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Using a Game Camera for Wildlife Monitoring On Your Personal Property

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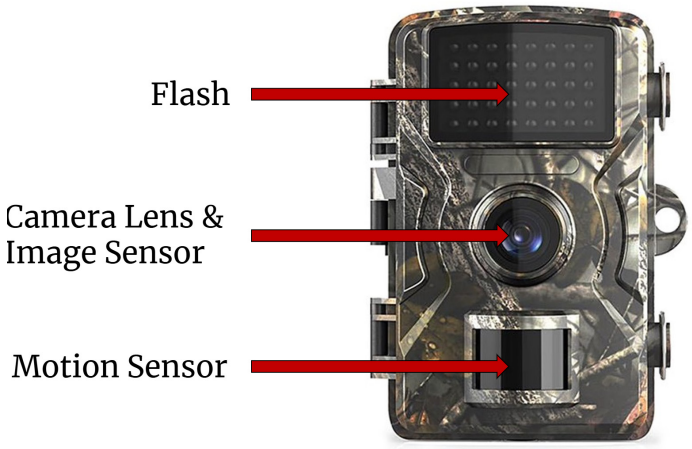
INTRODUCTION

Using wildlife cameras (also commonly referred to as game cameras or trail cameras) can be a great non-invasive tool for wildlife conservation and monitoring. Less human effort is required to monitor wildlife using this approach over other more invasive approaches (e.g., GPS collaring), making cameras an efficient method for determining wildlife presence and conservation needs. The first scientific application of camera traps dates back to the 1920s, but use of wildlife cameras is now rapidly expanding due to major technological improvements and cost reductions. Since the 1990s, research-focused wildlife camera studies have increased exponentially, but so have personal-use camera studies due to the accessibility of cameras in-store and online for personal use.

Early wildlife applications of trail cameras included species presence and behavior studies, avian nest predation, and endangered species monitoring. Now, applications of wildlife cameras have expanded beyond wildlife research to include accessible wildlife monitoring in your backyard, across a hunting property, or for security monitoring. How effective wildlife cameras can be for wildlife management or monitoring is largely determined by how well you use proper camera set-ups, procedures that we have outlined in the following document.

CAMERA SELECTION AND SETTINGS

Many different types of cameras that include different capabilities and price points are now available on the market. That being said, all cameras typically have a few things in common relating to how they work. Wildlife cameras have three components necessary to capture an image: flash, camera lens and image sensor, and motion sensor.



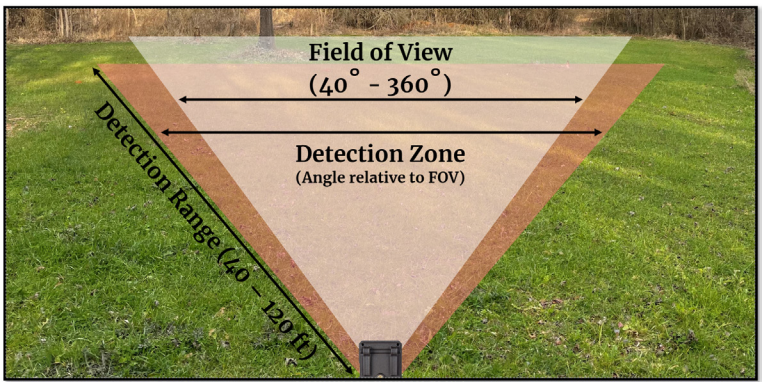
Parts of a game camera.

Flash. Each camera has a flash that emits light when capturing a photo. This will either be a white, infrared (IR; commonly referred to as 'low-glow'), or IR black flash (commonly referred to as 'no-glow'). Flash types involve the different wavelengths of light emitted when a camera is triggered to take a photo. It's also important to consider how the flash on each camera affects wildlife responses and behaviors. White flash typically creates the highest-quality images at night using a visible flash like those on most conventional cameras. This is beneficial for capturing color images at night, however, the brightness may startle or disturb animals. No-glow flash uses longer wavelengths of light not visible to the human eye and some animals, which makes it less likely to startle wildlife. However, no-glow flash does produce less illumination and use more battery power. Because the no-glow flash does not emit a visible flash, it will produce the lowest quality night-time images and its flash "range" (i.e., the distance that a flash will illuminate at night) will not be as far. The 'low-glow' flash is inbetween

the no-glow and white flash cameras in terms of quality and flash range. It will produce better nighttime images than the no-glow, but will also produce a red colored flash to a human eye. Because of this, in more urban areas where theft of cameras may be a problem, we recommend a 'no-glow' camera to reduce human detection of the cameras.

Which camera flash is best for your specific case will depend on your needs. It should be noted, however, that cameras with a white flash are exceedingly rare on today's market. Thus, the choice is often between a 'low-glow' or 'no-glow' camera. On today's market, these two types of cameras when made from the same company will usually differ slightly in price with the no-glow being more expensive (~ $20 more).

Camera lens and image sensor. The camera lens has a field view ranging from 40 to 360 degrees. For the image sensor, nearly all trail camera sensors have 2-5 megapixels. Most cameras will state much higher megapixel ratings, but these are actually interpolations of the raw image, and thus, they don't actually increase the amount of detail in the photo. As a result, don't necessarily be swayed by cameras that advertise super high resolution photos over other cameras. Rather, the detail of image quality is dependent on the lens quality, which is often not clearly advertised.



Detection range, zone, and field of view from a game camera.

Perhaps more important to many users is actually the focusing distance, which is the distance between the lens and the focused object. This distance is dependent on the lens specs; in most cameras, the minimum distance is usually greater than 2 feet. If you are attempting to use cameras for detecting species at closer distances (e.g., small mammals), it may require that you have a custom order camera built for shorter focal lengths.

Motion sensor. The motion sensor detects when a species enters the area in front of the camera. It typically has a wider range of detection than the image sensor, with the distance ranging from 40 to 120 feet. This is problematic for slower moving wildlife because the motion sensor may trigger the camera, but you would only obtain a partial image of the animal because it has not moved fully into the field of view.

Example of a triggered camera where the white-tailed deer was not fully within the field of view.

CAMERA TYPES

There are two major types of cameras you can use for monitoring wildlife. These include either cellular or store-on-board cameras. Cellular cameras use a SIM card to connect to a cellular network, sending and receiving data that allows one to view its images remotely (e.g., using a cell-phone app).

A store-on-board camera, frequently referred to as a traditional wildlife camera, uses an SD card to store its photos, which requires one to physically remove the SD card from the camera in order to view images. Most cellular cameras on the market also store images on an SD card making images accessible when cellular networks are not available in a given area. Different brands of trail cameras range in price and quality; the website trailcampro.com offers a detailed review of many of the major wildlife camera brands and models for both traditional and cellular-based cameras.

Viewing Images

Viewing images on a game camera can include non-cellular and cellular modes of viewing. For non-cellular cameras, this requires an SD card which is transferred from the camera to a computer. For cellular, this involves an application that can connect the camera to a mobile device. If your computer does not have the appropriate memory card readers, you can purchase a USB or USB-C type connection that will allow you to read the memory card.

Example memory card reader.

Capturing an Image

Nearly all modern wildlife cameras are 'triggered' to take a photo using a Passive Infrared Sensor (PIR). This PIR detects changes in background thermal radiation (heat) caused by movement in front of the camera. In other words, when a warm object moves in front of the camera, it detects a change in the infrared radiation, which triggers the camera to take a photo. Now, because everything reflects some heat, all moving objects, including things like vegetation that is moving in the wind, can trigger the PIR resulting in a high number of false images. Because of this, PIR angle which refers to the degree that a camera can sense movement, is important. Cameras with a high PIR angle, detect faster moving objects and are more likely to capture animals in the center of the image. Most high-quality cameras have a PIR angle of 48 degrees, whereas cheaper cameras may have a really low angle (e.g., 10).

While PIR is the most common sensor used to detect animals, some cameras may use optical motion sensors or sensors that respond to changes in sound. Regardless of how the camera is triggered, the process of taking a photo involves:

1. PIR detection (or optical or auditory detection)
2. Light meter relay (measuring ambient light)
3. Camera determines appropriate exposure settings or flash at night
4. Shutter opens and closes
5. Image sensor captures light and then writes data

The amount of time this 5-step process takes is known as the trigger speed. For places where an animal might move quickly through (e.g., game trail), a faster trigger speed (<= 0.5 seconds) is recommended. Slow trigger speeds (these can be > 1 second) are more common on cheaper cameras but may still be adequate in places where an animal is not expected to move quickly (e.g., deer in a food plot).

CAMERA SETTINGS

There are numerous settings that cameras can be equipped with. The information below does not represent an exhaustive list, and not all cameras will have each of these settings, but this list will provide you with a representative sample of potential camera setting options.

Capture Modes. Capture modes involve the types of images taken on the camera. These may include still images, burst modes, videos, and time lapses/field scans. *Still image mode* is a setting that will take a single photo when triggered. In contrast, *burst mode* takes 2 to 9 photo bursts with a defined time delay between photos (e.g., 0.5 seconds). Additionally, some camera models allow the user to define the time delay between each photo capture within the burst. *Time lapse mode* captures images at defined time intervals (e.g., every day at noon) and are not triggered by movement, which can be useful for monitoring areas outside of the PIR detection range. *Videos capture mode* provides a constant recording of the camera viewing area once the camera is triggered. The options for the length of video recording vary, often ranging from ten seconds to two minutes. Some cameras also have a hybrid photo/video option, in which the camera will take a photo, followed by a video.

Picture delay. Picture delay (sometimes referred to as "recovery time") determines how long the camera will remain inactive after taking a picture or video. These settings affect battery life and memory card maintenance as a shorter picture delay will result in an increased number of photos taken, ultimately using more storage space while simultaneously depleting the battery faster.

Sensitivity. Sensitivity involves the camera's ability to detect motion and trigger a photo. Higher sensitivity will trigger a photo to slight changes in light, which can be used to detect smaller animals. However, this could increase the chance of false triggers from moving vegetation, shadows, etc. Lower sensitivity will take greater changes in thermal radiation to trigger a photo, likely only capturing larger animals.

Image Quality. Image quality settings adjust the resolution, sharpness, and clarity of each photo taken. However, quality settings have trade-offs. Higher image quality settings take up more space, slow the camera down, and require you to transfer a larger file from SD card to computer. The flash intensity may also be adjusted in image quality settings. It is recommended to trial image quality settings before deployment.

SD Card Settings. SD card settings play a crucial role in image recording, so always ensure cards are formatted, which can be done on the camera. Most cameras come with overwrite options giving the user the ability to overwrite the oldest image on the card with the newest when the SD card storage space is full. SD cards range in size from 256 mb to 512GB, so consider the size and the estimated number of photos it can store when choosing the right SD card, as this will determine how frequently you need to revisit the camera to retrieve the images from the SD card. In general, an SD card will hold about 5,000-8,000 photos for every 32GB. The same 32 GB SD card may hold 2-4 hours of 1080p video files. It is important to purchase high quality SD cards from name-brands such as SanDisk with high write speeds (e.g., 100 MB/s).

It is best practice to use name-brand SD cards for your game cameras.

Date/Time settings. Date/time settings include the date and time the photo was taken. It's important to double-check these settings to ensure they are correct each time you visit the camera and consider daylight savings for changing times. Make sure to distinguish AM vs PM in time settings and check the date and time after replacing batteries.

CAMERA DEPLOYMENT

When the camera settings are finalized, it's time to deploy your camera. Your battery options often include alkaline batteries, lithium ion, and rechargeable batteries. Alkaline batteries are the most affordable but will deplete the fastest. Lithium ions (we recommend Energizer Ultimate lithium brand) are more expensive but typically last 2-4 times longer. Rechargeable batteries are the most expensive but will save costs over time if the users don't mind the extra labor involved with recharging

the batteries. Each battery type also perform differently under varying weather conditions (see table). Regardless of battery choice, avoid mixing different types of batteries.

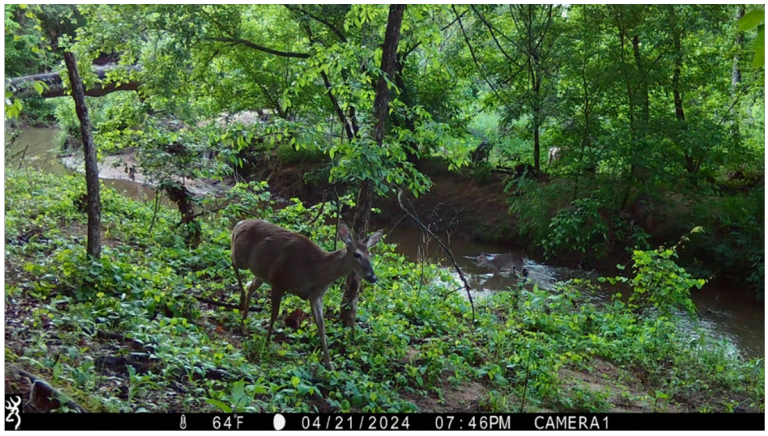
With multiple battery types available, these initial considerations are important when considering camera reliability:

Battery Type	Price per Unit	Shelf/Usable Life	Climate Conditions
Lithium	$2.00 - $2.50 each	20-year shelf life	Best for cold climates and warm/hot climates
Energizer Alkaline	$0.60 - $0.75 each	10-year shelf life	Best for moderate to warm conditions, avoid using in cold climates
Rechargeable	$2.75 - $3.25 each	5-year usable life	Best for moderate to warm conditions

In some cases, solar panels are an option to charge external batteries, which may be useful in remote sites.

Camera Placement

When placing cameras, the location of the camera is extremely important to maximize wildlife detections. You can do this by first envisioning where animals are most likely to occur, such as a wildlife trail or movement corridor. Remember, wildlife are trying to conserve energy as the walk, similar to us as humans. That means that they are more likely to cut across hillsides than go straight up or down the hill, and they are more likely to walk along easy paths. Thus, look around for linear paths where more dirt is exposed or where leaves and grass have been moved. If a trail cannot be found, it is recommended to place a camera along a linear feature such as a road, hiking trail, or fence that encourages or forces the animal to walk that path. If you can find an area that is generally clear with little underbrush, that is an added benefit as it will reduce false detections.



Place your camera along linear features such as a road, game trail, or stream to increase the likelihood of detecting an animal.

Once you have found a suitable location or path, place the camera approximately 15-25 feet away from the exact location you imagine an animal is most likely to pass through. Remember, the camera will likely detect wildlife up to 80-100 feet away from the camera, but the distance may lead to blurry photos that are unrecognizable. Take this into consideration when placing your camera trap.

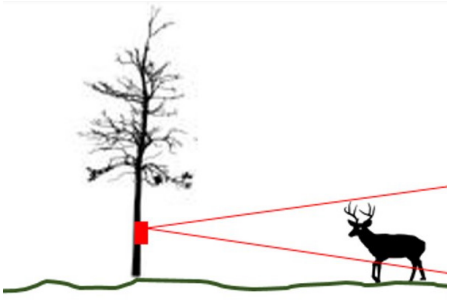


Diagram of camera placement for deer.

Once a site is selected, attach the camera strap around an appropriately sized tree, telephone pole, or fence post, if available. A good starting point is to place the camera at chest level. However, if you are in areas of high human presence where theft may be a concern, you can always place your camera higher on the tree via the use of a ladder. You can also use a 'security box' to prevent theft. These boxes can either be strapped to the tree or secured with screws directly into the tree/pole and are secured with a traditional padlock. Most camera companies provide their own security boxes, but you can also purchase from third party vendors such as camlockbox.com. If you want to avoid using screws to attach the box to the tree, you can use a 'python lock' to secure the camera. Python locks are padlocks that include a cable that will wrap around the tree, effectively securing the box to the tree. These are sold at any major sporting goods store for around $20 each. If you will be using multiple cameras, it is best to get all padlocks keyed the same to reduce confusion with matching keys to locks.

Example of a camera security box.

Now that you have placed the camera, you will need to consider the angle of the camera. Angling the camera to get a clear view of the ground without it taking up the entire frame is recommended. A simple trick to obtain the best camera angle is to place a stick or small branch behind the camera (either top or bottom as needed) to best direct the camera lens to the location you want. Test the camera angle by using a person or object as a reference. A good approach is to see if an average-sized person could be seen from head to toe when the image is taken. This would lead to images of all small-to-large-sized animals in Georgia.

Example of a python locking cable.

Try to place the camera such that an average person can be seen from head-to-toe in the camera image.

Game camera wrapped around an adequate-sized tree.

Setting Up a Camera

Once an appropriate position is found, it is time to set up the camera. Check the batteries and SD card to ensure they are functioning properly and set or reset the date and time settings. For data management purposes, keep track of the date and time it was set up and the location of the camera. Check all the camera settings listed above and make sure the camera is turned on. Check back on the camera as needed but starting once a week or every two weeks can be a good start.

Site Management

Make sure all equipment is ready and prepared at more remote sites and use lock boxes to prevent damage to cameras and/or stolen cameras. Reduce false triggers by mowing long grasses and pruning branches around the area, typically within 20 feet of the camera's vision. A good recommendation to avoid false triggers is to place the camera facing North or South to reduce glare from the sun. If this is not an option, then point the camera as close to N or S as possible while keeping in mind shadows as these can cause false triggers as well.

Example of before (left) and after (right) removing vegetation within the camera field of view. The camera is on the tree in the background, and field of view is within the orange triangle (right).

Use of Bait/Attractants

One can bait a site to promote more activity in the area by placing an attractant on the ground or on a tree across from the camera within its vision. For example, researchers may attach a can of sardines onto a tree to attract predators to the area directly in front of the camera. Such baits will not attract animals from other areas, but rather just position them in front of your camera. For example, you will not attract a racoon from 1 mile away, but if it is walking down a nearby trail (~30 yards), and smells the attractant, it will likely move toward the attractant and in front of your camera. This can increase the likelihood of getting a clear photo but may impact natural wildlife behavior. Try to place the attractant in the area where your camera is focused on, so that the wildlife is more likely to be centered in your camera view. The type of attractant you use will depend on the wildlife species you are most interested in photographing.

Example of a baited site. Photo by JT Pynne, Georgia Department of Natural Resources.

Natural Food Sources

If baiting is not desirable, place the game camera around a natural food source. For instance, place the camera by a tree or bush with berries, fruits, or acorns. You can also place the camera around or along a water source such as a puddle, pond, or stream to increase the likelihood of wildlife activity on your camera. Placing the camera in a wetland, a low-lying area that is easily flooded, can also increase the chance of activity due to its significant food and water source, but be cautious of camera height as it may be susceptible to flooding events that will ruin your camera.

CONCLUSION

In summary, camera traps can provide a simple, fun wildlife monitoring tool. By going through the camera's settings, one can create the optimal photo quality for wildlife in the area. Appropriate placement is an important consideration. Find a clear area, set the camera at an appropriate height for the species intended to photograph, angle the camera to provide an optimal view of the animal, check date and time stamp, and make sure the camera is turned on. With proper settings and strategic placement, camera traps can be an effective and enjoyable method for monitoring wildlife.