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Remote Sensing and Geographic Information System (GIS) Based Analysis of Historic Resources

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Remote Sensing and Geographic Information System (GIS) Based Analysis of Historic Resources

of the Carolinas Heights Region, Island of Tinian, Commonwealth of the Northern Marianas

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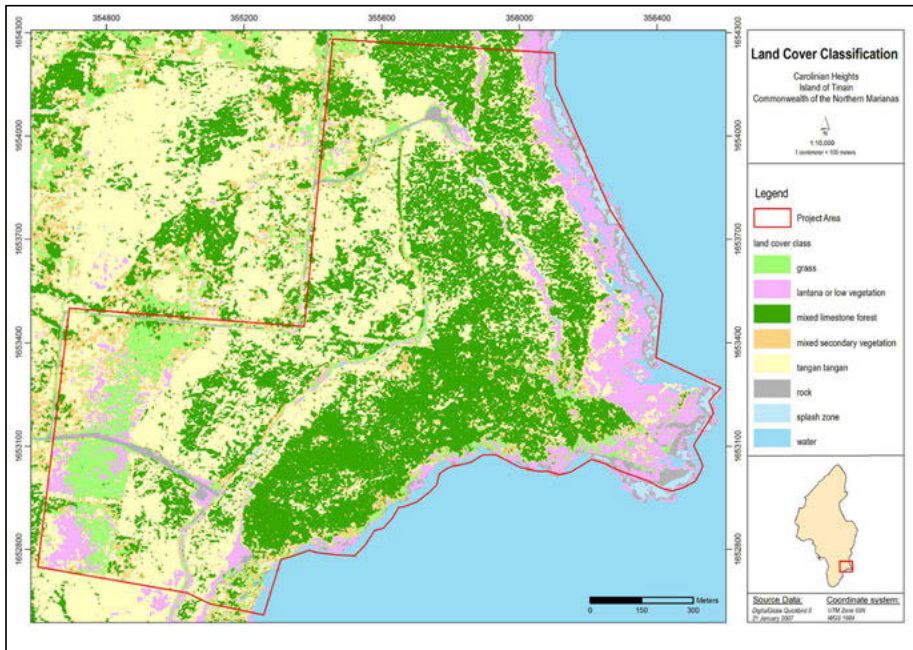Garcia and Associates (GANDA)

GANDA

Introduction

A remote sensing and geographic information system (GIS) based analysis was employed to model archaeological expectations and guide survey of the Carolinas Heights Region, Island of Tinian, Commonwealth of the Northern Marianas. Findings revealed that twentieth-century activities related to the Japanese occupation of Tinian, Nanyo Kohatsu Kaisha (NKK, or South Seas Development Company) commercial development of the island, and the U.S. invasion of Tinian during World War II have destroyed or obscured much of the physical evidence of pre-Contact occupation and land use.

GIS and Remote Sensing Methodology

Land Cover Classification
Carolinian Heights
Island of Tinian
Commonwealth of the Northern Marianas

1:10,000
1 centimeter = 100 meters

Legend

Project Area

land cover class

grass

lantana or low vegetation

mixed limestone forest

mixed secondary vegetation

tangan tangan

rock

splash zone

water

Remote sensing was used in conjunction with GIS data to create a predictive model of cultural resource distribution over the landscape. This model was used to guide fieldwork and identify patterns between existing environmental conditions and past land use practices. Since different site and feature types are associated with specific vegetation regimes that developed due to historical land use practices and events, remote sensing data was useful in defining site boundaries.

Information was extracted from a high-resolution multispectral satellite image of Tinian to perform a 'supervised classification' based on spectral signatures of predetermined land cover classes within the project area. Both 'hard' and 'per pixel with maximum likelihood' classification logic were employed using bands 2 (green), 3 (red), and 4 (near infrared). The results of this classification were transformed into a vector data layer consisting of eight land cover classes.

Pete above inaccessible rockshelter at Site TN-5-1208.
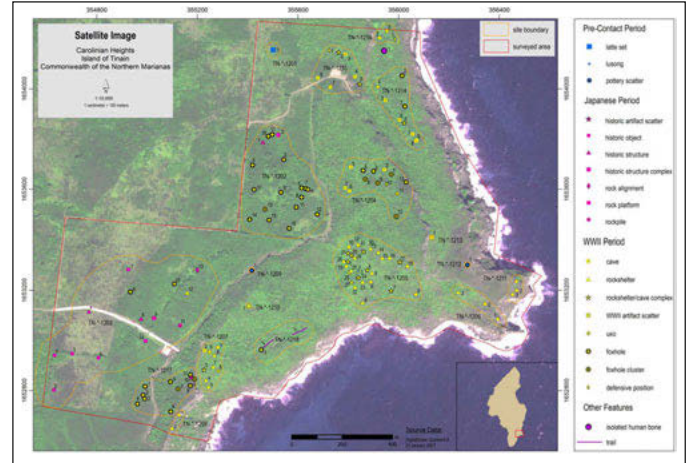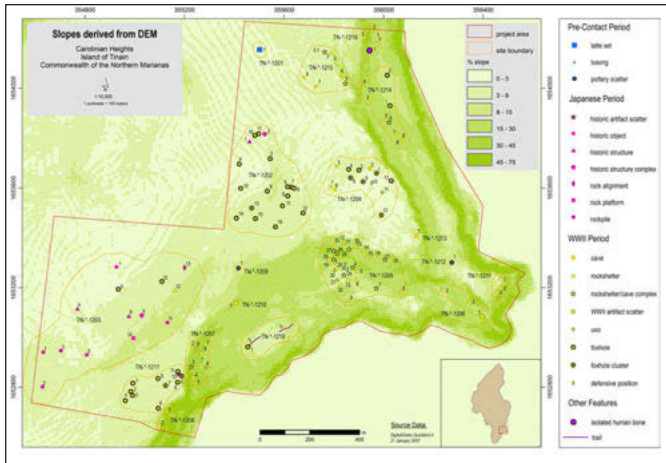
Environmental datasets, historical documents, archival materials, and both historic and modern maps of the Carolinas Heights Region were used in the GIS-based analysis. In addition to the development of the land cover layer, GIS data layers were extrapolated from a digital elevation model (DEM) (i.e. slope and contour layers), and then analyzed along with soil and natural feature layers to develop expectations and identify areas of high and low probability for containing cultural resources. For example, cliff slopes may encompass caves, limestone forests may contain prehistoric or historical period trails, and disturbed areas covered in grass or *tangan tangan* may evidence historic period farming. This prior knowledge allowed archaeologists to plan an efficient and dynamic survey itinerary that covered a maximum area while maintaining quality data collection.

Japanese Period cistern located on upper plateau at Site TN-4-1203.

Below: Stacked rock wall at entrance to World War II Japanese military rockshelter complex at Site TN-5-1207.

Bottom Right: Artifacts within rockshelter at Site TN-5-1205: Japanese bottle, alarm clock, and cookware.

The survey identified 134 features that were organized into 18 sites (Sites TN-1-1201 through TN-5-1218) based on cultural affinity, the topographic distribution of the features and artifacts, and the vegetation types associated with the different features. Feature locations were analyzed using Environmental Systems Research Institute (ESRI) ArcMap 9.3. The feature number, site number, period, description, slope, elevation, soil type, and land cover class were recorded for all identified features. The data generated for each site was used to examine spatial relationships between and within feature classes. The results of the analyses demonstrate patterns of archaeological and historical feature types in the project area's landscape. These features consisted of 68 caves and rockshelters, a single latte set, the remains of five historic concrete houses and structures, nine rock piles

and rock alignments, 40 shallow depressions representing foxholes, an isolated human bone, two pre-Contact artifact scatters, and an historic artifact scatter. Most of the sites and features were related to the Japanese occupation or the American invasion during World War II. Only three pre-Contact sites, or sites with a pre-Contact period component, were found during the survey.

Land cover variation within the project area is largely a product of land use during the Japanese Period. This is due to all the relatively level portions of the island, like the upper plateau segment in the project area, that were cleared during the Japanese Period for commercial agriculture. Land cover in these historically cleared areas is dominated by secondary vegetation. Below the cliff line of the upper plateau, mixed primary forest is the dominate land cover accounting for approximately 52 percent of the vegetation. The degree of vegetation disturbance varies between the two regions of the project area because of the terrain. The plateau is relatively flat, while the terrain below the cliff line consists of rock outcrops, clay or sandy loam slopes ranging from 3 percent to vertical bluffs. During the Japanese Period, prior to World War II, use of the lower area would have been limited to foraging as it is not easily accessible, while the upper plateau was under extensive cultivation. In general, the results of the land cover analysis indicate significantly less disturbance of native vegetation below the cliff line than on the upper plateau.

Overall, remote sensing analysis of the project area accentuated the unique circumstance of the Puntan Kastiyu region in terms of archaeological and historical events. The Japanese agricultural practices on Tinian completely modified the landscape during the first half of the 20th century. This is manifest today in the land cover patterns on the plateau of the Southeastern Ridge. However, the Japanese military activities in the final months of World War II below the crest of the plateau relied upon the extant vegetation and geological features to maintain concealment. This led to extensive modifications within caves and rockshelters when they were used as temporary camps. While the upper plateau of the project area demonstrates a relationship between land cover and the presence of archaeological sites, the Puntan Kastiyu region of steep slopes and vertical bluffs revealed a modified terrain under the limestone forest canopy where surficial evidence of pre-Contact archaeological features has been obscured or razed.

Outward view from cave modified by Japanese military during World War II at Site TN-5-1207.