Chapter 5. Mesocarnivores in the Baldwin Hills

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Abstract

Previous surveys for mammals in the Baldwin Hills were limited to small mammals, primarily rodents. Using remotely triggered wildlife cameras, we document the assemblage of mid-sized carnivores currently inhabiting areas comprising the Baldwin Hills, including Kenneth Hahn State Recreation Area and the Baldwin Hills Scenic Overlook. This assemblage includes native and introduced mammal species with generalist habits able to adapt and thrive in human altered environments. Most of these generalists directly or indirectly benefit from subsidized feeding by humans. At least one native carnivore, the gray fox, is apparently suppressed by the presence of the larger coyote. In contrast to generalists, mid-sized mammals suspected to be sensitive to habitat fragmentation were absent from the Baldwin Hills despite records of their occurrence prior to substantial urbanization. We include western spotted skunks and long-tailed weasels in the latter category. The occurrence of feral domestic cats at subsidized feeding stations may attract coyotes to those parts of the Baldwin Hills.

Introduction

Before urbanization, the Los Angeles Basin supported a diverse assemblage of native mammals, including populations of native mice, woodrats, shrews, moles, ground squirrels, weasels, badgers, skunks, bobcats, mountain lions, grizzly bears, coyotes, gray foxes, mule deer, and bats (Willett 1941). Dramatic increases in the human population in the basin beginning in the late 1800s altered the landscape, in turn altering the region's flora and fauna. Native carnivores such as the grizzly bear, mountain lion and coyote increasingly came into conflict with humans and were eliminated from populated areas, with reverberating effects on densities and distribution of subordinate and prey species. Further contributing to the "altered nature" of the region was the introduction of nonnative mammal species such as the eastern fox squirrel (*Sciurus niger*) in 1904 (Becker and Kimball 1947) and the Virginia opossum (*Didelphis virginiana*) in 1906 (Anonymous 1916). The highly transformed Los Angeles Basin of the twenty-first century includes areas such as the Baldwin Hills, with some intact native habitat, that function as "islands" where pockets of native fauna persist. Nevertheless, urbanization and habitat fragmentation are major threats to wildlife populations, in particular mammalian carnivores (Riley et al. 2003).

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The Baldwin Hills comprise a low mountain range in the Los Angeles Basin surrounded by highly urbanized areas. The land encompassing the Baldwin Hills is managed or owned by a mosaic of government agencies and private landowners. Major defined open areas in the Baldwin Hills include Kenneth Hahn State Recreation Area (KHSRA, a 400-acre multi-use park operated by Los Angeles County Department of Parks and Recreation); the Baldwin Hills Scenic Overlook (BHSO, a 58-acre interpretive park under the jurisdiction of the State of California), Culver City Park, Blair Hills, the Stocker Corridor, and large areas owned or leased by petroleum companies. Although sizable swaths of native coastal sage shrub habitat persist, historic oil drilling and human habitation and development in the Baldwin Hills has resulted in substantially degraded habitat throughout. Efforts to restore existing and add native habitat in some areas have been underway, and a better understanding of animal diversity and distribution within the Baldwin Hills can help inform the organizations and agencies involved in restoration efforts.

Previous studies of the mammal fauna in the Baldwin Hills used snap and/or live traps to establish the occurrence of small mammals, and a depauperate community of rodent species was documented using standard trapping methods (Marqua 1978, Dines 2001). Small mammal traps, however, are inherently unsuitable to detect the presence of most non-rodent mammals (e.g., bats and carnivores). Instead, museum specimen records, roadkill records, and indirect evidence such as scat and other sign, were used to develop a list of mammals that potentially inhabit the Baldwin Hills (Dines 2001).

For mammal species other than rodents, contemporary occurrence in the Baldwin Hills has not been robustly investigated. The present study takes advantage of technological advances in remotely triggered trail cameras to document presence of mammalian species, as well as how different species use distinct areas within the Baldwin Hills. The use of trail cameras to monitor wildlife activity has several advantages over older survey methods. Trail cameras monitor a site passively and are therefore a cost-effective way to continuously monitor activity in a location. Cameras are able to capture activity in nocturnal and crepuscular species that may use areas at times not convenient for human monitoring. Moreover, cameras are non-invasive and have the potential to capture images of species that would avoid areas where they can detect human presence (e.g., by smell or sight). Images recorded by trail cameras also provide permanent, verifiable evidence of species presence. Remotely triggered infrared cameras (trail cameras) have successfully been used, for example, to monitor coyote activity (Kays et al. 2015), measure the impacts of human recreation to carnivore activity levels (George and Crooks 2006), and estimate the abundance of large carnivores (Kelly et al. 2008).

From January 2014 to August 2015 we conducted a camera trap survey of multiple habitats within the Baldwin Hills, including areas separated by major roads. The specific objective was to assess carnivore species richness and activity across multiple open areas within the Baldwin Hills with varying sizes and human activity levels.

Materials and Methods

Camera Trail Surveys

From January 2014 to August 2015, we deployed fourteen Bushnell Trophy Cam HD trail cameras (Bushnell Outdoor Products, Overland Park, Kansas) in the study area comprising the Baldwin Hills (Figure 5-1 and Table 5-1). Cameras were securely mounted approximately 30 centimeters above ground level to maximize the chance that mid-sized mammals would trigger the cameras (Figure 5-2). Secure Digital (SD) memory cards with 8 MB to 32 MB memory were used in the cameras to store captured images until they could be retrieved. Eight AA batteries powered each camera setup. Cameras were set on maximum trigger sensitivity and configured to take two consecutive images for each trigger. Daytime photos were full color images; nighttime photos used infrared flash to minimize startling of wildlife. In areas of interest, cameras were occasionally set to video mode for short periods of time to record video of target species. Metadata (date, time, temperature and locality) were recorded with every image and were also maintained in a database.

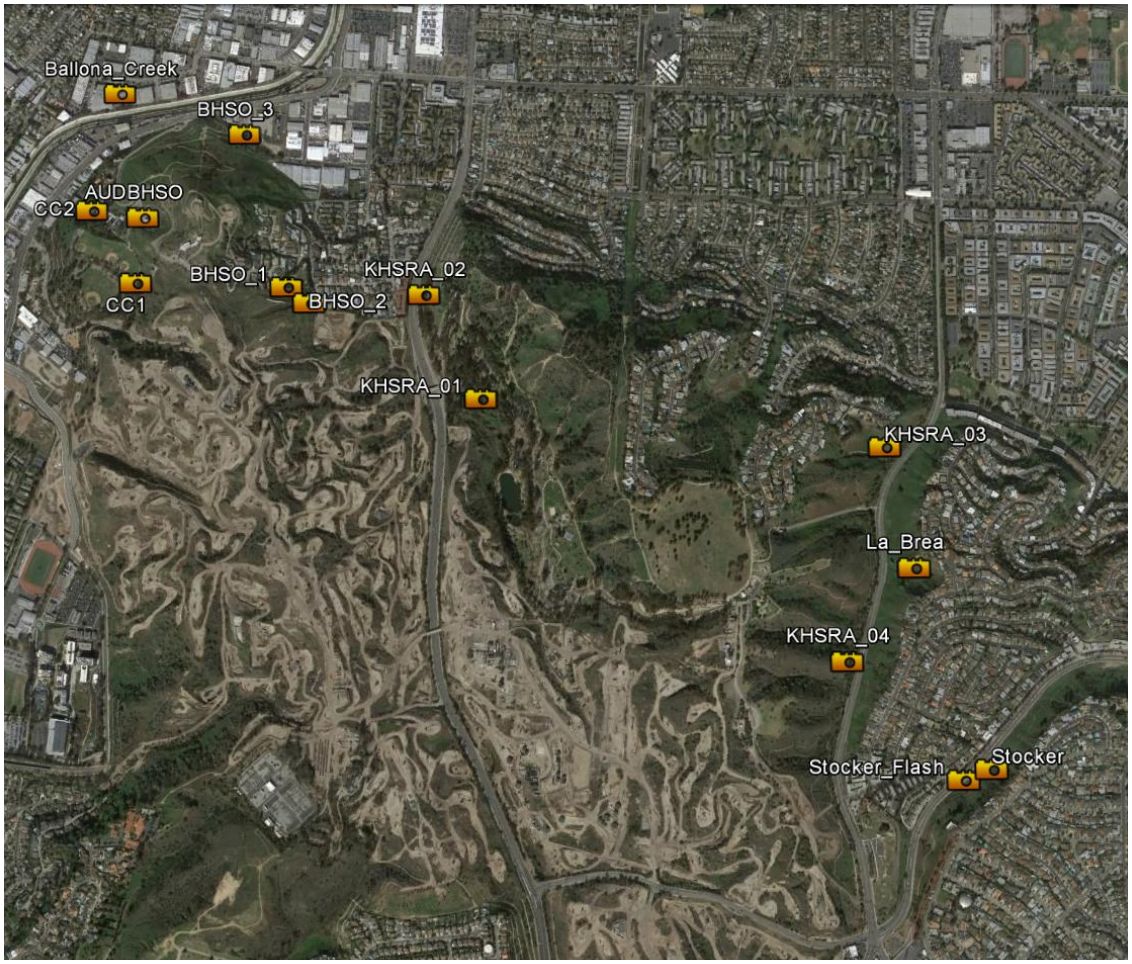

Figure 5-1. Locations of trail cameras deployed in the Baldwin Hills and vicinity.

Camera locations were chosen to give a broad sense of which mammal species use the different parts of the Baldwin Hills, with special attention to the potential use of corridors between areas and the potential of the large boulevards intersecting the Baldwin Hills to act as corridors. Therefore, cameras were installed in KHSRA, BHSO, along the Stocker Corridor, adjacent to La Brea Avenue, and along the Ballona Creek channel (Figure 5-1).

Table 5-1. Location information for the 14 trail cameras used in the study, including camera names (listed in alphabetical order), narrative description of the locations, and GPS coordinates of each location.

Camera Name	Site description	Coordinates
AUDBHSO	Audubon site at Baldwin Hills Scenic Overlook	34.01688°, -118.38110°
Ballona_Creek	Ballona Creek, upland from bike path, across from Hetzler/Jefferson intersection	34.02075°, -118.38491°
BHSO_01	Baldwin Hills Scenic Overlook; Blair Hills Corridor trail at concrete drainage ditch	34.01489°, -118.37859°
BHSO_02	Baldwin Hills S. O.; Blair Hills Corridor trail above former Ohr Eliyahu Academy Property	34.01444°, -118.37779°
BHSO_03	Baldwin Hills Scenic Overlook, lower trail near Jefferson Blvd.	34.01952°, -118.38034°
CC1	Culver City Park, southeast of baseball fields	34.01496°, -118.38394°
CC2	Culver City Park, northwest of baseball fields	34.01711°, -118.38562°
KHSRA_01	Kenneth Hahn State Recreation Area, eucalyptus grove just south of main entrance	34.01174°, -118.37169°
KHSRA_02	Kenneth Hahn State Recreation Area; near concrete ditch west of Japanese Garden	34.01484°, -118.37381°
KHSRA_03	Kenneth Hahn State Recreation Area; trail along west side of La Brea, northern end	34.01052°, -118.3575°
KHSRA_04	Kenneth Hahn State Recreation Area; trail along west side of La Brea, southern end	34.00431°, -118.358823°
La_Brea	La Brea Avenue, east side of road, in wooded ravine	34.00703°, -118.35654°
Stocker	Stocker Corridor Trail, upper trail	34.00134°, -118.35388°
Stocker_Flash	Stocker Corridor Trail, at southern opening of culvert going under lower trail	34.00101°, -118.35482°

Data Analysis

Cameras were checked at 2–3 week intervals during the study period and batteries refreshed as needed. For each camera location, digital images were downloaded from the memory card and stored in a temporary folder on an external hard drive for later sorting. Image sorting and processing were conducted by a trained student worker from the University of Southern California. Image processing and analysis were conducted using freeware developed by Jim Sanderson (Sanderson and Harris 2013). For sorting, image files in the temporary folder were relabeled using the *ReNamer* program, which automatically appends onto the file name the date and time the image was recorded, which facilitates data analysis as described below. Each relabeled image file was opened and the subject that triggered the camera was identified to species when possible. Possible identifications were: empty (no subject, camera possibly triggered by wind); bike; bird; **cat**; **coyote**; **dog**; **fox**; grasshopper; **human**; hummingbird; lizard; mourning dove; **mouse**; **opossum**; owl; **rabbit**; **raccoon**; **skunk**; snake; spider; **squirrel**; **unknown** (subject blurry or otherwise unidentifiable); and vehicle. Only the bolded subjects listed above are reported in the results of this study.

Figure 5-2. Typical camera trap deployment at optimal height (approx. 30 cm) for activation by medium-sized mammals.

Once each image file was identified, it was moved from the computer's temporary folder to a new file architecture according to the following hierarchy:

Location folder (location image was taken, e.g., AUDBHSO, Ballona Creek, etc.)

Species ID (unique species observed at each location, e.g., cat, dog, fox, etc.)

Number-of-individuals of same species in the same image (e.g., 1, 2, 3…)

In the event that two or more species were identified in a single image, a copy of that image file was saved for each species in the appropriate Species/Number-of-individuals folders. This process was repeated until all camera trap images were examined and moved to the appropriate folder(s).

The program *DataOrganize* was used to create an analyzable data file based on the number of image files in each folder. *DataOrganize* creates two editable text files: one that contains a list of all camera locations, the number of species, and a list of species; and one that has a list of all image files labeled with location, species, date and time image was taken, and number-of-individuals. Folders that contained "empty" images were eliminated from subsequent analyses. More than half of captured images were empty (triggered by wind, etc.), and would have been meaningless in the reported results. The program *DataAnalyze* was used to explore the data in the files created. An index of relative activity (RA) was estimated for each camera station by calculating the number of images of a species divided by the number of nights the camera operated at that location (George and Crooks 2006).

Results

More than 15,800 images were captured on the 14 deployed trail cameras with a total effort of 2,633 camera trap days (a camera trap day equals one full day that a camera is active). Of these, 13,768 images were identifiable and were used in the analyses. After excluding images of birds, lizards, snakes, insects, spiders, and vehicles, 11,831 images of mammals remained. Cameras detected a range of small and medium-sized mammals, both native and introduced (Table 5-2).

The assemblage of mammals present in the Baldwin Hills is typical of what is found in natural areas within urban zones: mammals that are generalists and adapted to a range of habitats, including anthropogenically altered habitats. More than 57% of images were of people (n=6774), demonstrating the very high use by humans of most areas in the Baldwin Hills.

The second highest number of image captures were of domestic/feral cats (n=1478). Cats (*Felis catus*) were photographed at every camera location, indicating widespread distribution of domestic/feral cats throughout the study area. With respect to individual camera sites, the highest number of cats (3.01 RA) was detected at site CC1 in Culver City Park, which was the location of a feeding/watering station. Cats encountered at this location would approach us during our regular camera checks, and clearly were not wary of human presence. Further, camera traps temporarily

placed at Culver City Park feeding stations documented cats, raccoons, and striped skunks drinking and feeding out of the same bowls alongside one another during the day. The next highest occurrence of domestic/feral cats (1.08 RA) was at KHSRA_3, a location in very close proximity to a neighborhood of single-family homes.

Domestic dogs (*Canis familiaris*) were detected at 9 of the 14 camera locations in the study area, in highest abundance at locations with high human numbers. In fact, the correlation coefficient between observation of humans and observation of domestic dogs is 0.97882. Dogs were typically photographed on leash or otherwise in close association with a human.

We documented the presence of the native gray fox (*Urocyon cinereoargenteus*) on both sides of La Cienega Blvd., a wide and busy boulevard running north-south that essentially bisects the Baldwin Hills (Figure 5-1). The greatest gray fox activity (0.06 RA) was recorded at KHSRA_1, an area just south of the main entrance to Kenneth Hahn State Recreation Area that is a dense, low-lying, brushy habitat dominated by eucalyptus trees. Only one gray fox image was recorded at KHSRA_2, a site approximately 400 meters north-northwest of KHSRA_1, but with much less dense vegetative cover. Gray foxes were not detected at any other sites within Kenneth Hahn State Recreational Area. Gray foxes were detected at three sites in the western Baldwin Hills, although at much reduced abundance: sites CC1 and CC2, at Culver City Park, and the nearby AUDBHSO, recorded 2, 3 and 1 images, respectively, of gray foxes.

Coyotes (*Canis latrans*) were present in low abundance in all major areas of the study area except at the Ballona Creek site and the La Brea Avenue site. Raccoons (*Procyon lotor*) and opossums (*Didephis virginiana*) were both present at every camera site. Striped skunks (*Mephitis mephitis*) were observed at every camera site except Stocker_Flash. Striped skunks were particularly abundant at CC1 and CC2 (540 and 318 images, respectively), sites that were adjacent to the baseball fields at Culver City Park.

Based on museum specimen records, the western spotted skunk (*Spilogale gracilis*) occurred in the Baldwin Hills at least to 1957 (LACM 009954, *Spilogale gracilis* preserved skull*,* Baldwin Hills, Los Angeles County, California, 09 April 1957). Spotted skunks were not captured on our trail cameras during the study period. Another small carnivore, the long-tailed weasel (*Mustela frenata*) has never been formally documented in the Baldwin Hills, but Willett (1944) discusses long-tailed weasels occurring throughout the Los Angeles basin from "coastal areas to foothills." A museum specimen collected from Playa del Rey in 1957 represents the closest documented long-tailed weasel to the Baldwin Hills (LACM 047297, *Mustela frenata* preserved skin and skull, Del Rey, Los Angeles County, California, 09 June 1957). No long-tailed weasels were captured on our trail cameras during the study period.

In addition to capturing the presence of species, trail cameras document conditions, such as time of day, when the images were recorded. This information can be used to provide a sense of variation in when different species are most active (Figure 5-3). In general, cats were active (caught on camera) during all hours of the day and night, but exhibited peaks in activity during the 8:00 A.M. hour and

5:00 P.M. hour. Ostensibly, this bimodal peak in activity was associated with times the feeding station was replenished by human caretakers.

Other target species showed primarily nocturnal activity patterns, with most activity occurring between 7:00 P.M. and 5:00 A.M. Raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) occasionally extended activity into twilight and even daylight hours.

Discussion

The most recent previous survey of mammalian fauna in the Baldwin Hills used live-trapping to document several rodent species and indirect observations such as scat and track identifications to infer the presence of larger species (Dines 2001). Using remotely triggered wildlife cameras, the objectives of the current study were to empirically confirm the continued presence of larger mammal species identified in the previous survey as well as document their distribution and movement patterns. An updated checklist of terrestrial mammal species presently occurring in the Baldwin Hills is another result of this effort (Table 5-2).

Notably absent from the study area were the long-tailed weasel (*Mustela frenata*) and the western spotted skunk (*Spilogale gracilis*). Based on the presence of voucher specimens in the Mammalogy collections at the Natural History Museum of Los Angeles, both species were previously proposed as potential inhabitants of the Baldwin Hills (Dines 2001). Both species are primarily carnivorous and rather restricted in their habitat preference, however, making them more sensitive to environmental disturbances associated with human habitation (Crooks 2002). Research in habitat preference for long-tailed weasels and western spotted skunks is insufficient; however, their relative scarcity in urban areas suggests they are sensitive to urbanization. Our evidence suggests that sufficient habitat no longer exists in the Baldwin Hills to support these two specialized carnivore species.

Also absent from the camera trap survey were black-tailed jackrabbits (*Lepus californicus*). Jackrabbits prefer relatively open habitat and may occur in the open oil fields adjacent to KHSRA. The previous mammal survey (Dines 2001) noted a roadkill jackrabbit in the vicinity (intersection of Stocker and Fairfax).

In contrast, the species of mid- to large-sized mammals that were detected in the study area comprise a homogenous assemblage typically found in urban and suburban fringe habitats: mesopredators with generalized habits that easily adapt to human altered environments (McKinney 2006). Mesopredators are small and mid-sized predators that, in the absence of suppression by apex predators such as coyotes, exhibit higher population densities and associated increased levels of predation on smaller prey in a process called "mesopredator release" (Soulé et al. 1988, Ritchie and Johnson 2009). Mesopredators include native and exotic species that typically exhibit generalist habits and are therefore adapted to making a living in urban and suburban settings with fragmented "edge" habitats and abundant food resources.

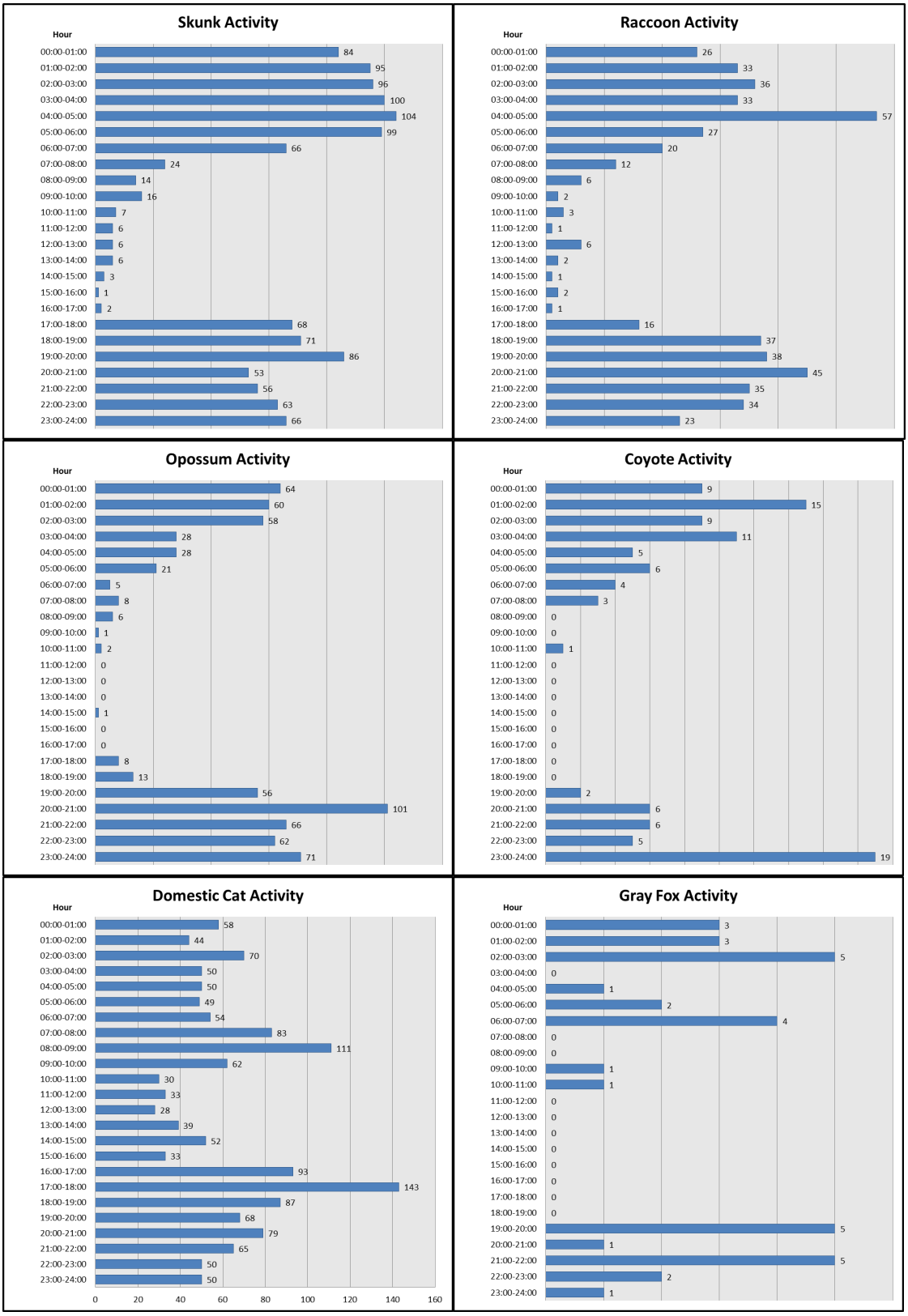

Figure 5-3. Species activity by hour showing diurnal versus nocturnal occurrence of target species.

Table 5-2. Updated list of terrestrial mammals documented as currently inhabiting the Baldwin Hills. Adapted from Dines (2001).

Species	Common Name	LAMC collection	Trapped in 2001	Sign in 2001*	Confirmed this study
Didelphis virginiana	Virginia Opossum	X		X	X
Canis latrans	Coyote	X			X
Canis familiaris	Domestic Dog			X	X
Urocyon cinereoargenteus	Gray Fox	X		X	X
Felis catus	Domestic Cat			X	X
Mephitis mephitis	Striped Skunk	X			X
Procyon lotor	Raccoon			X	X
Sciurus niger	Eastern Fox Squirrel			X	X
Otospermophilus beecheyi	California Ground Squirrel	X			X
Thomomys bottae	Botta's Pocket Gopher	X		X	X
Microtus californicus	California Vole	X		X	X
Mus musculus	House Mouse		X		X
Rattus rattus	Black Rat				X
Neotoma lepida	Desert Woodrat	X	X		
Peromyscus maniculatus	Deer Mouse		X		
Reithrodontomys megalotis	Western Harvest Mouse	X	X		
Sylvilagus audubonii	Desert Cottontail			X	X
Lepus californicus	Black-tailed Jackrabbit			X	

*Sign includes scat, tracks, runways, and roadkill.

As an ecological guild, carnivores vary in their sensitivity to fragmentation and degree of urban development (Crooks 2002; Ordeñana et al. 2010). Carnivores with specialized dietary and habitat needs are most sensitive to fragmentation and tend to disappear as habitat patches shrink and become more isolated. Included in this category are the mountain lion, bobcat, spotted skunk, and long-tailed weasel, all of which occur in the larger remaining expanses of Mediterranean habitat of Southern California but are absent from the present-day Baldwin Hills. Carnivores with more omnivorous habits, such as raccoons and striped skunks, are tolerant of, or may even benefit from fragmentation (Crooks 2002). Domestic cats and opossums are exotic species that actually increase in density in areas with fragmented habitats (Crooks 2002). Although opossums are marsupials and not carnivores taxonomically, they are included here as a mesopredator as they share that ecological niche. Mesopredator species with generalist habits perceive urban and fragmented natural habitats as contiguous (Crooks 2002) and thus readily move through and reside in developed areas.

Similar to the mammalian carnivores detected in other studies of urban habitats in coastal Southern California (Fedriani 2001, Crooks 2002, Ordeñana et al. 2010), the mesopredators we documented in the Baldwin Hills were primarily resource generalists that likely benefit from supplemental food sources available in association with human activities. Included in this group are the Virginia

opossum, raccoon, western striped skunk, gray fox, and domestic cat. Similarly, the dominant Southern California urban predator documented in previous studies, the coyote, was distributed widely throughout the Baldwin Hills. Below, we discuss the occurrence and distribution of each of these species.

*Domestic cat (*Felis catus*)*

After humans, domestic cats were the most abundant species captured on cameras in the study area (Table 5-3). Cats were most frequently photographed at site CC1 in Culver City Park, where a feral cat feeding/watering station was observed to have been maintained throughout the study period. Multiple studies suggest that feral cats have a strongly negative impact on native fauna (e.g., Hall et al. 2000, Nogales et al. 2004, Loss et al. 2013) as do inside/outside pet cats (Crooks and Soulé 1999, Kays et al. 2004). Cat activity is known to have a positive relationship with availability of anthropogenic food and habitat resources. In particular, the effects of feral cats that are subsidized (as at feeding stations, for example) are magnified by the fact that subsidized populations grow to as high as 100 times those of native predator population densities (Liborg et al. 2000). Moreover, predation on native fauna is concentrated in areas where subsidized cat populations exist (Schmidt et al. 2007). Previous studies have documented the displacement of cats from natural areas by coyotes (Gehrt et al. 2013; Kays et al. 2015) and direct predation of cats in urban areas (Grubbs and Krausman 2009), however, a combination of human-subsidized resources and potentially lower coyote densities in the Baldwin Hills allow cats to persist beyond the urban edge. The negative effects of exotic cats have occasionally been presented as equivocal (see discussion in Baker et al. 2010), but Longcore et al. (2009) and Loss et al. (2013) present clear evidence that urban cats kill large number of prey animals.

Table 5-3. Results of camera trap study, showing camera trap effort (trap nights) for each location, number of observations at each locality, and the Relative Abundance of each species (RA, in parentheses) at each locality. See Table 5-1 for location details.

		AUDBHSO	Ballona_Creek	BHSO_01	BHSO_02	BHSO_03	CC1	CC2	KHSRA_01	KHSRA_02	KHSRA_03	KHSRA_04	La_Brea	Stocker	Stocker_Flash	Total
Trap Nights		**146**	**41**	**146**	**87**	**106**	**183**	**204**	**465**	**228**	**322**	**180**	**240**	**133**	**152**	**2633**
Species	**Cat**	**16** (0.11)	**12** (0.29)	**3** (0.02)	**51** (0.59)	**51** (0.48)	**551** (3.01)	**63** (0.31)	**9** (0.02)	**13** (0.06)	**347** (1.08)	**135** (0.75)	**136** (0.57)	**88** (0.66)	**4** (0.03)	**1479** (0.56)
	Coyote			**4** (0.03)	**7** (0.08)	**4** (0.04)	**21** (0.11)	**9** (0.04)	**7** (0.02)	**1** (0.01)	**40** (0.12)	**4** (0.02)		**4** (0.03)		**101** (0.04)
	Dog				**15** (0.17)	**1** (0.01)	**3** (0.02)	**4** (0.02)		**2** (0.01)	**92** (0.29)	**298** (1.66)		**48** (0.36)	**1** (0.01)	**464** (0.18)
	Gray fox	**1** (0.01)					**2** (0.01)	**3** (0.01)	**27** (0.06)	**1** (0.00)						**34** (0.01)
	Human	**3** (0.02)	**6** (0.15)	**5** (0.03)	**411** (4.72)	**127** (1.20)	**141** (0.77)	**1** (0.01)		**13** (0.06)	**1871** (5.81)	**4041** (22.5)		**155** (1.17)		**6774** (2.57)
	Mouse		**1** (0.02)			**1** (0.01)		**2** (0.01)		**1** (0.00)	**10** (0.03)	**1** (0.01)	**22** (0.09)	**3** (0.02)		**41** (0.01)
	Opossum	**6** (0.04)	**35** (0.85)	**6** (0.04)	**2** (0.02)	**29** (0.27)	**50** (0.27)	**150** (0.73)	**12** (0.03)	**19** (0.08)	**84** (0.26)	**28** (0.16)	**234** (0.98)	**1** (0.01)	**3** (0.02)	**659** (0.25)
	Rabbit				**6** (0.07)						**4** (0.01)	**10** (0.06)				**20** (0.01)
	Raccoon	**11** (0.08)	**11** (0.27)	**6** (0.04)	**2** (0.02)	**18** (0.17)	**116** (0.63)	**99** (0.49)	**131** (0.28)	**4** (0.02)	**72** (0.22)	**11** (0.06)	**5** (0.02)	**15** (0.11)	**6** (0.04)	**507** (0.19)
	Skunk	**29** (0.20)	**30** (0.73)	**9** (0.06)	**24** (0.28)	**141** (1.33)	**540** (2.95)	**318** (1.56)	**13** (0.03)	**15** (0.07)	**91** (0.28)	**6** (0.03)	**4** (0.02)	**1** (0.01)		**1221** (0.46)
	Squirrel	**1** (0.01)		**1** (0.01)			**109** (0.60)	**67** (0.33)	**34** (0.07)	**12** (0.05)	**79** (0.25)	**40** (0.22)		**4** (0.03)		**347** (0.13)
	Unknown		**1** (0.02)	**2** (0.01)	**18** (0.21)	**8** (0.08)	**53** (0.29)	**18** (0.09)	**35** (0.08)	**1** (0.00)	**15** (0.05)	**5** (0.03)	**23** (0.10)	**3** (0.02)	**2** (0.01)	**184** (0.07)

*Gray fox (*Urocyon cinereoargenteus*)*

Gray foxes are relatively small canids that are widely distributed in North America and generally considered adaptable due to an omnivorous diet and behavioral plasticity (Riley et al. 2003). Gray foxes were present in low density and at limited sites in the current study, seemingly in contrast to previous studies that found gray foxes to be tolerant of—even thriving in—urban areas in Southern California (Riley 2006) and actually more abundant in small urban fragments (Crooks 2002). However, coyotes have been shown to limit the number and distribution of gray foxes by competitive dominance in the nearby Santa Monica Mountains (Fedriani et al. 2000). In the urbanized chaparral canyons of San Diego, gray fox populations are also controlled by coyotes (Soulé 1988, Crooks and Soulé 1999). Indeed, predation by coyotes is an important source of mortality for gray foxes, and gray foxes will avoid areas with high predation risk by coyotes (Farias et al. 2005). In the Baldwin Hills, the highest level of fox activity was in the western portion of KHSRA at site KHSRA_1, in habitat characterized by dense brush and trees. Coyotes were detected at the same site (n=27 for gray foxes, n=7 for coyotes, over 465 trap nights), although less frequently than at other sites in the study area. Fedriani (2000) also showed that gray foxes were restricted to brushy habitat in the Santa Monica Mountains, ostensibly to avoid the abundantly present coyotes. Gray foxes have the unique ability to climb trees to evade predators such as coyotes (Nowak and Paradiso 1999), so the dense brush and trees at site KHSRA_1 possibly provide cover and refuge from coyote activity. It is also possible that the dense cover of that site minimizes contact with humans and domestic dogs, which can also negatively influence gray fox activity.

*Striped skunk (*Mephitis mephitis*)*

The striped skunk is an opportunistic omnivore, in the wild feeding primarily on insects such as beetles and crickets, but also frogs, earthworms, snails, mice, bird eggs, fruit, carrion, and garbage. Like other mammalian resource generalists, the striped skunk is resilient to habitat fragmentation (Crooks 2002). Essentially, for species such as the striped skunk, the mosaic of urban habitats and fragmented pockets of natural habitats in suburban areas form a continuum of suitable territory for foraging and denning. In the present study, striped skunks were most abundant at sites CC1 and CC2 (2.95 RA and 1.56 RA, respectively), in close proximity to the baseball fields in Culver City Park (Figure 5-1). The turf on baseball fields comprise prime foraging grounds for striped skunks, as they are especially fond of grubs and are known to dig up lawns searching for them. Notably, the highest numbers of striped skunk images were captured at site CC1, the location of the feral cat feeding station. Striped skunks are attracted to outdoor feeding of pet cats and dogs (Rosatte et al. 2010). Our camera traps detected striped skunks using the cat feeding stations, demonstrating that the higher density of striped skunks at the Culver City Park sites is unequivocally a result of supplemental feeding. Notably, site CC_1 is adjacent to property with largely undisturbed native coastal sage shrub habitat that would provide skunks with suitable vegetative cover. Previous studies have suggested that when striped skunks occur in proximity to urban areas, they prefer patches of natural habitat for cover and den sites that are adjacent to human-altered landscapes with bountiful food resources (Crooks 2002, Ordeñana et al. 2010).

*Raccoons (*Procyon lotor*)*

Highly proficient at exploiting human structures and food sources, raccoons are resource generalists (Hadidian et al. 2010). Previous studies identified raccoons as tolerant of, or even enhanced by urbanization (Crooks 2002, Crooks and Soulé 1999, Ordeñana et al. 2010). Raccoons also appear to be less impacted by the presence of coyotes than other mesopredators, such as the gray fox (Crooks and Soulé 1999). Consistent with these studies, raccoons were ubiquitous in our study area and were detected at every camera site (Table 5-3). They were most frequently detected at sites KHSRA_1 (n=131) and CC1 (n=116). With its associated dense cover, KHSRA_1 provides natural denning habitat, one possible reason for the high detection rate at that site. Raccoons are readily attracted to feeding stations (Hadidian 2010) and were observed using the cat feeding stations near our site CC1.

*Virginia Opossum (*Didelphis virginiana*)*

Taxonomically, the opossum is a marsupial, not a carnivore, but like the other mid-sized mammals successful in urban settings, the opossum has a fairly generalist diet. Among food items found in an analysis of urban opossum stomachs are earthworms, snails, insects, fruit, bird eggs, small mammals, pet food and garbage (Hopkins and Forbes 1980). Native to the eastern United States, the Virginia opossum was introduced into the Los Angeles region as early as 1906 (Little 1916). Widespread introductions elsewhere in California, coupled with a high fecundity and generalized habits, led to broad occurrence in the state by the 1940s (Ingles 1965), particularly in agricultural and suburban areas. Previous studies of the Virginia opossum in urbanized habitats of California detected opossums near edges of habitat fragments within the urban matrix (Crooks 2002) and even within habitat surrounded by intense development (Markovchick-Nicholls et al. 2008). Although opossums are common in urbanized settings, they may need nearby natural areas for vegetative cover and den sites (Ordeñana et al. 2010). The current survey documented the opossum widely throughout the Baldwin Hills, with individuals detected at every camera site (Table 5-3). Opossums were most frequently detected at the La_Brea camera site (0.98 RA), a location with dense vegetative cover but in very close proximity to human residential developments (Figure 5-1).

*Coyote (*Canis latrans*)*

Well-known for its versatility, the coyote is widespread throughout North America. Prior to the persecution of larger competitors such as the mountain lions and wolf, the coyote was most common in grassland and desert habitats. The removal of larger competitors, however, allowed the coyote to significantly expand its range throughout the continent (Laliberte and Ripple 2004). Indeed, the remarkable behavioral plasticity of the coyote has allowed it to extend its range into metropolitan areas and quickly become a "denizen of the city" (Gehrt and Riley 2010). In southern California, coyotes are able to exploit urbanized areas due to their highly adaptable behavior and omnivorous diet, especially where garbage, cultivated fruit, pet food, and domestic animals are available as food subsidies (Crooks 2002, Fedriani et al. 2001, Riley et al. 2003). Coyotes in human-impacted areas can have densities of up to eight times higher than in natural areas (Fedriani et al.

2001). On the other hand, Ng et al. (2004) found that coyotes related positively with human activity but negatively with urban development, suggesting a tolerance threshold for urbanization.

Coyotes were not detected at every camera site in our study area. They were absent from all camera sites that lacked an obvious trail or path (i.e., La_Brea, Stocker_Flash, and AUDBHSO) and from the Ballona_Creek site, which was located on a path but detected low activity in general. Similarly, previous Southern California studies found positive relationships between coyotes and corridor width, natural habitat, and fragment area (Crooks 2002; Crooks and Soule´ 1999; Tigas et al. 2002), suggesting an overall preference by coyotes for established corridors and natural habitat. The coyote is the dominant predator in the Baldwin Hills and although widespread, is not particularly abundant. We documented the greatest coyote activity at the two sites where domestic cat activity was also the greatest: site CC1, with 3.01 RA for cats and 0.11 RA for coyotes; and site KHSRA_03, with 1.08 RA for cats and 0.12 RA for coyotes. The relatively high activity of cats at feeding stations potentially attracts coyotes, but the overall low density of coyotes in the Baldwin Hills may limit the top-down control of cat populations.

In the Baldwin Hills, parks and other open spaces are extensively used by humans for recreational activities. Studies elsewhere have shown that areas in urban parks frequented by humans and their pet dogs are less diverse in native carnivores (Mathewson et al. 2008, Ordeñana et al 2010). Increased human activity and recreation associated with urbanization may lead to the behavioral displacement of carnivores (Mathewson et al. 2008, Riley et al. 2003, Tigas et al. 2002; George and Crooks 2006). Although fragmentation-sensitive species are absent from the Baldwin Hills, more adaptable generalist species are ubiquitous at certain sites. The presence of this diverse assemblage of species presents challenges and opportunities.

Further development of proposed recreational trails and other areas within the Baldwin Hills will increase human contact with the urban wildlife inhabiting the remaining secluded habitats, leading to potential conflict. Sources of conflict include increased possibility of the transmission of zoonoses such as rabies, distemper, toxoplasmosis, and roundworms, as well as direct conflict with pets. Additionally, previous research indicates that increased recreation and human activity alters the circadian activity of carnivores, either displacing them from an area entirely or narrowing their window of activity that they use to hunt, patrol territories, and find mates (Tigas et al. 2002; George and Crooks 2006). Land managers and community leaders will need to weigh the benefits of securing more space for traditional recreational activities, such as hiking trails, against the cost of eliminating natural habitat necessary for cover and den sites of native fauna. Wildlife viewing opportunities, for mammals as well as birds and other taxa, have their own inherent recreational benefits, particularly in a society with limited access to nature (Louv 2008).

Regardless of increased development, the operation of feeding stations should be addressed. Supplemental feeding artificially increases populations of carnivores. In the case of domestic cats, that means more cats are killing more native fauna such as songbirds, native mice, and reptiles. The current study echoes the results of previous studies: whether intended or not, feeding stations lead

to increased populations and habituation of raccoons, skunks, and opossums, which increases conflict (Gehrt and Riley 2010). Increased densities of these mesopredator species may also lead to increased possibility of disease transmission, both between wildlife species and between domestic animals and wildlife.

Many major boulevards divide the Baldwin Hills into discrete areas. Roads can act as physical and social barriers to carnivores (Riley et al. 2006, Tigas et al. 2002). Our study showed that all of the carnivore species that inhabit the Baldwin Hills are found in KHSRA and in the Baldwin Hills Scenic Overlook/Blair Hills properties. Creating wildlife corridors that allow safe movement between those areas (e.g., wildlife overpasses and underpasses) would decrease vulnerability to mortality associated with crossing La Cienega Blvd, and potentially increase gene flow in the populations inhabiting those two areas. While the camera at the Ballona_Creek site did not detect the presence of significant numbers of carnivores, connectivity of the Baldwin Hills to Ballona Creek should be explored, particularly in light of Ballona Creek potentially being used as a wildlife corridor to and from the Ballona Wetlands to the west.

Conclusions

The Baldwin Hills have a long history of use by humans, including early Native American settlements, location of Rancho land grants during the Mexican era, suburban housing developments as Los Angeles developed into a major urban center, discovery of oil and development of petroleum operations, and most recently as recreational space. With some patches of native habitat remaining, the Baldwin Hills are essentially an "island" of habitat surrounded by the "sea" of the urbanized flatlands. As such, the Baldwin Hills support certain species, such as the native gray fox, that do not occur in the adjacent flatlands. Even so, urbanization has impacted the overall mammal fauna within the Baldwin Hills. Available habitats in the Baldwin Hills are typical of the "altered nature" found in similar urban recreation areas of the Los Angeles Basin (e.g., Ernest E. Debs Park and Elysian Park). Wildlife most able to co-exist in human-influenced environments is most abundant. Meanwhile, species that are sensitive to habitat fragmentation, in particular the long-tailed weasel and spotted skunk, have likely been extirpated. Despite the adaptive nature of the mammal species that endure, challenges remain. The large boulevards transecting the Baldwin Hills act as barriers and as a source of mortality, especially for more wide-ranging species such as the coyote. The abundant recreational use and associated presence of humans and their pet dogs, in the Baldwin Hills likely displaces the natural activities of wild animals. Paradoxically, those same wild species benefit from human presence to supplement their natural foraging activities. Finally, the density of generalist mammals in urban habitats, and their close proximity with humans and their pets, raises the potential for transmission of zoonotic diseases and conflict.

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