Scott E. Hygnstrom
Extension Wildlife Damage Specialist
Department of Forestry, Fisheries and Wildlife
University of Nebraska
Lincoln, NE 68583-0819

Dallas R. Virchow
Extension Assistant-Wildlife Damage
Panhandle Research and Extension Center
University of Nebraska
Scottsbluff, NE 69361

PRAIRIE DOGS

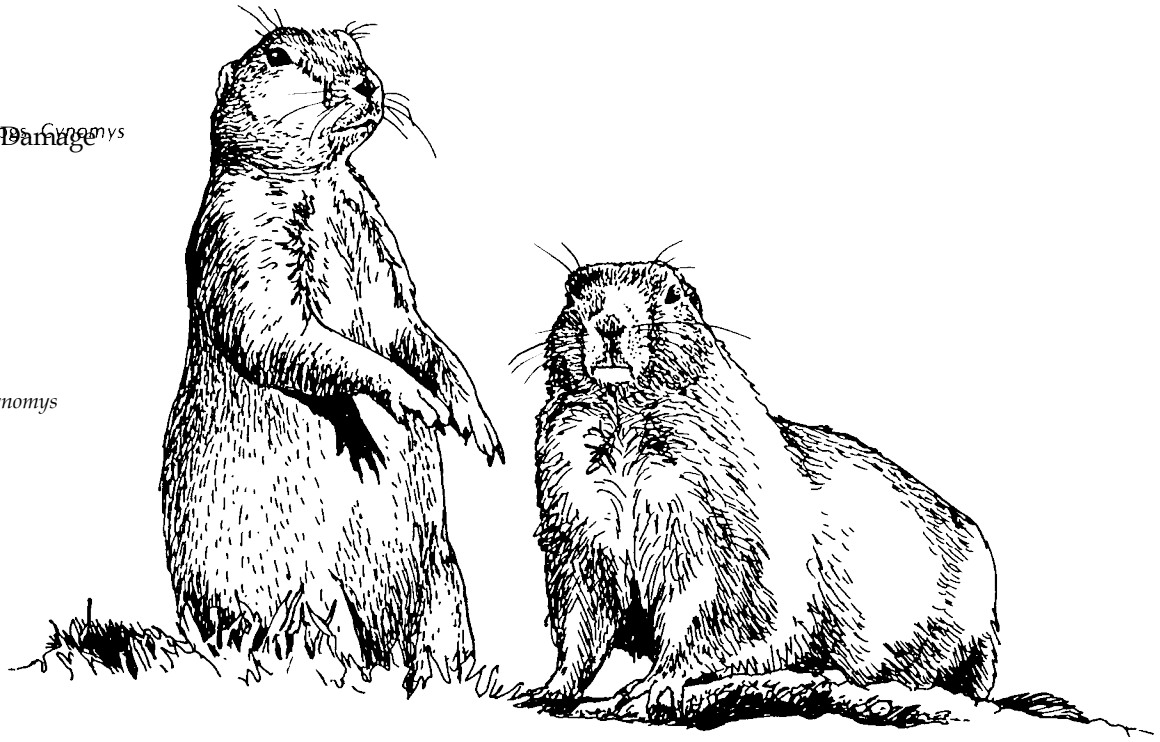


Fig. 1. Black-tailed prairie dogs, *Cynomys ludovicianus*

Damage Prevention and Control Methods

Exclusion

Wire mesh fences can be installed but they are usually not practical or cost-effective.

Visual barriers of suspended burlap, windrowed pine trees, or snow fence may be effective.

Cultural Methods

Modify grazing practices on mixed and mid-grass rangelands to exclude or inhibit prairie dogs.

Cultivate, irrigate, and establish tall crops to discourage prairie dog use.

Frightening

No methods are effective.

Repellents

None are registered.

Toxicants

Zinc phosphide.

Fumigants

Aluminum phosphide.

Gas cartridges.

Trapping

Box traps.

Snares.

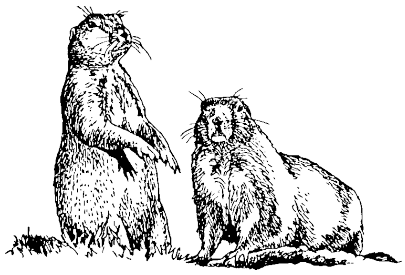
Conibear® No. 110 (body-gripping) traps or equivalent.

Shooting

Shooting with .22 rimfire or larger rifles.

Other Methods

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



PREVENTION AND CONTROL OF WILDLIFE DAMAGE — 1994

Cooperative Extension Division
Institute of Agriculture and Natural Resources
University of Nebraska - Lincoln

United States Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control

Great Plains Agricultural Council
Wildlife Committee

B-85

Identification

Prairie dogs (Fig. 1) are stocky burrowing rodents that live in colonies called "towns." French explorers called them "little dogs" because of the barking noise they make. Their legs are short and muscular, adapted for digging. The tail and other extremities are short. Their hair is rather coarse with little underfur, and is sandy brown to cinnamon in color with grizzled black and buff-colored tips. The belly is light cream to white.

Five species of prairie dogs are found in North America: the black-tailed (*Cynomys ludovicianus*), Mexican (*C. mexicanus*), white-tailed (*C. leucurus*), Gunnison's (*C. gunnisoni*), and Utah prairie dog (*C. parvidens*). The most abundant and widely distributed of these is the black-tailed prairie dog, which is named for its black-tipped tail. Adult black-tailed prairie dogs weigh 2 to 3 pounds (0.9 to 1.4 kg) and are 14 to 17 inches (36 to 43 cm) long. The Mexican prairie dog also has a black-tipped tail, but is smaller than its northern relative. White-tailed, Gunnison's, and Utah prairie dogs all have white-tipped tails. White-tailed prairie dogs are usually smaller than black-tailed prairie dogs, weighing between 1 1/2 and 2 1/2 pounds (0.7 to 1.1 kg). The Gunnison's prairie dog is the smallest of the five species.

Range

Prairie dogs occupied up to 700 million acres of western grasslands in the early 1900s. The largest prairie dog colony on record, in Texas, measured nearly 25,000 square miles (65,000 km^2) and contained an estimated 400 million prairie dogs. Since 1900, prairie dog populations have been reduced by as much as 98% in some areas and eliminated in others. This reduction is largely the result of cultivation of prairie soils and prairie dog control programs implemented in the early and mid-1900s. Population increases have been observed in the 1970s and 1980s, possibly due to the increased restrictions on and reduced use of toxicants.

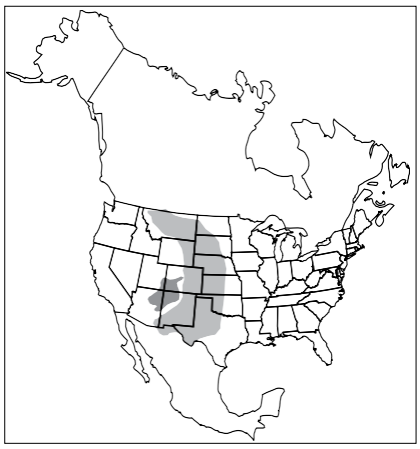


Fig. 2a. Distribution of the black-tailed (light), and Gunnison's prairie dogs (dark) in North America.

Fig. 2b. Distribution of the white-tailed (light), Utah (medium), and Mexican prairie dogs (dark) in North America.

Today, about 2 million acres of prairie dog colonies remain in North America.

The black-tailed prairie dog lives in densely populated colonies (20 to 35 per acre [48 to 84/ha]) scattered across the Great Plains from northern Mexico to southern Canada (Fig 2). Occasionally they are found in the Rocky Mountain foothills, but rarely at elevations over 8,000 feet (2,438 m). The Mexican prairie dog occurs only in Mexico and is an endangered species. White-tailed prairie dogs live in sparsely populated colonies in arid regions up to 10,000 feet (3,048 m). The Gunnison's prairie dog inhabits open grassy and brushy areas up to 12,000 feet (3,658 m). Utah prairie dogs are a threatened species, limited to central Utah.

Habitat

All species of prairie dogs are found in grassland or short shrubland habitats. They prefer open areas of low vegetation. They often establish colonies near intermittent streams, water impoundments, homestead sites, and windmills. They do not tolerate tall vegetation well and avoid brush and timbered areas. In tall, mid- and mixed-grass rangelands, prairie dogs have a difficult time establishing a colony unless large grazing animals (bison or livestock) have closely grazed vegetation. Once established, prairie dogs can maintain their habitat on mid- and mixed-grass rangelands. In shortgrass prairies, where moisture is limited, prairie dogs can invade and maintain acceptable habitat without assistance.

Food Habits

Prairie dogs are active above ground only during the day and spend most of their time foraging. In the spring and summer, individuals consume up to 2 pounds (0.9 kg) of green grasses and forbs (broad-leafed, nonwoody plants) per week. Grasses are the preferred food, making up 62% to 95% of their diet. Common foods include western wheatgrass, blue grama, buffalo grass, sand dropseed, and sedges. Forbs such as scarlet globe mallow, prickly pear, kochia, peppergrass, and wooly plantain are common in prairie dog diets and become more important in the fall, as green grass becomes scarce. Prairie dogs also eat flowers, seeds, shoots, roots, and insects when available.

General Biology, Reproduction, and Behavior

Prairie dogs are social animals that live in towns of up to 1,000 acres (400 ha) or more. Larger towns are often divided into wards by barriers such as ridges, lines of trees, and roads. Within a ward, each family or "coterie" of prairie dogs occupies a territory of about 1 acre (0.4 ha). A coterie usually consists of an adult male, one to four

adult females, and any of their offspring less than 2 years old. Members of a coterie maintain unity through a variety of calls, postures, displays, grooming, and other forms of physical contact.

Black-tailed prairie dog towns typically have 30 to 50 burrow entrances per acre, while Gunnison's and white-tailed prairie dog towns contain less than 20 per acre. Most burrow entrances lead to a tunnel that is 3 to 6 feet (1 to 2 m) deep and about 15 feet (5 m) long. Prairie dogs construct crater- and dome-shaped mounds up to 2 feet (0.6 m) high and 10 feet (3 m) in diameter. The mounds serve as lookout stations. They also prevent water from entering the tunnels and may enhance ventilation of the tunnels.

Prairie dogs are most active during the day. In the summer, during the hottest part of the day, they go below ground where it is much cooler. Black-tailed prairie dogs are active all year, but may stay underground for several days during severe winter weather. The white-tailed, Gunnison's, and Utah prairie dogs hibernate from October through February.

Black-tailed prairie dogs reach sexual maturity after their second winter and breed only once per year. They can breed as early as January and as late as March, depending on latitude. The other four species of prairie dogs reach sexual maturity after their first winter and breed in March. The gestation period is about 34 days and litter sizes range from 1 to 6 pups. The young are born hairless, blind, and helpless. They remain underground for the first 6 weeks of their lives. The pups emerge from their dens during May or June and are weaned shortly thereafter. By the end of fall, they are nearly full grown. Survival of prairie dog pups is high and adults may live from 5 to 8 years.

Even with their sentries and underground lifestyle, predation is still a major cause of mortality for prairie dogs. Badgers, weasels, and black-footed ferrets are efficient predators. Coyotes, bobcats, foxes, hawks, and eagles also kill prairie dogs. Prairie rattlesnakes and bull snakes may take young, but rarely take adult prairie dogs. Accidents, starvation, weather, parasites, and diseases also reduce prairie dog populations, but human activities have had the greatest impact.

Prairie dog colonies attract a wide variety of wildlife. One study identified more than 140 species of wildlife associated with prairie dog towns. Vacant prairie dog burrows serve as homes for cottontail rabbits, small rodents, reptiles, insects, and other arthropods. Many birds, such as meadowlarks and grasshopper sparrows, appear in greater numbers on prairie dog towns than in surrounding prairie. The burrowing owl is one of several uncommon or rare species that frequent prairie dog towns. Others include the golden eagle, prairie falcon, ferruginous hawk, mountain plover, swift fox, and endangered black-footed ferret (see Appendix A of this chapter).

Damage and Damage Identification

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

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

Other studies, however, indicate that prairie dogs may have little or no significant effect on livestock production. One research project in Oklahoma revealed that there were no differences in annual weight gains between steers using pastures inhabited by prairie dogs and steers in pastures without prairie dogs. Reduced forage availability in prairie dog towns may be partially compensated for by the increased palatability and crude protein of plants that are stimulated by grazing. In addition, prairie dogs sometimes clip and/or eat plants that are toxic to livestock. Bison, elk, and pronghorns appear to prefer feeding in prairie dog colonies over uncolonized grassland.

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

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

Rattlesnakes and black widow spiders also occur in prairie dog towns, but can be avoided. Rattlesnakes often rest in prairie dog burrows during the day and move through towns at night in search of food. Black widow spiders are most often found in abandoned prairie dog holes where they form

webs and raise their young. Bites from these animals are rare, but are a threat to human health.

Legal Status

Black-tailed, white-tailed, and Gunnison's prairie dogs are typically classified as unprotected or nuisance animals, allowing for their control without license or permit. Most states require purchase of a small game license to shoot prairie dogs. If the shooter is acting as an agent for the landowner to reduce prairie dog numbers, a license may not be required. The Utah and Mexican prairie dogs are classified as threatened and endangered species, respectively. Contact your local wildlife agency for more information.

The black-footed ferret is an endangered species that lives almost exclusively in prairie dog towns, and all active prairie dog colonies are potential black-footed ferret habitat. It is a violation of federal law to willfully kill a black-footed ferret or poison prairie dog towns where ferrets are present. Federal agencies must assess their own activities to determine if they "may affect" endangered species. Some pesticides registered for prairie dog control require private applicators to conduct ferret surveys before toxicants can be applied. Detailed information on identifying black-footed ferrets and their sign is included in Appendix A of this chapter. To learn more about federal and state guidelines regarding prairie dog control, black-footed ferret surveys, and block clearance procedures, contact personnel from your local Cooperative Extension, USDA-APHIS-ADC, US Fish and Wildlife Service, or state wildlife agency office.

Damage Prevention and Control Methods

Exclusion

Fencing. Exclusion of prairie dogs is rarely practical, although they may be discouraged by tight-mesh, heavy-gauge, galvanized wire, 5 feet (1.5 m) wide with 2 feet (60 cm) buried in the ground and 3 feet (90 cm) remaining aboveground. A slanting overhang at the top increases the effectiveness of the fence.

Visual Barriers. Prairie dogs graze and closely clip vegetation to provide a clear view of their surroundings and improve their ability to detect predators. Fences, hay bales, and other objects can be used to block prairie dogs' view and thus reduce suitability of the habitat. Franklin and Garrett (1989) used a burlap fence to reduce prairie dog activity over a two-month period. Windrows of pine trees also reduced prairie dog activity. Unfortunately, the utility of visual barriers is limited because of high construction and maintenance costs. Tensar snow fences (2 feet [60 cm] tall) are less costly, at about $0.60 per foot ($1.97/m) for materials. Unfortunately, they were inconsistent in reducing reinvasion rates of prairie dog towns in Nebraska (Hygnstrom and Virchow, unpub. data).

Cultural Methods

Grazing Management. Proper range management can be used to control prairie dogs. Use stocking rates that maintain sufficient stand density and height to reduce recolonization of previously controlled prairie dog towns or reduce occupation of new areas. The following general recommendations were developed with the assistance of extension range management specialists and research scientists.

Stocking Rate. Overgrazed pastures are favorable for prairie dog town establishment or expansion. If present, prairie dogs should be included in stocking rate calculations. At a conservative population density of 25 prairie dogs per acre (60/ha) and dietary overlap of 75%, it takes 6 acres (2.4 ha) of prairie dogs to equal 1 Animal Unit Month (AUM) (the amount of forage that one cow and calf ingest per month during summer [about 900 pounds; 485 kg]).

Rest/Rotation Grazing. Rest pastures for a period of time during the growing season to increase grass height and maintain desired grass species. Instead of season-long continuous grazing, use short duration or rapid rotation grazing systems, or even total deferment during the growing season. Livestock can be excluded from vacant prairie dog towns with temporary fencing to help vegetation regain vigor and productivity. Mid- to tallgrass species should be encouraged where they are a part of the natural vegetation. In semiarid and shortgrass prairie zones, grazing strategies may have little effect on prairie dog town expansion or establishment.

Grazing Distribution. Prairie dogs often establish towns in areas where livestock congregate, such as at watering sites or old homesteads. Move watering facilities and place salt and minerals on areas that are underutilized by livestock to distribute livestock grazing pressure more evenly. Prescribed burns in spring may enhance regrowth of desirable grass species.

Cultivation. Prairie dog numbers can be reduced by plowing or disking towns and leaving the land fallow for 1 to 2 years, where soil erosion is not a problem. Establish tall grain crops after the second year to further discourage prairie dogs. Burrows can be leveled and filled with a tractor-mounted blade to help slow reinvasion. Flood irrigation may discourage prairie dogs.

Frightening

Frightening is not a practical means of control.

Repellents

None are registered.

Toxicants

Safety Precautions. Use pesticides safely and comply with all label recommendations. Only use products that are registered for prairie dog control by the Environmental Protection Agency. Some pesticides registered for prairie dog control require that private applicators conduct ferret surveys before toxicants can be applied. Detailed information on identifying black-footed ferrets and their sign is included in Appendix A of this

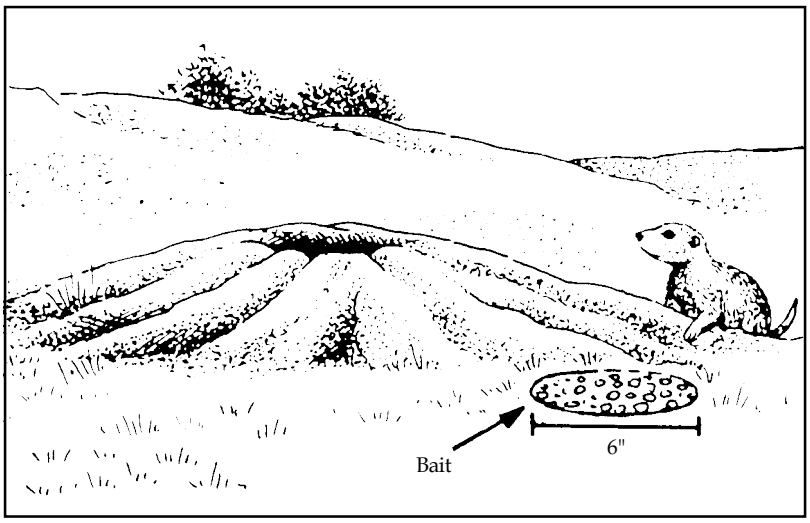


Fig. 3. Prebait and toxic bait should be scattered over a 6-inch (15-cm) circle at each burrow entrance.

chapter. Seek assistance from your local extension agent or from the USDA-APHIS-ADC if needed.

Toxic Bait. The only toxic baits currently registered and legal for use to control prairie dogs are 2% zinc phosphide-treated grain bait and pellet formulations. Zinc phosphide baits are effective and relatively safe regarding livestock and other wildlife in prairie dog towns, if used properly. These baits are available through national suppliers (see **Supplies and Materials**), USDA-APHIS-ADC, and local retail distributors.

Toxic baits are most effective when prairie dogs are active and when there is no green forage available. Therefore, it is best to apply baits in late summer and fall. Zinc phosphide baits can only be applied from July 1 through January 31.

Prebaiting. Prairie dog burrows must be prebaited before applying toxic bait. Prebaiting will accustom prairie dogs to eating grain and will make the toxic bait considerably more effective when it is applied. Use clean rolled oats as a prebait if you are using 2% zinc phosphide-treated rolled oats. Drop a heaping teaspoon (4 g) of untreated rolled oats on the bare soil at the edge of each prairie dog mound or in an adjacent feeding area. The prebait should scatter, forming about a 6-inch (15-cm) circle (Fig. 3). Do not place the prebait in piles or inside burrows, on top of mounds, among prairie dog droppings, or in vegetation far from the mound.

Apply toxic bait only after the prebait has been readily eaten, which usually takes 1 to 2 days. If the prebait is not accepted immediately, wait until it is eaten readily before applying the toxic bait. More than one application of prebait may be necessary if rain or snow falls on the prebait. Prohibit shooting and other disturbance of the colony at least 6 weeks prior to and during treatment.

Prebait and toxic bait can be applied by hand on foot, but mechanical bait dispensers attached to all-terrain vehicles are more convenient and cost-effective for towns greater than 20 acres (8 ha). Motorcycles and horses can also be used to apply prebait and toxic bait. See **Supplies and Materials** for information on bait dispensers.

Bait Application. Apply about 1 heaping teaspoon (4 g) of grain bait per burrow in the same way that the prebait was applied. About 1/3 pound of prebait and 1/3 pound of zinc phosphide bait are needed per acre (0.37 kg/ha). Excess bait that is not eaten by prairie dogs can be a hazard to nontarget wildlife or livestock. It is best to remove livestock, especially horses, sheep, or goats, from the pasture before toxic bait is applied; however, removal is not required. Apply toxic bait early in the day for best results and restrict any human disturbance for 3 days following treatment. Always wear rubber gloves when handling zinc phosphide-treated baits. Follow all label directions and observe warnings regarding bait storage and handling.

Apply prebait and bait during periods of settled weather, when vegetation is dry and dormant. Avoid baiting on wet, cold, or windy days. Bait acceptance is usually best after August 1st or when prairie dogs are observed feeding on native seeds and grains. Do not apply zinc phosphide to a prairie dog town more than once per year. If desired, survivors can be removed by fumigation or shooting. Treatment with toxic baits, followed by a fumigant cleanup, is most cost-effective for areas of more than 5 acres (2 ha).

Inspection and evaluation. Inspect treated prairie dog towns 2 to 3 days after treatment. Remove and burn or bury any dead prairie dogs that are aboveground to protect any other animals from indirect poisoning. Success rates of 75% to 85% can usually be obtained with zinc phosphide if it is applied correctly.

To evaluate the success of a treatment, mark and plug 100 burrows 3 days prior to treatment. Count the reopened burrows 24 hours later. Replug the same 100 burrows 3 days after treatment and again count the reopened burrows 24 hours later. Divide the number of reopened burrows (post-treatment) by the number of reopened burrows (pretreatment) to determine the survival rate. Abandoned burrows are usually filled with spider webs, vegetation, and debris. Active burrows are clean and surrounded by tracks, diggings, and fresh droppings at the entrances.

Zinc phosphide is a Restricted Use Pesticide, available for sale to and use by certified pesticide applicators or their designates. Contact your county extension office for information on acquiring EPA certification. Treatment of a prairie dog town with zinc phosphide-treated baits cost about $10 per acre ($25/ha) (includes materials and labor).

Fumigants

Fumigants, including aluminum phosphide tablets and gas cartridges, can provide satisfactory control of prairie dogs in some situations. We do not

recommend fumigation as the primary means of control for large numbers of prairie dogs because it is costly, time-consuming, and usually more hazardous to desirable wildlife species than toxic baits. Fumigants cost about 5 to 10 times more per acre (ha) to apply than toxic baits. Therefore, fumigation is usually used during spring as a follow-up to toxic bait treatment. Success rates of 85% to 95% can usually be obtained if fumigants are applied correctly.

For best results, apply fumigants in spring when soil moisture is high and soil temperature is greater than 60°F (15°C). Fumigation failures are most frequent in dry, porous soils. Spring applications are better than fall applications because all young prairie dogs are still in their natal burrows.

Do not use fumigants in burrows where nontarget species are thought to be present. Black-footed ferrets, burrowing owls, swift fox, cottontail rabbits, and several other species of wildlife occasionally inhabit prairie dog burrows and would likely be killed by fumigation. Be aware of sign and avoid fumigating burrows that are occupied by nontarget wildlife. Some manufacturers' labels now require private applicators to conduct black-footed ferret surveys before application. Detailed information on identifying black-footed ferrets and their sign is included in Appendix A of this chapter. Burrows used by burrowing owls often have feathers, pellets, and whitewash nearby. Natal burrows are often lined with finely shredded cow manure. Migratory burrowing owls usually arrive in the central Great Plains in late April and leave in early October. Fumigate before late April to minimize the threat to burrowing owls.

Aluminum Phosphide. Aluminum phosphide is a Restricted Use Pesticide, registered as a fumigant for the control of burrowing rodents. The tablets react with moisture in prairie dog burrows, and release toxic phosphine gas (PH_3). Use a 4-foot (1.2-m) section of 2-inch (5-cm) PVC pipe to improve placement of the tablets. Insert the pipe into a burrow and roll the tablets down the pipe. Place crumpled newspaper and/or a slice of sod in the burrow to prevent loose soil from smothering the tablets and tightly pack the burrow entrance with soil. To increase efficiency, work in pairs, one person dispensing and one plugging burrows.

Always wear cotton gloves while handling aluminum phosphide. Aim containers away from the face when opening and work into the wind to avoid inhaling phosphine gas from the container and the treated area. Aluminum phosphide should be stored in a well-ventilated area, never inside a vehicle or occupied building. Aluminum phosphide is classified as a flammable solid. Check with your local department of transportation for regulations regarding transportation of hazardous materials.

Aluminum phosphide can be purchased by certified pesticide applicators through national suppliers (see **Supplies and Materials**) or local retail distributors. It typically provides an 85% to 95% reduction in prairie dog populations when applied correctly and costs about $25 per acre ($63/ha) to apply. It is typically more cost-effective to use than gas cartridges because of the reduced handling time.

Gas Cartridges. Gas cartridges have been used for many years to control prairie dogs. When ignited, they burn and produce carbon monoxide, carbon dioxide, and other gases. To prepare a gas cartridge for use, insert a nail or small screwdriver in the end at marked points and stir the contents before inserting and lighting the fuse. Hold the cartridge away from you until it starts burning, then place it deep in a burrow. Burrows should be plugged immediately in the same way as with aluminum phosphide. Be careful when using gas cartridges because they can cause severe burns. Do not use them near flammable materials or inside buildings. Gas cartridges are a General Use Pesticide, available through USDA-APHIS-ADC. They provide up to 95% control when applied correctly and cost about $35 per acre ($88/ha) to apply.

Trapping

Cage traps can be used to capture individual animals, but the process is typically too expensive and time consuming to be employed for prairie dog control. Best results are obtained by trapping in early spring after snowmelt and before pasture green up. Bait traps with oats flavored with corn oil or anise oil.

It may be difficult to find release sites for prairie dogs. Releasing prairie dogs into an established colony will increase stress on resident and released prairie dogs.

Body-gripping traps, such as the Conibear® No. 110, are effective when placed in burrow entrances. No. 1 Gregerson snares can be used to remove a few prairie dogs, but the snares are usually rendered useless after each catch. Prairie dogs also can be snared by hand, using twine or monofilament line. These traps and snares may be effective for 1- to 5-acre (0.4- to 2-ha) colonies where time is not a consideration.

Shooting

Shooting is very selective and not hazardous to nontarget wildlife. It is most effective in spring because it can disrupt prairie dog breeding. Continuous shooting can remove 65% of the population during the year, but it usually is not practical or cost-effective. Prairie dogs often become wary and gun-shy after extended periods of shooting. They can be conditioned to loud noises by installing a propane cannon or old, mis-timed gasoline engine in the town for 3 to 4 days before shooting.

Long range, flat trajectory rifles are the most efficient for shooting prairie dogs. Rifles of .22 caliber or slightly larger are most commonly used. Bipods and portable shooting benches, telescopic sights, and spotting scopes are also useful equipment for efficient shooting. Contact a local extension office or state wildlife agency for lists of shooters and receptive landowners.

Other Methods

An amazing variety of home remedies have been tried in desperate attempts to control prairie dogs. Engine

exhaust, dry ice, butane, propane, gasoline, anhydrous ammonia, insecticides, nonregistered rodenticides, water, and dilute cement are all unregistered for prairie dog control. None have proven to be as cost-effective or successful as registered rodenticides, and most are hazardous to applicators and/or nontarget species. In addition, those methods that have been observed by the authors (exhaust, propane, ammonia, nonregistered rodenticides, and water) were substantially more expensive than registered and recommended methods.

A modified street sweeper vacuum has recently been used to suck prairie dogs out of their burrows. Inventor Gay Balfour of Cortez, Colorado, reports that the "Sucker Upper" can typically clear a range of 5 to 20 acres (2 to 8 ha) per day at a cost of $1,000 per day, not including travel expenses. This device, unfortunately, has not been independently tested. Although relatively expensive, this method may provide a nonlethal approach to dealing with prairie dogs where conventional methods are not appropriate or acceptable. The prairie dogs can either be euthanized with carbon dioxide gas or relocated if a suitable site can be found.

Integrated Pest Management

An integrated pest management approach dictates the timely use of a variety of cost-effective management options to reduce prairie dog damage to a tolerable level. We recommend the application of toxic bait in the fall, followed by the application of aluminum phosphide in the spring. If possible, defer grazing on the treated area during the next growing season to allow grasses and other vegetation to recover. A computer program was produced by Cox and Hygnstrom in 1993 to determine cost-effective options and economic returns of prairie dog control (see For Additional Information).

Economics of Damage and Control

Prairie dogs play an important role in the prairie ecosystem by creating islands of unique habitat that increase plant and animal diversity. Prairie dogs are a source of food for several predators and their burrows provide homes for several species, including the endangered black-footed ferret. Burrowing mixes soil types and incorporates organic matter, both of which may benefit soil. It also increases soil aeration and decreases compaction. Prairie dogs provide recreational opportunities for nature observers, photographers, and shooters. The presence of large, healthy prairie dog towns, however, is not always compatible with agriculture and other human land-use interests.

Prairie dogs feed on many of the same grasses and forbs that livestock do. Annual dietary overlap has been estimated from 64% to 90%. One cow and calf ingest about 900 pounds (485 kg) of forage per month during the summer (1 AUM). One prairie dog eats about 8 pounds (17.6 kg) of forage per month during the summer. At a conservative population density of 25 prairie dogs per acre (60/ha) and dietary overlap of 75%, it takes 6 acres (2.4/ha) of prairie dogs to equal 1 AUM. Small, rather widely dispersed colonies occupying 20 acres (8 ha) or less are tolerated by many landowners because of the sport hunting and aesthetic opportunities they provide. Colonies that grow larger than 20 acres (8 ha) often exceed tolerance levels because of lost AUMs, taxes, and increasing control costs.

The South Dakota Department of Agriculture (1981) reported that 730,000 acres (292,000 ha) were inhabited by prairie dogs in 1980, with a loss of $9,570,000 in production. The South Dakota livestock grazing industry similarly estimated losses of up to $10.29 per acre ($25.43/ha) on pasture and rangeland inhabited by prairie dogs and $30.00 per acre ($74.10/ha) for occupied hay land. Prairie dogs inhabited about 73,000 acres (29,200 ha) in Nebraska in 1987, with a loss estimated at $200,000. A reported 1/2 to 1 million acres (200,000 to 400,000 ha) are occupied in Colorado. A committee of the National Academy of Sciences (1970) concluded that "the numerous eradication campaigns against prairie dogs and other small mammals were formerly justified because of safety for human health and conflicts with livestock for forage."

On the other hand, Collins et al. (1984) found it was not economically feasible to treat prairie dogs on shortgrass rangeland with zinc phosphide in South Dakota because the annual control costs exceeded the value of forage gained. Seventeen acres (6.8 ha) would have to be treated to gain 1 AUM. Uresk (1985) reported that South Dakota prairie dog towns treated with zinc phosphide yielded no increase in production after 4 years. The cost-effectiveness of prairie dog control depends greatly on the age, density, and size of the prairie dog colony; soil and grassland type; rainfall; and control method employed.

Acknowledgments

We acknowledge M. J. Boddicker and F. R. Henderson, who authored the "Prairie Dogs" and "Black-footed Ferrets" chapters, respectively, in the 1983 edition of *Prevention and Control of Wildlife Damage.*

Figure 1 by Emily Oseas Routman.

Figure 2 by Dave Thornhill, University of Nebraska.

Figure 3 by Renee Lanik, University of Nebraska.

For Additional Information

Agnew, W., D. W. Uresk, and R. M. Hansen. 1986. Flora and fauna associated with prairie dog colonies and adjacent ungrazed mixed-grass prairie in western South Dakota. J. Range. Manage. 39:135-139.

Bonham, C.D., and A. Lerwick. 1976. Vegetation changes induced by prairie dogs on shortgrass range. J. Range Manage. 29:217-220.

Cable, K. A., and R. M. Timm. 1988. Efficacy of deferred grazing in reducing prairie dog reinfestation rates. Proc. Great Plains Wildl. Damage Control Workshop 8:46-49.

Cincotta, R. P., D. W. Uresk, and R. M. Hansen. 1987. Demography of black-tailed prairie dog populations reoccupying sites treated with rodenticide. Great Basin Nat. 47:339-343.

Clark, T. W. 1986. Annotated prairie dog bibliography 1973 to 1985. Montana Bureau Land Manage. Tech. Bull. No. 1. Helena. 32 pp.

Clark, T. W., T. M. Campbell, III, M. H. Schroeder, and L. Richardson. 1983. Handbook of methods for locating black-footed ferrets. Wyoming Bureau Land Manage. Tech. Bull. No. 1. Cheyenne. 55 pp.

Committee. 1970. Vertebrate Pests: Problems and Control. Natl. Acad. of Science. Washington, DC. 153 pp.

Collins, A. R., J. P. Workman, and D. W. Uresk. 1984. An economic analysis of black-tailed prairie dog (*Cynomys ludovicianus*) control. J. Range Manage. 37:358-361.

Cox, M. K., and S. E. Hygnstrom. 1991. Prairie dog control: a computer model for prairie dog management on rangelands. Proc. Great Plains Wildl. Damage Control Workshop 10:68-69.

Dobbs, T. L. 1984. Economic losses due to prairie dogs in South Dakota. South Dakota Dep. Agric. Div. Agric. Regs. Inspect. Pierre. 15 pp.

Fagerstone, K. A. 1982. A review of prairie dog diet and its variability among animals and colonies. Proc. Great Plains Wildl. Damage Control Workshop 5:178-184.

Franklin, W. L., and M. G. Garrett. 1989. Nonlethal control of prairie dog colony expansion with visual barriers. Wildl. Soc. Bull. 17:426-430.

Foster-McDonald, N. S., and S. E. Hygnstrom. 1990. Prairie dogs and their ecosystem. Univ. Nebraska. Dep. For., Fish. Wildl. Lincoln. 8 pp.

Hansen, R. M., and I. Gold. 1977. Blacktail prairie dogs, desert cottontails and cattle trophic relations on shortgrass range. J. Range Manage. 30:210-214.

Hygnstrom, S. E., and P. M. McDonald. 1989. Efficacy of three formulations of zinc phosphide for black-tailed prairie dog control. Proc. Great Plains Wildl. Damage Control Workshop 9:181.

Hygnstrom, S. E., and D. R. Virchow. 1988. Prairie dogs and their control. Univ. Nebraska-Coop. Ext. NebGuide No. C80-519. Lincoln. 4 pp.

Knowls, C. J. 1986. Population recovery of black tailed prairie dogs following control with zinc phosphide. J. Range Manage. 39:249-251.

Koford, C. B. 1958. Prairie dogs, whitefaces and blue grama. Wildl. Mono. 3:1-78.

Merriam, C. H. 1902. The prairie dog of the Great Plains. Pages 257-270 *in* Yearbook of the USDA. US Govt. Print. Office. Washington, DC.

O'Meilia, M. E., F. L. Knopf, and J. C. Lewis. 1982. Some consequences of competition between prairie dogs and beef cattle. J. Range Manage. 35:580-585.

Schenbeck, G. L. 1981. Management of black-tailed prairie dogs on the National Grasslands. Proc. Great Plains Wildl. Damage Control Workshop 5:207-213.

Sharps, J. C., and D. W. Uresk. 1990. Ecological review of black-tailed prairie dogs and associated species in western South Dakota. Great Basin Nat. 50:339-345.

Snell, C. P., and B. D. Hlavachick. 1980. Control of prairie dogs - the easy way. Rangelands 2:239-240.

South Dakota Department of Agriculture. 1981. Vertebrate rodent economic loss, South Dakota 1980. US Dep. Agric. Stat. Rep. Serv. Sioux Falls. 4 pp.

Uresk, D. W. 1985. Effects of controlling black-tailed prairie dogs on plant production. J. Range Manage. 38:466-468.

Uresk, D. W. 1987. Relation of black-tailed prairie dogs and control programs to vegetation, livestock, and wildlife. Pages 312-322 *in* J. L. Caperinera, ed. Integrated pest management on rangeland: a shortgrass prairie perspective. Westview Press. Boulder, Colorado.

Uresk, D. W., J. G. MacCracken, and A. J. Bjugstad. 1982. Prairie dog density and cattle grazing relationships. Great Plains Wildl. Damage Control Workshop. 5:199-201.

Whicker, A. D., and J. K. Detling. 1988. Ecological consequences of prairie dog disturbances. BioSci. 38:778-785.

Computer Software

Cox, M. K., and S. E. Hygnstrom. 1993. Prairie dog control: An educational guide, population model, and cost-benefit analysis for prairie dog control. Available from 105 ACB IANR-CCS, University of Nebraska, Lincoln, NE 68583-0918.

Appendix A

BLACK-FOOTED FERRETS

Fig. 4. Black-footed ferret, *Mustela nigripes*

Introduction

The black-footed ferret (*Mustela nigripes,* Fig. 4) is the most rare and endangered mammal in North America. Black-footed ferrets establish their dens in prairie dog burrows and feed almost exclusively on prairie dogs. The reduction in prairie dog numbers in the last 100 years and the isolation and disappearance of many large towns has led to the decline of the ferret population. Large and healthy prairie dog towns are needed to ensure that black-footed ferrets survive in the wild.

Identification

Black-footed ferrets are members of the weasel family and are the only ferret native to North America. The most obvious distinguishing feature is the striking black mask across the face. The feet, legs, and tip of the tail are

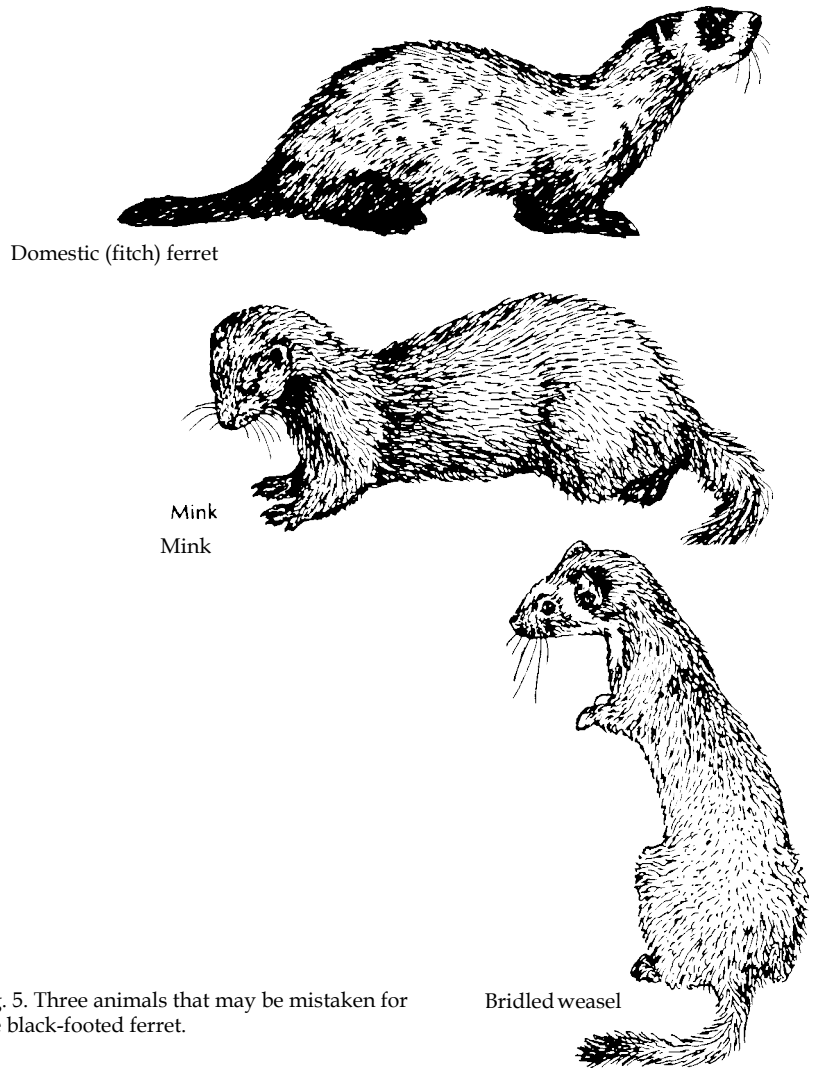


Fig. 5. Three animals that may be mistaken for the black-footed ferret.

also black. The remaining coat is pale yellow-brown, becoming lighter on the under parts of the body and nearly white on the forehead, muzzle, and throat. The top of the head and middle of the back are a darker brown. Ferrets have short legs, long, well-developed claws on the front paws, large pointed ears, and relatively large eyes.

Ferrets are similar in size and weight to wild mink. Adult male ferrets are 21 to 23 inches (53.3 to 58.4 cm) long and weigh 2 to 2 1/2 pounds (0.9 to 1.2 kg). Females are slightly smaller.

The native black-footed ferret may be confused with the domestic European fitch ferret, long-tailed weasel, bridled weasel, or wild mink (Fig. 5). The domestic fitch ferret has longer and darker pelage on the back, yellowish underfur, and an entirely black tail. The bridled weasel is a variant of the longtail weasel. It occurs in southwest Kansas, parts of Oklahoma, Texas, and New Mexico. The bridled weasel has a mask or dark markings on its face, but is smaller than a black-footed ferret. It does not have black feet, and it has a tail that is longer in relation to its total body length. Mink are about the same size as black-footed ferrets but are dark brown and occasionally have white markings on the throat.

Range

The original range of the black-footed ferret included most of the Great Plains area. Its current range within the Great Plains is unknown, although it is assumed to be greatly reduced from the original range. Currently the only known wild ferret population is an experimental population that has been released in north-central Wyoming. For the past 10 years, biologists have intensively searched for and investigated hundreds of reports of black-footed ferrets, but no new populations have been found. In addition, a public reward of $5,000 to $10,000 was available during the 1980s for sightings of black-footed ferrets, but none were confirmed. Current efforts are being made to identify black-footed ferret habitat and potential reproduction sites. Captive breeding populations are held at Wheatland, Wyoming, at the Wyoming Game and Fish Department's Sybille Conservation and Education Center, and at zoos in Omaha, Nebraska; Washington, DC; Louisville, Kentucky; Colorado Springs, Colorado; Phoenix, Arizona; and Toronto, Ontario.

Habitat

Black-footed ferrets rely on prairie dogs for both food and shelter. Therefore, all active prairie dog colonies are considered potential black-footed ferret habitat. Resident ferrets have only been found in prairie dog towns. Transient and dispersing ferrets may cross areas that are not occupied by prairie dogs.

General Biology, Reproduction, and Behavior

Normally 4 young ferrets are born per litter in May and June. The mother alone cares for the young and directs their activities until they disperse in mid-September. The young are first observed aboveground during daylight hours in July.

From June to mid-July, the ferret family remains in the same general area of the prairie dog town. Around the middle of July, after the young are active aboveground at night, the family extends its area of activity. By the middle of July the young ferrets are weaned at nearly one-half adult size.

By early August, the mother ferret separates the young and places them in different burrows. At this time some

of the young occasionally hunt at night by themselves. By mid-August, they can be seen during daylight hours, peering out of their burrow, playing near the entrance, and sometimes following the adult female.

By late August or early September, when the young are as large as the adult, the ferret family starts to disperse and is no longer seen as a closely knit group. The young ferrets are solitary during the late fall, winter, and early spring. In December, ferrets become active just after sunset and are active at least until midnight.

Legal Status

The black-footed ferret is classified as an endangered species and receives full protection under the Federal Endangered Species Act of 1973 (PL 93-205). The act, as amended, requires federal agencies to ensure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of a threatened or endangered species or their habitat. Regulations implementing Section 7 of the act require that federal agencies determine if any actions they propose "may affect" any threatened or endangered species. If it is determined that a proposed action "may affect," then the agency is required to request formal Section 7 consultation with the US Fish and Wildlife Service. Section 9 of the act prohibits any person (including the federal government) from the "taking" of a listed species. The term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, capture, or collect, or to attempt to engage in any such conduct. Habitat destruction constitutes the taking of a listed species.

Guidelines for black-footed ferret searches have been developed by the US Fish and Wildlife Service (Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act, 1989). Federal agencies are required by the US Fish and Wildlife Service to conduct black-footed ferret surveys if their proposed actions may affect ferrets or their habitat. Although encouraged to do so, private landowners and applicators are not required by law to conduct surveys unless their activities are associated with federal programs or if they are specifically directed by pesticide labels. Compliance with or disregard for black-footed ferret survey guidelines does not, of itself, show compliance with or violation of the Endangered Species Act or any derived regulations.

Guidelines for Black-footed Ferret Surveys

Any actions that kill prairie dogs or alter their habitat could prove detrimental to ferrets occupying affected prairie dog towns. The US Fish and Wildlife Service guidelines should assist agencies or their authorized representatives in designing surveys to "clear" prairie dog towns prior to initiation of construction projects, prairie dog control projects, or other actions that affect prairie dogs. If these guidelines are followed by individuals conducting black-footed ferret surveys, agency personnel can be reasonably confident in results that indicate black-footed ferrets are not occupying a proposed project area.

Delineation of Survey Areas. Until the time that wildlife agencies are able to identify reintroduction areas and to classify other areas as being free of ferrets, surveys for black-footed ferrets will usually be recommended. During this interim period the following approach is recommended to determine where surveys are needed.

A black-tailed prairie dog town or complex of less than 80 acres (32 ha) having no neighboring prairie dog towns may be developed or treated without a ferret survey. A neighboring prairie dog town is defined as one less than 4.3 miles (7 km) from the nearest edge of the town being affected by a project.

Black-tailed prairie dog towns or complexes greater than 80 acres (32 ha) but less than 1,000 acres (400 ha) may be cleared after a survey for black-footed ferrets has been completed, provided that no ferrets or ferret sign have been found.

A white-tailed prairie dog town or complex of less than 200 acres (81 ha) having no neighboring prairie dog towns may be cleared without a ferret survey. White-tailed prairie dog towns or complexes greater than 200 acres (81 ha) but less than 1,000 acres (400 ha), may be cleared after completion of a survey for black-footed ferrets, provided that no ferrets or their sign were found during the survey.

Contact the US Fish and Wildlife Service before any federally funded or permitted activities are conducted on black-tailed or white-tailed prairie dog towns or complexes greater than 1,000 acres, to determine the status of the area for future black-footed ferret reintroductions.

Defining a Prairie Dog Town/ Complex

For the purpose of this document a prairie dog town is defined as a group of prairie dog holes in which the density meets or exceeds 20 burrows per hectare (8 burrows/acre). Prairie dog holes need not be active to be counted but they should be recognizable and intact; that is, not caved in or filled with debris. A prairie dog complex consists of two or more neighboring prairie dog towns, each less than 4.3 miles (7 km) from the other.

Timing of Surveys

The US Fish and WIldlife Service recommends that surveys for black-footed ferrets be conducted as close to the initiation of a project construction date as possible but not more than 1 year before the start of a proposed action. This is recommended to minimize the chance that a ferret might move into an area during the period between completion of a survey and the start of a project.

Project Type

Construction projects (buildings, facilities, surface coal mines, transmission lines, major roadways, large pipelines, impoundments) that permanently alter prairie dog towns should be surveyed. Projects of a temporary nature and those that involve only minor disturbances (fences, some power lines,

underground cables) may be exempted from surveys when project activities are proposed on small prairie dog towns or complexes of less than 1,000 acres (400 ha), do not impact those areas where ferret sightings have been frequently reported, or occur on areas where no confirmed sightings have been made in the last 10 years.

The US Fish and Wildlife Service recommends that before any action involving the use of a toxicant in or near a prairie dog town begins, a survey for ferrets should be conducted. If toxicants or fumigants are to be used, and the town proposed for treatment is in a complex of less than 1,000 acres (400 ha), the town should be surveyed using the nocturnal survey technique 30 days or less before treatment. Prairie dog towns or complexes greater than 1,000 acres (400 ha) should not be poisoned without first contacting your local US Fish and Wildlife Service office.

Survey Methods

Method 1 **—** Daylight surveys for ferrets are recommended if surveys are conducted between December 1 and March 31. This type of survey is used to locate signs left by ferrets. During winter months, ferret scats, prairie dog skulls, and diggings are more abundant because prairie dogs are less active and less likely to disturb or destroy ferret sign. When there is snow cover, both ferret tracks and fresh diggings are more obvious and detectable.

Daylight searches for ferret sign should meet the following criteria to fulfill the minimum standards of these guidelines:

1. Three searches must be made on each town. Conduct each search when fresh snow has been present for at least 24 hours and after 10 or more days have passed between each search period.
2. Vehicles driven at less than 5 miles per hour (8.3 km/hr) may be used to search for tracks or ferret diggings, but complete visual inspections of each part of the town being surveyed is required (that is, visually overlapping transects).
3. If ferret sign is observed, photograph the sign and make drawings and measurements of diggings before contacting the US Fish and Wildlife Service and state wildlife agency.

Method 2 **—** Nighttime surveys involve the use of spotlighting techniques for locating ferrets. This survey method is designed to locate ferrets when the maximum population and the longest periods of ferret activity are expected to occur.

Minimum standards should be followed as recommended below:

1. Conduct surveys between July 1 and October 31.
2. Continuously survey the prairie dog town using spotlights. Begin surveys at dusk and continue until dawn on each of at least 3 consecutive nights. Divide large prairie dog colonies into tracts of 320 acres (130 ha) and search each tract systematically throughout 3 consecutive nights. Rough uneven terrain and tall dense vegetation may require smaller tracts to result in effective coverage of a town.
3. Begin observations on each prairie dog town or tract at a different starting point on each successive night to maximize the chance of overlapping nighttime activity periods of ferrets.
4. A survey crew should consist of one vehicle and two observers equipped with two 200,000 to 300,000 candlepower (lumen) spotlights. In terrain not suitable for vehicles, a crew should consist of two individuals working on foot with battery-powered 200,000 to 300,000 candlepower (lumen) spotlights. To estimate the number of crew nights for a survey, divide the total area of prairie dog town to be surveyed by 320 acres (130 km) and multiply by 3. One or both of the observers in each survey crew should be a biologist trained in ferret search techniques.

Additional information on data collection, reporting, and training workshops are included in *Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act, 1989*, available from the US Fish and Wildlife Service.

Black-footed Ferret Sign

To determine if black-footed ferrets are living in a given area, some sign must be found or a ferret observed. Evidence such as tracks, diggings, or droppings is uncommon, even where ferrets occur. They are secretive, nocturnal, and inactive for long periods of time, and therefore are very seldom seen by people.

Prairie dogs compact the soil around their burrows, making it difficult to find ferret tracks. Most ferret tracks are observed when snow covers the ground. The average distance between each "twin print" track in the normal bounding gait is 12 to 16 inches (30.5 to 40.6 cm) (Fig. 6). The track of a ferret is very similar to that of a mink or weasel. In Wyoming, ferrets are most active between December and early March, sometimes covering up to 5 miles (8 km) per night. Scent marks, scrapes, and scratches in the snow may be noticeable. Ferret droppings are rarely found above ground. They are long and thin, taper on both ends, and consist almost entirely of prairie dog hair and bones.

Ferrets sometimes form "trenches" or "ramps" when they excavate prairie dog burrows. Prairie dogs occasionally plug the entrances to their burrow systems with soil. When excavating such a plug in a burrow, the ferret backs out with the soil held against its chest with its front paws. It generally comes out of the burrow in the same path each time. This usually occurs when snow covers the ground. After repeated trips, a ramp from 3 to 5 inches (7.6 to 12.7 cm) wide and from 1 to 9 feet (0.3 to 2.7m) long is formed (Fig. 7). Badgers, foxes, and weasels occasionally form similar ramps.

Prairie dogs generally deposit excavated soil around the burrow entrance to form a mound, building it higher by

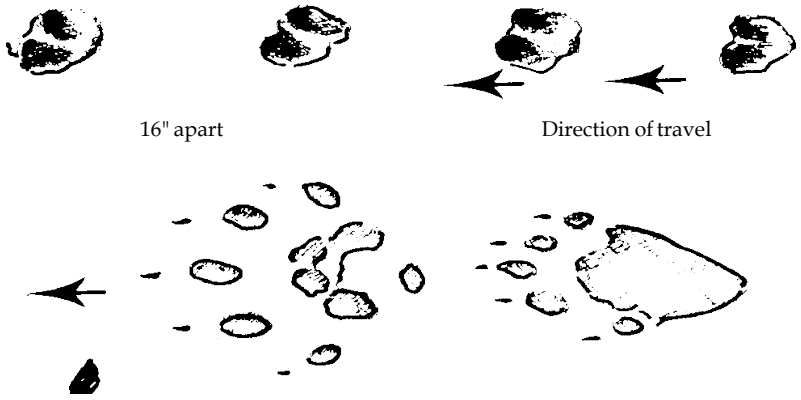


Fig. 6. Black-footed ferret tracks left in the snow.

Fig. 7. Ramp made by a black-footed ferret excavating a prairie dog burrow.

adding soil from outside the mound. The movement of soil toward the mound is in the opposite direction of that done by a ferret.

Ferrets sometimes dig in fresh snow. These "snow trenches" are narrow trough-like depressions in the snow that extend away from prairie dog burrow entrances. Snow trenches are relatively rare compared to trenches in the soil.

If you observe a black-footed ferret or identify ferret sign while conducting surveys, notify your local US Fish and Wildlife Service or state wildlife representative within 24 hours.

Acknowledgments

Figures 4 and 5 by Emily Oseas Routman.

Figure 6 courtesy of Thomas M. Campbell III, Biota Research and Consulting Service.

Figure 7 courtesy of Walt Kittams.

For Additional Information

Biggins, P.E., and R.A. Crete. 1989. Black-footed ferret recovery. Proc. Great Plains Wildl. Damage Control Workshop 9:59-63.

Clark, T.W., T.M. Campbell, III, M.H. Schroeder, and L. Richardson. 1984. Handbook of methods for location of black-footed ferrets. Wyoming BLM Wildl. Tech. Bull. No. 1. US Bureau Land Manage., in coop. with Wyoming Game Fish Comm. Cheyenne. 47 pp.

Hall, E.R. 1981. The mammals of North America. John Wiley and Sons, New York. 1181 pp.

Hillman, C.N. 1968. Field observations of black-footed ferrets in South Dakota. Trans. North Am. Wildl. Nat. Resour. Conf. 33:346-349.

Hillman, C.N. 1974. Status of the black-footed ferret. Pages 75-81 *in* Proc. symp. endangered and threatened species of North America. Wild Canid Survival Res. Center. St. Louis, Missouri.

Hillman, C.N., and T.W. Clark. 1980. *Mustela nigripes*. Mammal. Species 126:1-3.

Hillman, C.N., and R.L. Linder. 1973. The black-footed ferret. Pages 10-23 *in* R. L. Linder and C. N. Hillman, eds. Proc. black-footed ferret and prairie dog workshop. South Dakota State Univ., Brookings.

Sheets, R.C., R.L. Linder, and R.B. Dahlgren. 1972. Food habits of two litters of black-footed ferrets in South Dakota. Am. Midl. Nat. 87:249-251.

US Fish and Wildlife Service. 1988. Black-footed ferret recovery plan. US Fish Wildl. Serv., Denver, Colorado. 154 pp.

US Fish and Wildlife Service. 1989. Black-footed ferret survey guidelines for compliance with the endangered species act. US Fish Wildl. Serv. Denver, Colorado, 15 pp.

Editors
Scott E. Hygnstrom
Robert M. Timm
Gary E. Larson