Case Study 1:
Reservoir Water Level Change Impacts on Cultural Resources,
Amistad National Recreation Area, Texas

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Panther Cave contains extensive pictographs, which are threatened by fluctuating water levels tied to storm events and (indirectly) to siltation. Reservoir level in the photo is about 332 m (1,089 ft) above mean sea level, with 2.4 m (8 ft) of water covering the silt bed. Image credit: Jack Johnson, NPS.

The reservoir level was 344 m (1,130 ft) above mean sea level in July of 2010, nearly reaching the base of the pictograph panel. By May of 2013 the reservoir had dropped to a record low of 322 m (1,055.9 ft) above mean sea level, leaving the canyon bottom completely dry. Image credit: Randy Rosales, Texas Parks and Wildlife Department.

Goals

Amistad National Recreation Area, Texas, protects many archeological sites in the Lower Pecos Canyonlands region of southwest Texas. Sites are affected by lake level fluctuations related to climate change impacts including precipitation, storms, and changes in agricultural water use. Park managers are documenting the impact of changing water levels on the cultural resources in the park.

Challenges and Needs

The reservoir that is the centerpiece of Amistad National Recreation Area was created when the Rio Grande, Pecos, and Devils Rivers were dammed in 1969. The reservoir provides flood control, water for agriculture, and recreational opportunities for visitors. In addition to having more than 129 km (80 mi) of international border with Mexico along the Rio Grande, the park is located at the intersection of several distinct physiographic, biological, and climatic regions and is characterized by variable and unpredictable weather. The park's location at the intersection of the arid west, the humid east, the seasonal latitudes to the north, and the tropical climates to the south contributes to exceptionally unpredictable precipitation patterns. The park is also periodically impacted by tropical storms and hurricanes coming off the Gulf of Mexico, resulting in massive flash flooding. As the climate changes, it is likely that weather patterns will become increasingly erratic, and that greater outputs from the reservoir will be required to satisfy agricultural water needs. Fluctuating water levels in the lake, caused by both variability in precipitation and by outflow from the dam, expose cultural resources to a variety of physical, human, and biological threats.

The park protects a variety of archeological sites that are exposed to weather. Most of these are open sites, rock-shelters, and pictograph panels created by nomadic hunter-gatherers and dating to the Archaic period. Besides both older and younger Native American sites, the park also contains sites relating to the American Indian Wars and railroad development of the late 19th century, and ranching and hydroelectric power in the early 20th century. When lake levels decrease, archeological sites on previously inundated land are exposed to severe erosion by wave action along the shoreline. Such erosion has taken place over varying timescales and has impacted several burial sites, resulting in inadvertent discoveries and damage under section 3 of the Native American Graves Protection and Repatriation Act.

Sites on denuded, recently exposed lakebed are often highly visible and susceptible to looting by park visitors. Unintentional damage to sites is caused by backcountry boating and camping activities, such as digging cat holes, clearing ground for tents, or making fire rings for ground fires (a prohibited but nonetheless recurring activity). Visitor campsite selection varies with changes in lake level and shorelines, leading to widespread and concentrated camping impacts. Good camping places today were often good camping places a thousand years ago, begging the question of how to mark no camping areas on a wide-open landscape without drawing unwanted attention to cultural resources.

The silting up of some of the upper reaches of the reservoir poses another physical threat to park cultural sites, especially around the confluence of the Pecos and Rio Grande Rivers. Because the silt effectively decreases the capacity of the lake, flash flood waters that are typically associated with tropical storms and hurricanes coming off of the Gulf of Mexico are reaching previously unseen levels and are threatening two of the park's most significant rock art sites (Panther Cave and Rattlesnake Canyon). These two panels are among the five most significant sites in a region that is becoming world-renowned for its elaborate 3,000–4,000 year-old Pecos River Style pictographs. Portions of the Rattlesnake Canyon site have already been inundated and damaged by storms resulting from Hurricane Alex in 2010.

Archeological sites also face biological threats that may be linked to changing lake levels. Photo-monitoring has shown that the number of mud-dauber wasp nests built on the walls of Panther Cave, which contains pictographs, has increased dramatically in the last decade, possibly due to the increased proximity of the reservoir edge (and associated mud source) to the rock shelter. Additionally, when lake levels change, a nonnative Asiatic clam *(Corbicula fluminea)* that lives in shoreline zones is able to invade new areas in large numbers and burrow into previously pristine archeological sites, increasing bioturbation.

The National Park Service (NPS) owns the land surrounding and underlying the Amistad Reservoir, but has limited authority in the management of the water in the reservoir. In this situation, relatively little can be done to prevent most of the physical and biological threats facing cultural resources from changes in lake levels. The primary tool utilized by the park to respond to climate change and manage cultural resources is scientific documentation, with additional efforts towards monitoring, salvage, and minimizing human impacts.

At this time, the park does not have a 100% inventory of archeological sites. In 1999, the Texas Archeological Society held their annual field school at the park, providing several hundred volunteers for the park to do surveys and test excavations, primarily at sites exposed by record-low lake levels. At that time, the lake was over 15 m (50 ft) below conservation pool. In July of 2010 the reservoir reached its second highest level ever, almost 4 m (13 ft) above conservation pool. In May of 2013 the lake reached its all-time low, approximately 18.5 m (61 ft) below conservation pool and nearly 22.5 m (74 ft) below where it had been three years before. These changing conditions result in a massively different shoreline, different exposed land area, and different sites to monitor. As of fiscal year 2015, the NPS Archeological Sites Management Information System indicated that

there were 252 sites in the park, 111 of which were inundated. It should be noted that the unusual topography and ever-changing lake levels make "inundated" or "non-inundated" site status a moving target.

The extent of the 870 km (540 mi) shoreline in combination with the fluctuations in lake levels makes archeological monitoring efforts complex and labor intensive. At normal reservoir pool, some of the more remote sites in the park may only be accessible to park personnel by jet boat or overnight canoe trip. At lower lake levels, this becomes the case for an even larger area of the park. Because of security risks associated with illicit cross-border traffic, a law enforcement escort is needed when working in some remote areas of the park. Together, these factors make it difficult to monitor resources as extensively or as frequently as is desirable at low lake levels.

Responsive Actions

Park personnel are currently spending as much time in the field as possible to revisit known sites and to do condition assessments and improve documentation on recently exposed sites. Additionally, the park has recently completed a cutting-edge LiDAR and photo documentation project at Panther Cave in cooperation with the Texas Parks and Wildlife Department and local nonprofit rock art research and education center, Shumla.

The park is presently studying impacts to natural and cultural resources from illicit cross-border traffic and associated law enforcement activities—another human threat to cultural resources that is not yet well understood at the park. The fieldwork for this project allows park personnel to revisit sites and to complete more condition assessments and documentation than would be possible otherwise. Unsurprisingly, these assessments routinely show impacts to sites caused by threats associated with changing lake levels. One very successful measure the park has taken is that all new law enforcement rangers receive a three-day, intensive cultural resources orientation from the park archeologist. This increases their awareness of and enthusiasm for park resources and resource issues, and builds rapport between law enforcement and resources staff. Their informed observations while on patrol and timely communication with resources staff have proven very helpful.

The park also collaborates with Texas Parks and Wildlife Department and Shumla on outdoor experiential learning programs for local and area schools. These programs introduce elementary students to the cultural and natural resources of the area, and use these resources as a lens through which to teach and reinforce science and math concepts from the classroom that students will later be responsible for on standardized tests. Moreover, these programs work to instill an enjoyment of the natural and cultural landscape and appreciation of and respect for the resources, as well as to foster a sense of responsibility and stewardship.

This is an ongoing project. This case study is an example of the following adaptation strategies:

- Monitoring climate change impacts and adaptation efficacy
- Increasing/improving public awareness, education, and outreach efforts
- Conducting/gathering additional research, data, or products
- Conducting vulnerability assessments and studies

For more information:

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