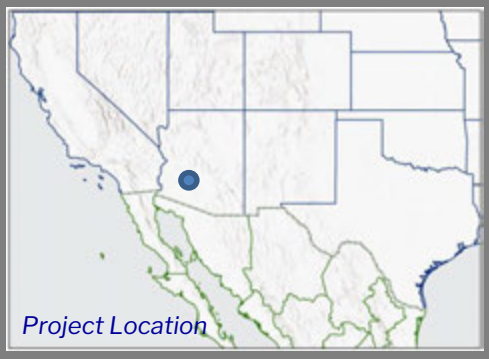
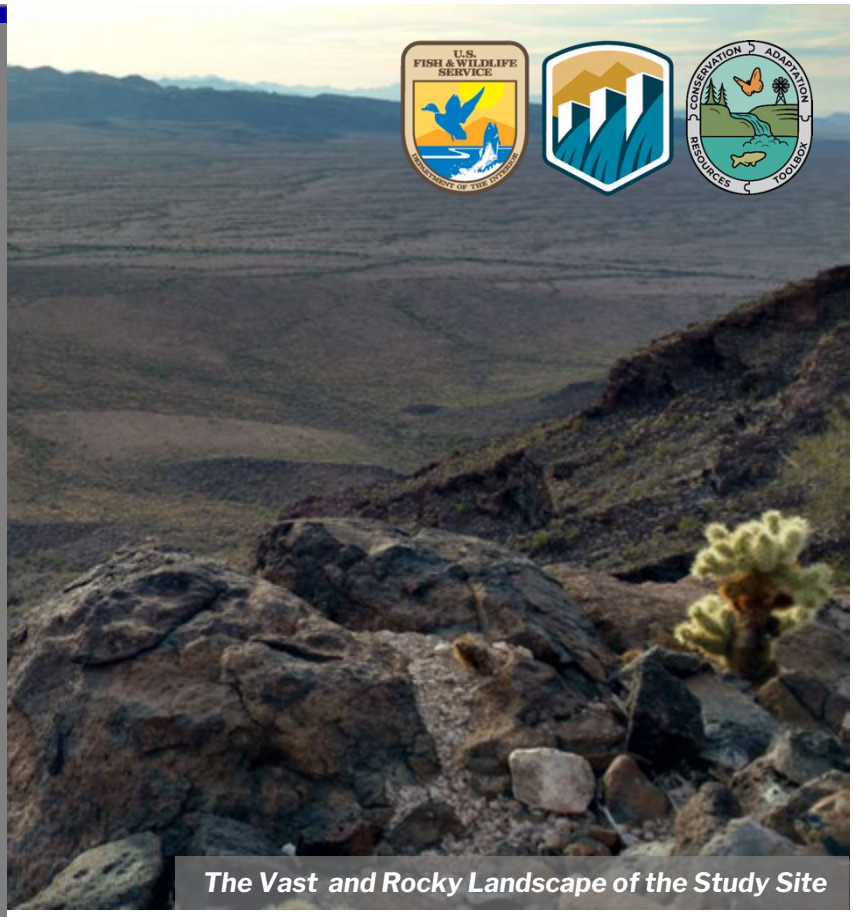
WATER RESOURCES

Testing a Model for the Prediction of Isolated Waters in the Sonoran Desert

The Barry M. Goldwater Air Force Range East is located in the Sonoran Desert of southwest Arizona. Here, most water naturally available for wildlife is located in isolated, temporary pools formed in rock (tinajas) and soil (charcos) that fill during rain events. Drought and heat waves speed evaporation, decreasing the quantity, duration, and quality of water in these isolated sites and harming wildlife dependent on these resources. In 2010, the U.S. Department of Defense contracted researchers from Texas Tech University to inventory aquatic resources and monitor the quantity of water available for wildlife. Additionally, the researchers created a model to predict the locations of unknown waters throughout the range.





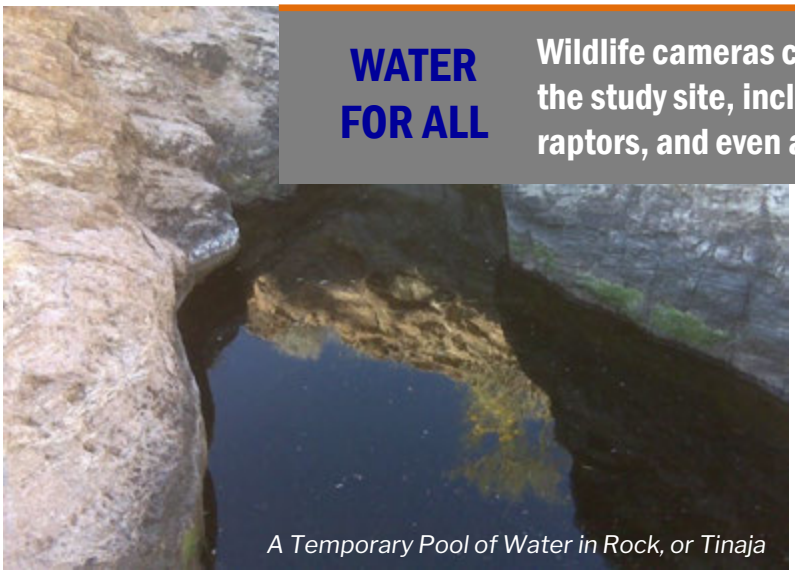
The Vast and Rocky Landscape of the Study Site

KEY ISSUES ADDRESSED

Tinajas and charcos are difficult to locate via ground searches due to the vastness of the terrain and lack of vehicle access to most of the Sonoran Desert. Additionally, they are ephemeral, generally lasting for relatively short periods of time. They are small and often indistinguishable from the rest of the terrain when dry, and they are often hidden by the terrain when wet. Tinajas and charcos are important for wildlife; however, with less precipitation, tinajas and charcos become shallower, and the time they are available to wildlife is decreasing. Addressing the ambiguity of tinajas and charcos is important for wildlife management because the conservation of desert wildlife depends on the comprehensive knowledge of the locations of available water.

PROJECT GOALS

- Create a model for predicting isolated waters using GIS analysis of topographic features that retain water within the study site
- Test the predicted locations and quantify model accuracy
- Use the model to locate isolated waters and create a more comprehensive inventory of known water in the study site



A Temporary Pool of Water in Rock, or Tinaja

WATER FOR ALL

Wildlife cameras captured a diversity of wildlife using tinajas within the study site, including bobcats, javelina, mule deer, pronghorn, raptors, and even a gila monster.

PROJECT HIGHLIGHTS

Predicting Water Location: To find tinajas and charcos, researchers developed a GIS model that used Mahalanobis Distance Analysis. This analysis identified locations with high probability of containing aquatic resources based on landscape features, such as Topographic Wetness Index values (TWI), slope, and curvature.

Testing Model Accuracy: Researchers visited random computer-generated sites and model-chosen sites to determine if the model could locate aquatic resources more accurately than random searches.

Streamlined Ground Searches: Using the model to locate water can significantly reduce the time and labor necessary to perform random ground searches. While managers must travel to the site for water monitoring, they will no longer have to "comb the desert" to do so.

Wildlife Management Tool: Researchers found water where the model predicted 60% of the time, and wet sites identified by the model contained twice as much water as random sites. These results indicate wildlife managers are likely to find larger quantities of water using the model compared to random ground searches, enhancing their ability to steward larger tinajas and charcos.

Collaborators

- Texas Tech University
- See online for full list of partners

LESSONS LEARNED

Wildlife managers should use caution when using TWI in arid environments because it was created for a temperate climate. In landscapes such as the Sonoran Desert, where there can be extremely large watersheds but little rain, TWI values can be misleading. Instead, managers can use climate as a variable in the Mahalanobis Distance Analysis, such as PRISM data overseen by Oregon State University. Normalized Difference Water Index (NDWI) and Normalized Difference Vegetation Index (NDVI) values can be used in models designed to locate aquatic resources; however, there is not vegetation that can indicate tinajas, while tinajas' small size and ephemeral duration prevent their adequate representation in satellite imagery. The team designed the model without NDWI and NDVI for the values' setbacks in this context. Similar analysis can be performed to assist managers with other natural resources and wildlife issues, such as locating suitable habitat for wildlife. Landscape variables important to wildlife, such as precipitation, elevation, and vegetation densities can be used in Mahalanobis Distance Analysis to predict species distribution, gene flow, and the spread of invasive species.

NEXT STEPS

- Expand model use to the entire Barry M. Goldwater Range East to create a more comprehensive inventory of aquatic resources
- Include water quality monitoring tinajas and charcos inventory and observation
- Include model data in landscape connectivity analyses to reflect aquatic resources large enough to support wildlife

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A Researcher Examines a Tinaja

CART Author: Jackelyn Alessi, Oregon State University, August 2023.
Photos courtesy of Kerry Griffis-Kyle/Texas Tech University
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