

Free-ranging and Feral Cats

Alex Dutcher
Hallux Ecosystem Restoration, LLC

Kyle Pias
Hallux Ecosystem Restoration, LLC

Grant Sizemore
American Bird Conservancy

Stephen M. Vantassel
Wildlife Control Consultant, LLC



Figure 1. Free-ranging and feral cats impact native wildlife through predation, competition, and spread of disease.

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Human-Wildlife Conflicts

Domestic cats (*Felis catus*) are a common household pet in the United States, with an estimated 25.4% of households owning cats (American Veterinary Medical Association 2018). While an increasing number of cat owners keep their pet cats exclusively indoors, a portion of society maintains that domestic cats are entitled to a free-ranging lifestyle and may even consider unowned domestic cats to be wildlife. Although wildlife managers recognize the beliefs of many concerned

stakeholders, including advocates who use strong emotional appeals on behalf of cats, it remains that free-ranging and feral domestic cats are an invasive species spread by humans (Lowe et al. 2000) (Figure 1).

For the purpose of this publication, a free-ranging cat is any cat that spends time unrestrained outdoors regardless of ownership status. The term “feral cat” is a type of free-ranging cat, but one which is

unowned, has limited or no interaction with people, and frequently avoids or exhibits aggressive behavior toward people.

Free-ranging cats are associated with a number of sociological and ecological conflicts. They impact people directly through the spread of parasites and diseases, damage to gardens and property, and noise nuisances. Cats also cause conflict through their direct and indirect impacts on native wildlife through predation, competition, spread of disease, and impacts on species survival (e.g., nest failure, injury, behavioral changes).

Removing free-ranging cats is the most effective strategy for addressing cat-caused damage. Such removals could include adoption, placement in a long-term holding facility (e.g., cat sanctuary), or euthanasia. Owned cats should be kept indoors or otherwise under their owner's control.

Wildlife

Up to 164 million cats reside in the United States, of which an estimated 30 to 80 million are unowned (Loss et al. 2013) (Figure 2). A large portion of owned cats are also free-ranging (Loss et al. 2013). The threat which free-ranging cats pose to native wildlife



Figure 2. There are approximately 30 to 80 million unowned cats in the United States.

cannot be understated. Proponents of free-ranging cats on the landscape argue that predation by such cats on wildlife is negligible when compared to other sources of mortality, however many studies have shown that cats are a major, if not the greatest, source of mortality to native birds, mammals, reptiles, and amphibians (Lepczyk et al. 2003; Beckerman et al. 2007; Van Heezik 2010; Lloyd et al. 2013; Loss et al. 2013 and 2015; Woinarski et al. 2017 and 2018; Li et al. 2021). While loss of habitat is the primary cause of species extinctions, cats have contributed to the extinction of at least 63 species in the wild around the world (Doherty et al. 2016). In addition to direct predation, cats impact species survival through nest failure, injury, and behavioral changes, such as reduced feeding opportunities due to harassment (Beckerman et al. 2007; Bonnington et al. 2013).

A wildlife rehabilitation facility in California reported that a third of all birds requiring treatment (36 species) sustained cat-related injuries, and one in Virginia found that, across ten years, cat interactions caused 13.7% of bird admissions and caused 80.8% of bird mortalities (Jessup 2004, Mrcuer et al. 2017). An analysis of data from 82 rehabilitation centers across North America found that cats were responsible for 52% of bird intake, and 78% of those cat-related admissions died or had to be euthanized (Lloyd et al. 2017).

In California, 67% of rodents, 95% of birds, and 100% of lizards brought home by cats were native species, and native birds were twice as likely to be seen in areas without cats (Crooks and Soule 1999). House mice (*Mus musculus*; an invasive species) were more abundant and native rodents less abundant in areas with cats (Hawkins et al. 2004). Cats also take common game birds, such as pheasants, native quail, grouse, turkeys (*Meleagris gallopavo*), and waterfowl, causing not only ecological but also economic harm.

Cats sometimes kill invasive species, such as pigeons (*Columba livia*), house mice, Norway rats (*Rattus norvegicus*), and European starlings (*Sturnus vulgaris*), but research indicates cats are not effective in controlling invasive species populations (Parsons et al. 2018).

In areas with feral cat colonies, cat “feeding stations” often attract local wildlife, such as raccoons (*Procyon lotor*) and coyotes (*Canis latrans*) (Hernandez et al. 2018). These animals may become habituated to people and aggressive toward food resources left by people for the cats, leading to more conflicts.

Human Health and Safety

Free-ranging and feral cats pose risks to public health and safety. They are the most common vectors of rabies in domestic animals, and it is unclear how many free-ranging cats are currently vaccinated for rabies and other diseases (Blanton et al 2007). Cats can transmit several other diseases and parasites to people including cat scratch fever (Bartonellosis), plague, ringworm, hookworm, salmonellosis, leptospirosis, and toxoplasmosis (Dubey et al. 2002; Bowman et al. 2010; Dabritz and Conrad 2010; Gerhold and Jessup 2013; Lepczyk et al. 2015; McGregor et al. 2015; Palerme et al. 2018; Chalkowski et al. 2019).

Cats are a definitive host species of the parasite *Toxoplasma gondii* which causes toxoplasmosis. Consequences of *T. gondii* infection in people, wildlife, and livestock vary but may include behavioral changes, blindness, and even death (McAllister 2005; Aguirre et al. 2019; Stelzer et al. 2019). Pregnant or immunocompromised people are particularly at risk.

A single cat may excrete in its feces hundreds of millions of infectious *T. gondii* oocysts into the environment where any bird or mammal (intermediate host) may ingest or inhale them and become infected (Aguirre et al. 2019). Oocysts may then spread among intermediate hosts or back to a definitive host by the consumption of infected tissues. High percentages of free-ranging cats (9 to 80%) tested seropositive for *T. gondii* in the United States, meaning that they have been exposed and potentially shed oocysts (Dabritz and Conrad 2010).

Livestock and Pets

Free-ranging and feral cats can contract and spread a wide variety of diseases, such as feline immunodeficiency virus (FIV or feline AIDS), feline leukemia virus (FeLV), feline

panleukopenia virus (FPV), rabies, and distemper, to other domesticated animals. These diseases are highly contagious and transmitted through body fluids and direct contact.

Any cat that spends time outside is also at risk for contracting and spreading various parasites to livestock and pets. For example, outdoor cats have been implicated in the spread of plague and typhus via the proliferation of fleas (Abbott and Rocke 2012; Anstead 2021).

Cats also impact livestock directly by preying on free-ranging chickens and other domestic fowl (Borroto-Páez and Pérez 2018).

Property and Nuisance Issues

Free-ranging and feral cats often use abandoned structures, including barns, sheds, warehouses, and homes as shelter and denning sites. Cats can fit into any hole that their head can fit through, so holes 3 inches in diameter or larger should be sealed to prevent entry. Cats can easily scale and jump over most fences. Only roll-top or predator-proof fences can keep cats out.

Cats can be a major nuisance in residential areas. Unneutered male cats may spray urine on car tires, houses, landscaping, fences, shoes, and other items left outside. Cats prefer loose soil for their latrines, making sandboxes, flowerbeds, and vegetable gardens a popular spot for cats to dig up and urinate and defecate around (Figure 3).

Unneutered male cats fight for territory and mates, yowling loudly late at night. During reproductive periods, female cats will also yowl. These disturbances can be a nuisance as they can keep people awake late into the night.

Unregulated feral cat colonies are often established at county and city parks (e.g., Castillo and Clarke 2003) which puts county and city administrations at risk of litigation if an unsuspecting park patron were scratched or bitten. Wherever concentrations of free-ranging cats are found, the public may feel justified releasing their unwanted pets or stray cats, assuming that they will be cared for by someone else.

Damage Identification

The ability to detect feral cats is dependent upon the environment, cat population density, and the level of socialization of the cats. For example, in areas where cats are fed and used to people being around, they might directly approach people or be easily seen on the landscape. In more remote wilderness areas, feral cats may be extremely difficult to detect. Cats in these areas are more secretive and rarely, if ever, seen. Detection relies almost entirely on the use of remote sensing devices, such as game cameras, or identifying sign and tracks. Hair snares treated with cat urine may be used to monitor for cat presence, however hairs may be difficult to distinguish from other species without microscopic or DNA analysis (Triggs and Brunner 2002; Hanke and Dickman 2013).

It should be noted that even in areas with high densities of sociable cats, there will likely be individual cats that are not easily seen and avoid people, coming out to feed only after people have left the area. For this reason, game cameras should be used to conduct population assessments instead of simple visual counts of individuals.

Carcasses of animals killed by domestic cats vary in condition based upon the taxon of the animal, its size, and whether the cat was hungry. If hungry, cats may eat whole

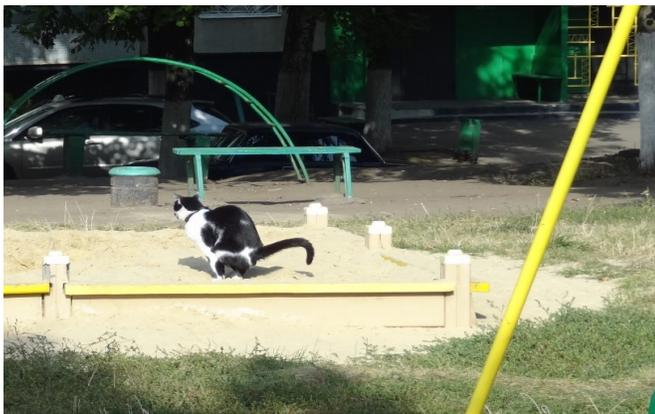


Figure 3. Cats prefer loose soil for their latrines, making sandboxes, flowerbeds, and vegetable gardens a popular spot for cats to dig up and urinate and defecate around.

small animals, such as invertebrates, small rodents (mouse-sized or smaller), reptiles, and amphibians. Small birds may be eaten whole, usually after feathers are plucked from the body. It is not uncommon to find a scattering or pile of body feathers where a cat has killed a small bird but no carcass. Uneaten small birds may also have their feathers removed by the cat (Figure 4).

Smaller animals that have been killed, but not eaten, can be identified as cat kills by the puncture marks left from the cat's incisors. When eating medium-sized animals, such as rats, the gastrointestinal tract of the animal may be discarded by the cat prior to consumption. These gut piles are good indicators of the presence of a cat kill. In larger animals, such as medium- to large-sized birds, often the breast and neck muscles are eaten, some of the organs are eaten (heart, liver), and bones may exhibit chew marks. The animal will often be left chest-up where it was eaten.

Domestic cat feces have pointed ends, are sub-sectioned and can be similar in size to bobcat feces, but slightly smaller. Feces consistency will vary with diet.



Figure 4. Pigeon killed by cat. Notice plucked feathers near carcass.

Management Methods

Responsible and professional reduction or elimination of wildlife damage is the goal of wildlife damage management practitioners. This is best accomplished through an integrated approach. No single method is effective in every situation, and success is optimized when damage management is initiated early, consistently, and adaptively using a variety of methods. Because the legality of different methods varies by state, consult local laws and regulations prior to the implementation of any method.

Some of the best measures to prevent cat damage start with local or state legislative actions. Encourage municipalities to ban the feeding of free-ranging cats. Feeding of free-ranging cats increases local cat abundance and densities and encourages irresponsible owners to abandon their cats. Furthermore, encourage municipalities to enact and enforce ordinances that prevent cats from existing outdoors and unrestrained to begin with or contributing to growing cat populations (e.g., microchipping, sterilization laws). Additional laws, such as leash-laws, which restrict the free movement of pet cats outdoors will aid in limiting cat damage and the spread of disease, as well as protect the health and wellbeing of pet cats.

When cats are removed from large landscapes such as islands, managers should prepare for potential increases in rodent populations which could harm native species (Courchamp et al. 1999; Ortega et al. 2021). However, this should not be used as a reason to maintain cat populations. Non-native species can sustain cat populations when native prey are seasonally absent. One study on Le Levant Island in the Mediterranean showed that cats shifted their diets from non-native species (e.g., invasive rats) to migratory native bird species as soon as birds arrive at breeding sites (Bonnaud et al. 2012).

For a summary table of feral cat management methods, please see Appendix I.

Biological Control

Biological control is the use of a parasite or disease to reduce or eliminate an organism. No biological controls are available in the United States for use with feral cats. Feline panleukopenia virus (FPV) has been used successfully to eradicate cats on Marion Island in the Southern Indian Ocean (Bester et al. 2002). FPV is a disease caused by a type of parvovirus closely related to the parvovirus found in dogs. The virus is spread by direct contact with infected cats or indirectly by contact with contaminated items.

Deterrents

Deterrents attempt to reduce cat predation on wildlife by hindering a cat's ability to hunt. Sound deterrents, such as bells attached to collars, theoretically make it harder for cats to stalk their prey (Ruxton et al. 2002; Woods et al. 2003; Nelson et al. 2005; Gordon et al. 2010). Brightly colored collars or bibs attempt to decrease a cat's ability to hide and stalk its prey (Calver et al. 2007; Hall et al. 2015; Willson et al. 2015; Pemberton and Ruxton 2020). Other deterrent efforts seek to improve cats' diets and play experiences to satiate their hunting instinct (Cecchetti et al. 2021). Deterrents can help to reduce certain types of cat predation but do not eliminate all predation and fail to address disease and harassment caused by free-ranging cats.

Exclusion

Cats are difficult to exclude from areas due to their ability to climb a variety of materials, including wood, concrete, cinder block, and brick. Straight fences, without the use of rollers or metal sheet hoods at the top, are easily scaled by cats.

Fencing and netting may be used to deter cats from gardens and flowerbeds, however very few fences are truly cat-proof. Fences should be at least 6 feet (ft) (1.8 meters (m)) tall with 1½ inch (3.3 centimeters (cm)) square mesh with a curved overhang, at least 2 ft (0.6 m) in length, hanging over the outer perimeter of the enclosure.

Rollers installed on the tops of fences, such as the Oscillot® system, can help prevent cats from scaling fences, and may also be used by pet owners to keep pet cats within a fenced yard (Figure 5). Rollers can be constructed using metal brackets and PVC over pipes or smaller diameter lengths of PVC.

To completely prevent climbing, fence mesh should be $\frac{1}{4}$ inch (0.6 cm) square. However, this size may be cost-prohibitive for most property owners. Install $\frac{1}{4}$ -inch mesh screen on porches, sheds, vents, and other structures to block entry by cats. Keep doors and windows closed and install $1\frac{1}{2}$ -inch mesh if ventilation is needed.

Several non-electric fences have proven effective at excluding cats for the protection of endangered species and sensitive environments. The Xcluder® Kiwi fence consists of a 6.5 ft (2 m) wall supporting a $\frac{1}{4}$ -inch wire mesh that extends the height as well as projects out at least 1 ft (30 cm) beneath the ground from the base of the fence (Figure 6) (Day and MacGibbon 2007). It is secured to the ground and covered with soil. To prevent animals from going over the top of the fence, cut a 2-ft (60 cm) wide steel hood and angle it downward with about 1 ft of metal bent back into an arc so that the plate looks like an upside-down sled runner. Use custom made brackets to hold the hood securely. Temporarily effective or ineffective



Figure 5. Oscillot® system for preventing cats from climbing over fences.

methods for excluding cats include cat spikes, electric fences, traditional fences/walls without hoods or rollers, hooded fences with mesh greater than $\frac{1}{4}$ inch, and catnip beds.

Fertility Control

Fertility control methods, such as contraceptives and Trap-Neuter-Release (TNR), aim to limit cat population growth by eliminating reproduction. Although research is ongoing, no long-term contraceptives are currently available for free-ranging cats. Though increasingly used by municipalities in the United States, TNR fails to reliably reduce free-ranging cat populations due to the inability to achieve a 70% or higher annual sterilization rate and increased

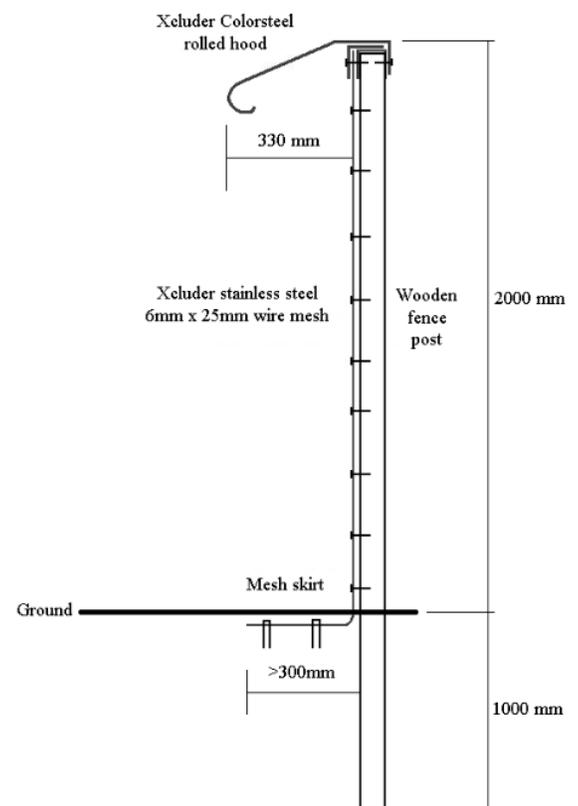


Figure 6. Xcluder® Kiwi fence.

abandonment of new cats at TNR sites (Castillo and Clarke 2003; Natoli et al. 2006; Longcore et al. 2009). Furthermore, TNR can cost over \$100 per cat (including trapping, spaying/neutering, vaccination, and transport). TNR is not condoned by animal cruelty organizations, such as People for the Ethical Treatment of Animals, due to the risk of disease exposure and cruelty of life outdoors (PETA 2021, Barrows 2004).

Treated cats are still able to prey on native birds and mammals and transmit diseases (Jessup 2004; Gerhold and Jessup 2013). For these reasons, The Wildlife Society (TWS) opposes local and state ordinances that legalize TNR colonies of free-ranging and feral cats, and TWS, the American Bird Conservancy, and the American Society of Mammalogists support the humane removal of cat colonies, as well as responsible cat ownership laws.

Frightening Devices

Frightening devices are used to haze or scare cats away from an area where they may be causing damage. Most frightening devices are only temporarily effective, depending on individual cat behavior and tolerance. Cats often grow accustomed to frightening devices or learn how to evade their triggering mechanism. To avoid acclimation to the device, vary the position, appearance, duration, or frequency of the frightening stimuli, or use them in various combinations. Many motion-activated sprinklers, noise makers, and lights are battery powered and programmable.

Dogs that show aggression towards cats can be an effective deterrent when placed in fenced yards and buildings where cats are not welcome. Methods like spraying with a hose or yelling and clapping are largely ineffective due to their need for constant human presence.

Habitat Modification

Habitat modification involves changing the landscape to reduce the availability of food, water, and shelter for free-ranging cats.

Eliminate sources of water by repairing leaky pipes and downspouts, and filling depressions where water can collect. Practice good sanitation by securing lids on dumpsters and placing trash in enclosed areas. Remove piles of boxes, lumber, unused equipment, and other debris. Secure or remove locations, such as abandoned buildings, sheds, and crawl spaces, where cats can find shelter, and seal holes 3 inches in diameter or larger.

Do not feed free-ranging cats. Eliminate their hunting opportunities by placing bird feeders and birdbaths in open areas at least 10 ft from foliage or objects where cats can hide. Reduce habitat for non-native rodents by mowing grass and other vegetation. Control rodents, especially rats and mice, by proper use of sanitation, rodent-proof construction, and trapping. For more information on rodent control and rodent-proof construction, refer to the following publications entitled [Controlling House Mice](https://wildlife.unl.edu/pdfs/controlling-house-mice.pdf) (https://wildlife.unl.edu/pdfs/controlling-house-mice.pdf), [Controlling Rats](https://extensionpublications.unl.edu/assets/pdf/g1737.pdf) (https://extensionpublications.unl.edu/assets/pdf/g1737.pdf), [Rodent Proof Construction—Structural](https://extensionpublications.unl.edu/assets/pdf/g1530.pdf) (https://extensionpublications.unl.edu/assets/pdf/g1530.pdf), and [Rodent Proof Construction—Drains and Feeding Equipment](https://wildlife.unl.edu/pdfs/rodent-proof-constructions-grains-feeding.pdf) (https://wildlife.unl.edu/pdfs/rodent-proof-constructions-grains-feeding.pdf).

Pet owners can make some simple changes to help prevent damage from free-ranging cats, such as feeding their pets indoors and limiting the amount of food and water kept outdoors for their pets. Pet cats can be kept indoors or in outdoor enclosures, such as catios or cat-proofed fenced yards.

Repellents

Repellents are available for use on surfaces and around gardens, flower beds, and landscaped areas to discourage cats. Always follow product labels for proper and safe application. Although available, repellents have not been proven to provide long-term protection against cat damage.

The U.S. Environmental Protection Agency (EPA) has registered methyl nonyl ketone (EPA Reg.#2217-942

Boundary and #2217-943) for use with cats. The compound is applied to surfaces and emits an odor that is foul-smelling to cats.

Shooting

Shooting is an efficient method for reducing cat populations in specific areas. The use of firearms requires skill and training to ensure activities are conducted efficiently and humanely. It is important to note that the lethal removal of cats is a very sensitive, and often contentious issue, and may be illegal in some areas.

Safety is a critical factor and may preclude the use of firearms due to local laws or human habitation. Consult local officials to determine if shooting cats is legal in your area. It is not legal to discharge a firearm, including air rifles, inside many cities. Additional complications arise when considering laws surrounding the legal status of free-ranging cats and their treatment as pets or wildlife. In most cases, shooting is avoided inside city limits unless an animal poses a threat to native or protected species or public health and safety is at risk. Consider all management options and proceed accordingly.

The choice of firearm, caliber, and bullet will vary based on circumstances in the field. For instance, distance to target is important in the selection of the appropriate firearm (shotgun with No. 6 shot or larger, 22 caliber rifle, or air rifle with similar sized caliber). The accuracy of firearms may be enhanced with accessories, such as night vision, illuminated or fiber optic sights, and tripods or shooting stands. Additionally, the use of monitoring tools, such as game cameras, can aid in the planning of operations by identifying areas of higher activity or attractiveness to cats. Shooting over bait or lure from an elevated or hidden position may enhance effectiveness. Ensure that every carcass is recovered. The use of non-toxic bullets is recommended to prevent scavengers from exposure to lead.

Toxicants

Pesticides are an important component in integrated wildlife damage management and their use in the United States is regulated by federal and state laws. No toxicants are registered for use with cats in the United States. Outside of the U.S., sodium monofluoroacetate (Compound 1080) and para-aminopropiophenone (PAPP) have been registered and used to control free-ranging cats.

Trapping

Trapping describes cage traps, foothold traps, and body-gripping traps commonly used to capture free-ranging cats. Foothold and cage traps are designed to live-capture animals. Body-gripping traps are designed to lethally remove animals.

Trapping rules and regulations vary by state. Consult local laws and regulations prior to using any traps. Traps should be checked frequently, with no more than 24 hours between checks for cage traps. Other trap types, such as foot holds, should be checked more frequently, depending on cat density and environmental exposure. Managers should always err on the side of caution and check traps as frequently as possible while balancing risk of scaring cats away from traps. Remote monitoring systems, such as cellular-transmitting cameras, can aid managers in ensuring traps are checked frequently.

Feral cats are difficult to capture, as they are intelligent and cautious and can easily become trap-shy. Poorly set traps can frighten cats away from traps, or allow them to escape. Cats learn from these experiences and will avoid traps. In the event that a cat becomes trap-shy, managers may need to disguise traps, use alternative traps, such as drop-traps or foot-hold traps, or use firearms. Trap companies and wildlife researchers continue to develop new styles of traps which may benefit cat management programs, so it is important to stay abreast of new developments and scientific research.

Once trapped, cats should be handled carefully by trained professionals. Many experts are available, including those

who work with private wildlife and animal control companies, such as National Wildlife Control Operators Association (NWCOPA), USDA Wildlife Services, and municipal Animal Control agencies. Take special care to determine if cats are owned. Many states have laws requiring owned pets to be tagged with a microchip, which can be scanned from outside of a trap using a chip scanner. Cats are protected by animal cruelty laws in many states and local municipalities, so it is important to consult local ordinances prior to starting a trapping program.

Trapper education programs exist in many states. This training may be required prior to receiving a trapper's license and actively trapping. Check with the local state agency for requirements and training opportunities. If none exist, the Association of Fish and Wildlife Agencies (AFWA) and some states offer online training.

Best Practices

Successful trapping of cats requires careful preparation and attention to detail. Trappers should identify cat feeding areas, den sites, and travel routes using game cameras and visual surveys. Effort should be made to determine the number of cats present at the location in order to set management targets and assess progress of the program. Given the secretive and shy nature of many cats, some may never be seen.

Always use fresh bait. Depending on the climate, baits may need to be replaced every day to ensure attractiveness. Preferred baits include protein-based baits with fat, such as fish packed in oil, beef, and cat food (moist or dry). Cats prefer bleached or unbleached tallow and yellow grease over other forms of fat. Fats appear to be most preferable when constituting 25% to 40% of the total diet (Kane et al. 1982). Avoid adding propylene glycol to any baits since some cats may experience negative reactions.

Where food is not a limiting or novel factor, gland-based bobcat or cat 'curiosity lures' can be effective tools for trapping both male and female cats. Lures can be placed in the back of a trap inside a scent "egg" or on a stick or cotton ball. The use of lures instead of bait can help reduce non-target captures.

Curiosity lures take advantage of a cat's senses of smell, hearing, and sight (Figure 7). Fresh catnip, hanging strips of aluminum foil, and battery-operated squeaker lures can be placed in the darkened end of the trap to capture cats.

Be mindful to wear scent-free gloves when handling traps, and use scent-free clothing when working your trap sets. Check traps frequently to remove captured cats and ensure the bait remains fresh. The quick removal of trapped cats reduces the potential for trap shyness and avoidance in the remaining uncaptured cats.

Avoid placing traps in areas where they might be seen by the public to prevent people from tampering with the traps or stressing trapped animals. Camouflage traps to prevent theft and make the trap seem more natural to wary cats. Consider placing cage-traps on elevated surfaces, like ledges or logs, to minimize the chance of catching striped skunks (*Mephitis mephitis*).

Learn how to handle non-target species before initiating a trapping program by visiting the Internet Center for Wildlife Damage Management (<http://icwdm.org/>) or contacting a trained professional.



Figure 7. Scent and curiosity lures can be highly effective. Here an experimental lure is set outside of a trap to observe the animal's response.

Cage Traps

Cage traps used for cats may have one or two doors and should be 30 inches (76 cm) or longer and have an opening about 10 x 12 inches (25 x 30 cm). Traps should have ½-inch (1.3 cm) mesh and a wide handle guard to protect the handler and cat during transport. Double-door traps should be 9 x 9 x 32 inches (23 x 23 x 81 cm) or larger. Slightly taller traps may catch more trap-shy cats due to the increased space. Similarly, double-door traps may encourage entry by cats that refuse to enter a single-door trap. Cats may be less likely to enter what appears to be a dead-end. Double-door traps can also be set without bait along narrow corridors, fence lines, and game trails (Figure 8). Solid-walled traps can be used instead of ½-inch mesh to protect the handler and provide cats with a sense of security.

Cage traps should always be set on a flat, stable surface with mesh on the floor of the trap completely covered. Expert trappers recommend the floor of the trap be covered with dirt and debris to match the surrounding landscape. Cats may hesitate to enter a trap if they feel wire under their feet, or if the trap wobbles when they take their first step inside. Additionally, the use of a stepping stick in front of the trap pan will prevent cats from standing in front of the pan and eating the bait without triggering the trap (Figure 9).

Traps should have shelter (a roofing shingle or corrugated plastic) over at least a third the length of the trap, and should be checked daily when active. Use of remote trap monitoring systems can aid in rapid notification of a trap closure.

Trap numbers and placement depend on the number of cats, vegetation or other forms of cover, and public exposure. Ideally, use as many traps as possible to ensure cats are caught quickly. However, traps should be placed out of view of each other to avoid “educating” untrapped cats. The denser the vegetation or the cat population, the closer together the traps should be placed. Place traps along fence lines, near congregation areas (e.g., trash collection sites, fresh water sources) and near cat travel



Figure 8. A properly set double-door cage trap.

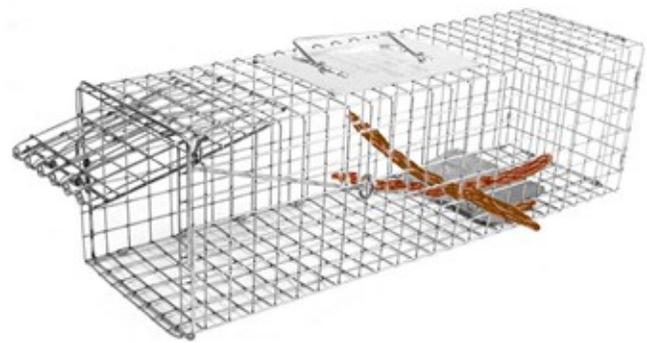


Figure 9. Stepping sticks placed in front of the pan force cats to step on the pan and trigger the trap.

corridors in order to maximize the chance of a cat encountering a trap. Consult Vantassel and Meyer (2017) for tips on the use of cage and box traps.

Foothold Traps

Foothold traps are live capture traps designed to capture an animal by the foot and restrain it (Figure 10). Do not use foothold traps on or near publicly maintained trails where capture of leashed animals or people is possible. Use No. 1 and 1½ sized foothold traps with padded and offset jaws and double swivels to minimize risk of injury to

the animal. It is important that foothold traps be washed, waxed, and in good working condition. For ease of setting, modify the trigger so that the “dog” (i.e., the bar that holds the jaw down and attaches to the trigger) makes a clicking sound as it positions into the notch. This modification is called a “night latch” and allows the setting of foothold traps in the dark. The trigger can be modified by using a flat file.

To set foothold traps, secure traps so that each set can withstand at least 50 pounds (lbs) (27 kilograms (kg)) of pull force. Ensure that each trap has at least two swivels, and that these will not become entangled in nearby structures or vegetation. Each foothold trap should be bedded (i.e., placed in the ground) so that it is perfectly stable when set. Once stable, ensure that the surface of the set blends in flush with the surface of the trail when it is covered with dirt and debris. Blind sets (i.e., traps without bait) may be made on known travel areas and near cat latrines. Set blind foothold traps along a trail using stepping sticks spaced the distance of a cat’s stride. Baited or lured sets can be used in open areas or where paths of cats are uncertain but presence is known.

Most states mandate a daily trap check. It is recommended that traps are checked at least every 6 hours for the humane treatment of trapped cats or use trap monitoring devices.

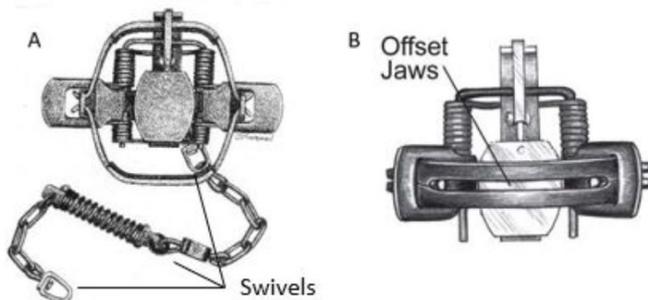


Figure 10. Examples of foothold traps with A) padded and B) offset jaws.

Body-gripping Traps

Body-gripping traps in sizes 220 and 280 can be used to quickly and humanely kill cats.

Only experienced trappers should use body-gripping or Conibear® traps due to the risk of capturing non-target species. Non-target capture can be limited by set type, trap placement, and trap container.

To reduce risk to non-targets, body-gripping traps can be placed in chimney cubbies (Figure 11) or another container, or at the top of inclined boards. The chimney cubby is typically a wooden box (approximately 37.5 x 10 x 10 inches/95 x 25 x 25 cm) made with 1-inch thick boards. Quarter-inch mesh screen secures the ends. A removable box (approximately 12 x 9.8 inches/30 x 25 cm) made of 1-inch boards serves as the “chimney” and is mounted on top so that the completed cubby looks like an inverted “T”. Two body-gripping traps, such as Belisle® Super X 220, are set at both ends and baited. The goal is to encourage the cat to enter the box through the chimney to gain access to one of the baited traps. Note this trap set will also be attractive to non-target species, such as raccoons and opossums.



Figure 11. Chimney cubby with body-gripping trap inside. Chimney cubbies help to prevent risks to non-target species.

Handling and Euthanasia

Wear protective equipment (i.e., gloves, safety glasses) when handling live or dead cats. Avoid contact with claws, teeth, blood, saliva, urine, or feces. As a precaution, those working with feral cats may want to consider getting a pre-exposure rabies vaccination. When working with a restrained or caged cat, move slowly and deliberately. Speak in a calm voice. Place a towel or blanket over the trap to reduce stress. Keep a live cat cool or in a shaded area to avoid heat-related injury.

A catchpole and pet carrier will aid in the removal and transport of an animal from a cage or foothold trap to a local veterinarian for spaying, neutering, vaccination, adoption, or euthanasia. Be aware that these options may cost over \$100 per cat. To capture a cat with a catchpole, place the loop over one of the front legs, securing the noose across the cat's shoulder. Never overtighten the noose. Avoid looping the noose solely around the neck as doing so can cause severe injury to the cat.

Cats captured in restraining devices may need to be transported to a different location for euthanasia. The American Veterinary Medical Association (AVMA) provides guidelines for euthanizing animals with firearms. Captured cats are commonly euthanized with a well-placed shot to the brain using a hollow-point bullet from a .22 rimfire cartridge (or of equivalent or greater velocity and muzzle energy). The AVMA approves of the use of barbiturates, inhaled anesthetics, carbon dioxide, carbon monoxide, and potassium chloride in conjunction with general anesthesia, nitrogen gas, and argon gas, for the euthanasia of cats (Leary et al. 2019; Leary et al. 2020).

Disposal

Follow local and state regulations regarding carcass disposal. In some disease-related cases, or in the case of animals euthanized using drugs, deep burial or incineration may be warranted/required. See the Wildlife Damage Technical Series publication on "Wildlife Carcass Disposal" (Vantassel and King 2018) for additional information.

Economics

Few peer-reviewed economic studies have investigated the costs associated with free-ranging cats. More reliable, comprehensive, and standardized data are needed to fully understand the costs associated with domestic cats.

Predation by feral cats on birds has an economic impact of approximately \$17 billion per year in the United States (Figure 12) (Pimentel et al. 2005). This assumes there are 30 million feral cats in the U.S. and 8 birds are killed per feral cat each year. Each adult bird is valued at \$30. This cost per bird is based on the literature that reports that a bird watcher spends \$0.40 per bird observed, a hunter spends \$216 per bird shot, and wildlife specialists spend \$800 per bird reared for release. This estimate does not include birds killed by other free-ranging cats or losses of other animals, such as small mammals, reptiles, and amphibians. A more recent study calculated a conservative cumulative worldwide damage and management costs for cats between 1970 and 2017 to be approximately \$22 billion (Diagne et al. 2021).



Figure 12. Domestic cats prey on birds, small mammals, reptiles, amphibians, and invertebrates in addition to eating food provided by people. Cat will kill prey even when their appetite is sated.

Species Overview

Identification

The domestic cat is a mammal familiar to most people. It is a common household pet and is free-ranging in a variety of human-centric and natural environments. *Felis catus* is the only domesticated species in the Felidae family, and multiple domestic breeds have been developed within the species. Cats are thought to have become domesticated with the onset of agrarian societies and their exploitation of subsequent agricultural pests.

Physical Description

Domestic cats are medium-sized carnivores. Their bodies average 18 inches (46 cm) in length with an average 12-inch (30 cm) long tail. Males are typically larger than females. Feral cats range from 7 to 9 lbs (3 to 4 kg). Owned cats average slightly heavier, around 8 to 11 lbs (4 to 5 kg), with some breeds averaging around 15 lbs (7 kg).

Domestic cats have a lean, muscular, and flexible body with quick reflexes. Their bodies are covered in fur ranging from ½ to 2 inches (1 to 5 cm) or more in length, depending on the breed. Their coats come in a variety of colors and patterns. Tabby patterns are the most common, which may include varying amounts and locations of white patches. Solid black is another common coat color, but cats may also be white, orange, or a mix of many colors (calico).

Their paws (or feet) have four hairless toe pads and one large, lobed heel pad with fur between the pads. Domestic cats have a long-furred tail (although some breeds may have short or no tails, and even no fur), which may be patterned or solid in color and its movement or position can often indicate the animal's mood.

Domestic cats have sharp canine teeth and curved, retractable claws for catching and killing prey. Cat senses revolve around the ability to hunt small mammals and birds, and therefore their night vision and hearing are very

sensitive. Cats' pupils are shaped as vertical slits and are adapted to dim light but cannot distinguish reds or greens well. Their sense of hearing allows them to hear a broad range of frequencies, and their large, pointed ears can independently rotate to help triangulate and amplify the location of sounds.

Cats have movable sensitive hairs on their body called whiskers or vibrissae. Whiskers aid in navigation and sensation, providing cats with information on the size of gaps or location of objects in the dark. The majority of whiskers are located around the face, ankles, and feet.

Range

The species of cat known today as the domestic cat was domesticated between 4,000 and 11,000 years ago in the Fertile Crescent area of the Middle East (Driscoll et al. 2009). At least five wildcat lineages in Europe, China, South Asia, Africa, and the Middle East contributed to the modern domestic cat. The domestic cat was first spread throughout the Old World by the Romans around 300 AD. The next major cat dispersal event occurred with the onset of European and Asian trade routes around the globe.

Today, the domestic cat is one of the most prolific and widespread invasive species, found on every continent except Antarctica, and on many remote islands and islets. Although commonly associated with urban environments, domestic cats can also be found in wilderness habitats.

Tracks

The tracks of cats are dimorphic (i.e., occurring in two different forms). Their rear feet measure 1½ to 1½ inches (2.9 to 3.8 cm) in width and 7⁄8 to 1½ inches (2.2 to 4.1 cm) in length, making them slightly smaller than their front feet which measure 1 to 1½ inches (2.5 to 4.1 cm) wide by 7⁄8 to 1¾ inches (2.2 to 4.4 cm) long (Figure 13). Though cats typically have 5 toes on their front feet, only 4 are functional and are visible in a paw print. Four toes are located on their back feet.

Toes are arranged in a semi-circular pattern around the heel pad, with a leading toe, second lateral from the midline. The heel pad has a trapezoidal shape with 2 lobes at the top and 3 on the bottom. Nails are retracted unless the cat is chasing, climbing, or walking on slippery surfaces. Tracks tend to be straight and found near cover or along habitat edges where prey may be found. Cats often follow game trails made by other species, including ungulates or people.

Sign

Cats may bury their scat (feces) and urine and often have one to many latrines around their territory, which they frequently visit. Male cats will spray urine on trees, fence posts, car tires, houses, etc., to mark their territory, often using a few of the same locations regularly. Occasionally, cats deposit scat in the middle of trails to mark their territory. Scats are twisted ropes with one blunt and one pointed end, and often contain fur and bones of prey items (Figure 14). A diet of predominantly kibble will produce scat of a smoother texture, while still maintaining a pointed end.

Voice and Sounds

Domestic cats are capable of producing a variety of vocalizations to communicate with one another and with

people. Such noises include purring, hissing, growling, grunting, trilling, and a range of “meowing” noises. In combination with body language, specifically the position and movement of the ears and tail, vocalizations can reveal a great deal about mood and sociability. Around people, feral cats are generally silent, sometimes hissing or growling as a sign of hostility and aggression. Owned cats or free-ranging cats which have interacted with people may emit a “meow” or “mew” which may be a greeting or food begging call. Purring often is a sign of contentment, often heard between a mother cat and kittens or a pet cat and a person, however, cats may also purr under stressful circumstances and when in physical distress. Certain vocalizations emitted by cats, such as the yowl of a female in heat or two cats fighting for territory, are widely considered a nuisance, especially when emitted late at night.

Reproduction

Most mating occurs during spring and summer as estrous is triggered by increasing daylight. In tropical to temperate regions, however, cats will breed year-round, having multiple litters per year.

Domestic cats are polyestrous, allowing a sexually mature female to produce up to 5 litters annually, with an average of 1.4 litters per year (Nutter et al. 2004). Females give



Figure 13. Cat tracks.



Figure 14. Cat scat.

birth to 2 to 10 kittens, with an average of 3 per litter, with a 63-day pregnancy, on average. Cats reach sexual maturity usually around 10.5 months (Nutter et al. 2004).

Both genders are promiscuous. It is not uncommon for one litter to have multiple fathers, and for one male to impregnate multiple females.

Young are raised at a single den site but are frequently moved to other locations. Kittens are weaned at 6 to 7 weeks of age and disperse around 6 months of age. Males do not assist in the rearing of young and occasionally kill kittens.

Dens

Preferred den sites are concealed, offering cover, warmth, and protection from the elements. Domestic cats often use multiple dens over the pre-weaning period. They are often moved in order to avoid predators and aggression from breeding males. Den sites vary by habitat availability and may include anthropogenic structures, such as decks, sheds, and abandoned vehicles and structures (Figure 15). In Hawaii, feral cats have been documented using seabird burrows in mountain areas as den sites after the female cat killed the breeding seabirds.

Mortality

Average life expectancy of owned cats is 13 to 17 years (Spector 1956). Spayed and neutered cats have the longest life expectancy of owned cats (Cozzi et al 2017). The life expectancy of unowned and free-ranging cats is not well understood, but free-ranging cats are more likely to be exposed to a variety of diseases including Feline Leukemia Virus (FLV), Feline Immunodeficiency Virus (FIV), and are 2.77 times more likely to be infected with parasites (and parasite-spread diseases) than indoor-only cats (Levy et al. 2006; Chalkowski et al. 2019). Factors which affect life expectancy of free-ranging cats include ownership status, presence of



Figure 15. Den sites vary by habitat availability and may include anthropogenic structures, such as decks, sheds, and abandoned vehicles and structures.

predators (e.g., coyotes), proximity to busy roads, reproductive status, and cat density. Kittens of free-ranging cats have up to a 75% mortality rate. Schmidt et al. (2007) noted that feral cats had shorter lifespans than owned cats, however the difference was not statistically significant.

Population Status

Domestic cats are invasive in all 50 states in the U.S. and in most countries, globally. Population estimates are difficult to obtain due to the secretive nature of cats and lack of consistent census by local municipalities. According to the most recent estimates, there are approximately 94.2 million owned cats (American Pet Products Association 2018) and an estimated 30 to 80 million feral cats in the United States (Loss et al. 2013).

Cat population densities are generally higher in residential areas, where people supplement populations with additional food sources and shelter. Density is lowest in areas uninhabited by people and in areas where native predators (e.g., coyotes, wolves, bears, mountain lions) still persist.

Habitat

Domestic cats are adaptable and reside in diverse environments including urban, suburban, rural, and areas without human habitation. The home range of a domestic cat can vary, and can change based on sex, ownership status, food availability, cat density, landscape features, and presence of predators (e.g., coyotes, wolves, feral dogs).

Some studies have shown feral cats, in the presence of predators, to prefer urban and grassland habitats, avoiding open areas which may be lacking in cover or shelter (Horn et al. 2011). Food availability is also thought to be a factor in habitat selection, as small mammals, birds, and reptiles are more available in grassland habitats and some urban environments. Cats are drought tolerant and prefer warmer, dryer environments. In urban areas, cats spend more time in gardens, parks, and other related greenspace habitats, likely seeking prey (Thomas et al. 2014).

Behavior

Cat behavior varies based on factors, such as socialization, habitat, food availability, cat density, and presence of predators. Cats hunt for both food and sport. Feral cats, not accustomed to human presence, are secretive by nature, and are most active in the early morning hours and evening/afternoon hours, using cover to move unnoticed by prey and potential predators. When they are not actively hunting or seeking mates, cats sleep for long periods of the day.

Vocalizations directed at people are a sign of habituation, as cats used to human presence or interaction tend to ‘meow’ even when caught in a cage trap. Unsocialized cats, when trapped, never meow at people, and will either be silent or growl and hiss.

Cats are generally solitary outside of breeding, but young may follow their mother for a number of months post-weaning. Cats rely on pheromones as an additional form of communication with potential mates and competitive counterparts. There are a number of scent glands in the

face, body, and toes as well as anal glands. These glands are often rubbed on various objects to leave pheromones and mark territory. Pheromones are also spread via urine in the case of territorial spraying by males.

Studies of free-ranging cats indicate that cat home ranges vary widely. Home range size is influenced by a variety of factors, including but not limited to: ownership status, sex, food availability, habitat type, and shelter availability. Home ranges can be smaller than a 2.5 acres (1 hectare) and as large as 4,942 acres (2,000 hectares), but most average under 25 acres (10 hectares) (Lepczyk et al. 2015). Male cats typically have larger home ranges than females (Liberg et al. 1994; Duffy and Capece 2012; Gehrt et al. 2013) and cats in rural and wilderness areas tend to have larger home ranges than cats in urban areas (Lilith et al. 2008; Metsers et al. 2010). However, contrary to popular belief, sexual status (neutered/spayed vs. unneutered/unspayed) has little influence over home range size (Horn et al. 2011; Thomas et al. 2014).

Food Habits

Domestic cats are obligate carnivores, meaning they only eat animal tissue, organs, and bones. Plant material is eaten for emetic purposes (i.e., to cause nausea and vomiting).

As terrestrial hunters, domestic cats prey on birds, small mammals, reptiles, amphibians, and invertebrates in addition to eating food provided by people. Domestic cats eat 10 to 20 small meals per day, consisting of prey or scavenged items. In the minutes prior to killing, cats will exhibit batting, mouthing, carrying, tossing, and tapping behaviors with their prey. The aforementioned “play” activities will be shorter in duration if the cat is hungry. Cats, however, may kill prey even when their appetite is sated (Adamec 1976; Loyd et al. 2013).

Predation of native species by free-ranging and feral cats is thought to be a significant cause for decline in many species native to North America and the outlying

states and territories. Scientific studies estimate that free-ranging and feral cats kill 1.3 to 4.0 billion birds and 6.3 to 22.3 billion mammals annually in the United States, and that the majority of diet items are native species (Loss et al. 2013).

Even owned and fed cats hunt prey and often do not eat it (Woods et al. 2003). According to a study using animal-mounted cameras, owned free-ranging cats only bring 23% of their killed and injured prey items to owners, eating only 28% of prey at the kill site, and leaving 49% behind (Loyd et al. 2013).

Cats, descended from the Near Eastern wildcat, are adapted to drier climates and ignore minor levels of dehydration. They compensate for reduced water intake by forming highly concentrated urine. Cats will drink from a variety of water sources but prefer moving water, such as streams or rivers.

Legal Status

Cats are considered domestic animals and as such are governed by laws and regulations governing the treatment of pets and livestock, even though they often persist on the landscape as an uncontained and uncontrolled feral population. In general, the control of cats is governed by legislation covering the use and treatment of domestic species and enforced by the local animal control authority. Free-ranging cats present special legal challenges. Should they be considered invasive wildlife or domestic animals? The lack of clear-cut responsibility and jurisdiction complicates the management of free-ranging cats for landowners, conservationists, and management agencies.

Acknowledgements

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Glossary

Catio: An outdoor enclosure for cats.

Definitive Host: An organism in which a parasite reaches maturity and reproduces.

Feral Cat: A cat with limited or no interaction with people and frequently avoids or exhibits aggressive behavior toward people.

Free-Ranging Cat: A cat that spends time unrestrained outdoors regardless of ownership status.

Home Range: An area routinely visited by an animal that includes all the resources the animal needs to survive and reproduce.

Indoor Cat: A cat that spends all of its time indoors or with restrained outdoor time (leashed or in a catio).

Intermediate Host: An organism that supports the immature or nonreproductive forms of a parasite.

Oocyst: Egg-like structure containing immature *Toxoplasma gondii*.

Owned Cat: A cat under the direct care of an owner, likely to have access to shelter, food, water, medical care, and vaccinations. Ownership definitions may vary by country, state, and county.

Promiscuous: An animal that mates frequently and often with multiple partners.

Set: Where and how a trap or capture device is placed.

Keywords

Cat, *Felis catus*, Feral, Free-ranging, Invasive, Predation

Disclaimer

Wildlife can threaten the health and safety of you and others in the area. Use of damage prevention and control methods also may pose risks to humans, pets, livestock, other non-target animals, and the environment. Be aware of the risks and take steps to reduce or eliminate those risks.

Some methods mentioned in this document may not be legal, permitted, or appropriate in your area. Read and follow all pesticide label recommendations and local requirements. Check with personnel from your state wildlife agency and local officials to determine if methods are acceptable and allowed.

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Appendix –Damage Management Methods for Feral Cats

Type of Control	Available Management Options
Biological Control	Few biological controls are available for use with domestic cats in the United States. Outside of the U.S., feline panleukopenia virus (FPV) has been used to control feral cats.
Deterrents	Bells, brightly colored bibs/collars, and food-based deterrents
Exclusion	<ul style="list-style-type: none"> • Net wire fencing with angled hood • Rollers installed on top of fences
Fertility Control	Spay and neutering
Frightening Devices	Motion-activated sprinklers, noise makers, and lights
Habitat Modification	<ul style="list-style-type: none"> • Eliminate sources of food, water, and shelter • Eliminate or reduce vegetation and piles of debris in areas that may provide cover or resting habitat • Place garbage in sealed containers or enclosed areas
Repellents	Foul smelling repellents: Methyl nonyl ketone (EPA Reg # 2217-942 Boundary and 2217-943)
Shooting	Allowed only with proper federal, state and local permits, or under state and local laws and regulations
Toxicants	No toxicants are registered for use with domestic cats in the United States. Outside of the U.S., sodium monofluoroacetate (Compound 1080) and para-aminopropiophenone (PAAP) have been registered and used to control feral cats.
Trapping	Cage traps, foothold traps, and body-gripping traps allowed with proper federal, state and local permits, or under state and local laws and regulations