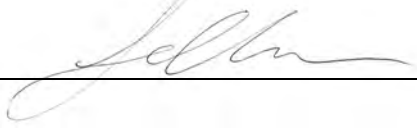


Arizona Game and Fish Department Heritage Fund Program

SAFE PASSAGES FOR WILDLIFE ON I-10 EAST FINAL REPORT

Project No.	U19008	Reporting period:	6/26//2019 – 6/26/2022
Project Title:	Safe Passages for Wildlife on I-10 East		
Participant's Name:	Coalition for Sonoran Desert Protection		
Signature:		Date:	6/26/2022



A bobcat walks north through the Site 3 box culvert on I-10 (our project's wildlife camera is visible on culvert wing wall). Photo taken by wildlife photographer Raynor VanDeven with a custom-built camera trap. Raynor's photos provided high quality outreach images to help promote this project.

Acknowledgements

This work as made possible thanks to the time, effort, and skill of the following volunteers:

Cindi Azuogu, Zoe Benson, Jennifer Curtis, Jeena Davidson, Christine DeMatteo, Joanne Devereaux, Diana Elbirt, Aiden Doherty, Charles “Butch” Farabee Jr., Charles “Chuck” Graf, Jane “Middy” Henke, John Hunt, Kevin Kasper, Liam Kennedy, Ken Lamberton, Lainie Levick, Gene McCormick, Patrick McGowan, Eduardo Moreno, Robert Morse, D’angelo Padilla, Lois Richardson, Amy Rule, Gay Russell, Josh Skattum, Virgil Swadley, Marcy Tigerman, Raynor VanDeven, Peter Vollmer, Althea Weeks, Daisy Weeks, Samantha Wilber, Robert Wisler, and members of the University of Arizona Ramblers Hiking Club.

Volunteers contributed 1,279 hours and 7,295 miles to this project.

We also want to thank Scott Sprague, Jeff Gagnon and Brit Oleson of the Arizona Game and Fish Department; Vanessa Prileson and Floyd White of Pima County Natural Resources Parks & Recreation; David Quiroz our Permit Inspector with the Arizona Department of Transportation; and Wayne Peters, Norris Dodd, and Matt Clark for their knowledgeable support.

With special thanks to our collaborating partners:

Myles Traphagen, The Wildlands Network
Brian Powell, Pima County Office of Sustainability and Conservation

**This project was funded by:
Arizona Game and Fish Department Heritage Fund**



Safe Passages for Wildlife on Interstate-10 East of Tucson, Arizona (SR83 to SR90), within the Rincon-Santa Rita-Whetstone Mountains Wildlife Linkage

June 26, 2022



Project Background

The 20-mile stretch of Interstate-10 (I-10) between Vail and Benson, east of Tucson, Arizona, divides the regionally important Rincon-Santa Rita-Whetstone Mountains Wildlife Linkage identified in the Arizona Wildlife Linkages Assessment. This linkage is one of the few remaining north-south I-10 wildlife crossing points found between Tucson and New Mexico and it encompasses several protected areas and important waters, including Davidson Canyon and Cienega Creek, making it critically important for desert wildlife in the face of climate change.

In addition to adjacent federally protected lands including Saguaro National Park, Rincon Wilderness, and Las Cienegas National Conservation Area, Pima County has invested in securing additional conservation lands in this linkage as mitigation under the Multi-Species Conservation Plan (MSCP), including Bar V Ranch, Cienega Creek Natural Preserve, Rancho Agua Verde, and Colossal Cave Mountain Park, which are managed under the Cienega Creek Management Plan. However, I-10 bisects this area of high-density wildlife movement, resulting in higher frequencies of wildlife-vehicle collisions for large animals such as black bear, mule deer, whitetail deer, javelina,

coyote, and mountain lion, as well as smaller species like box turtles, opossum, Antelope jackrabbit, white-nose coati, raccoon, badger, and bobcat. It also serves as a potential movement area for jaguars and ocelots. Existing culverts and right of way fencing are not currently adequate at reducing wildlife-vehicle collisions or facilitating safe wildlife passage in this area. Expanding ex-urban growth east of Tucson and the associated and projected increase in traffic volumes will only worsen the frequency of vehicle-wildlife collisions.

Since 2006, several qualitative assessments and reports have been produced that highlight the area's importance for wildlife movement, but there has not been a study that has collected comprehensive quantitative data to build a high accuracy geospatial model of wildlife movements and mortality along this corridor. With the lack of such a product, nothing has been done on the ground to reduce wildlife-vehicle collisions and to improve safe wildlife passage by employing effective mitigation structures like winged highway fencing or wildlife overpasses. The Coalition for Sonoran Desert Protection (CSDP), in conjunction with partners, is spearheading the effort to collect data to provide the information necessary to make this stretch of I-10 a safer passage for both wildlife and people in this important corridor.

In the spring of 2017, CSDP conducted comprehensive assessments and wildlife surveys of the nearly 80 existing concrete box culverts and metal plate pipe structures between milepost 277-302 (Houghton Road to SR90), with participants from several government, nonprofit, and community partners, including the Arizona Game and Fish Department, Cochise County, Pima County, Tucson Audubon Society, Sky Island Alliance, Defenders of Wildlife, and the Wildlands Network. Our results indicated that this wildlife linkage could be made safer for wildlife and motorists by 1) installing wildlife funnel-fencing to keep animals off the highway and to direct wildlife toward existing crossing points; 2) retrofitting and widening existing drainage culverts located in high volume areas; and 3) construction of an additional wildlife crossing between Cienega Creek and the railroad underpass near Empirita Rd Exit 292.

This project, Safe Passages for Wildlife on I-10 East, is the next phase of this effort: to gather species-specific baseline data on wildlife passage rates and roadkill hotspots, using wildlife camera monitoring of potential crossing points and roadkill surveys, with community science engagement. We hope this data will inform State and County highway and wildlife officials on where to focus mitigation efforts to improve highway safety and minimize wildlife-vehicle collisions with site-specific wildlife funnel-fencing installation, existing culvert retrofits, and new wildlife crossing structures. Our results illustrate the need to implement changes and provides baseline information to evaluate the success of future mitigation measures.

Project Objectives

1. Collect baseline data by conducting roadkill surveys, and monitoring key culverts and bridges for wildlife use and passage rates.
2. Engage the community to participate in monitoring wildlife cameras, sorting wildlife photo data, conducting formal roadkill surveys, and gathering ad hoc public roadkill observations on iNaturalist.org.
3. Increase public awareness of the issue by presenting the project and its findings to the public and to the science community.
4. Present results to the Pima County Regional Transportation Authority and Arizona Department of Transportation as part of a funding proposal for fencing installation and culvert modifications to improve wildlife permeability and motorist safety.



Thanks to aerial support provided by LightHawk, in February 2020 we were able to take to the air and photograph the project study area. The above photo is a view of the Rincon Mountains to the north with Cienega Creek and I-10 in the foreground. The Cienega Creek bridge, on the far center right, is one of the project's monitoring sites, and cameras have been placed at each of the tributary drainages where they cross I-10.

ACTION PLAN TASK 1

- ✓ **Acquire required research and access/encroachment permits from Pima County, State Land Department, and Arizona Department of Transportation (requests submitted Oct/Nov 2018).**

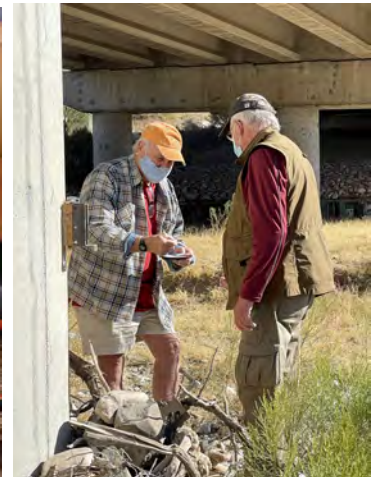
Completed. Research and right of way access permits were successfully secured from Pima County and the Arizona Department of Transportation and maintained for the duration of the project. Arizona State Lands recreational access permits were also secured for volunteers needing to cross State Lands to reach sites.

- ✓ **Conduct driving roadkill surveys with trained volunteers according to Wildland Network's established roadkill survey protocols with input and lessons learned from Arizona Game and Fish Department's SR77 roadkill surveys.**

Completed. See the attached Roadkill Surveys report on pages 13-18.

- ✓ **Deploy and monitor 30 cameras at 8-10 culverts and bridge sites with trained volunteers according to CSDP's established protocols.**

Completed. 35 wildlife cameras across 10 sites were deployed and maintained by 16 Desert Monitor volunteers. Data processing and analysis is in progress. See the attached Passage Rate Study report on pages 19-27.



- ✓ **Launch an iNaturalist.org project to collect additional wildlife sightings and roadkill data from the public, compatible with AZGFD's HDMS database.**

Completed. We created the Safe Passages for Wildlife project on iNaturalist.org and to date, iNaturalist.org records for this study area include 1,113 verifiable observations of 102 mammal, reptile, and amphibian species thanks to contributions from 646 participants. Roadkill observations outside of formal roadkill surveys made by staff, volunteers, and project partners were uploaded to this dataset.

ACTION PLAN TASK 2

- ✓ **Host 2 wildlife camera workshops and 2 volunteer orientation trainings to recruit and train community science volunteers for camera maintenance (Desert Monitors), photo sorting (Desert Identifiers), and roadkill surveys (Desert Roadies).**

Completed. We have held 38 volunteer trainings to recruit, train, and retain community science volunteers for camera maintenance (Desert Monitors), photo sorting (Desert Identifiers), and roadkill surveys (Desert Roadies). Due to the pandemic, these were held one-on-one in the field or virtually over Zoom. We recruited and trained 32 active volunteers for this project. Together these volunteers have contributed over 1,279 hours, and 7,295 vehicle miles to this project (mileage is larger than expected due to Covid safety precautions around carpooling). Our wildlife camera workshops were canceled due to Covid-19 and were replaced with virtual training and one-on-one field instruction, paired with development of new virtual teaching tools, and printed volunteer orientation materials and newsletters distributed by mail and in person. Community partner engagement has been highly successful, involving the Wildlands Network, Pima County, the local area rancher, and ADOT.

- ✓ **Promote opportunities to engage as volunteers or on iNaturalist.org via public outreach talks and online and print communications.**

Completed. Opportunities to engage as volunteers or on iNaturalist.org have been and continue to be promoted via our website (see <https://www.sonorandesert.org/learning-more/resources-for-living-with-desert-wildlife/> for one example), social media, monthly email newsletters and monthly volunteer updates, our print newsletter, and public outreach talks.



ACTION PLAN TASK 3

- Give up to 5 outreach talks to the public.

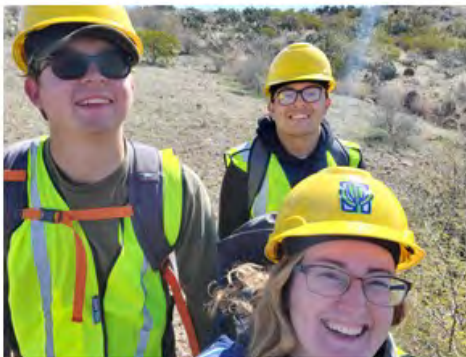
Completed/Exceeded. We have given 11 virtual talks about this project thus far, reaching over 325 people, with audiences ranging from professional retirees to University student groups, and professionals attending conservation planning workshops.

- Present the project at 2 scientific conferences.

Completed. We presented this project at two scientific conferences, including the International Conference on Ecology and Transportation in Sacramento, CA (September 2019), and the Joint Annual Meeting of the Arizona and New Mexico Chapters of The Wildlife Society in Prescott, AZ (January 2020).

- Pursue earned media and publish popular articles about the project, and promote awareness of wildlife-vehicle collision conflicts and solutions via social media.

Completed. Through website blog posts, print and online newsletters, and social media on Facebook (<https://www.facebook.com/sonorandesertprotection>), Instagram (<https://www.instagram.com/sonorandesertprotection/>) and Twitter (<https://twitter.com/forthedesert>), we are promoting awareness of wildlife vehicle collision conflicts and solutions. We were delighted to be able to provide interviews and images about this project for the Arizona Game and Fish Department YouTube channel and Arizona Views magazine. We also developed 2 videos sharing wildlife camera footage and updates from this project, which are available to view at <https://vimeo.com/sonorandesert>.



ACTION PLAN TASK 4

✔ Leveraging the information from previous assessments and reports, propose to the Regional Transportation Authority (RTA) Wildlife Linkages Working Group site-specific recommendations and funding request for wildlife funnel fencing, culvert modifications, and/or new crossing construction to improve wildlife permeability. Share this project's progress and final results at RTA Wildlife Working Group quarterly public meetings. The RTA Wildlife Linkages Working Group will review and recommend wildlife mitigation projects for funding. Recommendations go through the committee process and to the RTA Board for consideration.

On track. This action is well in progress according to realities of the RTA timeline. With Pima County and AZGFD input, we have drafted a proposal for the Regional Transportation Authority (RTA) Wildlife Linkages Working Group with site-specific recommendations and a draft funding budget for wildlife funnel fencing, culvert modifications, and new crossing construction to improve wildlife permeability. Our recommendations are for:

- Eight-foot-high wildlife funnel fencing, with escape ramps, east from the Union Railroad underpass at Empirita Rd to the MP 294 culvert crossing (Site 8) and/or to Pima County line.
- Eight-foot-high wildlife funnel fencing, with escape ramps, east from Cienega Creek, tied into Union Railroad underpass at Empirita Rd. ONLY IN CONJUNCTION WITH (long term) a wildlife bridge located east of Marsh Station Rd to ensure continued wildlife connectivity.
- Wing fences on the better crossing structures (Davidson Canyon, Cienega Creek, and Sites 4, 5, and 6).
- Structure replace/rebuild with wing fencing for Site 2 (pipe culverts), just east of Davidson Canyon.

Pima County has agreed to sponsor the final proposal to the RTA. The RTA Wildlife Linkages funds are available but may be held and incorporated into RTA Next, still in its planning stages. We continue to meet monthly with Pima County and are in close contact with the RTA Wildlife Linkages Working Group regarding this effort and the best timing for our proposal. A field visit has been scheduled for fall 2022 to map our proposed fencing site locations. We are also in communication with ADOT staff regarding guidance from FHWA on the new grant program resulting from the Infrastructure Investment and Jobs Act, which could provide additional matching funding.

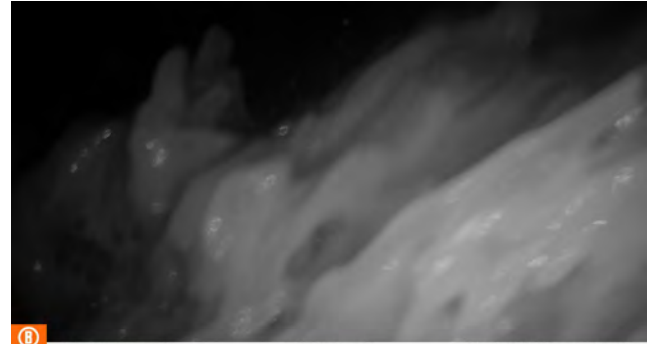


Project Milestones

Our project timeline has been updated below, shifted forward three months from original proposal. Agreement signed June 2019 and grant-in-kind funds were received September 2019.

1. June 2019 - Initiate project once appropriate research and access permits are secured from Pima County, ADOT, and Arizona State Lands **(completed)**.
 - a. Host first wildlife camera monitoring workshop **(completed as virtual and 1-on-1 trainings)** and volunteer orientation training **(completed)**.
 - b. Launch iNaturalist.org I-10 Safe Passages project page to gather community science roadkill data **(completed)**.
2. July 2019 – Deploy cameras with volunteer participation **(completed)**. Complete first roadkill survey **(completed)**. Present project to the Regional Transportation Authority (RTA) Wildlife Linkages Working Group in Tucson, AZ. Host second wildlife camera monitoring workshop **(completed as virtual and 1-on-1 trainings)** and volunteer orientation training **(completed)**.
3. June 2019 thru January 2022 – Monitoring, Data Sorting, and Outreach **(completed)**.
 - a. Monthly, wildlife cameras maintained by Desert Monitor volunteers **(completed)**.
 - b. Monthly, Desert Monitor volunteers will also document wildlife tracks, scat and other evidence of wildlife presence during these camera checks **(completed)**.
 - c. Monthly, Desert Identifier volunteers sort photos for analysis using a three-point verification protocol designed by CSDP **(completed)**.
 - d. Seasonally, driving roadkill surveys conducted by Desert Roadies volunteers **(completed)**.
 - e. Regular promotion and sharing of iNaturalist.org project results **(completed)**.
 - f. Ongoing public outreach presentations, social media outreach, and print and online media **(completed)**.
4. October 2019 – Present preliminary project results and a proposal for fencing and culvert modifications to the RTA Wildlife Linkages Working Group in Tucson, AZ **(completed)**.
5. October 2019 – First quarter results summarized **(completed)**.
6. September 2019 – Present project at the International Conference on Ecology and Transportation (ICOET) in Sacramento, CA **(completed)**.
7. November 2019 – Second quarter results summarized **(completed)**.
8. January 2020 – Present progress to the RTA Wildlife Linkages Working Group in Tucson, AZ (postponed).
9. February 2020 – Third quarter results summarized **(completed)**. Present project at Joint Annual Meeting (JAM) of the AZ and NM Chapters of the Wildlife Society, in Prescott, AZ on 2/1/2020 **(completed)**.
10. April 2020 – Present progress to the RTA Wildlife Linkages Working Group in Tucson, AZ **(meeting canceled; completed progress report shared informally)**.
11. June 2022 – Data analyzed, and a final report completed **(completed)**. Present results to the RTA Wildlife Linkages Working Group in Tucson, AZ **(shared informally due to pause in formal meetings; mitigation proposal in progress in collaboration with Pima County and AZGFD)**. Deliver copy of data, project reports, and results to AZGFD **(completed)**.

Overcoming Challenges



Equipment Loss: In July 2021, we lost an unexpected 21 out of 35 cameras in our project's fleet due to high water and heavy monsoon flooding. Some cameras were scoured off their secured mounts and not recovered, and others were water damaged beyond repair. Pima County's new pipe rail swing gates, designed to allow water and wildlife passage and to exclude cattle and vehicles, were swept downstream or ripped apart. With the remaining functional cameras, and thanks receiving the final 10% of the grant to purchase some additional replacement camera kits, we were able to continue coverage of each of the 8 active study sites, some of which include two separate culverts. For most sites, there is a resulting data gap between July and November.

Covid-19 impacts: The Covid-19 pandemic posed several challenges, but we were able to formalize our new remote and hybrid training methods. Our field volunteers were able to continue their work with social distancing and our volunteers who help us process data are able to do so remotely from home. We switched to a new camera photo database, using Colorado Parks & Wildlife Photo Warehouse software in Access, so were able to have volunteers help process photos and identify species remotely. We diversified our volunteer corps with more people looking for remote options for volunteer work. We focused on one-on-one volunteer trainings and by providing additional virtual training and support. Due to lockdowns and social distancing requirements the planned spring 2020 roadkill survey was canceled and replaced with a second monsoon season survey.

RTA meeting schedule: The RTA continues to experience some turmoil as it restructures and is now focusing more on RTA Next. CSDP is a member of the RTA Wildlife Linkages Working Group, and so we can convene informal informational meetings to keep folks up to date on the progress of this project despite canceled formal meetings. In the meantime, we continue to work with Pima County to further this effort.



We only had one minor field incident occur, when a volunteer’s Jeep lost its clutch after navigating the rough post-monsoon Gasline Rd and had to be towed out of Davidson Canyon to the highway. The Jeep needed a new clutch, but everyone got out fine. The volunteer wrote an excellent story about the adventure for the Pima County Master Naturalists:

<https://pimamasternaturalists.org/2021/10/23/what-to-do-when-you-get-stuck/>

Attachments:

1. Financial Report Form
2. Detailed Profit & Loss Report
3. Volunteer hours & mileage documentation

Print Copy includes:

4. Copies of articles published about the project
5. Project data

ACTION PLAN TASK 1

Roadkill Surveys



Introduction

We used participatory research and applied science to collect wildlife-vehicle mortality data on Interstate-10 between SR83 and SR90, east of Tucson, Arizona. By collecting information about where and when wildlife attempt to cross I-10, we hope to inform solutions to reduce wildlife-vehicle collisions and improve wildlife safe passage across the interstate. The data will also help provide baseline information to evaluate the effectiveness of future wildlife crossing and fencing modifications.

Data Collection Methods

Desert Roadies volunteers worked in teams of 2-4 people, including the staff biologist, to conduct driving roadkill surveys. Teams carpooled in one vehicle traveling along both westbound and eastbound lanes between SR 83 (Sonoita/Patagonia Exit) and SR 90 (Sierra Vista/Kartchner Caverns Exit). The survey route is approximately 40 miles roundtrip. The driver maintained a safe speed between 55-75 miles per hour while staying in the right-hand lane. A notetaker was responsible for entering data onto the datasheet and marking GPS locations as sightings were called out by observers. Observers looked to the right and left ahead of the vehicle for roadkill or live animals and kept track of passing milepost markers. For each observation, we recorded the GPS waypoint number, lat/long location, and nearest milepost number. Observers identified the animal to species if possible, or generally by size and clade at minimum (i.e. small/medium/large mammal, reptile, raptor, etc.). Identification confidence was also recorded. After the survey was completed, volunteers would loop around again to confirm observations if needed. If there was more than one individual of the same species at the same location, we noted how many animals were observed. Repeats, or animal remains already recorded on past surveys, could be recorded but were labeled and later excluded from the data – this allowed us to calculate our location accuracy by recording the same point repeatedly. At the end of the survey, volunteers reviewed the data sheet for completeness and added their survey time and mileage.

Coalition for Sonoran Desert Protection ROADKILL SURVEY Page 1

Date: _____ Start time: _____ End time: _____
 Name: _____ Miles driven: _____ Hours: _____
 Name: _____ Miles driven: _____ Hours: _____
 Notes (weather/visibility conditions, etc.): _____

Waypoint # _____ Nearest Milepost: _____ Lat: _____ Long: _____ Species: _____ Count: _____ <input type="checkbox"/> WB <input type="checkbox"/> EB <input type="checkbox"/> South ROW <input type="checkbox"/> North ROW <input type="checkbox"/> Median <input type="checkbox"/> On Road <input type="checkbox"/> Small <input type="checkbox"/> Medium <input type="checkbox"/> Large Animal <input type="checkbox"/> Mammal <input type="checkbox"/> Reptile <input type="checkbox"/> Bird <input type="checkbox"/> Amphibian <input type="checkbox"/> Unknown ID Confidence: <input type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Alive <input type="checkbox"/> Dead
Waypoint # _____ Nearest Milepost: _____ Lat: _____ Long: _____ Species: _____ Count: _____ <input type="checkbox"/> WB <input type="checkbox"/> EB <input type="checkbox"/> South ROW <input type="checkbox"/> North ROW <input type="checkbox"/> Median <input type="checkbox"/> On Road <input type="checkbox"/> Small <input type="checkbox"/> Medium <input type="checkbox"/> Large Animal <input type="checkbox"/> Mammal <input type="checkbox"/> Reptile <input type="checkbox"/> Bird <input type="checkbox"/> Amphibian <input type="checkbox"/> Unknown ID Confidence: <input type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Alive <input type="checkbox"/> Dead
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Waypoint # _____ Nearest Milepost: _____ Lat: _____ Long: _____ Species: _____ Count: _____ <input type="checkbox"/> WB <input type="checkbox"/> EB <input type="checkbox"/> South ROW <input type="checkbox"/> North ROW <input type="checkbox"/> Median <input type="checkbox"/> On Road <input type="checkbox"/> Small <input type="checkbox"/> Medium <input type="checkbox"/> Large Animal <input type="checkbox"/> Mammal <input type="checkbox"/> Reptile <input type="checkbox"/> Bird <input type="checkbox"/> Amphibian <input type="checkbox"/> Unknown ID Confidence: <input type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Alive <input type="checkbox"/> Dead

Survey schedule and timing – Surveys were conducted in the morning, starting up to 30 minutes before sunrise. Surveys occurred every week for 6 weeks during the monsoon season survey period beginning in July, except when conditions were bad for visibility or driving such as rain, dust storm, or other low visibility weather. There were two target days offered per week (Wednesday or Saturday) to give volunteers the flexibility to choose survey dates according to their schedules or to accommodate the weather. These days of the week were chosen based on lowest traffic volume data to improve driving safety and detectability during surveys. Most surveys occurred on a Saturday.

In addition to these formal roadkill surveys, we collected ad-hoc data on iNaturalist.org from community members, and personally investigated reports about black bear mortalities. We also requested ADOT records on reported animal-vehicle

crashes in the study area. This data was analyzed separately.

Limitations of the Study Design

We cannot accurately identify all wildlife mortalities to species without pulling over and stopping; and we also can't accurately collect photo vouchers during a drive-by. Volunteer observers are not always expert at discerning the difference between some species which decreases the overall accuracy of the data collection without photo vouchers to verify. In addition, surveys in a moving vehicle, especially at safe interstate driving speeds, are not ideal for accurate identification of species, for detectability, or for recording the precise GPS location. Driving roadkill surveys in other areas conducted by Saguaro National Park, Arizona Game and Fish Department, and the Wildlands Network, have not been done on an interstate at these speeds, and were usually also supplemented with walking surveys.

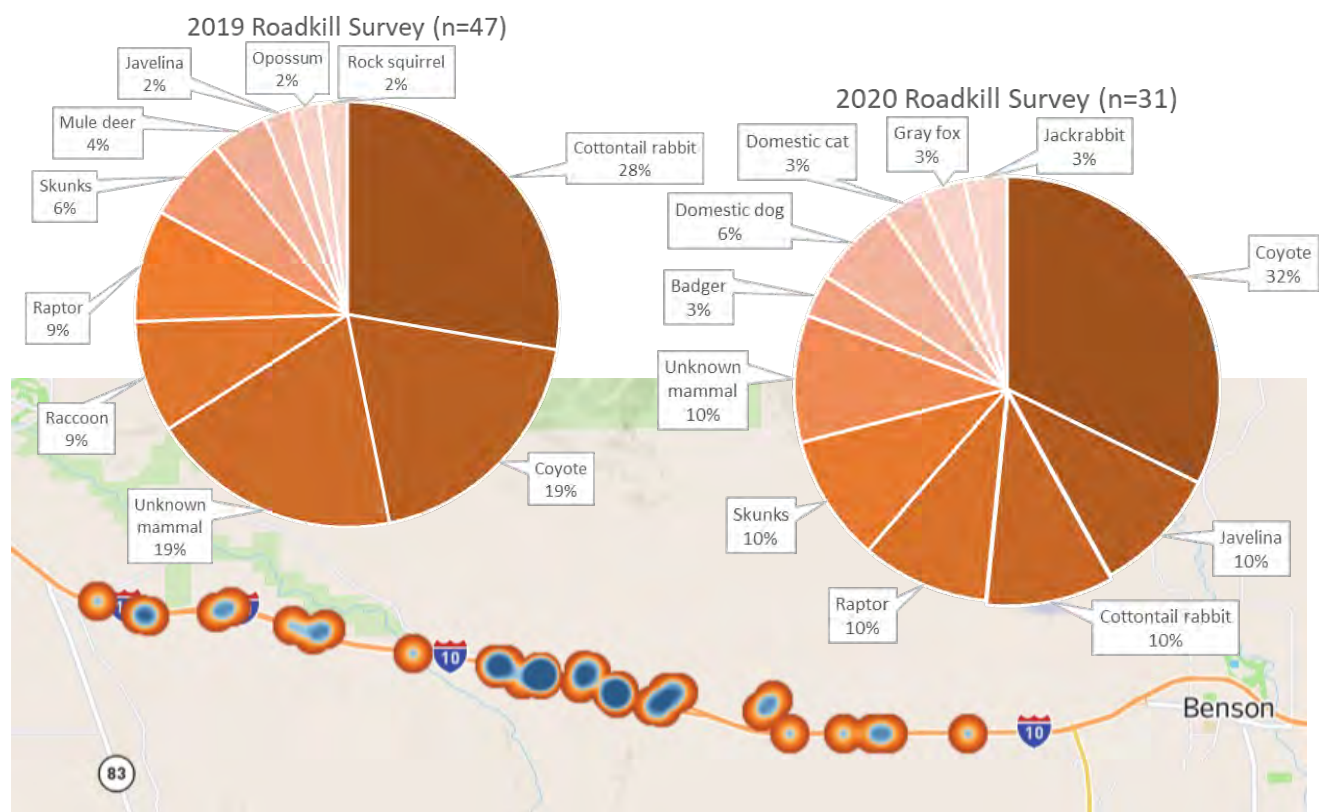
Walking surveys are the ideal method for complete and accurate data. But safety concerns eliminated that option because we are using volunteer participation, and this is a busy interstate highway with narrow right of ways. The 40-mile distance is also a challenge for walking surveys. Therefore, the roadkill survey portion of this project was designed to be a broad-brush stroke only, and we anticipated a small sample size. Recording categories of small, medium, large animals and/or by clade (reptile, bird, small/med/large mammal) are adequate for our purpose. Because of the project design, we have near zero detectability of small animals, and instead our target species are deer, bear, coyote, bobcat, gray fox, javelina, and those larger animals that the Arizona Department of Transportation consider most hazardous to drivers. However, volunteers recorded everything they could to the greatest detail they were able.

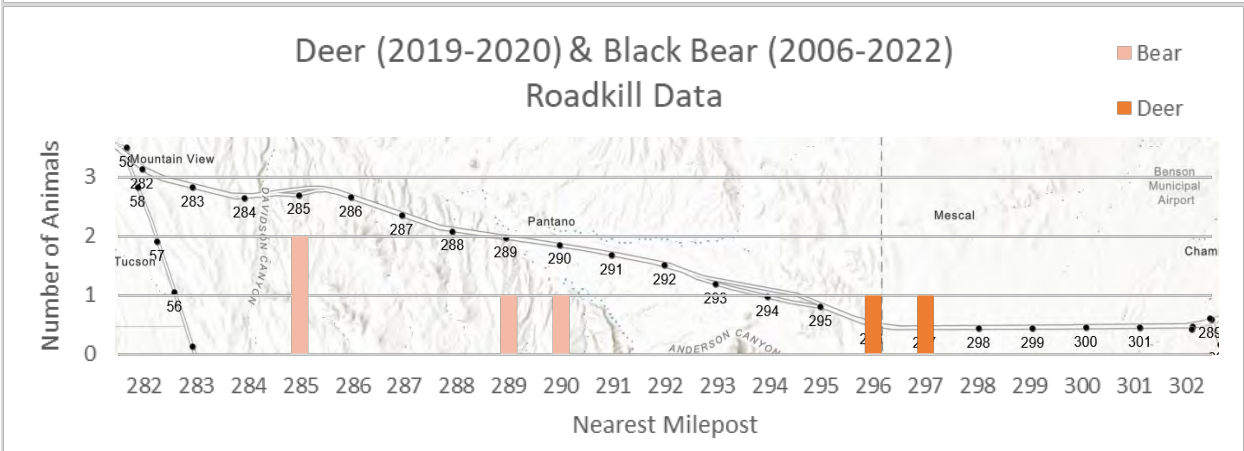
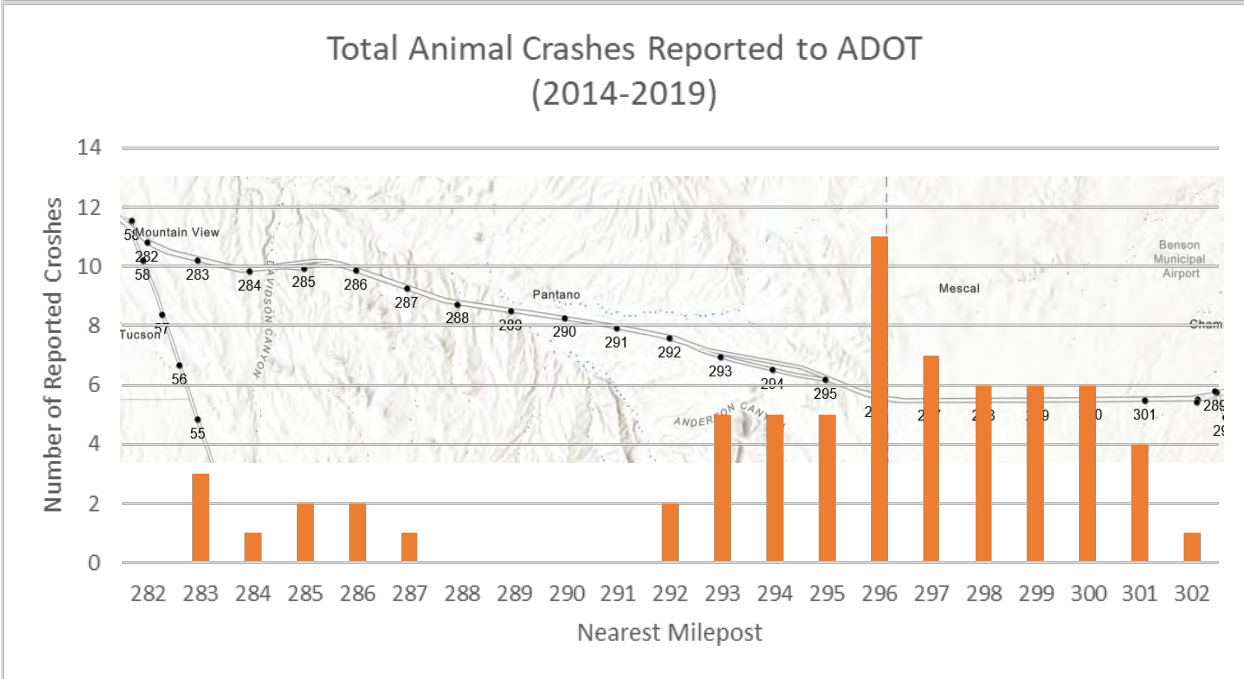
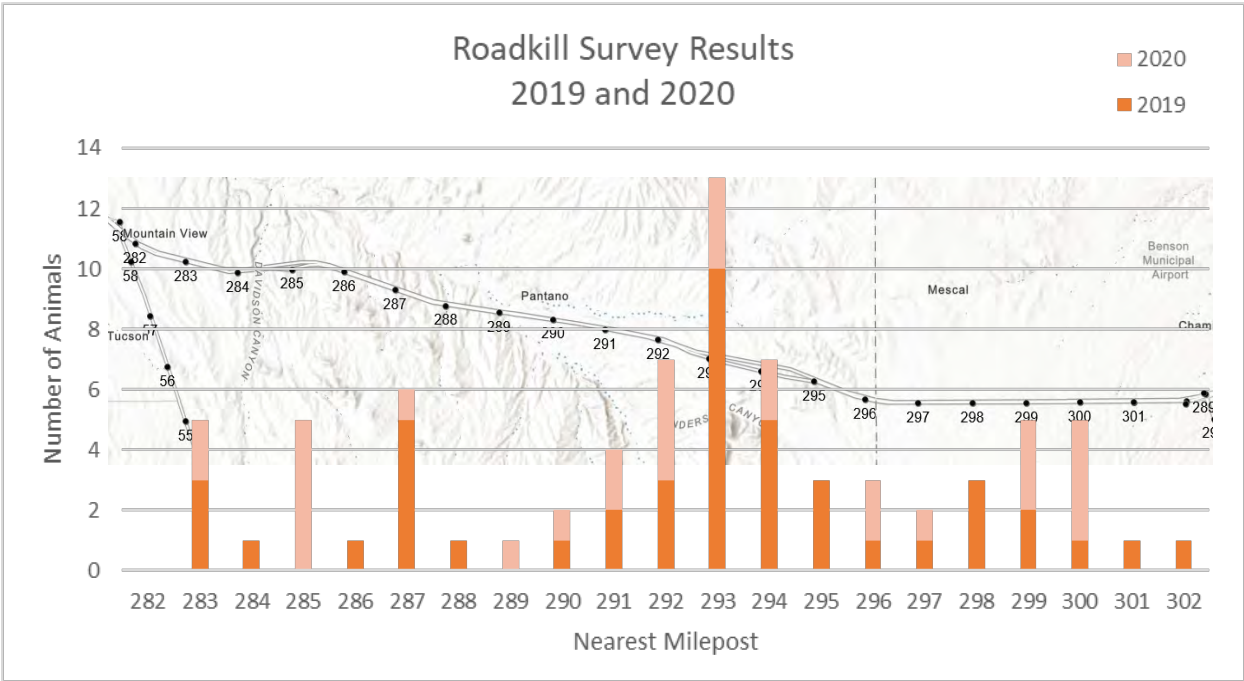
The data will hopefully serve to provide a preliminary look at potential roadkill hotspot areas. For best accuracy 1) our GPS units had a one-button click to mark points quickly, 2) volunteers could

also use maps and mileposts to confirm locations, 3) we analyzed the data in 1-mile segments, which better informs the fencing solution strategy and somewhat addresses imprecise location information, and 4) a staff biologist was always present to provide corroborating identification.

Results

We completed two monsoon survey seasons for roadkill observations in 2019 and 2020, resulting in 78 useable data points of at least 14 different species (Figure 1). We were able to detect animals as small as a rock squirrel or cottontail rabbit. Skunks, raptors, and deer were not identified to specific species. All of our deer mortality observations (n=2) occurred between mileposts 296-297, near the Pima-Cochise County line. A hotspot of roadkill observations occurred between mileposts 291-295 (between Cienega Creek and Empirita Rd) (Figure 2), in an area that coincides with a gap in culverts and crossing points, and near several culvert locations between mileposts 283-287.





Black Bear Mortality Observations

I-10 has been identified as a significant barrier to black bears in southern Arizona. In 2011, Todd Atwood et al published a study describing I-10 as a more significant barrier to functional gene flow for black bears than the U.S.-Mexico border, identifying I-10 as the dividing line between the Border subpopulation of black bears to the south, and the White Mountain subpopulation to the north. For black bears, I-10 may be a barrier to gene flow as well as a “population sink” due to wildlife-vehicle mortalities. This could pose a significant issue for the Border subpopulation, which now faces decreasing permeability at the U.S.-Mexico border due to the construction of the border wall and other border-related infrastructure such as roads and lighting. Without permeability north of I-10, this subpopulation is at risk of genetic isolation and extirpation.

We have gathered four records of black bear mortalities in recent years, and three of these are verified with photos:

1. On September 28, 2006, a black bear was struck and killed by a vehicle west of **milepost 285**, on the south shoulder of the eastbound lane of I-10, just east of Davidson Canyon bridge and above an at-grade double pipe culvert in the median. [This record](#) was reported to our staff biologist and uploaded into iNaturalist.org.
2. On August 23, 2019 around 8am (during our roadkill survey period but not captured in the survey), an eighteen-wheeler collided with a 400-pound male black bear in the westbound lane just west of the Cienega Creek bridge exactly at **milepost 289**. AZGFD collected the carcass.
3. On Friday, May 13, 2022, Peter Sundt, a retired ecologist, reported a roadkill black bear located 1/10 of a mile east of Davidson Canyon in the westbound lane near **milepost 285**. He was unable to get a photo voucher.
4. On Saturday May 14, 2022, around 11am, a bear was struck on I-10 just east of Cienega Creek at **milepost 290**. AZGFD collected the carcass.



These records indicate that the bears attempted to cross I-10 by following higher elevation ridgelines closely associated with the two largest underpass structures at Davidson Canyon and Cienega Creek. We also have animal track and camera trap data showing successful passage under

I-10 at a few specific culverts (See Passage Rate Study Report, page 13). Most of our observations show bears moving south.

Black bears are just one example of the impact I-10 is having on native wildlife. In addition to large animals like bear, deer, and jaguar, smaller animals are at risk as well. Saguaro National Park has been monitoring a disturbing decline in “lost carnivores” over the last decade, including skunks, foxes, and badgers. Biologists are also concerned about the local extirpation of smaller range habitat specialists affected by habitat fragmentation, including box turtles, Antelope jackrabbits, skunks, kit foxes, badgers, white-nose coati. Increasing wildlife connectivity conditions for black bears and deer should allow struggling populations to repopulate from connected habitat areas and while benefiting a wide array of species.



A black bear under the Cienega Creek bridge in May 2020. April-May and August-September appear to be peak periods of activity for black bears in this area according to our data.

Special Notes – Due to the onset of the Covid-19 pandemic in March 2020, carpooling with volunteers was no longer a safe option. The planned spring 2020 survey was canceled and replaced with another monsoon season survey, which was conducted by Jessica Moreno (staff biologist) and Eddie Moreno (an AZGFD biologist experienced in roadkill surveys). Surveys were completed during a period when the state was under curfew and lockdown, resulting in reduced traffic volumes. This likely was one reason for fewer observations of roadkill during this survey window.

ACTION PLAN TASK 1

Passage Rate Study



Introduction

We used participatory research and applied science to collect wildlife presence and passage rate data on Interstate-10 at ten culvert and underpass structures, east of Tucson, Arizona. The 20-mile stretch of Interstate-10 (I-10) between Vail and Benson divides the regionally important Rincon-Santa Rita-Whetstone Mountains Wildlife Linkage. This linkage is one of the few remaining north-south I-10 wildlife crossing points found between Tucson and New Mexico and it encompasses several protected areas and important waters, including Davidson Canyon and Cienega Creek, making it critically important for desert wildlife in the face of climate change. In the spring of 2017, the Coalition for Sonoran Desert Protection (CSDP), in conjunction with partners, conducted comprehensive assessments and wildlife surveys of the nearly 80 existing underpasses and drainage culverts in the study area. Our results indicate that this wildlife linkage could be made safer for wildlife and motorists by 1) installing wildlife funnel-fencing to keep animals off the highway and to direct wildlife toward existing crossing points; 2) retrofitting and widening existing drainage culverts located in high volume areas; 3) construction of an additional wildlife crossing east of Cienega Creek. This study used wildlife camera monitoring with community science engagement to gather data on species richness and wildlife passage rates. This data will inform State and County highway and wildlife officials on where to focus mitigation efforts to ensure continued wildlife permeability, improve highway safety, and minimize wildlife-vehicle collisions. The data will also help provide baseline information to evaluate the effectiveness of future wildlife crossing and fencing modifications.

Study Area

Wildlife cameras were placed within the ADOT drainage encroachment at the following bridge and culvert locations along I-10:



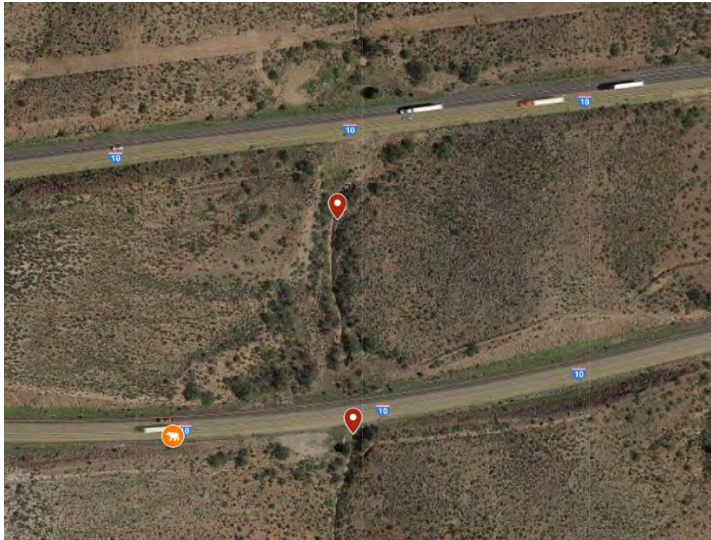
Blue and red pins represent the existing culverts along I-10 between mileposts 281 and 302 (SR83 to SR90). Red pins depict camera monitoring sites chosen for being most conducive to wildlife passage within the wildlife linkage (Beier 2006), shaded in yellow. Notice the absence of any culverts available as crossing points between Cienega Creek bridge and Empirita Rd. This map is available as an interactive map online at <http://bit.ly/SafePassagesI-10East/>.



Site 1: Davidson Canyon Bridges

MP 284.45, Davidson Canyon Bridges,
Lat/Long: 31.997605, -110.646033

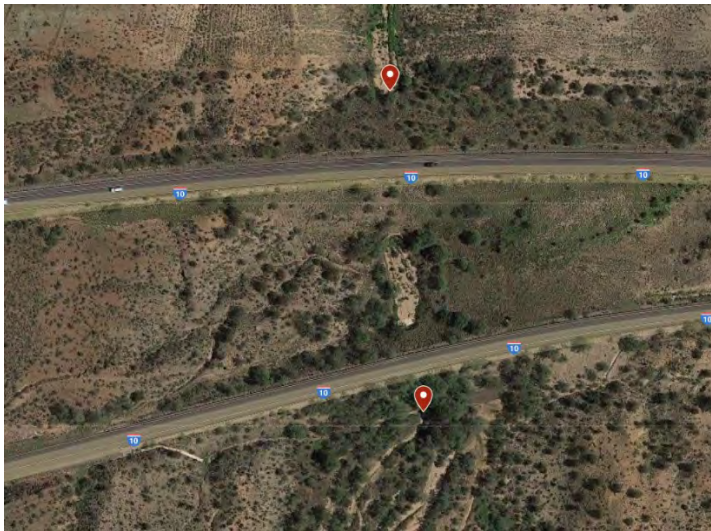
5 camera placements: In the drainage encroachment, 3 cameras on the south approach and 2 cameras on the north approach.



Site 2: Bear Mortality Site

MP 285, Unnamed Double Metal Pipe WB, Lat/Long: 31.998066, -110.636599; and Unnamed RCB (double culvert box) EB, Lat/Long: 31.996965, -110.636508

6 camera placements: In the drainage encroachment, 2 cameras on the south approach and 1 camera on north approach of the Double Metal Pipe WB and 1 camera on the south approach and 2 cameras on north approach at the Unnamed RCB EB. Bats roost in the pipe culvert for part of the year.



Site 3: Blue Nob Canyon

MP 285.24, Blue Nob Cyn RCB EB, Lat/Long: 31.9993527, -110.6323842; and MP 285.24, Blue Nob Cyn RCB WB, Lat/Long: 31.997674, -110.632175

4 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on the north approach of RCB EB and of RCB WB.



Site 4: Cattle Tank Site

MP 288.05, Unnamed RCB, Lat/Long: 31.993914, -110.611579

2 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on north approach of the culvert.



Site 5: Culvert Spring Site

Unnamed RCB, Lat/Long: 31.9902199, -110.5947143

2 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on north approach of the culvert. This site has an active seep at the south entrance to the eastbound culvert, which was assessed in a springs biological assessment in 2017 by Sky Island Alliance.



Site 6: Turner Site

Unnamed RCB, Lat/Long, 31.9884431, -110.5863324

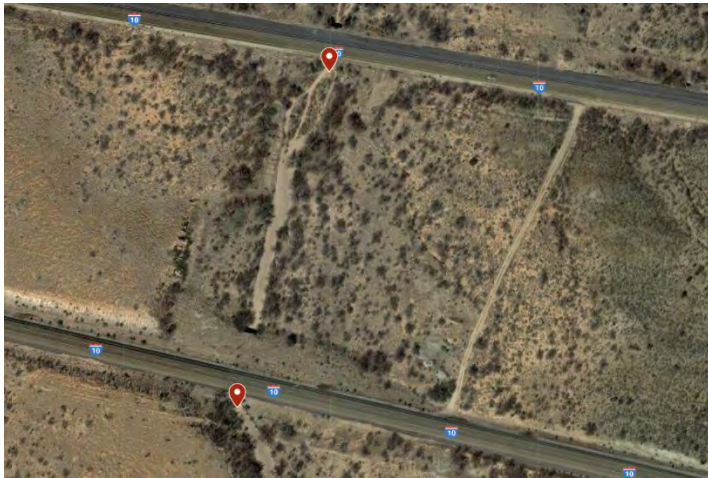
2 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on north approach of the culvert.



Site 7: Cienega Creek Bridges

MP 289.2, Cienega Creek Bridges, Lat/Long: 31.9859854, -110.5674212

10 camera placements: In the drainage encroachment, 6 cameras on south approach and 4 cameras on north approach. Additional cameras were needed here due to the width of the drainage.



Site 8: Speeden Wash

MP 294.01, Speeden Wash RCB EB, Lat/Long: 31.970747, -110.487384; and Speeden Wash RCB WB, Lat/Long: 31.97263, -110.48677

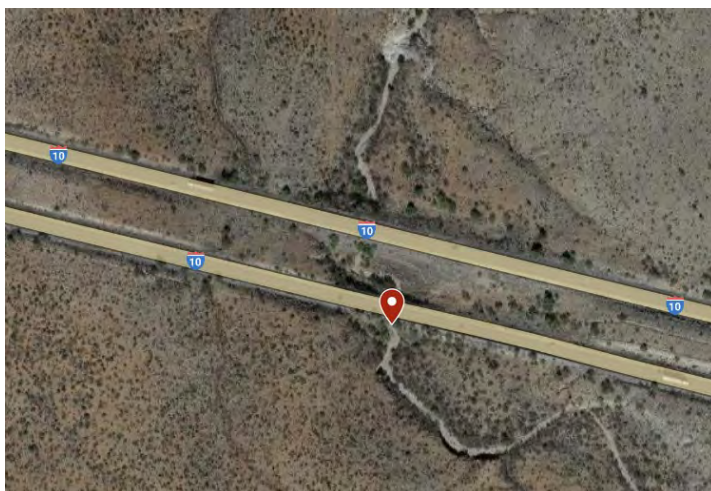
4 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on the north approach of RCB EB and of RCB WB. There is a closed cattle gate at the north entrance to the westbound culvert.



Site 9: Skyline

Unnamed WB, Lat/Long: 31.96329, -110.40113; and Unnamed EB, Lat/Long: 31.96285, -110.40112

8 camera placements: In the drainage encroachment, 2 cameras on south approach and 6 cameras on north approach. Additional cameras were needed here due to the width of the drainage and the culvert's multiple boxes.



Site 10: Swing Gate

Unnamed RCB, Lat/Long: 31.99936, -110.67156

2 camera placements: In the drainage encroachment, 1 camera on the south approach and 1 camera on the south swing gate set back 40 feet from culvert. This site was added to assist Pima County in monitoring new swing gate effectiveness for wildlife and to help monitor property damage.



Methods

This project involved the placement and once-monthly maintenance of wildlife camera traps to collect wildlife passage rates and species richness data at key wildlife crossing points for at least a one-year period. Cameras were deployed at both the north and south ends, and additionally in some medians, of two bridge and eight culvert structures on I-10, inside the ADOT right of way and attached to the culvert box structures, pipe culverts, or bridge columns, or on nearby trees, per ADOT Encroachment Permit guidelines. Structures were chosen based on openness ratio and wildlife passage suitability from our 2017 culvert assessment. Cameras were placed at the entrance to the culverts and less than 24 inches high, to get the best view of animals as they entered or exited the structure, unless a camera was mounted higher in a tree and aimed downwards. No baits or lures were used for this project.

We used Bushnell Core DS (dual sensor) and Bushnell Core DS-4K wildlife cameras with security boxes that were mounted by being 1) screwed or bungeed to a tree, or 2) screwed into a wood block that was first attached to the concrete culvert wing wall or bridge structure with a combination of heavy-duty liquid nails adhesive and 2-part epoxy. Cameras were locked with a padlock and labeled with the project's contact information. Cameras were serviced with new AA alkaline batteries at every maintenance check, the date and time settings corrected if needed, and the camera re-deployed with a fresh 16GB memory card.

Staff and trained Desert Monitor volunteers checking camera equipment wore safety hard hats and reflective vests while working in the ADOT right of way. For additional safety, camera sites were not accessed from the Interstate, but instead by hiking from the north or south approaches from the Gasline Road or Cienega Creek and its tributaries. Camera sites were never visited during upstream rain events or during flash flood risk conditions. Site 2 included a double metal pipe culvert, which was found to be a roosting site for bats during part of the year, so the culvert itself was not accessed during this time to avoid disturbing them.

After a field check, Desert Monitors uploaded the photos from the cameras to the staff biologist using WeTransfer (<https://sonorandesert.wetransfer.com/>). These were imported into the project's Access database by site visit, and a module (a set of photos with a linked database .accdr file) then sent to two different Desert Identifier volunteers again using WeTransfer. Desert Identifiers tagged blank/false positive photos for removal and identified animals in the images to species, counted number of individuals, and noted details such as predation. Photos documenting people were labeled with the following details: Pedestrian, Vehicle, Bicycle, Horseback, or CSDP Volunteer. Animals that could not be identified to species were labeled as "Unknown" and were tagged for the staff biologist to confirm, if possible. These results, saved in the .accdr file, were then imported back into the database, where discrepancies or disagreements could be addressed by the staff biologist.

Wildlife Camera Monitoring Results

Cameras were active between January 2020 and January 2022, during which time we collected over 789,000 photos and have identified over 36 species across our 10 monitoring sites (Table 1), including both mule deer and white-tail deer, Mexican opossum, black bear, mountain lion, Gould's turkey, white-nose coati, ringtail, striped skunk, hognose skunk, hooded skunk, Western spotted skunk, and badger. Interesting records included a photo of a bobcat carrying a bull snake in its

mouth, the Mexican opossum, and images of a likely mating pair of adult mountain lions traveling together.

We continue to process the data and will be looking at passage rates at each individual culvert and bridge site. We plan to produce a white paper before the end of 2022 with these findings.

Preliminary analysis shows that mountain lions and black bears have 100% passage rates upon approach at the sites they were detected (although black bear tracks documented prior to camera deployment did show some southbound bears approaching but not passing through at sites 4 and 8). Mountain lions and black bears have only been detected moving south.

Wildlife camera photo result highlights are available for viewing and download at <https://bit.ly/I-10EastWildlifePhotos>.

We experienced a short gap in monitoring with the unexpected loss of equipment. In 2020, we lost 3 cameras to monsoon flooding, 1 to vandalism at Site 8, and 4 lost to theft at Site 9. Then in 2021, heavy flooding permanently damaged 21 out of 35 cameras in our project's fleet. With the remaining functional cameras, and thanks receiving the final 10% of the grant in November 2021 to purchase a few more replacement camera kits, we were able to continue coverage of each of the active study sites, some of which include two separate culverts.



Table 1. Species detected at structures (indicated with “X”) by study site, grouped by animal size. Sites 1 and 7 are bridges and are the largest crossing structures. Site 2 is the smallest structure with a single box culvert and pipe culvert. Sites 9 and 10 were only monitored for a brief period.

		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
LARGE	Mule deer (<i>Odocoileus hemionus</i>)	X	X	X	X	X	X	X	X		
	White tail deer (<i>Odocoileus virginianus couesi</i>)	X		X	X	X	X	X			
	Black bear (<i>Ursus americanus</i>)						X	X			
	Domestic cow (<i>Bos taurus</i>)			X			X	X	X		X
	Domestic horse (<i>Equus caballus</i>)	X									
	Domestic dog (<i>Canis lupus familiaris</i>)	X		X	X	X	X	X	X		X
	Javelina (<i>Pecari tajacu</i>)	X	X	X	X	X	X	X	X		
	Coyote (<i>Canis latrans</i>)	X	X	X	X	X	X	X	X		X
	Mountain lion (<i>Puma concolor</i>)	X			X	X					
MEDIUM	Bobcat (<i>Lynx rufus</i>)	X	X	X	X	X	X	X	X	X	
	Gray fox (<i>Urocyon cinereoargenteus</i>)	X	X	X	X	X	X	X	X		
	Hooded skunk (<i>Mephitis macroura</i>)	X	X	X	X	X	X	X	X	X	
	Striped skunk (<i>Mephitis mephitis</i>)	X			X		X				
	Hognose skunk (<i>Conepatus leuconotus</i>)	X		X	X	X	X	X	X		
	Western spotted skunk (<i>Spilogale gracilis</i>)		X						X		
	Ringtail (<i>Bassariscus astutus</i>)					X			X		
	Raccoon (<i>Procyon lotor</i>)	X			X	X	X	X	X	X	
	White-nose coati (<i>Nasua narica</i>)	X	X	X	X		X				
	Badger (<i>Taxidea taxus</i>)	X	X	X							
	Mexican opossum (<i>Didelphis virginiana californica</i>)								X		
	Domestic cat (<i>Felis catus</i>)			X					X	X	X
	Gould's turkey (<i>Meleagris gallopavo mexicana</i>)								X		
	Black-tailed jackrabbit (<i>Lepus californicus</i>)	X		X		X		X	X	X	
	Desert cottontail rabbit (<i>Sylvilagus audubonii</i>)	X		X	X	X	X	X	X	X	
SMALL	White-thoated woodrat (<i>Neotoma albigula</i>)	X					X	X	X	X	
	Greater roadrunner (<i>Geococcyx californianus</i>)	X	X	X	X	X	X	X	X		
	Raven (<i>Corvus corax</i>)	X			X			X			
	Rock squirrel (<i>Otospermophilus variegatus</i>)	X						X	X		
	Antelope ground squirrel (<i>Ammospermophilus harrisi</i>)	X							X		
	Gambel's quail (<i>Callipepla gambelii</i>)			X			X	X	X		
	Great horned owl (<i>Bubo virginianus</i>)				X		X				
	Gila monster (<i>Heloderma suspectum</i>)	X									
	Bat species (<i>Chiroptera spp</i>)		X	X	X	X	X	X			
	Other bird species (<i>Aves spp</i>)	X	X	X	X	X	X	X	X	X	
	Other reptile species (<i>Reptilia spp</i>)	X	X			X	X	X	X		
	Other rodent species (<i>Rodentia spp</i>)			X	X	X	X	X	X		
Human	X	X	X	X	X	X	X	X	X	X	
TOTAL SPECIES DETECTED	26	14	21	21	20	24	27	24	9	4	