Introduction

Aircraft are inherently disruptive machines which damage the environment in several different ways; via emissions, noise, visual presence, etc. This is problematic because it causes unnatural change in the environment, down to local ecosystems, potentially drawing animals away from their habitats and natural resources, or by disturbing natural behaviors. This wastes the animals' energy by decreasing time allocated to foraging, parental care, increasing time for vigilance, and desertion of feeding grounds or other territories (Kelly & Allan, 2006).

Helicopters in particular have been shown to be the most disruptive category of aircraft because of the noise they produce as well as their visual presence (Anderson, 2007). In the desert Southwest, resources are often extremely limited, fleeing from resources can have potentially negative effects on body condition and reproduction of local wildlife. Currently, the regulatory altitude limit for wilderness areas as specified by the Federal Aviation Administration (FAA) is 2,000 ft Above Ground Level (AGL) (FAA, 2004), even though aircraft can be heard from far above that height.

Tucson, Arizona is located in the Sonoran Desert and at the cusp of the Chihuahuan Desert, is a hub of biodiversity across animal and plant life–it also happens to be one of the largest hubs for general aviation in the United States. The effects that helicopters have on wildlife as a whole isn't well documented, and not at all in Tucson. This project aimed to answer the question, how did helicopter presence affect the presence of local wildlife in a given area?

Methods

To identify animals and animal behaviors, we are using data from camera traps because they allow the observation of wildlife without disturbance from the researcher, which is essential for this project (O'Connell et al,. 2011). The Alston Lab at the University of Arizona previously deployed camera traps across the city of Tucson, which collected images between February 17th, 2024 – July 22nd, 2025. We chose a section of that timeline, February 9th - March 11th, when all of the cameras were deployed and actively taking images, we fit binomial generalized linear models to identify species and their presence as a result of helicopters and their altitudes. We used the flight history of 93 helicopters with different individual takeoff points and made a heat map of their local activity during the selected timeline.

To record flight history, I downloaded the .kml file for each day an individual helicopter flew through the Tucson area and assigned them to folders named with the helicopter's registration.

My project was to collect and analyze data from camera traps provided by my mentor. I used that data and compared it to flight logs to see if there was a correlation between helicopter presence and responses in local wildlife.

We used Timelapse (Greenberg, S. 2024. Timelapse. Software, University of Calgary) to process camera trap images. Using this software we tagged each image with the date-time it was taken. Processed image data was exported to a single .csv file. We obtained flight track history from ADS-B Exchange for all helicopters that flew over Tucson during the dates from our selected timeline. This data included latitude and longitude coordinates, altitude, and date-time.

We will use R (version 4.3.0) in Rstudio (version 2023.06.1) to complete statistical analyses for this project (R Core Team, 2021; Posit Team, 2025). We will use the unmarked package to model single-season occupancy with helicopter presence/absence as an explanatory variable (Kellner et al., 2023; MacKenzie et al., 2002). We will consider results with a p-value less than or equal to 0.05 to be statistically significant.

Results

Helicopter presence/absence

Coyote

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.98390	0.05680	-70.136	< 2e-16 ***
Helicopter	0.05186	0.20143	0.257	0.7968
Zhfi	0.19789	0.05007	3.953	7.73e-05 ***
Zdem	0.07673	0.04408	1.741	0.0818 .
Shrub	-0.17968	0.07404	-2.427	0.0152 *

Bobcat

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-6.7414	0.2213	-30.468	<2e-16 ***
helicopter	-0.2905	0.7165	-0.405	0.6852

Zhfi	0.1210	0.1393	0.869	0.3850
Zdem	0.1794	0.1360	1.319	0.1870
Shrub	0.6064	0.2557	2.372	0.0177 *

Rabbit

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-2.7989788	0.6858783	-4.081	4.49e-05 ***
Alt_avg	-0.0005522	0.0005869	-0.941	0.34681
Zhfi	-0.1955484	0.0905815	-2.159	0.03086 *
Zdem	-0.3259993	0.1240816	-2.627	0.00861 **
Shrub	0.3498531	0.2492750	1.403	0.16047

Javelina

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-6.6183	0.2000	-33.087	< 2e-16 ***
helicopter	0.7571	0.3920	1.931	0.05342 .
Zhfi	0.4028	0.1641	2.455	0.01410 *
Zdem	0.0849	0.1298	0.654	0.51297
Shrub	0.7124	0.2231	3.193	0.00141 **

Response to Altitude

Coyote

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-4.4422658	0.8645437	-5.138	2.77e-07	***
Alt_avg	0.0003391	0.0007050	0.481	0.6305	
Zhfi	0.4950558	0.2834029	1.747	0.0807	.
Zdem	-0.0911726	0.2347728	-0.388	0.6978	
Shrub	-0.0626466	0.4028421	-0.156	0.8764	

Bobcat

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	5.238491	5.202977	1.007	0.3140	
Alt_avg	-0.012413	0.005959	-2.083	0.0372	*
Zhfi	2.109966	2.609018	0.809	0.4187	
Zdem	1.598299	1.227716	1.302	0.1930	
Shrub	0.123443	1.515961	0.081	0.9351	

Rabbit

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-2.7989788	0.6858783	-4.081	4.49e-05	***
Alt_avg	-0.0005522	0.0005869	-0.941	0.34681	
Zhfi	-0.1955484	0.0905815	-2.159	0.03086	*
Zdem	-0.3259993	0.1240816	-2.627	0.00861	**

Shrub	0.3498531	0.2492750	1.403	0.16047

Javelina

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.801336	2.298165	-1.654	0.0981 .
Alt_avg	-0.001609	0.002089	-0.770	0.4412
Zhfi	0.803104	0.844328	0.951	0.3415
Zdem	0.896833	0.558254	1.606	0.1082
Shrub	0.005323	0.785231	0.007	0.9946

Summary of Results

Coyotes and bobcats did not exhibit a response to helicopter presence. Desert cottontail rabbits and javelina both showed a positive relationship with helicopter presence. Desert cottontails were 0.6 times as likely to be observed on our cameras within the hour when at least one helicopter passed within 500m. Javelina were 0.7 times as likely to be observed on our cameras within the hour when at least one helicopter passed within 500m. Helicopter altitude did not have an impact on presence/absence of either of these species.

Interpretation and Future Improvements

With coyotes and bobcats not exhibiting any visible response, it can be inferred that they've grown accustomed to the stimuli of the urban areas of Tucson in which they were captured. Rabbits were less likely to be present at the same time as a helicopter, which could be an instinctual response as a prey animal. And peculiarly, Javelina were more present at the same time as a helicopter, which is potentially a result of the human shield effect in which animals will use human-inhabitted areas to avoid their natural predators.

Future work would benefit from comparing reactions in urban populations to those in rural and remote (wild area) populations of each of these species. Additionally, we had to assess observations within the hour due to processing power limitations for analyses, but this would be better observed at 1-minute intervals to better capture acute response to helicopter presence. Our results could be skewed by our selection of wildlife and helicopter presence at 1-hour intervals. Additionally, rather than gathering from locations across an entire city, it could be more sensible to choose one location for observation, because different areas of a city will possess different stimuli or at least different magnitudes of a stimuli, which can muddy up the final results.

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