Aerial Thermal Infrared Imaging White - tailed Deer Counts
Fort Thomas, Kentucky

Submitted to:

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Vision Air Research was retained by Fort Thomas, KY, to conduct the deer population survey within the township. The goal of the project was to conduct and aerial infrared survey for white – tailed deer within Fort Thomas, Kentucky, map group locations, and provide a count of deer observed.

Study Area

The study area for the survey was the same as conducted by Vision Air Research in 2010 and 2011. The study area encompasses the town of Fort Thomas, which is bounded by the Ohio River on the east and north, Highway 275 on the south and by Highway 471 on the west. The area is slightly dissected by stream draws. The eastern part of the study area has a steep break of almost 100 ft into the Ohio River. Elevations ranged from 540 ft to 820 ft above mean sea level (MSL). This is a residential area dominated by houses, other buildings, recreational fields, open parks, and hardwood forests.

Methods

The survey was conducted February 17, 2013 between 1800 and 2200 hours. The same transect array used for this survey was used in the 2010 and 2011 survey (Appendix A – Figure 1). North – south transects were established to conduct the survey. 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 as needed. 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 tapes were reviewed by playing the tape 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.

Duplicates or repeat groups were identified. Groups were mapped at their observed position not the position of the airplane. 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.

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. Deer located within survey session includes 47 deer groups with a total of 110 deer (Appendix A – Figure 2). Of these deer groups detected, 40 groups totaling 96 deer were located within Fort Thomas proper while an additional 7 groups and 14 deer were found directly adjacent to Fort Thomas. Deer group size ranged from 1 – 5 groups with most groups being 1 – 2 individuals.

Figure 1. Infrared image clarity was very good during the FLIR survey by Vision Air Research in the Fort Thomas, KY survey area, February 17, 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. Other research I've conducted to determine detection rates have been based on known target subjects. For example, 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 vegetation. As such, evergreen species can thwart detection. Branches and tree boles can also influence detection based on the size of the animal. Some animals may effectively hide behind tree boles or be masked by dense branches. Detection rates for open areas such as parks and meadow were 100%, deciduous forests were roughly 86%, and conifer can range from 50 – 80% depending on the canopy closure.

What was not obvious was the effect of bud break on detection. Although the deer, for example, could be seen visually 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 was not an issue during the survey for Fort Thomas, KY.

The other variable which had a strong influence on detect was "sky" or the effect the cloud deck had on how quickly infrared energy was emitted. A cloud layer allows the animals to glow hot compared to the radiant energy emitted by rocks, soil, and vegetation. A cloud layer enhances detection. The solar gain during daylight hours can reduce detection depending on the vegetation cover types and background conditions (i.e., snow, sand).

Appendix A

Figure 1. Aerial infrared survey transects established over the Fort Thomas, KY project area. These transects were used in the 2010, 2011, and 2013 surveys.
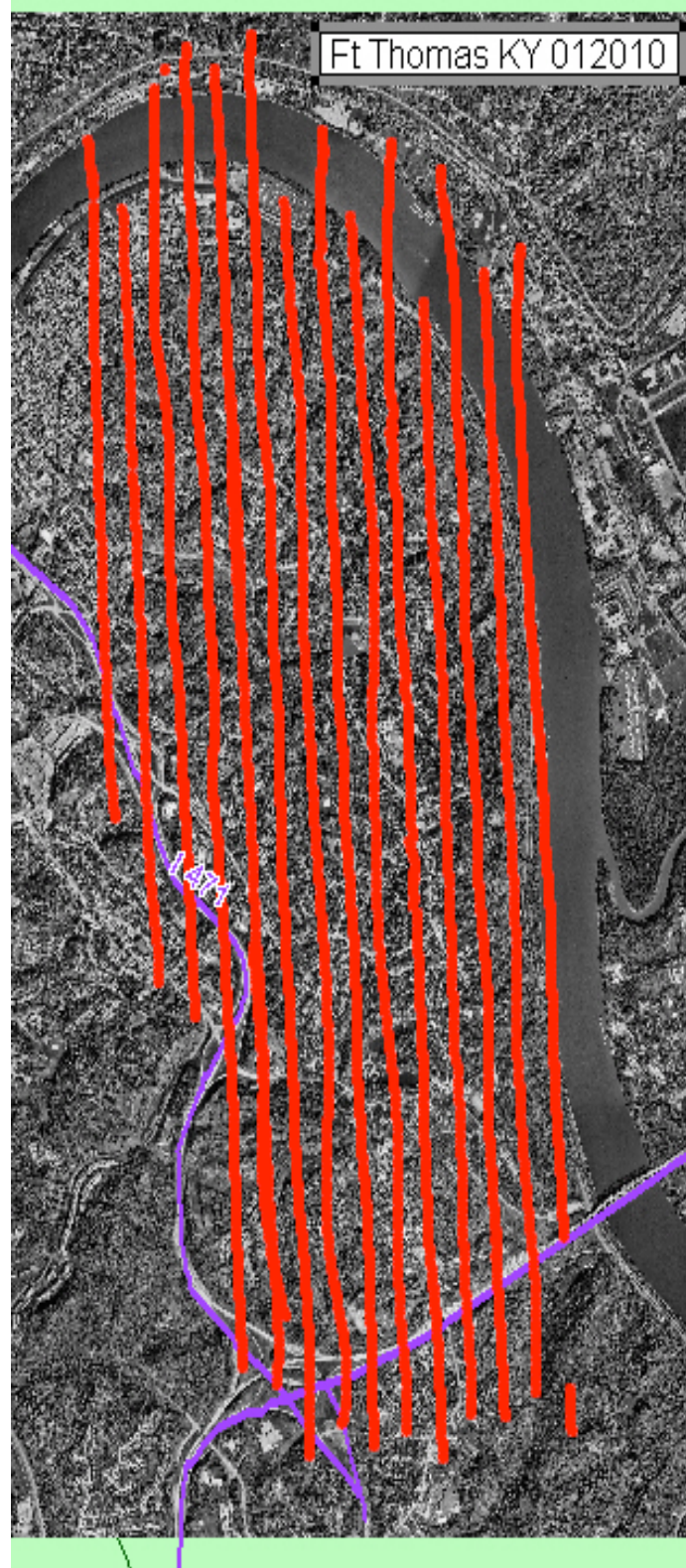
Figure 2. Deer groups found within Fort Thomas, Kentucky project area during the aerial infrared deer surveys on February 17, 2013. Deer groups within Fort Thomas have red icons while those within the survey area but outside Fort Thomas have yellow icons.