

Predator Control as a Tool in Wildlife Management



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(Texas Parks and Wildlife Department)

Figure 1. Predation is an ecological reality for most species of wildlife.

Predation is the act of catching prey for food (Fig. 1). It is a natural and necessary process. Predator and prey populations ebb and flow and usually neither population becomes so low or so high as to cause undue concern for wildlife managers. Sometimes, however, predation can significantly threaten wildlife populations. In this publication we review the effects of predation on game animals—deer, wild turkey, quail, pronghorn antelope and exotics—and discuss how to determine when predator management may be appropriate.

Predator management is often necessary in livestock enterprises—especially those involving sheep and goats—to sustain profitability. With the growing economic importance of wildlife (for example, hunting leases), the question often arises: Should predators be managed to preserve wildlife populations? To answer that question you must evaluate the effect of predation on the wildlife on your land. That may be difficult to do, because simply producing more wildlife is not the only issue.

Before implementing a predator management program, ask yourself these questions:

- Is predation actually limiting local wildlife populations?
- Can the available habitat support a larger game population if predators are controlled?
- Will the surplus game produced as a result of predator control be used? That is, can (and will) harvest rates be increased to justify the predator control?

The information in this publication can help wildlife managers weigh the pros and cons of predator management.

Understanding Predators and Prey

Predator/prey relationships

The relationship between predators and their prey is complex and subject to many variables. There are two general schools of thought about the role predators play in ecosystem management: Ecosystems work from the (1) top down (predator-driven) or from the (2) bottom up (prey-driven). Those who support and use predator control measures are implementing the top down theory. That is, if predators are removed, prey (game)

species will increase. Those who believe in the bottom up idea support habitat manipulation over predator control. Both management strategies can be supported by various studies.

Sometimes a predator may be a "keystone species," which means that it plays a disproportionate role in the ecosystem. If it is removed, other species will be affected. A predator may affect other species (prey or predator) either directly or indirectly. For example, if coyotes are removed from a site for a long period of time there may be increased deer fawn survival (direct influence), but the absence of coyotes may also increase the populations of nest predators such as gray foxes and feral cats, which could cause the quail population to decline (indirect influence).

Factors affecting predation

The effect of predation on wildlife varies over time and is influenced by both natural and human-induced conditions.

A **short-term over-abundance of predators** can occur if a primary prey species (for example, rabbits for coyotes) increases dramatically and then suddenly and sharply declines. Hungry predators will then prey more on other prey species.

Changes in habitat can cause prey to concentrate in certain areas, making them easier to catch. Roads, power line rights-of-way and large areas where brush has been

cleared are examples of human-induced habitat changes. There are also natural causes of habitat change. Over much of west Texas, quail lack sufficient nesting cover because of drought and desert termites (in addition to overgrazing), so they are forced into smaller and smaller areas where they are more exposed to nest predators.

Prey animals naturally concentrate along creek banks and in other special habitats (for example, isolated turkey roosts), but **unnatural concentrations** can occur near supplemental feeding areas or water sources developed in arid environments. Any concentration of prey attracts predators and may make it easier for them to catch a meal.

The **population structure** of predators and/or prey also has an effect. For example, some people think older coyotes may kill more fawns than younger coyotes. Distorted buck-to-doe ratios (with many more does than bucks) can cause extended breeding and fawning seasons. Because of the rigors of rutting, bucks are more vulnerable in the post-rut period; if this period is protracted more bucks may be killed by predators. A longer fawning season lengthens the period in which fawns are exposed to predators.

Predator Management—An Integrated Pest Management Approach

Integrated Pest Management (IPM), which is standard operating procedure in crop production, can be applied nicely to predator management as well. An IPM strategy recognizes that:

1. Predators can be "beneficials" or "pests" or both, depending on the specific situation.
2. Scouting is necessary to determine the population levels of predators and prey and the amount of damage predators are causing.
3. There are economic thresholds or "action levels" to help determine when the level of pest damage justifies control measures.
4. A combination of lethal and nonlethal control practices is usually necessary (and best) in any situation.

Scouting for population numbers and interpreting sign

In an IPM-based predator management program you must first determine what predator and game species are present and whether a particular predator is causing a problem.

Begin by learning about the animals on your land and studying their relative populations. There are various ways of estimating population numbers, from helicopter or spotlight counts for deer to whistle counts for quail (see <http://teamquail.tamu.edu> for more information). Over time you should be able to note trends or patterns in the populations of different species and have an idea of the effect predators are having on game animals.

Predators usually leave enough evidence that wildlife managers, with some experience, can determine their presence and abundance. **Tracks** are the most common method of identifying predators. Field guides and silhouettes of tracks are important tools. Look for tracks at fence crossings, along the banks of ponds, in draws that animals use as travel corridors, on known game trails, and on pasture roads. Using "scent stations" (Fig. 2) is a practical way to study tracks. To create one, spread flour on bare ground in a circle about 1 yard across (the size of a hula hoop) and 1/4 inch deep. Place a scent lure (for example, bobcat urine or a fatty acid scent tablet) in the center of the circle. The next morning identify the tracks left in the flour. Repeat the scent stations at intervals (no closer than 1/2 mile) to get a crude index to predator abundance.



Figure 2. Scent stations baited with an olfactory attractant (a fatty acid scent tablet is pictured here) can be used to monitor predator trends in different regions or over time.

A predator's **scat (droppings)** indicates not only its presence but also what it was eating. The scat of predators often contains hair, bones, feathers and other remains.

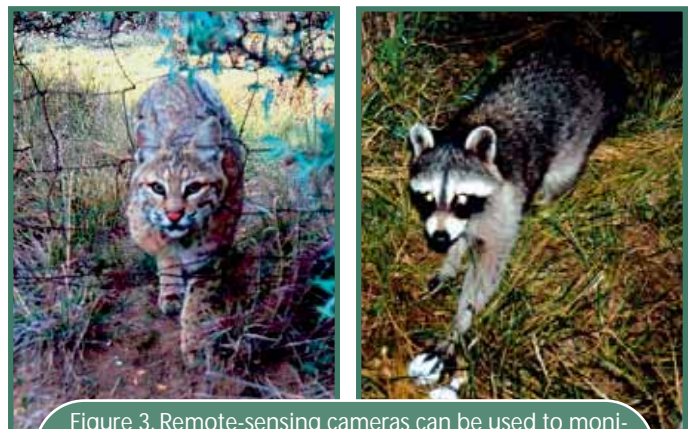


Figure 3. Remote-sensing cameras can be used to monitor predator activity. Here a bobcat (left) is "caught" crossing through a hole in a fence, and a raccoon (right) is caught with its paw in the "cookie jar."

Scat usually has characteristics that help in identifying the animal (see the individual predator profiles beginning on page 11). For example, coyote scat is generally cigar shaped and smaller than that of a domestic dog.

Game monitoring systems can be useful in studying game and predator species. Managers can view wildlife via video or still photography (Fig. 3). Surveillance cameras are placed at strategic locations such as wildlife feeders, water sources, fence crossings and game trails.

To monitor upland game birds, cameras can be placed near dummy nests (artificial nests containing chicken eggs) to measure depredation. Then a strategic predator management plan can be developed to address specific problems (for example, only raccoons) or areas (for example, around deer feeders).

Camera systems range in price from about \$200 to about \$1500 depending on their features. A list of cameras is available at <http://texnat.tamu.edu>.

Other kinds of animal signs are hair caught in fences at crossings (Fig. 4), territorial markers or "scrapes," distinct odors or other signs such as hog rooting areas.



Figure 4. This hog hair caught in a fence "slide" is evidence of feral hogs.

Investigating kill sites

When livestock are killed by predators there normally is evidence to help identify the predators responsible. However, game animals—especially fawns and game birds—may disappear without a trace. If a carcass is discovered, the mere presence of predators or predator sign near it does not confirm predation. Animals die from many causes and predators will scavenge carcasses they did not actually kill. For that reason, hair, feathers, bones and other remains found in predator droppings (feces) do not necessarily confirm predation.

The most conclusive evidence of predation is observation of the event, but such opportunities are rare, especially with wildlife. With knowledge and skill, though, you can often reconstruct the event and determine the cause of death. Each predator species has a typical way of killing and feeding upon prey. For example, one can usually distinguish a quail killed by a mammal from one killed by a hawk (Fig. 5). However, individual predators within a



Figure 5. Inspecting a kill site can provide clues to the species involved. The scene on the left depicts a quail killed by a raptor; the quail on the right was killed by a mammal.

species may vary from those patterns depending on their level of skill. Young or inexperienced predators may bite and release prey many times to make a kill, whereas a more experienced animal may make just one set of tooth punctures.

First, examine the carcass for tooth, claw or talon punctures, some typical signs that indicate a predator kill rather than a scavenged carcass. If possible, determine whether the wounds were made by mammals (canine teeth or claws), by birds (talons or beaks), or by other causes (barbed wire, vehicles). You may need to skin the animal to see wounds and bruising clearly (Fig. 6). Note the size, depth and location of any tooth, talon and claw marks.



Figure 6. Skinning the shoulder and neck area of this sheep revealed numerous, comma-shaped hemorrhages, characteristic of a bobcat attack, that were not evident from external inspection.

The spacing of canine tooth punctures is an important clue in identifying the predator responsible (Fig. 7).



Figure 7. Spacings of canine teeth for (from left) mountain lion, coyote, bobcat and gray fox.

Scout the area for separate attack, kill and feeding sites—a strong indication of predation.

The position of the carcass may be important. Animals that die from natural causes are usually found lying on their sides or chests with their legs folded under them. Animals that are killed are rarely found in a natural position. Remember, though, that scavengers may move or flip a carcass while feeding.

Causes of wildlife loss other than predation are:

- starvation, stress or exposure
- internal parasites
- disease
- trauma (automobile collisions, fences)
- injuries sustained while fighting or from being wounded
- pesticide exposure.

Interpreting circumstantial evidence

The circumstantial evidence at the scene—including tracks, scat and egg shell fragments—is very important. Avoid walking over and destroying such evidence. Look for tracks and scat in the entire vicinity of the carcass.

When investigating nest depredation, the most important clues are the size of egg shell fragments and their location relative to the disturbed nest (Fig. 8). Guidelines for interpreting egg shell evidence are included in the section on individual predators. Researchers have used artificial nests and remotely triggered cameras to study nest depredation (Fig.9).



Figure 8. Eggshell evidence at a depredated nest (left) may provide clues to the predator species involved. Studies suggest that egg size determines how much, and how often, eggshells are found at depredated nests. These chicken eggs were eaten by a raccoon (center) and a bobcat (right).

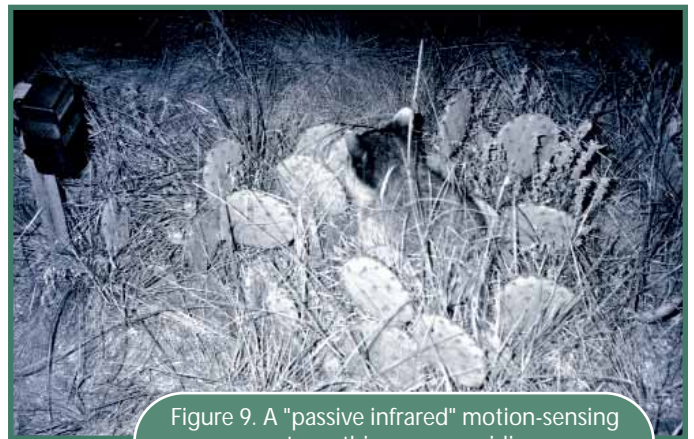


Figure 9. A "passive infrared" motion-sensing camera captures this raccoon raiding a simulated quail nest.

With careful examination of the carcass and the circumstantial evidence, predation usually can be confirmed or dismissed as the cause of death and often the specific predator can be identified.

Determining economic thresholds

Scouting for wildlife populations and investigating kills and disturbed nests will help you answer these questions:

- Is predation limiting game populations?
- What predators are causing a problem?
- What game animals (and what age animals) are most affected by predators?
- In what season of the year is most predation occurring?
- Will the habitat support more game animals if predators are controlled?
- Is predation sometimes beneficial to my wildlife management goals?

An important part of the IPM concept is deciding how much damage (predation) can be endured before corrective measures become feasible. This can be difficult to quantify in wildlife management. If the land is capable of producing more game animals, the additional animals would increase profits, and those extra profits exceed the cost of predator control, then predator management is cost effective.

As discussed earlier, economic thresholds of predators depend on the relative abundance of predators and prey and where prey species are on their population curves. For example, consider the role of coyotes in the management of deer. Coyotes can kill adult deer (especially post-rut bucks) and are the primary cause of death for deer fawns in some parts of Texas. But the largest deer ("trophy bucks") typically occur where coyote densities are highest (south Texas and the Rolling Plains). One economic threshold suggested for white-tailed deer in the Rolling Plains is based on the ratio of deer fawns to coyotes observed

during fall helicopter counts (Fig. 10): If more coyotes are observed than deer fawns, controlling coyotes may be beneficial. Another measure is the number of white-tailed deer fawns observed per 100 does during deer surveys. If that number is less than 30 percent, predator control may be warranted. Studies in Utah suggest that coyote control is sometimes cost effective for increasing the survival of mule deer and pronghorn fawns.

Here are some questions to ask when determining whether predator management would be cost effective:

- Is the management goal to increase the numbers of deer, turkey, quail, antelope or exotics?
- What other factors besides predation may be affecting wildlife?
- Do local populations of predators transmit diseases such as rabies?
- What detrimental effects might predator control have?
- What if no predator control is done?
- What effect will predator control have on other predator species?
- What are the noneconomic benefits of predator control?
- What are the economic benefits?



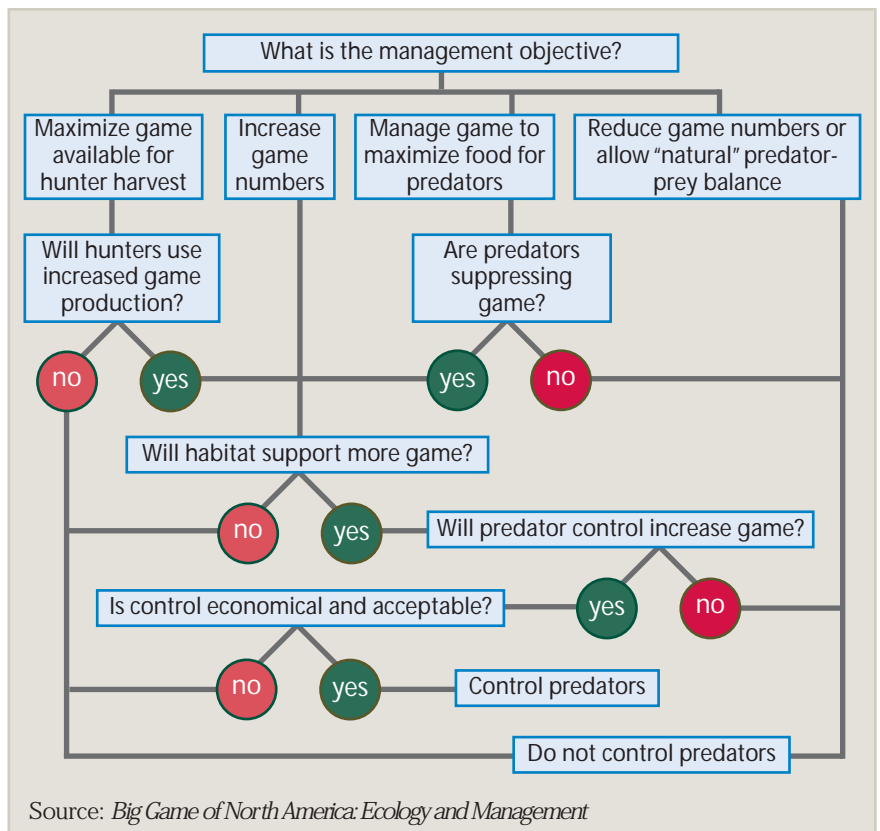
Figure 10. If you count more coyotes than deer fawns during a helicopter survey in October, coyote control may be warranted.

Selecting a Control Method

It is important to develop a control strategy that addresses the following:

- the species to be controlled;
- the scale of control;
- the season and length of control;
- lethal and nonlethal methods to be used;
- the cost-benefit ratio; and
- ways of evaluating results.

As shown in Table 1, there are both lethal and nonlethal methods of controlling predators. Lethal methods kill the



target animal, while nonlethal methods disrupt its ability to cause damage. Some lethal methods used to protect livestock also can be used to protect wildlife, including shooting, snaring and trapping. Toxicants registered for livestock protection are not registered for wildlife protection. Nonlethal options for protecting wildlife are limited, but should be implemented first where practical. Some habitat enhancement processes can take years to become fully effective, so lethal predator control may be needed concurrently. Lethal methods should be as precisely targeted as possible to limit costs and minimize undesired effects.

Table 1. Control alternatives for managing predation on wildlife in Texas.

Technique	Comments
Nonlethal	
Habitat enhancement	Usually first line of defense; examples are improving nesting cover
Fencing	Most effective for free-ranging dogs
Cage traps ("live traps")	Effective for many species (but not coyotes)
Conditioned Taste Aversion	Experimental at this time
Immunocontraception	Experimental at this time
Lethal	
Foothold traps	Wide range of applications
Neck snares	Easily used but not selective
Calling/shooting	Highly selective but time consuming
Aerial gunning	Highly effective for some species and situations but can be expensive

A predator management program should be evaluated periodically to determine whether it is achieving its goals. All wildlife populations rise and fall. Predation may be a minor problem one year but a major one the next. Game populations may or may not respond to predator control as anticipated. Drought, disease, weather extremes and other environmental factors can affect the result of a control program.

Before using any control methods, check local, state and federal laws to make sure the methods are legal in your area and to determine whether or not special licenses are required. In Texas, you must have a trapper's license to trap any animal and retain its pelt for sale. Fur-bearing predators can be trapped without a license, but their pelts can not be traded or sold. Bobcats are not considered fur-bearers, but you must have a tag from the Texas Parks and Wildlife Department to sell the pelt. A hunting license may be required to shoot some of the predators discussed in this publication. The legal status of predators in Texas is listed in Table 2.



Figure 11. The first line of defense against predation of quail is to provide adequate screening and nesting cover. Good grazing management is the key.

to improve only isolated patches of the landscape, but rather to make the landscape uniformly habitable. This allows the prey species to use the entire site to escape from predators.

To improve wildlife habitat you must understand the needs of the prey species you are trying to protect. Lighter stocking rates or rotational grazing systems can improve nesting areas. Bunchgrass (e.g., little bluestem) densities of at least 250 plants per acre are recommended for quail. Taller grasses (about 18 inches) provide better concealment for deer and antelope fawns and turkey nests. Brush management (or "brush sculpting") may be necessary to increase the carrying capacity of large game. For quail, suitable brush coverts (or "quail houses") should be spaced about a softball throw apart (Fig. 12). These habitat manipulations should give prey a competitive advantage.

Various kinds of **fencing** can restrict or "funnel" predator movement. Net-wire fencing in good condition with openings no larger than 6 inches will restrict coyotes if it makes uniform contact with the soil, but will not keep out foxes, bobcats and other small predators. Modifying existing net-wire fences with electrified trip wires and buried aprons can make them a greater deterrent to predators (Fig. 13). Electrified wires about 6 and 20 inches off the ground on the outside of the fence can keep some predators from crossing fence lines. Maintaining such electrical fencing can sometimes require considerable time and effort, especially if vegetation is dense.

Conditioned Taste Aversion (CTA) is the process by which animals come to associate the taste of a food with an acute gastric illness that occurs soon after consumption. CTA is largely experimental. It isn't likely to become a tool for controlling predation on game animals, but it may someday be useful in controlling nest predation, especially when:

- predators are relatively small (raccoons, skunks, etc.);
- predators occupy small, overlapping home ranges;

Table 2. Legal status of various predators in Texas.

Class	Species	Status	Protected	Jurisdiction	
Mammals	Badger	Fur-bearing	No	State	
	Bobcat	None	No	State	
	Coyote	None	No	State	
	Fox (red and gray)	Fur-bearing	No	State	
	Opossum	Fur-bearing	No	State	
	Mountain lion	None	No	State	
	Raccoon	Fur-bearing	No	State	
	Skunk	Fur-bearing	No	State	
	Feral cat	None	No	N/A	
	Feral dog	None	No	N/A	
	Feral hog	None	No	N/A	
	Birds	Caracara	Migratory	Yes	Federal and state
		Crow	Migratory	Yes	Federal
Eagles		Migratory	Yes	Federal	
Hawks		Migratory	Yes	Federal	
Roadrunners		Nongame	Yes	State	
Vultures		Migratory	Yes	Federal	
Reptiles	Snakes	Nongame	No	State	

Nonlethal Methods

Habitat enhancement is the most "natural" way to minimize predation. This involves manipulating the habitat to favor the prey species. Generally, the more cover available to a prey species the better its odds of survival. Habitat enhancement ranges from strategic brush removal to subtle changes in grazing (Fig. 11). The goal should not be



Figure 12. Quail habitat should feature "quail houses" (loafing coverts) about a softball's throw apart. This aerial view shows a pasture that was "sculpted" for quail.

will catch raccoons, opossums, skunks, foxes, bobcats, feral cats and dogs, and feral hogs. They usually will not catch coyotes.

The size of the trap and the bait used should correspond to the size of the target. Baits include corn, pet food, meat, fish and eggs. Eggs are good for trapping raccoons and skunks during warm weather in lieu of meat (which attracts flies and fire ants). A good place to trap for raccoons is around deer and quail feeders. Large cage traps that can hold several animals are good for catching feral hogs. Baiting the trap with the door wired open for a while allows the hogs to become comfortable moving in and out of the trap and increases the chance of a multiple catch when the wire is removed. Hogs caught live can be sold or killed; but they cannot be relocated to other areas without being tested for various diseases.

There are hazards when any trapped wild animal is released. Be very cautious.



Figure 13. Net-wire fences equipped with electrical "trip wires" can deter some predators.

Lethal Methods

The steel **foothold trap** is versatile and available in sizes and shapes appropriate for coyotes, foxes, bobcats, feral dogs and cats, mountain lions and raccoons. The size or number of the trap should correspond with the size of the predator (Table 3). Stakes or drags must be attached to the trap to anchor the trapped predator.

- there are few kinds of predators in the area; and
 - the area to be treated is small.
- Because of these constraints, CTA is generally not feasible for most game managers at this time.

Table 3. Sizes of foothold traps recommended for various predators.

Trap size	Species
1	Opossum, skunk
2	Raccoon
3	Bobcat, raccoon, coyote
4	Coyote
4½	Mountain lion

Cage traps are inexpensive, available in many sizes, easy to use, and can be used almost anywhere (Fig. 14). They are also called live traps because trapped animals are not harmed and nontarget animals can be released. Cage traps



Figure 14. Cage traps are simple to use. Raccoons, bobcats and feral hogs can be trapped easily in appropriately sized traps.

To set the trap you will need a kneeling cloth or pad, digging tool, hammer, dirt sifter, small whiskbroom, trap pan covers, gloves and scent lure (Fig.15). The trapper kneels on the cloth and places the dirt from the trap hole on it. The pan cover should be slightly larger than the pan on the trap and can be made from canvas, denim, screen wire or plastic sandwich bags. The trapper should wear gloves when handling clean traps and when setting traps because many predators (especially canines) have a keen sense of smell and can detect human odors on buried traps.

Pick trap sites wisely to avoid catching nontarget animals. Good locations are the places predators travel regularly, including road and trail intersections, water holes, fence corners, "crawls" under fences, pasture gates, stream crossings and fresh animal carcasses. Visit traps often so any nontarget animals caught can be released. Adding a



Figure 15. The foothold trap is an important tool in predator management. Various sets can be used to increase the selectivity of trapping.

tension device under the pan will minimize the capture of nontarget species. Some traps have a pan tension adjustment on their trigger mechanisms. Adjust the trap so that it will spring only with the weight of larger predators, usually 4 to 5 pounds.

A scent lure, or bait, arouses the curiosity of the predator and attracts it to the trap. A scent lure can be predator urine and droppings, commercial lures or scents, or fetid meat or fish. Cats rely less on their sense of smell than other predators and may need a visual attractant such as a feather or piece of fur. It is important to place the scent or lure at the proper distance behind the trap. A good rule of thumb is: The smaller the animal, the closer the lure should be to the trap.

Successful trapping requires skill. Incorrectly set traps will make predators "trap-wise" and harder to catch. Inexperienced trappers can learn from literature, videos and workshops. Sometimes it is more effective to hire a professional trapper.

Other common traps include **Conibear™** and **EGG™** traps. Conibear traps have jaws that snap shut around the body of the animal and kill it rapidly. They are generally used for nutria and beaver control, seldom for predator control. Only Conibears #330 or smaller, or with jaw spreads of 8 inches or less, may be used on land. Anything larger must be placed in at least 6 inches of water to be used legally. EGG traps have small holes that animals (specifically raccoons) reach into. The EGG trap is shaped like a large egg and is easy to use. It is also touted as dog proof, which makes it ideal for controlling raccoons in areas where there are pets.

Snares are rather simple mechanical devices (Fig. 16). They are economical, effective and do not require as much skill or training to use correctly. Any animal traveling through a snare is likely to be caught, so they must be used with extreme care. Snares used for predator control are made

of flexible wire cable from 1/16 to 1/8 inch in diameter. Larger cable can be used for mountain lions. At the anchor end of the cable is a swivel that prevents the snare from twisting and breaking. Snares should be long enough that the swivel end can be attached to a firm object or drag, with enough cable left to make a loop 8 to 10 inches in diameter (for raccoons, bobcats, foxes and coyotes) or larger (for feral hogs). The snare is placed so that the animal must pass its head or body through the loop as it travels. When tripped, the snare begins to close around the head or body and the locking device keeps the loop tight.

Snares are typically used where there is net-wire fencing. They are set under the fence or between wires where animals pass through. They also can be set along brushy trails or at den entrances. The snare is set by firmly attaching the swivel end to the fence or to a drag with the heavy wire.

As the animal pulls, the snare tightens. Using a drag will minimize damage to the fence and keep the snare site from being disturbed. If the loop is too small the snare may be knocked down when an animal crawls under the fence. If it is too large an animal may crawl through the snare without being caught. The snare should be placed directly underneath the fence with the top of the loop attached to the fence by a small wire or thread. This will keep the snare in the proper upright position but allow it to release with the slightest pull.



Figure 16. Neck snares are popular in regions where netwire fencing is common. Snares are relatively nonselective, so monitoring the traffic through such crawls is a key to reducing nontarget catches.

The most selective lethal control option is **shooting**, because the predator is seen before it is taken. Night hunting with spotlights is legal in Texas but is subject to special regulations; the local game warden should always be contacted beforehand. Shooting can be done with or without **calling**. Most predatory species can be called to within a

short distance of a concealed hunter (Fig. 17). Calling is done with a mouth-blown call or with an electronic device that imitates the sound of an animal. Many makes and models are available. Proficient mimicking of the distress cries of rabbits, rodents, kid goats, fawns and birds can get excellent results.



Figure 17. This coyote is approaching a camouflaged hunter (lower right).

A good calling location allows an unobstructed circular view of the surrounding area, is upwind of the targeted calling area, has a higher elevation than the surrounding area, and allows a reasonable shooting distance. Clearings, old roadways, senderos, clear-cuts and brush piles make good calling locations. A caller must blend with the background. Decoys and scents can be useful for attracting the predator's attention away from the caller. Remember, predators may show up from any direction and disappear as quickly as they came. Most predators (especially coyotes) will try to circle the call and approach from downwind.



Figure 18. With the proper permits, aerial gunning can be used for some species of predators. It is a quick, selective way to lower predator numbers in a specific region.

Rifles are best for open country and long shots, while shotguns are best for brushy areas or close shots. The type of firearm used, type of call used, weather, ability of the caller and the shooter, the target predator, time of day, and terrain are all important to a successful calling session.

Predators can become "call-shy," which means they will not respond to calling. Probable causes are too much calling in the area, improper calling, missed shots, or carelessness on the part of the caller and/or hunter. Changing to a different sound may help, but it is usually best to let the area "rest."

Aerial gunning is the use of aircraft (fixed-wing or helicopters) to take target animals that are causing problems or to quickly reduce the number of predators (Fig. 18). Aerial gunning is regulated by state and federal laws. A state aerial gunning permit can be obtained from the Texas Parks and Wildlife Department. Coyotes, bobcats, feral hogs, red foxes and coyote-dog hybrids are the only predatory animals that may be taken with the use of aircraft.

Aerial gunning is most effective in areas with open, flat terrain and little brush. A fixed-wing aircraft is most often used over flat or gently rolling terrain with little brushy cover, whereas a helicopter can be used for all types of terrain and cover. A 12-gauge semi-automatic shotgun is the weapon of choice for aerial hunting from either type of aircraft. Ammunition should be from BB to No. 4 buckshot in size.

Other Considerations

There are often social and political concerns attached to the issue of predator management. Such issues affect the regulations that are in place, and wildlife managers should be aware of them.

Ethics of predator management

Like many professionals, wildlife managers could benefit from a code of ethics. Individuals decide whether or not to adopt the code and abide by it. The conscientious manager will embrace ethical behavior to ensure that predator control practices are above reproach. Ethical predator management requires:

- strict adherence to laws, regulations and policies regulating predator control;
- exceptionally high levels of respect for people, property and wildlife;
- conservation of natural resources;
- the recognition that predators have ecological value;
- respect for varying viewpoints on predator management;

- determining the species responsible for losses and targeting only that species for control;
- broadening one's knowledge and skills relative to predator management;
- choosing the most humane, selective and effective control methods;
- monitoring traps and snares regularly;
- dispatching trapped animals humanely; and
- proper carcass disposal (e.g., do not hang them on fences or in trees).

Political concerns

Wildlife (including predators) is a shared resource owned by all the citizens of Texas. Public perceptions of the effects of predator control vary greatly depending on the situation (Table 4). These perceptions influence the laws and regulations made by elected officials and public agencies. Therefore, it is important that the public have sound, scientific, research-based information on predator management.

Good neighbor policy

When wildlife managers control predators they affect not only their own property but also their neighbors' properties. Since predator control is more effective over a large area, it is wise to work with neighboring landowners. All should discuss their goals and seek consensus about the goals of the program and the methods to be used.

Table 4. Public support for managing predators to meet different wildlife management goals, according to a 1996 survey. Responses "Don't know" and "Neutral" not included.

Predator control scenario	Support control
Control foxes, raccoons and skunks	
To protect duck species in danger of extinction	81%
To protect endangered shorebirds	67%
To increase songbird populations	55%
To improve upland game bird populations	56%
Control hawks and owls to improve upland game bird populations	
	36%

Adapted from Messmer et al., 1999. United States public attitudes regarding predators and their management to enhance avian recruitment. *Wildlife Society Bulletin* 27:75-85.

Predator control aimed at protecting livestock often protects game species as well. For example, the high population of deer in the Edwards Plateau is likely a result of sustained, wide-spread predator management programs to protect sheep and goats. This is an example of neighboring landowners working together toward a common goal. Another way is to support local predator management associations, or "trapping clubs." Ask your county Extension agent whether there are trapping clubs in your county.

Coyote

Other common names: prairie wolf, brush wolf, God's dog, song dog



Figure 19. Most Texas coyotes weigh between 25 and 35 pounds.

Description: Coyotes are slender, dog-like carnivores (Fig. 19). They have good eyesight and hearing and a keen sense of smell. In Texas, adult males weigh 25 to 45 pounds, adult females 20 to 35 pounds. Their color ranges from light gray to pale yellow to dark reddish to nearly black. The tawny gray agouti (salt and pepper) pattern is the most prevalent.

Legal status: Coyotes are not protected in Texas, but may be subject to other regulations. Because the Texas Department of Health has declared rabies an ongoing state health emergency, animals that transmit rabies, such as coyotes, North American fox species and raccoons, may not be transported to, from or within the state.

Distribution: Coyotes are found everywhere in Texas, with the highest densities in south Texas and the Rolling Plains (where there are sometimes as many as six coyotes per square mile). Home range size varies among areas, seasons and individuals and is dependent upon the abundance of food.

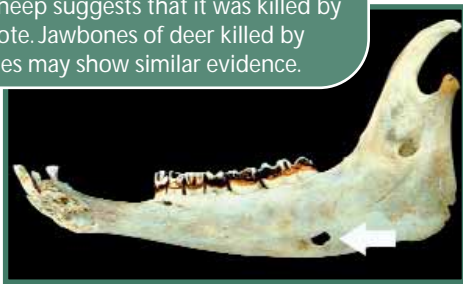
Biology: Coyotes breed annually between January and March. Pups are born 60 to 63 days later. A typical litter has four to seven pups. Male and female coyotes are monogamous for at least one breeding season and may pair for life. Both adults care for the young, as do nonbreeding adults

associated with the mated pair. Pups begin to leave the den at 3 weeks of age and by 8 to 12 weeks of age are following the adults to prey or carrion. Pups remain with the adults until late summer or early fall, when they disperse.

Effect on wildlife: Coyotes are opportunists and eat a variety of foods, including carrion, garbage, mammals (wild and domestic), insects, birds, poultry, fruits, mesquite beans, prickly pear tunas, berries, seeds and other plant matter (see Appendix B). Their natural prey consists largely of rabbits, rodents and fawns when available. Livestock, especially sheep and goats, are also an important part of the coyote's diet. They often scavenge cattle carcasses.

Evidence of predation: Coyotes typically attack large animals (e.g., deer) at the throat. They bite just behind the jaw and below the ear. Death results from suffocation and shock. Tooth punctures often can be found in the lower jawbone of an animal killed by a coyote (Fig. 20). Coyotes may bite smaller prey on the head, neck or back. A coyote bite measures more than 1 inch between the canine teeth (Fig. 7). Coyotes normally begin feeding on kills at the flanks or just behind the ribs. The viscera (heart, lungs, liver) are often eaten first. Coyotes also gnaw on the bones, particularly the rib bones. Small animals may be entirely consumed. Small pieces of egg shell near a nest are evidence of coyote predation. Coyote droppings are cigar-shaped and usually found along pasture or county roads.

Figure 20. A hole in the mandible of this sheep suggests that it was killed by a coyote. Jawbones of deer killed by coyotes may show similar evidence.



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Control alternatives: Net-wire fencing and managing habitat to benefit prey species (such as providing good fawning cover) are the best

nonlethal techniques. Some people believe that encouraging an abundance of small mammals helps prevent coyote predation on deer and livestock. Coyotes also can be trapped, snared and hunted aerially and from the ground. Calling can be effective. An integrated approach that uses a variety of methods is the best solution.



Coyote scat



Coyote tracks

Gray Fox

Other common names: tree fox



Figure 21. Gray foxes are common in central Texas.

Description: Gray foxes weigh about 7 to 10 pounds (smaller than red foxes) and have a distinct gray coat along the back and sides with red markings along the edge of the gray and a white underbelly (Fig. 21). The long, bushy tail is black along the top and on the tip. This is the only canine in Texas that routinely climbs trees.

Legal status: The gray fox is a fur-bearer (see page 13). Because they transmit rabies, gray foxes can not be transported to, from or within Texas.

Distribution: Gray foxes are found throughout the state but are especially common in areas where coyotes have been controlled (e.g., the Edwards Plateau).

Biology: Gray foxes are omnivorous; they

feed on mice, cottontails and other small mammals, birds, eggs, insects, plants and fruits. Mating takes place from January to March. Pups are born after 63 days, with an average of three to five pups per litter. Both parents care for and train the pups. Hollow logs, badger holes and brush piles may serve as den sites. Pups stay with their parents until late summer or fall.

Effect on wildlife: Gray foxes may prey on newborn fawns (e.g., black-buck antelope), but their predation mostly affects game birds and their nests (Fig.22).

Evidence of predation: When a nest is destroyed by a gray fox, scattered egg shell fragments may be found more than 100 yards away. Usually the eggs are bitten across the long axis.

Control alternatives: Creating good nesting cover helps protect game birds from gray foxes. When habitat manipulation is not enough, foxes may need to be removed. They can be trapped, snared and hunted. (Gray foxes cannot be hunted aerially; red foxes can). Locating the dens and removing the pups also is effective. Gray foxes are easily called.



Figure 22. Foxes are adept predators of game birds and their nests. Foxes typically carry the eggs some distance from the nest before eating or caching them.



Gray fox scat



Gray fox tracks

Red Fox

Description: Red foxes are about the size of small to medium-sized dogs and weigh 8 to 16 pounds. They are red-orange with black legs and feet and a white underbelly. The tail is long, bushy, and always white-tipped (Fig. 23).

Legal status: The red fox is a fur-bearer (see below). They can not be transported to, from or within Texas.

Distribution: Red foxes are found over much of the state, except in south Texas and the western Trans-Pecos region.

Biology: Red foxes eat mostly small rodents, rabbits, bird eggs, insects and fruits, but also prey on fawns, game birds and young livestock. Males and females reputedly pair for life and usually breed in late winter. They dig a den or use an abandoned badger burrow or similar location. Pups are born after a gestation period of 52 days, with three to eight pups in the average litter. The pups begin to venture outside the den when they are about a month old and disperse in late summer.



Figure 23. The red fox's white-tipped tail distinguishes it from the gray fox.

Effect on wildlife: Foxes prey on game birds and eat the eggs of ground-nesting birds. They may occasionally kill fawns.

Evidence of predation: Evidence is similar to that of the gray fox.

Control alternatives: Good nesting habitat is critical to reducing red fox depredation of game bird nests. If lethal control methods are also needed, red foxes can be trapped, snared and hunted (including removing pups from dens). A squealing bird call (such as a woodpecker or flicker) is effective with red foxes.



Red fox tracks



Red fox scat

Fur-Bearing Animals

By state law, one must have a trapper's license or hunting license to take and possess a fur-bearing animal. No part of the animal can be sold, and the number of fur-bearers taken can not exceed the daily bag limit of one, or the possession limit of two. Landowners (or their authorized agents) on their own land do not have to have trapping or hunting licenses to take a fur-bearer while it is damaging agricultural crops, livestock, poultry or personal property. However, neither the animals nor their pelts can be possessed or sold. Before controlling fur-bearing predators, check with local law enforcement officials to determine if any other ordinances are in effect in your area.

Bobcat

Description: Bobcats are about the size of a medium-sized dog (Fig. 24). The upper parts are reddish brown streaked with black and the under parts are white spotted with black. The backs of the ears are white with black rims and slightly tufted. The short tail is tipped with black above white and has three or four black bars just below the tip. The legs are relatively long with large feet. Adult bobcats in Texas weigh 20 to 35 pounds.

Legal status: Bobcats are not protected in Texas and may be taken at any time. A hunting license is required to shoot them and a pelt tag is required to sell or trade the pelt.

Distribution: Bobcats can be found throughout the state in a variety of habitats. They prefer rocky canyons or outcrops; in rockless areas they resort to thickets (such as whitebrush) for protection and den sites.

Biology: Bobcats are active mostly at night. In hilly country they often drop their feces on large rocks on promontories or ridges. Males make scrapes—small piles of leaves and sticks on which they urinate—like those of mountain lions, only smaller. They den in crevices in canyon walls, in boulder piles or in thickets. Bobcats often seek refuge by climbing trees. Breeding usually begins in February, with the young born after a gestation period of about 60 days. They may have two to seven young, with three being the average litter size. Kittens are weaned at about 2 months and remain with their mother until early fall, when they begin to fend for themselves. Females do not breed during their first year, but after that they breed annually until 8 or 9 years of age.

Effect on wildlife: A bobcat's diet consists mainly of small mammals (rats, ground squirrels, mice and rabbits) and birds. They occasionally kill and eat deer (primarily fawns). Wild turkeys, quail, and domestic sheep, goats and poultry are also susceptible to bobcat predation. Bobcats may partially cover their kills and return later to feed.

Evidence of predation: Bobcats usually stalk their prey and then ambush from cover. They bite the back of the skull or neck, and may also attack the throat just behind the victim's jaw. Claw marks may not be visible on the outside of the victim but will appear as comma-shaped marks on the inside of the skin along the back, sides and shoulders. The canine incisions will be 3/4 to 1 inch apart (Fig. 7). When depredating ground nests, bobcats bite across the egg, leaving a portion of the yolk in the shell and the egg still in the nest.

Control alternatives: The best nonlethal control method is to manage habitat to the benefit of prey species. All lethal methods mentioned previously can be used for bobcats. An integrated approach is best.



Figure 24. Bobcats are common over much of Texas.



Bobcat tracks



Bobcat scat

Mountain Lion

Other common names: cougar, puma, panther



Figure 25. The number of mountain lions in Texas has increased over the last decade.

Description: Mountain lions are the largest wild felines in Texas (Fig. 25). Adult toms measure 7 to 8 feet from nose to tip of tail and weigh 100 to 150 pounds. Adult females are smaller, 55 to 90 pounds. A lion may live up to 10 years in the wild.

Legal status: Mountain lions are not protected in Texas.

Distribution: Mountain lions once occupied all of Texas. Although they are scarce now in most parts of the state, their numbers appear to be growing in remote, lightly populated areas such as south Texas and the Trans-Pecos region.

Biology: Mountain lions are solitary, secretive and nocturnal. They prefer steep canyons, breaks or thick brush. They seldom use caves for dens, preferring overhanging ledges, crevices in cliffs, dry cavities in rock piles or under tree roots, or dense thickets. They breed at any time of year, but most litters are born in summer or fall. Females first breed at about 2 years of age and then every 2 to 3 years thereafter. Gestation is about 96 days. Litters range in size from one to six with an average of three. Females seek secluded, secure locations where they can protect the young from male lions that might otherwise kill them. Kittens remain with their mother up to 24 months, gradually acquiring hunting skills until they leave to find territories of their own.

Lions create scrapes near kills and trails to mark their territories. Scrapes are 6 to 8 inches high and up to 2 feet long and 12 inches wide. These mounds of soil, grass,

leaves or snow are created by a backward motion of the hind feed, which indicates a lion's direction of travel. The lion places feces and urine on top of the scrape.

Effect on wildlife: Where abundant, deer and javelina are the major part of a mountain lion's diet. A lion may kill a deer every 3 to 14 days, depending on how quickly the carcass spoils and on the abundance of deer. Females kill most often when the kittens are youngest. Lions also prey on feral hogs, porcupines, skunks, rodents and livestock.

Evidence of predation: Mountain lions usually stalk and then ambush their prey, biting the upper neck to break the spine while holding on to the victim's chest with their claws. Examining the inside of the prey's skin will usually reveal canine punctures 2 inches or more apart (Fig. 7) and teardrop-shaped holes where the claws held the animal. Lions occasionally kill by crushing the top of the head or collapsing the trachea. Kills are sometimes dragged away and covered (cached) with grass, sticks and other debris (Fig. 26). These "drags" can leave obvious trails to kill sites. The lion may return to feed again and then re-cache the carcass.

Control alternatives: The most selective method is the use of trained lion-tracking dogs to pursue and "tree" a lion so that it can be captured or killed. Foothold snares are effective but must be used with caution to avoid trapping nontarget species. Buried foothold traps (No. 4½, with chain and drag-hook) are also effective, but nonselective unless set by an experienced trapper.



(Doug Ward)



Figure 26. Drag marks are a sign of a lion kill (left). This mule deer (right) was killed and partially consumed by a mountain lion. Lions and bobcats will cache, or partially cover, their kills for subsequent feedings.



Mountain lion tracks



Mountain lion scat

Raccoon



Figure 27. Raccoons are common omnivores in most regions of Texas and may be the single most important nest predator in much of the state.

Description: Raccoons are medium-sized mammals weighing 10 to 25 pounds (Fig. 27). They have salt-and-pepper fur, a black facial mask, and a long tail with four to seven black rings.

Legal status: Raccoons are fur-bearers (see page 13).

Distribution: Raccoons are found statewide. They prefer living near streams, rivers, lakes and marshes and they require trees, brush and other cover. They usually den in hollow trees, logs, rocky crevices, brush piles or abandoned armadillo holes. They also inhabit structures such as barns and deer blinds.

Biology: Raccoons are opportunistic feeders. They eat fish, crayfish, small mammals, frogs, eggs, fruits, berries, insects, birds, snakes and mollusks. They also feed on corn, sorghum and other cultivated crops. Near urban areas, raccoons will raid garbage cans and pet dishes. They also eat supplemental feed intended for deer, quail and livestock (Fig. 28).

Raccoons produce one litter a year. They breed in February and March and the young are born in April or May after a gestation period of about 63 days. A litter contains one to seven young, which are weaned at 2 to 4 months of age but stay with the mother until the following spring. Yearling females do not always breed, but adult females normally breed every year. The average life span of a raccoon in the wild is 2 to 3 years, but they have lived as long as 17 years in captivity.

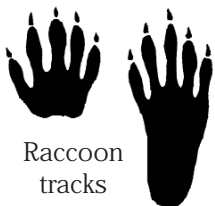
Effect on wildlife: Raccoons are a major predator of ground-nesting birds and their eggs. They may consume more feed at deer and quail feeders than the deer and quail do.

Evidence of predation: Raccoons usually leave medium-sized to large egg shell fragments within 25 feet of a nest. If a single raccoon was responsible the shell fragments will be concentrated in one area. If a family of raccoons was involved there may be shell fragments dispersed around the nest.

Control alternatives: Good nesting habitat helps reduce raccoon depredation on game bird nests. However, nonlethal control methods may not be enough. Raccoons are easily caught in cage traps baited with canned cat food or sardines. Whole chicken eggs also make good bait and do not attract fire ants or flies. EGG traps are specifically designed to catch raccoons selectively. Raccoons also can be snared or shot. To reduce the amount of feed raccoons consume from spincast supplemental feeders, traps can be placed nearby and wire cages used to limit access to the spin plate.



Figure 28. The increasing trend of providing supplemental deer feed may be stimulating raccoon reproduction and survival. Studies show that simulated nests near deer feeders have low survival rates.



Raccoon tracks



Raccoon scat

Striped Skunk, Spotted Skunk, Hog-Nosed Skunk

Other common names: polecat, civet cat



Figure 29. Of the several species of skunks in Texas, the striped skunk is most common. Skunks are nest predators.

Description: Skunks are about the size of house cats, with spotted skunks slightly smaller than the other two species. Skunks have distinctive black and white color patterns—white stripes along the back on striped and hog-nosed skunks and white spots along the back and sides on spotted skunks. The legs are short and stocky and the feet are large with claws for digging. Hog-nosed skunks have a long snout that is hairless for about an inch at the tip. All skunks can discharge a nauseating musk from glands located near the anus.

Legal status: Skunks are classified as fur-bearers (see page 13).

Distribution: Striped and spotted skunks can be found throughout Texas, while hog-nosed skunks are found only in the southern and western parts of the state. Striped skunks (Fig. 29) are by far the most common species.

Biology: Skunks prefer insects (grasshoppers, crickets, beetles) but will eat plant matter, mice, eggs and small mammals also. Skunks produce one litter each year, with an average of four to six young per litter. Breeding begins in late February for adults; yearling females breed into late March. Young are born in late spring or early summer and remain with the mother until fall. Skunks are generally nocturnal and may be inactive during the coldest part of winter.

Effect on wildlife: Skunks depredate the ground nests of game birds. Adult birds caught on nests also may be consumed.

Evidence of predation: Skunks tend to leave large egg shell fragments close to the nest. They are very "neat" nest predators.

Control alternatives: Increasing the density of bunchgrass can help protect ground-nesting birds from skunks. Foothold traps, cage traps and shooting (spotlighting) are effective ways to remove skunks.



Skunk tracks



Skunk scat

Badger

Description: A badger is a medium-sized mammal with a stocky, muscular build (Fig. 30). It has a broad head, a silver-gray coat, black patches on the cheeks, and a white stripe extending from the nose over the top of the head. The front legs are short, powerful and adept for digging. The tail is short and bushy. The average weight is 20 pounds.

Legal status: Badgers are fur-bearers (see page 13).

Distribution: Badgers occur throughout the state.

Biology: Badgers are nocturnal but may be active at dawn and dusk. Their diet includes mammals, reptiles, amphibians and insects. They may dig burrows in pursuit of ground-dwelling prey. Badgers are solitary animals except during the breeding season in late summer or early fall. If implantation is delayed, gestation does not begin until February. The two to three young born in early spring remain with the mother until midsummer.



Figure 30. Badgers are uncommon in Texas. You are more apt to see a badger's prominent diggings than the animal itself.

Effect on wildlife: Badgers eat quail and turkey eggs, as well as adult birds incubating nests.

Evidence of predation: The exact damage to egg shells is not known. Disturbed soil and tracks at the nest site may be evidence of a badger.

Control alternatives: Good nesting habitat helps reduce badger depredation of game bird nests. Net-wire fencing with a buried apron may exclude badgers. Foothold traps are the most common control method.



Badger tracks



Badger scat

Opossum

Other common names: possum



Figure 31. Opossums are found throughout most of Texas.

Description: This small, white-gray mammal is about the size of a house cat (Fig. 31). It has a long, pointed face with rounded, hairless ears and a hairless, rat-like tail that is about half the length of the body.

Legal status: Opossums are fur-bearers (see page 13).

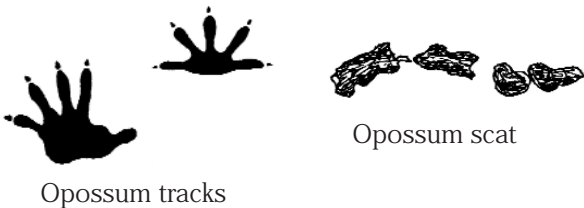
Distribution: Opossums are found in all parts of Texas except the western Panhandle.

Biology: Opossums are the only marsupials in North America. They are nocturnal and solitary creatures that feed on eggs, insects, carrion, fruits and grains. Near urban areas they may raid garbage cans or pet food dishes. The mating season is from January to July. Two, sometimes three, litters may be raised each year. Gestation lasts only 13 days. The six or seven young are only 1/2 inch long when born. They quickly find their way to the mother's pouch where they attach to a teat and remain for 7 to 8 weeks. The young remain with the mother another 6 to 7 weeks until weaning.

Effect on wildlife: Opossums depredate bird nests and may catch adult birds (Fig. 32).

Evidence of predation: Opossums usually leave large egg shell fragments within 20 feet of the nest.

Control alternatives: Good nesting habitat helps protect game birds. Opossums can be shot or trapped with cage and foothold traps.



Opossum tracks

Opossum scat



Figure 32. Opossums often eat the eggs of ground-nesting birds.

Feral Hogs



Figure 33. Feral hogs are found in many areas of Texas

Description: Feral hogs, or "wild" pigs, include domestic hogs that have escaped captivity, true Eurasian wild boars, and their crosses. They can be any color. Their size varies greatly, depending on the amount of crossbreeding with wild boars (Fig. 33). There are few, if any, pure Eurasian wild boars in Texas.

Legal status: Feral hogs may be taken at any time, but a hunting license is required to shoot them.

Distribution: Feral hogs are found in 230 Texas counties and in a wide range of habitats across the state. They prefer areas of dense brush. They are less common in portions of the High Plains and Trans-Pecos regions.

Biology: Feral hogs eat a wide variety of foods. They prefer mast (primarily acorns), but also eat vegetation, crops, roots, carrion and invertebrates. They prey on young livestock (primarily kid goats and lambs), reptiles, rodents, snakes, other small game, and eggs. Feral hogs can produce two litters of two to six young each year, but usually produce only one. Gestation lasts 114 days. Litters can be born at any time of year, usually with a peak in March.

Effect on wildlife: The damage feral hogs do to livestock and crops is well known. They also destroy the nests of ground birds, prey upon deer fawns, and consume large amounts of supplemental feed intended for deer (Fig. 34). Feral hogs can transmit to livestock and wildlife diseases such as swine brucellosis, pseudorabies, anthrax, and the exotic foot and mouth disease (should it become established in the United States). However, some game managers and sportsmen consider them a game species and valuable hunting commodity.

Evidence of predation: Hogs may completely consume their prey and leave little evidence beyond "rooted up" soil and tracks. At nests, feral hogs may or may not leave egg shell fragments and/or disturbed soil.

Control alternatives: Most nonlethal methods are ineffective. Where deer are fed, changing to a feed less palatable to hogs (such as whole cottonseed) may be useful. Pens of sturdy hog panels around feeders may keep hogs out. Aerial hunting is currently the best control method, though they also can be trapped in large, walk-in style cage traps (Fig. 35). (Note: It is unlawful to trap feral hogs and transport them for the purpose of stocking other areas unless they have been tested and certified free of pseudorabies and swine brucellosis.) Because of the short gestation period, high birth rates, and ability to breed all year, controlling the population of feral hogs is difficult.



Figure 35. Feral hogs can be trapped effectively with walk-in traps baited with grain or carrion.



Figure 34. Feral hogs are a nuisance at deer feeders and also can be serious predators of ground-nesting game birds.



Hog tracks



Hog scat

Feral Cats

Description: A feral cat is simply a domestic cat living in the wild (Fig. 36). They weigh 3 to 8 pounds, stand 8 to 12 inches high at the shoulder, and are 14 to 24 inches long. The color range is like that of domestic cats.

Legal status: Cats that are not personal property are considered feral and are not protected under state law.

Distribution: Feral cats occur mostly near human populations. They live in abandoned buildings and other places that provide cover. However, they can survive miles away from humans, especially in areas where there are few coyotes (such as the Edwards Plateau).

Biology: Feral cats can produce a litter of two to ten kittens at any time of the year. Up to three litters can be produced annually if food and habitat are sufficient. Cats are active primarily at night and twilight, but may be seen during the day. They live an average of 3 to 5 years and occupy a home range of about 1.5 square miles.

Effect on wildlife: Feral and even free-ranging domestic cats are serious predators of game birds and songbirds. They also consume rodents, rabbits, insects, reptiles, fish and carrion. Cats can carry diseases to which humans and wildlife are susceptible, including cat scratch fever, distemper, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various internal and external parasites.

Evidence of predation: The presence of an uneaten gizzard or egg at a quail kill site suggests that a feline predator was responsible.

Control alternatives: Feral cats can be controlled by blocking entrances to abandoned buildings, covering holes under foundations, and removing piles of debris such as old machinery and junked cars. Cats also can be removed with foothold and cage traps. Domestic cats should be confined or have a bell attached to their collars.



Figure 36. Free-ranging or feral housecats are notorious predators on birds.

Feral Dogs

Description: Feral dogs are domesticated dogs that have become wild, or their descendants. They no longer rely directly on humans for food, water or shelter. Their appearance and size are the same as the various breeds of domestic dogs.

Legal status: Dogs that are not personal property are considered feral and are not protected by law.

Distribution: Feral dogs are found throughout the state. They concentrate near human populations, but are also found in remote areas.

Biology: Truly feral dogs develop many of the same behaviors as coyotes. They often establish social groups or packs. A feral dog's range is dictated by the presence of food, and may be as large as 50 square miles. Females produce one litter of two to six pups annually.

Effect on wildlife: Deer fawns are especially vulnerable to feral dogs.

Evidence of predation: Like coyotes, feral dogs may chase and harass wildlife. They usually attack the neck and throat, but may attack the hindquarters of larger animals. Small prey are often bitten across the shoulders or at the base of the skull. Feral dogs tend to feed on the hindquarters and viscera first. Free-ranging domestic dogs generally mutilate their prey while attacking and do not feed on their victims.

Control alternatives: Net-wire fencing in good condition is a deterrent to feral dogs. Other alternatives are snares, cage traps, foothold traps and ground and aerial hunting. If dogs are damaging livestock they can be controlled with M-44 devices.

Birds

- Hawks, owls, eagles and all other nongame birds and songbirds (except for the few species listed below) are protected by various state and federal laws and may not be killed, taken from the nest, picked up, or possessed for any reason. Their feathers may not be possessed or sold. Only habitat manipulation can be used to protect wildlife from protected bird species. For game birds and fawns this means providing adequate nesting, screening and escape cover.
- The only birds not protected by any state or federal law are European starlings, English sparrows and feral rock doves (common pigeons). These species can be killed at any time.
- Yellow-headed, red-winged, rusty and Brewer's blackbirds, and all grackles, cowbirds (not cattle egrets), crows and magpies may be controlled without a state or federal depredation permit when they are found damaging or about to damage ornamental shade trees, agricultural crops, livestock or wildlife, or when they concentrate in numbers large enough to constitute a health hazard or other nuisance.

Owls, Hawks, Eagles and Harriers



(Wyman P. Meinzer, Jr.)

Figure 37. Great-horned owls are often referred to as "tigers of the sky." They are common across all of Texas.

The **great-horned owl** has a large head, forward-facing eyes, and feathers on its head that resemble horns. Its wingspan can be as large as 5 feet. It occurs throughout Texas. Owls are nocturnal and feed mostly on mice, rabbits, skunks, birds and other small animals. The great-horned owl is the primary owl species responsible for wildlife predation important to game managers (Fig. 37). Quail and turkey poults are often eaten, and turkeys (especially poults) may be killed off the roost. There will be scant evidence because owls ingest their prey in large gulps and then regurgitate pellets of indigestible items such as bones (Fig. 38).



Figure 38. This radio-tagged blue quail was killed and consumed by a great-horned owl. The foot, gizzard lining, and radio transmitter are all that remain.

The **golden eagle** (also called Mexican eagle) is the largest raptor (bird of prey) in Texas (Fig. 39). Adults are dark brown or bronze, up to 32 inches long, and have a wingspan of 6 to 7½ feet. The legs are feathered to the foot. The golden eagle is found over much of western Texas, usually from November through March. Golden eagles prey on deer and pronghorn fawns, and sometimes yearlings and adults. They also eat small game, rodents, livestock, fish, reptiles and carrion.

The **bald eagle** (Fig. 40) is about the same size as the golden eagle, but adults have a distinct white head and tail. Young bald eagles closely resemble golden eagles except that their legs are feathered only halfway down. Bald eagles prefer secluded, timbered areas near large bodies of water. They are most common in winter in the eastern half of Texas. Bald eagles eat the same prey as golden eagles, but feed mostly on fish where available.



(Wyman P. Meinzer, Jr.)

Figure 39. Golden eagles are most common in west Texas during winter and early spring.

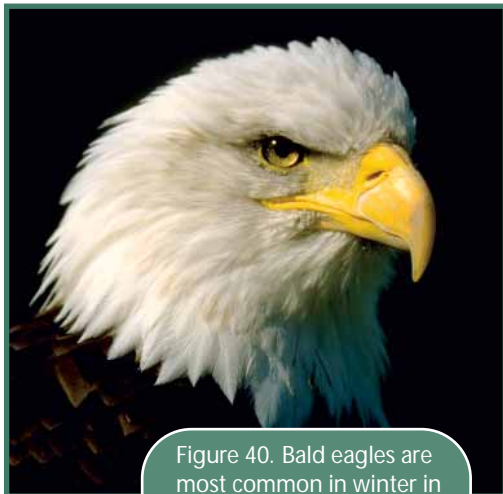


Figure 40. Bald eagles are most common in winter in the eastern half of Texas.

Eagles often "skin out" the carcasses of large prey, turn the hide inside out, and clip the ribs off near the spine (Fig. 41). They pluck the larger feathers of birds. They will often eat the brain through the bottom of the skull. Eagle talons leave tear drop-shaped holes in the hide of their prey. Their ability to carry large prey may be exaggerated, but they can carry up to 6 pounds with the right wind conditions.

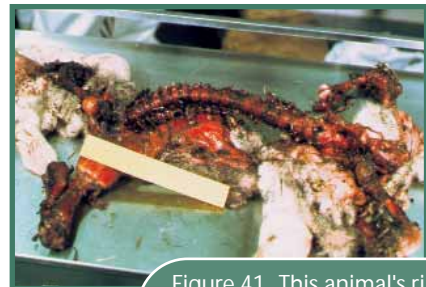
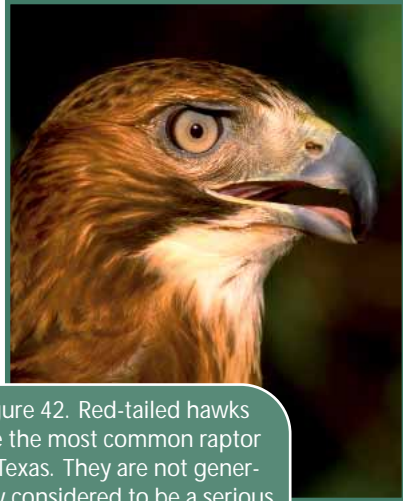


Figure 41. This animal's ribs were "pruned" off the backbone, which is characteristic of an eagle kill.



(Wynnan P. Meizer, Jr.)

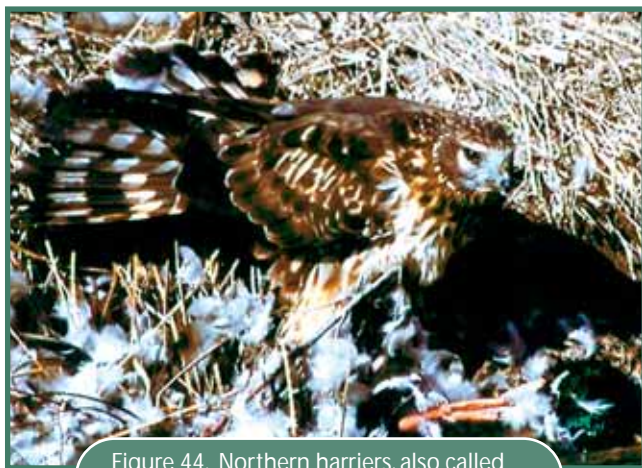
Figure 42. Red-tailed hawks are the most common raptor in Texas. They are not generally considered to be a serious predator of game birds.

Hawks are divided into two categories—buteos and accipiters. Buteos, such as the **red-tailed hawk** (Fig. 42), **Harris hawk** and **Swainson's hawk**, have broad wings, short and fan-like tails, and soaring flight patterns. They are often seen on power lines and in dead trees. Accipiters, such as the **Cooper's hawk** (Fig. 43) and **sharp-shinned hawk**, have relatively short, rounded wings and long tails. They are more agile than buteos and fly with rapid wing beats followed by a long glide. Accipiters are secretive and less easy to see, except when they dart through the brush. Hawks feed on mice, birds, reptiles and other small mammals. Buteos feed mostly on mammals, accipiters almost exclusively on birds. In fact, accipiters



Figure 43. Cooper's hawks are perhaps a quail's most feared enemy. Cooper's hawks and sharp-shinned hawks are adept at catching birds on the wing.

are probably the most proficient predator of adult quail. Kill sites will have feathers that have been plucked from the prey and skeletal remains that have been stripped. The wings are usually clipped off near the body.



(Dick Wilberforce)

Figure 44. Northern harriers, also called marsh hawks, are abundant during winter.

The **northern harrier**, or marsh hawk (Fig. 44), migrates into Texas in early fall and remains until April. It is common across most of Texas. Males are pale gray above and white underneath, while females are brownish above with streaked breast feathers. Juveniles resemble females but have cinnamon-colored breasts.

Females are slightly larger than males with a wingspan of up to 4 feet. Both sexes have white rump patches just above their long tails; this makes them easy to identify in flight. Harriers usually fly low, circling and quartering open fields



Figure 45. This bobwhite was killed by a northern harrier. Harriers are not as efficient at catching quail as Cooper's hawks, but they are far more abundant.

as they search for prey. Their diet consists of mice, rats, frogs, snakes, insects and small birds. Quail, pheasant and dove are generally the only game birds harriers prey on (Fig. 45). Kill sites will have feathers and skeletal remains that have been stripped.



Figure 46. Crows and ravens (pictured here) can be important egg predators if suitable nesting cover is limited.

Crows and ravens are scavengers that look much alike. Both are completely black. The common raven is about 21 inches long, and the crow about 17 inches long. The raven also has a larger, heavier bill. Crows have square tails and ravens rounded tails. Crows are also known for the distinctive "caw," while the raven has a hoarse "croak." Crows are found statewide. Ravens are found mostly in south and west Texas. Both species depredate game bird nests, leaving eggs with small, round holes or carrying off the entire egg (Fig. 46). They also attack young animals that cannot escape or defend themselves. The attacks usually start at the eyes, nose, naval and anal area. Survivors may be blind.

Predator Profiles



Figure 47. Turkey vultures (left) and black vultures (right) are common scavengers. Both species prey upon animals if the circumstances allow.

Turkey vultures (also called buzzards, red-necked buzzards or turkey buzzards) and **black vultures** are found throughout Texas (Fig. 47). **Caracaras** are most common in south Texas (Fig. 48). Black vultures have black heads and short, broad wings with white patches on the tips. Turkey vultures are similar but slightly



Figure 48. Caracaras are found in the southern part of Texas.

larger, with longer wings and distinctive red heads. Crested caracaras are in the falcon family. They stand erect and have white throats, wing tips and tail bands. Turkey vultures are primarily scavengers. Black vultures and caracaras can cause problems killing newborn fawns, lambs and goat kids. They attack the eyes, nose, navel and anal area. Survivors are usually blind.



Figure 49. Roadrunners are common across the western half of Texas.



Figure 50. Many people believe roadrunners eat quail chicks and eggs, but the scientific evidence available is not convincing.

The **roadrunner** (also called chaparral and paisano) is a slender bird with black plumage streaked with white above, mostly white plumage below, and a long, black tail (Fig. 49). The bird is 20 to 24 inches long and is found throughout the western half of Texas. An analysis of roadrunner stomachs in Texas revealed that their main food is grasshoppers, though they also eat dragon flies, honeybees, cottontail rabbits and even young roadrunners. Quail chicks were found in only two of the 130 roadrunner stomachs examined in a south Texas study. Roadrunners have been photographed at dummy nests but did not depredate the nests (Fig. 50).



Eagle tracks



Raven tracks



Roadrunner tracks

Snakes

There are many species of snakes in Texas. The most common venomous snake is the **western diamondback rattlesnake**. Common nonvenomous snakes include **bull snakes**, **coachwhips** and **rat snakes**. Rattlesnakes sometimes prey on quail and other small game (Fig. 51). Most snake species will depredate ground nests. Animals killed by rattlesnakes but not consumed were likely victims of the snake's self-defense. Skinned carcasses show fang punctures in a swollen area of discolored tissue. Controlling snakes to protect game birds is generally not feasible, but providing good nesting cover can help.



Figure 51. Rattlesnakes can take prey the size of full grown cottontails (and even jackrabbits). They also prey on quail.

Managing Game Animals

White-tailed Deer

The white-tailed deer is the king of game animals in Texas. Ranchers, hunters and game managers often strive to produce larger bucks or more deer, and reducing the losses to predators can be one way to accomplish this. Fawns less than 45 days old are especially vulnerable (Fig. 52). Mature bucks weakened during the rut are also at risk.

Reducing the number of large predators (coyotes and bobcats) may be especially beneficial in the spring just before fawns are born. This is best done with aerial gunning. Once the white-tailed deer population is the proper size for the carrying capacity of the region, predator control is probably unnecessary and can even be counterproductive. Intensive coyote control programs in south Texas did not increase the survival of post-rut bucks. Managers should plan to harvest the extra deer that result from predator control.



Figure 52. Deer fawns are most vulnerable to coyotes and bobcats until they are about 6 weeks of age.

Mule Deer

In Texas, mule deer generally live where their populations are limited by environmental factors such as low rainfall. But when predation becomes the main factor in keeping mule deer populations lower than desired, predator control should be considered. Selective methods, targeted at mountain lions and coyotes, may be beneficial. Case studies in Utah suggest that targeted control methods that increase fawn survival are cost effective. It is also important to maintain proper livestock stocking rates, especially during prolonged droughts, so that fawns have adequate cover.

Antelope

Pronghorn antelope live on open grasslands and prairies where their sharp eyesight, camouflage markings and tremendous speed help them survive predators. The fawns, however, are vulnerable. Coyotes, bobcats and golden eagles are the main predators of antelope fawns, and mountain lions sometimes kill adults as well. Keeping cattle at proper stocking rates will preserve good fawning cover. Deferring grazing before the fawning season also creates more suitable habitat. Where pronghorn numbers are low, coyote control in April and May can increase fawn survival by as much as 100 percent. Managers who monitor rainfall to estimate the next year's grass cover have a better idea when to control predators. In "normal" or "wet" years, it is probably not necessary.

Exotics

Exotic ungulates in Texas include axis, sika and fallow deer, blackbuck antelope and aoudad (Barbary sheep). Although wild, these species are legally considered to be "livestock." Most of the exotics in Texas inhabit the Edwards Plateau and have likely benefited from the ongoing predator control programs there aimed at protecting sheep and goats. Making sure fawning cover is adequate is the most important management practice.

Upland Game Birds

Wild turkey, bobwhite quail and scaled quail are important game birds in Texas. Both nests and adult birds are susceptible to predation, and these species have high mortality rates. Wild turkey and quail survive by hiding from and evading their enemies, so improving the habitat on a broad and uniform scale (over several square miles) rather than in a piecemeal fashion helps these birds more than removing predators. However, sometimes predator control is appropriate.

Turkeys are most vulnerable during spring and summer. They concentrate near draws or streams and use mature trees for roosts. They also congregate near supplemental feed sources.

Quail are preyed upon at all stages of their lives by a large number of animals, birds and reptiles. With so many possible predators, creating more useable habitat is essential—specifically, increasing the density of bunchgrasses (nesting sites) and producing more loafing coverts and screening cover. If predator management is deemed necessary, it should focus on removing nest predators such as skunks, raccoons, opossums and foxes.

For Further Information

Texas Cooperative Extension conducts predator awareness workshops. To find one in your area, contact your county Extension agent.

Materials Available from the Texas Cooperative Extension Bookstore

<http://tcebookstore.org>

The Role of Predator Control as a Tool in Game Management (SP-113)

Coyotes in the Southwest (SP-19)

Feral Swine (SP-18)

Preserving Texas' Quail Heritage into the 21st Century (SP-60)

Coping with Coyotes (B-1664)

Procedures for Evaluating Predation on Livestock and Wildlife in Texas (B-1429)

Other Contacts and Sources

Texas Cooperative Extension

Wildlife Services

P.O. Box 100410

San Antonio, Texas 78201-1710

(210) 472-5451

Prevention and Control of Wildlife Damage

<http://wildlifedamage.unl.edu/handbook/handbook>

The Mammals of Texas

<http://www.nsr.ttu.edu/tmot1/>

Texas Natural Resources Server

<http://texnat.tamu.edu>

Texas Parks and Wildlife Department

<http://tpwd.state.tx.us>

Texas Department of Agriculture

<http://www.agr.state.tx.us>

P.O. Box 12847

Austin, Texas 78711

(512) 463-7476

Animal and Plant Health Inspection Service

<http://www.aphis.usda.gov>

The Noble Foundation

<http://www.noble.org>

The Berryman Institute

<http://www.berrymaninstitute.org>

Texas Sheep and Goat Predator Management Board

233 Twohig

San Angelo, Texas 76903

(325) 659-8777

Texas Trappers and Fur Hunters Association

Box 883

Marfa, Texas 79843

Appendix A. Scientific names

Common name	Scientific name	Spanish name
Coyote	<i>Canis latrans</i>	coyote
Bobcat	<i>Lynx rufus</i>	gato montes, gato rabon
Mountain lion	<i>Felis concolor</i>	puma, leon
Red fox	<i>Vulpes vulpes</i>	zorra roja
Gray fox	<i>Urocyon cinereargenteus</i>	zorra gris
Raccoon	<i>Procyon lotor</i>	mapache, tejon
Striped skunk	<i>Mephitis mephitis</i>	zorrito
Spotted skunk (Eastern)	<i>Spilogale putorius</i>	
Spotted skunk (Western)	<i>Spilogale gracilis</i>	
Hog-nosed skunk	<i>Conepatus leucontus</i>	
Badger	<i>Taxidea taxus</i>	tejon, tlalcoyote
Opossum	<i>Didelphis virginiana</i>	
Feral Hog	<i>Sus scrofa</i>	marrano salvaje, cerdo, puerco
Feral cat	<i>Felis domesticus</i>	gato salvaje
Feral dog	<i>Canis familiaris</i>	perro salvaje
Great-horned owl	<i>Bubo virginianus</i>	tecolote
Bald eagle	<i>Haliaeetus leucocephalus</i>	
Golden eagle	<i>Aquila chrysaetos</i>	aguila
Red-tailed hawk	<i>Buteo jamaicensis</i>	
Cooper's hawk	<i>Accipiter cooperii</i>	
Sharp-shinned hawk	<i>Accipiter striatus</i>	
Northern harrier	<i>Circus cyaneus</i>	
Common crow	<i>Corvus brachyrhynchos</i>	cuervo
Common raven	<i>Corvus corax</i>	cuervo serrano
Turkey vulture	<i>Cathartes aura</i>	aura, buitre
Black vulture	<i>Coragyps atratus</i>	zopolite
Crested caracara	<i>Caracara plancus</i>	
Roadrunner	<i>Geococcyx californianus</i>	paisano
Rattlesnake	<i>Crotalus spp.</i>	vibora
White-tailed deer	<i>Odocoileus virginianus</i>	venado
Mule deer	<i>Odocoileus hemionus</i>	venado
Pronghorn antelope	<i>Antilocapra americana</i>	
Rio Grande turkey	<i>Meleagris gallopavo</i>	guajalote
Bobwhite quail	<i>Colinus virginianus</i>	codorniz
Scaled (blue) quail	<i>Callipepla squamata</i>	codorniz azul
Collared peccary (javelina)	<i>Tayassu tajacu</i>	javelina



**TEXAS SHEEP & GOAT
PREDATOR MANAGEMENT BOARD**

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