An Experiment in Deer Detection by Thermal Scanning[1]

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Highlight

An airborne, thermal infrared scanner was tested for deer detection over penned mule deer (*Odocoileus hemionus hemionus*) near Fort Collins, Colorado. The animals were detected at 300- and 500-ft altitudes, but not at 1,000 ft.

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[2] Forest Service, U.S. Department of Agriculture, with central headquarters maintained at Fort Collins in cooperation with Colorado State University.

Although the theoretical potential of airborne thermal scanning in big game censusing has been speculated by numerous authors (Zanon, 1964; Bartholomew and Hoffer, 1966; Cain, 1966), no published results of field trials have been found since 1968 (Croon et al., 1968).

Personnel of the Rocky Mountain Forest and Range Experiment Station, in cooperation with the Colorado Division of Game, Fish and Parks, have been studying the basic principles that underlie the technique since 1969. This report describes the results of our first attempt at deer detection by aerial thermal scanning.

Methods and Equipment

The thermal imagery was obtained during a flight on August 20, 1971, before sunrise, between 4:00 and 4:30 AM, MST. The wind was calm, air temperature was 56 F (13.3 C), and humidity was near 100%. The imagery was produced by a Bendix model 7M/LN-2-LW thermal infrared scanner,[3] mounted in an Aerocommander 500B owned by Colorado State University. Operating characteristics of the scanner, as quoted by the manufacturer, were: instantaneous angular field of view, 2.5 milliradians; total angular field of view, 120°; detector, HCT (mercury-cadmium-telluride); thermal resolution, 0.2 C; wavelength response, 0.8 to 13.0 micrometers; and data output mode, continuous 70 mm film strip.

The target area for the test was a complex of six animal holding pens at the foothills campus of Colorado State University west of Fort Collins. The pens were used to retain mule deer and other animals for various kinds of research. At the time of the flight, the pens contained 55 adult mule deer and 11 adult pronghorn antelope

[3] Trade names are mentioned for the benefit of the reader only, and do not constitute endorsement or preferential treatment by the U.S. Department of Agriculture.

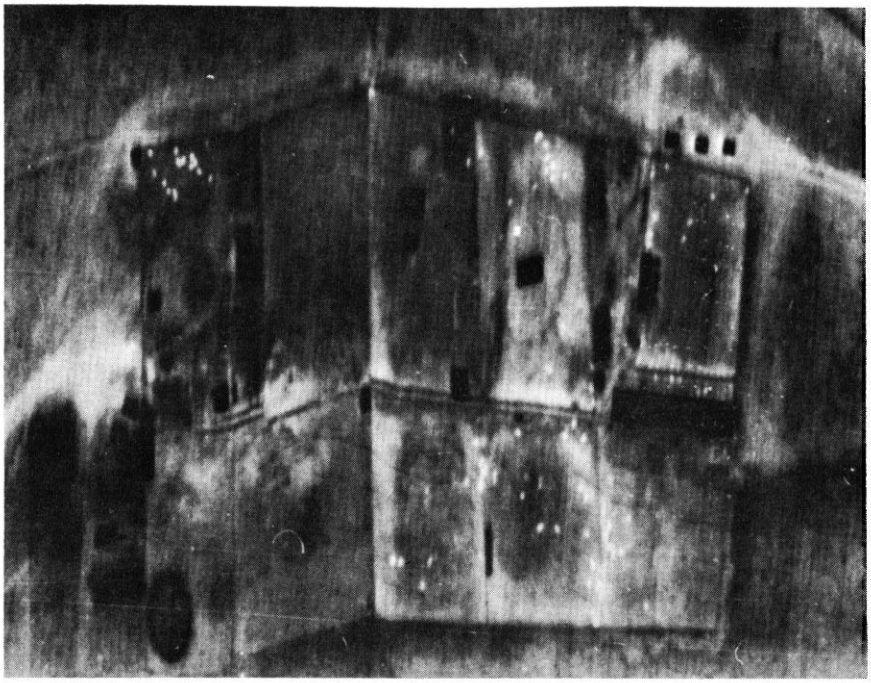

FIG. 1. Photograph of the original imagery at 500-ft altitude.

(*Antilocapra americana*). During the flight, surface radiant temperatures of the animals and of the ground surface in the pens were sampled with a Barnes PRT-5 infrared radiometer. Three north-south passes were made at altitudes of 300, 500, and 1,000 ft above the ground.

Results

The deer radiant temperatures varied from 21.0 to 26.0 C over the 12 readings taken, with a mean of 23.4 C. The five pronghorn measurements varied from 19.0 to 23.0 C and averaged 21.0 C. The three pen measurements were the most uniform, all 15.0 C.

The imagery obtained at the 500-ft altitude is reproduced in Figure 1. Although considerable quality was lost in reproduction, the animals can be seen as white spots. They were similarly imaged at 300 ft. At 1,000 ft, however, the animals were indistinguishable.

Interpretation of the imagery by three interpreters unfamiliar with the imagery, and having no knowledge of the number of animals present, resulted in counts as shown in Table 1.

There were no errors of commission (type II error) in total counts by any of the interpreters. However, attempts at species separation increased the error considerably. As shown above, deer were frequently mistaken for antelope.

The criterion for species separation was the shading of the spots. The deer imaged lighter than the antelope because of their higher temperatures and larger size.

Discussion

No final conclusion can be drawn from this experiment in regard to the value of the thermal scanning technique for animal detection; too many variations on the basic method must yet be investigated. However, two comments on operational procedures and equipment requirements can be made as a result of the flight.

The failure of the scanner to detect the animals at the 1,000-ft altitude is believed to be mainly the fault of the system's 2.5 mr spatial resolution. The temperature difference between the individual animals and the background (4.0 C or greater) was great enough to permit detection provided the angular resolution of the scanner was sufficiently small to resolve an object the size of an adult deer or antelope. Although an altitude of 500 ft is probably satisfactory for many deer detection applications, the wider area coverage possible from 1,000 ft is often desirable. Moreover, fluctuation in topographic relief may often require mean altitudes of at least 1,000 ft.

An accessory feature, available on most scanners but not used on this mission, is automatic roll compensation. This unit corrects for aircraft roll, thus reducing lateral distortion in the imagery produced. Even though winds appeared to be calm at takeoff, enough turbulence existed during the flight to cause significant distortion in the imagery, especially at the higher altitudes.

Table 1.—Species and total count of animals as interpreted from imagery.

	Deer	Antelope	Total
Animals present in pens	55	11	66
Animals counted			
Interpreter 1			
(Trial 1)			65
(Trial 2)	49	12	61
Interpreter 2 (Trial 1)	42	23	65
Interpreter 3 (Trial 1)	47	17	64

Literature Cited

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