Evaluation of Portable Infrared Cameras for Detecting Rio Grande Wild Turkeys

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Abstract

*Observing nocturnal, cryptic, highly mobile, or elusive wildlife in the field is difficult. Precise abundance estimates are necessary to make management decisions. Numerous methods have been examined to estimate wild turkey abundance with limited success. The use of forward-looking infrared (FLIR) technology has increased and may improve the detection of wildlife. We sought to estimate Rio Grande wild turkey (*Meleagris gallopavo intermedia*) abundance using FLIR surveys and to assess the accuracy of these estimates by comparing them with independent estimates from ground surveys. We conducted 8 ground and aerial FLIR surveys of roost sites in 3 distinct ecological regions of Texas, USA. We were unable to aerially detect roosting turkeys using the portable FLIR camera because of altitudinal restrictions required for safe helicopter flight and lack of thermal contrast. Flight altitude was a principal obstacle because topography and aerial obstructions (i.e., utility poles, towers, and wires) often required higher-altitude flights than ideal for turkey observation. From an aerial perspective, wild turkey thermal signatures were camouflaged by their surroundings. The external temperatures of turkeys, tree branches, and other background objects (e.g., rocks, bare ground) were within 1.5°C of each other despite ambient temperatures or other weather variables (i.e., wind speed, humidity, and cloud cover). Therefore, there was not sufficient difference in radiant temperature of a turkey and its background to permit adequate detection from an aerial perspective.* (WILDLIFE SOCIETY BULLETIN 34(3):839–844; 2006)

Key words

abundance estimation, forward-looking infrared, Meleagris gallopavo intermedia*, Rio Grande wild turkey, Texas*.

Many wildlife are nocturnal, cryptic, highly mobile, or elusive; therefore, observing them in the field is problematic (Boonstra et al. 1994). The foundation of many wildlife studies is to obtain a precise, unbiased estimate of abundance (Krebs 1999). Estimates of abundance are required to evaluate the impact of management activities (Kurzejeski and Vangilder 1992, Weinstein et al. 1995), to establish harvest regulations (Kurzejeski and Vangilder 1992), and to model population dynamics (Vangilder 1992). Because of the mobility and evasive behavior of many species, abundance estimates are difficult to obtain. Wild turkeys (*Meleagris gallopavo*) exemplify a species where numerous abundance-estimation methods have been evaluated with limited success (Cook 1973, Weinstein et al. 1995), which constrains wild turkey management programs (Cobb et al. 1997). Reliable methods for estimating wild turkey numbers at broad spatial scales have long been sought by natural resource agencies (Cook 1973, Weinstein et al. 1995).

The advent of technology such as thermal-infrared cameras has recently gained broad attention for potential use in wildlife population surveys (Garner et al. 1995, Thompson 2004). The use of forward-looking infrared (FLIR) may improve the detection of individuals, thus increasing survey precision (Havens and Sharp 1998). Aerial FLIR has been used primarily for large ungulate species (Wiggers and Beckerman 1993, Naugle et al. 1996, Adams et al. 1997), but few studies have evaluated the ability of FLIR to detect and survey smaller wild animals. As with all species, estimating wild turkey abundance is dependent upon detectability (Thompson et al. 1998, Buckland et al. 2001), which is influenced by various factors including vegetation, terrain, weather, and observer experience (Buckland et al. 2001). Researchers have reported an increase in detection of target species with the use of FLIR (Belant and Seamans 2000, Focardi et al. 2001). Evaluation of FLIR for detecting wild turkeys is limited (Wakeling et al. 1999), particularly across a range of various cover types, and no one has evaluated the effectiveness of FLIR technology for aerially detecting roosting Rio Grande wild turkeys (*M. gallopavo intermedia*). Recent declines in turkey abundance have prompted Texas Parks and Wildlife Department (TPWD) to assess landscape-scale methods of surveying turkey populations. Brood counts and harvest data have been used by TPWD to estimate population trends and numbers, but presently, no methods to estimate Rio Grande wild turkey densities are used. Here, we describe our application of FLIR technology in detecting wild turkeys in 3 Texas, USA, ecological regions where they commonly are found (Edwards Plateau, Rolling Plains, and Gulf Prairies and Marshes; Gould 1962). We sought to estimate turkey abundance using aerial thermal-imaging surveys and to assess the accuracy of these estimates by comparing them with independent estimates from ground surveys.

Study Areas

Rio Grande turkeys are distributed in the central-western regions of Texas (Beasom and Wilson 1992), occupying 3 ecological regions: Edwards Plateau (EP), Rolling Plains (RP), and Gulf Prairies and Marshes (GPM). The EP ecoregion contains approximately 9.7 million ha (Fig. 1). The region is predominately rangeland with various species of bluestem (*Andropogon* spp.), grama (*Bouteloua* spp.), and panicum (*Panicum* spp., Gould 1962). Common overstory species include semievergreen live oak

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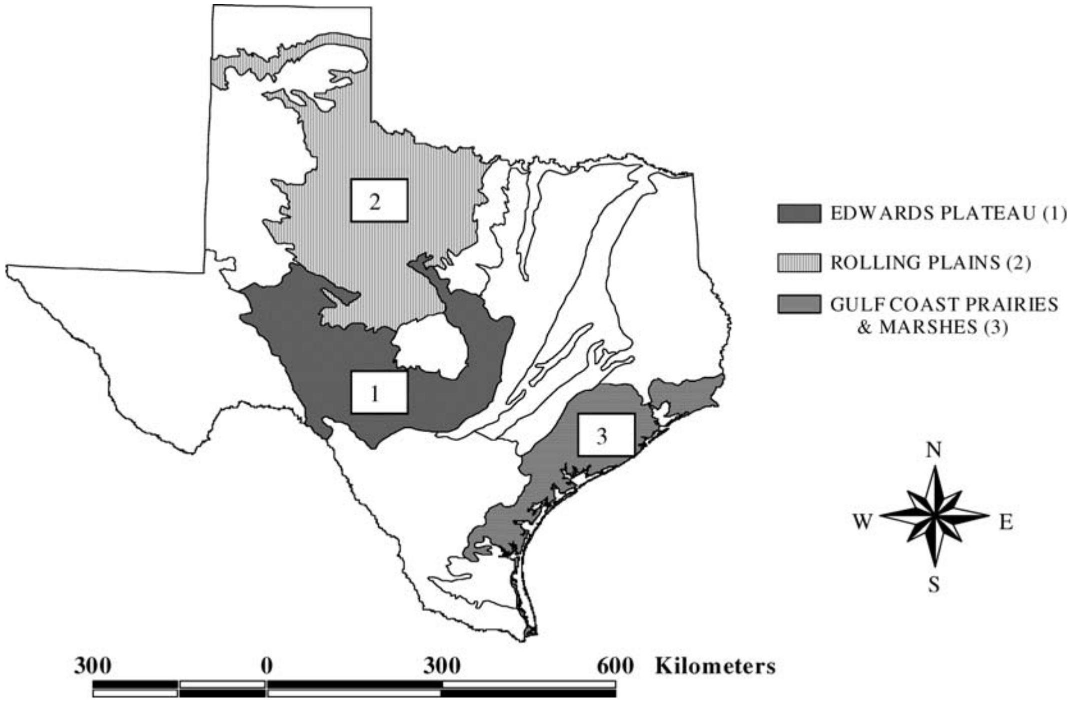

Figure 1. Three ecological regions of Texas, USA (Edwards Plateau, Rolling Plains, and Gulf Prairies and Marshes), that were aerially surveyed for roosting Rio Grande turkeys using thermal imagery, Nov 2004–Apr 2005.

(*Quercus virginiana*) and evergreen ashe juniper (*Juniperus ashei*). Other deciduous overstory species, bald cypress (*Taxodium distichum*), cottonwood (*Populus deltoides*), and pecan (*Carya illinoinensis*) are found along riparian zones to a lesser degree (Larkin and Bomar 1983). The EP consists of rolling hills, steep canyons, and ranges of approximately 30 to 915 m above sea level (asl; Gould 1962). The climate of the EP is subtropical to semiarid, with mean annual precipitation from 84 cm/year on the eastern edge to 38 cm/year on the western edge; droughts occur frequently.

The RP ecoregion is approximately 9.7 million ha within the Great Plains region of North America (Fig. 1; Gould 1962). The RP is predominately rangeland and primarily consists of tall and mid-grasses, including various species of bluestem, grama, tobosa (*Pleuraphis mutica*), and three-awn (*Aristida* spp.). Deciduous mesquite (*Prosopis glandulosa*), low-lying shinnery oak (*Quercus havardii*), and sand sage (*Artemisia filifolia*) are common invader species. Large cottonwood and pecan trees are found along the riparian areas. Topography is gently rolling to moderately rough, and elevation ranges between 243–914 m asl. The climate is semiarid, and mean annual precipitation varies from 55–76 cm in the western and eastern portions, respectively.

The GPM ecoregion, located along the Gulf coast of Texas, USA, is approximately 3.8 million ha (Fig. 1; Gould 1962). The GPM is a mixture of rangeland, improved pasture, and woodlands. Typical rangeland species include bluestem, indiangrass (*Sorghastrum nutans*), and gulf muhly (*Muhlenbergia capillaries*). Trees species, such as mesquite and live oak, have invaded the area, along with brush species, including prickly pear (*Opuntia* spp.) and acacia (*Acacia* spp.). Topography is generally flat and ≤46 m asl. Mean annual precipitation varies between 50–127 cm from west to east, respectively.

Methods

We collected data similarly among the 3 ecoregions. To aid in estimating turkey detectability, we captured birds and outfitted them with a backpack-style, motion-sensitive radiotransmitter (150–152 MHz, Advanced Telemetry Systems, Isanti, Minnesota) in conjunction with concurrent research projects (Texas A&M University, Texas A&M University–Kingsville, Texas Tech University). Radiomarked turkeys allowed us to readily locate numerous roost sites across study areas. The evening before an aerial survey, we located roost sites of radiomarked turkeys via homing (White and Garrott 1990) and estimated flock size via ground counts. We estimated ground counts of roosting turkeys in 1 of 2 ways: 1) we established ground blinds near roost sites and counted turkeys as they flew into the trees, or 2) we located roost sites at night via homing radiomarked turkeys and counted them using a spotlight with a red filter, binoculars, or the portable FLIR camera. We recorded Universal Transverse Mercator (UTM) coordinates of the roost sites with a handheld global positioning system. We collected ambient temperature, wind speed, humidity, and cloud cover information from the ground.

We conducted aerial FLIR surveys from a Robinson R-22 helicopter (Holt Helicopters, Uvalde, Texas; Flap Air, Canadian, Texas; Mesquite Helicopters, Alice, Texas) using a FLIR ThermaCAM® B-20 (FLIR Systems, North Billerica, Massachusetts) handheld infrared camera with a 24° lens. The B-20 is a long-wave (7.5–13-μm) infrared camera with a thermal sensitivity of 0.06°C at 30°C. The 24° lens provides a field of view of 24 × 18° and a minimum focus distance of 0.3 m with a spatial resolution of 320 × 240 pixels. A built-in 10-cm liquid crystal display viewfinder allowed the operator to view real-time images and to zoom in to potential targets. A built-in flash memory and 128-megabyte, removable flash card allows the operator to store radiometric thermal images.

We performed surveys (1–4 flights/region) during predawn hours (0300–0600 hours) of winter months (Nov 2004–Apr 2005) to take advantage of the leaf-off period for each ecological region. Additionally, Rio Grande wild turkeys form large flocks in the winter and congregate at traditional roost sites typically located along riparian areas (Thomas et al. 1966, Beasom and Wilson 1992). We handheld the FLIR camera out the passenger side door of the helicopter, which was removed to maximize the field of view (Havens and Sharp 1998). The pilot navigated to the roost sites based on the UTM coordinates collected from the ground and orbited around the roost while slowly decreasing in altitude until turkeys were detected or until it was unsafe to fly any lower. Using a helicopter allowed the pilot and FLIR operator to hover over potential targets and search for thermal signatures of roosting turkeys. Flight altitudes differed by study area because of topography and aerial obstructions (e.g., utility poles, towers, and wires). We recorded aerial survey data to a video home system video tape and compared data with ground counts to determine the proportion of turkeys detected. Radiant surface temperatures of turkeys and their surroundings were captured on the radiometric thermal images and analyzed using the ThermaCam QuickView 1.1 analysis software (FLIR Systems, North Billerica, Massachusetts).

Rio Grande wild turkey capture and handling protocols were permitted under Texas A&M University Animal Use Permit 2001-119 and 2005-005 and Texas Tech University Animal Care and Use Committee 02266-09.

Results

We conducted 8 ground and aerial FLIR surveys (4 EP, 3 RP, and 1 GPM) of roost sites during the study period. We located 3 roosts in the EP, with 2 roosts of 28–33 turkeys and the third roost consisting of 14–17 turkeys. The RP roost sites consisted of a large roost with 66–75 turkeys and a smaller roost with 47–52 turkeys. We located 9 roost sites in the GPM, and each included 5–15 turkeys. Ground counts were estimates of roosting turkeys, and variation in counts was due to actual changes in the number of turkeys from night to night or due to counting error. In our study, we were unable to aerially detect roosting turkeys using the portable infrared camera because of altitudinal restrictions required for safe helicopter flight and because of the lack of thermal contrast. Based on the analysis of the radiometric thermal images, we found that the external temperatures of turkeys, tree branches, and other background objects (i.e., rocks, bare ground) to be within 1.5°C of each other, despite ambient temperatures or other weather variables (i.e., wind speed, humidity, and cloud cover). Therefore, there was not sufficient difference in the radiant temperature of a turkey and its background to permit adequate detection from an aerial perspective.

Discussion

Use of FLIR technology in aerially detecting Rio Grande turkeys in 3 ecological regions of Texas was limited for various reasons. First, flight altitude was a principal obstacle because topography and aerial obstructions often required higher-altitude flights than ideal for turkey observation, most notably in the EP. We found thermal signatures for wild turkeys to be small (Buchholz 1996); thus, flights <10–15 m above the tree canopy were required for observation of turkeys. Aerial surveys at this altitude were 1) unsafe for proposed landscape aerial surveys and 2) resulted in turkeys flushing from the roosts before we could complete the counts. Further, the required thermal contrast to differentiate between a target of interest (i.e., a turkey) and its background (i.e., branches of roost trees; Wyatt et al. 1985) was inadequate. Radiant temperatures of the background (i.e., tree, leaves, ground cover) in each study location retained and emitted energy throughout the night, making it difficult to detect turkeys. Thus, heat signatures of roosting turkeys were effectively camouflaged within the rest of the tree from an aerial perspective (Fig. 2A). However, roosting turkeys were more readily detected from the ground (horizontal view) using the portable infrared camera because the background consisted of the cool night sky (Fig. 2B). Finally, we observed that Rio Grande wild turkeys in the RP and EP preferred to roost in riparian areas, typically on branches overhanging water (Thomas et al. 1966, Cook 1973, Crockett 1973). Because water retains heat even if ambient temperatures are low (i.e., near or <0°C), turkeys roosting over water were camouflaged and difficult to differentiate from an aerial perspective (Fig. 3). Therefore, we suspect that if the flight altitude had been lower, detection still would have been limited.

The combination of inadequate thermal contrast caused by background objects, and the required altitude needed to adequately detect roosting Rio Grande turkeys (because of the small thermal signature), limited the use of FLIR technology for all 3 Texas study areas. Our findings were similar to those reported by Wakeling et al. (1999) in aerial surveys of Merriam's wild turkeys (*M. gallopavo merriami*) in northern Arizona. In that report, the authors concluded that the dense ponderosa pine (*Pinus ponderosa*) canopy obscured turkeys and that thermal signatures were too small to detect with an infrared camera. Although the tree species in our study differed, we confronted similar complexities. Because of the limitations of aerial FLIR surveys for wild turkeys, we recommend TPWD seek alternative methods for estimating Rio Grande wild turkey densities in the state of Texas.

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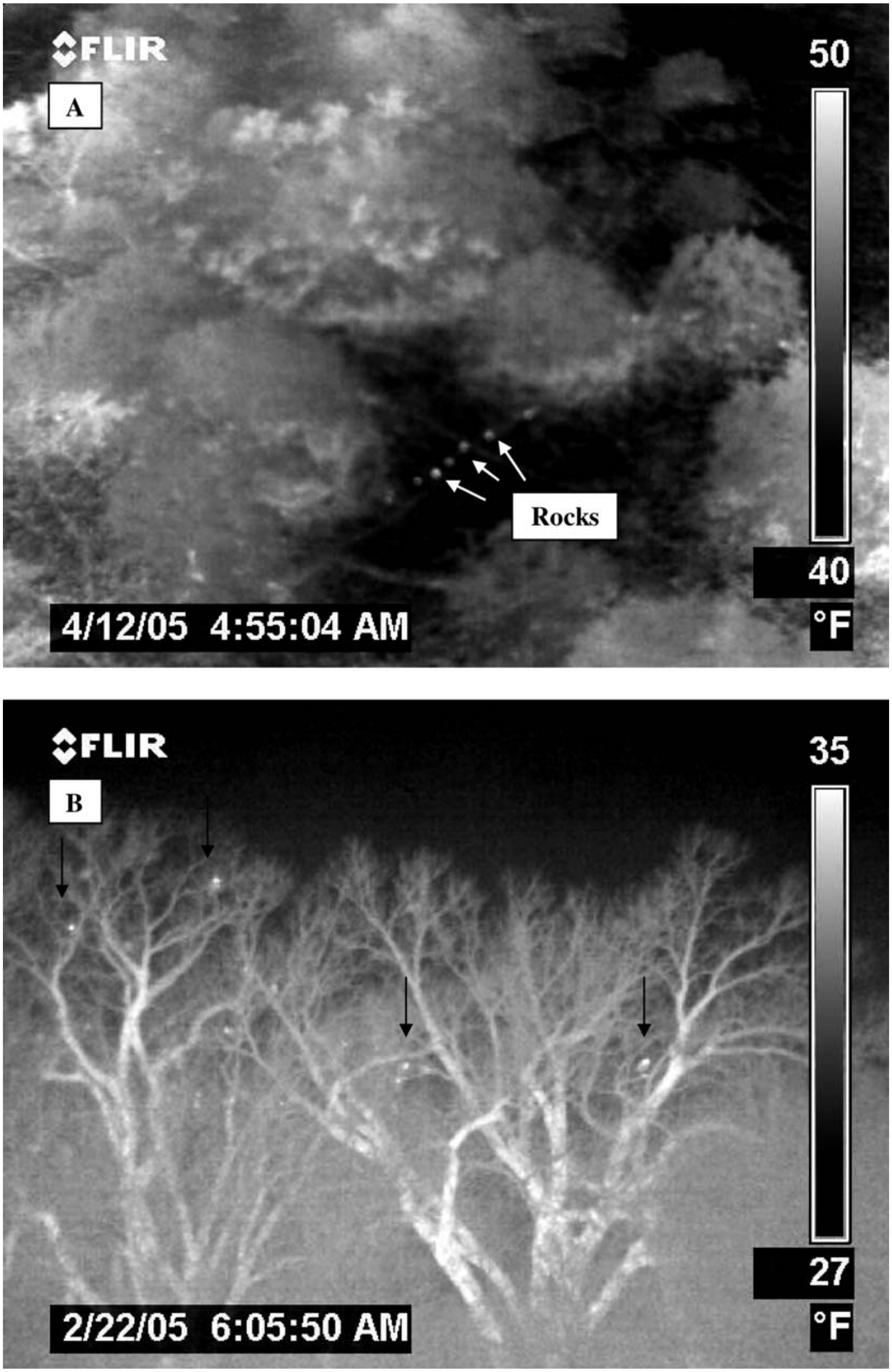

Figure 2. (A) Aerial image of Rio Grande wild turkey roost sites (note heat signature from inanimate objects). Photo was taken approx. 10–15 m above the canopy. (B) Horizontal view, from the ground, of roosting wild turkeys (delineated with arrows).

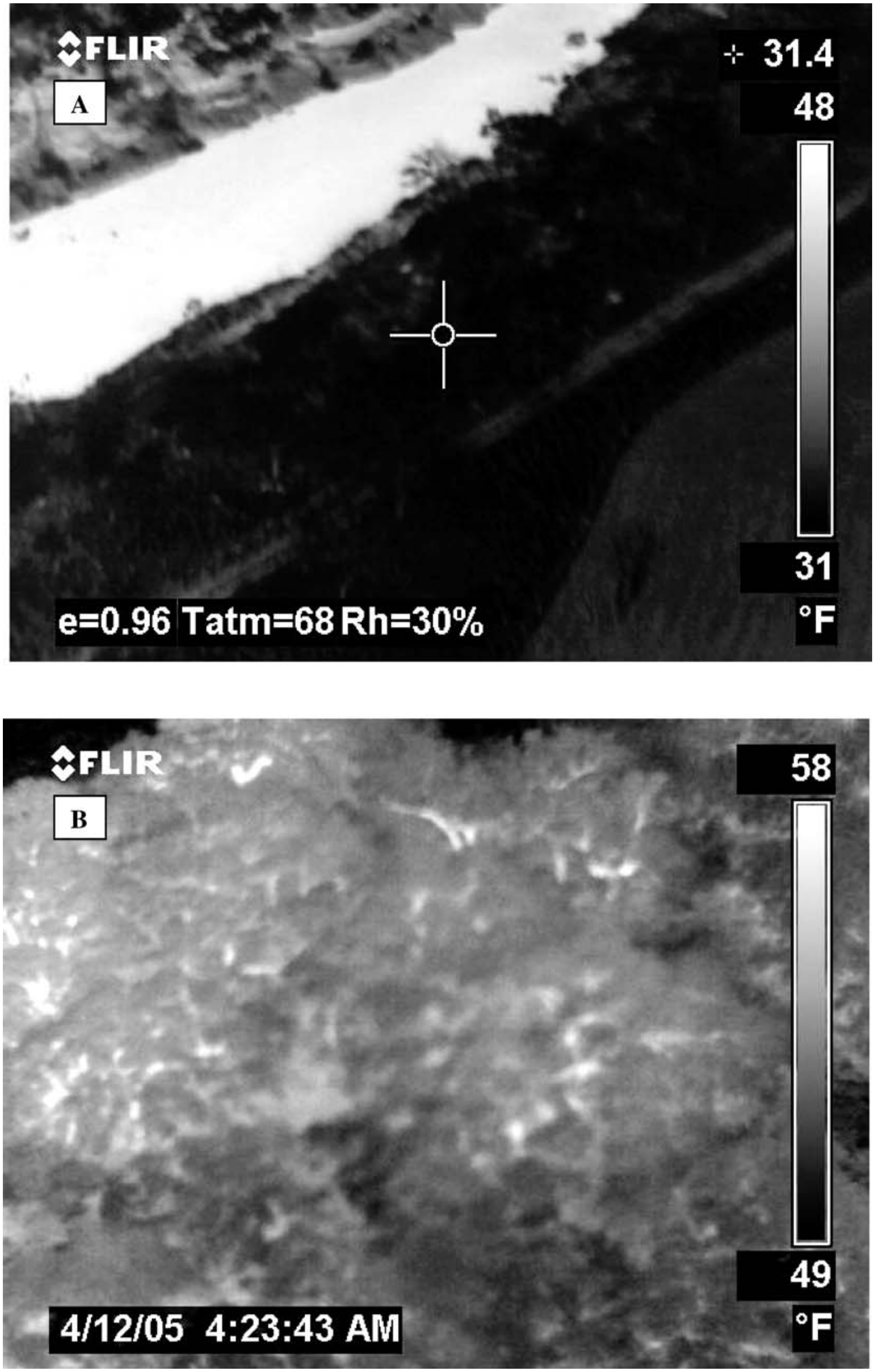

Figure 3. Aerial views of Rio Grande wild turkey roost sites (A) along the Medina River and (B) in live-oak woodlands. Wild turkeys could not be observed because of heat signatures from nontarget objects and because of the dense, semievergreen overstory cover, respectively.

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