Control of mosquitoes in small areas for a limited time is possible by using sprays, aerosols, or fogs. Persons doing significant, area-wide mosquito control work should become certified in category 7D, Community Insect Control.

Bees and wasps

Bees and wasps are nuisances and may be dangerous because of the female's ability to sting. These insects have complete life cycles, passing through four stages: egg, larva, pupa, and adult.

Types of social wasps

Paper wasps build open comb nests under eaves of houses, in shrubs, and in other protected places. **Hornets'** nests are large, covered, grayish-brown paper structures usually seen hanging in trees or bushes (Fig. 29). **Yellow-jackets** build their nests in the ground, in rock or timber retaining walls, or in the walls or attics of houses and buildings.

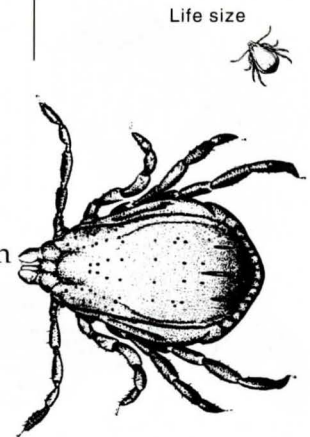


Fig. 28. Brown dog tick



Fig. 29. Hornets' nest

Life size

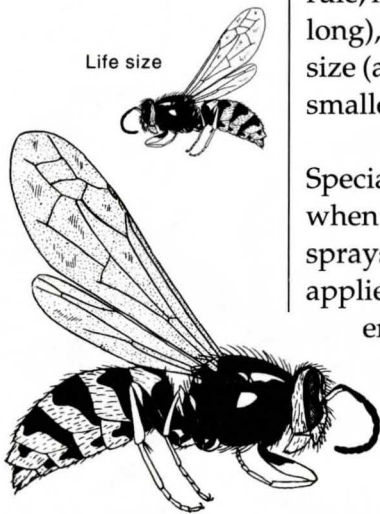


Fig. 30. Yellowjacket wasp

These wasps vary in color. As a general rule, hornets are largest (about 1½ inches long), paper wasps are intermediate in size (about 1 inch), and yellowjackets are smallest (about ¾ inch) (Fig. 30).

Special protective clothing is desirable when controlling wasps. Insecticide sprays work well, but they must be applied at night with a sprayer large enough to do the job quickly without getting too close to the nest. Dusts are often more effective and may be blown into the nest openings of hornets and yellowjacket for residual control. Baits are also

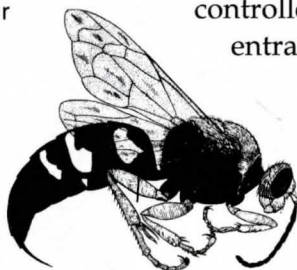
available for use against some species of wasps.

Types of solitary wasps

Solitary wasps work alone to build a nest and provision it with food for offspring. Nests of solitary wasps are much smaller than those of social wasps and no workers are produced to care for the offspring.

Our largest and best known solitary wasp is the **cicada killer**. It is black and yellow and about 1½ inches long (Fig. 31). Nests are vertical burrows dug in soft soil and provisioned with cicadas. These wasps do not sting or otherwise cause harm in spite of their size and menacing appearance. If necessary, cicada killers can be controlled by dusting the burrow entrance.

Fig. 31. Cicada killer wasp



Life size

Mud dauber wasps

construct their nests of mud in protected places such as in sheds and under porch roofs. Most are black with yellow markings. They are not dangerous since they do not aggressively defend their nests. Mud daubers can be eliminated simply by tearing down their nests.

Types of bees

Bees such as the honey bee, bumble bee, and carpenter bee may be pests in and around buildings.

Honey bees may building nests in walls, chimneys, and attics. In addition to the threat of being stung, their comb may melt and allow honey to seep through or stain walls. Old honey bee combs may be infested by other insects and should be removed after the bees are killed with insecticide dust (preferred) or spray. Bumble bees build their nests in the ground, in straw, rags, or occasionally in buildings.

Carpenter bees drill ½-inch holes into exposed wood. The holes make a 90 degree turn below the surface and run with the grain of the wood for distances up to 12 inches. Bumble bees and carpenter bees look very much alike, though the nesting sites are distinctly different. Bumble bees have yellow hair on the top of the abdomen.

Bat bugs and bed bugs

The bed bug is an historically important, bloodsucking parasite of humans. Improved quality of life over the last 40 years has reduced the bed bug to minor importance. Bed bugs are so rare today as to be virtually extinct in the United States, though infestations still come to our attention on rare occasion.

A close relative of the bed bug, the bat bug, is moderately common in Iowa, and may be found in houses and buildings that are infested with bats. Microscopic examination is needed to confidently tell bed bugs from bat bugs. Both bat bugs

and bed bugs (Fig. 32) can be described as:

- nearly round and ¼ inch in diameter
- dark reddish brown
- very flat
- wingless

Bat bugs feed on blood from bats, but when they wander away from the bat roost area, because of bat elimination or migration, they will feed on other warm-blooded animals, including people. This feeding is an annoyance, but is not dangerous.

Controlling bat bugs requires the elimination of any bats that are present in the home or building. This is accomplished by exclusion techniques as described later in this manual. There are no pesticides to control bats in attics.

Insecticides can be used to control bat bugs after bats and their debris have been removed. Dusts or residual sprays labeled for attics should be used. A crack and crevice treatment to rooms below the bat roosting area is possible if needed to control the few remaining bat bugs that have wandered away from the roost area.

Human lice

There are three species of human lice: **head lice** (Fig. 33), **pubic or crab lice** (Fig. 34), and **body lice**. All three suck blood only from humans and are not found on birds, dogs, cats, farm animals, or other hosts.

The incidence of head lice among elementary school-age children remains small, but steady. Large infestations are rare and the current standard of living and expectations of modern society are such that even small populations cause alarm and demand for action. Head lice do not roam

from person to person, but instead are transported on shared items such as hats, scarves, and hair brushes. Lice do not survive for long if they are removed from the warm, moist environment of the scalp.

Body lice are all but extinct in the U.S. because of modern standards of sanitation, housing, and laundering. Infestations have been reported recently only on people unable to care for themselves, such as homeless individuals who do not change clothes for cleaning, and older, incapacitated individuals. Infested clothing passed from one person to another is the common method of body lice transmission.

Hint to PCOs: A request for home or office treatment for body lice should be very carefully evaluated before making any application. Consider very carefully the possibility of delusory parasitosis, described below.

Crab lice are confined to coarse pubic or body hair and sometimes eyelashes. The common method of transmission is by sexual contact with an infested partner. Transmission by detached pubic hair on underwear, in beds, or on toilet fixtures is only remotely possible.

Louse control is not a pest control operation. Premise treatments are generally not required, as louse control involves a medical treatment of the infested person using over-the-counter or prescription insecticidal shampoos and rinses made specifically for that purpose. Advise clients to contact their physician, pharmacist, or public health nurse; to wash bedding, caps, scarves, combs, and brushes in hot water; and to vacuum clean floors, mats, toys, and other items

Life size

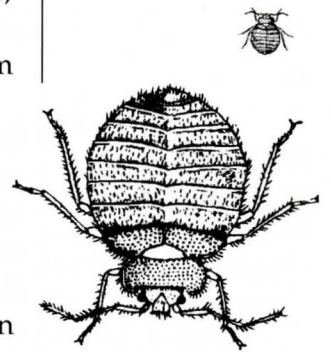


Fig. 32. Bed bug

Life size

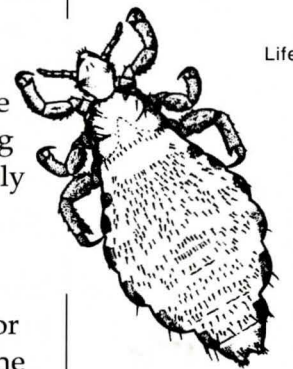


Fig. 33. Head louse

Life size

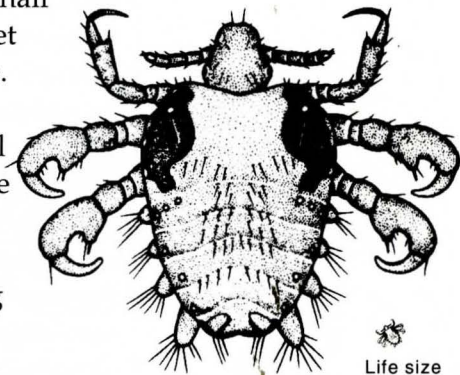


Fig. 34. Crab or pubic louse

◆
Solving mystery
bug problems is
seldom easy.

where children lie or play. It is not necessary to apply insecticides to rooms, toys, or furniture.

Delusory parasitosis

It is common to be approached by clients seeking (more often demanding) an insecticide treatment to cure bite-like skin reactions, itching, or skin irritations that are assumed to be caused by insects but for which no insects or mites can be seen or found. **Illusory or delusory parasitosis** are two of many names used to describe these extremely emotional and sensitive situations. Other names used for the nonexistent arthropods assumed to be the cause of a skin irritation are "paper mite," "sand flea," and "cable mite." There are no such animals and use of these names by a client should be a warning of a difficult situation. Use of these names by a PCO is unethical and a flagrant breach of professional conduct.

There are only a few biting insects that produce skin reactions and these are all large enough to be seen and readily identified. Common biting pests include fleas, head lice, ticks, bat bugs, bird mites, and mosquitoes. Obscure or microscopic organisms that may bite are possible (for example, the scabies mite), but these can be isolated and identified by a dermatologist.

One characteristic of delusory parasitosis is a client's recent history of seeking relief through excessive treatments or bizarre remedies. These include frequent fogging or spraying of the house; spraying sheets and bedding daily with insecticide; washing clothing in gasoline or kerosene; bathing with disinfectants; repeated use of lice shampoos or rinses; or constant use of insecticides or repellents on the body or clothing. Another characteristic is the

client's contact with several physicians, dermatologists, psychiatrists, entomologists, health department officials, and pest control companies; all without success at eliminating the skin itching or irritation. Finally, the sufferer cannot see or capture any bugs to describe and an inspection of the problem environment and examination of specimens alleged to be parasites affirms the absence of an infestation.

Several studies and articles on this topic exist. Many give a long list of potential causes for skin irritation that may cause "biting" sensations. Some of the most common causes are: physical agents, including dry air, static electricity, detergents, cosmetics, jewelry, microscopic fibers such as fiber glass or paper splinters, and gases or indoor air pollution referred to as "sick or tight building syndrome;" physiologic factors, including allergy, diseases, or disorders; and psychological state of anger, anxiety, stress, or nerves.

Obviously, entomologists are not the appropriate specialists to make a diagnosis of these other causes of dermatitis. Advise clients suffering from skin irritation of unknown cause to work closely with a dermatologist. Remember that the skin irritation or itching sensations these clients feel are real to them. Treat all clients with sensitivity and concern.

Always be honest in answering questions. Do not agree to seeing pests that are not there. **Never** apply a pesticide unless biting arthropods have been discovered and you have confirmed their presence. Applying pesticides may reinforce the client's belief that more or stronger pesticides will solve the problem, or ironically, individuals that originally believed pests were responsible for their

reactions will shift their conviction and blame the pesticide as the cause of their suffering.

Solving mystery bug problems is seldom easy; it will be, more likely, frustrating and time consuming. A thorough investigation and referral to other professional specialists rather than quick pesticide application is the best course of action.



Vertebrate pests

An animal with a backbone or spinal column is called a **vertebrate**. Humans, dogs, snakes, and birds are examples of vertebrates, while insects, worms, jellyfish, and snails are not. A few vertebrates, such as rats and mice, are common pests in urban and industrial sites. Others are not pests in their normal habitats, but may occasionally become pests when they conflict with humans, such as bats, rabbits, raccoons, skunks, and snakes.

People feel an attachment toward vertebrates that they do not feel toward other pests. Many people today are actively involved in promoting the welfare of animals. Control of vertebrates, other than rats and mice, is more of a public relations problem than a pest problem. Killing is the control method of last resort.

Public concern for the welfare of animals and the risk from vertebrate poisons to people, pets, and other nontargets have made rules governing vertebrate pest control particularly strict. Be sure you understand all the regulations that apply.

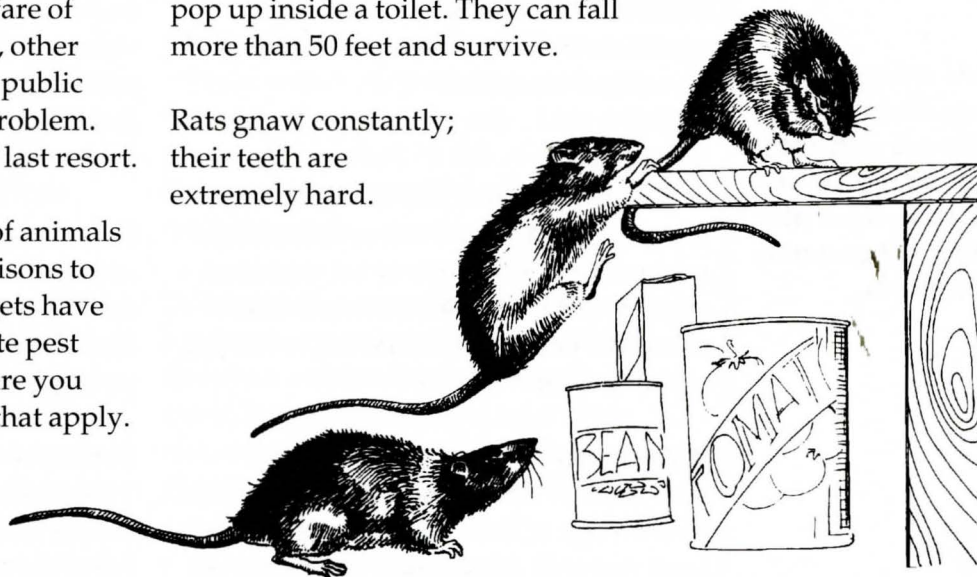
Rats

Rats have caused more human suffering and more economic damage than any other vertebrate pest. From plague epidemics, such as the "Black Death" of Europe to rat-bite fever, whether feeding on stored grain, or gnawing electric wires, rats are enemies of humankind. Statisticians estimate that rats destroy 20 percent of the world's food supply every year—directly by feeding and indirectly through contamination.

Rats have adapted to nearly all human environments. They live in granaries, fields, city sewers, attics, basements, street trees, on top of 30-story buildings, and inside subway tunnels.

Rats can leap three feet straight up and four feet horizontally. They can scramble up the outside of a pipe three inches in diameter, and climb inside pipes one-and-a-half to four inches in diameter. They can walk between buildings on telephone or power lines, and scramble on board a ship on its mooring line. Rats can swim through a half mile of open water, tread water for up to three days, swim against a strong current in a sewer line, and dive through a sewer trap to pop up inside a toilet. They can fall more than 50 feet and survive.

Rats gnaw constantly; their teeth are extremely hard.



◆
Rats have caused more human suffering and more economic damage than any other vertebrate pest.



The key is to control rat populations, not individual rats.



Rats are social animals and live in colonies with well-defined territories that they mark with urine and glandular secretions.

They commonly chew through building materials, such as cinder block, aluminum siding, wall board, wooden cabinets, lead sheathing, and plastic or lead pipes. After gnawing a hole, an adult rat can compress its body and squeeze through an opening only a half-inch high.

Successful long term rat control is not simple. The key is to control rat populations, not individual rats. Rat control requires an integrated approach that includes nonlethal tools, such as careful inspection, upgraded sanitation, and rat-proofing structures. Lethal control often combines the use of rodenticides with nontoxic control measures such as snap traps or glue boards.

Rats as disease carriers

Rats may be responsible for the spread of many diseases. Some of the more important diseases associated with rats are plague, murine typhus fever, rat bite fever, salmonella food poisoning, and trichinosis.

Rats have never been found to be infected with rabies in nature. Rabies transmission from rats to humans has never been documented in the United States. The U.S. Public Health Service recommends against antirabies treatments in the case of rat or mouse bites.

Kinds of rats

In the United States, the two most important pest rats are the **Norway rat** and the **roof rat**. Only the Norway rat is encountered in Iowa. The Norway rat is also called the brown rat, house rat, sewer rat, and wharf rat.

Habits of rats

Rats must be understood to be controlled. Knowledge of their life histories, habitat, food requirements, patterns of behavior,

range, and other factors is essential to their management.

Life cycle: A mature female rat can give birth to about 20 young in a year (four to six at a time), if she lives that long. The average life span of a rat in the field is less than one year.

The young are born in a nest. They are hairless and their eyes and ears are closed. Within two weeks their eyes and ears open; they become furry and ratlike; and they begin exploring the nest area.

Young are totally weaned at four or five weeks old. They then weigh about 1½ ounces. At three months, the young are independent of their mother. They will mate and continue the cycle in the same location or will migrate to a new, unoccupied nest area.

Social behavior: Rats are social animals and live in colonies with well-defined territories that they mark with urine and glandular secretions. The colony has a complex social hierarchy with a dominant male leader and a "pecking order" of subordinate males and ranking females. The strongest and most dominant animals occupy the best nest and resting sites, and feed at their leisure. Weaker, subordinate rats are pushed out to less favorable sites, or forced out of the territory completely.

Rats are aggressive, and social conflicts are most common at feeding sites, prime resting areas, and territorial boundaries. Females fiercely defend their nest and young from other rats.

Senses of rats: Rats have poor vision. They are nearly color blind, reacting to shapes and movement rather than identifying objects by sight. Thirty to 45 feet is

the limit of their vision. Their eyes are adapted to dim light.

Other senses, however, compensate for poor vision. They use their sensitive nose to locate food, follow pathways, identify other rats, and identify new objects in their territory. They use long whiskers and guard hairs to "touch" their way through dark burrows, pipe chases, wall voids, and other runways. Their ears detect faint sounds that signal danger.

Fear of new objects: Rats are wary of anything new that appears in their territory. A bait station, a trap, a block of wood will be avoided for a few days until the rats become familiar with the new object; even then, they approach cautiously. This fear of new objects can make baiting and trapping difficult. Rats will avoid poison bait when it is first placed. Later, they may nibble warily. If the poison bait makes them ill, but doesn't kill them, they will avoid similar baits or stations in the future.

Food & water: Rats need about one ounce of food daily. Norway rats prefer protein-based foods such as meat, fish, insects, pet food, nuts, and grain. Household garbage is ideal food for Norway rats.

Rats need water every day. The amount varies, depending on the moisture content of their food, but is usually around ½ to one fluid ounce. Rats prefer to nest where water is easily available.

Range: Rats usually begin foraging just after dark. Most of their food gathering occurs between dusk and midnight, but short bursts of restlessness and activity can occur anytime. Rats commonly travel 100 to 150 feet from their nest looking for food and water and patrolling their territory. It is not unusual for a colony of

rats that nests outdoors to forage inside a building 100 feet away.

Nests: Outdoors, Norway rats usually nest in burrows dug into the ground. The burrows are shallow (less than 18 inches) and usually short (less than three feet), with a central nest. Extra "bolt holes," used for emergency escapes, are hidden under grass or boards or lightly plugged with dirt. Burrow openings are two to four inches in diameter. Indoors, Norway rats nest inside walls, in the space between floors and ceilings, underneath equipment, between and under pallets, and in crawl spaces, storage rooms, and any cluttered area that is normally unoccupied. They prefer to nest in the lower floors of a building.

Control and management

Successful rat control programs use a combination of tools and procedures. The following techniques and tools are commonly used in controlling rats: inspection, sanitation, rat-proofing, trapping, and rodenticides.

Inspection

Rats give many signs that they are infesting an area. Inspection will determine if a site is infested, and will identify where rats are feeding and nesting, their patterns of movement, the size of the population, and the extent of the infestation. Common signs of rat infestation include the following:

Dead or active rats: Dead rats are signs of a current or past infestation. If all that are found are old dried carcasses and skeletons, it may mean an old infestation. If rats are actively observed during the day, the rat population is probably high.

◆
Successful rat control programs use a combination of tools and procedures.

◆
Baiting programs often fail because the bait can't compete with the rats' regular food. Reducing the rats' normal food encourages them to feed on any rodenticide baits placed in their territory.

Sounds: When a building is quiet, squeaks, fighting noises, clawing, scrambling in walls, or gnawing sounds may be heard.

Droppings: A single rat may produce 50 droppings daily. Norway rat droppings are generally three-quarters-inch long. The highest number of droppings will be found in locations where rats rest or feed. You can determine if a rat population is active by sweeping up old droppings, then reinspect a week later for new droppings.

The appearance of the droppings will indicate if rats are currently active. Fresh rat droppings are black or nearly black. They may glisten and look wet, and they have the consistency of putty. After a few days or a week, droppings become dry, hard, and appear dull. After a few weeks, droppings become gray, dusty, and crumble easily.

Urine: Both wet and dry urine stains will glow blue-white under an ultraviolet light (blacklight). Portable ultraviolet lights are used in the food industry to identify rat urine on food items. Other substances besides rat urine also glow, which can be confusing, so proper use of this inspection method takes practice.

Grease marks: Oil and dirt rub off of a rat's coat as it scrambles along. The grease marks build up in frequented runways and become noticeable. Look along wall/floor junctions, on pipes, ceiling joists, and on sill plates where rats swing around obstacles. Grease marks are also found at regularly used openings in walls, floors, and ceilings.

Runways: Outdoors, rats constantly travel the same route; their runways appear as beaten paths on the ground

next to walls, along fences, under bushes and buildings.

Tracks: A rat's foot print is about three-quarters-inch long, and may show four or five toes. Rats may also leave a "tail drag" line in the middle of their tracks. Look in dust or soft, moist soil.

Gnawing damage: A rat's incisor teeth grow at a rate of about five inches per year. Rats keep their teeth worn down by continuously working them against each other and by gnawing on hard surfaces. Look for gnawing damage as evidence of a rat infestation. Gnawed holes may be two inches or more in diameter.

Burrows: Outdoors, rat burrows may be found singly or in groups along foundation walls, under slabs and dumpster pads, in overgrown weedy areas, beneath debris, and in embankments. Look for a burrow opening that is free of dirt, leaves, and debris, often with smooth, hard-packed soil.

Odor: Heavy infestations have a distinctive odor which can be identified with practice. The odor of rats can be distinguished from the odor of mice.

Sanitation

Food: Like all animals, rats need food to survive. Baiting programs often fail because the bait can't compete with the rats' regular food. Reducing the rats' normal food encourages them to feed on any rodenticide baits placed in their territory.

- Close or repair dumpsters and garbage containers that are left open or damaged.
- Clean food spills.
- Do not allow food to be left out overnight.

- Ensure food in storage is rotated properly (first in, first out) and is stored on pallets, not on the ground or against walls. The pallets should be 18-24 inches from the side walls and placed so that aisles permit inspection and cleaning around the stored food.

Habitat:

- Remove plant ground covers such as ivy near buildings.
- Remove high grass, weeds, wood piles, and construction debris that permit rats to live and hide adjacent to a building.
- Reduce clutter in rarely-used rooms and organize storage areas.

Rat-proofing (exclusion)

Long term, the most successful form of rat control is to build them out. Also called **rat-proofing**, this technique makes it impossible for rats to get into a building or an area of a building. Rat-proofing prevents new rats from reinfesting a building once it has been cleared.

- Seal cracks and holes in building foundations and exterior walls.
- Block openings around water and sewer pipes, electric lines, air vents, and telephone wires.
- Screen air vents.
- Caulk and seal doors to ensure a tight fit, especially between door and floor threshold.
- Fit windows and screens tightly.

Traps

Snap trap: The snap trap is an effective method of killing rats when used correctly. Trapping is advised for use in places where rodenticides are considered too risky or aren't working well, if the odor of dead rats in wall or ceiling voids

would be unacceptable, or when there are only a few rats infesting a limited area.

Careful attention to detail is necessary to ensure proper placement in adequate numbers, or rats will simply pass them by.

- Leaving the traps unset for a few days may increase the catch by reducing the chance that wary rats will trip the traps without capture.
- Set traps with bait, if food for rats is in short supply, or without bait if food is plentiful. Good baits for Norway rats include peanut butter, hot dog slices, bacon, or nut meats. Tie moveable bait to the trigger using string or dental floss, or else the rat may simply remove the bait without triggering the trap.
- Sprinkle cereal, such as oatmeal, around traps to make them more attractive.
- Set unbaited traps along runways, along walls, behind objects, in dark corners where the rat is forced through a narrow opening. Place the trigger side of the trap next to the wall.
- When runways are located on rafters and pipes, set expanded trigger traps directly across them, fastening them to pipes with wire, heavy rubber bands, or hose clamps, and to rafters with nails.
- Set traps where droppings, gnawing damage, grease marks, and other evidence of activity is found.
- Use enough traps. (A dozen may be needed for a house, a hundred for a small warehouse.) Set five or 10 traps in an active corner of a room. Set three traps in a row so a rat, leaping over the first, will be caught in the second or third. If unsure about sites of activity, set traps along

◆
...the most successful form of rat control is to build them out.

◆
The snap trap is an effective method of killing rats when used correctly.

◆
A rodenticide is a pesticide designed to kill rodents. There are three major formulations of rodenticides used to control rats: food baits, water baits, and tracking powders.

possible runways spaced 10 to 20 feet apart.

- Camouflage traps when left with only a few rats that resist capture. Set traps in a shallow pan of meal, sawdust, or grain.
- Move boxes and objects around to create narrow runways to the traps.
- Avoid spraying insecticide on the trap, or even storing traps with application equipment. The odor of other rats improves a trap's effectiveness. Likewise, the odor of insecticide can make a rat steer clear.
- Inspect traps frequently to remove dead rodents and change old bait.

Glue boards: Another way to trap rats is with glue boards that use a sticky material that captures rodents. Although most often used against mice, they are sometimes effective against rats. Be sure to use larger glue boards that have been designed to trap an animal the size of a rat.

- Place glue boards in the same location as you would place snap traps. Place them lengthwise flush along the wall, box, or other object that edges a runway.
- Do not place glue boards directly over food products or food preparation areas.
- Secure the glue board with a nail or wire so a rat can't drag it away.
- Install glue boards in bait stations if people might be upset to observe a struggling rat, where children or pets could come in contact with the glue, or in areas with excessive dust or moisture.
- Check glue boards frequently and dispose of rodents humanely.
- Adding a dab of bait to the center of the glue board may improve its effectiveness.

Rodenticides

A rodenticide is a pesticide designed to kill rodents. There are three major formulations of rodenticides used to control rats: food baits, water baits, and tracking powders.

Food baits: Rat baits combine a poison effective against rats with an attractive food. Baits are packaged as extruded pellets, in a dry meal, or molded into paraffin blocks.

Rodenticides must be used very carefully; they are made to kill animal species of the same class as humans.

Several general guidelines should be followed when using a poison bait. First and foremost, keep children, pets, wildlife, and domestic animals from eating the bait. All rodenticides have warnings on the label telling the applicator to place the bait "in locations not accessible to children, pets, wildlife, and domestic animals, or place in tamper-proof bait boxes." What are safe, inaccessible areas is determined by evaluating each case.

Bait boxes: A tamper-proof bait box is designed so that a child or pet cannot get to the bait inside, but the rat can. (Bait trays and flimsy plastic or cardboard stations are not tamper-proof bait boxes.) Tamper-proof boxes differ in the type and quality of construction, but they are usually metal or heavy plastic. Rat bait stations are normally larger than those used for mice. Most designs are not considered to be truly tamperproof unless they can be secured to the floor, wall, or ground.

- Ensure that bait boxes are clearly labeled with a precautionary statement.

- Check stations or boxes periodically to ensure rats are taking the bait and that the bait is fresh. (Rats will rarely feed on bait that has spoiled).
- Bait boxes should be placed wherever the rats are most active as determined by droppings and other signs.
- Put **place packs** in burrows, in wall voids, and similar protected sites. If a site is damp, use paraffin bait blocks or other water-resistant formulations.
- Put out enough bait and check it often. Incomplete baiting can lead to bait shyness and make control difficult.
- Be sure to limit the rats' normal food supply or your baits may be rejected.
- Remember that rats fear new objects at first so that your baits may not be taken for a few days or a week.
- Once bait is taken, leave the box in place for some time; the rats now consider it to be part of their normal surroundings.
- Good bait placements can be effective even when placed 15 to 50 feet apart. Bait placed outdoors around a commercial building can kill rats that are moving in from nearby areas.

Water baits: Rats drink water daily if they can. When rat water supplies are short, water baits—specially formulated rodenticides that are mixed with water—can be extremely effective. Several types of liquid dispensers are available. The best are custom designed for toxic water baits, but plastic chick-fountains can also be used in protected sites. Use water baits only where no other animals or children can get to them.

Tracking powders: This formulation is a rodenticide carried on a talc or powdery clay, applied into areas where rats live

and travel. The powder sticks to the rats' feet and fur, and is swallowed when the rats groom themselves. The major advantage to tracking powders is that it can kill rats even when food and water is plentiful, or if rats have become bait or trap shy.

- Apply tracking powders heavier than an insecticide dust (but never deeper than 1/8 inch.) Best application sites are inside wall voids, around rub marks, along pipe and conduit runs, and in dry burrows (when permitted by label). Apply with a hand bulb, bellows duster, or with a (properly labeled) flour sifter or salt and pepper shaker.
- Do not use tracking powders in suspended ceilings, around air ventilators, or near food or food preparation areas. The powder can become airborne and drift into nontarget areas.

Mice

The most commonly encountered rodent pest is the house mouse. House mice are found in most areas of human habitation. They are also found living in the wild. House mice are a common problem in homes and in all types of businesses. They ruin stored food and fiber and damage personal possessions. House mice also have the potential to transmit diseases and parasites to people and domestic animals.

The house mouse is a delicate, agile, little rodent. Adult weights vary, but usually range from 1/2 to one ounce. Adult house mice vary in color from light brown to dark gray, but most often are a dusky gray or medium brown over most of their bodies, except the belly, which may be a slightly lighter shade of their general color.

◆
House mice are a common problem in homes and in all types of businesses.

◆
Control of house mice requires understanding their biology and habits.

The mouse has moderately large ears for its body size. The tail is nearly hairless and about as long as the body and head combined (1/2 to 4 inches). The feet are small in proportion to its body. The eyes are also relatively small.

Our native deer (white-footed) mice (*Peromyscus* sp.), that often invade buildings adjacent to fields and woodlands, are about the same size as or slightly larger than house mice. Deer mice have a distinct, bicolored tail; the upper portion is brown or gray and the underside is distinctly white, with a well-defined line where the two colors meet.

Meadow mice or voles (*Microtus* sp.) sometimes invade homes; they are less agile, have larger, chunky bodies, and weigh at least twice as much as house mice. They also have much shorter tails and small ears and eyes.

Habits of house mice

Control of house mice requires understanding their biology and habits.

Life cycle: Under optimum conditions, house mice breed year round. Outdoors, house mice may tend toward seasonal breeding, peaking in the spring and fall. Under ideal conditions, females may produce as many as ten litters (about 50 young) in a year. At very high densities, however, reproduction may nearly cease despite the presence of excess food and cover.

Newborn mice are quite undeveloped nearly hairless. Eyes and ears are closed, but by the end of two weeks, the body is covered with hair and the eyes and ears are open. At about three weeks, the young begin short trips away from the nest and begin taking solid food.

Social behavior: While mice primarily are active at night, some day activity occurs. Movements of house mice are largely determined by temperature, food, and hiding places. Home ranges of mice tend to be smallest where living conditions are good.

Mice tend to travel over their entire territory daily, investigating each change or new object that may be placed there. They are very aggressive. Unlike rats, they show no fear of new objects. They dart from place to place, covering the same route over and over again. This behavior can be used to advantage in control programs. Disturbing the environment at the beginning of a control program by moving boxes, shelves, pallets, and other objects can improve the effectiveness of traps, glue boards, and bait. Mice will investigate the changed territory thoroughly.

Senses of mice: Like rats, mice have relatively poor vision and are also color blind. They rely heavily on smell, taste, touch, and hearing. Like rats, mice use long sensitive whiskers near the nose and the guard hairs on the body as tactile sensors to enable them to travel in the dark, pressing against walls and boxes, scurrying through burrows.

Curiosity: Mice do not fear new objects as do rats. As mentioned earlier, they quickly detect new objects in their territory and investigate them. They will immediately enter bait stations and sample a new food, although they may only nibble on a small amount. They will also investigate traps and glue boards. Control programs against mice often have success early, just the opposite of rat programs.

Physical attributes: It is difficult to mouse-proof a building or control mice without understanding their physical capabilities:

- For their size they are excellent jumpers, with some of the more agile individuals jumping 12 inches high from the floor onto an elevated flat surface.
- They can jump against a wall or flat vertical surface using it as a spring board to gain additional height.
- They can run up almost any rough vertical surface.
- They can run horizontally along insulated electrical wires, small ropes, and the like, with ease.
- They can squeeze through openings slightly more than ¼ inch high.
- They can easily travel for some distance hanging upside down from ¼ inch hardware mesh.
- They are capable swimmers, although they generally do not take to water as well as do rats and tend not to dive below the surface.
- They can walk or run along ledges too narrow for rats.
- They can jump from a height of eight feet to the floor.
- They can survive at a constant 24°F (-30°C) temperature for ten generations.

Food and water: House mice prefer cereals over other items, although they will feed on a wide variety of foods. Mice sometimes search for foods high in fat and protein, such as lard, butter, nuts, bacon, and meat. Sweets, including chocolate, are taken at times. Mice get much of their water from moisture in their food, but they will drink if water is readily available. Mice are nibblers, feeding 20 or more times during evening rounds.

Range: Mice are territorial and seldom travel more than 30 feet from their nest. Their range is much smaller than the rats' range of 100 to 150 feet. When food is nearby, mice may restrict their activity to a few feet.

Nests: House mice may nest in any dark, sheltered location. Nests are constructed of fibrous, shredded materials such as paper, cloth, burlap, insulation, or cotton and generally look like a loosely woven ball. They are approximately four inches in diameter. Outdoors, house mice sometimes dig and nest in small burrows.

Control and management

Prevention and control of house mice is a four-part process:

- inspection
- sanitation
- mouse-proofing, and
- population reduction with traps or toxicants

Inspection

Common signs of mouse infestation include the following:

Sounds: Squeaks, scrambling, and sounds of gnawing are common at night where large numbers of mice are present.

Droppings: A house mouse produces about 70 droppings per day. Mouse droppings are frequently the first evidence that mice are infesting.

Urine: House mice occasionally make small mounds known as "urinating pillars." These consist of a combination of grease, urine, and dirt and may become quite conspicuous. Urine stains will fluoresce under ultraviolet light.

◆
Prevention and control of house mice is a four-part process:

◆
It isn't easy to completely mouse-proof a building since mice are reported to be able to squeeze through an opening as little as ¼ inch high.

Grease marks: Like rats, mice produce greasy smears where dirt and oil from their fur mark pipes and beams. House mouse spots are not easy to detect.

Tracks: Footprints or tail marks may be visible on dusty surfaces or on mud. A nontoxic tracking dust can be used to help to determine the presence of house mice within buildings.

Gnawing damage: Recent gnawings on wood are light in color, turning darker with age. Look for enlarged cracks beneath doors and wood chips with a consistency like coarse sawdust around baseboards, doors, basement windows and frames, and kitchen cabinets.

Visual sightings: Mice are often active in daylight and this may not indicate a high population as it does with rats. Use a powerful flashlight or spotlight at night in warehouses and food plants to confirm house mouse presence.

Nest sites: Be alert to fine shredded paper or other fibrous materials used for nest-building.

Mouse odors: A characteristic musky odor is produced by mice. It can be easily differentiated from that of rats.

Sanitation

Good sanitation makes it easier to detect signs of mouse infestation. It also increases the effectiveness of baits and traps by reducing competing food. However, the best sanitation will not eliminate house mice; they require very little space and small amounts of food to flourish.

Store bulk foods in mouse-proof containers or rooms. In warehouses, restaurants, and food plants stack packaged foods in

orderly rows on pallets so that they can be inspected easily.

Keep stored materials away from walls and off the floor. A 12- to 18-inch yellow or white painted band next to the wall in commercial storage areas permits easier detection of mouse droppings. This band and the areas around pallets should be swept often so that new droppings can be detected quickly.

Mouse-proofing

It isn't easy to completely mouse-proof a building since mice are reported to be able to squeeze through an opening as little as ¼ inch high.

- Seal large holes to limit the movement of mice into and through a building.
- Plug holes in foundation walls with steel wool or copper mesh.
- Caulk and fit doors and windows tightly.
- Seal holes around pipes, utility lines, vents, etc., to make it difficult for mice to move in and out of wall and ceiling voids.

Traps

Snap traps: If used correctly, snap traps are very effective in controlling mice. They must be set in the right places, in high numbers, and in the right position or mice will miss them entirely. Here are some factors to keep in mind when trapping mice.

- Remember that the territory of mice rarely extends further than 30 feet from the nest, and more often is about 10 feet. If mice are seen throughout a building it means that there are numerous discrete locations where you will have to set

traps. Place snap traps not only wherever you see obvious signs of mice, but look for good trap locations in a three-dimensional sphere about 10 feet in diameter around those signs.

- Mice can be living above their main food supply in suspended ceilings, attics, inside vertical pipe runs, and on top of walk-in coolers. Or they can be below, in floor voids, crawl spaces, or under coolers and/or processing equipment.
- The best trap sites are those with large numbers of droppings since that means the mice are spending a lot of time there. Other good sites are along walls, behind objects, and in dark corners, particularly where runways narrow, funneling the mice into a limited area.
- Good mouse baits increase a trap's effectiveness. Peanut butter, bacon, cereal, and nuts are traditional, but one of the best baits is a cotton ball, which the female mice like to use for nest material. It must be tied securely to the trigger. Food baits must be fresh to be effective.
- Probably the biggest mistake made in mouse trapping is not using enough traps.

Multiple-catch traps: Multiple-catch mouse traps catch up to 15 mice without requiring reset. Some brands are called "wind-up" traps; the wind-up mechanism kicks mice into the trap. Others use a treadle door. Live mice must be killed humanely.

Mice like to investigate new things. They enter the small entrance hole without hesitation. Odor plays a role too; traps that smell "mousy" catch more mice. Place a small dab of peanut butter inside the tunnel entrance to improve the catch.

- Check traps frequently. Mice are captured alive but may die in a day or two. Some traps have a clear plastic end plate or lid so you can see if any have been captured.
- Place the traps directly against a wall or object with the opening parallel to the runway, or point the tunnel hole toward the wall, leaving one or two inches of space between the trap and the wall.
- If mice are active, place many traps six to 10 feet apart. For maintenance trapping, place the traps in high risk areas and also at potential mouse entry points such as loading docks, near utility lines, and at doorways.

Glue boards: Glue boards are very effective against mice. As with traps, placement is the key. Locations that are good trap sites are good sites for glue boards.

- Do not put glue boards directly above food products or in food preparation areas.
- Set glue boards lengthwise and flush against a wall, box, or other object that edges a runway.
- Move objects around; create new, narrow runways six inches wide to increase the effectiveness of glue boards.
- Put peanut butter or a cotton ball in the center of the board.
- Place the glue boards 5 to 10 feet apart in infested areas, closer if the population is large.
- If no mice are captured in three days, move the boards to new locations.
- If a trapped mouse is alive, kill it before disposal. Replace the boards if they fill up with insects.

◆
Birds can become pests when they feed on crops, create health hazards, roost in large numbers on buildings, contaminate food, or create a nuisance.

Rodenticides

Food baits: Observe the same safety guidelines for mouse baits as discussed in the section on rat baits. Children, pets, wildlife, and domestic animals must be protected by putting the bait in inaccessible locations or inside tamper-proof bait boxes.

- Apply many small bait placements rather than a few large placements.
- Use baits labeled for mouse control.
- Place baits in favorite feeding and resting sites as determined by large numbers of droppings.
- Place baits between hiding places and food, up against a wall or object to intercept the mice.
- Bait in three dimensions (see earlier discussion on trapping).
- Place baits 10 feet apart or closer in heavily infested areas.
- If bait is refused, try switching to a different type, and replace the baits often.
- Use small bait stations which are more attractive to mice than the larger rat-type stations.
- Make sure that sanitation is such that other food is not competing with the baits.
- Place secured tamper-proof bait boxes in safe locations near doors in late summer to intercept mice entering from the wild.

Liquid baits: Mice get most of their water from their food but they will drink from a water container. Liquid baits that are labeled for mouse control can be effective in sites that do not have a ready supply of water. The same water bait dispensers used for rats can be used for mice. As with food baits and traps, many water stations will be necessary to put the bait into the territory of all mice infesting a building.

Tracking powders: Tracking powders are especially effective against mice. Mice groom themselves more than rats, and they investigate enclosed areas which can be dusted with tracking powder.

- Apply inside dry, infested wall voids.
- Dust tracking powder into voids in heavily infested apartment or office buildings.
- Use a bait station, PVC tube, cardboard tube, or any small, dark shelter that a mouse could enter in cases where tracking powder cannot be applied. Mice will explore such a shelter. Apply the tracking powder in a layer less than $\frac{1}{16}$ inch deep.
- Do not allow tracking powder to drift into nontarget areas.

◆◆◆
Birds

Birds provide enjoyment and recreation while enhancing the quality of life. These colorful components of natural ecosystems are studied, viewed, photographed, or hunted by most Americans. Bird watching as a sport and recreational activity involves more than 10 million people. For this reason, birds are protected by laws, regulations, and public opinion.

Birds can become pests when they feed on crops, create health hazards, roost in large numbers on buildings, contaminate food, or create a nuisance. No particular species can be flatly categorized as good or bad; whether birds are beneficial or harmful, depends on time, location, and activity.

Pigeons, Fig. 35

The **domestic pigeon** developed from the rock doves of Europe and Asia and was introduced into the U.S. as a domestic bird. Rock doves originally nested in caves, holes, and under overhanging rocks on cliffs, so they comfortably adapt to window ledges, roofs, eaves, steeples, and other building components.

Pigeons have become the most serious bird pest associated with buildings; they may congregate in flocks of a hundred or more. Although primarily seed or grain eaters, in urban areas pigeons feed on garbage, spilled grains, insects, food left by outdoor diners, and food provided by bird lovers who feed pigeons bread, peanuts, and cookie crumbs.

Habits of pigeons

Pigeons are gregarious and feed, roost, and loaf in each other's company whenever possible. Feeding, roosting, and loafing sites are usually separate. Roosting sites are sheltered from the elements and used for nesting, congregating at night, and protection from bad weather. Loafing sites will be nearby to be used by inactive birds during the daytime. Feeding sites may be several miles away.

Pigeons prefer flat and smooth surfaces on which to rest and feed. They will feed on rooftops, or open ground, and occasionally on ledges. Typical roosting and loafing sites are building roofs and ledges, cooling towers, bridges, and signs. Typical feeding sites are parks, squares, food loading docks, garbage areas, railroad sidings, food plants, and wherever people eat outdoors.

Pigeons nest on a frail platform of small twigs, straw, and debris in which they make a slight depression. Nests are usually located in protected openings in

or on buildings and structures.

The male usually selects the nest site, but both adults actually build the nest with the male often bringing nest materials to the female.

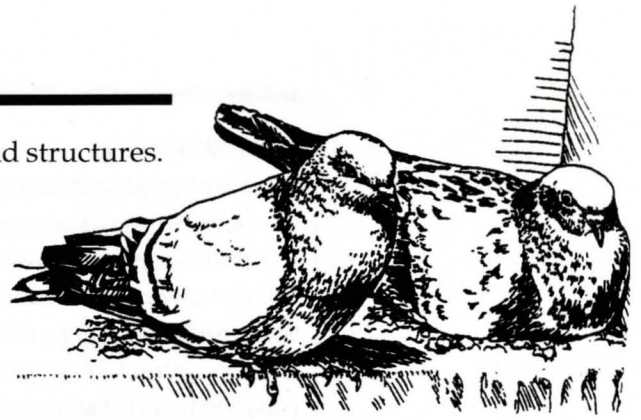


Fig. 35. Pigeons

Pigeons nest during all seasons when conditions permit. City pigeons generally remain in one area year-round and produce 10 young per year. Life span is highly variable, ranging from three to 15 years in urban roosts. They have lived for 30 years in captivity.

Starlings, Fig. 36

European starlings were introduced into the United States in 1890 when 60 were brought to New York City. They rapidly expanded into new areas. Today, 140 million starlings range throughout North America.

Starlings are robin-sized birds that weigh about three ounces. Adults are dark with light speckles on their feathers in winter; the feathers turn glossy purplish-black and green in summer. The bill of both sexes is yellow from January to June, and dark at other times. Young birds are grayish.

Starlings have relatively short tails and appear somewhat chunky and humpbacked. The wings have a triangular shape when stretched out in flight. Starling flight is direct and swift, not rising and falling like many blackbirds.

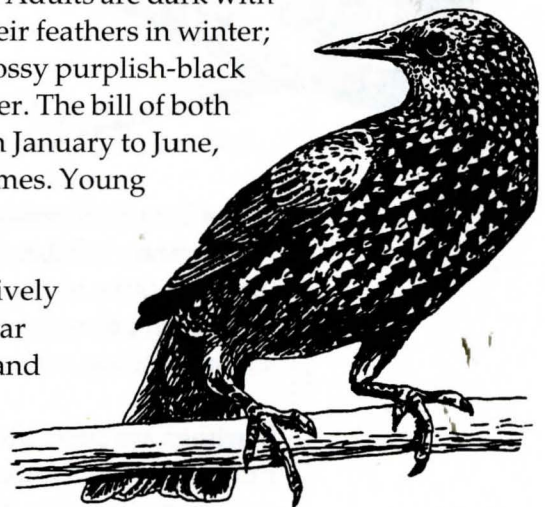


Fig. 36. Starling

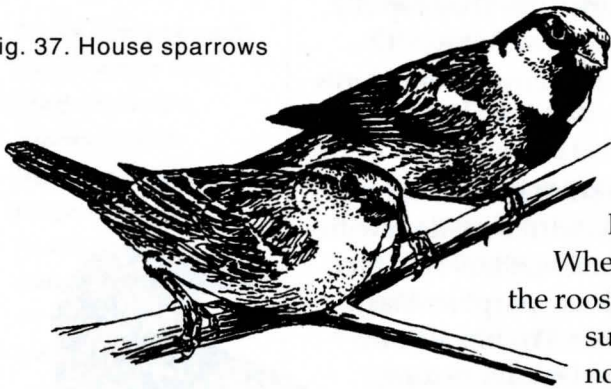
Habits of starlings

Starlings nest in holes or cavities in trees or rocks; or in urban areas on buildings, in birdhouses, on power stations and water towers, and other structures.

Starlings average two broods a year with four to seven young per brood. Both parents build the nest, incubate the eggs, and feed the young.

Starlings migrate in some parts of the country. As cold weather begins in the fall, they begin forming larger flocks. The major sources of food shift from insects and fruits to grains, seeds, livestock rations, and food in garbage. Roosting areas may shift from rural and suburban settings to cities and towns. Each day they may fly up to 30 miles to their feeding sites. Each starling eats about one ounce of food a day.

Fig. 37. House sparrows



Leaving their evening roost at sunrise, they travel to feeding sites over well-established flight lines.

When they return to the roost just before sundown, they do not fly straight to their roost. They

“stage” on high perches such as trees, power lines, bridges, and towers. The birds are quite social at these times and remain on pre-roost sites until after sunset, singing and calling to each other.

Starlings are pests because of their high numbers. Thousands or tens of thousands can roost at one site. Droppings at the roost site damage car finishes, tarnish buildings, drop on people below, and build up to such levels that they become a health hazard.

House sparrows, Fig. 37

The **house sparrow**, also called the **English sparrow**, was introduced into the United States in the 1850s. Populations now flourish all over the continental United States except in heavy forests, mountains and deserts. It seems to prefer human-altered habitats in cities and around farm buildings and houses. In fact, while still one of the most common birds, its numbers have fallen drastically since the 1920s when food and waste from horses furnished unlimited food.

The house sparrow is a brown, chunky bird five to six inches long. The male has a distinctive black bib, white cheeks, a chestnut mantle around a gray crown, and chestnut upper wing covers. The female and young birds have a gray breast, light eye stripe, and a streaked back.

Habits of house sparrows

House sparrows average three broods per season with four to seven eggs per brood. Breeding can occur in any month; through much of the country, it is most common from March through August. Eggs are incubated for about two weeks, and the young stay in the nest another two weeks.

The male usually selects the nest site. Nests are bulky and roofed over, and located in trees and shrubs, on building ledges, in signs, on light fixtures, and under bridges. Nests often plug rain gutters or jam power transformers.

Sparrows are very tolerant of human activity, and will not hesitate to set up housekeeping in high traffic areas. They feed preferentially on grain. They will also feed on fruits, seeds, and garbage.

Health hazards associated with birds

Health risks from birds are often exaggerated. Nevertheless, large populations of roosting birds may present risks of disease to people nearby. The most serious health risks are from disease organisms growing in accumulations of bird droppings, feathers, and debris under a roost (for example, histoplasmosis and cryptococcosis). If conditions are right, particularly if roosts have been active for years, disease organisms can grow in these rich nutrients. Food may be contaminated by birds, but this risk is usually limited to food manufacturing or processing plants. When parasite-infested birds leave roosts or nests to invade buildings, their parasites can bite, irritate, or infest people.

Legal considerations

With very few exceptions, all birds are protected by one or more federal laws and regulations.

- Pigeons, starlings, and house sparrows are not directly protected at the federal level, but applications of toxicants or repellents must be according to the product label and under the restrictions that apply under FIFRA.
- Other birds are regulated in some way at the federal level.
- Nontarget birds in the treatment area are protected, and any actions that kill or damage protected birds or their habitats will be a violation of various federal and state regulations.
- State and local regulations may require permits or restrict what actions may be taken against these three pest birds.
- When in doubt, contact your state Natural Resources Agency or the

United States Fish and Wildlife Service District office in your area for further information.

Tools and methods for managing birds

Inspection

The first step in controlling birds is to conduct a detailed and accurate bird survey. Surveys should be conducted early in the morning, midday, and again in the evening to correspond to the different activity periods of birds. The survey should not be limited to information about pest birds; nontarget bird activity is just as important in order to minimize risk to these birds. The survey should investigate:

- What birds are present?
- How many?
- Are they residents, migrants, adults, juveniles?
- Are they nesting, feeding, roosting, or loafing?
- Where do they eat and drink?
- What is attracting them to the various sites?
- Are the birds causing a health risk?
- Are the birds causing physical damage?
- If dispersed, where would they go?
- If poisoned, where would they die?
- Is there risk to nontargets?
- What are the legal considerations?
- Could there be public relations problems?
- Is exclusion or habitat modification practical?

Habitat modification

Habitat modification for birds means limiting a bird's food, water, or shelter. Attempting to limit the food or water of pigeons, starlings, and house sparrows is not practical. These birds will have a number of feeding and watering sites—

◆
The first step in controlling birds is to conduct a detailed and accurate bird survey. Surveys should be conducted early in the morning, midday, and again in the evening to correspond to the different activity periods of birds.

◆
Some building designs and conditions lend themselves to bird infestation. Flat ledges, openings in water towers and vents, unscreened windows, and other attributes make a building an attractive location for roosting, nesting, and loafing.

often far from roosting and loafing sites. Where people are feeding birds in parks or lunch areas, education can help reduce this source of food. In most cases, people will pay little attention to requests to stop.

The most successful kind of habitat modification is to exclude the birds from their roosting and loafing sites (addressed in the section on exclusion). Pigeons may be induced to move from an infested site by the persistent destruction of nests and eggs. Nest destruction is ineffective against sparrows and starlings but pruning trees sometimes deters roosting.

Exclusion

Some building designs and conditions lend themselves to bird infestation. Flat ledges, openings in water towers and vents, unscreened windows, and other attributes make a building an attractive location for roosting, nesting, and loafing. Modification or repair can exclude birds.

Typical solutions include replacing broken windows, adding screens, eliminating large crevices, blocking openings into vents, cooling towers, and rooftop equipment with hardware cloth or similar material.

Exclusion methods also include the use of netting, custom-designed sheetmetal or plastic covers, porcupine wire (Nixalite, for example), electrified wires, and sticky repellents to keep birds from roosting on ledges, roof edges, window sills, building signs, and other surfaces favored by pest birds. Two advantages are that the birds are not killed and the control is comparatively long-lasting.

Ultrasonic sound devices

Ultrasonic sound devices are not effective in repelling birds. Numerous tests by

university, government, and private independent researchers have failed to demonstrate any efficacy against birds by any of the ultrasonic devices tested. These devices do not work against birds.

Other repelling devices

Visual devices such as owl decoys, rubber snakes, etc., may work for a few days, but become ineffective because birds will become accustomed to their presence. Likewise, noisemaking devices (fireworks, distress calls, warning calls) may be used to disperse birds, such as roosting starlings or black birds, but their effectiveness will diminish as birds habituate.

Trapping

In many instances, trapping can be an effective supplemental control measure. Trapping is especially effective against pigeons. Where a group of birds are roosting or feeding in a confined and isolated area, trapping should be considered the primary control tactic.

Lethal alternatives

AVITROL products are restricted use poison baits with flock-alarming properties used to control many kinds of birds. AVITROL baits are made with whole corn for pigeons, smaller grains for sparrows and other birds. Within 15 minutes of eating a toxic dose of AVITROL, birds flutter erratically and go into convulsions. They may fly away from the baiting site, they may fly into windows, or they may "dive bomb" into the ground.

Affected birds convulse for an hour or more. Most die within a few hours, but some last for as long as 15 hours. Only a small percentage of the flock (usually from 5 to 15 percent) needs to be affected for an AVITROL program to be successful. The flock becomes frightened by the

convulsions and distress of the poisoned birds, and anywhere from 65 to 85 percent of the flock will leave the area.

At most sites, birds must be trained to feed on bait. Careful observations of the birds' feeding habits must be made to establish proper feeding locations and to determine that no nontarget birds are feeding on the pre-bait. Remove all of the pre-bait corn before switching over to AVITROL. The better the acceptance of the bait, the better the chance to move the flock quickly.

Toxic perches: A toxic perch is a metal container with a wick surface that holds a liquid contact poison that birds absorb through their feet when they stand on the perch. The toxicant (fenthion) is hazardous to all birds and animals, **including people**. Toxic perches are particularly useful where food is in constant supply or AVITROL bait is not accepted. They are installed in locations where birds will perch on them, usually in the evening hours. An average-sized job will require 10 to 12 perches. A large job might require 30.

Toxic perches can only be used in certain sites: inside buildings and structures (nonfood areas), on building tops, structural steel, power plants, substations, at feed lots, loading docks, and storage yards. Perches usually need refilling twice per year. In hot weather, perches sometimes leak toxicants.

Birds can absorb a toxic dose in less than a minute but may not die for four days. Pigeons will normally find a protected place out of the sun and wind once they begin feeling the effects of the toxicant. They usually don't fly after that time and so usually die with 20 to 30 feet of the perch, if it was set in a roosting site. There

is secondary poisoning hazard if other animals feed on dead birds. There have also been reports of hawks and owls dying after using the perches. By law, dead birds must be picked up, buried, or burned.

Chemosterilants: Chemosterilants (ORNITROL), have often been called the "birth control pill" for pigeons. When fed to pigeons, it inhibits ovulation in the female and sperm production in the male. The effects of treatment last for six months in the female and three months in the male. When applied as directed on the label, it will not kill birds, but populations will slowly decline over the years from the natural mortality in an aging nonreproducing pigeon population. Efficacy on birds associated with agriculture has been reported to be more variable.

Shooting: A possible alternative or supplemental method for eliminating birds is shooting with air-powered pellet guns, if legally allowed.

Risks to nontargets: Most lethal tactics in bird control pose some risk to nontarget birds, as well as other animals. Nontarget are protected by various federal, state, and local regulations, as well as by public opinion. Care must be taken to minimize the threat to nontargets or to use tactics that minimize the risk.

Public relations: People often react more negatively to one dying bird than to accumulated pigeon droppings on sidewalks or potential risks of parasites and disease from bird roosts. Pigeons and sparrows are seen as pets rather than pests. The public's perception of bird management operations needs to be considered. All bird management programs should put some effort into avoid-

◆
Most lethal tactics in bird control pose some risk to nontarget birds, as well as other animals.

◆
Bats in the United States are almost always beneficial. Many bats feed on insects, and can consume up to half their body weight in insects in one feeding.

ing "people problems"—particularly when using AVITROL or other toxic control techniques.

Bats

Bats in the United States are almost always beneficial. Many bats feed on insects, and can consume up to half their body weight in insects in one feeding. Occasionally, however, they become a nuisance inside buildings or pose a public health problem.

In Iowa, **little brown bats** and **big brown bats** sometimes hibernate or roost in building attics, wall, ceiling voids, bell-fries, chimneys, unused furnaces, and the like. The bats' droppings and urine can cause a foul odor and stains in walls and ceilings. Their squeaking and scrambling noises can be intolerable to residents of the building.

Bats are associated with a few diseases that affect people. Rabies and histoplasmosis are the most serious. Rabies is a dangerous, fatal disease. However, the bat's role in transmission has been exaggerated. Although bats are confirmed carriers of the disease, only a few human fatalities have been attributed to bat bites. Nevertheless, use care when handling bats.

Bat bites should be considered to be potential rabies exposure.

- Because most bats will try to bite when handled, they should be picked up with heavy gloves, forceps, or a stick.
- If a bat has bitten someone, it should be captured without crushing its head.
- Refrigerate it (don't freeze).

- Then contact the local health department for testing.

The incidence of histoplasmosis being transmitted from bat droppings to humans is not thought to be high. However, when working in a bat roost site with lots of accumulated droppings, wear a respirator and protective clothing.

Habits of bats

During warm weather, bats feed on flying insects in late afternoon, evening, and early morning. They are not active in bright daylight. If you see a bat at this time it has either been disturbed from its daytime resting place or is sick. When not in flight, they rest in dark hiding and roosting sites (caves, buildings, hollow trees). Bats are able to enter these places of refuge through holes as small as $\frac{3}{8}$ inch.

In Iowa, bats migrate or hibernate when the weather turns cold. Sometimes they hibernate in hanging clusters inside buildings. Depending on the species and geographic location, they breed from late spring to midsummer. Young bats grow rapidly and can fly in three to seven weeks.

Control and management of bats

There are no pesticides available for bat control. The way of getting rid of bats roosting in a building is through "bat-proofing."

Bat-proofing: Making a building "bat-proof" means sealing or screening all of the openings used by the bats to enter a building. It can be a difficult job because, in many cases, all upper openings $\frac{3}{8}$ inch and larger must be sealed, but this is the only permanent method of ridding a building of bats.

Be sure there are no bats inside before the building is sealed. Bats trapped inside may be even more of a problem than before.

June and July are peak months for bat complaints. Unfortunately, this is the worst time of year for control. At this time, bats are rearing young in their colony. The young cannot fly and, therefore, stay in the roost. Bat-proofing during this period traps the young bats. They will die, rot, and smell. They may also crawl and flutter into living areas.

The best time of year to bat-proof a building is either in late fall after bats have left for hibernation or in late winter and early spring before the bats arrive. If bat-proofing must be done in summer, it should be done after mid-August.

- Seal all but one or two principal openings.
- Wait 3 to 4 days for the bats to adjust to using the remaining openings.
- Seal those openings some evening just after the bats have left for their nightly feeding.
- **Bat valves** can also be used. These are placed over the remaining openings and allow the bats to leave but not to return.

Standard bat-proofing materials include ¼-inch hardware cloth, screening, sheet metal, caulking, expanding polyurethane foam, steel wool, and duct tape.

Bat repellents: If bat-proofing is not possible, or bats need to be forced out of a building before it is bat-proofed, the bats can sometimes be repelled from their roost. At this time, only one chemical is registered as a bat repellent. Naphthalene crystals or flakes can be spread on attic floors or placed in voids. The crystals are

most effective in confined air spaces. Three to five pounds will treat an average attic.

While naphthalene may repel the bats, it evaporates, and disappears in a few weeks. The bats often return. Many humans dislike the smell of naphthalene as much as bats; some people are very sensitive to the smell of naphthalene and should avoid all contact.

Blasts of air and bright lights have had some success in repelling bats. Ultrasonic devices do not repel bats.

When a single bat finds its way into a home, office, or store, it will usually find its way out again. When it cannot, capture the bat with an insect net, a coffee can, or even with a gloved hand. The bat can be released.

Tree squirrels

Many species of tree squirrels have adapted well to suburban and city life. Occasionally, squirrels enter buildings and cause damage or disturbance.

Control and management

Squirrel proofing: The first step in eliminating a squirrel problem in a building is to find out where the squirrels are entering. Common points of entry include damaged attic louvers, ventilators, soffits, joints of siding, knot holes, openings where utility wires or pipes enter, chimneys, and flashing.

Heavy gauge one-half-inch hardware cloth or sheet metal can be used to seal most openings. Make other suitable repairs as for ratproofing or batproofing.

Repellents: Naphthalene has been used (in the same way as for bats) to keep

squirrels out of attics, particularly in summer homes and camps that are unoccupied in winter. There is at least one sticky repellent product for squirrels. It is similar to the sticky repellents used in bird control. Apply it to ledges, gutters, window sills, and the like, to keep off squirrels.

Trapping: Live trapping with box or wire traps can be used to remove one or a few squirrels from a building. Traps should be left open and unset for a few days, surrounded by bait, so that the squirrels get used to the trap. Good baits include peanuts, nut meats, peanut butter, whole corn, sunflower seeds, or rolled oats. Squirrels are nasty biters. Handle them carefully. Release captured squirrels five miles away so that they do not return. Be sure to check with local game conservation officers if you plan any kind of lethal control or trapping program.

Where lethal control is permitted, rat snap traps can be used to kill squirrels in attics. The bait should be tied to the trigger and the trap nailed or wired to a beam.

Snakes

Most snakes are nonpoisonous, harmless, and beneficial, but few people want them in their home.

You can identify snakes common to Iowa by obtaining the book, *The Snakes of Iowa*. Send \$2 to the Iowa Department of Natural Resources, Boone Wildlife Center, 1436 255 St., Boone, Iowa 50036.

If snakes are a regular problem, the best solution is to eliminate snake hiding places. Clean up brush piles, wood piles, rock piles, and other debris. Keep shrub-

bery away from foundations and cut tall grass.

Often, snake problems follow rodent problems. Eliminate the rodents—the snakes' food—and the snakes will move elsewhere. Snakes often enter structures through broken block foundations, cracked mortar, damaged vents. These should be repaired.

Snake removal

If a snake gets into a house or other building, several methods are available to remove it:

- Place damp burlap sacks on the floor and cover them with dry sacks. Check them every few hours to see if the snake has crawled underneath. The snake and bags can be lifted with a shovel and taken outside. The snake can be killed or released.
- Rat glue boards will capture all but the largest snakes. The glue boards should be tied down or attached to a plywood base. Place the glue boards along wall and floor junctions. Captured snakes can be killed, or they may be released. Before release, pour vegetable oil over the snake and glue.
- Expanded trigger rat traps set in pairs along wall and floor junctions can kill smaller snakes.

A granular snake repellent can keep some species of snakes away from homes, camp sites, garages, and yards. Containing sulfur and naphthalene, the repellent is applied in a narrow band around the area to be protected.

Skunks, raccoons, and opossums

These three vertebrates are considered together because they are similar pests

◆
Where lethal control is permitted, rat snap traps can be used to kill squirrels in attics. The bait should be tied to the trigger and the trap nailed or wired to a beam.

with similar management and control recommendations. Management of these animals almost always involves exclusion and/or live trapping.

Skunks

Skunks usually live in underground burrows, hollow logs, or rock piles. They may decide to live under houses, sheds, cabins, or storage buildings.

Of course, the main problem with skunks is their odor. They become "pests" when they change their dietary selections from rodents, insects, and wild fruit, to garden crops, garbage, and lawn insects and locate their habitat closer to humans. Another major problem in some areas of the country is the transmission of rabies.

Raccoons

Raccoons are common throughout North America. They are commonly found near streams, lakes, swamps, and often do quite well in suburban areas, even in city parks. Raccoons den inside hollow trees or logs, rock crevices, deserted buildings, culverts, chimneys, attics, and crawl spaces. More than one den may be used.

Raccoons feed on animals and plants. In the spring and summer, they feed on crayfish, mussels, frogs, and fish. In the fall, they switch to fruits, seeds, nuts, and grains. They also eat mice, squirrels, birds, and are quite happy knocking over a garbage can. Raccoons, too, can transmit rabies.

Opossums

Opossums prefer to live near streams or swamps. They den in the burrows of other large animals, and in tree cavities, brush piles, and under sheds and buildings. Occasionally, they move into attics and garages.

They eat nearly everything, from insects to carrion, fruits to grains, garbage to pet food. Opossums are active at night. As a pest, the main complaint with opossums is that they get into garbage, bird feeders, or pet food left outside.

Management and control of skunks, raccoons, and opossums

Exclusion: These animals can be prevented from entering buildings by repairing breaks in foundations and screening crawl space vents with hardware cloth.

- If the animal is currently living under the building, seal all openings but one, then sprinkle a tracking patch of talc at the opening.
- Examine the area after dark. If tracks show that the animal has left, close this last opening immediately.
- Seal attic openings.
- Cap chimneys with a wire cage or other animal-proof cover.
- Pour one or two boxes of naphthalene balls down vent chimneys to run out racoons.

When excluding animals in spring or early summer, be aware that young may also be present. Be sure that all animals have been removed before sealing the building. Otherwise, an odor problem from a dead animal could result.

Live trapping: The best way to remove animals from around buildings is to trap them.

- If the animal must be killed, lower the trap into a tub of water or gas it with a fumigant.
- If the animal is to be released, do it far away from human dwellings. Try to use what you have learned about the biology of the animal to find a suitable habitat. The release site for

◆ **These animals can be prevented from entering buildings by repairing breaks in foundations and screening crawl space vents with hardware cloth.**

◆
Mounting a good level of sanitation in a neighborhood is the best preventive measure for skunks, racoons, and opossums.

these large animals should be more than ten miles away. Check state regulations.

- Set traps as close to the den as possible where damage is occurring, e.g., at corners of gardens, breaks in stone walls, or along obvious animal trails.
- Set multiple traps in a number of different locations.
- Since these animals are active at night, check traps at least every morning; preferably twice a day.
- Check traps often to spot and release nontarget animals.

There is obviously a special problem when trapping skunks. Skunks don't like to "shoot," if they can't see their target.

- Cover all but the trap entrance with burlap or canvas before placing the trap, or use a commercially-sold solid skunk trap.
- Approach the trap slowly and transport it gently.

To release a trapped skunk, stand more than 20 feet away and release the trap door using a string or fishing line.

The best baits for each animal are listed below:

- **Skunk:** Chicken parts and entrails, fresh fish, cat food, sardines, eggs
- **Raccoon:** Chicken parts and entrails, corn, fresh fish, sardines
- **Opossum:** Apple slices, chicken parts and entrails, fresh fish, sardines.

Mounting a good level of sanitation in a neighborhood is the best preventive measure for skunks, racoons, and opossums. Remind clients that released vertebrates must fight to establish themselves into new territory and overcrowded habitat results in increased risk of disease and marginal nesting sites. Prevention is the most humane way of managing vertebrate pests.

Before Using Any Pesticide

STOP

READ THE LABEL

**All pesticides can be harmful to
health and environment if misused.**

**Read the label carefully
and use only as directed.**