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The effect of camera-trap viewshed obstruction on wildlife detection: implications for inference

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Fig. S1. A study area map showing 204 camera trap locations (blue circles) arranged throughout Cleveland Metroparks, Cleveland, Ohio, USA (outlined in black). We determined the location of camera trap sites using a Generalized Random Tessellation Stratified experimental design (see text for details). Basemap image Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community (accessed 12 September 2018).

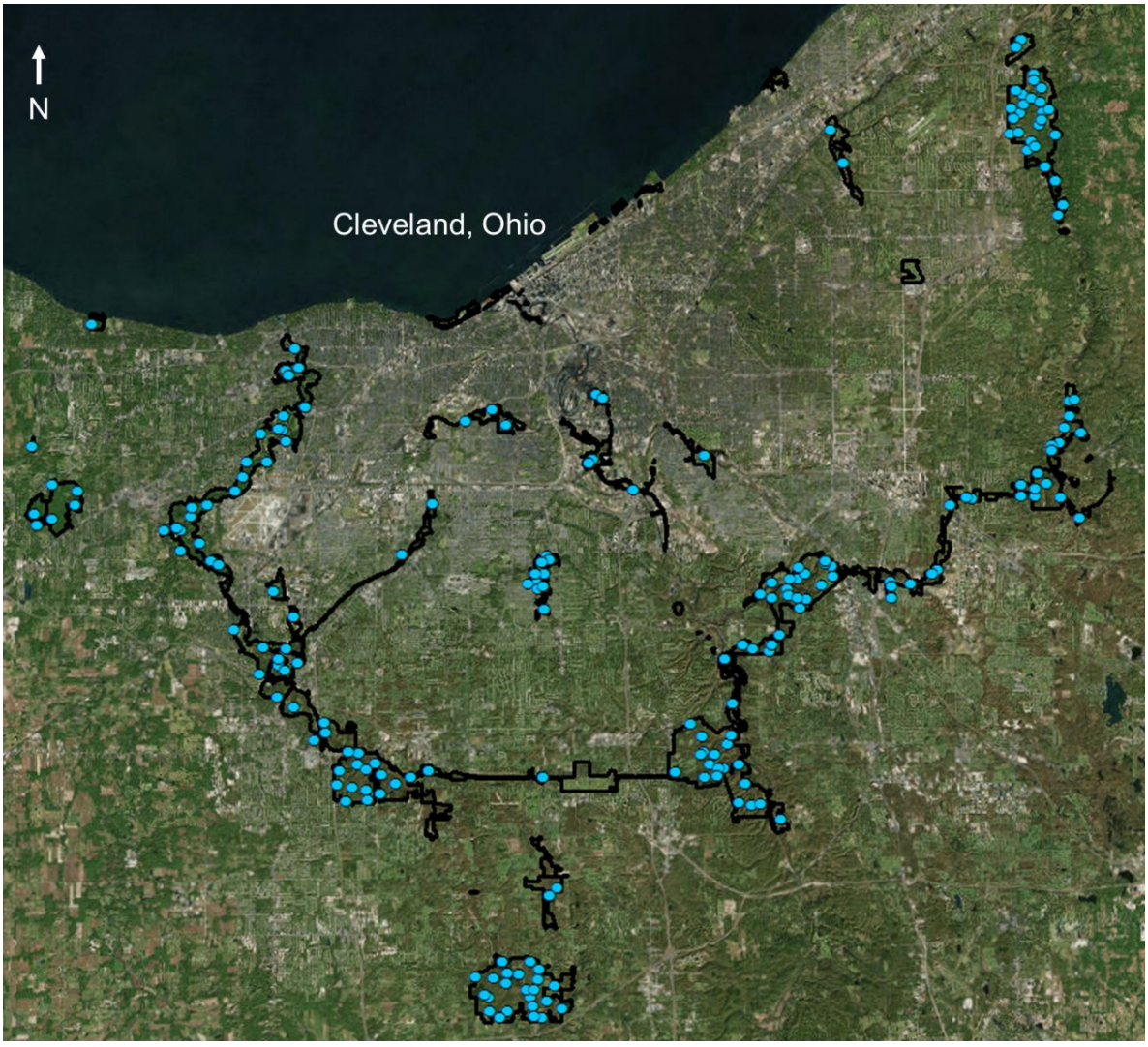
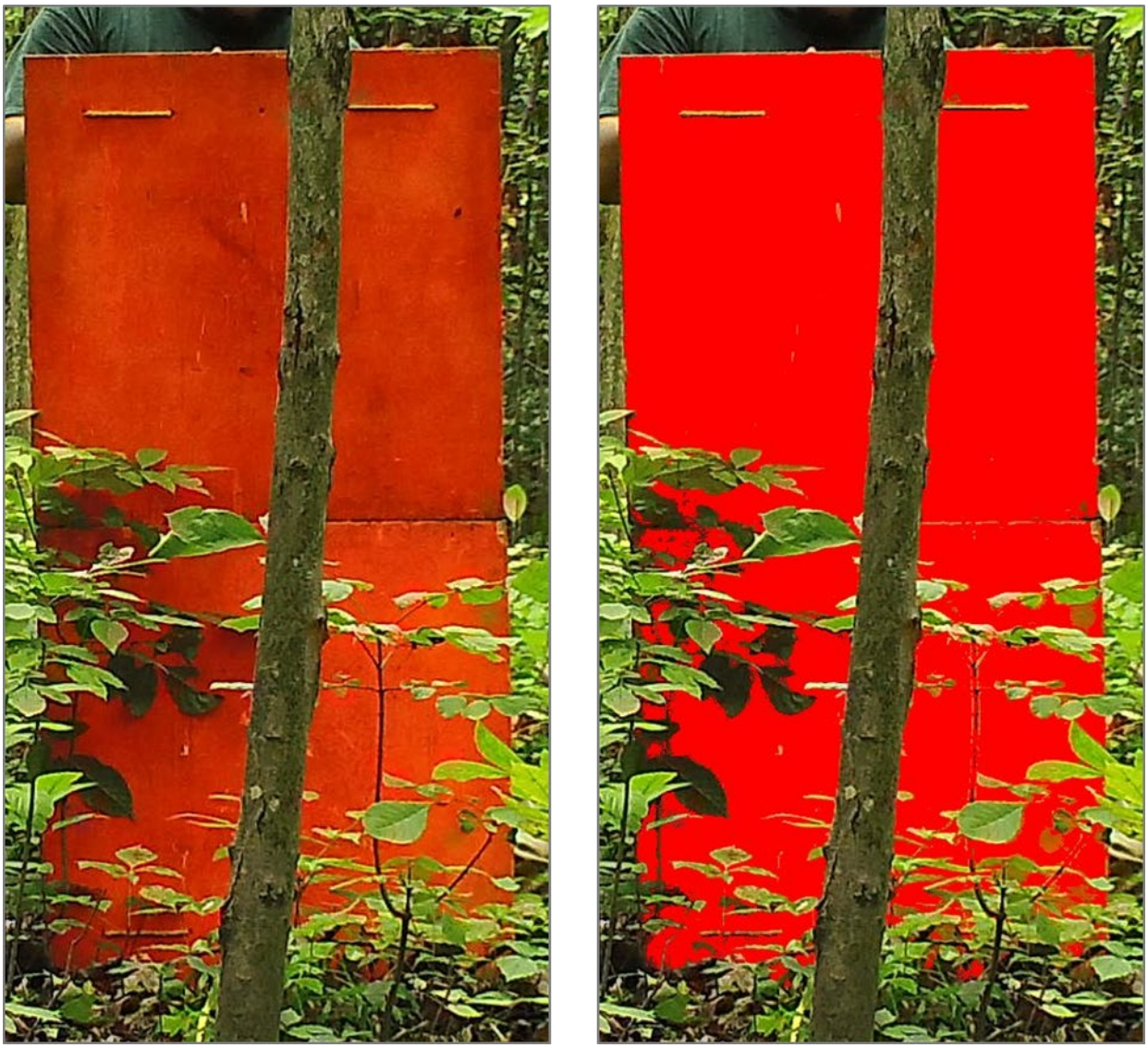


Fig. S2. Pre- (left) and post-processed (right) images of the cover board used for measuring viewshed obstruction at 204 camera traps in the Metroparks of Cleveland, Ohio, USA. At each site, three transects extended 15 m and we collected images of a cover board at nine locations along the transects.



Camera-trap site set-up and placement protocol

Camera Settings

There are 19 parameters available on this camera.

Items in **BOLD** are settings used

Mode: (**Camera**, Video, Hybrid) photo or video only or both

Image Size: (**3M**, 8M, 14M Pixel) *based on my testing approximate pictures on an 8GB SD Card are: 3M=8389-11079, 8M=2936-3877, 14M=1609-2134*

Image Format: (**Full Screen** or Wide Screen) Selects 4:3 (Fullscreen, like old TV sets) or 16:9 (Widescreen, like new flat TVs) "aspect ratio" for still photos. If you like to view your photos on a TV set or computer monitor, you can set the format to match it.

Capture number: (1, 2 or **3** photos) number of photos taken in sequence when motion triggers camera RECOMMEND 3

LED Control: (Low, Medium, **High**) Controls how many LED lamps fire when images are taken in low light. "High"= all LEDs fire (48), which is the default setting. Set to Medium or Low if you are getting overexposed flash photos or will place the camera at very close range to the subject you want to photograph. In general, select High if most of your intended subjects will be over 30 ft. from the camera, Medium for the 15 to 30 ft. range, and Low for subjects under 15 ft. away.

Camera Name: (input) camera will imprint name on photos but not videos USE PCAP PLOT # and add Reservation 2 digit identifier example MS1115 for PCAP plot 1115 which is located within Mill Stream Run Reservation.

Video Size: (1920x1080, 1280x720, 640x360) N/A will not use video

Video Length: (5s to 60s, default 10s) N/A will not use video

Interval: **Interval 60S (second)** default, with a 60M (minute) to1S (second) range of settings available. (60M-1M are set in one minute increments, 59S-1S are set in one second increments) Selects the length of time that the camera will "wait" until it responds to any additional triggers from the PIR after an animal is first detected and remains within the sensor's range. During this user set "ignore triggers" interval, the camera will not capture photos/videos. This prevents the card from filling up with too many redundant images. Settings begin with 10 second default when parameter is first selected. Setting the Interval time to 1 second will decrease battery life. Note: after setting down past "1S", settings start over at "60M".

Sensor Level: (Low, Normal, High, **Auto**) Selects the sensitivity of the PIR sensor. The "High" setting will make the camera more sensitive to infrared (heat) and more easily triggered by motion, and the "Low" setting makes it less sensitive to heat and motion. The High setting can be useful when the ambient temperature is warm (making it more difficult for the sensor to detect animals), and the Low setting may help in cold weather if the camera is being triggered too often by anything warmer than the surroundings. "Normal" is for average or moderate conditions. The default "Auto" setting will allow the camera to determine the best setting based on its current operating temperature. This is an ideal setting if the weather is expected to change significantly during the period the camera will be used.

NV (night vision) shutter: (**High**, Medium, Low) Affects the shutter speed during Night Vision operation. High will freeze motion better, but photos may be darker. A Low shutter speed setting will produce brighter photos, but rapid motion may be blurred. Medium is a good compromise. Note: if LED Control (level) is set to Medium or Low, only "High" NV Shutter is available.

Camera Mode: (**24hrs**, Day, Night) Allows user to limit operation to only day or night period if desired. An ambient light level sensor determines "Day" vs. "Night" automatically. This setting takes priority over any Field Scan settings.

Format: (execute followed by **No**/Yes) erases all files stored on card

Time Stamp: (Off, **On**) Of course ON also records current temp, moon phase and camera name

Set Clock: (Set) **Enter local Ohio time (Adjust with Daylight Savings Time changes)**

Field Scan: (On, **Off**) Turns Field Scan (Time Lapse) recording mode on/off. When activated, Field Scan forces the camera to take photos or videos even when it is not triggered by a nearby live animal, useful for constant monitoring of an area that might be far away from the camera. The user can set the start and stop times for up to two independent "blocks" of Field Scan recording, as well as the interval time between each photo/video.

Coordinate Input: (Off, **On**) Allows the user to input latitude and longitude coordinates for the camera's location. This data will be embedded in the files saved on the camera's SD card (if "On" is selected). This makes it possible to see each camera's location as a "pushpin" on Google Earth maps when reviewing a folder full of photos from multiple cameras, or use other "geotag" capable software (Picassa, etc.).

Video Sound: (On, **Off**) Select "On" to record audio along with the video when the camera is set to video mode (saved file sizes will be slightly larger).

Default Set: (**Cancel**, execute) rest all defaults (which I have highlighted in **bold** above).

Camera Placement

1. Cameras will be placed within 50 meters of point generated by the Generalized Random Tessilation Grid method within a similar community type as the point unless exceptional circumstances (high risk of theft, open areas, meadows, utility right of ways, bodies of water), in which case within 100 meters.

2. Cameras will be placed in a northerly direction to minimize direct sunlight exposure to the camera trap. Excessive heat reduces the sensitivity of the heat sensor. South-facing bearings between 91 and 269 should be avoided.

3. Find the closest straight tree that you can get a cable lock around; but not so thin that people can cut through to get the camera. If a cable lock will be highly visible, then use a padlock.

4. Mount camera to the tree with 2 bolts through the metal case.

5. When using cable-lock, ensure lock faces down so it does not accumulate ice/rain. This might require leaving some slack in the cable. Do not knot excess cable.

6. When there are no suitable trees within 100 meters and it is absolutely necessary we will use signposts sunk 2-3 ft in the ground, with cable lock run through the holes on the post to reduce the chance of theft. Coordinate with Jon Cepek.

7. For sites are on streams and rivers, take into consideration flooding, and ice breakup and flotsam in spring and floods, fishing activities and theft. Modify camera location accordingly.

8. For sites that are in mowed, paved, or urban areas, consider park operations: mowing, controlled burns, snow plowing, and vehicle traffic that will trigger camera.

9. Camera security cases will be mounted about knee height, approximately 50 centimeters off the ground, and parallel to the ground. NOTE: if there is any rise immediately in front of the camera it will cause the flash to white out that part of picture so take this into consideration.

10. Point camera parallel to the ground. If on a hill, point across the slope. Don't point up or down hill as the terrain will white out picture. Use shims, <u>not sticks</u>, to adjust camera angle. Use multiple shims to create larger angles.

11. Camera traps should be set back at least 2 meters from the nearest point at which wildlife might travel across the sensor. At least 3-5m of cleared space in front of the camera is preferred (see below). This allows for clear, focused pictures and a large enough field of detection for the sensor. Do not point directly at logs or large trees.

12. If the site is in forest or dense vegetation, find a suitable opening to place the camera. There should be little or no vegetation or slope obstructing the view within 5-10m. You should not have any objects or vegetation within at least 3-5 meters of the camera, as it will cause problems with the lens of the flash and cause blowout of photo. It is allowed to minimally clear the view by removing coarse debris, and herbaceous vegetation, but do not disturb the soil.

13. ***SUMMARY***: The above are guidelines; use your best judgement to find a safe location to place the camera that generally faces the direction of the bearing (or back-bearing) with a clear field of view, as conditions allow. Please take detailed notes regarding any exceptional cases or unusual circumstances during camera placement.

Guiding References:

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