

**Bird and Bat Fatality Monitoring of Six Un-guyed, Unlit Cellular
Telecommunication Towers within the Coconino and Prescott National
Forests, Arizona: 2006 Season Results**

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I. INTRODUCTION

I.A. Background

In 2002, American Tower Corporation and DW Tower were awarded contracts to construct seven unlit, un-guyed cellular communication towers along Interstate 17 south of Flagstaff, Arizona (Figure 1). Tower sites are located within the Coconino and Prescott National Forests. DW Tower was awarded the contract for the Onion Mountain site, while American Tower was awarded the remaining six sites (Rarick Canyon, Rocky Park, Woods Canyon, Douglas Mountain, Ritter Mountain, and James Canyon). As a condition of the U.S. Forest Service (USFS) Environmental Assessment, American Tower and DW Tower were to research the impacts of the towers on birds and bats (USFS 2001). The U.S. Fish and Wildlife Service's (USFWS) Division of Migratory Bird Management (DMBM) Region 9 Headquarters Office (Arlington, VA) proposed a protocol for monitoring and assessing the impacts of these towers on migratory songbirds, avian species listed under the Endangered Species Act (ESA), and bats listed under the ESA (Manville 2002). The protocol used in this study (Derby et al. 2002) was a refinement of Manville (2002), based on discussions with USFS personnel, consideration of tower design, and consideration of local vegetation and topography.

To date, very little information exists regarding the impact of un-guyed and unlit towers on wildlife. This study begins to address this issue, as well as the impacts of towers less than 200 feet above ground level. The Communication Tower Working Group, chaired by Albert Manville, agreed at its June 2000 meeting that assessing the impacts of "short" towers was a nationwide priority because of the need to determine the cumulative impacts of "short" towers.

Surveys began in April 2004, and were conducted seasonally to correspond with peak bird migration periods and breeding seasons. Surveys occurred in spring, summer and fall of 2004, 2005, and 2006. Results from the 2004 and 2005 project years are detailed in Derby et al. (2004) and Tidhar and Derby (2006), respectively. This report details 2006-year results and reviews findings from the previous two years.

I.B. Location and Tower Design

This study was conducted on six cellular communication towers constructed as part of the "Interstate 17 Wireless Communication System Proposal". Tower sites were located within the Coconino and Prescott National Forests, along the Interstate 17 corridor, south of Flagstaff, Arizona (Figure 1). Seven new commercial mobile radio services communication sites were established. New towers were constructed in 2003-04 at six of these sites (Onion Mountain, Rocky Park, Woods Canyon, Douglas Mountain, Ritter Mountain, and James Canyon). Surveys began in spring 2004 and were only conducted at these six tower sites. The towers are between 150-195 feet above ground level, un-guyed, unlit, and painted a drab brown or gray (U.S. Forest Service 2001). A ten-foot high cinder-block wall or chain-link wire fence, measuring approximately 95 by 95 feet, surrounds each tower and associated buildings.

Manville (2002) recommended that "at least one un-guyed, unlit tower" be used as a reference for tower collision studies. Because all towers in this study are short, un-guyed and unlit, studies

at other towers of similar design would not be useful. For this study, no reference tower sites were monitored. As an alternative, comparisons to mortality estimates from other studies (e.g., Erickson et al. 2001 and Young et al. 2001) can be utilized in future analysis.

II. METHODS

II.A. Project Design

As Manville (2002) suggested, this study used a double sampling approach. The study included net sampling (Avery et al. 1978, Avery and Beason 2000) as well as ground sampling. Net sampling allows for adjustment of the visual ground survey estimates by correcting for carcass removal and searcher efficiency bias based on the relative ratio of the number of carcasses found per unit area, using both sampling methods. Negligible carcass scavenging/removal and complete searcher efficiency is assumed for net sampling. Net sampling also allows adjustment for these biases without the use of scavenging/carcass removal trials (Avery et al. 1978 and Erickson et al. 2000b).

An area within 200 feet of each cell tower was sampled for bird and bat carcasses. During their tower study, Avery et al. (1978) found 63% of the birds within 300 feet of the structure, which was a 1,210 foot guyed tower. Towers included in this study are less than 200 feet AGL (150 to 195 feet in height) and are un-guyed. Assuming the distance carcasses are found from a tower is related to the tower's height, most carcasses for this study should be located within 50 feet of the towers (300ft/1210ft approximates 50ft/200ft). Similarly, a study conducted at a wind farm in Wyoming found most of the fatalities within one-half of the height of the structures (Young et al. 2003). Most carcasses were located within 100 feet of the 200 feet AGL turbines with a rotor sweep diameter of 138 feet. Studies conducted at other wind farms have had similar findings (e.g., Erickson et al. 2000a, Johnson et al. 2002).

II.B. Net Sampling

A portion of each tower study area was sampled for mortalities using suspended nylon nets to catch dead and wounded birds and bats as they fell to the ground. Avery et al. (1978) successfully used suspended nylon mesh nets to assess songbird mortality at a 1,210 foot tower in North Dakota. For this study, the area within the 10-foot-high wall (tower compound) was divided into four equal blocks. One block from each tower compound was selected for the installation of a 40 by 40 foot nylon net (size 15 twine) with a 0.75-inch mesh size and a rope border (Figures 2-7). Nets were placed approximately 10-feet above the ground to allow for personnel access to buildings and equipment. Nets were anchored to the surrounding brick wall/fence as well as the tower and its supporting structures. Unlike Avery et al. (1978) a wooden railing around the top perimeter was not used. A representative photograph is provided in Appendix 1.

Nets were also used to sample outside the walled tower compound. Four 20 by 20 foot nets (size 15 twine) with a 0.75 mesh size and a rope border were installed outside of each tower compound. Three of the nets were placed between the compound wall and a distance of 100 feet from the tower. The fourth net was placed at a distance between 100 and 200 feet from the tower

(Figures 2-7). Nets were anchored using four 6-foot steel t-posts. The nets were hung approximately four feet above the ground and anchored in the center by a weight and rope to create a funnel effect and minimize the potential for carcasses to be removed from the nets by wind gusts or other factors. A representative photograph is provided in Appendix 1.

II.C. Ground Sampling

Ground searches for dead and wounded birds and bats, as well as “feather spots”, were conducted at each tower site. For this study, feather spots are defined as two or more flight feathers or 10 or more body feathers that are located together. Using this definition, feather spots are considered to indicate a fatality, but individual or a small number of body feathers are not considered indicative of mortality (e.g., feathers lost during preening, molting). The entire area within the tower compound was searched thoroughly by walking transects approximately 6 m apart (3 m search area to either side of transects), including areas with and without suspended nets. The area inside each compound was covered with cinders or gravel, creating a monotypic surface that allowed complete searches to be conducted inside the compounds. Electrical wiring and structures within the tower compound were also visually inspected for evidences of bird and bat collisions during each survey. The tower was also visually inspected from multiple angles for evidence of bird and bat collisions.

Eight transects were walked outside of each tower compound. Each transect began at the compound wall/fence and extended to approximately 200-feet from the tower center. Four transects began at the center of each wall/fence and continued perpendicular from the wall/fence. The remaining four transects began at the corners of the compound and extended outward from each corner (Figure 2-7). Transect lines were marked approximately every 25 feet using pin flags to facilitate searching of the same area each survey.

II.D. Survey Schedule

This study began in spring 2004 and was concluded with the fall 2006 effort. Each year monitoring surveys were conducted during three seasons: spring (April 15-May 15); summer (May 16-August 31); and fall (September 1-September 30). Spring and fall survey periods were established to coincide with the peak passerine bird migrations based on input from the USFS and Non-Governmental Organizations. Surveys were conducted four days per week during the spring and fall periods and once per week during the summer period. The six tower sites were surveyed on a rotating schedule, so that each tower was surveyed at different times of the day. All surveys began early in the morning.

During the spring and fall seasons both ground sampling and net sampling were conducted. The nets outside the walled compound at the Ritter Mountain site were stolen by vandals the first weekend of the spring 2004 period and were not replaced, as agreed to by the USFS, due to the high risk of repeated theft at the site. Summer surveys included only ground searches.

II.E. Data Collection

Each time a tower site was surveyed, tower name, date, time of day, time spent searching, time since last survey, and weather data was recorded (see Appendix 2) and subsequently entered into an MS Excel database. Weather data was recorded for that day and for the time since the last survey. Weather data, including wind speed, cloud cover, precipitation, barometric pressure, and temperature were collected on site using a hand held weather station (Brunton ADC Summit) and by ocular estimations. Weather between surveys was obtained using data from area weather stations (MesoWest weather stations: Flagstaff, Mormon Lake, and Verde) and by ocular estimations. The Verde weather station was substituted in 2005 for the Cherry Mountain station used in 2004 for the Onion Mountain site. Inclement weather conditions and especially hazy or smoky (from forest fires or prescribed burns) were specifically noted.

When a bird carcass or feather(s) was located, data recorded included: species; quantity; tag ID#; body condition; probable cause of death or injury; evidence of scavenging; distance from tower; direction from tower; found in net or on ground; and distance from transect line if found on ground (see example datasheet in Appendix 2). The specific location of each recovery was indicated on a map. All recovered carcasses and feathers were photographed, tagged, collected, and frozen for future reference.

III. RESULTS

Derby et al (2002) discussed several statistical analyses that were anticipated for this study. However, with the 2006 data (like those from 2004 and 2005) these analyses were not completed because of the paucity of carcasses and/or feather spots located during the survey period that could be attributed to fatalities associated with the towers. If the statistical analyses were completed, the results would have indicated zero to a small fraction of fatalities per tower per year. This report documents survey effort employed, the carcasses and feather spots located, where they were located, and the circumstances under which they were located for the 2006 field survey period. This report also reviews cumulative results for the 2004 and 2005 project years.

III.A. Survey Effort

A combined total of 288 site surveys were made during 2006 at the six towers. Each tower was visited 19 times during the spring, 13 times during the summer, and 16 times during the fall. Survey efforts in 2006 were similar to efforts in 2004 and 2005.

III.B. Bats

No bat carcasses or other evidence of bat mortalities were observed during 2004, 2005, or 2006.

III.C. Bird Carcasses

No bird carcasses were found in 2006.

In 2005, two bird carcasses (one yellow-headed blackbird (*Xanthocephalus xanthocephalus*) and one MacGillivray's warbler (*Oporornis agilis*)) were recovered during the fall survey period (Tables 1 and 2) (Tidhar and Derby 2006). The juvenile female yellow-headed blackbird carcass was found on the ground within the Rocky Park compound approximately 9 m from the tower (Tables 1 and 2, Figure 6). The juvenile female MacGillivray's warbler was recovered from the 40 by 40 foot net within the James Canyon compound (Tables 1 and 2, Figure 2). Both birds were recovered close to the towers and appeared to have died as a result trauma (i.e., broken neck) consistent with colliding with a tower. Both birds were juveniles with good body condition and revealed no sign of predation or scavenging.

In spring 2004, a single carcass of a chipping sparrow (*Spizella pallida*) was recovered from a 20 by 20 foot net outside the James Canyon (Tables 1 and 2, Figure 2) compound. The 2004 mortality was not likely to have resulted from collision with the tower (i.e., placed in net by someone) (Derby et al. 2004).

III.D. Feather Spots

No feather spots, indicating a fatality, were found in 2006. Ten individual feathers were found, 1 at Ritter Mountain, 4 at Rocky Park, 2 at James Canyon, 2 at Douglas Mountain, and 1 at Onion Mountain. The individual body and flight feathers were from rock dove/pigeon, raven/crow, woodpecker, and unidentified small body feathers.

Two feather spots were found in 2004 and 3 feather spots were recovered in 2005 (Table 1). All recovered feather spots were located on the ground (Table 2). In all instances feather spots consisted of multiple flight and/or body feathers and no carcass was discovered in the vicinity. All feather spots were documented as having been scavenged, inhibiting determination of cause of death (see Section IV. Discussion).

IV. DISCUSSION

No bat mortalities were detected in this project. The discovery of bird carcasses on both the ground and in nets suggests the effectiveness of the employed methodology in detection of fatalities is adequate. It seems unlikely bat fatalities are going undetected, considering the rotating schedule between tower visits, and the early, near-dawn survey start times. More likely, the effect of the sampled towers on bat populations is zero or minimal during sampled periods.

One bird carcass was found in 2004. The circumstances under which this carcass was found were suspect and it was believed that the carcass was placed in the net (see Derby et al. 2005). Both bird carcasses detected in 2005 were found soon after death had occurred and there were no signs of scavenging (Tidhar and Derby 2006). Predation was ruled out as the cause of death due to the absence of bite or claw marks and the overall condition of the feathers. Mortality resulting from disease, while it cannot be completely ruled out, seems unlikely as body condition for both individuals was excellent and the birds were young post-fledglings. These were the only carcasses found as part of this study where the cause of death or location of the find was not suspect. Both carcasses located in 2005 were found immediately following localized haze and smoke from fires near the towers. Other studies have suggested weather conditions, such as fog,

in conjunction with lighting may increase the potential for bird and bat collisions with towers (Longcore et al. 2005); however, the towers included in this study are not lit and are painted a drab brown or gray.

Determination of cause of death from feather spots found in 2004 and 2005 (none found in 2006) was difficult, and confidence in the ability to differentiate tower-related mortalities to other forms of death (predation, disease, etc.) is low. All feather spots found could have been the result of predation (e.g., pile of feathers under a perch, possibly indicating a raptor had consumed the bird) or human involvement (e.g., feathers located near Interstate along with animal bones and other refuse).

V. SUMMARY

No bat mortalities were documented at the six un-guyed, unlit cellular communication towers from 2004-2005. One bird carcass was recovered in 2004, with cause of death suspect. Two bird carcasses were recovered during the fall 2005 survey. Both 2005 carcasses are likely attributed to tower collision. No carcasses were located in 2006. A total of 5 feather spots were found from 2004-2006. All feather spots were found under suspect conditions as related to a tower related fatality (e.g., raptor predation, human placement). A larger sample size is required for additional, meaningful, statistical analysis. Care must be given and assumptions documented (e.g., assume all bird mortalities attributed to the towers, assume no bird mortalities attributed to the tower) if future analyses is conducted. Regardless, very few birds were documented as mortalities associated with the six cellular communication towers from 2004-2006.

Table 1. Carcasses and feathers spots located in 2004, 2005, and 2006.

Tag #	Tower	Date	Carcass or Feathers	# and Type of Feathers	Species
2	Woods Canyon	5/1/2004	Feathers	8; Flight and Body	Green-winged Teal
3	Onion Mtn	5/1/2004	Feathers	50; Flight and Body	Raven or Crow
4	James Canyon	5/15/2004	Carcass	n/a	Chipping Sparrow
17	Rocky Park	5/19/2005	Feathers	>50; Body and Flight	Mountain Bluebird
18	James Canyon	5/25/2005	Feathers	~20; Body and Flight	Chipping Sparrow
19	Douglas Mtn.	6/3/2005	Feathers	>50; Body and Flight	White-breasted Nuthatch
20	Rocky Park	9/16/2005	Carcass	n/a	Yellow-headed Blackbird
21	James Canyon	9/27/2005	Carcass	n/a	MacGillivray's Warbler

Table 2. Locations of recovered carcasses and feathers spots in 2004, 2005, and 2006.

Tag #	Net or Ground	Distance from Tower (m)	Bearing from Tower (degrees)	Distance from Transect (m)	Tower
2	Ground	66	80	20	Woods Canyon
3	Ground	63	10	10	Onion Mtn
4	Net	25	190	n/a	James Canyon
17	Ground	25	320	1	Rocky Park
18	Ground	60	60	17	James Canyon
19	Ground	42	210	n/a	Douglas Mtn.
20	Ground	9	10	n/a	Rocky Park
21	Net	6	200	n/a	James Canyon

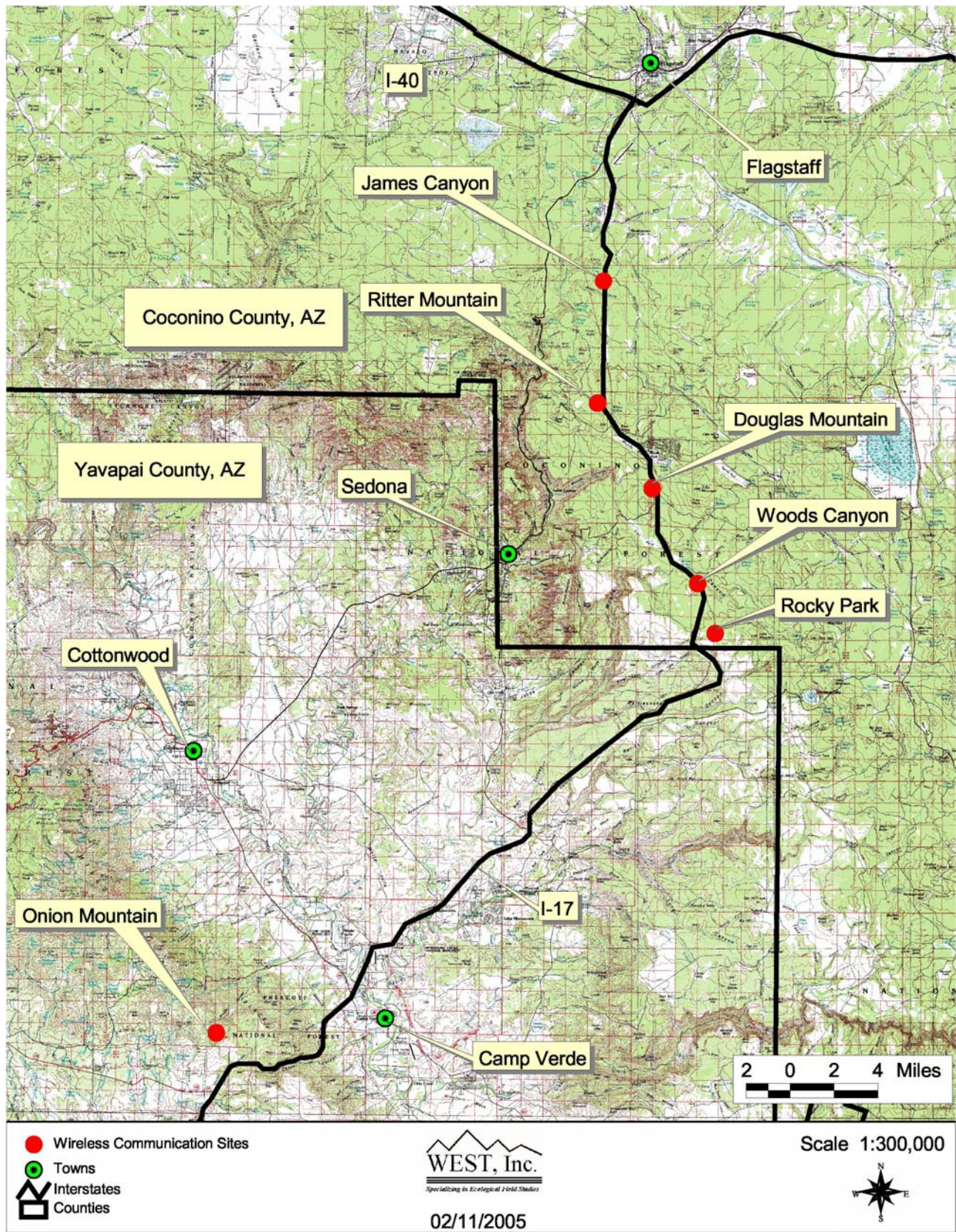


Figure 1. General project area identifying the tower locations surveyed in 2006.

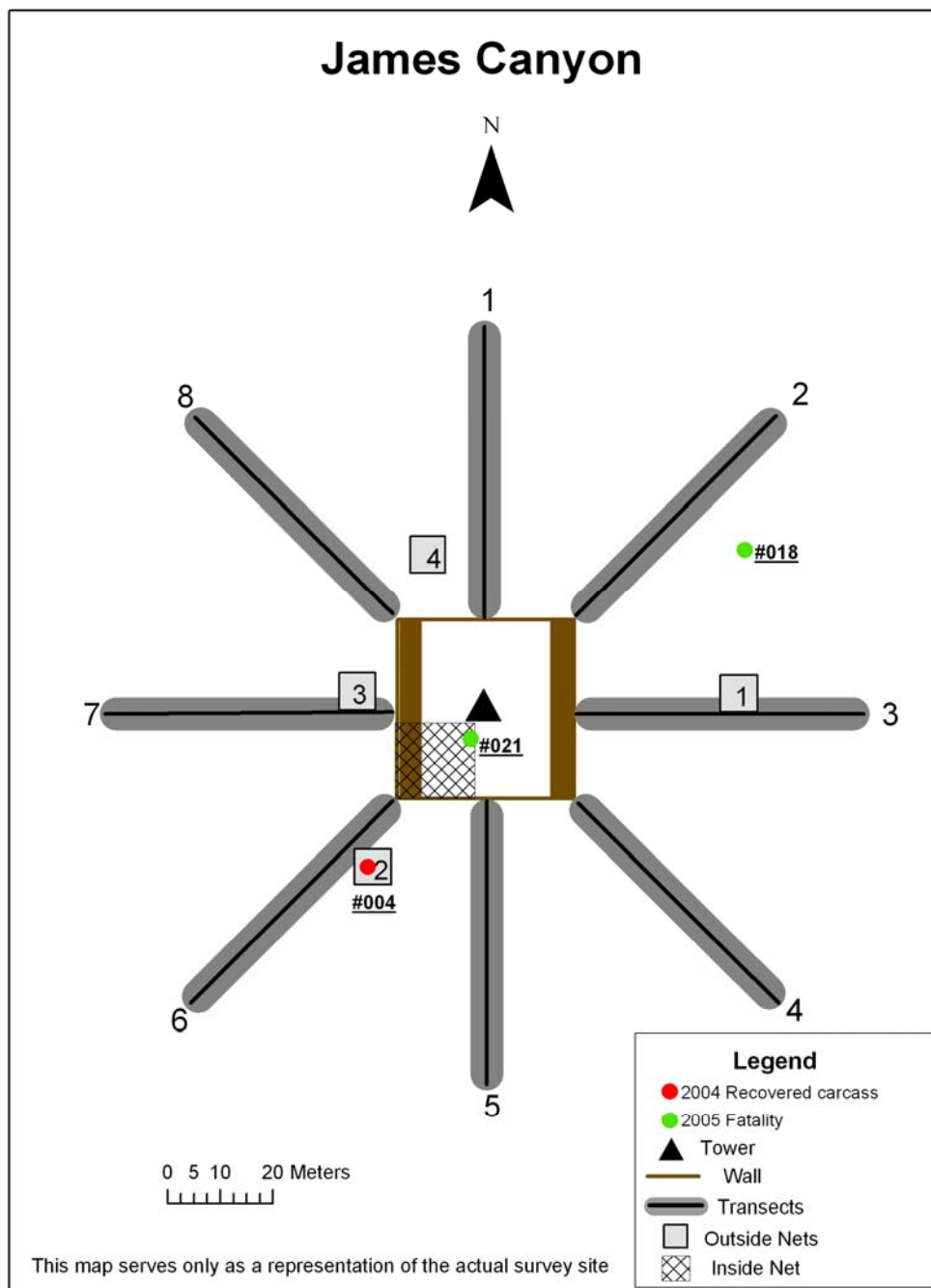


Figure 2. Schematic of the James Canyon tower site and survey area identifying carcasses and feather spots.

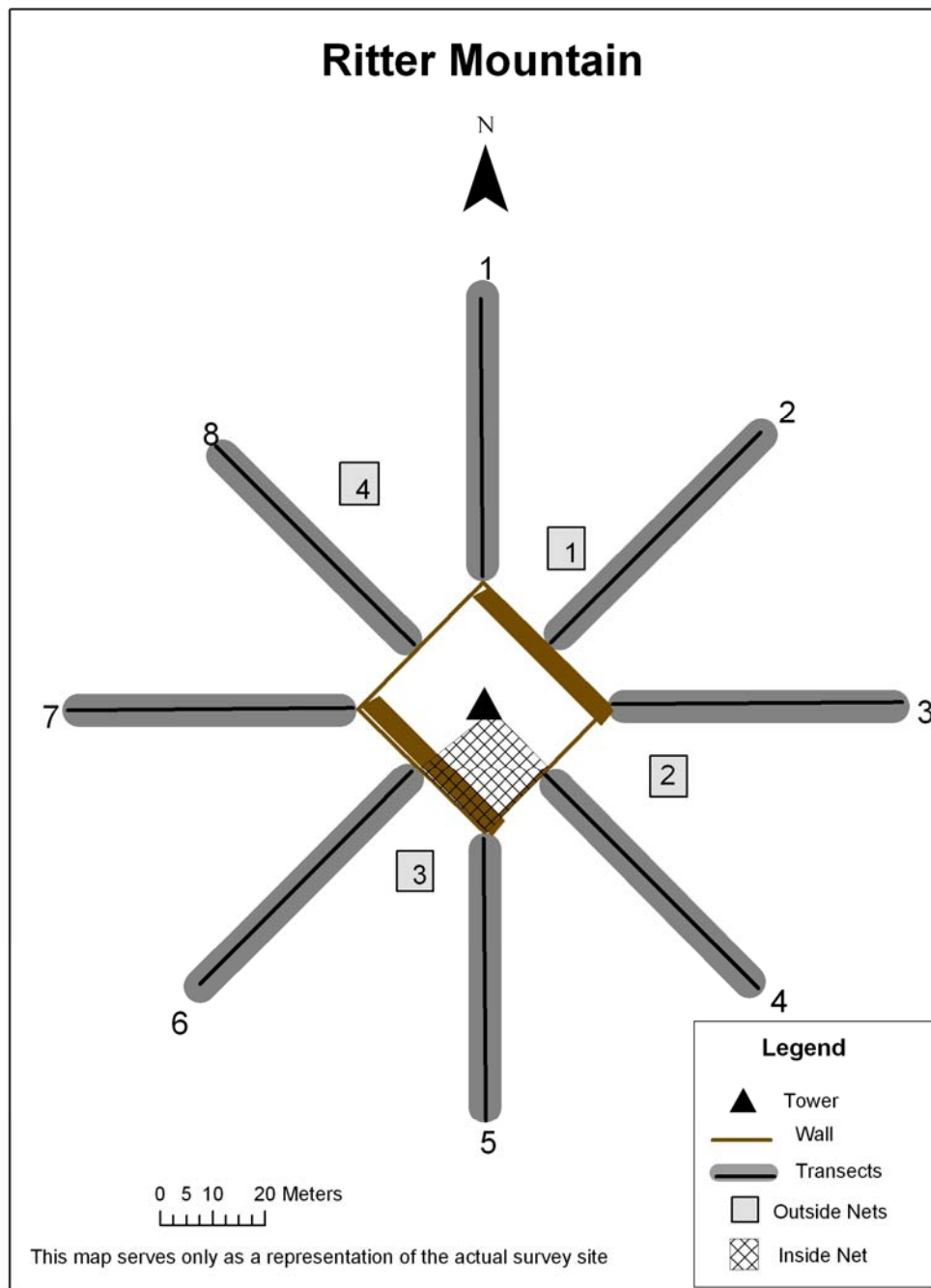


Figure 3. Schematic of the Ritter Mountain tower site and survey. No carcasses or feather spots found.

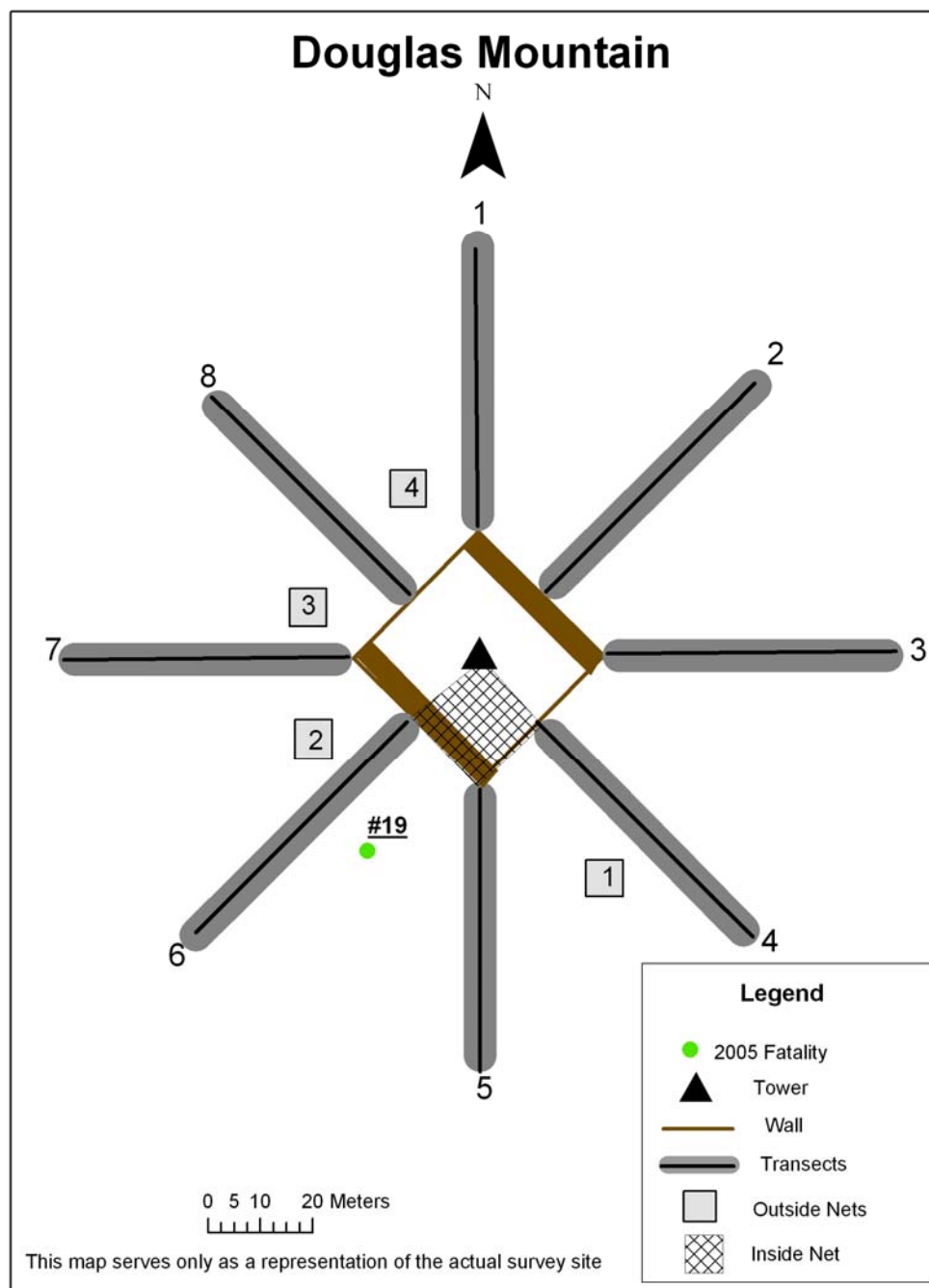


Figure 4. Schematic of the Douglas Mountain tower site and survey area identifying carcasses and feather spots.

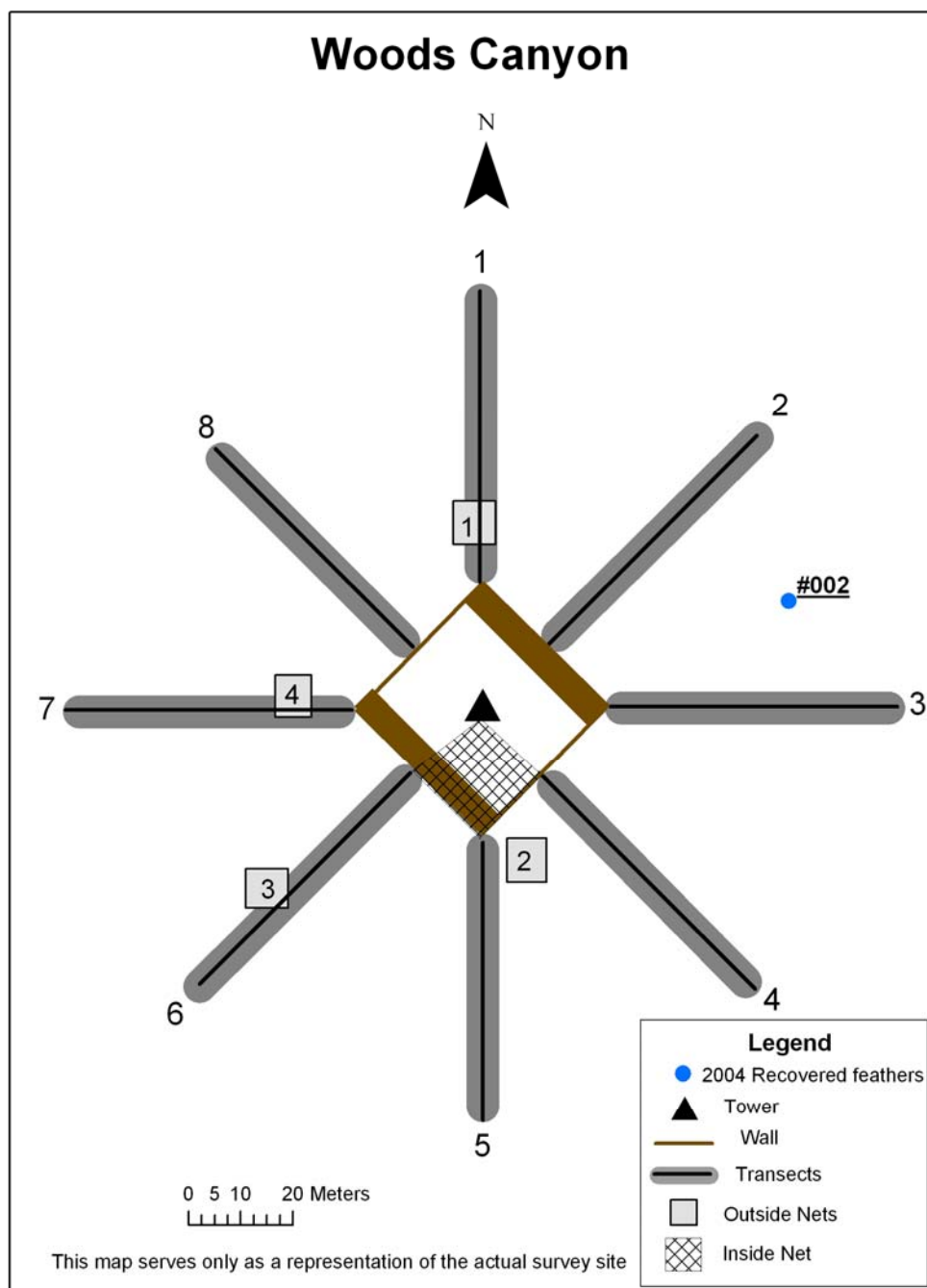


Figure 5. Schematic of the Woods Canyon tower site and survey area identifying carcasses and feather spots.

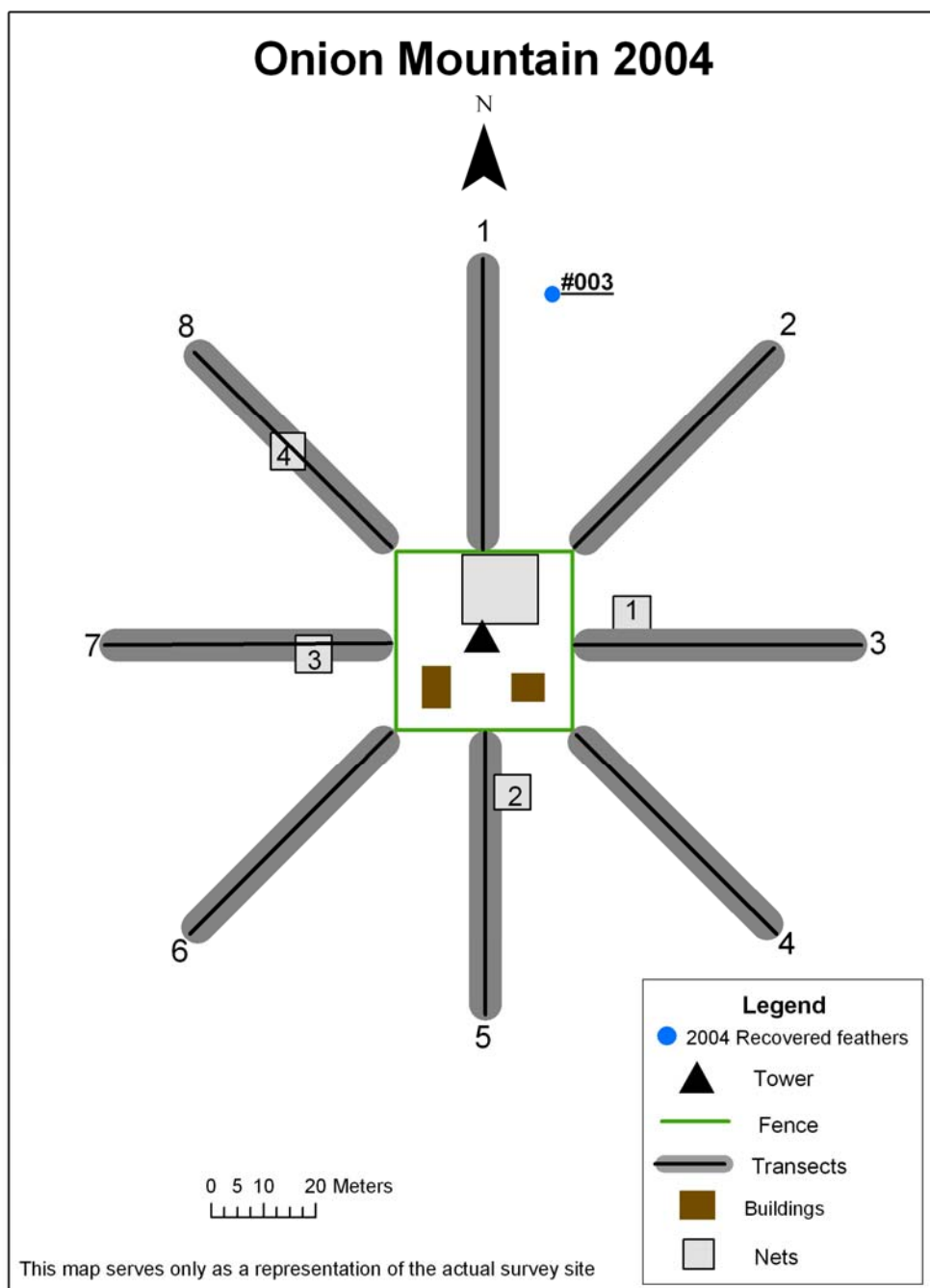


Figure 7. Schematic of the Onion Mountain tower site and survey area identifying carcasses and feather spots located in 2004 and 2005.

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Appendix 1. Representative site photographs



Photograph of 40' X 40' net placement located inside the compound at Douglas Mountain.



Photograph of 20' X 20' net placement located outside the James Canyon compound area.

Appendix 2. Example datasheet

COCONINO AND PRESCOTT NATIONAL FORESTS' CELL TOWER STUDY DATA SHEET

GENERAL SURVEY INFO:

Tower ID _____ Date _____ Observer _____ Days/hours since last survey _____ Start time _____
End time _____ Total time _____

WEATHER:

CURRENT: Source _____ Temperature _____ Wind _____ Barometric pressure _____

Cloud cover: <10% 10%-90% >90% Precipitation: None Light rain Heavy rain
Fog: None Light Fog Thick fog

SINCE LAST SURVEY (AVERAGES): Source _____ Temperature: Low _____ High _____ Wind _____
Barometric Pressure _____

Cloud cover: <10% 10-90% >90% Precipitation: None Light rain Heavy rain Total ____
Fog: None Light fog Thick fog

SURVEY RESULTS:

Carcasses recovered? YES NO Total number recovered: _____ Map attached? YES NO

Injured birds/bats recovered? YES NO Total number recovered: _____ Fate: _____

Feathers recovered? YES NO

Tag #	Species	Dead or Injured	Feather Spot Only? # of Feathers	Body Condition	Probable Cause of Death or Injury	Scavenged? Yes or No	Found in Net or on Ground? If net, Net ID#	Distance and Direction from Tower	Distance from Transect Line, and Transect LineID#

COMMENTS: