



The Impact of Predators on Deer in the Southeast

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INTRODUCTION

In the Southeast, white-tailed deer have multiple predators and individuals are sometimes killed by those predators. However, healthy deer herds can and do coexist in places with abundant predators. Although it is easy to dismiss the role of predators as purely negative in regard to deer management, it is important to remember that predators are a natural and normal part of a healthy, well-managed ecosystem. To assume predators have no beneficial purpose in deer management is to ignore the facts. However, when predator populations become too abundant and affect deer management goals, open discussions regarding the appropriate management actions are justified. Management strategies to balance the effects of predators on deer including trapping/shooting of predators, habitat management, and/or changes in deer harvest are all possible options that require careful and calculated review of available facts. These possible options require a careful and calculated review of available facts. The answer is **not a landscape without predators**. That approach is not practical and has led to drastic overabundance of deer populations that degrade habitat for many wildlife species, including deer. In this document we will discuss the current state of knowledge (i.e., scientific evidence) about predators as related to white-tailed deer in the Southeast, what management options are available, and the effectiveness of those options.

DEFINING WHITETAIL PREDATORS

In general, deer predators are fox-sized or larger mammals, but can even be as large as the American alligator. Foxes rarely prey on deer but sometimes kill fawns when larger dog-related predators (wolves and coyotes) are missing in an ecosystem. Feral pigs are opportunistic feeders, which might occasionally prey on fawns, but research has not shown them to be important predators of deer. In the very limited areas where they are found in the Southeast, red wolves and cougars are deer-hunting specialists. In the absence of larger cats and coyotes, bobcats can be the main predator of fawns and sometimes adult deer. Domestic dogs sometimes kill deer but probably have little effect on deer numbers. Although reported in the northern United States¹, it is rare for black bears to kill adult white-tailed deer. However, since it was first reported in 1982², black bears are now known to be important predators of fawns in some locations. Across the Southeast, coyotes can be another major predator of deer fawns, however, recent research has shown that coyotes rarely take adult deer³.

DEER PREDATORS

The primary deer predators in the Southeast are typically coyotes, bobcats, and black bears with the exception of cougars and red wolves where they exist. Other predators such as foxes, feral pigs, domestic dogs, and alligators kill deer infrequently and do not pose a serious threat to deer populations.



Photo: Shane Roberts



Figure 1: Researchers prepare a predator track station by creating a 3-foot diameter circle of hydrated lime and placing an attractant in the center of the circle. Photo: Will Gulsby

How Researchers Monitor Predators. The most obvious signs that deer predators exist on a property are footprints (i.e., tracks), scat (feces), or trail camera photos. Without photos, learning to identify tracks and scat is the first step to predator identification. Wildlife biologists use manmade track stations to inventory predators (Fig. 1). In addition, they collect scat to determine predator diets and sometimes to collect DNA samples. From these DNA samples they can identify predator species and sometimes even individual bobcats, coyotes or other predators⁴. Individual identification is important when researchers try to estimate the total number of predators in an area and their distribution across the landscape.

Unpaved roadways frequently are traveled by predators and provide a good location to search for tracks and scat. Predator tracks can be identified based on shape, size and relative placement (Fig. 2). For example, members of the dog family all make tracks showing four toes and the toenail marks usually are visible. Cat tracks typically are rounder than dog tracks but also show four toes with the toenail marks missing. Scat identification can be difficult when diets of the predator species are similar. However, cats have a habit of covering their scat by scratching together mud and debris. Members of the dog family might scratch near scat, but they do not make an effort to cover it. Bear scat changes in shape, size and consistency depending on seasonal changes in diet.

In addition to tracks and scat, it is possible to make other direct and indirect observations of predators. Where coyotes exist, their high-pitched barking and howling at night is a sure sign of their

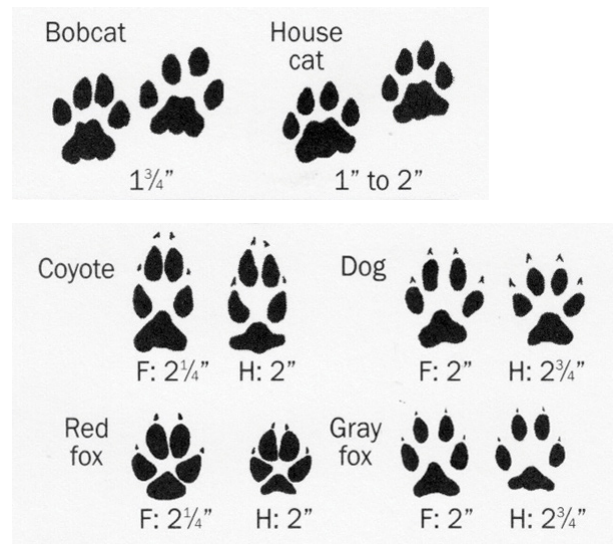


Figure 2: Examples of common predator tracks that may be encountered in Georgia. Graphics adapted from *Pocket Guide to Florida Animal Tracks*.

Researchers most often use track and scat surveys to monitor predator abundance. For coyotes they sometimes also use howling surveys.

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presence. Researchers sometimes perform howling surveys to monitor coyote abundance. Although elusive, predators occasionally can be seen while driving through a property, from a deer stand, or from trail camera photos (Fig. 3). Although these types of data can be used to estimate predator abundance, they require complex analytical techniques to provide reliable estimates. It is important to note, however, that the detection of predators on a property does not necessarily mean they are having a large negative effect on the deer herd. In fact, under certain circumstances predators might be helping to better manage the property's deer herd.

Deer Carcasses. Finding a dead deer that has been fed upon does not necessarily mean it was killed by a predator. In fact, predators frequently feed on deer that died from other causes. In addition, a deer killed by one predator might be fed upon by another. Therefore, researchers must be careful to not rush to judgement when they find a suspicious deer carcass. When they need to make an educated guess regarding which predator killed a deer, they use a systematic approach. They first examine the kill site for detectable patterns that might help identify the predator. For example, was the carcass dragged or carried to secluded cover and fed on without much scattering of remains? If so, a bobcat or black bear might be involved⁵. Alternatively, if coyotes were involved, remains likely would have been scattered over a much larger area⁵. Did the predator leave behind its tracks, scat, or hair?

Researchers often skin the carcass and examine it for puncture wounds and other tissue damage (Fig. 4). Predators sometimes can be distinguished by the location and other characteristics of bite and claw marks. For example, when fawns are killed by coyotes, they typically have bite marks on their head and/or neck with occasional bite marks on their backs, or elsewhere⁶. Sometimes, when fawns are killed by coyotes, the only evidence is blood, a few tufts of hair and pieces of flesh, bone, or fat⁶. Bobcats also bite the head, neck or throat but are more likely to leave claw marks on the back, sides and shoulders⁷. In addition, bobcats often cover the carcass remains with live or dead vegetation⁸. When black bears kill fawns, bone fragments might be the only remains left at the feeding site⁹. Domestic dogs typically feed very little on the carcass and they haphazardly bite the deer to kill it. Modern DNA techniques also allow researchers to test saliva and scat samples taken to determine which species of predators fed on a carcass. Although this is highly valuable information, this technique does not separate between a predator that killed the prey versus one that scavenged on the carcass.

Changes in the deer herd. Landowners and hunters should avoid jumping to the conclusion that they have a predator problem just because predators are on their property. Remember, some amount of predation is



Figure 3: Trail camera photos can be used by researchers to estimate predator distribution and abundance. Photo: Michel Kohl



Figure 4: Researchers measure the distance between tooth puncture wounds to help determine which predator killed this deer. Photo: Daniel Crawford

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normal for all wildlife. In addition, deer die from other natural causes even when predators do not exist. From a deer management standpoint, losing a few deer to predators likely will not have a noticeable effect on a deer herd due to what researchers call *compensatory mortality*. Compensatory mortality happens when an animal dies from one cause of mortality (e.g., predator) but would have eventually died from another cause (e.g., starvation, disease).

For example, imagine that 10% percent of a deer herd dies on your property each year because of limited food sources. In the next year, a coyote pack moves into the area and kills 5% of the deer herd. However, with more food on the ground, only 5% percent die from starvation. Thus, the same number of deer (10%) die that year, meaning coyotes did not reduce the deer population despite coyote-caused mortality.

It is also possible that coyotes can lead to an increased deer population. This could happen in our previous example, if for example, only 3% of deer die due to starvation in the next year. So, in this case, yearly deer mortality would be reduced to 8% (5% coyote mortality + 3% starvation) because of the extra food availability. *These cases are common rather than the exception*. Similarly, for herds with moderate to high production of fawns, removal of some fawns by predators can help prevent excessive herd growth when the harvest of adult females is too low.

It is important to remember, however, that when deer populations are low due to other factors (e.g., poor habitat), and predators kill too many fawns or when predator-related mortality is combined with excessive hunter harvest of adult females, it can lead to localized declines in deer numbers. Given these possibilities, the only way to know if a property has a predator problem is to monitor characteristics of the deer herd over time. To achieve this, researchers often use trail cameras and hunter observations to estimate the number of bucks, does and fawns. Of particular importance is the fawn recruitment rate (number of fawns surviving to six months of age per adult doe). ***Just because a property has deer predators does not necessarily mean it will have low fawn recruitment.***

Monitoring changes in a deer herd requires a degree of quality control. For example, trail camera surveys must follow a strict protocol to prevent erroneous conclusions¹⁰. Common mistakes are a lack of consistency in the timing of cameras being deployed from year to year, failure to maintain adequate bait (corn) at camera sites, and different numbers of cameras being used each year. These unintentional mistakes could lead to a misunderstanding about the state of a deer herd. Generally speaking, 1 camera per 100 acres for 14 consecutive days will provide the best estimate of population characteristics¹⁰.

PREDATOR DIET STUDIES

Wildlife researchers learn what predators eat by studying the contents of their stomachs and scat (Fig. 5). In general, these food habit studies provide a good idea of predator diets. However, remember that predators sometimes eat deer they find dead and the remains of hunter-harvested deer. In addition, predator diets change seasonally with some foods being important only during a particular season.

Coyote. A University of Georgia (UGA) study conducted in western South Carolina documented fawns to be the most common animal food item of coyotes during May and June despite low deer numbers at that location¹¹. A study conduct-



Figure 5: University researchers collected this coyote scat and dissected its contents to reveal what plants and animals were eaten. Photo: Jennifer Ward

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ed in Alabama, Mississippi, Kentucky and Tennessee found the number of fawns in the diets of coyotes was directly related to deer herd density with more fawns eaten when deer numbers were greater¹². A UGA study documented similar results even when the area with the high-density deer herd contained relatively more alternative coyote foods¹³. In other words, coyotes not only opportunistically killed fawns when they were available, they actually selected for them even when other foods were common. However, research conducted by UGA in southern Georgia found the occurrence of small mammals (e.g., rabbits and rodents) in coyote scat decreased the chances of finding adult deer in the same scat¹⁴. The researchers also found that when more fruit occurred in coyote scat, the chance of finding deer fawns in the same scat decreased. Therefore, the more fruit coyotes ate, the fewer deer fawns they ate¹⁴. This does not necessarily suggest that managing for rodents, fruits and other alternative coyote foods will result in reducing coyote predation on fawns. More research is needed including use of DNA metabarcoding techniques which enables more complete identification of foods contained in scats versus traditional visual examination.

Bobcat. Rodents and rabbits are the most common foods of bobcats. However, deer can be an important food in certain locations¹⁵. Occurrence of deer in bobcat scats collected from central Mississippi did not differ by season because of high use of deer by bobcats during both the summer fawning season and the fall-winter deer hunting season¹⁵. A UGA study conducted in northeastern Alabama also found peaks in deer use by bobcats during fawning and deer hunting seasons¹⁶. Although bobcats kill and eat deer, food habit studies have shown use of deer by bobcats occurs much less frequently than use by coyotes in the same area¹⁵. In Florida, only 4 of 87 bobcat scats contained deer remains, all collected during the fawning season¹⁷. In Arkansas, deer remains were found in only 11 of 150 bobcat stomachs¹⁸. Of the stomachs containing deer, 8 were collected during the November and December deer-hunting season suggesting that bobcats might have taken advantage of wounded deer and scavenged carcasses of hunter-harvested deer.

Black Bear. A UGA study conducted in southeastern North Carolina found that plant parts comprised most of black bear diets each month with deer remains found only in small amounts in May, July and October¹⁹ (Fig. 6). Other food habit studies in the eastern U.S. also reported little or no use of deer by black bears with insects providing the greatest amount of animal-based dietary protein²⁰⁻²². However, a black bear food habit study from Oregon reported deer to be an important food during seasons when other sources of protein were unavailable²³.



Figure 6: Food habit studies have shown that plants constitute the majority of black bear diets, as suggested by the abundance of fruit parts in this bear scat. Photo by David Osborn

DEER SURVIVAL STUDIES

Researchers study the survival of deer by placing collars around their necks which emit a signal when the deer does not move for several hours and is presumed dead (Fig. 7). As discussed above, when a dead deer is found, researchers then attempt to determine why it died. That is not always easy. Fortunately, with a large enough sample of collared deer it is still possible to obtain reliable evidence. Also, new DNA technology can identify a predator from a sample of its saliva, an approach currently being applied in the UGA North Georgia Deer Project. Therefore, researchers sometimes swab the wound site and the head and neck of a dead deer in hopes of collecting a saliva sample.

To date, we have learned a great deal about deer survival. Across populations, fawn survival is a driving factor in local deer abundance. A recent survey of 29 deer-fawn studies from across the United States suggests that average fawn survival to 3-6 months of age is only 41% in forested landscapes²⁴. This may help explain why the 3 lowest fawn survival rates were observed here in the southeastern United States. Across these studies, canid predation represented the greatest source of mortality (40%), followed by bear (17%), and bobcat (7%)²⁴. In the ongoing UGA North Georgia Deer Project, fawn survival (17%) also appears lower than that of other populations in the United States.

However, it is important to note that many of these fawns would have likely died anyway due to “compensatory mortality.” This was recently demonstrated by a study from Delaware which reported 3-month fawn survival to be 44% in an area where predators did not occur²⁵. In comparison, adult deer survival is high and relatively constant across years ranging between 80-90% in most populations regardless of the presence of predators²⁶. Human harvest, followed by deer-vehicle collisions, is the primary source of mortality for adult deer.

Coyote. In a South Carolina study involving 91 radio-collared fawns, 56 (80% of deaths) likely were killed by coyotes²⁷. A UGA study conducted in southwestern Georgia resulted in the killing of 11 of 47 collared fawns²⁸. A few other deer survival studies have similarly shown that coyote predation can be the primary source of fawn deaths and predation by coyotes might limit fawn recruitment in the Southeast^{7,29,30}. Although rare, coyotes do have the ability to prey upon adult deer as demonstrated by a North Carolina study that reported 4 of their 28 radio-collared adult female deer were killed by coyotes³¹. However, over a 7-year period, a South Carolina study documented none of the deaths from 138 radio-collared yearling and adult females were the result of coyotes in spite of high coyote abundance³. Similarly, the UGA North Georgia Deer Project has reported no adult deer mortality due to coyotes from 2018-2020.

Bobcat. A Florida study examined both food habits of bobcats and survival of 66 radio-collared fawns¹⁷. Although they concluded that deer were not a very important component of bobcat diets based on scat analyses, bobcats killed 11 of their collared fawns. In another Florida study, bobcats killed 33 of 83 (40%) radio-collared fawns⁸. In contrast, all other predators killed a total of 23 fawns in that study. A UGA study on Kiawah Island, South Carolina monitored survival of 134 radio-collared fawns³². In the absence of coyotes, bobcats killed 70 of the fawns with a single adult male radio-collared bobcat likely responsible for many of those deaths. It appears that although deer are not the primary food of most bobcats, some bobcats learn to prey on deer and can be effective at killing them, especially fawns.

Black Bear. Radio-collared fawns and adult deer have been reportedly killed by black bears in northern locations^{1,9,33-35}. However, until recently, no studies had documented black bear predation on deer in the Southeast. A UGA study in Louisiana recently used DNA analysis of 45 fawns to confirm that 15 were killed by black bears³⁶. Black bears killed more fawns at this location than either bobcats or coyotes, however, none of these predators had a significant impact on adult female deer²⁶. The UGA North Georgia Deer Project identified bears as the second most important predator of deer fawns after coyotes.



Figure 7. Researchers study fawn survival by capturing fawns and fitting them with radio-transmitting collars. This technology enables them to know when and where a collared fawn has died. Photo: Becky Shuman

PREDATOR REMOVAL STUDIES

Predator studies have clearly demonstrated that deer are an important food to some predators and that predators often are effective at killing deer. However, those studies only looked at the effect of predators on individual deer, not the entire herd. Therefore, researchers have designed studies to measure deer herd productivity with and without predators. These studies have measured fawn recruitment before and after removing coyotes, bobcats and sometimes other medium-sized carnivores.

Research conducted in Texas demonstrated removal of 80% of the predators (132 coyotes and 18 bobcats) resulted in a 70% increase in fawn numbers the first year and 43% increase the second year when compared to an area without predator removal³⁷. An Oklahoma study reported a 154% increase in fawns after 4 years of intensive removal of coyotes³⁸. A UGA study, on a large property in southern Georgia with a low-density deer herd, measured fawn numbers after removing 34-43% of the estimated coyote population from a coyote-removal zone³⁹. Data collected in February, after the coyote removal, suggested there were twice as many fawns per adult doe (0.97 fawns:doe) in the removal zone as in a similar non-removal zone (0.45 fawns:doe). Another UGA study conducted in northeast Alabama showed that removing almost all coyotes and bobcats before fawning season when combined with no harvest of does allowed that deer population's fawn numbers to increase dramatically¹⁶. However, in central Georgia, UGA researchers documented increases in fawn numbers



Photo: John Hickman

at only 1 of their 2 study sites regardless of similar efforts to remove coyotes on both sites⁴⁰. In addition, a South Carolina study documented continued declines in fawn numbers despite a consistent, large-scale predator removal program²⁹. Another South Carolina study reported only modest recovery of fawn numbers after predator removal and believed coyote control alone was an ineffective management tool⁴¹. This explains why predator removal, which can be expensive and difficult to accomplish, may have no effect on prey numbers⁴¹⁻⁴³. However, when combined with reduced harvest of adult female deer and habitat management, predator removal might help to stabilize or increase deer numbers on some properties^{29,44}. Because predators can repopulate an area within a few months to a year after a large removal⁴², it likely is necessary to conduct an annual removal just before each fawning season to realize an increase in fawn recruitment.

OTHER PREDATOR STUDIES

It is obvious that predators can directly affect individual deer and possibly deer herds. Predators also might have an indirect effect on deer by creating an environment of fear associated with predation risk. Recent UGA research tested the effects of coyotes on deer behavior⁴⁵. By building large, fenced pens which excluded predators (predator exclosures) they were able to create predator-free refuges for deer. They then measured deer behavior inside and outside of the exclosures. When deer co-existed with coyotes (i.e., those outside of the exclosures) they increased their vigilance and spent less time feeding when compared to deer within the relative safety of the predator exclosures. In addition, females with fawns were most active (i.e., caught on cameras) at dawn and dusk when predators were excluded, however they switched to primarily daytime activity when predators were around⁴⁶. Together, this suggests that younger animals may be active in the hottest parts of the day while also spending less time feeding which may have a negative effect on herd health.

HABITAT-RELATED STUDIES

Research conducted in the Midwest and Great Plains reported that habitat characteristics related to fawn escape cover influenced fawn survival^{47,48}. In other words, fawns were less likely to be caught by predators if they had thick understory vegetation like grasslands and wetland marshes to escape⁴⁹. Irregularly shaped forest

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patches which result in increased amounts of edge may also contribute to increased fawn survival⁴⁷. In theory land managers could inventory available fawn escape cover and modify the habitat as needed to increase fawn survival. Unfortunately, similar studies have shown no survival benefit related to forest patch shape or vegetation density^{3,50}. Although it seems logical that quality and arrangement of escape cover could influence fawn survival, habitat modifications for this purpose need further evaluation before they are prescribed.

Some studies have suggested that habitats containing abundant fruits during fawning season may buffer coyote predation on fawns by providing a readily available alternative food at that time of year^{11,14,51}. Although the relationship between fruit crops and fawn predation has not been rigorously tested, managing for quality, early successional habitat will benefit deer and other wildlife with similar needs; therefore, it is always a viable strategy.

MANAGEMENT IMPLICATIONS

It is unlikely that predators limit population growth of highly productive deer herds with relatively low natural mortality. Unfortunately, in some studies, 70-100% of fawns died each year of natural causes including predation. In these situations, predation likely is limiting population growth and reducing the percentage of the herd available for hunting. When other forms of natural mortality are combined with predator- and hunting-related deaths of females, some deer population declines are inevitable. If trail camera surveys and hunter observations suggest a deer herd is stable or growing in spite of predators, there is no reason to take actions against predation. In fact, predators might help to better manage the deer herd by reducing deer numbers and competition for resources. When information suggests that fawn recruitment is low, predation might be a problem. However, before turning to predator control as a solution for poor fawn recruitment, landowners must first be sure the habitat is providing enough quality nutrition and cover. Is the deer herd in balance with the available habitat? If not, then removing predators will only make the problem worse. If a landowner is uncertain about the quality of their habitat or health of their deer herd, it is best that they ask for help from a state wildlife agency biologist. The [Georgia Deer Management Assistance Program](#) (DMAP) is a program recently established to provide such assistance.

Biologists can help set deer harvest quotas. As a general rule, 20-40% of the sexually mature females must be removed each year to prevent excessive population growth. However, if fawn recruitment is low because of losses to predators, the harvest quota for adult females might need to be reduced to allow more fawns to be born the following year. Similarly, if doe harvest is too high and has reduced fawn recruitment to a level where the effect of predators is greater, then a reduction in doe harvest is necessary. In situations where predator control has proven ineffective, a reduction in doe harvest may offset losses to predation. While maintaining a consistent doe harvest is usually recommended to maintain deer populations at healthy levels, the situation can be quite different when predators are minimizing your ability to achieve deer management goals. Researchers have recommended reduced doe harvest to increase fawn recruitment^{29,31} and aside from habitat management, this may be the only viable option when predator control is ineffective. In some cases, both a reduction in hunter harvest and predator removal might be necessary to stabilize a declining deer herd. Again, it is impossible to know which management option is best for a particular property without closely monitoring the deer herd.

Predator trapping is labor intensive and requires a long-term commitment. Removing a few random coyotes will not affect fawn recruitment. Predator removal is also expensive. It is reasonable to assume that a professional trapper will charge an average of \$123 to \$199 per coyote removed²⁷.

In the studies mentioned above, predator numbers (especially coyotes) typically recovered to their previous levels after a year or two of population reduction. This trend is the rule, rather than the exception and illustrates the need to continuously maintain trapping efforts to maintain any benefit gained from it. Recent research out of southern Georgia shows that coyote population size typically does not decline even with consistent, annual removal efforts⁴². This is largely a result of immigration of new coyotes into the area. Therefore, overall reduc-

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tion in coyote population size may not be an achievable goal. However, timely, targeted coyote removal efforts during fawning season could increase fawn survival in some situations.

In most parts of the Southeast, numerous fee-based, predator control companies exist that can be contracted to trap and shoot predators. However, based on the research mentioned above regarding the effectiveness of this approach, the costs may or may not outweigh the benefits. Careful consideration regarding the cost-benefit of predator reduction should take place before implementation.

The single most important thing a landowner can do for deer on their property is provide quality habitat. Deer can eat 5-10 pounds of forage per day and require an abundance of high quality vegetation to maintain healthy body condition. Healthier does have more fawns and healthy fawns survive better. Ensuring adequate food and cover for a deer population through timber management via thinning, prescribed fire, or old-field management is the first step in maintaining a healthy and productive deer herd. If food and cover requirements are being met, deer harvest levels are appropriate, and a decline in the deer herd due to predators has been documented, managing predators is a reasonable to consideration.

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