

RODENT MANAGEMENT IN ALFALFA

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ABSTRACT

Rodents, particularly pocket gophers, ground squirrels, and voles (meadow mice) cause significant damage in alfalfa and forage production fields in the western states. Left uncontrolled, these pests can be a serious threat to farming operations. Fortunately, there are tools that are effective in reducing populations and damage. Habitats can be manipulated, and traps and toxicants can be used to lessen damage to acceptable levels. These three rodent pests are reviewed along with appropriate control methods. It is important to use an integrated pest management approach, thus assuring that the situation is defined and understood, pest populations are monitored, legal methods are used, socio-political concerns are addressed, and the environment and non-target resources are protected.

Key Words: alfalfa, meadow mice, vole, pocket gopher, ground squirrel, rodent control, baits, traps, rodenticides, fumigants

INTRODUCTION

Agricultural settings support a wide array of wildlife because of the mix of cover and forage. Some wildlife species are welcomed and even encouraged in areas around alfalfa production. However, many species of wildlife can cause damage to agricultural resources, including ungulates, carnivores, rabbits, rodents, and birds. The types of damage include crops in the field; reforestation, nurseries, and orchards; rangeland forage; property, structures and cables; stored commodities; natural resources; and disease hazards. Rodents, in particular, cause serious problems that need to be addressed. Three species groups (pocket gophers, ground squirrels and voles, also called meadow mice) feed on above- and below-ground parts of plants. Additionally, their burrowing and mounding disrupts irrigation and maintenance operations, and can cause damage to harvesting equipment. Finally, mounds cover and kill nearby plants and open the stand for weed invasion. Burrowing can damage structures, roads, and pathways. This damage is expensive to repair, and may even result in livestock, pet or human injury when a burrow system is stepped on.

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PRELIMINARY CONSIDERATIONS

Wildlife is a public-owned resource that is managed by state wildlife agencies. Because the public is very fond of their wildlife, it is important to make sure that our actions are in keeping with state and local wildlife laws. In most states, the Fish and Game Code classifies most rodent species as non-game mammals. Usually, if landowners find them injuring or threatening their crops or other property, the rodents may be controlled at any time, using legal methods.

Additionally, some species (e.g., federal-listed threatened and endangered species and migratory species) are managed by the federal government and related rules and regulations must also be followed. For example, in some areas of California, federally- and state- protected endangered species live in and around alfalfa fields such as San Joaquin kit foxes, several species of kangaroo rats, and blunt-nosed leopard lizards. Special guidelines apply to the use of toxic baits and fumigants for vertebrate pest control in these areas. In some cases, the use of rodent kill traps is also restricted.

Toxicants (rodenticides and fumigants) are important tools in the management of rodent pests. These chemicals are potentially dangerous to people, pets, livestock, and non-target animals. They are carefully regulated by the EPA and state agencies. The use of some rodent toxicants are restricted to certified pesticide applicators; others products are available “over the counter” and can be used by anyone. In either case, however, the EPA label instructions that accompany the product must be fully and carefully followed to avoid problems and to be compliant with the law.

In integrated pest management (IPM) approach should be used when addressing rodent pest problem situations. This involves (among other things) that the pest is properly identified, its ecology and behavior is understood, the damage situation understood, the pest population size is monitored, all available methods are considered, legal methods are used, socio-political concerns are addressed, and the environment and non-target resources are protected. Following the principles of IPM resulted in effectively resolving pest problems while assuring that resources, including dollars, are not wasted and the health of the agro-ecosystem is safe-guarded.

HABITAT MANAGEMENT

Intensive agricultural practices often create a setting that does not support abundant rodent populations. Annual plowing, burning, mowing, grazing, crop residue removal, and herbicide application can result in the disruption of burrow systems and/or the absence of forage and protective cover during portions of the year. This results in periodic reductions in rodent populations, and hence, less damage is likely to occur.

In some situations, the land manager can consider other options or land practices that can help avoid serious rodent damage situations, including crop and variety selection, planting time, periodic flooding. For example, the root structure of some varieties of alfalfa is less prone to damage by rodents.

Land managers can also control the areas bordering their crop fields. These areas (fencerows, permanent grass cover areas, woodlots) often provide year round harborage for rodents. Rodents can survive here even when conditions in the crop fields are not ideal for rodents. Then, when conditions in the crop fields improve, they can quickly invade those fields to exploit new resources. With their high reproductive potential, rodent numbers can rapidly increase and serious crop damage can result.

POPULATION CONTROL

Unfortunately, when perennial crops are grown or no-till agriculture is practiced, rodent populations often flourish because there is less disruption of the soil and forage and cover is almost always available to rodents. In these situations, direct population control is often needed to prevent serious crop losses.

Encouraging natural predation can help reduce rodent populations, but seldom results in significant reduction of crop damage. This is because, in most cases, prey populations usually drive predator populations, not the other way around. If foxes or hawks eat most of the rodents in an area, the predator populations will crash and will be very slow to recover (because of their normal low densities and relatively low reproduction potential) even when the rodent population eventually recovers. Nonetheless, raptor perches and nest boxes can be placed at various locations around one's property to encourage the presence of birds of prey (hawks and owls). Also, some hay bails can be left about for protective cover for foxes and any dens of foxes and other carnivores on the property can be protected to encourage the presence of mammalian predators.

A variety of rodenticides are also available for the direct control of rodent populations. Some people want to start control efforts whenever pests occur or even when they think they might cause a problem. While this is appropriate in certain situations, a good IPM program is based on monitoring the pest to determine when control is necessary. When the population density reaches the threshold level-the level at which control is economically justified-control should be undertaken. Threshold levels for rodents and other vertebrate pests in alfalfa are not generally established although the experiences of growers give us some ideas about when and if control measures should be taken. Because of the nature of rodent damage (killing plants and interfering with harvest) and the fact that they remain in the general area for life, the tolerable level is very low, in some cases, nearly zero. Rodent populations can be monitored by mound or burrow counts, by trapping, and, in the case of ground squirrels, by animal counts during daylight hours.

The timing of a control program and the methods and materials to use depend on (1) the pest species, (2) how the area is managed, (3) the availability of equipment and labor and (4) other site and situation specific factors. We will discuss specific rodenticides used for each featured rodent group in those subsections.

POCKET GOPHERS

Pocket gophers (*Thomomys* spp.) are fossorial, stout bodied rodents. They are well adapted for burrowing and are truly digging machines. Their common name is derived from the fur-lined external cheek pouches, or pockets, used to carry food and nesting materials. The pocket gopher's lips close behind its four large incisor teeth, keeping dirt out of its mouth when it is using its teeth for digging. They live by themselves in an extensive underground burrow system that can cover an area of several hundred square feet. These burrows are about 2 inches in diameter, usually located from 6 to 12 inches below ground. They eat a wide variety of roots, bulbs, tubers, grasses, and seeds, and sometimes even the bark of trees. Their feeding and burrowing can damage alfalfa and surrounding areas. In addition, they may damage plastic irrigation lines and their tunnels can divert and carry off irrigation water, lead to soil erosion and cause some structures to fail. Pocket gophers seldom travel aboveground. They are sometimes seen above ground feeding, pushing dirt out of their burrow system, or moving to a new area. The mounds of fresh soil that are the result of burrow excavation indicate their presence. Their mounds are usually crescent shaped and are located at the ends of short lateral tunnels branching from a main burrow system. One gopher may create several mounds in a day. Because they lead solitary lives, a group of fresh mounds is generally evidence of the presence of one gopher. A female gopher usually produces one litter of 3-4 young per year.

Because of the nature of pocket gopher damage, successful control programs depends on early detection and prompt measures to prevent damage. Most people control gophers in alfalfa by baiting using mechanical baiting probes, hand probes or a tractor-drawn baiting device. Trapping is sometimes used although it is usually too labor intensive to be effective over large areas. Recently, fumigation for pocket gopher control has gained popularity and is something to consider if the gopher problem is severe and other methods do not seem to be working. A program incorporating these methods should result in significant reduction in pocket gopher damage in the area.

Traps can be effective in controlling pocket gophers if continuous effort is applied. Several types and brands of gopher trap are available. The most common is a two-pronged pincher trap that triggers when the gopher pushes against a flat vertical pan. Another popular version is the squeeze-type box trap. A person should locate the gopher's main tunnel, open it with a shovel or garden trowel and set traps in pairs facing opposite directions. This placement will intercept a gopher coming from either direction. The burrow may need to be enlarged to accommodate wire traps. The box trap is somewhat easier to set but requires more excavation because of its size. Box traps are useful when the diameter of the gopher's main burrow is small (less than 3 inches). All traps should be wired to stakes so as to not lose track of them. After setting the traps, exclude light from the burrow by covering the opening with dirt, sod, cardboard, or some other material. Fine soil can be sifted around the edges to ensure a light-tight seal. If light enters, the gopher may plug the burrow with soil, filling the traps and making them ineffective. Check traps often and reset them when necessary. If no gopher is caught after 2-3 days, reset the traps in a different location.

Strychnine-treated bait is the most common type used for pocket gopher control. It can only be used underground and is placed in burrow systems which are then covered to prevent non-target exposure. Zinc phosphide is another single-feeding bait that is registered in some areas. When used in alfalfa, these are Restricted Use Materials. They are usually effective with one application. Baits containing anticoagulants are available in some areas although their usefulness in large scale agricultural areas such as alfalfa fields is unknown. They require multiple treatments or one larger treatment to be effective. All gopher bait is poisonous and should be used with caution. Because gopher bait is placed underground, it is considered safe to use because it is not exposed to most other animals, or to children. However, dogs and other animals can dig up gophers and might be exposed to bait in this way. Always read and follow product label instructions carefully.

Simple hand probes or hand probe dispensers are used for baiting pocket gophers (see trapping section for probe description). To be effective, baits must be placed in the underground tunnel. After locating the main gopher burrow with a probe, enlarge the opening by rotating the probe or inserting a larger rod or stick. Then place the bait carefully in the opening, taking care not to spill any on the ground. A funnel is useful to prevent spillage. Close the probe hole with sod, rock, or some other material to exclude light and prevent dirt from falling on the bait. Tamp or rake down existing mounds so that new activity can be distinguished. If gopher mounding activity continues for more than 2 days after strychnine or zinc phosphide bait, or 7 to 10 days after anticoagulant baits have been used, repeat the control efforts.

The mechanical bait applicators are also available for gopher control. They offer a good way of controlling gophers over large areas with a once-over operation. This tractor-drawn device constructs an artificial underground burrow and deposits poison grain bait in it at regular intervals and quantities. The artificial burrow should be used only where gophers are active and should not be used as a prophylactic to prevent gophers from invading an area. The artificial burrow will intercept the natural gopher burrow systems in the treated area. Gophers readily explore these artificial tunnels and will consume the bait. In alfalfa, the machine will cut the plants and leave a slight ridge. Soil moisture is critical when this machine is used. If the soil is too wet, the tractor bog down; too dry and the artificial burrows will collapse. The strychnine bait used in this machine is usually a higher strength than those used for hand baiting. Recently, the availability of strychnine bait, especially at the higher strengths has been very limited. Check with the local agricultural chemical supplier.

Fumigation is not usually considered effective for pocket gopher control although aluminum phosphide (a Restricted Use Material) has been very effective if used properly. Aluminum phosphide tablets react with the moisture in the air to evolve phosphine gas. Start by probing for a main tunnel. Once found, enlarge the probe hole by using a bigger rod (some growers use a 3/4" PVC pipe) and place the tablets down into the burrow system. Cover the probe hole with soil or close it by healing the ground. Knock down all mounds in the area. Re-inspect after 48 hours. If new mounds are being formed, re-treat the active burrows. While phosphine gas is toxic to all animals, it does not build up in the tissues of the gopher so there is minimal hazard if another animal eats a poisoned gopher. If using a fumigant, be sure not to use it under or near

buildings. Read and follow the label carefully. Fumigation with smoke or gas cartridges is usually not effective because gophers quickly seal off their burrow when they detect smoke or gas.

Once pocket gopher damage has been controlled, a system should be established to monitor the area for gopher re-infestation. Level or stamp down all existing mounds after the control program and clean away weeds and debris so fresh mounds can be seen easily. A monitoring program is important because pocket gophers may move in from other areas and a recurrence of damage can occur within a short time. They probably do this by using the tunnel systems left by other gophers. Experience has shown that it is easier, less expensive and less time consuming to control gophers before they build up to the point where they do excessive damage.

GROUND SQUIRRELS

Ground squirrels (*Spermophilus* spp.) are common in most alfalfa growing areas. Ground squirrels live in colonies of 2 to 20+ animals in a wide variety of habitats. Populations may be particularly dense in areas disturbed by humans, such as road or ditch banks, fencerows, near buildings, and in or near many crops. They usually avoid thick chaparral, dense woods, and wet or moist areas.

Ground squirrels are active during the day and are easy to spot, especially in warm weather, from spring to fall. During winter, ground squirrels hibernate but some young squirrels remain active year round. Most adults go into summer "hibernation" (estivation) during the hottest times of the year. At night and in bad weather squirrels will remain in their burrows.

Ground squirrels reproduce once a year in early spring. Litter sizes vary, but seven to eight young are average. The young remain in the burrow for about 6 weeks before they emerge. Ground squirrels are primarily vegetarians. During early spring, they consume green grasses and other small plants. When the vegetation begins to dry, squirrels switch their diet to seeds, grains, and nuts.

When ground squirrels cause or threaten damage, a control program suitable for the situation and time of year should be implemented. The activity cycle of ground squirrels determines when various control measures are appropriate. Each species is controlled differently and the availability of baits and other control materials varies throughout the county. While information on one species might not apply to all others, a person can often get some good ideas from seeing how other people deal with their squirrel problems.

Ground squirrels can be killed in their burrows with several types of fumigants, some of which require special use permits. Fumigation should not be used near or beneath buildings, or when a fire hazard exists (e.g. dry grass). It is most effective in the spring or at other times when soil moisture is high. The soil moisture helps hold the gas in the burrow system by limiting its

diffusion into the small cracks often present in dry soil. Ground squirrels have fairly large burrows that can have several entrances. Treat all entrances and then seal them. Check treated burrows in 24-48 hours and re-treat any newly opened burrows. Fumigation is not effective during periods of hibernation and aestivation because at those times squirrels plug their burrows with soil. The plug usually can't be seen.

Since fumigants will generally kill any animal in the burrow, take care to ensure other animals are not present. For example, burrowing owls live in abandoned ground squirrel burrows. If a person observes these owls sitting on the burrow mound, or sees bird droppings or feathers in and around a burrow opening, they should not fumigate the burrow. Additionally, the gases emitted from some fumigants are dangerous to people so they should be applied carefully. They occasionally ignite, creating a fire danger. Do not use such fumigants where a significant fire hazard exists such as near buildings, dry grass, or other flammable materials. Always read and follow the fumigant label instructions and restrictions.

Oral rodenticide baits can also be used to control ground squirrels. Some rodenticide baits are available over the counter while others require a special permit from the appropriate regulatory agency. When rodenticide baits or any other rodent control materials are used, read and follow label instructions carefully.

Anticoagulant baits are recommended for control of ground squirrels because they are effective and relatively safe to humans, pets, and most other wildlife. Anticoagulants interfere with an animal's blood-clotting mechanism, eventually leading to death. They are effective when consumed in several feedings over a period of 5 days. These features, as well as an effective antidote (vitamin K₁), make anticoagulant baits relatively safe to use.

For ground squirrels, anticoagulant baits can be applied in three ways: bait stations, spot baiting, or repeated broadcast application. Bait stations are small structures that the squirrel must enter to eat the bait. A station contains sufficient bait for repeated feedings, minimizes bait exposure to weather, and helps keep children and pets from reaching the bait. The bait station is the preferred baiting method around homes and in other areas where children, pets, and poultry are present. Follow the product label regarding use, construction and placement of these stations.

There are several things you should consider when you are designing a bait station for ground squirrels. The entrance hole(s) should be about 3-4 inches across to allow access to squirrels but keep out larger animals. A self-feeding arrangement will ensure that the pest gets a continuous supply of bait. Construct a lip or other arrangement to prevent bait from spilling out when squirrels exit. In areas accessible to children, provide a lock or devise some other method that will make it difficult for children to find or open the station. The bait station should be secured so that it cannot be turned over or easily removed.

Place bait stations in areas frequented by ground squirrels such as near runways or burrows. If ground squirrels are noticeable throughout the area, space the stations at intervals of 100 to 200 feet. Initially, inspect bait stations daily and add bait if all is eaten overnight. Fresh bait is

important. It may take several days or longer before squirrels become accustomed to and enter the bait station. Anticoagulant baiting with bait stations generally takes 3 to 4 weeks or more to be effective. Once feeding begins the squirrel usually dies in 5-6 days. Continue baiting until all feeding ceases and you observe no squirrels. Upon completion of the control program, pick up unused bait and store or dispose of according to label instructions.

Ground squirrels are excellent foragers for seeds. Spot and broadcast baiting uses this behavior to apply bait over the area where squirrels live and feed. With spot baiting, spread the bait by hand using a spoon or cup around the squirrel burrows or in the runways. Do not pile the bait. Mechanical seed broadcasters are also used to spread bait evenly over the area around the squirrel burrows or runways. With both of these methods the bait is spread very sparsely (approximately 3-4 grain kernels per square foot). This is sufficient for the squirrel to find it, but too sparse for some other wildlife. It is necessary to repeat the bait application 4-5 days after the first treatment. Spot and broadcasting baiting can only be used if it is specified on the rodenticide label. Always read and follow label instructions carefully.

Anticoagulant baits have the same effects on nearly all warm-blooded animals, including birds. Cereal based baits are attractive to dogs as well as to other non-target animals, so take care to prevent access to the bait. The hazards to children and pets can be reduced by placing bait out of their reach in a bait station and by keeping them out of areas where baiting is underway. Dead ground squirrels can contain small amounts of the anticoagulant in their tissues. Carcasses should be buried or put in plastic bags in the trash. Do not handle them with bare hands.

Single-feeding type baits are also available for controlling ground squirrels, but there are more restrictions on their use. Apply single-feeding baits such as zinc phosphide by hand or with a mechanical broadcaster according to the label instructions. Spread the bait near the ground squirrel burrow or at places where the squirrels are feeding. Ground squirrels are good foragers and can easily find the broadcast grain. Do not pile bait, as this will increase the hazards to non-target animals. Dead squirrels should be buried or put in plastic bags in the trash. Follow label instructions carefully.

Ground squirrels like open areas where there is good visibility. Dense plantings might be a deterrent to ground squirrels living near alfalfa although this is not likely particle. A new device on the market is an exploding gun that pumps propane and oxygen into the tunnel system and ignites the mixture with a spark. While some growers are using this device, little information is available on its effectiveness for ground squirrel control. Repellents are not effective in protecting plants from ground squirrels feeding. Frightening squirrels with sound, vibration, electromagnetic radiation, or other means has not proven effective in driving them from an area or preventing their damage.

Although ground squirrels can be trapped, using cage traps or conibear traps (kill traps placed over burrow openings). This approach to population control, however, is generally considered too labor intensive.

Once ground squirrels damage has been controlled, a system should be established to monitor the area for re-infestation. Ground squirrels will invade old burrows, even when covered with a layer of soil. Monitor these areas and other places when the squirrels have been a problem. Experience has shown that it is easier, less expensive and less time consuming to control squirrels before they build up to the point where they do excessive damage.

VOLES (MEADOW MICE)

Voles (*Microtus* spp.), also known as meadow mice, damage alfalfa by feeding on alfalfa roots and stems. These small rodents have stout bodies and small eyes and ears. Their coarse fur is blackish brown to grayish brown in color. When full grown, they are 4 to 5 inches long. Voles are active all year and are normally found in areas with dense ground cover. They dig short, shallow burrows and make underground nests of grass, stems, and leaves. The peak breeding period is spring with a second, smaller breeding period in fall. Litters average four young. Vole numbers fluctuate from year to year; under favorable conditions, their populations increase rapidly and become very dense. In many regions, voles are cyclic with high densities occurring every 3-5 years.

Preventing vole damage usually requires a management program that keeps down the population in the area. If appropriate, the first step is to remove or reduce the vegetative cover surrounding the alfalfa field, making the area less suitable to voles. Removing cover also makes detecting voles and other rodents easier. Since this is not always practical or desirable, a program to control the vole population may be necessary. Because the damage voles do to alfalfa can be quite severe, and because of their rapid reproductive rate, initiating a program of habitat modification and/or population reduction before their numbers explode is important.

Trapping is a common detection tool used to confirm that the burrows or runways observed are from voles. When vole numbers are low or when the population is concentrated in a small area, trapping may be an effective control method although this is rarely the case in alfalfa fields. The simple, wooden mouse snap trap is used. Peanut butter, oatmeal, or apple slices make excellent baits for meadow voles. Often, no bait is needed because voles will trigger the trap as they pass over it. Trap placement is crucial. Voles seldom stray from their usual travel routes, so set traps along these routes. Look for nests, burrows, and runways in grass or mulch in or near the alfalfa. Place traps at right angles to and flush with the ground in these runways. Traps must be set in sufficient numbers to detect the presence and degree of vole infestation. A trap line of 50-100 traps should be used. Examine traps daily. Remove and bury dead voles or place them in plastic bags in the trash. Do not handle dead voles without gloves.

When voles are numerous or when damage occurs over large areas you may need to use toxic bait to achieve adequate control. When you use toxic baits, take care to ensure the safety of children, pets, and non-target animals. Do this by following product label instructions carefully.

Baits that require only one feeding to be lethal are called single-feeding baits. They are particularly useful where vole populations are spread over large areas. Zinc phosphide has a

24(c) registration for meadow vole control in alfalfa crops in California. This allows the bait to be used with the alfalfa crop; something that can only be done if it is allowed on the rodenticide label. Place bait in runways or next to burrows where voles will find it, or broadcast in the area where voles are found. Always follow label instructions. When using zinc phosphide, be aware that voles that feed on the bait but do not die may become bait shy. When this happens, they remember that the bait made them sick and will likely not eat it again. For this reason, zinc phosphide should not be used in the same field more than once in a 6 month period. Zinc phosphide bait is rapid acting and a person should find dead voles within 12 hours of baiting. When practical (e.g. dead voles in the open such as along roads), dispose of dead voles by burying them or placing them in plastic bags and putting them in the trash. Do not handle them with bare hands. Because zinc phosphide does not accumulate in the tissue of the voles, predators or scavengers such as dogs and cats are not likely to be affected by eating the poisoned rodents. However, children, as well as pets, birds, and other animals, can be affected by the bait, so store it out of reach and use it carefully in a way that will minimize their access to it. Zinc phosphide is a Restricted Use Material and a person must obtain a special permit from the appropriate regulatory agency buy and use it. Check for local restrictions.

Anticoagulant baits, generally called multiple-feeding baits, are registered for vole control but not for use in alfalfa crops. They can be used in areas adjacent to the alfalfa field or during crop dormancy or where contact with the alfalfa plant will not occur. Anticoagulant baits are slow acting and must be consumed over a period of days to be effective. Whole grain baits are commonly recommended, but pelleted baits are also available. Moisture-resistant paraffin block baits are useful around ditches and other areas where high moisture may cause other types of baits to spoil.

Because voles must feed on anticoagulant baits over a period of days, the bait must be available until the population is controlled. As with trapping, bait placement is very important. Place it in runways or next to burrows so voles will find it during their normal travel. If the rodenticide label allows it to be broadcast, be sure to spread it evenly over an infested area. Multiple broadcasts may be necessary. Read the label carefully. These baits are toxic to other animals so take care and keep non-target animals from eating the bait. No anticoagulants are registered for in-crop use at this time.

Some anticoagulant paraffin bait blocks are registered for voles. Place them in runways or near burrow openings or both. Keep replacing them as they are eaten and remove those that remain when feeding stops. Bait blocks should not be used where children or pets might pick them up.

To detect the presence of voles, look for fresh trails in the grass, as well as burrows, droppings, and evidence of feeding. Routine monitoring of the alfalfa field and surrounding area is important. Pay particular attention to adjacent areas that have heavy vegetation because voles can build up in these areas and invade the alfalfa field.

CONCLUDING COMMENTS

Rodents cause significant damage to agricultural resources each year. Fortunately, tools are available to greatly reduce losses. Importantly, pest populations and damage need to be monitored so that appropriate action can be taken in a timely way. Rodenticides are an important part of the rodent IPM toolbox, but are carefully regulated and should be used with care. Traps are also useful in rodent monitoring and, in some cases, can be used to reduce populations.

Many other methods, such as frightening devices, repellents, and barriers, are not very effective in preventing rodent damage. Research continues, however, to improve these tools and to develop new methods. Research is also underway to improve delivery systems and traps, and for rodent fertility control.