Aerial Thermal Infrared Imaging White-tailed Deer Count
Mount Lebanon, Pennsylvania

Submitted to:

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Vision Air Research was retained by the Municipality of Mt Lebanon, PA to conduct the deer population survey. The goal of the project was to conduct and aerial infrared survey for white–tailed deer within the Municipality of Mt Lebanon PA, map group locations, and provide a count of deer observed.

**Study Area**

The study area encompasses the Municipality of Mt Lebanon PA located southwest of Pittsburg, PA. The municipality has an irregular boundary. To reduce flight time and thus flight costs the project area was squared off to facilitate transition from one transect to the adjacent transect. This is a residential area dominated by houses, other buildings, recreational fields, open parks, and hardwood and mixed forests.

**Methods**

The survey was conducted February 25 between 1800 and 2100 hours. Flight line transects were established running northwest to southeast. Transects were spaced 800 ft apart and flown at 1,000 ft above ground level. The sensor look angle was approximately 45° elevation. The sensor was aimed to gain more oblique or vertical look angle. Wide field of view was used to search for the deer while the narrow field of view was used to verify the object, as needed. Portion of the flight along transects were recorded to on onboard computer. The pilot and sensor operator communicated to verify the location of the boundaries at the start and end of transects.

The video was reviewed by playing the video backward and forward and in slow motion and frame by frame as needed to identify deer group and count within the group, and map group location. Deer were located by observing their level of emitted infrared energy versus background levels. Video editing and image extraction was not conducted. The video was collected for population counts by a skilled thermographer not for entertainment or educational purposes.

Duplicates or repeat groups were identified. Groups were mapped at their approximate observed position. I performed an additional check of the data through sampling the videotape for detection verification, and checking for duplicate groups. Orthophoto quadrangles were used as the base layer, which provided vegetation cover type to assist in mapping group locations. Group mapping locations are approximate.

**Equipment**

We used a forward–looking infrared (FLIR) by PolyTech Kelvin 350 II (Sweden) mounted on the left wing of a Cessna 206 “Stationair”. The sensor gimbal allows 330° of azimuth and 90° of elevation allowing us to look in all directions except directly behind the airplane. The infrared sensor installed in the gimbal is the high resolution Agema Thermovision 1000, which is a long wave system (8-12 micron). It has 800 by 400 pixels providing good
resolution with the ability to determine animals by their morphology or body shape. The thermal delta is less than 1°C, which means it can detect objects with less than 1°C different than the background. There are 2 fields of view (FOV): wide (20°) and narrow (5°). At 1,000 ft. above ground level looking straight down using the wide FOV the footprint or area covered by the sensor is 360 ft. x 234 ft. while the narrow FOV provides a footprint 90 ft. x 59 ft. The sensor operator / wildlife biologist sat in the rear seat and watched a high resolution 15 in. monitor to aim and focus sensor.

Results

The meteorological conditions were good for flight safety and infrared surveys. Image clarity was good (Figure 1). Locations of deer groups were plotted and the total number in each group was tallied. A total of 342 deer were found in 117 deer groups (Appendix A). Deer group size ranged from 1 – 10 individuals.

Figure 1. Infrared image clarity was very good during the FLIR survey by Vision Air Research in the Municipality of Mt Lebanon PA survey area, February 25, 2013.
Detection Potential

Cover type influences the availability of the deer to be detected by the sensor. A dense canopy will make it more difficult to detect the deer since infrared doesn’t see through vegetation. Research I’ve conducted to determine detection rates have been based on known target subjects. One or more individuals in a group had radio collars. The location of the target subject was monitored by a second aircrew in another airplane or via ground based crews to avoid any detection bias. These controls allowed me to determine if the individual or groups were detected, were available to be detected and subsequently missed, or unavailable to be detected because they were no longer in the search area. In areas where no collared animals were available, previously detected animals were used as targets in subsequent replicates. This is similar to a mark – recapture method for determining detection. These efforts have revealed a consistency as to which variables influence detection. The vegetation cover type is the primary variable to confound detection rates. Infrared cannot detect or “see” through a canopy cover. As such, evergreen species can thwart detection. Branches and tree boles can also influence detection based on the size of the animal (Figure 2). Cloud cover can enhance detection. Ambient temperatures do not influence detection unless it changes the subject animals habitat use or behavior. The temperatures during this survey were not unusual and no changes were expected.

Figure 2. The bedded deer can be seen on the lawn and under the deciduous canopy.
The multiple look angles provided by an oblique angle and the ability to aim and focus increases detection. Video capture instead of still images provides a dynamic view of the landscape.

Detection rates for open areas such as parks and meadow can be 100%, deciduous forests were roughly 86%, and conifer can range from 50 – 80% or less depending on the canopy closure (Figure 3). What was not obvious was the effect of bud break on detection. Although the deer, for example, could be seen visually through tree branches during bud break, the deer can be masked by the energy given off by the bud break. Buds effectively “glow” masking deer behind the canopy. Bud break may have diminished detection under some tree species and shrubs but it did not appear to be widespread during this survey.

All wildlife surveys are a snapshot in time whether they conducted from the air or ground. This survey can provide a good index or baseline for density and distribution of deer within the community.

*Figure 3. The deer in the meadow are easier to see than the deer in the shrubs. There is an additional deer crossing the road. This is an example from another project area.*
Appendix A: A total of 342 deer were located in 117 groups within the Mt Lebanon PA project area during the aerial infrared deer survey conducted by Vision Air Research on February 25, 2013. Deer groups are shown in blue icons. Deer locations are approximate.