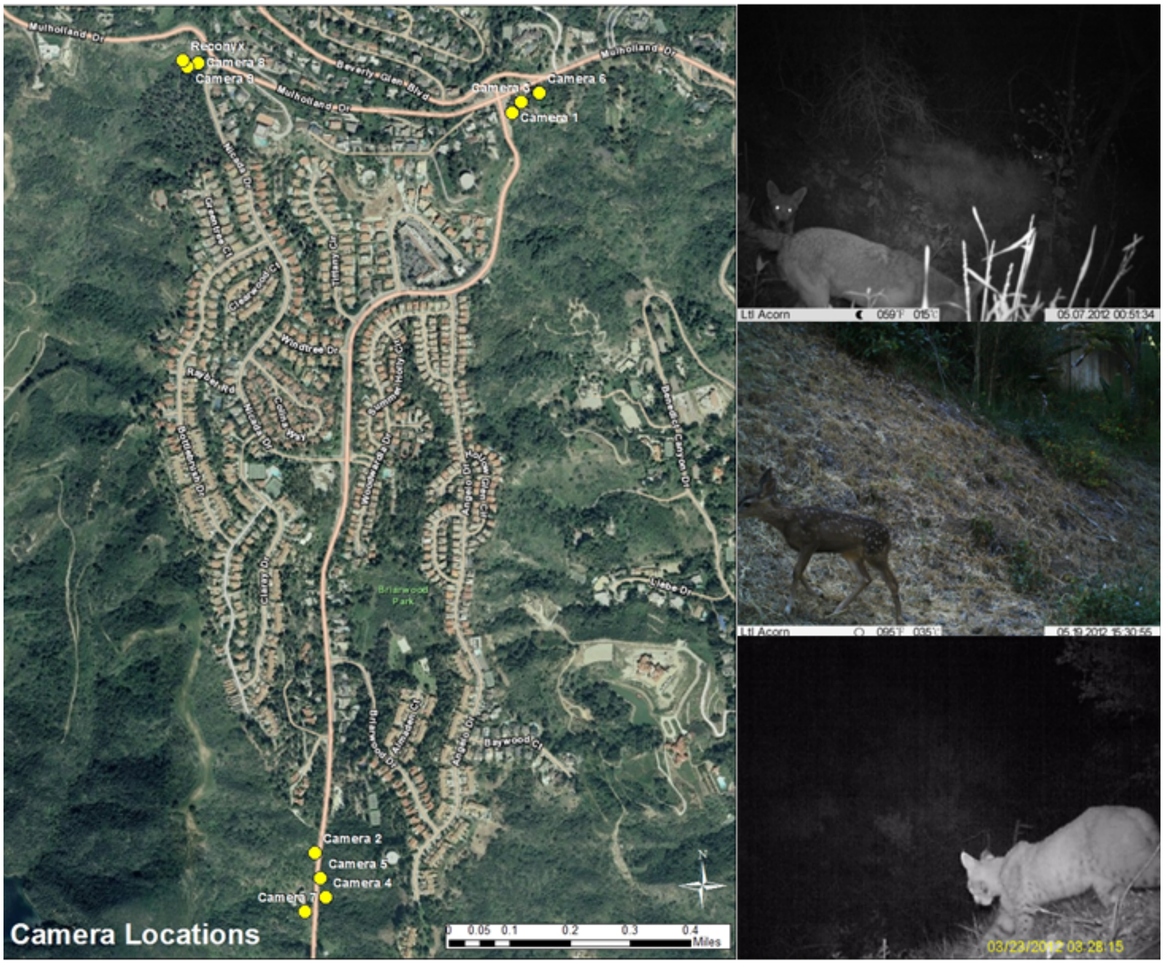
Exhibit 4



Large Mammal Movement in the Eastern Santa Monica Mountains

Gabriel Albano
Tanya Bitcon
Maanya Condamoor
Sirena Lao
Greg Lopez
Ryan Sokolovsky
Allen Vicencio

Client: Mountains Recreation and Conservation Authority

Advisors
Dr. Travis Longcore (UCLA)
Dr. Erin Boydston (U.S. Geological Survey)

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Abstract

A variety of wildlife live on the edge of habitats where native vegetation and land development meet. Although animal presence is often overlooked by suburban inhabitants, wildlife populations persist amongst these fragmented habitats, often right next to homes and other human developments. The area between Stone and Franklin Canyon in the Santa Monica Mountains is broken up into areas of residential development, which have fragmented natural habitats into small pieces. Furthermore, animal movement between these two canyons is restricted, causing wildlife to seek alternative connective routes, such as wildlife corridors. In order to monitor the species present and the potential flow between these two key habitats, remotely triggered cameras were set up for three months at choke points surrounding the Beverly Glen neighborhood. Over the course of the study, cameras were able to document the presence of coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), and California ground squirrel (*Otospermophilus beecheyi*) in this area. From the data gathered, we were able to demonstrate that wildlife use areas on the edge of suburban development to move between habitat patches. Animal flow in the area was also documented using pictures depicting animals moving between different camera site areas. The documented presence of such a variety of wildlife in this area has protection and conservation implications which will affect development in this area in the future.

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1 Introduction

The comfortable climate and predictable weather patterns created due to the close proximity of the Pacific Ocean, makes Southern California an ideal living destination and an astoundingly diverse ecological location. The Santa Monica Mountains extend for forty miles in an east to west fashion, bordered by the Pacific Ocean, and occupy a total area of roughly 60,000 ha. The Eastern portion of the mountain range extends into the Hollywood district; an area considerably more developed than the western Malibu and Ventura sections. This important Southern California ecoregion includes the largest number of endangered plant species in the contiguous United States (Swenson, 2000). The sought-after Mediterranean climate that Southern California boasts, offers prime natural environments that support an expansive array of local species. Vegetation throughout the transverse range includes a dominance of coastal sage scrub, chaparral, and coast live oak (Swenson, 2000). Unfortunately, due to a combination of variables, these plant numbers are diminishing and in turn, negatively affecting the local animals that rely on these plant species for survival. Both large mammals: mountain lions (*Puma concolor*), bobcats (*Lynx rufus*), coyotes (*Canis latrans*), mule deer (*Odocoileus hemionus*), and small mammals: raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), cottontail rabbits (*Sylvilagus auduboni*), rely on the pre-urbanized, natural environment for shelter, food, water, and everyday livelihood (Ng et al. 2004). Bobcats and coyotes have been found to be widely distributed in areas across Southern California, suggesting that they may be able to better adapt to habitat alterations than mountain lions (Ordeñana et al. 2010). This may be attributed to a less extensive home range requirement or a greater tolerance towards development and human activity, especially for coyotes. Bobcats were found to avoid areas surrounded by development (Ng et al. 2004). Coyotes also prefer natural environments, but they do occur frequently in areas with human activity and are found closer in proximity to urbanized areas on a regional scale (Ordeñana et al. 2010).

Currently, a majority of the Santa Monica Mountain's land usage is designated as open space and parks, with the eastern portions of the range feeling the constant pressure of expansion of the metropolitan districts of Los Angeles. Land property is a precious and expensive commodity and as municipal centers become crowded, city expansion is eminent, sparking the search for surrounding undeveloped regions. The Santa Monica Mountains become an area of interest for potential urban development, fueled by an increasing Los Angeles population

(Swenson, 2000; Coffin, 2007; Ordeñana et al. 2010). This "growing" problem raises concern for the National Park Service and private conservation groups who strive to preserve the natural environment for local species.

The Eastern portions of the Santa Monica Mountains exhibit a unique balance in which urbanization and nature compete for dwindling land resources. As we extend further into natural environments in this region with housing developments, roads, and vegetative clearing, we dismember the natural habitat into a mosaic. The most invasive device that separates the natural ecosystem, producing habitat fragmentation, is the construction of freeways and roads (Riley, 2006). Highways and roads can have particularly significant impacts on animals as they isolate individuals in small habitat fragments, increase animal mortality from cars, and distress animals with high amounts of movement and light (Bennett 1991). While roads serve as the primary cause of habitat dispersion, sectioning off potential animal home ranges and reducing their ability to reach necessary resources, vehicle mortalities, especially in the automobile-driven city of Los Angeles, prove as the leading threat to animal existence near urban environments (Riley, 2006). In order to lessen the negative influence our extensive road network forces on local fauna, a variety of accessible passageways for animal movement should exist.

Due to increasing fragmentation from urbanization, conservationists have proposed the establishment of protected connections between habitat patches for the purpose of allowing animals to reach core habitat areas. A core area is a large piece of habitat that has the potential to serve as an important long-term ecosystem to fauna and flora (Beier et al. 2005). The ultimate goal of these connections would be to conserve ecological connectivity, or the ability to support movement, gene flow, and other ecological and evolutionary processes for a particular species or ecosystem (Beier et al. 2011). This may be achieved through the establishment of wildlife corridors, which allow animals to move between core habitat areas (Morrison and Boyce 2009).

The Santa Monica Mountains National Recreational Area (SMMNRA) is the nation's largest park with a mixture of urban and wildlife interfaces, located 40 kilometers from downtown Los Angeles. Due to the high degree of threat from urbanization and increased fragmentation in this region in Southern California, studying the role of wildlife corridors and the viability of potential linkages are vital to preserving the native wildlife.

Tracking animal movements and monitoring connections is important for evaluating their effectiveness and seeing where animals are crossing. This is especially important for determining where missing linkages exist and whether they warrant protection. The most commonly used techniques to track large animals and their use of corridors include radio collars, particularly for mountain lions, and camera trapping (Moruzzi et al. 2002; O'Connell Jr et al. 2006). These technologies can also reveal previously unidentified areas that animals are using to cross to different habitats, giving insight on what areas should be protected. In order to confirm that there is wildlife movement between Stone Canyon and Beverly Glen Drive in the Santa Monica Mountains, our group set up 10 wildlife tracking cameras in strategic locations where animals funneled into chokepoints in addition to any observable trails (Brown and Gehrt, 2009). Cameras were set up on both sides of our proposed corridors, to gather physical evidence that wildlife were using our proposed corridors to travel between habitat patches in our study area. The cameras not only gathered data which demonstrated the variety of wildlife which are present in the Santa Monica Mountains, but also gathered evidence that there are wildlife movement corridors on Perdido Lane and Mulholland Drive, which are in regular use by a variety of large mammal species in the Santa Monica Mountains.

2 Significance of the Project

In our research, we hope to provide information in order to determine the characteristics and locations of successful wildlife linkage corridors in the Santa Monica Mountains, specifically in the area surrounding Stone Canyon. Identifying these linkage corridors will be important in the future for conservation efforts taken by the Mountains Recreation and Conservation Authority in this region, as important linkage locations can be protected from development or monitored for further wildlife movement, if already developed. This project is important as it furthers expands upon previous research done regarding wildlife movement, linkage corridors, and the impacts of urbanization in the Santa Monica Mountains, focusing on the area between Stone Canyon and Beverly Glen Drive. Confirming wildlife movement in this area will encourage increased conservation and protection of the undeveloped areas between the heavily urbanized sections of the Santa Monica Mountains, an important wildlife habitat in the heart of southern California.

3 Research Questions

3.1 Where do animals cross N. Beverly Glen?

We have chosen two potential choke points located at the north and south ends of the housing development located at the top of Beverly Glen to observe as wildlife corridors. In-between Mulholland and Perdido Lane, a dense residential neighborhood obstructs animal movement across the landscape. North Beverly Glen is a commonly driven road and serves as a main artery that divides two canyons, Stone Canyon to the west and Benedict Canyon to the east. The high levels of daily traffic pose a difficult and dangerous obstacle for animals to cross. In order to adapt, animals will choose the least hazardous, easiest point of access to penetrate the topography. We are examining two potential vectors for movement, Mulholland and open areas slightly north of Perdido Lane.

3.2 What animals are consistently utilizing wildlife corridors in the Stone Canyon/Benedict Canyon area?

The eastern Santa Monica Mountains are home to a variety of fauna species. Both large and small mammals rely on the natural ecosystems interspersed throughout the landscape for their survivial. For the purpose of this study we will be focusing on observing, photographing, and tracking large mammals. These species generally make use of more expansive home ranges while small animals travel less distances. The number of animal pictures and diverse range of species captured reinforce the presence of wildlife in the native fragments, feet from roadways and housing developments.

3.3 Do the proposed wildlife corridors exhibit consistent directionality?

The canyons on either side of North Beverly Glen offer distinct resources and habitats to local animals species. The movement between these two patches represents one part of a dangerous path across the mountain range. In order to understand a general flow of animals across this landscape, our team is interested in determining the direction animals are moving through our posed wildlife corridors.

4 Methodology

Documenting each stage of the scientific process is important to the methodology of capturing wildlife movement and activity. This is especially important for determining where missing linkages exist and whether they warrant protection. For our research, we utilized remote camera technology to track animal movements. In order to collect accurate data to answer our research questions, we created a series of methods ensure camera placement optimized data collection.

Study site selections began by utilizing aerial photography to find choke points where animals would be funneled into a potential corridor, followed by physically surveying these areas for optimal camera locations. Once accomplished, remotely triggered cameras with infrared motion sensors were installed, ensued by scheduled data collection and management. The following section of the report will present these steps in further detail to give insight into the methodology used.

4.1 Aerial Photography and GIS Database

The study area between Stone and Franklin Canyon was very large and needed to be brought to an area that was more manageable for this project. To accomplish this, the team identified areas between the two canyons using aerial photography from Google Maps & Earth and used the following criteria: proximity to development, amount of vegetation cover, directness of the route, steepness of the slope, and capacity for a funnel point. The optimal site would have little development, moderate vegetation cover, direct connection to a resource, and act as a funnel for wildlife into the corridor.

Additionally, the team utilized GIS databases that contained information regarding land ownership in the area. We suspected that public property would be more likely to be undeveloped, allowing for the safe passage of wildlife. Once the GIS maps were available, they were cross-referenced with Google Maps & Earth to aid in determining possible sites for animal corridors.

From this, two areas of interest were generated near the North Beverly Glen neighborhood: the intersections of Perdido Lane towards the south, and Mulholland Drive towards the north.

Perdido Lane is a mixed area of development and natural landscape; it is perpendicular to Beverly Glen and is a site of well known wildlife crossing. It is the site that appeared to contain the least amount of development while having abundant vegetation cover. Despite the presence of residencies, aerial maps showed a possible corridor directly connecting Stone Canyon from the west and Beverly Glen Park on the east.

As Beverly Glen continues northward, it intersects with Mulholland Drive, another populous and tumultuous road. At this intersection, there is an inlet that leads directly to Benedict Canyon. To the west of the site along Mulholland, there is intersection at Nicada Drive, which leads directly into the Stone Canyon Reservoir. For this study, the site at Mulholland and Beverly Glen is labeled East Mulholland, and the site at the intersection of Nicada Drive and Mulholland is labeled West Mulholland. Aerial maps showed the possibility of corridors across Mulholland, but the question of where exactly animals would choose to cross required both field inspection and analysis.

4.2 Ground Truthing

To validate the GIS information, the team explored the proposed sites utilizing a mobile GPS device and GIS data to inspect if the public properties are in fact open to allow for wildlife passage. The surrounding areas were also observed for any breaks in property fencing or for areas that may be too hazardous for wildlife crossing, such as steep slopes. By doing this, the team was able to narrow down the site to areas that are optimal for camera setup. Also by physically assessing the areas, the team was able to determine the quantity and orientation of the cameras in order to generate data. Issues that were considered when installing the cameras included: the potential of misfiring due to human traffic or vegetation, the angle of placement, and range in the field of view.

Upon field inspection, the Perdido Lane corridor was found to be passable from one side to another. Beverly Glen can be a very busy road during the day, but reverses substantially during the night. Given this lower frequency of human activity, significant vegetative cover on each side, and a small gap between two favorable habitats, Perdido Lane was chosen to be site of study for possible wildlife movement.

The Mulholland Drive corridor was found to be more difficult than expected when observing aerial photography. The stretch of Mulholland that connects both East and West study sites is narrow and little to no vegetation along a winding, paved path. However, given the location of the two sites, it provided a unique opportunity to determine if animals were using Mulholland Drive to cross between Stone Canyon and Benedict Canyon because it was the most direct route, or if animals were crossing Mulholland to get into the undeveloped land of the two canyons.

4.3 *Camera Details & Installation*

Picture 1: Complete installation of Ltl Acorn labeled Camera 1, East Mulholland study site.

For our study, we decided to use remote triggered cameras in order to collect data. When selecting equipment, we selected the models Little Acorn and Reconyx since they do not require the use of a flash in nighttime photography. This was crucial for our project because we did not to scare potential wildlife from the sudden flash which has been observed to cause trap shyness (Wegge et al., 2004; O'Connell et al., 2011).

Ten cameras were installed at the three study sites: three at west Mulholland, three at east Mulholland, and four at Perdido Lane. Remote sensing infrared cameras were used because they caused the least disturbance to the animals. Nine Little Acorn 5210A cameras, and one Reconyx were installed in different locations throughout the three study sites. We placed the cameras in open areas that appeared to be potential bottlenecks for animal activity.

The Ltl Acorn 5210A is a 12 megapixel camera equipped with infrared vision for night use, capable of capturing both color picture and video. Initially, the Ltl Acorns were set to take two pictures and one ten second video in order to acutely identify wildlife movement. Video capture was stopped once the team realized that this feature used a lot of memory on the SD cards, inhibiting possible animal capture when the cards were full. The Reconyx is also equipped with infrared night vision for night use; video was not an available option for this camera, only black and white images.

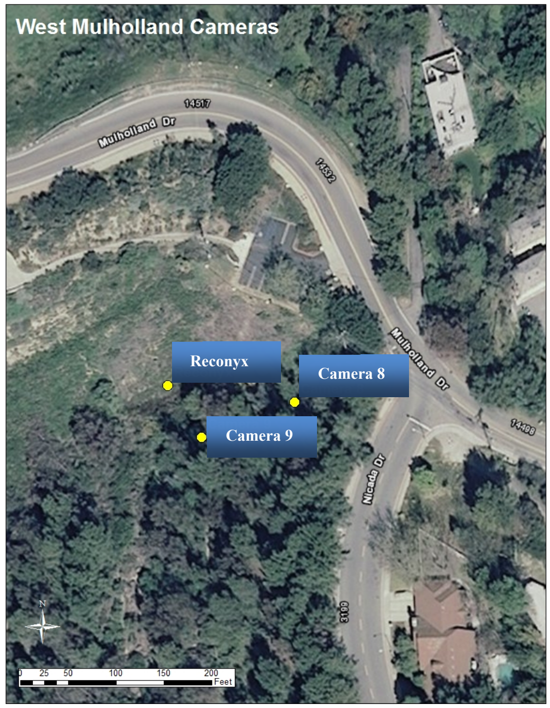
All the cameras were set to normal sensitivity for the first couple weeks of the study, which caused a lot of misfires due to vegetation movement, such as leaves swaying in the wind. All the cameras were then switched to low sensitivity and the number of misfires significantly dropped, saving both memory space and battery life.

The cameras were all attached to five foot Telespar poles and each of them was placed in a metal box secured with a lock to prevent theft. They each had four AA batteries and a 2 GB memory card. Once the cameras were secured, the Ltl Acorns were labeled one through nine and the GPS coordinates were taken so that we knew the precise location of each camera.

4.3.1 Camera Locations

The following section outlines the placement and reasoning behind camera placement at our three study sites. Aerial Photography for each site is included, as well as a table of the exact GPS coordinates of each camera.

4.3.1.1 *Site #1 West Mulholland*



Picture 2: Camera Placement at Study Site #1, West Mulholland

Camera 8 - This camera was closest to the road at this site, which was next to the Stone Canyon Overlook. It faced towards the road in order to capture animals coming down into the area from the road. We hoped to use this camera to prove that animals were crossing from East Mulholland to West Mulholland, or moving in the opposite direction, from West to East Mulholland.

Camera 9 - This was the first camera set up, and it was placed in an area which overlooked a large portion of the lower section of the Stone Canyon Overlook. This camera was placed in front of what seemed to a possible pathway for animals to move up and down throughout the over look.

Reconyx - This the only camera not attached to a post, but to a tree with bungee cords. It is tied to a tree so that it faces a clearing at the bottom of the section of Stone Canyon Overlook where we have placed all our cameras. We hoped that it would be able to capture animals coming down one side of the overlook moving upwards to another, closer towards the road and Cameras 8 and 9.

4.3.1.2 Site #2 East Mulholland

Picture 3: Camera Placement at Study Site #3, East Mulholland.

Camera 1 - This camera was placed in a section which could be used as a walkway between the locations of Cameras 3 and 6. It also faced upwards toward the road, so that we could capture animals moving down from the east side of Mulholland into the area that contained the cameras, in addition to showing movement within the area itself.

Camera 3 - This camera was set up near Beverly Glen, near the Mulholland intersection. It was further down from the road, and faced the intersection at an angle, so that any animals walking down into this area from either Beverly Glen or Mulholland would be captured, particularly if they were walking from the West Mulholland Site.

Camera 6 - This camera was set up furthest to the east of the three cameras set up at the East Mulholland study are. It was placed in a small grassy clearing close to a home built further down in this area. It faced the other cameras so that animals moving past Cameras 3 and 1 would also be shown on this camera if they were moving in a general eastward direction.

4.3.1.3 Site #3 Perdido Lane

Picture 4 - Camera Placement at Study Site #3, Perdido Lane

Camera 2 - This camera was the furthest north of our four cameras on Beverly Glen Boulevard, on the west side of Beverly Glen. It was slightly north of Perdido Lane, placed in a clearing facing a natural corridor coming down towards the road. Though this camera faced away from the road, it was approximately 10 yards from the road, and would be able to be seen by cars driving up Beverly Glen Drive. We hoped that this camera, along with Camera 5, would confirm that animals were crossing across Beverly Glen Boulevard.

Camera 7 - This camera was the furthest south of our four cameras in this area, located in open area in front of a home on Perdido Lane, on the west side of Beverly Glen. This camera was elevated from the road, and faced the homes on Perdido Lane. The clearing in which it was placed was a prime crossing area for animals moving down from the mountains to the paved section of Perdido Lane, and eventually across Beverly Glen Boulevard to the opposite side of the road. Though this camera was also approximately

10 yards from the road, it could not be seen from the road due to its elevation and cover by surrounding vegetation and fencing.

Camera 4 - This camera was set up to be the furthest south of our cameras on the east side of Beverly Glen, in a covered clearing facing a natural corridor which animals would be able to move through in order to cross Beverly Glen. This camera was the furthest up the mountainside of any of our Perdido cameras, and we hoped this location would allow it to capture the movement of animals before they were disturbed by the sounds and sights of the road below.

Camera 5 - This camera was set up closest to the road of all our Perdido Lane cameras. It was placed atop a hill looking down into a clearing in this area which led down to the road. The camera faced down into the clearing, though away from the road, so that it would be able to capture animals moving from West Perdido (near Camera 2), as well as animals moving North from Camera 4, which was set up further South on East Perdido. We hoped that this camera would be able to cover a wider area than the others, while not being disrupted by traffic on Beverly Glen. This camera was also visible from Beverly Glen Boulevard.

Alias	Location	GPS Coordinates	Installation Dates
Camera 8	W. Mulholland	N 34°07.882 W 118°26.955	3/15/2012
Camera 9	W. Mulholland	N 34°07.877 W 118°26.971	3/15/2012
Reconyx	W. Mulholland	34° 7'53.06"N, 118°26'58.61"W	3/10/2012
Camera 1	E. Mulholland	N 34°07.837 W 118.26.494	4/9/2012
Camera 3	E. Mulholland	N 34°07.822 W 118°26.505	3/15/2012
Camera 6	E. Mulholland	N 34°07.846 W 118.26.466	4/9/2012
Camera 2	Perdido Lane	N 34°06.944 W 118°26.788	3/22/2012
Camera 4	Perdido Lane	34° 6'53.49"N 118°26'46.38"W	3/22/2012
Camera 5	Perdido Lane	34° 6'54.83"N, 118°26'46.78"W	3/22/2012
Camera 7	Perdido Lane	N 34°06.874 w 118°26.802	3/22/2012

Table 1- GPS coordinates, locations, and installation dates of cameras placed at West Mulholland, East Mulholland, and Perdido Lane study sites.

4.4 Data Acquisition and Site Maintenance

Field visits every two weeks were necessary in order to check battery levels and change out memory cards. Particularly during the first week of installation of each camera, the team consistently monitored any situations that may have compromised data, such as a high misfire rate or possible tampering. The cameras captured any observed traces of wild-life traffic in their vicinity and the data, be it photographs or video, was extracted promptly after acquired from a field visit. Backups were made instantly using either a portable hard drive or flash drive. The data on the camera's card was then erased to allow the cards to be replaced during the next trip and rearmed for further data collection. Each camera had two memory cards which were alternatingly used, in order to allow for memory to constantly be collected from the field.

4.5 Data Storage and Analysis

Data was backed up promptly upon acquisition from the field through the use of laptops and external storage devices. The latest sets of pictures and data was also backed up and distributed through the use of *Dropbox*, an online file syncing service.

To compile and statistically analyze the photo data, the team will use the program *Camera Base*. Manual analysis was also considered in order to view and document the timestamp of the photographs. A '30-minute rule' was used in this analysis, in order to properly document repeated animal movement that was separate from one photo capture to another. This was helpful in distinguishing animal movement that occurred frequently in a small time window, less than 30 minutes, in order to not count the animal more than once as using that corridor. The manual review of the timestamps also allowed us to determine which cameras were being triggered and when, which aided in our determination of the di-rectionality of animal movement.

5 Results

From 13 total weeks of data collection, we found at least 15 different species at our camera traps (Figure 1).

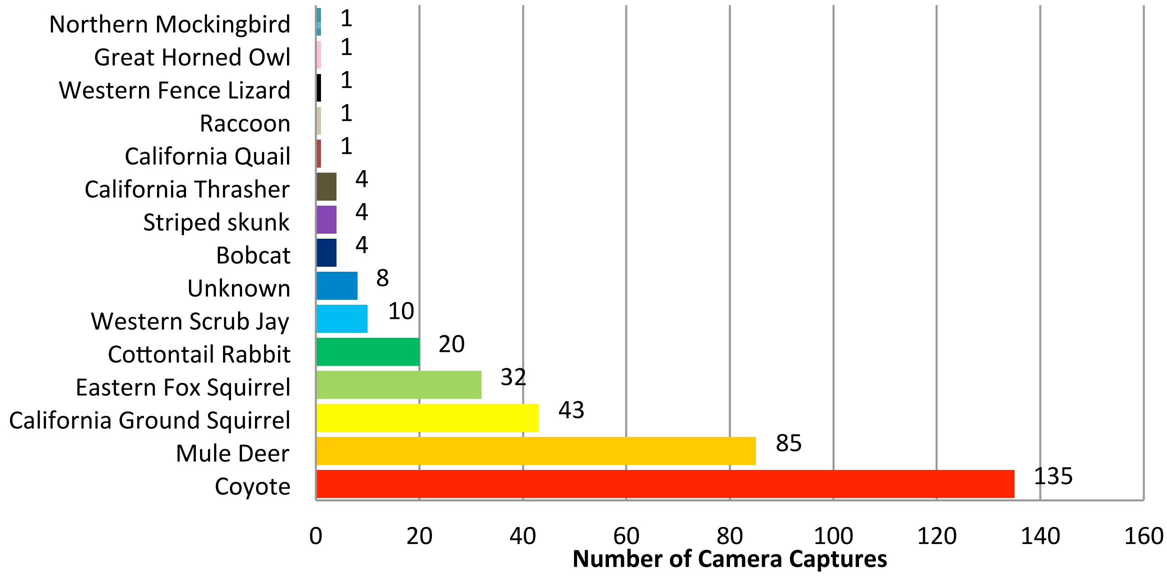


Figure 1. Wildlife photographed by remotely triggered cameras near Beverly Glen and Mulholland Boulevards, March–May 2012.

5.1 Species Diversity and Capture by Camera

While we obviously enjoyed a decent amount of wildlife diversity in our camera captures for such a heavily disturbed area, there was a huge variety in the number of captures per site, as well as the diversity per site. One camera recorded no captures at all, while another had over a hundred captures. And while some sites seemed to only be home to one or two species, some had 10 or more. The following figures highlight this variety by showing the number of captures by species at each camera site.

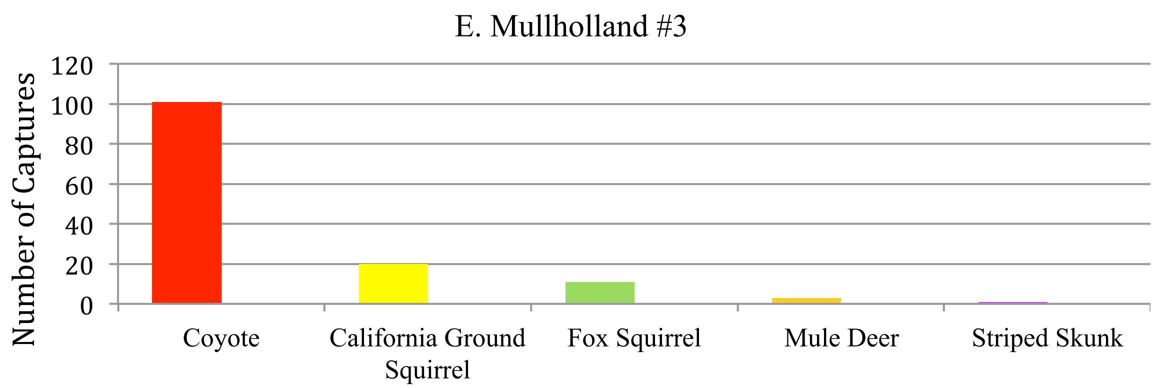


Figure 2. Wildlife photographed by Camera 3 at E. Mulholland site March-May 2012.

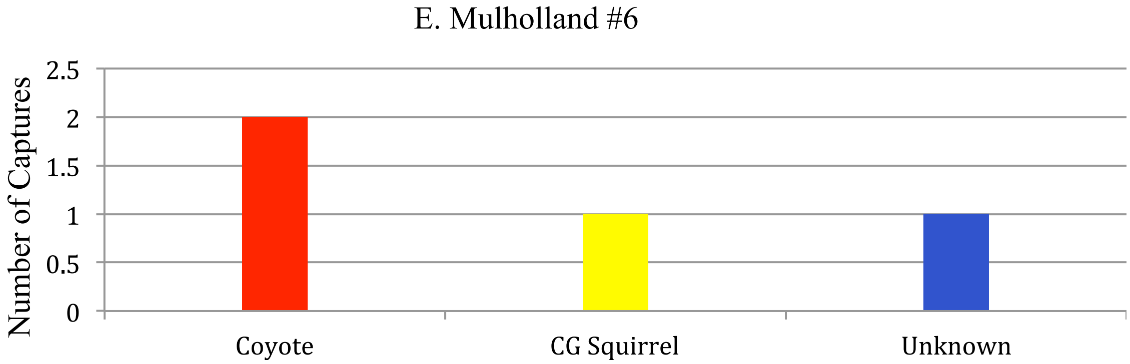


Figure 3. Wildlife photographed by Camera 6 at E. Mulholland March-May 2012.

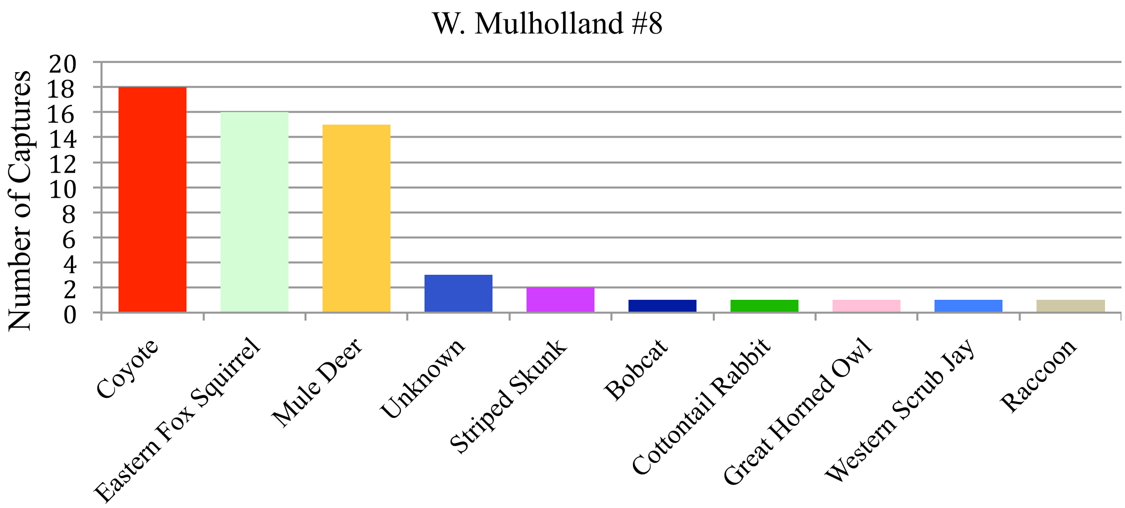


Figure 4. Wildlife photographed by Camera 8 at W. Mulholland March-May 2012.

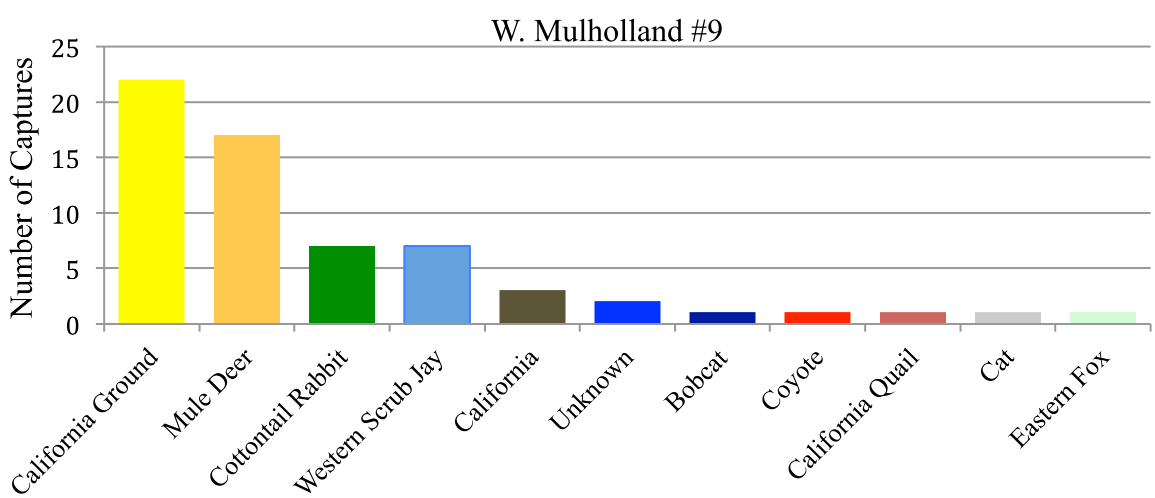


Figure 5. Wildlife photographed by Camera 9 at W. Mulholland March-May 2012

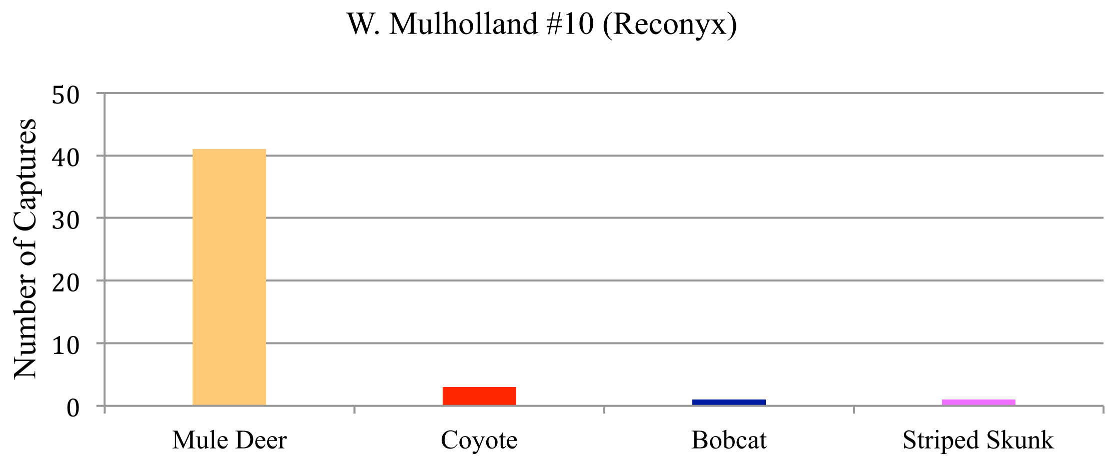


Figure 6. Wildlife photographed by Camera 10 (Reconyx) at W. Mulholland March-May 2012.

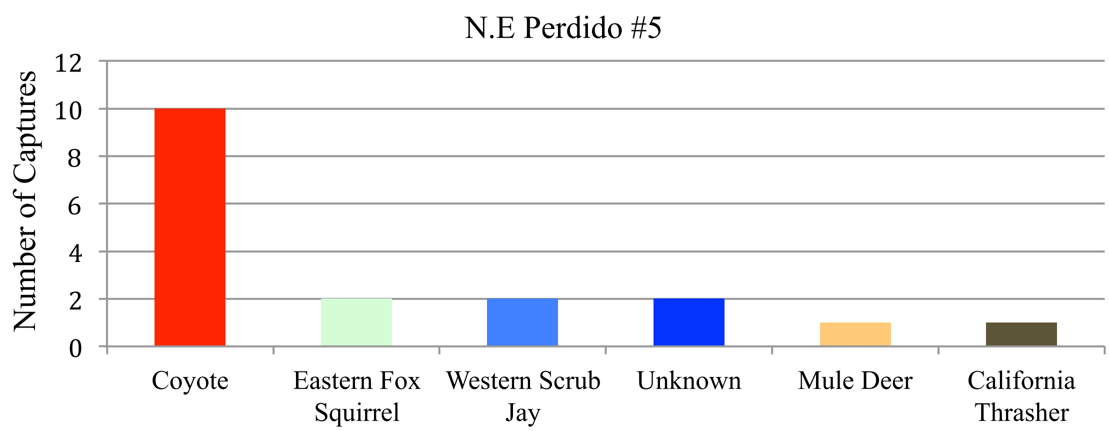


Figure 7. Wildlife photographed by Camera 5 at N.E Perdido March-May 2012.

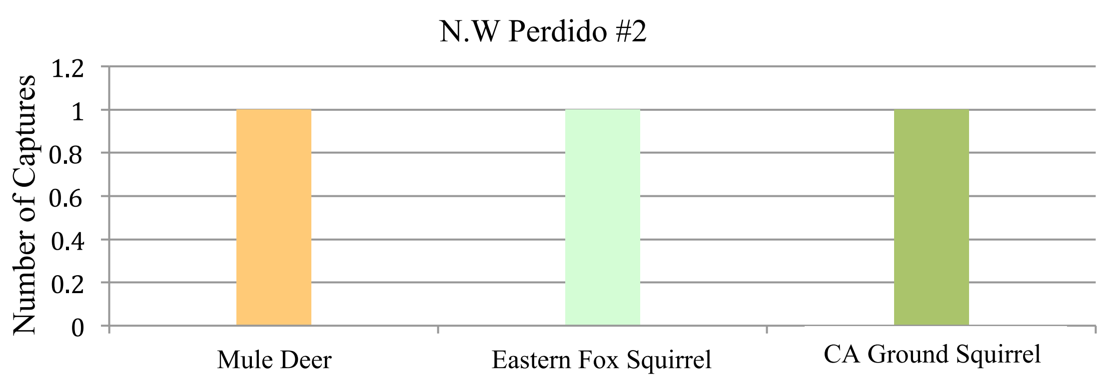


Figure 8. Wildlife photographed by Camera 2 at N.W Perdido March-May 2012.

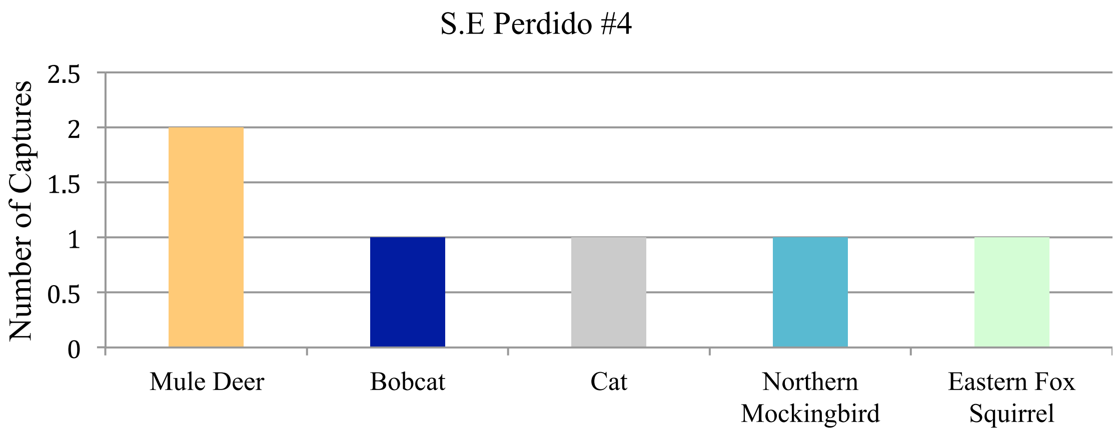


Figure 9. Wildlife photographed by Camera 4 at S.E Perdido March-May 2012.

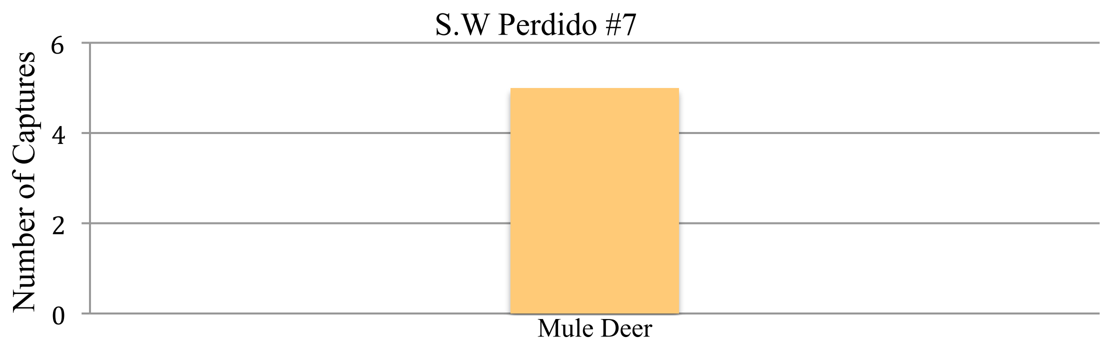


Figure 10. Wildlife photographed by Camera 7 at S.W Perdido March-May 2012

5.2 Target Species Captures and Movement

Focusing on our three target species, coyote, bobcat, and mule deer, the following maps show our study area, sites, and individual cameras. The initial maps presented show relative wildlife movement relative to their capture rate (captures per night) followed by a discussion of likely wildlife corridors we documented. We determined these likely wildlife corridors by judging which of the same animals we captured at different sites. Criteria used to identify animals included fur patterns, body size, body mass, and gender.

5.2.1 Coyote Presence and Movement

Figure 11. Coyote activity relative to capture rate by camera at West Mulholland, East Mulholland, and Perdido Lane.

Coyote presence was very strong throughout the duration of our study, particularly in the West and East Mulholland study sites. As seen in Figure 11, Cameras 5 and 8 had the most coyote captures per trap night. The strong capture presence between these two sites signaled that coyotes may be using Mulholland Drive as a corridor between East and West Mulholland, following from our hypothesis.

Picture 6 shows a coyote at Camera 8 at 7:02 am heading northeast towards Mulholland Drive leaving Stone Canyon. Approximately 49 minutes later, a very similar coyote was captured at Camera 5 heading southeast into Benedict Canyon (Picture 7). Captures like these indicate possible movement along Mulholland Drive, but are not conclusive.

Picture 6: Coyote capture at Camera 8, West Mulholland study site at 7:02 am.

Picture 7: Coyote capture at Camera 5, East Mulholland study site at 7:51 am. (Note 12 hour correction due to set-up error)

5.2.2 Bobcat Presence and Movement

Figure 12. Bobcat activity relative to capture rate by camera at West Mulholland, East Mulholland, and Perdido Lane

Bobcat capture was unfortunately very low. A total of four bobcats were captured at the West Mulholland and Perdido Lane study sites. The captures at the two sites suggest possible movement between them. We captured two videos of bobcat movement, strongly suggesting this result.

The first video was taken March 17, 2012 at 8:42 pm with a bobcat moving south into Stone Canyon at Camera 8. Six days later, March 23, 2012 at 3:28 am, a very similar bobcat was caught moving east into Benedict Canyon at Camera 4. Captures like these indicate possible movement from West Mulholland to Beverly Glen Park by using Perdido Lane as a corridor, but again, are not conclusive.

Picture 8: Video still of bobcat captured at Camera 8, Perdido Lane study site

5.2.3 Mule Deer Presence and Movement

Mule Deer was the second most abundant species captured in our study. Though they were captured at all three sites, West Mulholland, Camera 9 and Reconyx, and Perdido Lane, Camera 4, contained the most captures.

The relative activity at Perdido Lane suggests movement between the east and west basins surrounding Beverly Glen Drive. Picture 9 shows a mule deer captured at Camera 7, and two days later, a very similar individual is captured at Camera 4 (Picture 10). Captures like these result in possible corridor movement at the Perdido location.

Figure 13- Mule Deer activity relative to capture rate by camera at West Mulholland, East Mulholland, and Perdido Lane

Picture 9: Mule Deer captured at Camera 7, West Perdido study site.

Picture 10: Mule Deer captured at Camera 8, East Perdido study site.

5.3 Total Target Species Activity

From our data, we also extrapolated the activity patterns of each of our target species (figure). The radar graph below shows the number of species captures for each hour. As expected, coyotes and bobcats were primarily seen at night, while deer were largely crepuscular. Not surprisingly, this is in agreement with the literature on these various animals.

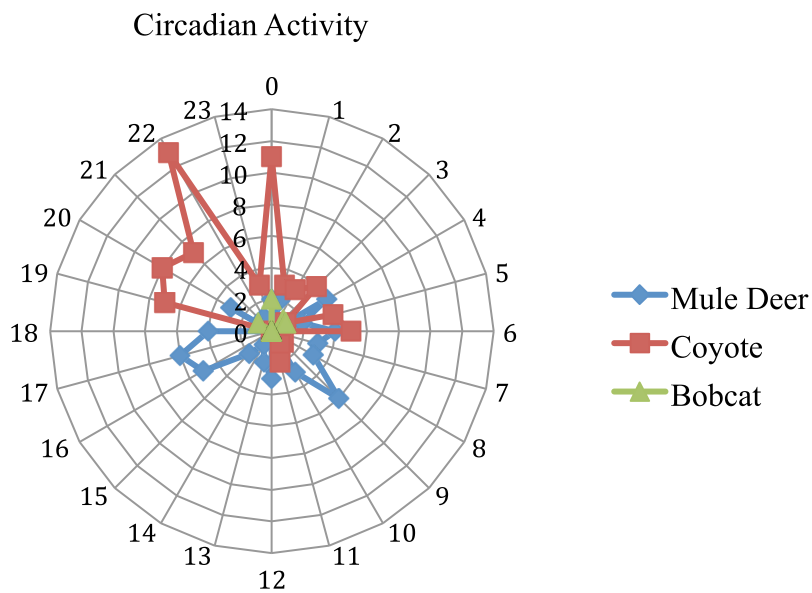


Figure 14 - Circadian Activity of captured Mule Deer, Coyote, and Bobcat

6 Discussion

The reason for the stark difference in number of captures of large mammals at each site may be explained by the impact of human development, qualities of the landscape, expected population densities of the various mammals, as well as disparities in total number of capture days. Our cameras were placed in a variety of areas, including some that would provide obvious difficulties to wildlife crossing the area. In general the West Perdido cameras had the least captures of target species. Both cameras were extremely close to a road: Camera 2 was situated near a wall, while Camera 7 was in front of a house. Low captures in E. Mulholland can be explained by the total logged capture days. Camera 1 and 6 were the last to be included in our study, and due to technical difficulties Camera 1 only logged a total of 6 capture days.

We only had few bobcat captures throughout our study, but most were seen on West Mulholland. It seems that bobcats are less likely to use extremely disturbed linkages to move between habitats. Bobcats in general have been found to avoid urban areas to a greater extent than our other target mammals, which we considered as a possible explanation as to why we saw so few (Riley 2003). However, in other research studies conducted in this area, bobcats have been found to be more abundant (L. K. Serieys, pers. comm.), so it is possible that our cameras were not placed in areas that were easily usable or accessible by bobcats, or that they were more difficult to capture due to their low sociality and highly territorial nature (Bailey, 1974). One capture suggests that the same individual moves into the east side of Beverly Glen, showing that even more elusive species find ways to disperse to different habitats in the midst of heavy development.

While most of our coyote captures occurred at the E. Mulholland sites, the presence of some captures on the western side combined with the consistent directionality of the coyote movement (parallel along Mulholland) allows us to infer that coyotes are frequently using Mulholland as a corridor between habitats. This is also consistent with the existing literature, which shows that coyotes have been able to utilize corridors that are heavily disturbed (Tigas 2002). There are many qualities unique to the East Mulholland site that would also increase the likelihood of it being used for movement. An important quality of this area is that it included the most wide open space, which is generally preferred by many wildlife species. We were also able to capture coyotes moving in pairs in this area, confirming that they are indeed social carnivores (Beckoff, 1980), as compared to bobcats, which are known to be more solitary and which we only ever captured moving on their own.

Deer were recorded most frequently on West Mulholland cameras, but were found in all study sites, the only one of our main target species to do so. Past research has shown deer use of corridors can be correlated with a larger cross sectional area of habitat patches (Ng, 2001). Since our corridors are between fairly large habitats, it seems appropriate that deer would be recorded using our chosen sites as corridors. Deer sighted in East Mulholland were all captured during the night, which could indicate a pattern of daily movement. Our data also confirm that the mule deer in this area are mating, due to the presence of a fawn.

Picture 11: Mule Deer fawn captured at Camera 7, West Perdido study site.

Deer have also been recognized as “edge species” which means that they prosper best near the edge of development, explaining the high frequency of deer captures on our cameras. Animal behavior can also change among different patch types. Edge specialists, such as deer, can browse in one patch of habitat, and seek protection and nutrients from another (Seagle 2003).

6.1 Management Implications

The most invasive device that separates the natural ecosystem, producing habitat fragmentation, is the construction of freeways and roads (Riley 2006). Beverly Glen Drive is a prime example of this man-made barrier, separating the natural landscapes of Stone Canyon Park and Beverly Glen Park. The Perdido and Mulholland sites all recorded activity of coyotes, deer, and bobcats over a thirteen week period, providing evidence that these animals are frequently navigating between residencies and natural land in each of the three study areas. Given our results, it is relevant to discuss what they mean to the population, both human and animals, in the area.

It is important to investigate the home ranges, activity and movement of both large carnivores and ungulates in order to develop practical management policies needed to curb species degradation in urban habitats. Carnivores and ungulates reside and move in highly preferred habitat patches whether or not urbanization has occurred within these areas. Therefore it is imperative that the particular habitats of a species are protected from housing, road, and other landscape development in order to aid in maintaining a stable population (Dickson and Beier, 2002). The frequent nocturnal activity recorded in the coyote, mule deer, and bobcat suggests that these animals adapt their behavior to avoid human interaction rather than to seek it, which is contrary to some fears people have about wildlife interaction and management. Therefore it is important to understand that these animals are not a nuisance or a public hazard roaming around residencies; they are merely trying to survive in the same shared space by finding linkages to travel through. Management practices in these three areas should be designed to heighten public awareness, which would help to dispel any false beliefs about the wildlife and also create a community awareness of the importance of preservation. Better infrastructure for corridors at these sites is also critical, which can include such items as fences, barriers, signs, or notices to help solidify the corridor against impending development and human activity. Our results aim to aid in the management of the Beverly Glen Drive sites by providing the knowledge of the existence of wildlife activity in these areas to residents, developers, and governmental agencies. By doing so, we hope to promote corridor preservation from potentially harmful development and lower anthropogenic influence to protect the integrity of a hybrid, urban and natural, ecosystem.

Given the scope of our project, we were only able to conduct research on one small part of the largely unknown Santa Monica Mountain corridors. Our results are conclusive, but are not meant to be inclusive. They are meant to provide a part of the puzzle, and inspire future research to fully map the corridors of the area with complete confidence. We know definitively that animals are present in this area, but we can only hypothesize in regards to their overall movement. The management implications of our study are simple: spread public awareness and foster a preservation attitude to coincide with the development of appropriate infrastructure and the ongoing research of wildlife corridors.

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