Using Camera Surveys to Estimate White-tailed Deer Populations

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There are two primary categories of white-tailed deer (*Odocoileus virginianus,* hereafter deer) management: population management and habitat management. Habitat management includes such actions as prescribed fire, timber harvest, timber stand improvement, food plot plantings and grazing. Habitat management can increase the carrying capacity of the land for deer as well as influence deer distribution, body weights and fawning rates. Population management (or harvest) has the ability to alter deer density, age structure, sex ratio and fawn-to-doe ratio. Both habitat and population management are needed to fully realize deer potential on a property. However, without reliable estimates of white-tailed deer population characteristics, managers are limited in their ability to make appropriate management decisions or monitor the effects of those decisions.

Traditional methods used by landowners to estimate deer populations include strip counts (spotlight, aerial, thermal and infrared), track counts and pellet counts. These methods can be expensive, labor-intensive or limited to vegetation cover that is open (such as cropland or grassland) to provide high visibility. Additionally, these methods often have low detection probabilities and high variability, resulting in underestimations, particularly in areas with dense vegetation such as forests.

In the late 1990s, researchers introduced a technique to survey deer populations using baited infrared triggered cameras (ITCs). With the widespread availability of these cameras and the decreased cost, many managers can now use them for deer population estimation. Camera surveys are relatively simple to set up, non-intrusive and provide permanent documentation of captured animals. If conducted correctly, ITC surveys are a reliable technique to estimate deer population size and characteristics. Specifically, they allow for the estimation of sex ratio, fawn-to-doe ratio, age structure of bucks, population size and deer density. This fact sheet will cover estimating sex ratio, fawn-to-doe ratio, population size and deer density. Estimating the age of bucks from images is beyond the scope of this document. For information on this topic, visit https://www.qdma.com/articles/aging-bucks-on-the-hoof or contact your local Oklahoma Department of Wildlife Conservation biologist.

Despite the information provided by ITC surveys, they have several limitations and considerations. In addition to the cost of the cameras themselves, the cost of bait can be considerable, especially for larger properties. Further, sorting through the images is labor intensive. The use of bait also concentrates wildife, which can have negative consequences from predation and disease. Finally, ITC surveys do not provide estimates of habitat quality or the carrying capacity (the number of animals the land can support). This publication discusses the methods to conduct an ITC survey, the information that can be estimated from the surveys and the additional information that cannot be estimated from ITC surveys.

Survey Timing

To ensure deer visitation to camera locations, ITC surveys include the use of bait. Additionally, individual identification of bucks is determined by unique antler characteristics. Therefore, surveys should be conducted at times when natural food sources are less abundant, but before bucks drop their antlers. While timing can vary widely from one area to the next, antler shed typically occurs from late January to early March in Oklahoma. Further, food resources are generally limited in late winter as acorns, woody browse and crops are depleted and spring green up has not occurred. Therefore, early January is one of the best times to conduct an ITC survey.

Camera Density

The ability to determine accurate sex ratios and population estimates is dependent upon appropriate camera density on the property. Conducting a study with too few cameras or poorly placed cameras may result in reduced deer detections, and biased population estimates. Research suggests doe detection increases as camera density increases, resulting in unreliable sex ratio estimates at lower camera densities. A density of at least 1 camera per 100 acres has been found to be adequate in most situations. However, for small properties, a higher density of cameras will be needed, as bucks tend to dominate camera sites when only a few cameras are present, making estimates of sex ratios unreliable. Confidence in population and sex ratio estimates can only be achieved through saturation of the property with baited ITCs. Therefore, the use of ITC surveys is less reliable on smaller properties (less than 1,000 acres). If you own or manage less, consider forming a hunt cooperative with your neighbors to conduct surveys and formulate management actions. This will enable better deer management, and reduce individual expense related to camera purchase and associated survey costs.

Camera Placement

In general, camera stations should be evenly distributed across the property. However, placement consideration should include areas deer will actually use, such as food plots, natural food sources and deer trails. Areas with dense vegetation that limits deer movement and makes detection difficult are not desirable. Additionally, stations should be accessible by vehicle, making bait placement during the survey feasible. Install cameras on a tree or post at waist level, facing either north or south to avoid sun glare. Remove standing grass and tree limbs within the sensor area. Cameras may be triggered by vegetation moving in the wind. These false captures use unnecessary battery power, occupy camera data storage and increase labor when sorting images. Additionally, vegetation may reduce the ability to accurately identify individual bucks, which will bias population estimates.

Bait Selection

Bait type is another important consideration when conducting ITC surveys. The bait selected may influence both the cost of conducting the survey, and the resulting population estimates (Table 1). Individual deer may preferentially visit one bait type over another, or spend an unequal amount of time at different bait types. These preferences may lead to unequal capture probabilities, and result in biased population estimates.

Table 1. Comparison of herd composition and population estimates for a population of white-tailed deer at the Oklahoma State University Cross Timbers Experimental Range, Payne County, Okla. In December 2010 and 2011, infrared-triggered cameras were baited with either corn or milo. Notice the different bait types resulted in vastly different estimates of the doe population in 2010, which affected the estimated sex ratio, population size and deer density.

	2010		*2011*	
	corn	*milo*	*corn*	*milo*
Captures				
Buck	1,118	965	829	1,011
Doe	1,667	2,469	1,948	2,320
Fawn	1,321	1,626	1,366	1,778
Ratios				
Doe:Buck	1.49	2.56	2.35	2.29
Fawn:Doe	0.8	0.65	0.7	0.77
Estimates				
Buck	30	33	31	32
Doe	45	84	73	73
Fawn	36	55	51	56
Population	111	172	155	161
Density (acre/deer)	3.6	2.3	2.6	2.5

Due to these differences, it is critical to be consistent in the bait type used across a property, between years or between properties if you intend to make comparisons.

Corn is frequently selected to bait ITCs. Baiting with corn has been shown to result in significantly greater visitation to ITCs compared to protein pellets and minerals. Non-target wildlife such as various birds, northern raccoons and feral hogs frequently visit bait piles, and may consume a large amount of bait intended for deer. Non-target visitation and consumption of bait increases the overall cost of conducting ITC surveys. This increase in survey cost is a result of increased bait cost, fuel cost and labor in sorting images. Due to this issue, consider using grain sorghum, such as milo. It is readily consumed by deer, and has lower non-target visitation (Table 2), making it a suitable alternative to corn when baiting ITCs. Additionally, aflatoxin is less of a concern with milo (see **Aflatoxins**).

Conducting the Survey

To ensure adequate visitation to ITCs during the survey period, pre-baiting should be conducted for 10 to 14 days prior to the survey. Bait should be placed on the ground 10 to 15 feet from the ITC. The appropriate amount of bait to dispense, as well as how often the bait needs to be replaced, will be

Aflatoxins

Aflatoxins are the toxic by-products from certain molds (*Aspergillus* spp.). Grain crops may become contaminated prior to harvest, during curing and storage and while in use as wildlife feed. Aflatoxin exposure can cause organ dysfunction, internal bleeding and death. Even ingestion of small amounts of contaminated grain can lead to decreased reproduction, birth defects, tumors and suppressed immunity. When conducting a baited ITC survey, there are several ways to reduce the risk of aflatoxin exposure.

1. Avoid baiting in warm, moist conditions. Baiting should be limited to times when temperatures are below 60 F, and rain is not expected. Aflatoxin production begins when grain moisture content exceeds 18 percent. Therefore, high humidity and dew may provide sufficient moisture to facilitate the formation of aflatoxin.
2. Aflatoxin production occurs when fungus has access to the sugar present in grains. Purchasing bait with lower available sugar, such as milo, reduces the chances that aflatoxin will be present at the time of purchase.
3. Reduce the length of time that grain is available by limiting the amount of bait dispensed at any given time. If possible, remove uneaten bait before dispensing new grain. Replenish bait every three to four days.
4. Never bait or feed wildlife with damaged grain. Grain that has mold or is clumping should not be used as bait.
5. Piling bait should be avoided. Piling grain facilitates the accumulation of moisture, increasing the risk that aflatoxin production occurs. When baiting, disperse grain as much as possible within the infrared zone of the camera.

Table 2. Comparison of nontarget image capture at the Oklahoma State University Cross Timbers Experimental Range, Payne County, Okla. In December 2010 and 2011, infrared-triggered cameras were baited with either corn or milo. Note: milo yielded many fewer non target image captures, particularly from birds, northern raccoons and eastern fox squirrels.

	Corn		*Milo*	
	Captures	*Proportion*	*Captures*	*Proportion*
Bird (multiple spp.)	1,176	78.50%	571	87.71%
Northern raccoon	135	9.01%	2	0.31%
Eastern fox squirrel	128	8.54%	8	1.23%
Eastern cottontail	36	2.40%	63	9.68%
Coyote	20	1.34%	7	1.08%
Gray fox	3	0.20%	0	0.00%
Total	1,498	100.00%	651	100.00%

determined by deer density and visitation. Avoid dispensing more bait than can be consumed in a three- to four-day period to reduce the risk of feed contamination from aflatoxin.

Following pre-baiting, cameras should be set to take an image every four to five minutes when motion is detected on or near the bait pile. This will reduce the likelihood of repeated captures of the same individuals. ITC locations should be visited every three to four days to replenish the bait and ensure that the ITC is working correctly. The duration of the survey should be 10 to 14 days.

Analyzing Photographic Captures

Once the survey period is complete, download all images into separate folders for each camera. Each image must be viewed, with each deer in each photograph identified and counted as a buck, doe or fawn. A single photograph containing two does and a fawn is counted as three separate captures (doe captures = two and fawn captures = one). When all of the photographs have been examined, you will have a total capture count for bucks, does and fawns. Below is an example data set to illustrate how to make calculations from ITC data.

STEP 1: View Images

Number of buck captures: 1,950
Number of doe captures: 2,985
Number of fawn captures: 3,532

The calculations for estimating population size are based on the number of identifiable bucks observed in the survey. While sorting the images, identify each individual branch-antlered buck using antler configuration (number of points, relative length of points, angle of projection of points and relative location of points on the antler beam). A reference photo of each buck should be selected and referred to during sorting. If possible, individual spike-antlered bucks are also identified and counted using antler configuration. The numbers of branch-antlered and spike-antlered bucks are summed to estimate the number of antlered bucks within the population. It is assumed that each buck within the population will be captured during the survey period.

STEP 2: Identify Individual bucks

Number of identified bucks: 38

To calculate the doe-to-buck ratio (or sex ratio), the total number of doe captures is divided by the total number of buck captures.

STEP 3: Calculate Doe-to-Buck Ratio

Divide 2,985 (the total number of doe captures) by 1,950 (the total number of buck captures).

2,985 / 1,950 = 1.53 doe-to-buck ratio

The doe-to-buck ratio is then multiplied by the number of individually identified bucks to estimate the number of does within the population.

STEP 4: Estimate Does

Multiply 1.53 (the calculated doe-to-buck ratio) by 38 (the number of individually identified bucks).

1.53 X 38 = 58 does

The fawn-to-doe ratio is calculated by dividing the total number of fawn captures by the total number of doe captures.

STEP 5: Calculate Fawn-to-Doe Ratio

Divide 3,532 (the total number of fawn captures) by 2,985 (the total number of doe captures).

3,532 / 2.985 = 1.18 fawn-to-doe ratio

The fawn-to-doe ratio is then multiplied by the number of estimated does to estimate the number of fawns within the population.

STEP 6: Estimate Fawns

Multiply 1.18 (the calculated fawn-to-doe ratio) by 58 (the number of calculated does).

1.18 X 58 = 69 fawns

Total population size is estimated by summing each segment (buck, doe and fawn) of the population.

STEP 7: Estimate Total Population

Sum each segment of the population.

38 bucks + 58 does + 69 fawns = 165 deer

Deer density is estimated by dividing the number of acres in the survey area (property) by the total estimated population size.

STEP 8: Calculate Density

Divide the number of acres by 165 (the estimated total population size).

2,000 acres ÷ 165 deer = 12.1 acres per deer

Summary

The use of ITC surveys can aid managers in making appropriate and informed management decisions. The information from the surveys can be used to estimate sex ratio, fawn-to-doe ratio, population size, deer density and age structure of bucks (See https://www.qdma.com/articles/aging-bucks-on-the-hoof for instructions). These surveys do have several limitations, including cost of cameras, bait and labor. Additionally, this method works best for larger properties. Managers may want to consider spotlight surveys, helicopter surveys or thermal surveys as an alternative if the vegetation is fairly open across the property. However, forested areas are not conducive to spotlight surveys. Track counts and pellet counts are not reliable for any property. While ITC surveys can provide important information for land management decisions, they are imperfect and do not provide all the information needed. For example, knowing how many deer are on a property does not indicate whether more of fewer should be harvested. Some measure(s) of habitat condition and deer condition will be needed to make that determination. Body weight of each harvested deer is a measure managers should record, as it provides an index of habitat quality and available food resources. Additionally, browse surveys may be used to assess whether deer are exceeding the food resources during late winter. The use of ITC surveys does provide an index for how population measures change across time in response to habitat management or harvest. Further, ITC surveys can be useful to compare different properties to each other. Despite the limitations of ITC surveys, if properly used, they can aid managers in better deer management on their property. For additional information about deer habitat and population management, contact your local Oklahoma Department of Wildlife Conservation biologist or visit QDMA.com for assistance.

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