# McDowell Sonoran Preserve

# Corridor Viability Project Report



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MCDOWELL SONORAN CONSERVANCY



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# McDowell Sonoran Preserve (MSP)

# Corridor Viability Project Results and Summary

**Key results from research**

- During this project, 4,243 independent (> 60 minutes apart) photos of mammal species were assessed.
- 15 species of mammals were recorded, including species previously unseen in the region (e.g., American badger [*Taxidea taxus*]).
- Species highlights include American badger, mountain lion, and spotted skunk.
- All species that may face difficulty moving through MSP's corridor (e.g., mountain lion and mule deer) were found in the corridor and surrounding regions of the preserve, as were middle-sized carnivores (e.g., bobcat, coyote, gray fox).
- Results indicate that MSP's gooseneck corridor successfully supports the occupancy of at-risk mammal species, and that the preserve maintains a large diversity of mammals.
- Further information on landscape characteristics influencing species occupancy and gene flow could improve our understanding of how the corridor supports mammalian species.

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## OVERVIEW AND RATIONALE

Situated within the most biodiverse desert in the world, and near Phoenix, AZ—the fifth most populous and one of the fastest growing cities in the USA—McDowell Sonoran Preserve (MSP) maintains 30,500 acres of Sonoran Desert and 225 miles of public use trails just north of the city in Scottsdale, AZ. As a key educational resource with an extensive steward program, McDowell Sonoran Conservancy (MSC) also supports the continued engagement of the community with the local landscape. A call to science-based stewardship of the largest urban preserve in the USA has also resulted in partnerships between MSC's research team, the Arizona Center for Nature Conservation/Phoenix Zoo, and Arizona State University to assess the viability of the preserve's narrow gooseneck corridor.

The 4.5km$^2$ gooseneck corridor connects a 62km$^2$ patch of land in the northern extent of the preserve to a 135km$^2$ patch of land in the preserve's southern extent, adjacent to McDowell Mountain Regional Park. Conservation corridors are an important tool for maintaining biodiversity, gene flow, and providing habitat for wildlife populations and ecological communities. Assessing a corridor's ability to maintain viable habitat for species, especially those that migrate or maintain large home ranges, is therefore essential in determining corridor success. This is especially true of corridors that support wildlife movement near highly disturbed areas, such as cities. To monitor wildlife populations and assess the viability of MSP's gooseneck corridor, 26 remote wildlife cameras were placed throughout the preserve between 2017 – 2019. Collaborators sought to assess the mammal species present throughout the preserve, how species occupancy differed between the northern, southern, and corridor regions of the preserve, as well as information to support wildlife management. Through this analysis, the McDowell Sonoran Conservancy will be able to better understand and maintain the extensive network of habitats found within the US's largest urban preserve, thereby supporting the preserve's extensive biodiversity.

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Sonoran Conservancy

## OBJECTIVES

We asked if the gooseneck corridor in McDowell Sonoran Preserve (MSP) successfully functions as a wildlife corridor for native mammal species. Since movement of wildlife across a corridor often defines its success, we investigated the occupancy of species, in particular larger species (i.e., mountain lion [*puma concolor*] and mule deer [*Odocoileus hemionus*]) in the corridor compared to other regions of the preserve. We further investigated the occupancy of middle-sized carnivores (i.e., coyotes [*Canis latrans*], gray fox [*Urocyon cinereoargenteus*], and bobcat [*Lynx rufus*]) in the corridor compared to other regions of the preserve, with the expectation that mesopredator release could result in the loading of middle-sized carnivores in the corridor. If larger-bodied mammal occupancy decreases in the corridor—and if mesopredators utilize the corridor as habitat more frequently than other areas of MSP—we will conclude that movement throughout the preserve via the corridor is limited. For purposes of wildlife monitoring and maintenance, we also assessed the overall mammalian biodiversity and distribution of species throughout the preserve, as well as the activity patterns of each mammal species recorded.

## METHODS AND STUDY DESIGN

To assess mammal species occupancy and diversity throughout McDowell Sonoran Preserve, we deployed 26 remote wildlife cameras in three phases from 2017 – 2019 (Fig. 1). A minimum of 20 cameras are required to adequately estimate occupancy of common species in camera trapping surveys, and so we considered this number of cameras sufficient for our assessment of local biodiversity. Phase 1 involved placing six cameras in each section of the preserve (north, corridor, and south) from May or June 2017 – April or May 2018, with outlier cameras including one in the corridor that was placed from October 2017 – April 2018 and one in the south that was placed from May 2017 – November 2017. In Phase 2 (started May 2018), six cameras between the corridor and southern extents of MSP were moved to secondary locations in the northern extent of the preserve. The remaining and newly placed cameras were then maintained until March, April, or May 2019. Phase 3 cameras remained at their study site for the full duration of the project (May 2017 – May 2019). Cameras were moved to maximize limited resources and ensure a more comprehensive assessment of the preserve. When looking

at the species accumulation curve (see Results, Fig. 2), saturation occurred by day 37 of the study, suggesting moving cameras had minimal effect on species detection.

We placed cameras at knee-height on trees along washes, aside from one camera in the southern extent of the preserve that was placed on a T-bar in a wash. Cameras were also placed off human-use trails, aside from one camera in the north. We sought to space cameras approximately 1km apart, per standard methods when assessing several species of varied home range sizes. However, due to spatial limitations—especially within the corridor—the average distance of each camera to its nearest neighbor was $\bar{x}$ = 0.83km (SD 0.25km). Cameras were also left without lures to eliminate possible effects on community composition, visitation rates, and probabilities of detection.

Citizen scientists through MSP's Conservancy (MSC) maintained camera traps and sorted data in association with the Sanderson CameraSweet sorting protocol. MSC fosters a citizen science program of over 700 highly dedicated stewards. Stewards were trained by a researcher and then
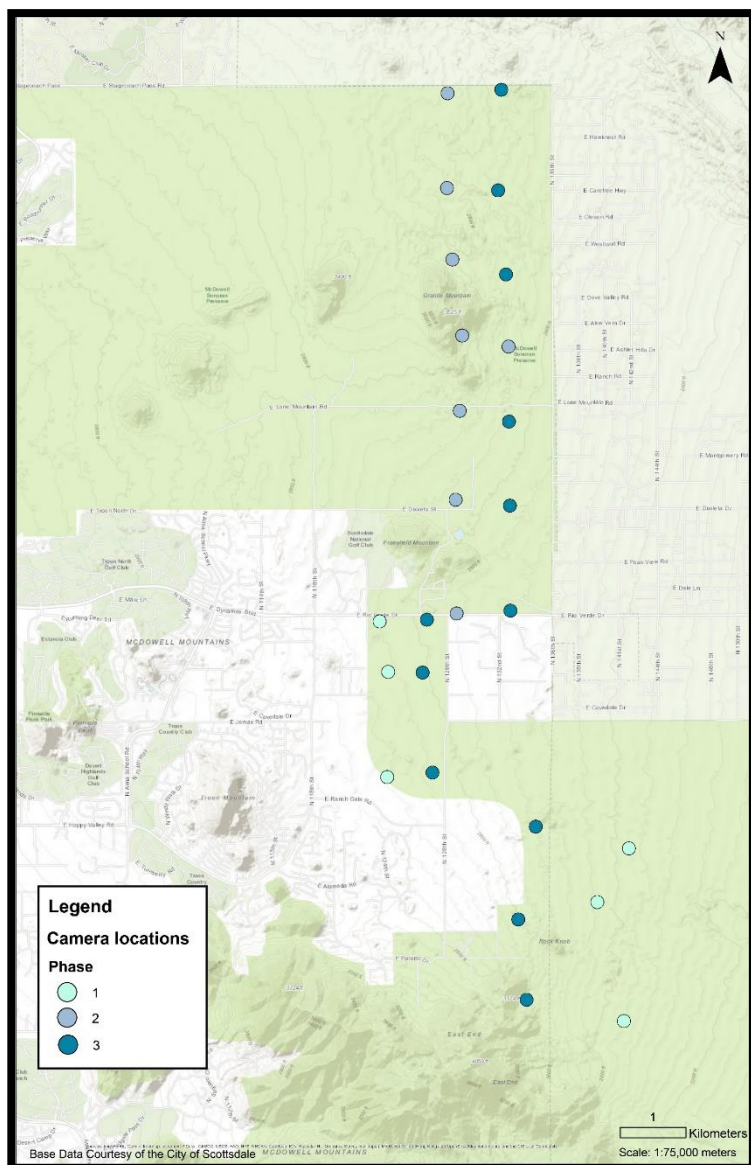


*Figure 1. Camera locations in McDowell Sonoran Preserve during Phase 1 (May 2017 – May 2018), Phase 2 (May 2018 – May 2019), and Phase 3 (May 2017 – May 2019) of our study.*

placed three different camera trap models throughout the course of the study (Scoutguard, Bushnell, and Browning brand cameras). Due to challenges in maintaining consistency across camera orientations and settings, only naïve occupancy, naïve relative abundance, and naïve activity pattern analyses (i.e., that do not incorporate imperfect detection) were able to be conducted. Due to the impact of flight on species movement and difficulties in reliably detecting herpetofauna on camera traps, bird and herpetofaunal species were omitted from our analyses.

MSC stewards sorted camera trap photos in association with the Sanderson CameraSweet protocol. Sanderson's CameraSweet is a set of analytical programs with an associated photo sorting protocol for camera trap data that is free, easy to use, available offline, and only requires the file folder structure within a computer to sort photos. This method of photo sorting is therefore helpful when working with citizen scientists. After photos were sorted and reviewed by a lead steward, a researcher at Arizona State University conducted subsequent checks on all photos. Data were then processed using the Sanderson CameraSweet's DataOrganize, DataAnalyze, and OccupancyMatrix programs, with 60 minutes selected to define an independent photo period.







*Camera traps were set and maintained by trained McDowell Sonoran Conservancy stewards (all three photos). Cameras were set with security cases and locks (first image) to prevent theft and protect the camera from the elements and other animals.*

**PROJECT RESULTS**

Throughout the duration of our study, 10,721 total and 4243 independent photos (> 60 min apart) of mammal species were assessed across 722 total trap nights and 26 cameras from May 2017 – May 2019 (Table 1). All species recorded during our study were detected within the first 37 days (Fig. 2). A total of 15 mammal species were recorded during the duration of our study, with bobcats (*Lynx rufus*) and mule deer (*Odocoileus hemionus*) detected at all 26 sites (Table 2). Three of the four species of skunk found within Arizona (striped skunk [*Mephitis mephitis*],

hooded skunk [*Mephitis macroura*], and spotted skunk [*Spilogale gracilis*]) were detected, while American hog-nosed skunk (*Conepatus leuconotus*) was not detected.

Table 1. Summary of mammal photos taken across the McDowell Sonoran Preserve Corridor Viability Study.

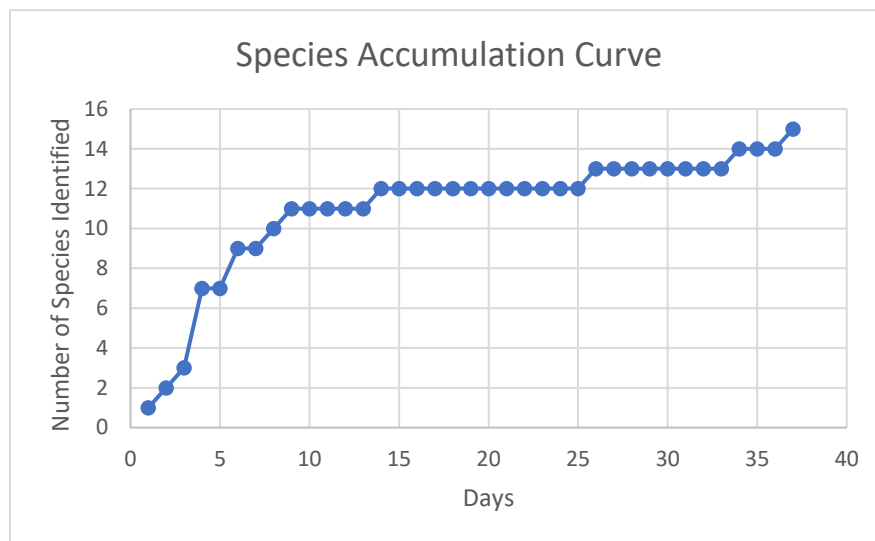| Year | Total Photos | Total Independent Photos (> 60 minutes apart) |
|---|---|---|
| 2017 | 4473 | 1648 |
| 2018 | 4169 | 1804 |
| 2019 | 2079 | 791 |
| Total | 10721 | 4243 |



Figure 2. Species accumulation curve. Saturation of mammal species was achieved at day 37.

Table 2. Summary of mammal species detected, the number of sites they occupied, and their naïve occupancy (i.e., does not account for imperfect detection; refers to the percentage of sites occupied).

| Mammal Species | Sites Occupied | Naïve Occupancy (%) |
|---|---|---|
| Bobcat (*Lynx rufus*) | 26 | 100 |
| Mule deer (*Odocoileus hemionus*) | 26 | 100 |
| Black-tailed jackrabbit (*Lepus californicus*) | 25 | 96.15 |
| Coyote (*Canis latrans*) | 25 | 96.15 |
| Desert cottontail rabbit (*Sylvilagus audubonii*) | 25 | 96.15 |
| Collared peccary (*Pecari tajacu*) | 21 | 80.77 |
| American badger (*Taxidea taxus*) | 17 | 65.38 |
| Gray fox (*Urocyon cinereoargenteus*) | 17 | 65.38 |
| Harris's antelope squirrel (*Ammospermophilus harrisii*) | 16 | 61.54 |
| Rock squirrel (*Otospermophilus variegatus*) | 10 | 38.46 |
| Striped skunk (*Mephitis mephitis*) | 9 | 34.62 |
| Hooded skunk (*Mephitis macroura*) | 8 | 30.77 |
| Mountain lion (*Puma concolor*) | 6 | 23.08 |
| Raccoon (*Procyon lotor*) | 4 | 15.38 |
| Spotted skunk (*Spilogale gracilis*) | 2 | 7.69 |

Due to resource and spatial constraints, cameras were unevenly distributed throughout the northern, southern, and corridor extents of the preserve, with 14 cameras placed in the north and six cameras placed in both the southern region and corridor (Fig. 1). Nonetheless, most species—including all larger-bodied species—were detected in all three regions of the preserve, including the gooseneck corridor (Table 3). Similarly, all medium-sized carnivores predicted to be released from top-down pressure from apex predators (i.e., bobcats, coyotes, and gray foxes) were still detected in the corridor (Table 3). The only species not identified in the corridor were the three skunk species. The northern extent, which had the most cameras, detected all mammal species recorded during the time of the study, while the southern region detected all mammal species except raccoon (*Procyon lotor*) and hooded skunk.

*Table 3. Mammal species detected in each region assessed during the McDowell Sonoran Preserve Corridor Viability Project. X's represent the species that were detected in each area, while blank spaces indicate the species was not detected.*

| Mammal Species | North (n = 14) | Corridor (n = 6) | South (n = 6) |
|---|---|---|---|
| American badger (*Taxidea taxus*) | X | X | X |
| Black-tailed jackrabbit (*Lepus californicus*) | X | X | X |
| Bobcat (*Lynx rufus*) | X | X | X |
| Collared peccary (*Pecari tajacu*) | X | X | X |
| Coyote (*Canis latrans*) | X | X | X |
| Desert cottontail rabbit (*Sylvilagus audubonii*) | X | X | X |
| Gray fox (*Urocyon cinereoargenteus*) | X | X | X |
| Harris's antelope squirrel (*Ammospermophilus harrisii*) | X | X | X |
| Hooded skunk (*Mephitis macroura*) | X | | |
| Mountain lion (*Puma concolor*) | X | X | X |
| Mule deer (*Odocoileus hemionus*) | X | X | X |
| Raccoon (*Procyon lotor*) | X | X | |
| Rock squirrel (*Otospermophilus variegatus*) | X | X | X |
| Spotted skunk (*Spilogale gracilis*) | X | | X |
| Striped skunk (*Mephitis mephitis*) | X | | X |
| Total Naïve Species Richness | 15/15 | 12/15 | 13/15 |

Sites varied in their naïve mammal species richness (i.e., raw number of species detected, without accounting for imperfect detection) (Table 4). Overall site-level richness varied from 7-11 (Table 4), while regional richness varied from 12-15 (Table 3). The three sites with the lowest species richness (richness = 7) were all in the corridor, though one site in the corridor also had a species richness of 10 and species richness of 8-11 varied widely throughout the northern and southern extents of the preserve (Table 4).

The number of mammal species detections also varied, ranging from two (spotted skunks) to 1472 (desert cottontail rabbit [*Sylviagus audubonii*]) (Table 5). Critically, seven mountain lion and 434 mule deer were detected (Table 5) across all regions of the preserve (Table 3). A species previously unknown to occupy the preserve, American badger (*Taxidea taxus*) was also found in all three regions of the preserve (Table 3), with 39 independent detections. Similarly, naïve relative abundance also varied across species, ranging from 0.05% (spotted skunks) to 34.69% (desert cottontail rabbit) (Table 5).

*Table 4. Naïve mammal species richness at each camera site.*

| Site | Region | Naïve Mammal Species Richness (N = 15) |
|------|--------|----------------------------------------|
| N01A | North | 8 |
| N01B | North | 10 |
| N02A | North | 9 |
| N02B | North | 9 |
| N03A | North | 11 |
| N03B | North | 11 |
| N03A1 | North | 9 |
| N03B1 | North | 8 |
| N04A | North | 11 |
| N04B | North | 10 |
| N05A | North | 10 |
| N05B | North | 11 |
| N06A | North | 8 |
| N06B | North | 9 |
| S01A | Corridor | 7 |
| S01B | Corridor | 7 |
| S02A | Corridor | 8 |
| S02B | Corridor | 10 |
| S03A | Corridor | 7 |
| S03B | Corridor | 8 |
| S04A | South | 8 |
| S04B | South | 9 |
| S05A | South | 11 |
| S05B | South | 10 |
| S06A | South | 8 |
| S06B | South | 10 |

*Table 5. Naïve relative abundance and number of independent photos of each mammal species detected throughout McDowell Sonoran Preserve.*

| Mammal Species | Number of Independent Photos | Naïve Relative Abundance (%) |
|----------------|------------------------------|------------------------------|
| Desert cottontail rabbit (*Sylvilagus audubonii*) | 1472 | 34.69 |
| Black-tailed jackrabbit (*Lepus californicus*) | 835 | 19.68 |
| Coyote (*Canis latrans*) | 570 | 13.32 |
| Mule deer (*Odocoileus hemionus*) | 434 | 10.23 |
| Bobcat (*Lynx rufus*) | 383 | 9.03 |
| Gray fox (*Urocyon cinereoargenteus*) | 169 | 3.98 |
| Collared peccary (*Pecari tajacu*) | 148 | 3.49 |
| Harris's antelope squirrel (*Ammospermophilus harrisii*) | 95 | 2.24 |
| Hooded skunk (*Mephitis macroura*) | 43 | 1.01 |
| American badger (*Taxidea taxus*) | 39 | 0.92 |
| Rock squirrel (*Otospermophilus variegatus*) | 26 | 0.61 |
| Striped skunk (*Mephitis mephitis*) | 16 | 0.38 |

| Mountain lion (*Puma concolor*) | 7 | 0.16 |
| Raccoon (*Procyon lotor*) | 4 | 0.09 |
| Spotted skunk (*Spilogale gracilis*) | 2 | 0.05 |
| Total | 4243 | 100.00 |

We also assessed naïve activity for each species, with most species exhibiting nocturnal or crepuscular activity patterns (Fig. 3). Species with few detections (< 30; mountain lion, raccoon, spotted skunk, rock squirrel, striped skunk) have also been reported, though their activity should be assessed with caution.

*Figure 3. Naïve activity patterns (i.e., using raw data) for each species.*
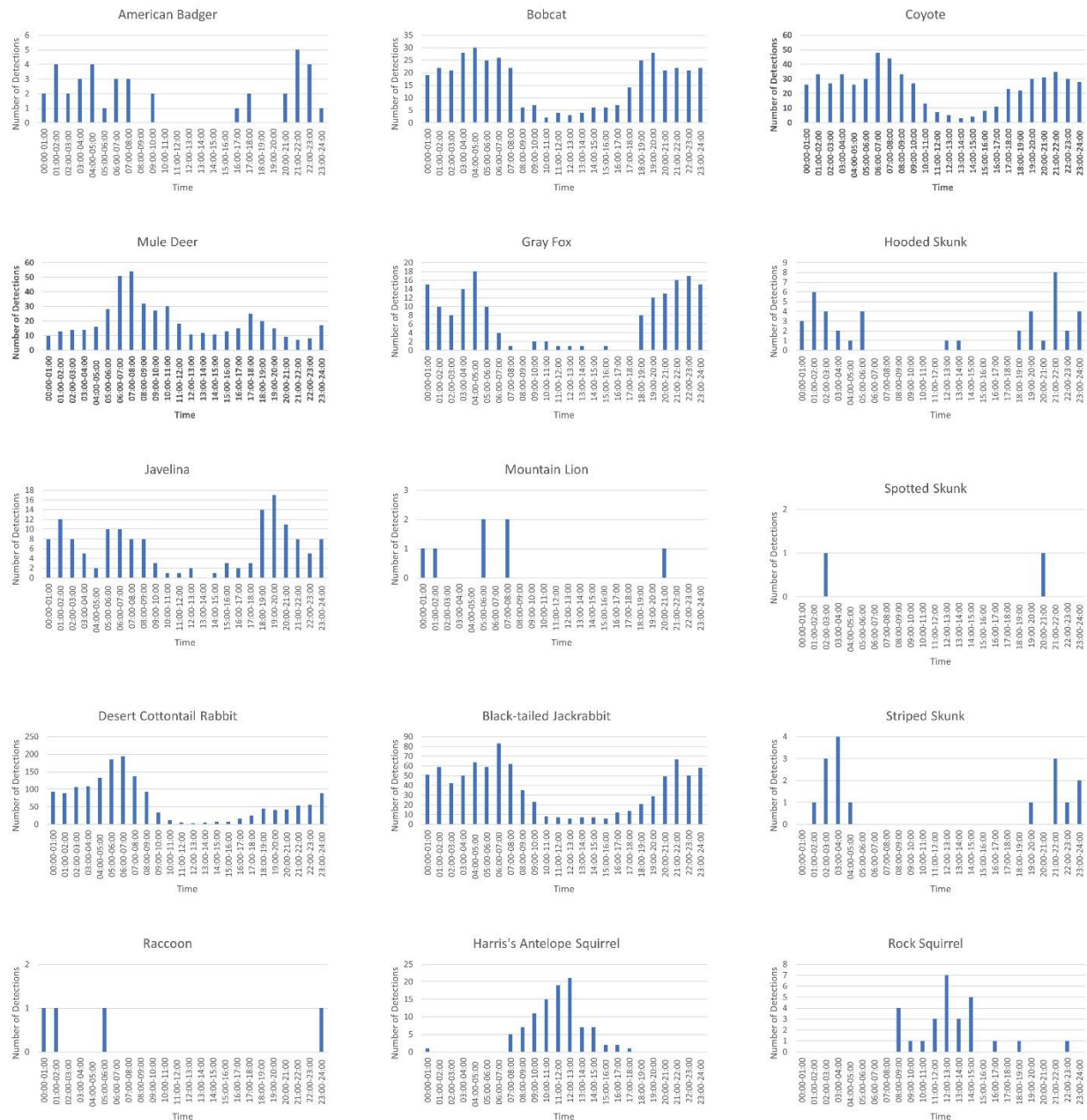
## CONCLUSIONS AND RECOMMENDATIONS

While challenges with camera placement and sample size limited the scope of our analyses, this project has been effective at answering our original research questions and objectives. If the corridor limited species movement throughout the preserve, we would expect mountain lion and mule deer occupancy (naïve or otherwise) to decrease and middle-sized carnivore occupancy (specifically bobcat, coyotes, and gray fox) to increase in the corridor. However, each of these species were found across all regions of the preserve. This suggests every region of the preserve provides the needed resources for these species to survive and reproduce. Additionally, prey species (i.e., desert cottontail rabbits and black-tailed jackrabbits) were the most frequently detected species. In combination with our findings on predator relative abundance and occupancy, these data suggest that mammalian biodiversity in McDowell Sonoran Preserve supports both top-down and bottom-up ecosystem processes.

The data reported herein also provide insight into where and at what time of day different species may be found throughout the preserve for monitoring or future research purposes. The project's results also indicate that the preserve maintains populations of unexpected species, such as American badger. Species expected to be present within the preserve but that have not yet been recorded through our camera trapping surveys include American hog-nosed skunk and ringtail cat (*Bassariscus astutus*). Placing cameras in areas with different topography, vegetative cover, or outside of washes may result in detection of these species. Future research endeavors may also seek to identify how different landscape characteristics (e.g., vegetative cover, distance to urban elements or preserve edge, frequency of trail use, etc.) influence wildlife occupancy and activity patterns. Though our data indicate larger-bodied species are found throughout the preserve, past data collected on mule deer movement suggests that these species may still be prevented from moving across the corridor due to E. Rio Verde Drive. To fully understand how the gooseneck corridor influences wildlife species, studies on gene flow could help elucidate the extent to which movement is limited by this roadway. By working to better understand the distribution and occupancy of wildlife species throughout McDowell Sonoran Preserve, McDowell Sonoran Conservancy continues to demonstrate their commitment to the exemplary stewardship of the Sonoran Desert's extensive biodiversity.



Photo courtesy of McDowell Sonoran Conservancy

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