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The Basics of Using Remote Cameras to Monitor Wildlife

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Landowners are often interested in monitoring wildlife on their property for a variety of reasons, some of which are the observation of wildlife and the identification of problem animals. Additionally, landowners may want to assess the effectiveness of habitat management plans by monitoring various wildlife species' responses.

Some animals, such as songbirds, are easily seen and heard, but many animals are secretive or nocturnal, making them difficult to detect. To determine the presence of hard-to-see animals, landowners must often use indirect methods such as identifying tracks, scat, or burrows. Fortunately, new technology such as remote cameras can assist in the identification of hard-to-view wildlife species (Fig. 1).

Figure 1. A coyote, typically an animal difficult to observe, "captured" by a remote camera.

Remote cameras have become increasingly accessible and affordable to the general public. These cameras, also known as trail cameras, are often found in sporting goods stores due to their popularity among sportsmen. The Internet is also a great source for finding trail cameras as well as reviews of different models and manufacturers.

Remote cameras can assist hunters with locating game, estimating population numbers, and understanding animal activity patterns (Fig. 2). However, remote cameras can also be used by anyone interested in observing wildlife. With the burgeoning market, options for trail cameras are changing rapidly and are becoming more affordable. For example, in 2008 we identified more than 30 manufacturers that designed and sold trail cameras with a wide variety of options and prices.

Figure 2. Wild turkeys, popular game animals, "captured" by a remote camera. This model of camera provides a time stamp, which can be helpful information for hunters.

Given the rapid advances in remote cameras, it is helpful to understand the associated terminology, options, and strategies for use. In this fact sheet, we describe camera options and considerations for use as monitoring tools for landowners interested in documenting wildlife on their property. Our review is not exhaustive, as new models enter the market each month. However, the general principles should be helpful for those that have limited experience with trail cameras.

Options and Terminology

Sensors

Cameras with **active infrared (AIR) sensors** have triggers that consist of two pieces of equipment: an IR (infrared) transmitter that emits an IR beam, and an IR receiver that detects an IR beam (Fig. 3). The detection zone (the area the animal must enter to activate the camera) is a straight line, which can span up to 150 feet, between the transmitter and the receiver. The system will only activate and capture an image after an object enters the detection zone, thus breaking the IR beam for a specified period of time.

Advantages: The IR beam can be set at a desired height to exclude certain species. Also, these systems are relatively insensitive to changes in ambient temperature, including movement of sunlight.

Disadvantages: AIR systems are expensive and require much setup time to ensure that all system components are aligned. Furthermore, because AIR systems require only that the IR beam is broken, they are often activated by vegetation that enters the detection zone and breaks the IR beam. This can result in many images of leaves instead of animals.

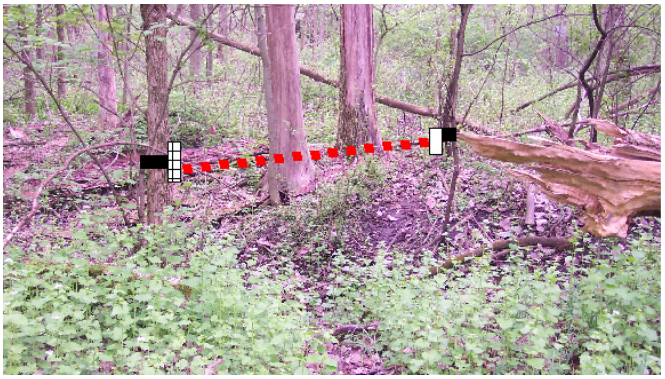

Figure 3. A diagram of a typical AIR design.

Cameras with **passive infrared (PIR) sensors** represent a majority of the remote camera market and have triggers that consist of one piece of equipment that detects both heat and motion (Fig. 4). Motion is required, as the system is activated by a rapid change in the amount of heat detected in the detection area. Thus, if an animal does not move in the detection zone, the system will not detect a change and will not activate to capture an image.

Depending upon the system, the detection zone for many PIR systems has sensitivity adjustments, providing the user with the option to set the sensitivity high enough to detect even small amounts of change. PIR detection zones can also vary drastically in the amount of area they cover. Some systems have a long-wide detection zone that covers the entire photo area; others cover only a short-narrow strip in the middle of the photo area as well as everything in between. (See Detection Zone Size on page 5 for more information.)

Advantages: PIR systems are easy to setup, have large detection zones, and have low sensitivity to vegetative movement.

Disadvantages: PIR systems have a low tolerance for rapid changes in temperature or movement of sunlight through the detection area; therefore, PIR systems can often be activated by such events (due to heat detection). These systems are also less sensitive to small animal movement. Furthermore, high ambient temperatures can reduce a system's sensitivity to the presence of large animals.

Figure 4. A diagram of a typical PIR design.

Flash

Incandescent flash is the typical visible flash used by most cameras and is widely available by many different trail camera manufacturers. An incandescent flash can frighten wary animals. Furthermore, the bright visible light makes the system conspicuous, which increases the probability of theft at unsecure sites. However, an incandescent flash allows color images to be taken during night and day, but unfortunately, an incandescent flash system does not have nighttime video capability.

Advantages: Trail cameras equipped with incandescent flashes are typically less expensive than those equipped with infrared (IR) flash, and they will allow for color images during both night and day.

Disadvantages: The visible flash frightens some species of wildlife, consumes more battery power than a typical IR flash, and does'nt take nighttime video.

Infrared flash functions in the same way as incandescent flash but produces light that is not visible to humans or to most animals. Most trail cameras that use IR flash are in the 850 nm wavelength range and emit a slight orange glow—seen only when looking directly at the unit—when the flash is activated. Currently there are only a few trail cameras in the 900 nm wavelength range that do not glow orange; these systems produce a completely invisible IR flash. More models with IR flashes in the invisible range will likely become available in the near future. Cameras that use 900 nm wavelength require more power for the flash to illuminate the same area as cameras using the 850 nm wavelength and will likely require the use of NiMH or lithium batteries. IR flash has become a common option on trail cameras, as it is less likely to draw the attention of humans or influence wildlife activity at the camera site. IR flashes give trail cameras the ability to take nighttime and daytime video; however, all nighttime images are black and white.

Advantages: IR flash makes the system inconspicuous, and it will not frighten most animals. It also allows videos to be recorded at night, when nocturnal species are the most active.

Disadvantages: IR flash is more expensive than incandescent flash, and images are black and white when used at night (Fig. 5).

Figure 5. A gray fox family "captured" by an infrared flash.

Camera Type

35mm cameras are very affordable but are becoming increasingly difficult to find due to the popularity of digital technology. They require film to record images and are limited by the number of exposures (typically 36) that can be recorded on a roll.

Advantages: These systems are inexpensive.

Disadvantages: These cameras can store only a small number of images, and the cost of film development can be high. Maintaining the system (e.g., changing film) can also be labor intensive.

Digital cameras have become very common as trail cameras. They store pictures based on a light detection sensor that breaks the image down into a digital format that is stored on the camera as digital data. Digital images can be stored in a variety of formats (e.g., JPEG, TIFF, GIF, BMP), all of which affect file size and image quality. Digital cameras can store a large number of images, all of which can be easily edited using photo editing software on a home computer. Many digital trail cameras allow images to be viewed in the field using an external or built-in LCD screen. Many also provide the capability to record video clips.

Advantages: Digital cameras can store a large number of images (depending upon memory card size). The photos are easily edited and can be viewed in the field, and many systems allow video to be taken. These systems can be left in the field for long periods of time, without changing batteries or memory cards.

Disadvantages: Digital cameras and memory cards usually have a high initial expense.

Additional Camera Options

The following is a partial list of available camera options; however, more options are becoming available. Please note that not all options are available from every manufacturer.

Memory

Digital cameras require memory for image file storage. Different cameras produce photos in different file formats (JPEG [most common], GIF, BMP, and TIFF), each of which requires more or less memory accordingly. It is also important to match the correct memory card (SD [secure digital], XD [xD-picture card], MS [memory stick], MMC [multimedia card], CF [compact flash], SM [smart media]) and memory card size (typically, a maximum of 2 GB) with the requirements and capabilities of different cameras.

Resolution

Digital cameras record images within a predetermined resolution range, which can vary anywhere from 0.3 megapixels to 11 megapixels. An increase in resolution/megapixels increases the file size of each photo, thus reducing the total number of images that can be stored.

Images Per Triggering

This feature typically allows the user to predetermine the number of images he/she wants taken each time the camera is activated. Increasing this number will help to ensure that all animals are photographed (as opposed to photographing only the first animal to break the detection zone).

Viewable in Field

Digital images can be viewed on a TV monitor or built-in viewing screen and can be downloaded to a computer. A built-in screen or monitor is helpful during setup because it allows the user to see the camera's viewing area. This eliminates the possibility of missed photos due to poor alignment of the camera with the target area.

Information on Pictures

Date, time, temperature, moon phase, location, and other input information can be printed on each picture (depending upon the camera unit purchased). This can be useful for filing images (by date) or obtaining information about activity patterns of animals.

Timer

Many systems allow the user to set the camera to function during the day, night, or both. A timer can save battery life and memory storage by taking images during the time when target animals are most likely to be active.

Security Options

Built-in security options for trail cameras range from cable locks, lock boxes, steel bars that can be locked on to the unit, and electronic passwords. Some

systems allow personal contact information that is saved on the camera to be printed on all pictures in case the camera is ever lost or stolen. These security methods are designed to secure images and protect the camera from theft.

Laser

Some models have a built-in laser to help aim the camera during setup.

Video Capability

This option is only present on digital trail cameras or trail-monitoring systems that use a camcorder. Videos will use significantly more memory/storage than still images, and usually are not used for general surveillance. Systems vary in the available length of video recording, ranging from five seconds or more.

Detection Zone Size

The detection zone is the area in which the IR sensor is able to detect motion and heat thus triggering the camera to take an image. Manufacturers vary widely in the size and shape of the area that is covered in the PIR detection zone, ranging from short and narrow to long and wide and everything in between. A long and wide detection zone provides the largest detection area, and will record images of animals that may not enter the center of the detection area. A short and narrow zone will provide the opportunity to capture the best images if the camera has a fast trigger speed, as the camera will only trigger when the animal is in the center of the image.

One must consider the camera's trigger speed (see below) and flash capabilities when determining the best size and shape of the detection zone. For example, the flash of a camera might not illuminate a detection zone that is too long, resulting in frustrating and indiscernible images of eye-shine. If the camera has a slow trigger speed and a narrow detection zone, moving animals move might make it all the way through the image area prior to the image being taken.

Trigger Speed

Trigger speed refers to the amount of time that elapses between camera activation and picture-taking. Trigger speed varies from 0.15 seconds to 5 seconds. A quick trigger speed is important because it will provide the best opportunity to record an image of an animal moving through the detection area.

Recovery Speed

Recovery speed refers to the amount of time that elapses between successive pictures. Recovery speed ranges from near instantaneous to 60 seconds. A quick recovery speed will provide the best opportunity to record multiple images of the same animal, as well as all the animals in a group/herd.

Cameras with wide detection zones, fast trigger speeds, and fast recovery speeds provide the best opportunity to record multiple images of animals moving through the view.

Wireless Picture Transmission/Camera Control Capability

Using a license-free radio frequency system, some camera systems can send recorded images to a computer base station up to two miles away. From the base station, settings on all cameras can be changed without having to visit each camera site. Furthermore, camera systems such as these can be arranged in two-mile increments from base station, allowing images outside of the base station's range to be relayed to the base station via cameras along the way (Fig. 6).

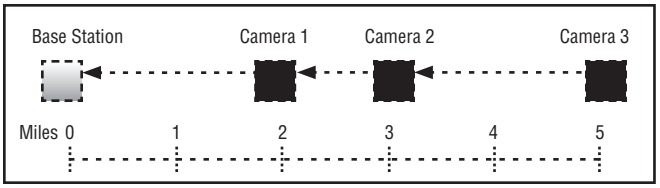

Figure 6. Cameras arranged in a series allow images to be relayed from cameras outside the transmission range of a base station to other cameras within range of the base station.

Cell Phone Capability

Images taken from a trail camera can be viewed online or sent to a cell phone. The camera settings can be altered wirelessly from a computer. When deciding whether to purchase a cell phone-capable camera, one should consider cost as well as the cell phone coverage available in the location where the camera will be used.

Trail Camera Accessories

Solar Chargers

Solar chargers allow a camera to run for an extended period of time without changing its batteries.

Additional Motion Detectors

Additional motion detectors can be used to increase the size of the detection zone, or they can be placed along the trail prior to the camera so that the video starts before the animal reaches the detection zone. This can minimize the chance that animal activity will be missed due to slow trigger speed.

External Batteries

External batteries allow a camera to operate for an extended period of time without having to replace internal camera batteries.

Transportable Image Viewer

A transportable image viewer allows photos to be viewed in the field using a handheld card reader and viewing device. Some camera brands allow the use of a small portable TV to view images.

Security Boxes

Trail cameras can be placed in metal lockboxes that provide additional security from theft and destruction.

Camera Mount

A camera mount provides stable support for a camera, and is also available in a tripod configuration.

Remote Camera Strategies

Placement

Camera placement is important when using trail cameras, as it can affect the quality of the images as well as the efficiency of the triggering mechanism. In order to optimize the use of trail cameras, they should be placed on trails, latrines, buck scrapes or rubs, food plots, water sources, bird feeders, or any other area that is likely to attract the species of interest. It is important to carefully aim the camera at the desired location. If the system is pointed in the wrong direction or aimed too high or low, the camera may not activate at the proper times. If a camera is placed in an area where an animal is just passing by (e.g., on a trail), it should be pointed so that the animal will be in the detection zone of the camera for as long as possible, as all systems have some delay (potentially up to 4 seconds) between detection and recording. For example, rather than aiming the camera at a 90° angle to a trail, aim the camera up or down a trail. Keep in mind that the delay is longer at night because the camera must power up the flash prior to activating.

Cameras should be placed at least 5 feet from any bait or area of attraction. This will reduce image overexposure due to the flash, and it will help ensure that the animal is in the best part of the picture frame (Fig. 7). Orienting cameras in a north- or south-facing direction will prevent back-lighting of the subject (thus overexposing the images) and will reduce the chance of the sun activating the PIR sensor. Also, strapping or nailing the camera to a tree or post that will not move in the wind will help eliminate unwanted images that may be taken due to camera movement.

Figure 7. A bird carcass was used to attract this coyote. A feather is hanging from its mouth.

Vegetation

Vegetation that surrounds the camera can interfere with the performance of the system in several ways. PIR and AIR sensors may be triggered by moving vegetation, but AIR systems (which require only that an IR beam be broken) are more sensitive to this problem. At night, flash effectiveness can be reduced because light from the flash can be absorbed by surrounding vegetation resulting in poor image quality.

Be sure to clear away any branches or leaves that potentially block the camera unit. However, be careful

not to clear so much vegetation that the natural surrounding of the camera is affected. Doing so might deter certain species from entering the detection area and might attract unwanted human attention.

Camera Testing

Sometimes cameras don't function correctly and won't trigger when an animal is in the detection zone. For this reason, each camera should be tested regularly. To test if a system is functioning properly, place it in an area where hair might be left if an animal passes by. If animal signs are detected but the system doesn't trigger, the system might not regularly detect certain species or animals. Keep in mind, however, that the size of an animal and/or distance between it and the system can affect whether the system will activate when that particular species is in the detection zone.

Sensitivity

Remote cameras are important tools for wildlife managers, landowners, and hunters. The use of remote cameras has varied, but their popularity for monitoring deer has had an impact on the market. Consequently, some brands of cameras might not work well for smaller species and this is important to consider when selecting cameras. On systems that have an adjustable PIR sensor, the sensitivity can be set at a higher level for use on smaller species.

Additional Strategies

The chance of capturing successful images increases when the habits of the species to be photographed are considered. Wildlife species vary in their choice of habitats, trails, and types of foods. Water sources attract nearly all wildlife species; therefore, ponds, cattle troughs, and streams are natural focal points for wildlife and are great places to set up trail cameras.

It is also possible to attract some animals to specific locations by using bait or lures. Depending upon the target species, a piece of meat or some other type of food can be used as bait. Lures, however, are commercial products made from glands, urine, or other body products of the target animal or its prey. Lures are often available at sporting goods stores, where hunting and trapping supplies are sold.

Using Cameras for Research

Use of remote cameras in research has varied greatly and has provided researchers insight into many aspects of wildlife behavior that could not have been obtained without this technology. For instance, trail cameras have been used to estimate populations of jaguars, ocelots, and other species that can be distinguished by unique markings. More recently, trail cameras have been used to estimate deer populations, initially by estimating the number of branch-antlered bucks (as it is possible to identify individuals from antler structure, such as Fig. 8). Once the number of bucks is known, the rest of the deer population can be estimated by using images from the same cameras to estimate the buck-to-doe ratio, doe-to-fawn ratio, and branch-antlered buck-to-spike-buck ratio (Jacobson et al., 1997).

Remote cameras have also been used to study nest predation, nesting behavior, feeding ecology, scavenging behavior, activity patterns, behavioral interactions, presence-absence monitoring, population estimates, and population-estimating parameters (Cutler & Swann, 1999).

Figure 8. An antlered buck "captured" by a PIR device. The presence of antlers or other distinguishable features enables one to identify individual animals.

References

Cutler, T. L., & Swann, D. E. (1999). Using remote photography in wildlife ecology: A review. *Wildlife Society Bulletin, 28,* 630–635.

Jacobson, H. A., Kroll, J. C., Browning, R. W., Koerth, B. H., & Conway, M. H. (1997). Infrared-triggered cameras for censusing white-tailed deer. *Wildlife Society Bulletin, 25,* 547–556.

Additional Resources

We do not endorse any of the companies or products listed below; rather, this list is merely an example of what is available on the market.

Survey

Walker, J. W., & Engdahl B. S. *Survey of wildlife surveillance cameras*. Retrieved April 16, 2009, from **http://texnat.tamu.edu/symposia/survey_of_cameras.pdf**

Journal Article

Swann, D. E., Hass, C. C., Dalton, D. C., & Wolf, S. A. (2004). Infrared-triggered cameras for detecting wildlife: An evaluation and review. *Wildlife Society Bulletin, 32,* 357–365.

Companies

BuckEye Cam
www.buckeyecam.com

Bushnell
www.bushnell.com

CamTrakker
www.camtrakker.com

Leaf River OutdoorProducts
www.vibrashine.com

Moultrie Feeders
www.moultriefeeders.com

Predator Trail Cams
www.predatortrailcams.com

Recon Outdoors
www.reconoutdoors.com

Reconyx
www.reconyx.com

HuntingCamOnline
www.huntingcamonline.com

Smart Scouter
www.smartscouter.com

Spy Point
www.ggtelecom.ca

Stealth Cam
www.stealthcam.net

TrailMaster
www.trailmaster.com

Wildgame Innovations
www.wildgameinnovations.com/products/timber-eye.html

Wildview
www.wildviewcam.com