Military Thermal Technology Adapted to Wildlife Control and Management

ROD PINKSTON, *JAGER PRO Thermal Hog Control, Columbus, GA, USA*

ABSTRACT The advanced infrared technology of U.S. military continues to dominate the battlefield in combat operations all over the world. This equipment is now available to our state and federal wildlife professionals who are involved with the removal of many different animal species. We demonstrate the use of this technology for feral hog (*Sus scrofa*) removal in southwest Georgia by implementing tactical control methods. Nuisance animal removal is very effective and efficient at night using military-grade, high-resolution thermal devices.

KEY WORDS urban deer, feral hog, Georgia, wildlife control techniques, wildlife damage management

Urban and rural communities in several states are requesting an effective solution to growing white-tailed deer (*Odocoileus virginianus*) and feral hog (*Sus scrofa*) overpopulation and crop damage problems. Technical advances in thermal imaging equipment derived from military operations are currently being applied to feral hog control in southwest Georgia using this "first to market" high-resolution equipment. These new devices allow users to acquire and identify targets solely from the animal's body heat for improved research, management and control purposes. Professionals trained for nocturnal operations are equipped with long-range thermal spotting scopes to identify targets in total darkness out to ½ mile (0.8 km) for roost surveys, population density estimation and research. Wildlife managers may mount high-resolution thermal scopes directly to suppressed rifles to control several wildlife species in a variety of vegetation and weather conditions, including rain and fog.

BACKGROUND

Numerous wildlife management and research programs call for nocturnal detection and observation of wildlife under circumstances in which the observer remains unnoticed. Night-vision and thermal imaging approaches are seeing increased use (Naugle et al. 1996, Focardi et al. 2001, Lavers et al. 2005, Allison and DeStefano 2006). Thermal imaging allows for the detection and observation of wildlife with limited observer interference, and relatively high levels of human and animal safety (Lavers et al. 2005), but results vary depending upon species, habitat, weather and other factors (Allison and DeStefano 2006, Butler et al. 2006).

The human eye can detect only a tiny part of the electromagnetic spectrum, called visible light. But there are other forms of light around us such as ultraviolet and infrared. Infrared light requires a specific device or technology to become visible. Infrared light occurs in three forms; near-infrared (near-IR), mid-infrared (mid-IR) and thermal-infrared (thermal-IR). The key difference between thermal-IR and the other two is that thermal-IR energy is emitted by an object instead of reflected off them. Infrared imaging strategies differ depending on the device or technology used, i.e., image enhancement and thermal imaging (Morovision 2009).

Image Enhancement is what most people think of as night vision. This technology works by collecting tiny amounts of visible

light, including the lower portion of the infrared light spectrum, which is undetectable to the naked human eye before amplification through night vision devices (Morovision 2009).

Thermal Imaging works by capturing the upper portion of the infrared light spectrum which is emitted as heat by objects. Relatively hot objects such as living animals emit more of this light than cooler objects like trees or buildings. Thermal imaging devices capture this heat and transfer it into an image on a monitor. When viewed in a gray scale, the hottest things appear white and the coolest things appear black. A thermal imaging device transforms thermal energy into visible light via five basic steps (Morovision 2009):

1. A special lens focuses the infrared light emitted by all of the objects in view.
2. Infrared detectors are then used to scan this focused radiation. The detectors create what is called a thermogram or temperature map.
3. The thermogram is translated into electric impulses.
4. The electric impulses are then sent to a signal-processing unit where they are translated into data.
5. Once translated, the signal-processing unit sends the data to a display where it then becomes visible to the viewer.

Thermal Imaging in Wildlife Management

Research (Handheld, tripod, or vehicle window-mounted)

- Animal detection
- Population censusing and density estimation
- Roost surveys and migration monitoring
- Observation of feeding habits and patterns
- Crop damage monitoring
- Thermal video recording

Population management & control (Rifle-mounted)

- Disease surveillance and control
- Crop damage management
- Conservation

METHODS

Three-person hog control teams are equipped with a single long-range thermal spotting scope and three thermal rifle scopes for crop damage control. The best locations for observing problem fields are at the highest elevations, facing the wind. Spotters should identify and consistently use the same dominant shooting eye when peering through long-range scopes to ensure that the opposite eye retains optimal night vision.

Team leaders use long-range spotting scopes to lead the shooters single-file with rifles at sling arms (i.e., sling over shoulder) for safety. Team leaders observe target animal behavior to determine how close to stalk. Wind direction is the most important factor for scent control. It is also important for the shooters to move only when the team leader moves, making one silhouette on the horizon.

Long-range thermal spotting scopes with 640x480 resolution can detect movement out to 2,000 m. Spotters are consistently able to distinguish hogs from deer, coyotes and cattle out to a 750 m recognition range. Rifles are equipped with either short range (680 m detection, 225 m recognition) 320x240 resolution (Fig. 1) or medium-range (1100 m detection, 360 m recognition) 640x480 resolution thermal scopes.

The hog control strategy described here is to stalk within 50 yards of a group to facilitate complete removal (Fig. 2). After a team leader selects an appropriate location, shooters move up on either side. Simultaneous first shots are coordinated by team leaders (e.g. based on a 3-2-1

countdown method). Remaining hogs will likely be running for follow-up shots. Consequently, it is important to have pre-established shooting lanes for safety and efficiency. Adults are targeted for the initial shot to create chaos and a communication void in the sounder group. The confused juveniles will offer easier follow-up shots without adult direction.

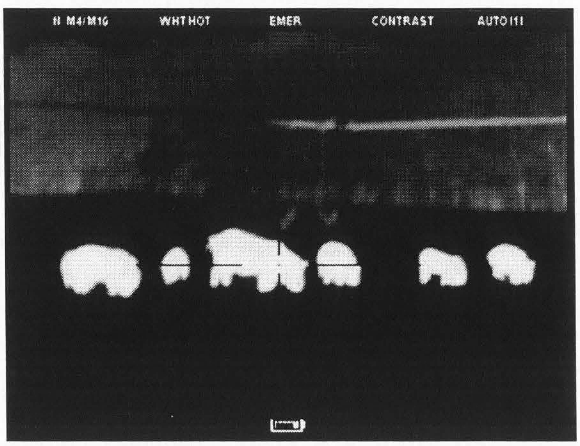

Figure 1. 320x240 resolution thermal rifle scope image at 100 m.

Figure 2. Hog control team in shooting position 42 m from their targets.

RESULTS

In 2008, we removed 649 hogs over 90 nights to protect approximately 55,000 acres of cropland (removal rate = 7.2 hogs/night, or 0.9 hogs/hour based on an 8-hour control period).

Winter

Thermal hog control in open agricultural areas is only employed approximately 180 days of the year. Night operations are avoided from mid-October to mid-January during the Georgia rifle deer season because feral hogs feed on mast crops in wooded areas at this time of year. Also, a great deal of farmland is leased for deer hunting purposes and thermal hog control efforts would disrupt lease hunting activities. Annual thermal hog control work begins in mid-January, when feral hogs have exhausted mast crops in the woods and return to harvested peanut fields to forage. A total of 81 hogs were removed during January and February as peanut fields are a primary food source during these cold winter months (Table 1).

Spring

A total of 121 hogs were removed from approximately 25,000 acres during March, while farmers were planting corn. All corn fields were planted and had germinated by the second week in April. Night operations were avoided from mid-April until peanut planting began during the second week of May. The next four weeks were very effective as 157 hogs were removed from approximately 30,000 acres as farmers continued planting peanuts (Table 1). All peanut fields were planted and had germinated by the second week in June.

Summer

Night operations were avoided from mid-June until mid-August because of hot, humid temperatures and zero thermal visibility in the tall vegetation of mature corn fields (Table 1).

Fall

Thermal hog control work resumed in mid-August as farmers began harvesting corn. A total of 258 hogs were removed from

Table 1. Thermal imaging hog control in Georgia: 2008.

Month	Control period (days)	Food resource	Hogs removed	Removal rate (daily)
January	5	Old peanuts	28	5.6
February	8	Old peanuts	53	6.6
March	14	Corn	121	8.6
April	4	Corn/other	32	8.0
May	18	Peanuts	134	7.4
June	4	Peanuts	23	5.8
July	0	Corn	0	NA
August	4	Corn stubble	29	7.3
September	19	Peanuts	138	7.3
October	14	Peanuts	91	6.5
November	0	Acorns	0	NA
December	0	Acorns	0	NA

approximately 30,000 acres during the next eight weeks (Table 1). When farmers finished harvesting corn, feral hogs congregated in maturing peanut fields for a high protein food source. Thermal equipment was able to easily detect their movement at night in the shorter vegetation of mature peanut fields. This method was very successful until all peanuts were harvested and deer season began in mid-October.

CONCLUSIONS

Thermal technology allows users to detect nuisance wildlife from long distances, and is considered superior to spotlighting for feral hog detection (Focardi et al. 2001), as well as affordable (Lavers et al. 2005). The highest quality 640x480 resolution devices can detect heat sources from 2,000 m and allow users to stalk close without being detected. Wildlife management and research activities that may be facilitated or enhanced by thermal imaging include population size estimation, buck/doe ratio assessments, roost surveys, feeding pattern observations, crop damage monitoring and thermal video recording.

The procedure described above has been very effective at eradicating entire feral hog sounder groups and substantially reducing crop damage in Georgia corn and peanut fields. This method may have applications to other wildlife damage management operations, especially those for white-tailed deer, which Conover (1998) found agricultural producers in the United States considered the most injurious wildlife species. Thermal imaging equipment is versatile enough to perform population management duties and disease control work for most wildlife, avian and invasive species, and is also easily adapted for both urban and rural uses.

Thermal imaging equipment performs solely by capturing infrared energy from objects, and no light at all is required for the device to function (Morovision 2009). This may allow biologists and wildlife service agents to perform their work at night without attracting attention from the public. Humans and warm-blooded animals become easily visible at night. Automobiles, houses and other objects stand out in urban environments to create improved safety conditions in residential subdivisions. It is much easier to determine safe backgrounds for pass-through shots and possible ricochets with thermal equipment than with other night vision or spotlight methods. This equipment also performs in all types of weather conditions, including rain and fog.

Military-grade thermal technology is available (Lavers et al. 2005) and affordable to the wildlife service industry. U.S. Department of Defense (DOD) manufacturers are building 1,500 units per month for combat purposes in Iraq and Afghanistan. JAGER PRO, LLC has the sole contract with the DOD manufacturer to deliver 25 units per month to state and federal wildlife service agencies at General Services Administration (GSA) pricing. This provides an opportunity for state and federal wildlife control professionals to use the best technology to perform their daily research, management and control work.

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