Aerial Infrared Deer Count Report

Eastern Wildlife Management Partnership

26 January 2015

A large 26,837-acre deer count area was the subject of an aerial infrared (IR) deer count flight on three nights in late-December and is composed of the eight northeastern Ohio jurisdictions named below. The IR imaging conditions were very good during the three flights. Additional details can be found in the analysis notes below.

This report package includes this written report, multiple DVD+R discs containing video of the raw infrared imagery of the count areas, a map printout of the deer count and dispersion within and near the count areas and a copy of the maps in *.jpeg* format on CD-ROM. Google Earth KMZ files of the boundaries of the jurisdictions and the number and location of the deer and possible deer sightings are also included. Deer and possible deer are noted on the map by dots of different colors. Deer are magenta and possible deer are bright green. A possible deer is defined as an animal that is thought to be a deer but whose infrared signature is somewhat weak or otherwise difficult to plainly distinguish it as a deer. Groups of deer are sometimes indicated by one dot with an annotation of the number of deer in that group. The dots representing animals cover an area approximately 60 feet in diameter on the maps so they can be seen and printed easily.

Results:

		DEER							
LOCATION	**Acres**	**Inside**	**/**	**Possible**	**//**	**Outside**	**/**	**Possible**
Pepper Pike	4595	**265**	**/**	**4**	**//**	**37**	**/**	**0**
Mayfield Heights	2675	**43**	**/**	**0**	**//**	**43**	**/**	**5**
Lyndhurst	2838	**41**	**/**	**3**	**//**	**10**	**/**	**0**
University Heights	1168	**26**	**/**	**4**	**//**	**0**	**/**	**0**
Shaker Heights	4055	**57**	**/**	**3**	**//**	**14**	**/**	**0**
Beachwood	3357	**157**	**/**	**4**	**//**	**42**	**/**	**0**
South Euclid	2980	**56**	**/**	**1**	**//**	**20**	**/**	**4**
Cleveland Heights	5169	**48**	**/**	**0**	**//**	**28**	**/**	**1**
Totals	26,837	**693**	**/**	**19**	**//**	**194**	**/**	**10**

Analysis Notes

Night 1 - Mayfield Heights and Pepper Pike **12/25/2014**

The aerial infrared imaging flight for the eastern portion of Mayfield Heights (east of I-271) and Pepper Pike was conducted between 2130, 25 December and 00041, 26 December 2014. Imaging conditions were very good. Small animals were visible in the imagery on the ground and in trees in the count area. Surface winds were from the south-southwest around eight to nine knots during the count with moderate turbulence, later subsiding to minimal, at the imaging altitude of 1500 feet above ground level. The ground was clear of snow and the temperature was 36-37 degrees Fahrenheit. The sky cover was initially overcast at 3500 feet and later became clear.

Night 2 - Beachwood, Shaker Heights, University Heights, Cleveland Heights **12/28/2014**

The flight over these jurisdictions occurred on the night of 28 December between the hours of 2250, 28 December and 0315, 29 December 2014. Conditions for the count were very good. Small animals were visible in the imagery: an indicator of good imaging conditions. Winds at the surface were from the west-northwest at 11 knots, shifting later to northwest at 8 knots, while winds at altitude (1500 feet above ground level) were light from the southwest. There was very light turbulence at the imaging altitude. Temperatures were 35-36F during the flight. The sky was overcast at 3400 feet and the ground was free of snow.

Night 3 - Mayfield Heights, Lyndhurst, South Euclid, Cleveland Heights 12/29/2014

The flight over the western portion of Mayfield Heights, Lyndhurst, South Euclid and the northern portion of Cleveland Heights (and a tiny corner of northwest University heights) occurred on the night of 29 December between the hours of 0035 and 0505, 30 December 2014. Conditions for the count were again quite good. Some small animals were visible in the imagery. Winds at the surface were initially calm, then from the north at 10 knots, while winds at altitude (1500 feet above ground level) were light from the north. There was no turbulence at the imaging altitude. Temperatures diminished from 28 to 20F during the flight. The sky was clear and the ground was free of snow.

Mapping:

If the deer count number and dispersion information is destined for a Geographic Information System (GIS), the KMZ files provided should pose no problems of incorporation. Otherwise, the KMZ's may be opened directly in Google Earth.

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Equipment:

This count was accomplished with a single-engine Cessna 182 airplane and using a high-resolution Mitsubishi M-600 thermal imager oriented 'looking' straight down through a camera hole in the belly of the airplane. The thermal imager NTSC video output is routed through a video encoder-decoder (VED) that labels the video with a continuous stream of GPS-derived position, time, date, speed and altitude information. A guide to the alpha-numeric annotation seen on the accompanying videotape may be found at the end of the specification block below. A bar code of the same GPS alphanumeric information is recorded on the far left side of the imagery although it may not be within the visible portion of a conventional TV screen. The bar-coded information is used by the VED during video playback and analysis. The annotated video imagery is recorded with a Sony MiniDV digital video cassette recorder using digital videotape capable of storing 500 horizontal lines of video information (over 50% more than the 330 lines found on conventional VHS videotape.) The mapping program used for marking the count area borders and laying out the flight lines is DeLorme's GPS Link II and MapExpert version 2.0.

Mitsubishi M-600 thermal imager specifications:

Detector	Platinum Silicide Schottky-Barrier IRCSD
Number of Elements	512 X 512 pixels
Detectable Wavelength Band	3 to 5 microns
Lens	Infrared, polarized f50 mm, F 1.2
NETD (Noise Equivalent Temperature Differential)	0.08 degrees C blackbody at 80.6 deg. F. (27 deg C) using f50 mm, F 1.2 lens
Field of View (using f50mm lens)	14 degrees horizontal X 11 degrees vertical
Field Time	1/60 second
Cooling Method	Stirling Cycle cooler
Image Display	Monochromatic, 256 gray levels
Video Output	RS170 video output (1 BNC port, 75 ohms)

Annotation Guide:

Flight Methodology:

The counts are flown at an average altitude of 1500 feet above ground level. The camera view directly below the airplane from that altitude is 375 feet wide on the ground surface. Flight lines are spaced an average of 325 feet apart to allow for image overlap and 100 percent coverage of the study area. A 'bread crumb' feature of the mobile mapping software used for the flight allows me to track my flight path and helps guide me along predetermined flight lines to assure complete coverage. The recording device is normally paused during the turns outside the study area; hence the tape appears to jump from the end of one run to the beginning of the next.

Analysis Methodology:
After the flight, I analyze the videotape using a TV monitor and a computer monitor. As the videotape plays, the VED decodes the bar-coded GPS signal that was received from the GPS during the flight. The VED recreates the original GPS signal and sends it to the computer so the mobile mapping software 'thinks' it is receiving a live signal. The mapping software shows the moving position of the airplane superimposed on a street map on the computer screen while the recorded infrared imagery of the area below the airplane is visible on the TV monitor. The GPS updates the airplane position once per second throughout the flight and at the same rate during the post-flight analysis.

To count the deer, I watch the entire tape, pausing and playing it backward and forward at regular speed and in slow motion, as necessary. Generally, for each hour of tape, three or more hours of analysis and reporting are required to complete the count. As I view the tape and note the deer, I mark each one as a dot on a computer version of the maps accompanying this report. When I have viewed the entire tape, I count the dots on the map to find the number of deer in the count area. If I note large domestic animals on the computer map, I mark them with a different color dot. In these counts, red dots denote deer, gray or yellow dots (if any) denote possible deer or other unknown animal similar in size to a deer but apparently not a deer and blue dots (if any) represent domestic animals such as cattle, sheep or horses. These animals are always much warmer and in the case of horses and cattle, substantially larger than any deer.

Deer usually appear as a fairly bright white dot or narrow line (similar to a grain of rice) in the infrared imagery. In this imagery, white and lighter shades of gray represents warmer objects while black and darker shades of gray are cooler. Other white (warmest in the scene) objects that are common are roads and pavement that retain latent heat from sunshine during the day, man hole covers, street lights, house lights, fires, furnace stacks on houses, car engines that are running or have run recently, groundwater seepages, puddles, ponds, streams, rivers and large rocks and boulders in the woods. Other animals in the picture are often white or bright. Domestic animals are commonly very bright—hotter than deer, which have highly insulating coats.

In order to count deer with a high degree of confidence and accuracy, several factors have to be taken into account. Among them are deer infrared signatures, background infrared signatures, deer behavior and location. Questions I am commonly asked, and the answers I give, include the following:

Q. How do you know you are not counting the same deer twice?

Given:
- deer are not disturbed by a light plane flying more than a quarter of a mile above them,
- deer often congregate in groups of two or more—up to 20 or more in extreme cases,
- deer generally move very slowly as they graze, congregate or rest,
- deer live and act according to generally well known behaviors,
- I fly along a well documented flight path with an 'infrared view' of a known area below the aircraft that is recorded on videotape.

A. With the help of the moving map program, I can place dots representing deer on a map in their respective positions and orientation to one another quite accurately, particularly when referring to the nearby streets, intersections, rivers and streams that may be in view or recently in view on the videotape. As I analyze the tape, becoming quite familiar with the 'neighborhood' of the count area (houses, roads, hills, streams, rivers, golf courses, trails, etc.) and place the dots on the map, I recognize specific deer and groups of deer as I pass them a second and sometimes third time. For example, I may see and place a group of three deer/dots in an equilateral triangle near a trail a few seconds after passing a particular road. In the case where I first saw them they may have been on the right side of my screen. When I fly the next adjacent run, thanks to overlapping imagery, they may appear on the extreme left side of the screen. Very often, they will be in the same spot or not far from it, in the same or similar 'formation' five, ten, fifteen or even thirty minutes later. If I fly along and see a lone deer in the forest, it will still be there in the same general area when I make adjacent passes. On occasion, I will fly over a group of deer in an area, and on subsequent passes, I will see an additional deer that I did not see earlier because it may have been out of the picture, too close to another deer

(appearing larger than normal—but not counted as two) or it may have been obscured by a tree or foliage on the first pass. In those cases, I add the dot to the map. In uncommon cases where deer are moving quickly, I will look for them elsewhere in the direction they were originally seen moving. If I later see deer in the vicinity and cannot recognize them as the same group, I have to make a judgment whether to count them or not.

Q. How do you know what you are seeing and counting are deer and not some other animal?

Given:

- there is usually a sizable quantity of deer in the area in which I am flying the deer count,
- there are other wild and domestic animals in the same area, usually in smaller numbers,
- deer don't climb trees,
- deer are somewhat 'brazen' in their occupation of human communities,
- domesticated animals are often corralled, fenced in, densely grouped or tethered,
- deer are notably larger than foxes, raccoons, skunks and many dogs and smaller than cows and horses,
- deer have a variety of apparent temperature ranges/thermal signatures but are nearly always cooler than common domestic animals (dogs, horses, cattle, sheep),
- skunks, raccoons, and foxes appear to have warmer apparent body temperatures than deer and often look like a bright pinpoint of light in the woods, whereas a deer is larger, usually cooler and with less distinguishable edge contrast with their surroundings (i.e., they look slightly 'fuzzy' around the edges).
- deer congregate more and move less, and generally less rapidly, than smaller nocturnally active wild animals such as skunks, raccoons, coyotes and foxes.

A. Experience, practice and experiments with the Michigan Department of Natural Resources and others in counting and identifying a variety of captive animal types have given me high confidence in identifying deer in their normal forest, rural and suburban habitats. The deer that I have difficulty identifying and counting are those that are partially hidden from view in evergreen vegetation or exhibit such a low apparent temperature (thermal signature) that I cannot see them or distinguish them sufficiently enough to identify them as deer, or even as animals. I do not count 'white dots or blobs' that I do not have a strong feeling are deer. This includes deer bedding areas in light snow cover that contain melted through areas to the ground that approximate deer thermal signatures. Close examination of most infrared deer count videotapes will reveal to the viewer quite a few animals in trees or on the ground that do not appear on the deer count map. These animals are most likely to be something other than deer. My deer counts are generally considered a minimum definite number, as opposed to a maximum. Some deer will go undetected in nearly every environment.

Q. How accurate is the count?

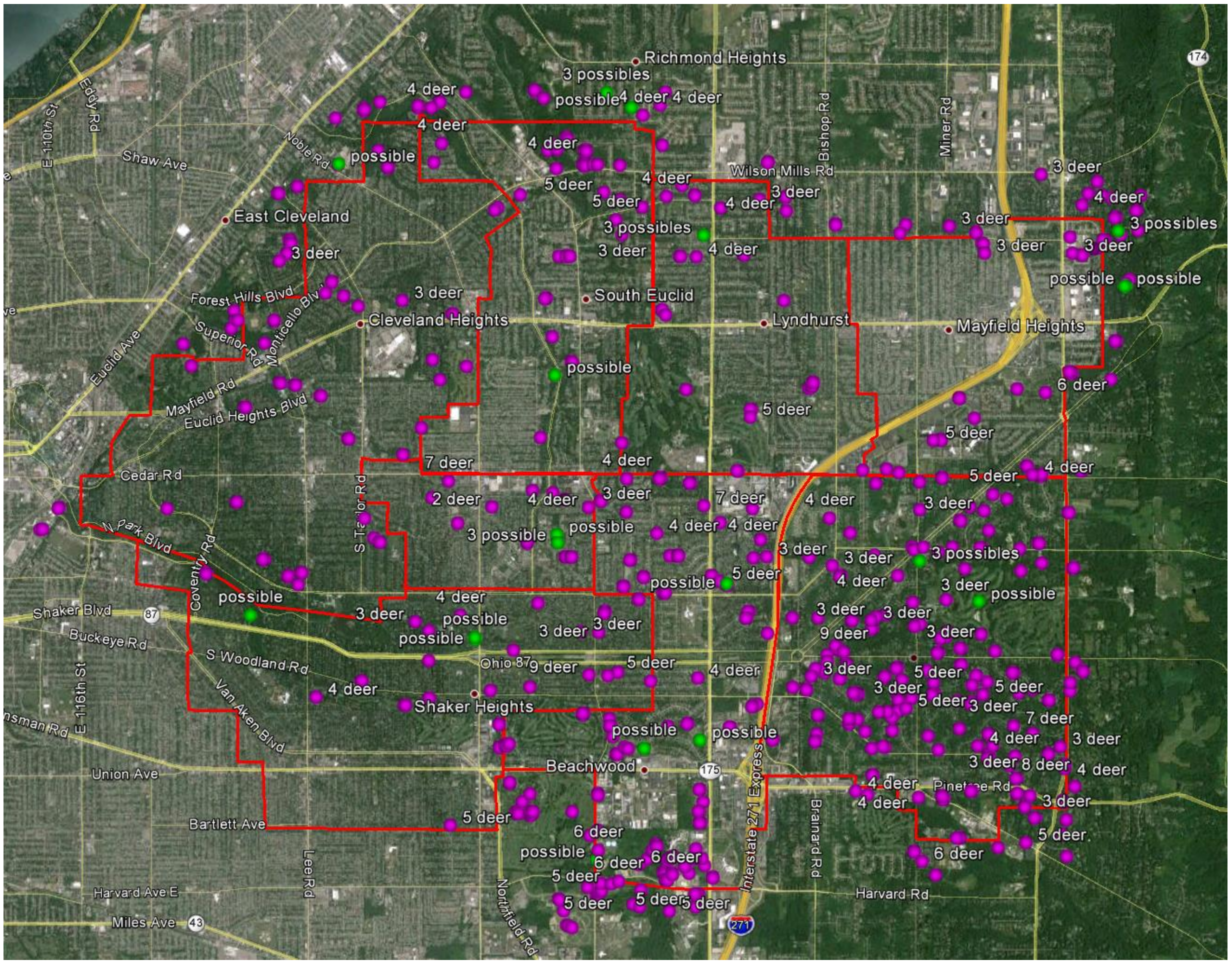
A. I don't know. I believe an average of 90% is in the ballpark, perhaps better for very good and excellent conditions, sometime worse. Conventional methods (deer-car collisions, spotlighting, pellet counts) are considered to be accurate within 30 to 40 percent—not a high number. In this method, we are looking at 100% of the area in question and under good conditions all active deer not hidden from view should be seen and counted with infrared.

Note: I will retain the original digital video tape of this deer count for at least one year.

Larry Davis
Kent, Ohio
davises@sprintmail.com
(330) 554-4794

A particularly vivid image of seven deer in a neighborhood backyard near the corner of Hilltop Drive and Orchard Way, in northeast Beachwood

Overall distribution of deer in the EWMP


Richmond Heights
East Cleveland
South Euclid
Cleveland Heights
Lyndhurst
Mayfield Heights
Shaker Heights
Beachwood
Wilson Mills Rd
Bishop Rd
Miner Rd
Shaw Ave
Noble Rd
Forest Hills Blvd
Superior Rd
Monticello Blvd
Euclid Ave
Mayfield Rd
Euclid Heights Blvd
Cedar Rd
S Taylor Rd
Coventry Rd
Shaker Blvd
Buckeye Rd
S Woodland Rd
Van Aken Blvd
E 116th St
E 110th St
Eddy Rd
Union Ave
Bartlett Ave
Lee Rd
Harvard Ave E
Miles Ave
Northfield Rd
Interstate 271 Express
Brainard Rd
Harvard Rd
Pinetree Rd
Ohio 87