Reconstruction of Prehistoric Shorelines for Cultural Restraints using GIS

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Introduction

During the mid-Pleistocene, eroded sediments from the Colorado Plateau were deposited into the Colorado River Delta to form a natural sediment dam across the Salton Trough (Downs and Woodward 1961). The Salton Trough is a northwestern landward continuation of the Gulf of California rift, formed by gradual subsidence coincident with the uplift of the surrounding mountains during the Miocene, Pliocene, and Pleistocene eras (Dibblee 1954; Hamilton 1961). Over time the same actions that formed the dam also altered the course of the Colorado River to flow north, creating periodic stands of water in the Salton Basin.

Waters and Wilke estimated that there were three or four possible lacustral intervals in Salton Basin, based upon travertine deposits, lake-related cultural resources and other geomorphic evidence. The highest stand obtained an elevation of 12m (39ft) above sea level (asl) between 100 B.C. and 1580 A.D. (Waters 1981; Wilke 1978). Wilke identified three lacustral intervals for Lake Cahuilla, but Waters concluded that there were four lacustral intervals from 695 A.D. to 1580 A.D. (Waters 1981). At its climax, Lake Cahuilla encompassed over 5700km^2 and reached depths of 95m.

For Lake Cahuilla to reach a maximum height of 12m asl, flows from the Colorado River would have to continually fill the Salton Basin for a period of 12 to 20 years (Wilke op. cit.). At a height of 12m asl, Lake Cahuilla would begin to spill over the drainage divide at Cerro Prieto, Mexico, draining to the Sea of Cortez. When the

Colorado River would resume its course directly to the Gulf of California, it would take approximately 53 years for the basin to dry at an evaporation rate of 1.8m per year.

Materials and Methods

The most valuable tool available to the investigators was Remote Sensing. LANDSAT-TM images of the Salton Sea Basin offered the first preliminary look at possible areas where the shoreline was visible from space. Digital Ortho Quarter Quads were utilized in areas in which the shoreline was not visible from space and for increased accuracy of preliminary shoreline elevations.

Global Positioning Units were primarily used to collect control points at areas where shoreline evidence such as tufa deposits, differences in soil composition, or other geomorphic features were present. Using the GPS receiver, clusters of 180 geographic positions were collected for post-processing in the laboratory.

Post-processing involved differential correction and determination of a centroid within the point cluster. The control points were then plotted on 7.5-minute digital raster graphics (DRGs). Elevations of the control points were correlated with a digital elevation model (DEM) to produce a shoreline delineation at 11.9m asl.

Results

Of the fourteen control points taken, three were eliminated due to inconsistencies with GPS satellite telemetry. By differential correction, the remaining 11 control points achieved 95% locational accuracy. This process eliminates 95% of the error introduced by the Department of Defense on the GPS system and distortion from the ionosphere.

The 11.9m-contour was plotted on a LANDSAT-TM base image. The shoreline delineation for Mexico was not obtainable due to pending acquisition of digital elevation data for this region. To supplement this, a 10m contour was interpolated with the 11.9m contour used for the California side of Lake Cahuilla (Figure 1). The 11.9m-contour is consistent with the approximated shoreline elevation of Wilke and Waters (op. cit.).

The data was represented in the form of two posters outlining the process and the investigators results. These maps are freely shared with archeologists who run regional information centers for the Office of Historical Preservation. Karen and Ed Collins of the Imperial Information Center at the Imperial Valley Desert Museum have used the maps to confirm the locations of suspected shore habitation sites. They have also used the posters for courses in archeology at the Imperial Valley College.

Discussion

Originally, the objective of this project was to create a cultural restraints model for the Salton Sea Database program. The construction of this model is still subject to the completion of the California Historical Resources Inventory System (CHRIS) database. Once complete, it will be possible to search for Lake Cahuilla related resources electronically eliminating the need for an extensive search though printed documents and indexes.

Conclusion

Although a direct correlation between Lake Cahuilla contours and cultural resources is not yet possible, there is abundant archaeological evidence of a relationship to early American settlements and the prehistoric lake. For this reason the Lake Cahuilla contour may be used as an indicator of cultural resource potential. The Lake Cahuilla model may also be used to identify cultural resource areas that might be affected by Salton Sea restoration alternatives.

The importance placed on creating the data for visual presentation opened up an unexpected discovery. The data has proved its value in the educational and archeological fields. Using the data in this way is a rewarding product of the investigators work.

References

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