Wildlife surveys and monitoring with the use of remote camera traps in the Greater Oak Flat Watershed near Superior, Arizona.

Roger Featherstone, Director, Arizona Mining Reform Coalition; Sky Jacobs, Wild Sonora; Sergio Avila-Villegas, Sky Island Alliance; Sandra Doumas, University of Arizona.

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In September, 2011 we initiated a two-year "camera trap" mammal survey in the Greater Oak Flat Watershed near Superior, Arizona. Our survey area covers a total of 6,475 Hectares. The area surveyed is primarily a mixing zone of upper Sonoran Desert and interior chaparral, with influences from the Madrean vegetation community. Elevations range from 1150 to 1450 m. Ten cameras were deployed in early October of 2011 and information gathered and analyzed from that date to April 2012. We located cameras primarily in riparian and xero-riparian drainages. Locations were chosen as logical wildlife corridors to obtain a sampling of wildlife while allowing relatively easy access to cameras for data collection. To date, we have identified 13 mammalian species, including bobcat (Lynx rufus), ringtail (Bassariscus astutus), and coati (Nasua narica).

***Monitoreo de vida silvestre con el uso de cámaras remotas en la Cuenca* Greater Oak Flat cerca de Superior, Arizona.**

En septiembre de 2011 iniciamos un proyecto de monitoreo de mamíferos de la Cuenca Greater Oak Flat cerca de Superior, Arizona. Nuestra área de estudio abarca un total de 6,475 hectáreas. El área monitoreada es principalmente una mezcla de desierto Sonorense y chaparral, con influencias de vegetación Madrense. El rango de elevación va desde 1150 a 1450 m. Diez cámaras fueron colocadas a principios de octubre de 2011 y la información recopilada y analizada desde esa fecha hasta abril de 2012. Colocamos las cámaras principalmente en drenajes ribereños y xero-ribereños. Los sitios fueron escogidos como corredores lógicos de fauna para obtener una muestra de la fauna silvestre permitiendo un acceso relativamente fácil a las cámaras para colectar información. Hasta ahora hemos identificado 13 especies de mamíferos silvestres incluyendo gato montes (Lynx rufus), cacomixtle (Bassariscus astutus), y coati (Nasua narica).

INTRODUCTION

The study focuses on the Greater Oak Flat Watershed east of the town of Superior, Arizona. It is approximately 100 km east of downtown Phoenix, Arizona. The survey area is bounded on the west by "Apache Leap", no more than 1 km north of Highway 60 on the north, 1 km east of Gaan Canyon (known as Devil's Canyon on most maps) on the east and an arbitrary southern limit. The survey area is primarily public land managed by the US Forest Service, Tonto National Forest. See Figure 1 for map of the survey area.

Pyroclastic welded tuft, specifically "Apache Leap tuff", is the most common substrate throughout our study area (USDA Forest Service 2010). These formations create a generally rugged and steep topography with deep canyons and jagged spires and ridges.

The study area is contained within the watershed drained by Gaan Canyon (Devil's Canyon), which has perennial flows through most of the survey area. Previous flora and fauna surveys have shown that Gaan Canyon is botanically diverse and supports a high diversity of bird species (Jacobs 2009).

Eleven special status bird species exist within 5 miles of the project area according to review tools provided by the Arizona Game and Fish Dept.

The area surveyed is primarily a mixing zone of upper Sonoran Desert and interior chaparral, with some influence of Madrean evergreen woodland. The elevation ranges from approximately 1150 to 1450 m.

Interior chaparral vegetation includes manzanita (*Arctostaphylos pungens*), catclaw acacia (*Acacia greggii*), desert broom (*Baccharis centennial*), and scrub oak (*Quercus turbinella*) (Spangle 2008). Other common upland species include hop bush (*Dodonaea viscosa*), birchleaf mountain mahogony (*Cercocarpus betuloides*), jojoba (*Simmondsia chinensis*), wait- a-minute bush (*Mimosa biuncifera*), cholla (*Opuntia* sp.), and agave (*Agave* sp.) (Jacobs 2009). Vegetation composition throughout the uplands is significantly influenced by Arizona Uplands division Sonoran Desert elements as evidenced by the presence of saguaros (*Carnegiea gigantea*), which are fairly common on rocky east- and south-facing slopes.
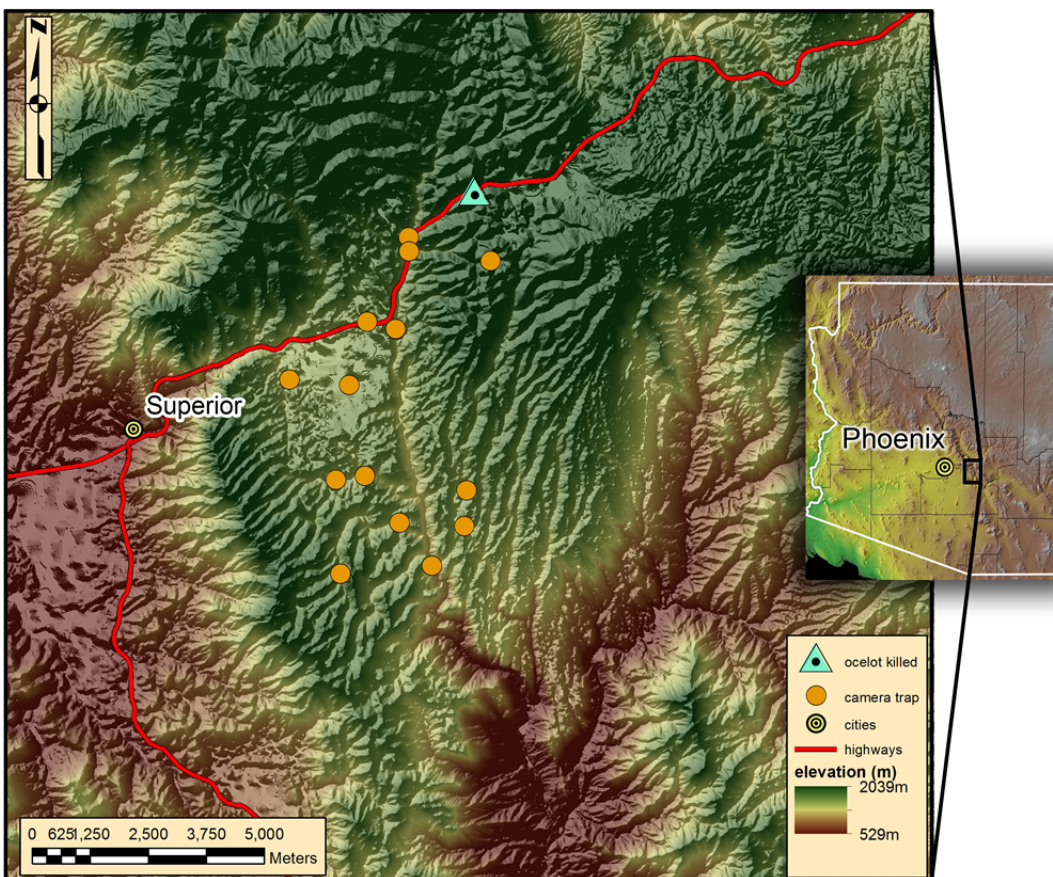

Figure 1

The primary human uses of the Greater Oak Flat Watershed include recreation, mining, and cattle grazing (Spangle 2008). A mining company is investigating the area for a large underground copper mine and is conducting pre-feasibility drilling. Federal legislation has been introduced to privatize much of the study area to accommodate the construction of a large underground mine. A portion of the Greater Oak Flat Watershed was set aside from mining by executive order in 1955 (Federal Register 1955).

There has been little to no survey of land mammal species in the study area to date and no comprehensive study of human recreational activities in the study area. This study will assist land managers and decision makers in understanding movement, behavior patterns, and distributions of species that use the watershed and to understand use and movement of human recreational activities within the watershed.

Remote cameras are extremely useful for the study of rare, threatened or endangered species, and/or elusive or cryptic animals. In recent years they have been used to evaluate the presence and abundance of jaguars, ocelots and other mammals (Karanth and Nichols 1998; Avila 2009; McCain and Childs 2008). Remote cameras are a wildlife-safe, non-invasive technique, and in some cases can provide estimations of wildlife population densities (Silver 2004; Silver et al., ditto 2004). In 2007, Sky Island Alliance initiated a remote camera study on cross-border permeability in northern Sonora, Mexico, with the goal of identifying wildlife corridors that connect the northernmost populations of jaguars and ocelots with individuals documented in southern Arizona; the study quickly documented ocelots in Sonora's Sierra Azul (Avila 2009).

Oak Flat and the Ocelot

In 2010 the Arizona Game and Fish Department reported a road-killed ocelot (*Leopardus pardalis)* found on Highway 60 east of Superior, Arizona, between Oak Flat Campground and Top of the World, possibly representing the northernmost record for the species. DNA analysis from the US Fish & Wildlife Service's forensic lab shows the ocelot was of wild origin. However, due to lack of additional samples or sequence data from Sinaloa or Sonora, the lab was not able to determine whether the ocelot was of Sonoran origin (De Young and Holbrook 2010).

The ocelot has been associated with a wide range of habitats, including mangrove forests, savannah grasslands, thornscrub and tropical forests of all types (Lopez-Gonzalez, Brown, and Gallo Reynoso. 2003). Recent records by Sky Island Alliance (Avila 2007) document ocelots in Madrean evergreen woodland, in elevations above 1200 m (Sergio Avila, pers. comm.).

(Lopez-Gonzalez, Brown, and Gallo Reynoso. 2003) emphasize the importance of considering the ocelot's short dispersal distances (5-25 kms). when protecting and connecting patches of suitable ocelot habitat. The location of the road-killed ocelot reported by AZGFD is in the interior chaparral vegetation community, at an elevation of 1334 m within the Greater Oak Flat Watershed.

OBJECTIVES

Our primary objective was to conduct non-invasive surveys of land mammal species and secondarily to survey human activities in the Greater Oak Flat Watershed. We were interested in gaining baseline data due to future potential habitat destruction from construction and operation of a proposed underground block cave mine in the area. Block cave mining techniques create a void the size of the ore body leading to severe subsidence and altering of surface water flow patterns (Featherstone 2012) and lowering of aquifer levels.

We conducted a preliminary habitat survey prior to placement of cameras which indicated sufficient habitat for decent land mammal diversity. An initial literature search showed that to date no intensive mammal surveys have been conducted in the Greater Oak Flat Watershed.

METHODOLOGY

We adopted a standardized remote camera protocol to validate presence/absence of mammal species in a given area (Chavez and Ceballos 2006). The selection of camera sites was chosen carefully to maximize probability for photographing land mammals. We established basic criteria to select camera locations using regional topographic maps, satellite imagery, and GIS surveying for the following variables: topography, geographic connection of mountain ranges, elevation, vegetation type, presence of temporary or permanent water source, and size of corridors (arroyos).

10 remote cameras are located within a 6,500 hectare study area. We are using Cuddeback Attack IR cameras within lockable bear proof camera safes (Cuddeback 2012). Cameras and safes were supplied at a discount by Cuddeback and we are grateful for their support. The cameras are equipped with 4 GB memory cards to assure ample storage space between camera checks.

After deployment in select areas, cameras were revisited every 4 to 5 weeks, based on battery life and memory card space. We did not use any type of attractants, lure or bait near our cameras, to avoid species bias or modification of behavior. Cameras are placed with minimal disturbance to the surrounding vegetation, although care is taken to make sure that false triggers from blowing vegetation are kept to a minimum. All remote cameras were set to display time and date on photographs helping us better evaluate daily activity patterns.

Cameras were set to record a still photograph followed by 30 seconds of video. Several cameras have been moved during the course of the survey to date. Potential for damage/theft based on proximity to human activity prompted us to reposition one of our cameras. (A camera was stolen with only one month of data accumulated.) More than one camera was moved due to a lack of mammal activity at the site. As the study matures, we will be better able to gauge whether to move cameras for optimal observation or to leave them in place to record seasonal fluctuations in activity.

In order to manage the numerous photographs in an organized manner we developed a system for labeling remote cameras, their location, and corresponding memory cards. After each field visit, we collected information on all wildlife species, time and date of each photo-event and observations, including gender, approximate age, health status, number of animals in photo, and behavior, into a database for the purpose of analyzing data systematically.

Both photographs and subsequent 30-second videos were used to tally species numbers. Redundant counts were reduced, such as when an animal stayed in the vicinity and was captured multiple times. However, if good judgment would indicate that >1 individuals were present, all were counted, even if all were not in the frame at the same time (e.g. an individual runs across the frame at the beginning of the video and a second individual runs in the same direction later). Different species together (dogs with people or hikers with trucks) generated two records, each counted separately. Skunks and deer were not identified to species for the tallies. People on foot or horseback were counted individually but a vehicle (truck, ATV, motorcycle) was counted as one, regardless of the number of occupants. Birds were recorded, but not counted because their detection was incidental to this survey. People and domestic dogs that could be identified as the same individuals were counted only once if detected again within 10 minutes. Those returning later in the day, however, were counted again.

Camera locations were grouped into three types of terrain depending on the slope, as measured within 25 and 100 meters of the camera location (flat, wide, and narrow) depending on the slope as calculated from a 10 meter resolution digital elevation map (DEM) averaged within 25 m and 100 m buffers surrounding each camera location (Figure 2). Flat terrain had slopes of less than 15 percent at both 25 and 100 meters, wide canyons are less than 15 percent at 25 meters but greater than 15 percent at 100 meters and narrow canyons are characterized as having greater than 15 percent of slope at both 25 and 100 meters.
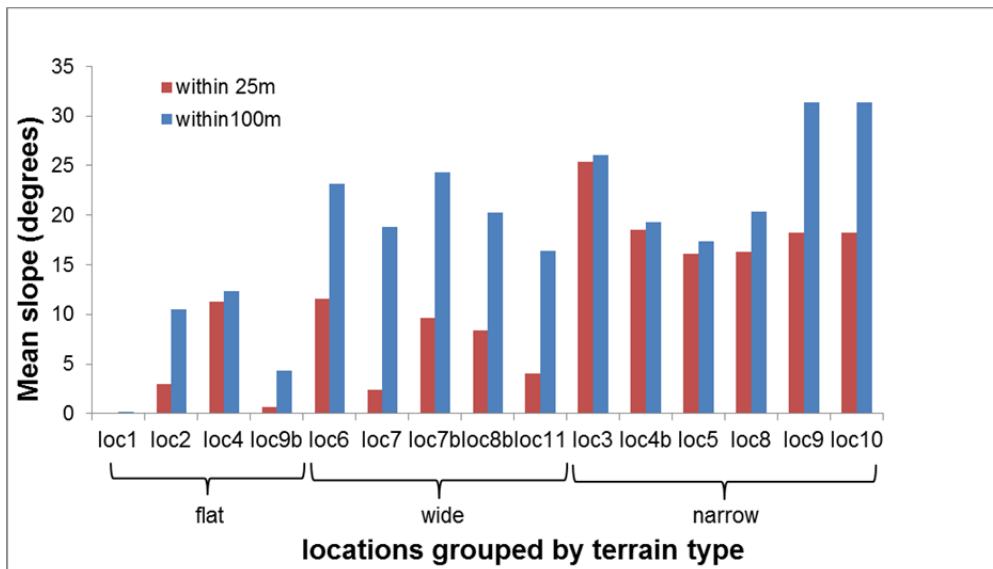

Figure 2

"Effort" varied across 15 camera trap locations because cameras were moved or removed during the survey period. The number of camera-days was used to adjust summary statistics for this varying effort. Cameras were in place for a total of 1750 camera–days.

RESULTS

We have identified 13 species of wild mammal, as well as humans and domestic animals in 15 camera locations. See table of species in Table 1. We had 418 detections of wild mammals or 0.24/camera-day of 13 different species (deer were counted as 1 species, striped and hooded skunks were counted as 1 species, Table 1). Mean detections of wild mammal individuals across 15 locations was 0.414 ± 0.438 (95% CI) detections/camera-day (range 0.01-3.5).

Table 1: Species detected by camera traps in Greater Oak Flat Watershed near Superior, AZ, October, 2011-April, 2012.

Common name	*Genus species*
bobcat	*Lynx rufus*
coati	*Nasua narica*
cottontail	*Sylvilagus audubonii*
coyote	*Canis latrans*
deer	*Odocoileus virginianus* (white-tailed), *O. hemionus* (mule)
gray fox	*Urocyon cinereoargenteus*
javelina	*Pecari tajacu*
striped & hooded skunk	*Mephitis mephitis* (striped)*, M. macroura* (hooded)
spotted skunk	*Spilogale gracilis*
hog-nosed skunk	*Conepatus mesoleucus*
raccoon	*Procyon lotor*
ringtail	*Bassariscus astutus*
rock squirrel	*Spermophilus variegatus*
domestic dog	*Canis familiaris*
domestic cat	*Felis catus*
domestic cattle	*Bos taurus*

Sightings per camera broken down by species are shown in Figure 3. The greatest variety and number of species were found in the wide canyon group with one location showing as many as 4.5 sightings per day for all species.

We grouped species photographed into 4 categories: mesocarnivores, herbivores, domestic, and human (including trucks and ATVs). Figure 4 shows the distribution of total species from each category by terrain type. Mesocarnivores included ringtail, raccoon, coyote, coati, bobcat, skunks, and gray fox. Herbivores included squirrels, cottontail, javelina and deer. Domestics included dogs, feral cats, and cattle. Humans included those on foot, on horseback, and motorized vehicles.

Our data indicate that the most common and widely distributed focal species in our study area is the grey fox (*Urocyon cinereoargenteus*). Javelina (*Pecari tajacu*) was the least recorded with only 1 photograph (tracks of javalina have been noted in the area). Preliminary results indicate that mammal density is highest in wide canyons while both numbers and species richness are lower in narrow/steep canyons. It also appears that bobcat and coyote favor roads for travel despite higher human traffic.

Data collected to date show that human activity is highest in the wider canyons and is the lowest in narrow canyons. The heaviest use by humans occurred in March, while the least was in December (Figure 5).
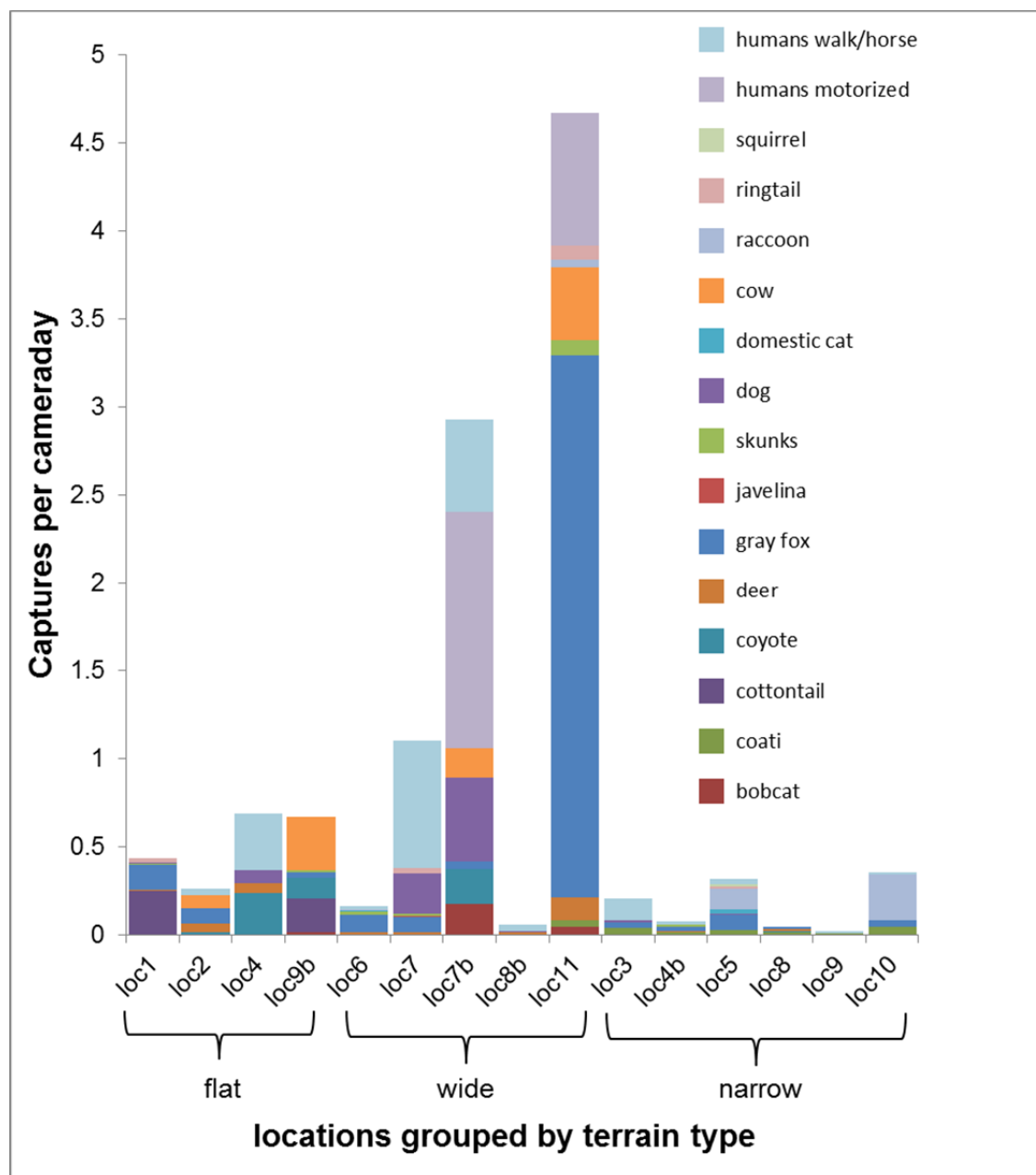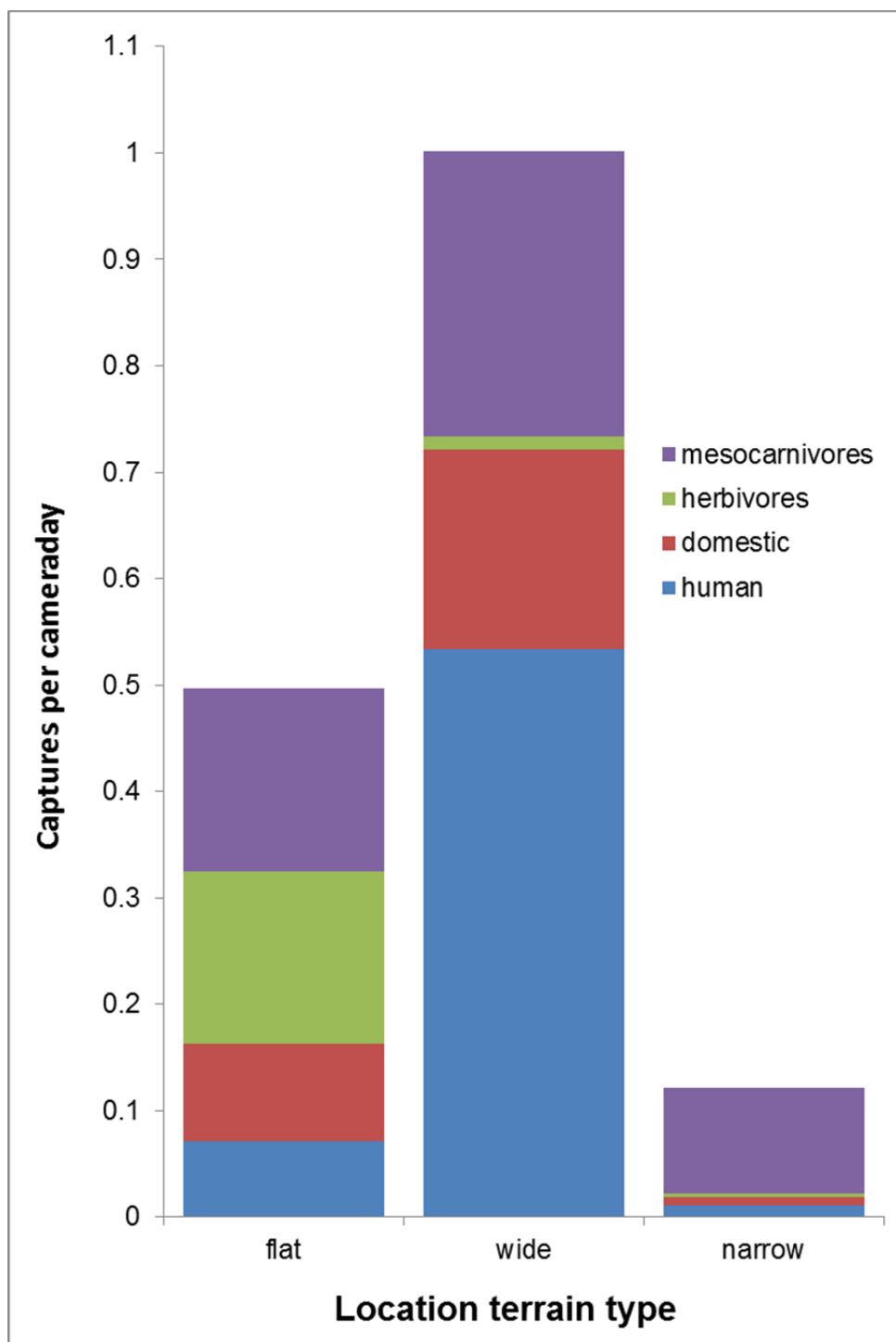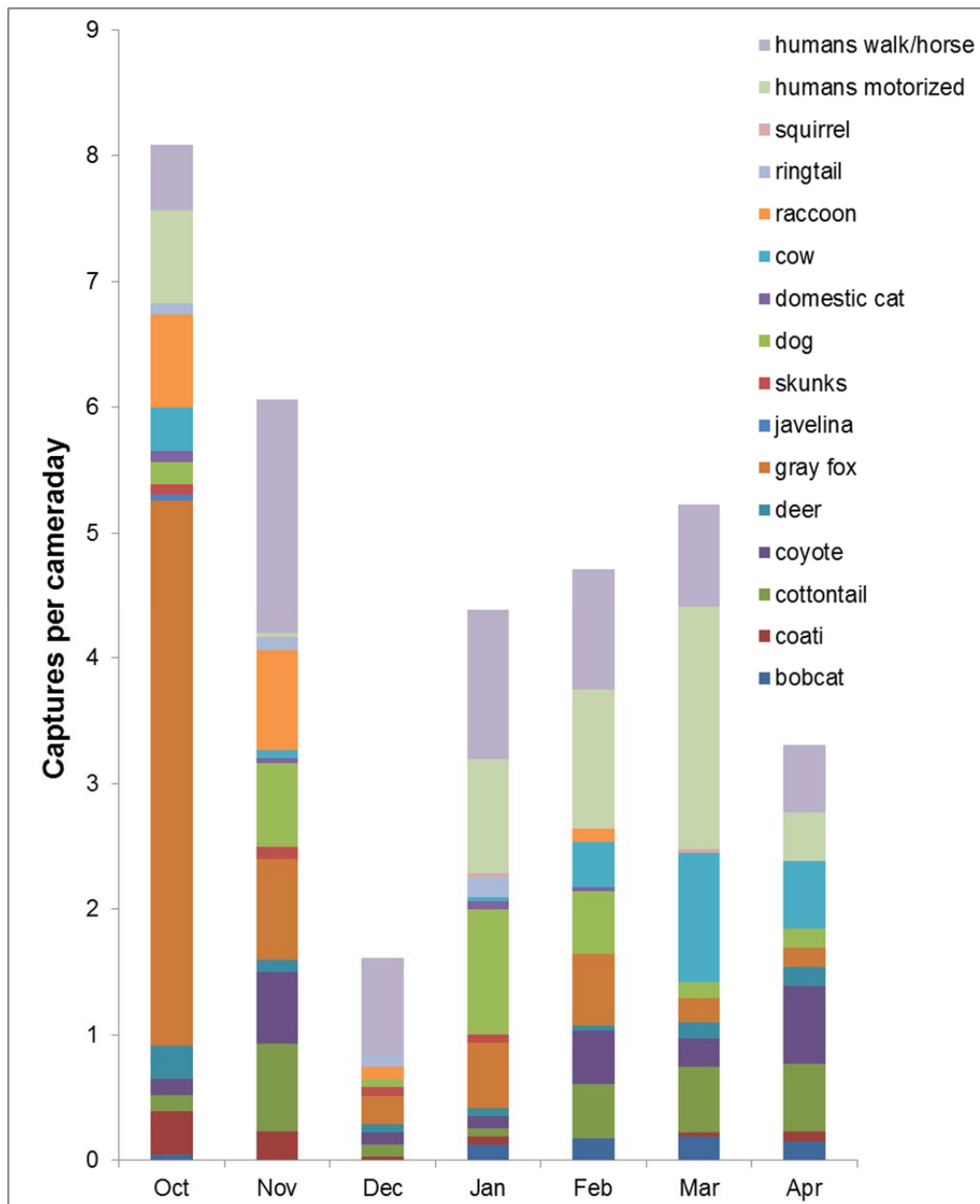

Figure 3

Figure 4

Figure 5

DISCUSSION

Although this survey's primary purpose is to study land mammals, the versatility of using camera traps to also record human activities and movements allows us to expand the scope of the survey to also include mapping of human recreational activities such as hiking, rock climbing, and 4 wheel drive activities. In most cases it is easy to differentiate whether we are observing a hiker or a rock climber by the gear that is carried. We have several observations of domestic cats (*Felis catus*) that appear to have gone feral, but observations of domestic dogs (*Canis familiaris*) show that all have been paired with humans. Locations with domestic cats were those closest to

paved roads and permanent human activity. Records and analysis of human activities hopefully will not only allow us to determine whether wild species are being displaced, but will also create a useful record for land managers to provide ongoing recreational opportunities on public land.

The data so far show a broad distribution of herbivores and mesocarnivores, but to date is lacking records of large carnivores such as black bear (*Ursus americanus*) and mountain lion (*Puma concolor*). Previous wildlife surveys have indicated that black bear occur in the study area (Jacobs and Flesch 2007) and there appears to be suitable, if not ideal, habitat for mountain lions. Possible reasons for this may include insufficient time to capture images of less abundant species or that they have been displaced by increasing human activities such those associated with drill rigs and industrial mining activities. While recreation has been ongoing for generations in the study area (Roy Chavez personal communication), additional human activities such as those associated with drill rigs and other mining equipment have not.

CONCLUSION

The period of this survey to date has been the year's cooler months (Oct. through April). We expect human recreational activity to be higher in the cooler months and to drop off over hotter summer months. This project has been recording data for a relatively short time frame of 6 months. Over the course of the study, which is planned to be two years or longer, clearer trends and usage patterns should develop. In addition, a full year of data should solidify seasonal trends.

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Figure 1--Map of survey region, camera trap locations, and location of road-killed ocelot, Greater Oak Flat Watershed near Superior, AZ, October, 2011-April, 2012.

Figure 2—Mean percent slope within 25-m and 100-m circular buffers surrounding each camera location, as calculated from 10-m resolution DEM, Greater Oak Flat Watershed near Superior, AZ.

Figure 3—Sitings per camera-day for camera locations, grouped by terrain type. Flat terrain had slopes of <15% within 25 m and 100 m, wide canyons had slopes <15% within 25 m and >15% within 100 m, and narrow canyons had >15% slope within 25 m and 100m of the camera location, Greater Oak Flat Watershed near Superior, AZ.

Figure 4—Sitings per camera-day, grouped by mammal type and terrain type, Greater Oak Flat Watershed near Superior, AZ.

Figure 5—Sitings per camera-day, grouped by month, Greater Oak Flat Watershed near Superior, AZ.

Table 1--Species detected by camera traps in Greater Oak Flat Watershed near Superior, AZ, October, 2011-April, 2012.

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