



Bordering Disaster: Vegetation Disturbance Along the U.S-Mexico Border Wall in the Chihuahuan Desert

Rissa Garcia-Prudencio - Ysleta del Sur Pueblo, Haskell Environmental Research Studies Institute



Introduction

The border wall built by the United States is an artificial infrastructure used to divide Mexico and the United States that affects the vegetation of the Chihuahuan Desert. The Chihuahuan Desert is the largest desert ecosystem in North America, spanning an area of approximately 250,000 square miles (647,500 square km) and is one of the most biodiverse arid ecosystems in the world (Hoyt 2002). Only the northernmost part of the Chihuahuan Desert is in the U.S., extending into southern Texas and New Mexico.

The boundary shared by the U.S and Mexico is an area of great controversy, with the militarization of the border increasing after the events of September 11th, 2001 (Ogden 2017). According to a 2020 report by the United States Customs and Border Patrol, 738 miles of barriers have been placed along the 2000-mile border (U.S. CBP 2020). There are three primary types of barriers: pedestrian barriers built along the more populated areas, concrete vehicle barriers, and patrolled roadways that act as barriers along the more remote areas of the southern borderlands.

There is ample research on vegetation disturbance from anthropogenic sources in the Mojave and Sonoran Deserts (Abella 2010), however, little research exists on the effects of the U.S-Mexico border on vegetation in the Chihuahuan Desert. The focus of this research seeks to fill this gap by investigating if and how different barrier types built on the U.S-Mexico border wall disrupt vegetation.

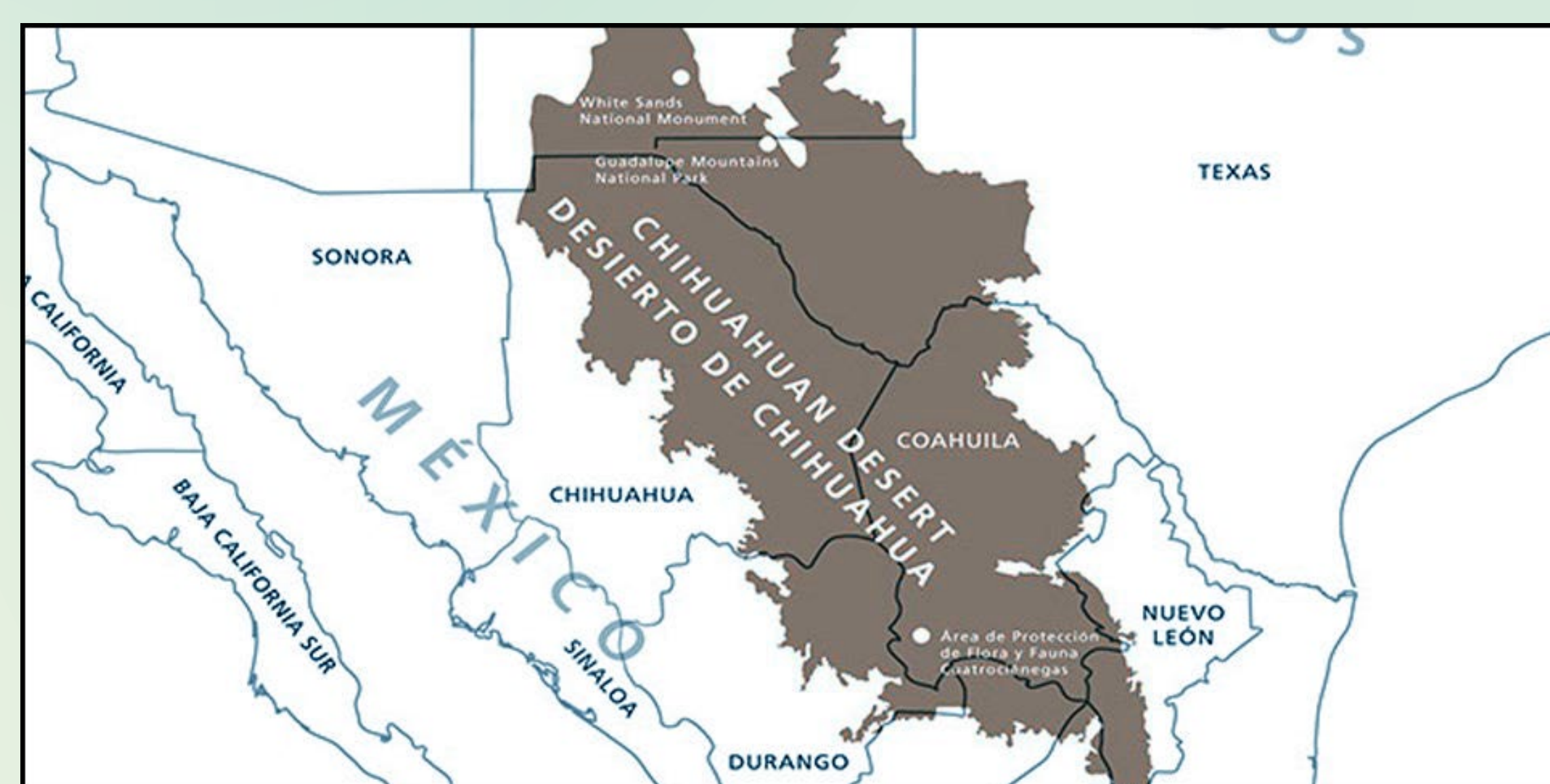


Image from the National Park Service

Research Question:

How have the different types of barrier walls along the U.S-Mexico border affected vegetation cover in the Chihuahuan desert in New Mexico over the last 30 years?

Methods

Data collection:

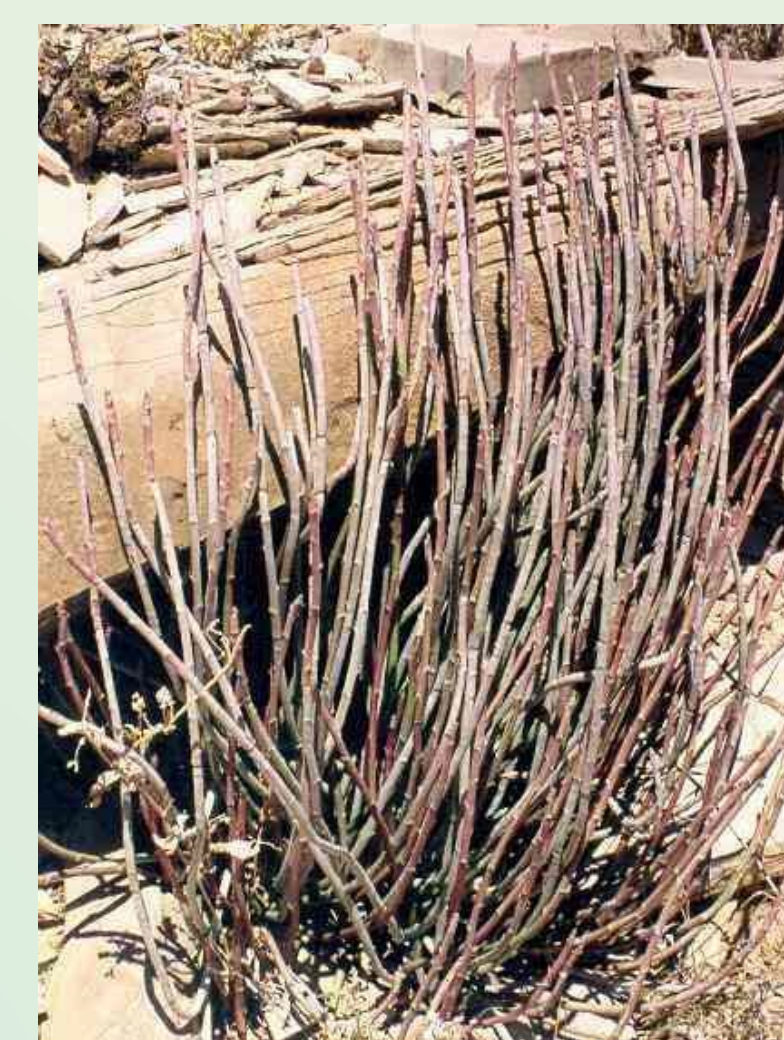
I propose to use Landsat data to assess differences between three sites through time. Landsat images provide medium resolution (30 meters) data that covers the entirety of the study period. I chose four locations near the New Mexico-Mexico border, each with a different type of border barrier: a pedestrian barrier, a vehicle barrier, a patrol road and a near by control area with no barriers. I will acquire images for each site from three time periods: the early 1990s, the mid 2000s, and the 2020s.

Data analysis:

I will analyze the fractional vegetation (Fr) per pixel for each of the nine images. I will calculate the change through time by subtracting the Fr of the earlier images from the recent images. To investigate whether the types of barriers affect change in vegetation differently I will use an analysis of variance (ANOVA). ANOVA compares the within group variance to the between group variance to determine if there is a significant difference between the groups.



Spanish bayonet(left) and soap tree yucca (right) Image from University of Edinburgh



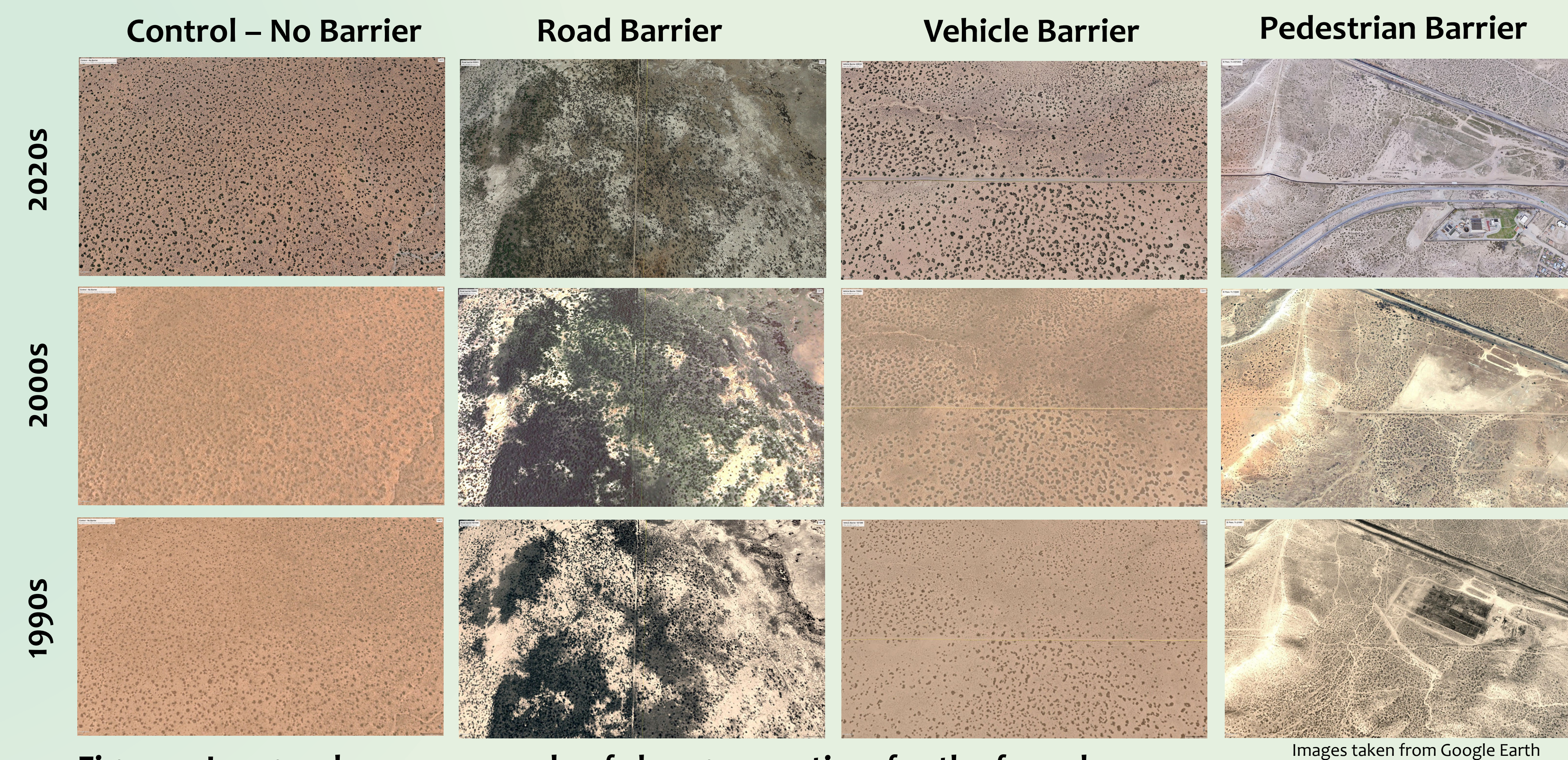
Candelilla plant, Image from University of Edinburgh



Agave, Image from NPS/Ann Wildermuth



Cats claw cactus (front) and Lechuguilla agave (back) image from University of Edinburgh



Images taken from Google Earth

Figure 1: Images show an example of change over time for the four chosen areas

Vegetation Disruption in Arid Environments

Researchers have been studying how anthropogenic disturbances like the building of:

- roads
- railways
- towns
- military facilities

affect vegetation in arid environments. These mass disturbances often strip away vegetation and topsoil layers. A literature review of 47 studies in the Sonoran and Mojave Deserts examining revegetation processes in disturbed areas, estimated that complete revegetation varied from as little as five years to over 200 years depending on the severity of the disturbance (Abella 2010)

Additionally, due to the harshness of desert environments, the unpredictability of weather, and the monetary expense associated with revegetation projects, most of the disturbed vegetation in the American Southwest has been left to recover naturally (Abella 2010). Understanding how the southern border wall is affecting vegetation in the Chihuahuan Desert is crucial to protecting this important ecosystem.

Habitat Fragmentation

Habitat fragmentation occurs when an ecosystem habitat is divided by some sort of physical barrier such as a road, railway, or fence (Liu et al. 2020). These barriers make it so that plant and animal populations have a harder time migrating and interbreeding which reduces genetic diversity. An example is bighorn sheep whose population has been divided by the southern border wall. Sheep on the U.S. side of the border and sheep on the Mexican side of the border can no longer interbreed causing the population to dwindle (Flesch et al. 2010).

Current research on habitat fragmentation has focused mainly on roads and railways, however, little research exists on habitat fragmentation caused by the boundaries between international countries (Ogden 2017). The border wall at the U.S.-Mexico border has caused extensive habitat fragmentation. My research seeks to understand how the fragmentation caused by different barrier types affects vegetation cover.

References

- Abella, Scott R. 2010. "Disturbance and Plant Succession in the Mojave and Sonoran Deserts of the American Southwest." *International Journal of Environmental Research and Public Health* 7 (4): 1248–84. <https://doi.org/10.3390/ijerph7041248>.
- Flesch, Aaron D., Clinton W. Epps, James W. Cain III, Matt Clark, Paul R. Krausman, and John R. Morgart. 2010. "Potential Effects of the United States-Mexico Border Fence on Wildlife." *Conservation Biology* 24 (1): 171–81. <https://doi.org/10.1111/j.1523-1739.2009.01277.x>.
- Hoyt, Cathryn. 2020 "The Chihuahuan Desert: Diversity at Risk." *Endangered Species Update* 19, no. 6.
- Liu, Jijia, Ding Li Yong, Chi-Yeung Choi, and Luke Gibson. 2020. "Transboundary Frontiers: An Emerging Priority for Biodiversity Conservation." *Trends in Ecology & Evolution* 35 (8): 679–90. <https://doi.org/10.1016/j.tree.2020.03.004>.
- Ogden, Lesley Evans. 2017. "Border Walls and Biodiversity." *BioScience* 67 (6): 498–505. <https://doi.org/10.1093/biosci/bix044>.
- U.S Customs and Border Protection. 2020. "Border Wall Status Report." Federal Agency Report <https://www.cbp.gov/document/report?page=1>

Acknowledgements

I would like to thank the Haskell Environmental Research Studies Institute (HERS), EPSCoR, the National Science Foundation (NSF), Haskell Indian Nations University and the University of Kansas. I would also like to acknowledge the Indigenous people whose land on which we currently reside, as well as my ancestors the Thur Tai'n (People of the Sun), Dr. Dan Wildcat, Trina McClure, Dr. Jay Johnson, Cody Marshall, Elizabeth Wesley and Josh Meisel. This project was supported by KS NSF EPSCoR Award 1656006

CONTACT
rgprudencio@gmail.com
(505) 977-6088

