ACTIONABLE SCIENCE

Assessing the Hydrologic Effects of Erosion Control Structures on the Babacomari Ranch

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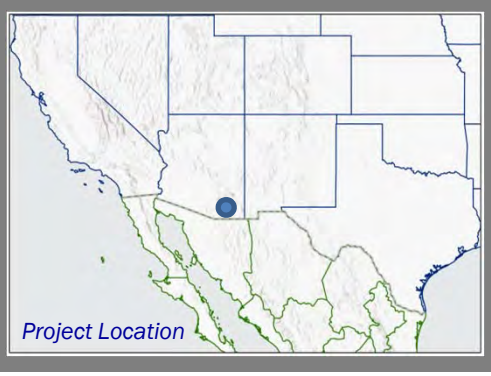
Restoration practitioners and scientists are investigating whether low-technology rainwater harvesting methods can increase infiltration and promote aquifer recharge in tributaries of the San Pedro River of southeastern Arizona. Research is being conducted on the Babacomari Ranch, property of the Brophy family. Researchers are studying mountain-front recharge (infiltration of water to the aquifer) and the potential to augment it by installing rock detention structures (gabions) in ephemeral drainages. This research combines watershed modelling, in-channel restoration, and scientific methods to determine, implement and monitor management practices for augmenting groundwater resources in the Upper Babocomari River.



A Monitoring Plot Set up Near a Gabion on the Babacomari Ranch/ Natalie Wilson

KEY ISSUES ADDRESSED

During approximately 1865-1915, much of the Southwest was overgrazed by domestic livestock, causing rapid vegetation loss and soil compaction and leading to soil erosion on hillslopes. This land degradation, combined with infrequent but intense rainfall events, causes rapid runoff from hillslopes which contributes to the formation of incised ephemeral channels, or arroyos. Arroyos transport stormwater quickly, leading to further incision and reduced infiltration of water into the aquifer. This process lowers water tables and leads to depleted surface and subsurface water availability for ecosystems, ranchers, and municipalities. Simple rock structures can be used to slow in-channel water flow and improve water retention on hillslopes and channels. Rock structures can increase infiltration and recharge, and improve downstream riparian ecosystem conditions. However, few quantitative studies assess the effectiveness of this strategy with respect to infiltration.

PROJECT GOALS

- Use remote sensing and geospatial hydrologic modelling to delineate sites where erosion control structures might be most effective in increasing groundwater recharge
- Quantify the effectiveness of erosion control structures in enhancing infiltration, using a combination of data-logging instruments and wildlife cameras
- Use high-resolution field data from restoration sites to verify model utility and monitor impacts

APPLYING RESULTS

The results of this study could be used as part of a proactive groundwater management plan to promote sustainable utilization of scarce water resources.

An Aerial View of Gabions in Tributary of the Babocomari River/ Oliver Lysaght

PROJECT HIGHLIGHTS

Geospatial Models Inform Restoration Locations: The study area was divided into zones of suitability for recharge based on remote-sensing and hydrologic modeling. Gabions (wire baskets filled with rock) were installed at selected locations in ephemeral channels to slow the flow of water and promote infiltration.

High-resolution Data Collection: Surface and subsurface data-logging temperature sensors were installed upstream and downstream of one gabion. This data was used to estimate water infiltration using daily temperature fluctuations. Repeat wildlife camera imagery allowed researchers to relate infiltration to total flow, with and without gabion influence.

Modeling Infiltration Volumes: Results from these studies were used with existing stream discharge data to calibrate a model to extrapolate the study results to the larger aquifer and estimate cumulative impacts to the year 2050.

Collaborators

- USGS Land Change Science (LCS) Program
- Babacomari Ranch
- Borderlands Restoration
- Cuenca los Ojos
- University of Arizona
- Lacher Hyrdological Consulting

Funding Partners

- USGS Land Change Science (LCS) Program
- National Science Foundation
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- UA Hydrology and Water Resources Department

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Photos courtesy of USGS

LESSONS LEARNED

Installing erosion control structures at the Babacomari Ranch can increase infiltration rates and potentially increase groundwater recharge.

There was limited ponding above the gabion during flow events; instead, water flowed over and through the gabion more rapidly than expected resulting in downstream scouring. More observations are needed to assess whether gabions are effective restoring channel incision.

The hydrologic model allows land managers to visualize and plan for long-term impacts on water budgets and the multiple shared benefits of investing in restoration, especially in close proximity to major population centers.

For a 5-hour flow event, models estimated that a single gabion could increase the total infiltrated volume between it and the next gabion by an average of 10%, but there was a high degree of variability.

NEXT STEPS

- Use data collected in 2016 to extract impacts of structures on vegetation, soil-moisture/recharge, sedimentation, and site prioritization for future structures
- Work with partners to incorporate lessons learned at the Babacomari Ranch into other aridland water harvesting projects

PROJECT RESOURCES

For more information on this project, contact Laura Norman: lnorman@usgs.gov

For additional project resources and case studies, visit the Collaborative Conservation and Adaptation Strategy Toolbox: WWW.DESERTLCC.ORG/RESOURCE/CCAST

Natalie Wilson and Chloe Fandel Install Infiltration Monitoring Devices/ James Callegary