Wildlife use of overpass crossing structures on the Central Arizona Project canal

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Introduction

- Anthropogenic linear infrastructures (ALIs) are essential to the transportation of people and resources across landscapes.
- ALIs, including canals, can reduce landscape connectivity for wildlife (Figure 1).
- However, crossing structures over ALIs can facilitate animal movement across landscapes and maintain connectivity among populations.
- Wildlife use of crossing structures can be influenced by spatial factors including landscape features at broad and fine scales and structural attributes of crossing structures, and temporal factors, such as season.

Figure 1. The Central Arizona Project canal runs for 541-km through central and southern Arizona.

- However, relatively little is known about the spatial and temporal factors that influence wildlife use of overpass crossing structures on canals.
- In particular, wide-ranging and highly mobile species, such as bobcat, coyote, mule deer, and peccary are of management and conservation interest at canal crossing structures.

Research Objectives

The objective of this project was to evaluate the spatial and temporal factors that influence wildlife use of overpass crossing structures over the Central Arizona Project canal.

Objective 1: Determine what species use canal overpasses, and how frequently.

Objective 2: Evaluate how structural and environmental variables influence use of canal overpasses across three seasons for focal species (Table 1).

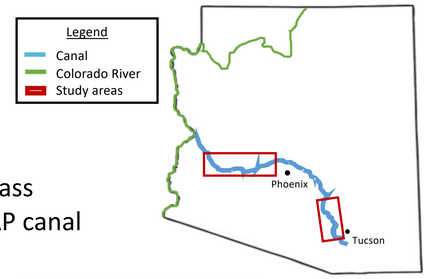
Table 1. Structural and environmental variables that potentially influence wildlife use of canal overpasses.

Broad-scale environmental (1000m buffer)	Fine-scale environmental (200m buffer)	Structural
Plant productivity (NDVI)	Vegetation cover	Overpass type
Topographic diversity		
Human development		

Study Area

- The Central Arizona Project (CAP) canal transports water from the Colorado River through central and southern Arizona for agricultural, municipal, and recreational use (Figure 2).

Figure 2. Sites on the CAP canal occur within two regions west of Phoenix and north of Tucson. We are sampling 56 crossing structures (data from 40 overpasses are presented here).



- There are two types of overpass crossing structures on the CAP canal (Figure 4).

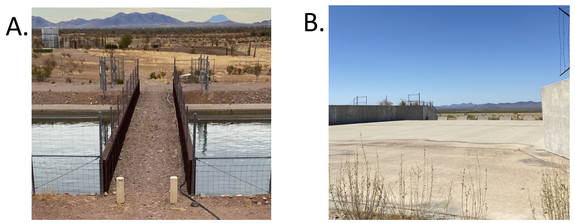


Figure 4. Types of crossing structures include wildlife bridges (A, n = 25), cement overshoots (B, n = 15)

- The Sonoran Desert exhibits fluxes in temperature and precipitation which create seasons unique to the region (Figure 3).

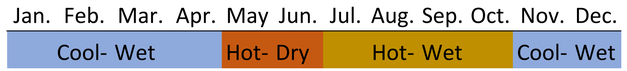


Figure 3. Periods of temperature and precipitation in the Sonoran Desert fall into three seasons lasting variable lengths of time.

Methods

- Cameras were deployed for one year (January 2021 – February 2022).
- Total number of independent detections of wildlife species were evaluated at 40 overpass crossing structures on the CAP canal across three seasons.
- Royle-Nichols models were used to evaluate relative use of overpasses by focal species in relation to environmental and structural variables across three seasons (Table 1).
  - We evaluated all possible model combinations and ranked models using AIC.

Results

- 16 species of small to large-sized mammals were detected (Table 2).

Table 2. Number of crossings and crossing rate (# detections/active sampling days, averaged across sites) for 17 species detected at 40 overpasses on the canal.

	Season					
	Hot-Dry (61 of days)		Hot-Wet (123 days)		Cool-Wet (182 days)	
Species	Total crossings	Crossing rate (± SE)[1]	Total crossings	Crossing rate (± SE)[1]	Total crossings	Crossing rate (± SE)[1]
Badger	67	2.89 (± 0.94)	30	0.71 (± 0.27)	54	0.96 (± 0.44)
Bighorn sheep	12	0.52 (± 0.41)	35	0.77 (± 0.52)	20	0.34 (± 0.25)
Black-tailed jackrabbit	445	19.25 (± 8.14)	444	9.81 (± 4.50)	699	11.10 (± 4.33)
Bobcat	143	6.25 (± 1.35)	189	4.55 (± 0.99)	287	5.55 (± 0.98)
Collared peccary	288	12.99 (± 3.51)	552	13.12 (± 2.68)	810	13.82 (± 2.25)
Cottontail rabbit	56	2.45 (± 0.75)	21	0.52 (± 0.20)	115	1.72 (± 0.50)
Coyote	2326	104.08 (± 15.88)	3303	83.33 (± 13.36)	5093	84.99 (± 11.14)
Gray fox	268	11.85 (± 4.01)	357	7.87 (± 2.94)	884	14.31 (± 3.90)
Hooded skunk	63	2.72 (± 1.50)	37	0.81 (± 0.35)	115	1.93 (± 0.89)
Kit fox	239	10.36 (± 5.68)	340	7.47 (± 3.40)	991	14.37 (± 5.26)
Mountain lion	7	0.35 (± 0.16)	1	0.02 (± 0.02)	29	0.53 (± 0.23)
Mule deer	1315	63.80 (± 15.88)	2058	49.02 (± 10.43)	2172	34.89 (± 8.28)
Raccoon	2	0.09 (± 0.06)	12	0.30 (± 0.11)	16	0.24 (± 0.09)
Ringtail	0	0.00 (± 0.00)	2	0.05 (± 0.03)	2	0.03 (± 0.02)
Spotted skunk	0	0.00 (± 0.00)	0	0.00 (± 0.00)	1	0.02 (± 0.02)
Striped skunk	6	0.26 (± 0.22)	6	0.13 (± 0.06)	29	0.46 (± 0.22)

[1]Daily crossing rate was multiplied by 100; values represent average number of crossings per 100 days.

- Focal species exhibited different responses to environmental and structural variables associated with canal overpasses (Table 3).

Table 3. Beta estimate relationships between variables and relative habitat use (λ) based on whether variables occurred in a top model that outperformed the intercept-only model.

		Variable				
Species	Season	NDVI	Topography	Human development	Vegetation cover	Structure type
Bobcat	Hot-Dry				+	WB > CO
	Hot-Wet			–		
	Cool-Wet	+				
Coyote	Hot-Dry		–			WB > CO
	Hot-Wet		–			WB > CO
	Cool-Wet	–	–		–	
Mule deer	Hot-Dry	+	–	–		
	Hot-Wet	+		–		
	Cool-Wet	+		–	–	WB < CO
Peccary	Hot-Dry	+	+			
	Hot-Wet	+				
	Cool-Wet	+			+	

Conclusions

- Animals exhibited variability in use of overpasses associated with a range of environmental and structural variables.
- To preserve landscape connectivity for a suite of species, managers should provide a range of crossing options on canals and other ALIs.

Acknowledgements

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