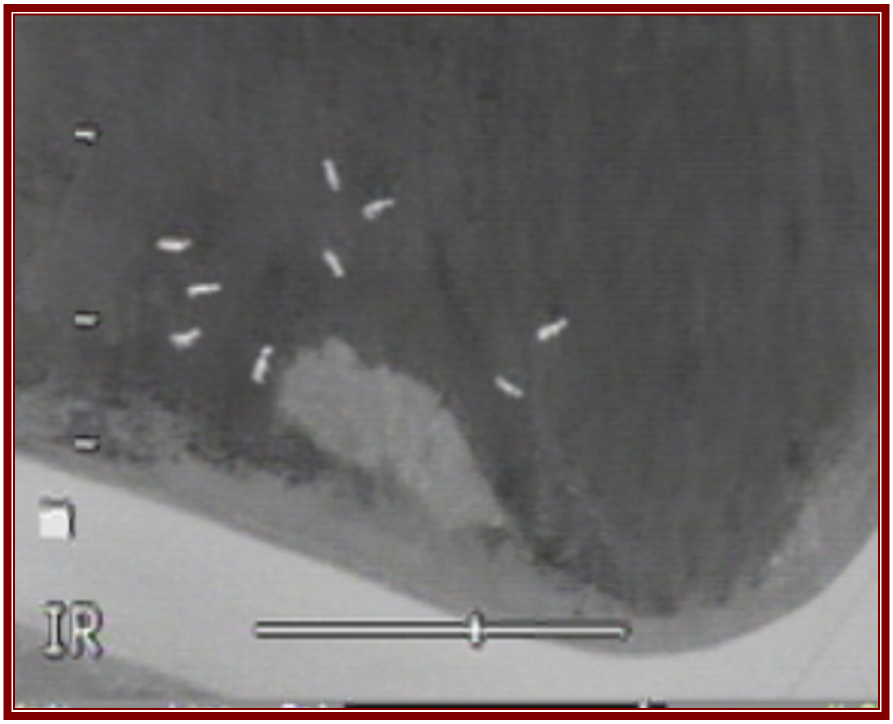
Thermal Infrared Imaging White - tailed Deer Count
City of Morgantown, West Virginia



Deer group found long a road during the aerial infrared survey for deer within the City of Morgantown, WV, March 2011

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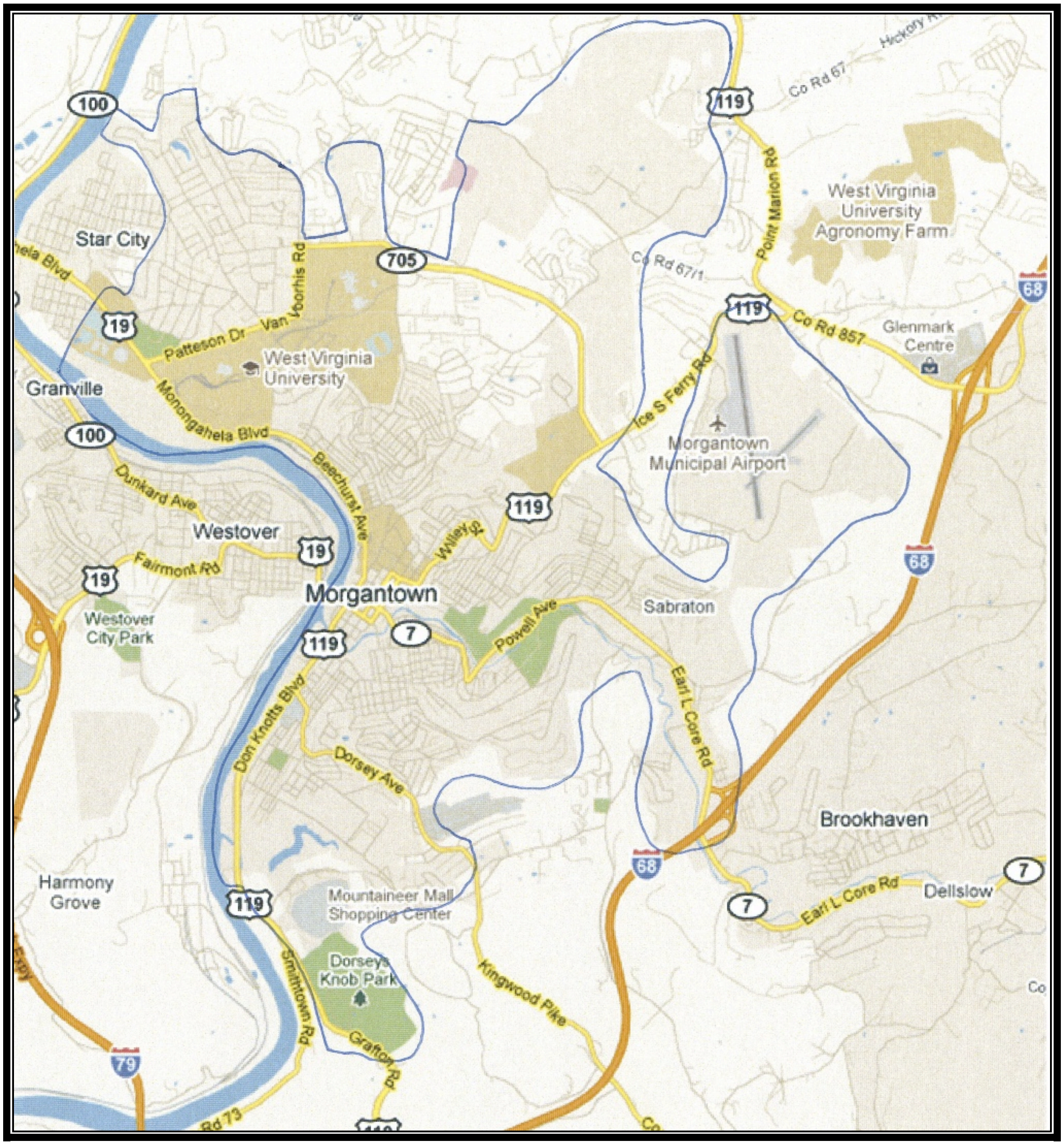
The City of Morgantown, West Virginia retained Vision Air Research to conduct a deer count. The project goal was to conduct an aerial infrared survey for white – tailed deer within the City of Morgantown, WV; map deer group locations, and provide a count of deer observed. A map of the study area was provided by the City of Morgantown (Figure 1).

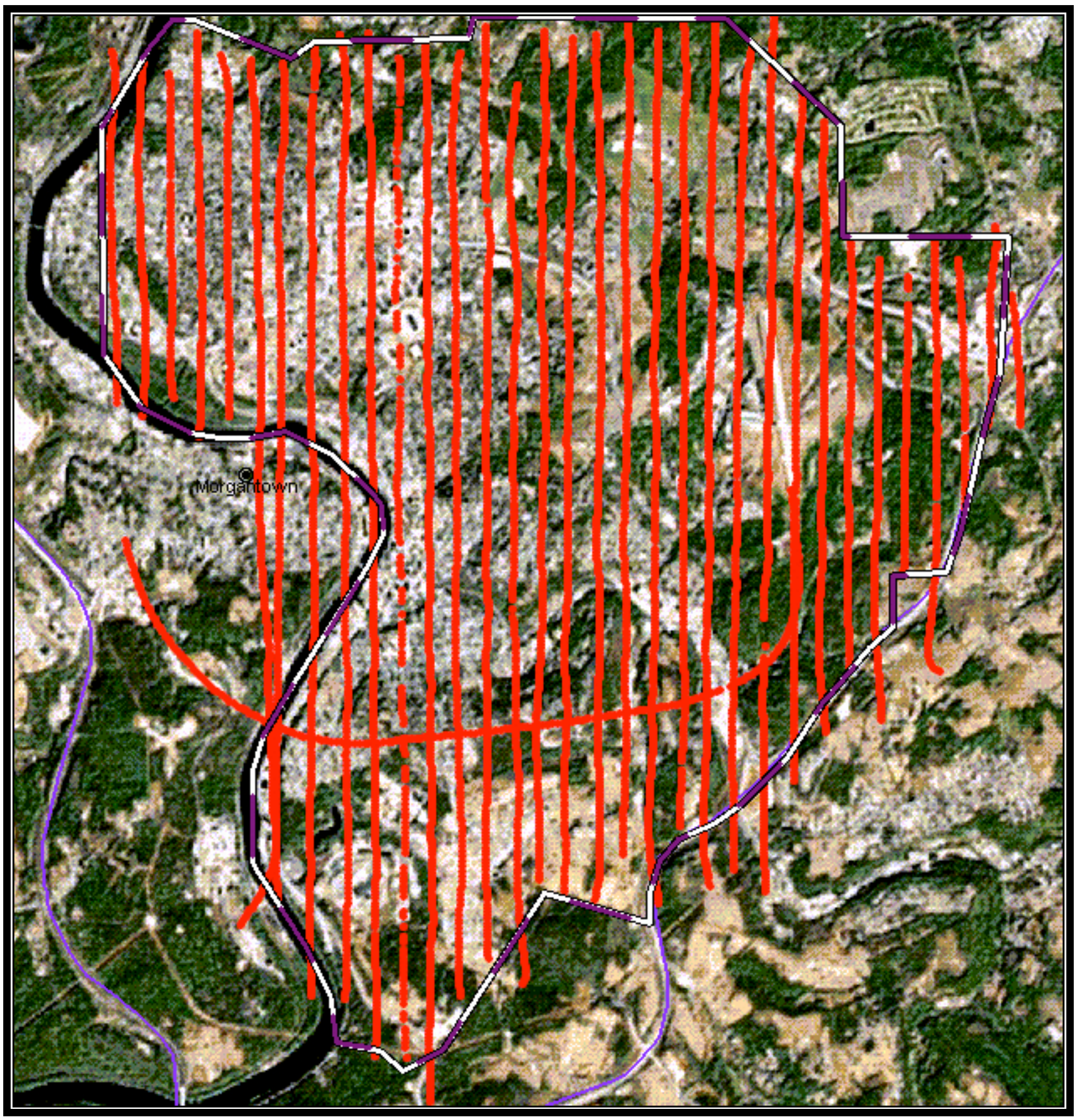
Figure 1. A solid blue line delineates City of Morgantown, WV.
Source: City of Morgantown, WV.



Methods

The City of Morgantown, WV, boundary is irregular in shape. The survey area was squared to allow a cost effective survey. North – south transects were established to conduct the survey (Figure 2). Transects were spaced 800 ft apart and flown at 1,000 ft above ground level. The pilot used a Garmin 496 which provided the transect locations and tracked transects flown. The sensor look angle was approximately 45^{o} elevation or look angle. The sensor was aimed to gain more oblique or vertical look angle as needed for species identification. 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.

Figure 2. City of Morgantown, WV survey transects for deer conducted in March 2011.



The survey was conducted March 13, 2011 between 1800 and 2200 hours. Portion of the flight along transects were recorded on mini digital videotape. The pilot and sensor operator communicated to verify the location of the boundaries to turn the tape off and on. The sensor operator turned the tape off at the transect end and commenced recording at the transect start. Deer were located by observing their level of emitted infrared energy versus background levels.

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. I performed an additional check of the data through sampling the videotape for detection verification, and checking for duplicate groups. Groups were mapped at their observed position not the position of the airplane. Group location is approximate. Orthophoto quadrangles (year 2000) were used as the base layer, which provided vegetation cover type to assist in mapping group locations.

Equipment

We used a PolyTech Kelvin 350 II (Sweden) mounted on the wing of a Cessna 206 (Figure 3). The sensor gimbal allows 330 ^{o} of azimuth and 90 ^{o} 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 ^{o} C, which means it can detect objects with less than 1 ^{o} C different than the background. There are 2 fields of view (FOV): wide (20 ^{o}) and narrow (5 ^{o}). 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.

Figure 3. Forward-looking infrared attached to the left wing of the Cessna 206.

Results

The meteorological conditions were good for flight safety and infrared surveys. Locations of deer groups were plotted and the total number in each group was recorded. A total of 156 deer groups were identified with a total of 654 deer (Figure 4). Example deer groups are presented in Appendix A. A shapefile was sent for import into a GIS.

Figure 4. Deer group locations within the City of Morgantown, WV, found during the March 13, 2011 FLIR survey by Vision Air Research.

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 the vegetation canopy. Detection rates for open areas such as agricultural fields and meadow were 100%, deciduous forests were roughly 86 %, and conifer can range from 50 – 80 % depending on the canopy closure.

There were no "controls" or known deer to allow developing a search image of deer in this study area. 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 leaf cover. 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 be able to effectively hide behind tree boles or masked by dense branches. This variable is fairly easy to comprehend – if the animal is hidden it is not available to be detected. If the animal can't be seen by visual methods (e.g., a deer is bedded behind a tree bole) it can't be see or was considered "unavailable". 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.

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 – in a separate file.