DOS HOMBRES TO GRAN CACAO ARCHAEOLOGY PROJECT (DH2GC): 2011 AND 2012 INTERIM FIELD REPORT

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INTRODUCTION: THE 2011 AND 2012 DH2GC FIELD SEASONS

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This report provides an overview of recent settlement investigations between two Maya sites, Dos Hombres and Gran Cacao, located in northwestern Belize. Specifically, the study seeks to investigate political and economic organization by systematically analyzing the settlements between these sites. Gran Cacao is located 12 km northeast from Dos Hombres. The future transects will be between Great Savannah and Dos Hombres – the distance between these two sites is 10 km (kilometer), and Great Savannah and Gran Cacao are four km apart. Settlement studies require multiple lines of data and multiple scales of analysis before sufficiently advanced settlement patterns can be discerned. The archaeological investigation of ancient polities maintains an enduring appeal. In order to characterize the amount of political centralization present, one must examine the hinterlands for evidence of political activities. For example, the argument has been made that in centralized polities, elite in lower-order centers do not have the ability to draw the tribute and labor required for large civic projects while the reverse is true in decentralized polities (de Montmollin 1989, 1995). Thus far, one way in which political centralization was inferred from the transect data was through a spatial analysis of architecture. At less than 1 km from the site center of Dos Hombres, an elite site was located. The settlement prior to this new site was relatively modest; community organization was varied between Dos Hombres and the one km covered thus far.

Archaeological research data within the project area has produced a preliminary dataset including: settlement configuration, landscape utilization, water management, and ecological data based on tree surveys and soil sampling. The research questions revolve around the socioeconomic conditions within the context of the surrounding communities. The subsistence strategies practiced in this area will be examined in relation to the chosen environment for site placement. The investigators worked during summer sessions in 2009-2012 field seasons and a substantial amount of data has already been collected that can address some of our research questions. The data are of different varieties, including mapped surface features (structures, water management features, terraces, and settlement concentrations), and reconnaissance. This report provides a brief summary of these categories of data that reflect preliminary patterns of the settlement and local adaptation to the environment between Dos hombres and Gran Cacao.

Previous Work and Methodology

Investigations on the DH2GC Project began during the 2009 field season, when the investigators laid out the grid for the transect. The 2009 and 2010 field seasons were predominantly survey and reconnaissance. Excavations began in 2011 and continued through the 2012 field season. During 2011, investigations focused on three household groups (noted as N150, N250, and N350) and a small water feature on the transect. Building upon the work of the 2009 and 2010 seasons, the 2011 season was formulated with five goals in mind:

1. Continue and expand upon surveying and mapping of features located along the transect to determine the density of rural settlement and any other sites within the survey boundaries.
2. Collect matrix samples from excavation units and other contexts for geophysical analysis.
3. Map features with the Total Mapping Station (TMS).
4. Carry out ecological survey on tree species along the transect (by Dr. Nick Brokaw).
5. Continue and expand upon the documentation and evaluation of the ecological and environmental significance of the numerous depressions (*aguada*s) and water management features.

The 2012 season had very similar goals to the 2011 season. However, some excavations were not completed during the 2011 season, and were continued during the 2012 season in addition to new goals and excavations. These additional goals presented as follows.

2012: Continuation of Excavations

The test units from the previous 2011 field season that did not reach bedrock were reopened:

- Operation 1 (Op 1) was located on N150E75; it is a small residential group. Two 1 x 1 meter (m) test units, Suboperations (Subops) A and B were set up to investigate the occupational history.
- Op 3 was assigned to N300W125, another residential group. The same operation encompassed three small depressions. It was assumed these

were possible quarries and later on were used for water catchment. One of the excavation units was placed in Water Basin 1. These excavations were continued during the 2012 field season.

2012: New Excavations

- N750: there are a series of structures located on the baseline. We investigated these structures by strategically placing 1 x 1 m units.
- N950: a new small elite site was documented during previous field seasons on this segment of the transect. 2012 Goals for this area were:
    - Define the stairs that lead from the front of field number (FN) 36 down towards FN 30 and FN 32.
    - Set up 1 x 1 mt units on the plaza.
    - Set up small units in the front/side of FN 36 to define the corners and steps of this small pyramidal structure.
    - Set up a 1 x 1 m unit between FN 30 and FN 32.
    - Investigate a series of water management features in the vicinity of FN 36 to ascertain construction dates and use (small water basins, possible *aguada*s and two channels).
    - Investigate small caves located in this group.
    - Record the *chultuns* in this group with the TMS.
- N250W75: a small residential household group was investigated.
- Shovel Test pits and soils testing as part of a graduate student's MA thesis.

Archaeological Mapping Methodology

It is estimated that Gran Cacao is at 60º from the northeast corner of Plaza A at Dos Hombres, thus a grid was established at a 60º azimuth. The first datum was marked as N0E0. A perpendicular baseline was cut at 150º and 330º from the main datum. The transect width is 150 m with an estimated length of 12 km, upon completion. At every 50 m from the main datum, another perpendicular line was cut and stakes were placed at 25 m interval along the perpendicular baselines. Each stake was marked with its corresponding grid coordinate. For example, N150E25 is located 150 m north from N00 and 25 m east from N150. These stakes were also used as points of reference to map structures located within sight, in order to tie any cultural features back to the grid. The survey team also carried out pedestrian surveys between each quadrant. Each person would stand approximately 10 m apart from each other with a cutter in front of them. Each individual would have a compass to keep the cutter at a 60º azimuth from one perpendicular baseline to the other.

Survey challenges on the transect have been met by a variety of adaptive procedures to provide detailed settlement data. We employed a variety of survey techniques and technologies, such as tape and compass, theodolite, Magellan Mobile Mapper Unit No. 6 (MM6) with an external antenna, and a TMS (Nikon DTM 322). Structures, terraces, and other features were mapped and recorded. Additionally, vegetation changes were recorded in order to correlate structure density with each type of micro-environmental zone. This information was plotted in Surfer and differentiated by using different symbols per vegetation zone. The investigators are in the process of importing the survey data into a Geographical Information System (GIS) database.

Mapping operations were carried out by three teams in 2011. Marisol Figueroa directed the principal mapping team, which employed a Nikon DTM 332 TMS. Leslie Perkins employed GIS 9.3 software to post-process topographic and structural information recorded with the TMS and handheld GPS units. Mike Cavanash led the "transect" team; this particular team had two functions: 1) lay out the transect at 60º azimuth towards Gran Cacao and 2) carry out reconnaissance and flag any features for the GPS team. Subsequent to the efforts of the TMS and the transect teams, Kyle Ports and Shannon Willer led the GPS team; they utilized a MM6 to record cultural features along the transect and Garmin Etrex Hcx handheld GPS units for recording topographical information.

The goals of the various mapping operations during the 2011 season were largely met and in some cases, were exceeded. They were to:

1. Continue and expand upon surveying and mapping of features located along the transect to determine the density of rural settlement and any other sites within the survey boundaries;
2. Map the residential groups located during the 2009 and 2010 season with a TMS;
3. Resolve spatial inconsistencies in the areas of N150E75, N250W75, and N800 that remained from last season's settlement investigations;
4. Record the structures at the new site located at N950 with the TMS;
5. Record the large water features at the N950 site with the TMS;

6. Record previously unmapped platforms and related features.

Most of the mapping and survey goals for the 2012 season were met. These are defined below, but are expanded in Swavely *et al.* (this volume):

1. Continue refining maps for N150E75, N750, and N350W125
2. Georeference points between N150-N300 and N950-N1000
3. Relocate structures between N550 and N700E75

Excavation Methodology

Excavations were conducted under the supervision of project staff members Sarah N. Boudreaux, David Sandrock, and Jeff Bryant. Soil matrix collection was carried out under the direction of Jeff Bryant. As of this writing, the matrix samples have recently arrived at our laboratory and will shortly be under study. Geophysical variations will be recorded and correlated with ancient natural and cultural contexts in an upcoming report.

During the 2010 field season, three residential groups were chosen for off-mound excavation with a total of six excavated units. Based on the results from surface collections the year before, it was surmised that there were certain residential areas of the transect that needed to be tested to have a complete overall result of the occupational history. Some of the structures chosen were from the northwest and southeast quadrants of the transect.

Within these aforementioned areas, structures for the 2011 and 2012 field season were chosen based on quantity of surface ceramic observations and visibility of architectural feature. 1 x 1 m units were set up near the structures to gather ceramic material, midden deposits and/or collapsed debris from the structures. Excavation teams excavated each lot stratigrafically or according to changes in the type or frequency of cultural material. The termination of a particular lot was prompted by a change in the matrix or change in cultural material. All units were terminated with the identification of bedrock. Photos were taken at the beginning and completion of each lot. Photos were taken of anything of research interest, such as artifacts identified *in situ*. Each lot's excavated matrices were screened using 1 x 1 cm mesh screens. These artifacts were bagged, labeled and then sent to the field laboratory for analysis. Termination procedures of a pit began with photos taken of the unit's profile and plan view. Profile and plan view maps were hand-drawn, and were later digitized. After all termination procedures were completed, a piece of tarp measuring 1 x 1 m was cut and set at the bottom of the unit. The terminated units were backfilled and the corners were marked with pin flags to aid future researchers in relocating the units.

Operation numbers were assigned to a particular group within the transect, Suboperation letters were assigned to test units. The information below includes each operation description with each associated group, data from each test pit and chronological information for each unit. Off-mound excavations in the summer of 2011 and 2012 continue to further our understanding of:

1. Growth and development of the area
2. Range of variation in settlement arrangements
3. Architectural forms
4. Distributions of possible occupational specializations
5. Resource(s) exploitation.

Soils

In 2011, we began the collection of soils from excavation units. Small samples were collected from test units. These were processed in water flotation machine during the 2011 field season. The remainder was sent to Humboldt State University-Archaeology Research Laboratory for further examination.

GIS Methods

Mapping data was recorded using a variety of field methods including: pace and compass, tape and compass, GPS survey, and TMS. Survey equipment included a MM6 GPS, four Garmin Etrex Hex GPS, and a Nikon DTM 332 TMS. Raw data was converted into formats, which were compatible for integration into ArcMap 9.3.1. Each GPS generates a text file with all raw data initially processed on "the ground" (description of the point, northing, easting and elevation). The text file was converted into a delimitated spreadsheet using Microsoft Excel and edited to remove unnecessary information. Individual GPS data spreadsheets were then merged into one master waypoint data spreadsheet. TMS data was first processed in Connex and then exported as a comma delimited text file. This information was imported into an excel spreadsheet, where the data was cross-checked with the 2011 TMS notebook to ensure data accuracy.

Once all the data was compiled, each spreadsheet was loaded into ArcMap. Each feature layer was properly defined with the appropriate datum (North American Datum 1927 or NAD 27) and then projected to the correct projection (North American Datum 1927 Universal Transverse Mercator Zone 16 North or NAD 1927 UTM Zone 16N). After all the points were properly projected in ArcMap, a contour map was made created based on the elevation ("Z") values from the Mobile Mapper baseline and topographic files.

A separate contour map was made for the N950 group based off the TMS data. The N950 map was created in Adobe Illustrator. First, the TMS data was uploaded as an image file into Adobe Illustrator. The points were then connected in Illustrator to show the structures and features of the site. Each area of the map was labeled, and a key was made. This map assisted preliminary analysis of the N950 site and nearby household groups.

Humboldt State University Staff, Students and Volunteers for the 2012 Season
There were 14 Humboldt State University students (see Table 1.1), two new volunteers (see Table 1.2), and 11 returning volunteers (see staff section).

Table 1. Humbolt State University Students for the 2012 Season.

Laura Alvarez	Adam Forbis
Natalie Avila	Dan Gardner
Sophia Chorich	Leah Gordon
Denise De Los Santos	Nic Grosjean
Adam Erwin-Martinetti	

Table 2. Volunteers for the 2012 Season

Mark Arsenault	Cynthia Lewis
Ashley Ginther	Claire Mannheimer
Jenifer Leonard	Diego Rocha

2012 Staff Names

Project Director: Marisol Cortes-Rincon, Ph.D.

- Project Ecologists: Nicholas Brokaw and Sheila Ward
- Field Director: Sarah Nicole Boudreaux
- Excavation Director: Lindsey Moats

Survey Supervisors: Marisol Figueroa and Ty Swavely

Operation Supervisors:

- Kyle Ports
- David Sandrock

Soils Supervisor: Jeff Bryant

Team Leaders:

- Nicole Chenault
- Alexandra Cox
- Samantha Sandy
- Melanie Sparrow
- Leslie Perkins

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OPERATION 1: 2011 AND 2012 REPORT

David Sandrock, SWCA Environmental Consultants

Operation (Op) 1 is a small informal residential cluster consisting of four household mounds located at N150E75. Suboperation (Subop) A was placed to the west of structure (STR) 4. Subop B was positioned to the west of STR 1 and to the southeast of STR 2 in the same group. Subops A and B were aligned north to south along a 360º azimuth.

EXCAVATION GOALS FOR SUBOPERATION A

1. Investigate a possible off-mound midden deposit associated with STR 4
2. Gain information regarding the area's general chronology, focusing on ceramic typology
3. Gain information on soil types and natural activity from soil samples taken from different stratigraphic layers
4. Recover diagnostic artifacts that would permit dating of construction, and perhaps use of the structures and the surrounding area.

RESULTS

Some difficulty was encountered during the initial excavation of Subop A. Hard-packed thick clay was prevalent throughout the entire unit, hindering excavation efforts. Subop A was closed prior to termination at the end of the 2011 field season. It was subsequently reopened and terminated during the 2012 field season.

Excavation of Subop A during the 2012 field season began by removing the previously excavated soils. A high concentration of ceramic sherd deposition was encountered throughout Subop A. This characteristic holds true for both field seasons. In addition, a total of 11 fragments of obsidian prismatic blades and various chert flakes were recovered, some showing signs of use-wear. The unit became culturally sterile after excavation reached a depth of approximately 127 cm below datum (cmbd). Large uncut cobbles (up to approximately 30 cm across) of degraded limestone dominated the remainder of the unit. No evidence of cut stone or a floor was present throughout Subop A.

Subop B reached bedrock approximately 85 cm below surface (cmbs). This unit uncovered well-preserved ceramic sherds, which allowed for informed chronological analysis. The stratigraphy of this unit included a humus level, a pair of plaster surfaces, construction fill, and a packed earth surface.

Stratigraphy

Subop A's stratigraphy (Figures 1 and 2) is characterized by a heavy presence of dense, dark-brown clay. The overall profile of the strata in Subop A indicates a depositional flow from the structure group area to the lower, more level areas located to the east of STR FN 4. Gilgai soil at multiple levels and the generally flat, linear dispersion of cultural material are indicative of flooding activity, suggesting that the area east of FN 4 is a probable flood plain. The 2011 field season encompasses Strata I through Strata IV, while the 2012 field season reopened Strata IV and terminated the unit with Strata V.

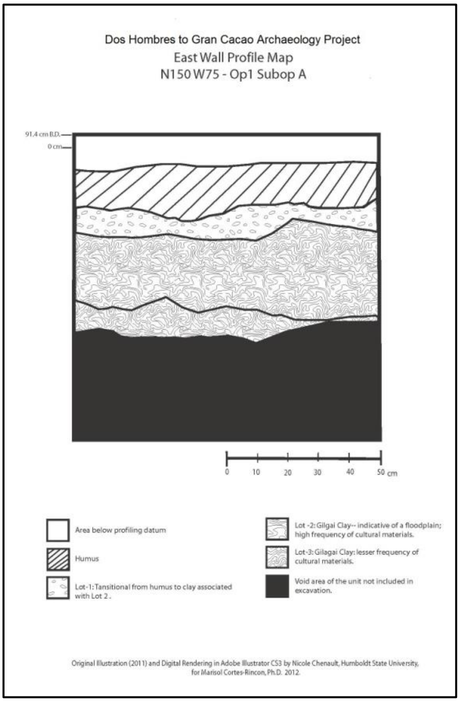

Figure 1. Op 1, Subop A, East Wall Profile.

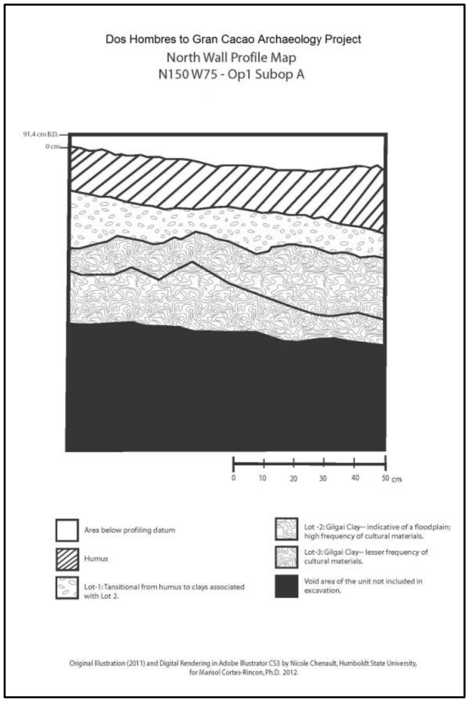

Figure 2. Op 1, Subop A, North Wall Profile.

Strata I was a humus layer that included silty clay loam with an average depth of 20 cmbs, including approximately 3 cm of cracked gilgai soil at the surface. It extended from 46.8 to 71.3 cmbd. This layer contained root systems typical of local fauna. The first cultural materials appeared in the form of ceramic sherds located in the central third of the unit, approximately 10 cmbs. A soil sample was taken via surface scraping at 23 cmbd. As depth increased, the moisture did the same, and we began encountering a dense very dark brown clay starting just under the surface. This matrix, like those below it, appeared to have little disturbance outside of root activity.

Strata II, a combination of Lots 2 and 3, was a transitional layer between the humus layer and what was thought to be a possible plaster surface. The plaster turned out to be isolated chunks of decomposing plaster, which were more indicative of displaced eroded material from associated structures. This layer contained Tinaja Red body sherds, indicative of Tepeu 2 styles. This level began at 71.3 cmbd, ranged from 9 to 16 cm thick, and ended an average of 24 cmbs. At 90.1 cmbd, the unit's matrix transitioned from very dark brown clay to a dense rocky clay configuration. Strata II was terminated due to this change in the matrix's composition.

Strata III was composed of limestone fragments, believed to be remnants from STR FN 4 intermixed within a dense clay. The layer is a combination of Lots 4 and 5. Its thickness varied from 8 to 20 cm with the thickest deposit located in the eastern half of the unit. Well preserved diagnostic ceramic sherds including Unslipped Tepeu 1 type vessel sherds, as well as Cayo Unslipped and Subin Red were present in this layer. Strata III was terminated at 101.5 cmbd.

Strata IV was a 7 to 18 cm thick layer located between 34 and 58 cmbs. This level contained 11 obsidian blade fragments, a possible chert etching tool, and a total ceramic assemblage greater than the combined ceramic count of strata I-III. This represents the most diverse assemblage of cultural materials recovered from Subop A. Many of the ceramic sherds were fairly small in size, and possibly undiagnostic in nature. In addition, many of the ceramics uncovered in this layer only remained as impressions in the clay, and were unable to be recovered without considerable damage. The diagnostic sherds in this strata included Tinaja Red, Garbutt Creek Red, Cayo Unslipped, Tres Mujeres, Achote Black, Rio Bravo Red, Cubeta Incised, Chilar Fluted and Dos Arroyos, which date the lot from Early to Late Classic periods. The dense clay in strata IV was similar to the clay from strata I-III. As excavation progressed, the soil turned darker, with a nearly black soil present in the bottom-most strata. This level marks the termination of the 2011 season.

The 2011 excavations contained four strata, and with the preservation procedures taken at the end of that season, we were able to un-backfill the unit and resume excavations almost exactly where we left off after the termination of strata IV. The following is the continuation of Subop B during the 2012 field season.

Strata V saw a transition from the silty clay soil, with small chunks of limestone found in most of the unit, to similar silty clay (10 YR 4/3) oil with large pieces of degraded limestone bedrock. These chunks were up to 30 cm across, and increased in size with depth. None of the stones had any apparent cuts or intentionally flattened sides. Some diagnostic sherds were recovered, with a similar distribution to strata IV. The Tinaja Red and Dos Arroyos ceramic types were present, this strata dated to the Early Classic time period. The unit became culturally sterile approximately 125 cmbd. The unit was terminated when massive, impassible limestone was reached, roughly 150 cmbd.

The overall distribution of artifacts seen over two seasons of excavation is indicative of two separate midden deposits, with two patches of high artifact concentration. The first was found between 90 and 105 cmbd and showed Tepeu 2 and 3 styles. The second, lower deposit was between 115 and 125 cmbd, and contained ceramics dating from the Early to Late Classic periods. The 10 cm between these two deposits had a lower artifact density and higher soil content than either of the adjacent pockets. The ceramics recovered were mostly vessel sherds, with the exception of a single fragment of a loom spool/weight uncovered in the eastern half of the unit approximately 110 cmbd.

EXCAVATION GOALS FOR SUBOPERATION B

1. Investigate a likely area of high traffic leading into the group from the northeast between STR 1 and 2
2. Gain information regarding the area's general chronology, focusing on ceramic typology
3. Gain information on soil types and natural activity from soil samples taken from different stratigraphic layers

4. Recover diagnostic artifacts that would permit dating of construction, and perhaps use of the structures and the surrounding area.

Stratigraphy

Strata I opened at 91.4 cmbd and was terminated at 108 cmbd (Figures 3 and 4). The 16.6 cm humus layer was comprised of very dark brown silty clay with some gravel inclusions. Cultural material recovered from this layer included ceramic sherds, chert flakes, and an obsidian prismatic blade fragment. The first ceramic sherds were encountered 8 cmbs. Ceramic quantities increased approximately 11 cmbs but were characterized as poorly preserved undiagnostic sherds.

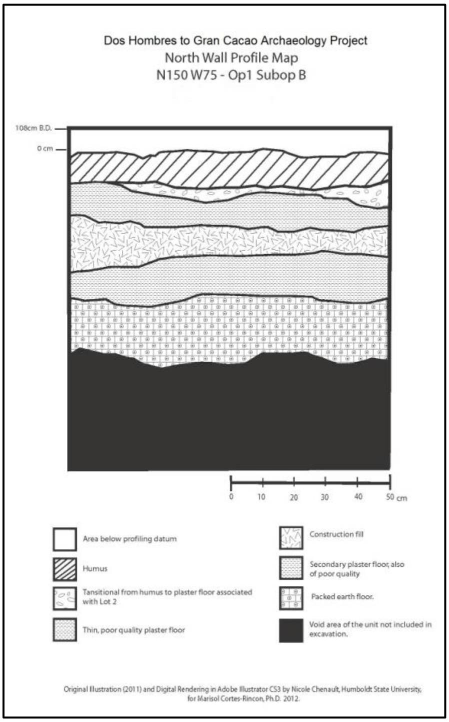

Figure 3. Op 1, Subop B, North Wall Profile.

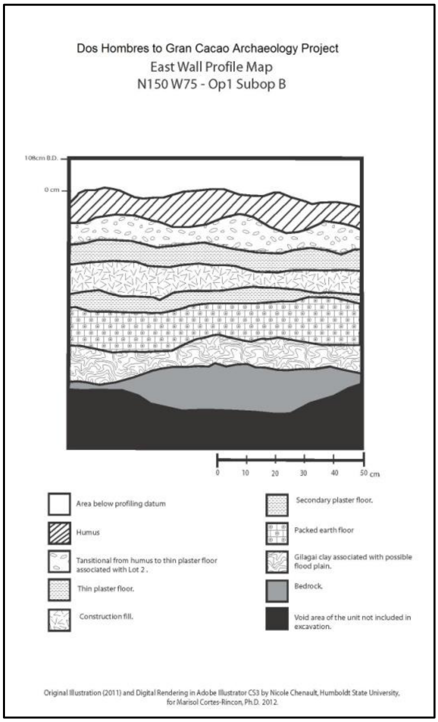

Figure 4. Op 1, Subop B, East Wall Profile.

Strata II was an intermediate transitional layer between 108 and 110.5 cmbd. The layer contained a very dark brown silty clay loam interspersed with small gravel. A small grey inclusion was present in the west half of the unit. Strata II included small ceramic sherds and chert flakes with a similar depositional rate to that of

Strata I. Some of these were diagnostic Tepeu 2 styles, including Lemonal Cream and Cayo Unslipped. Strata II terminated at a plaster surface, uncovered at 110.5 cmbd.

The plaster surface was poorly preserved and was roughly 3.5 cm thick. The plaster surface was highly fragmented and difficult to see, even in the profile of Strata III. The presence of this plaster layer positioned above another plaster surface in strata V is indicative of multiple construction events, which is discussed in more detail below. Artifact density was much lower in this level, with very few ceramics recovered until the appearance of construction fill just below this surface in strata IV. Those that were recovered were dated to the Late and Terminal Classic periods -Tepeu 2 and 3.

The construction fill of strata IV was comprised of small (less than 5 cm in diameter) rocks, larger cobbles (no more than 16 cm across), and ceramic sherds of various size and composition. Eroded Achote black and Tinaja Red, Late Classic Reds, Sierra Red, and Aguila Orange were all present, and show a mixed typology, including Tepeu 2, Tepeu 3, Chicanel, and Tzakol types. This strata is a combination of Lots 4, 5, and 6, which were opened in an attempt to more carefully investigate a possible surface. This 8 to 18 cm thick layer extended from 114.4 to 128.6 cmbd. Several of the larger stones which started showing at 50 cmbs appeared to be arranged in a linear alignment. However, upon further investigation the stones were determined to be most likely fill rather than some other structural element. In addition, the weight of the components of this strata likely contributed to the damage leading to the degradation of the plaster surface below it.

In strata V, another poorly preserved plaster surface was uncovered between 33 and 42 cmbs. This degraded layer was between 128.6 and 133 cmbd, and contained fewer artifacts than the previous strata. Many of the ceramic sherds present (none of which were diagnostic) were likely part of the construction fill of strata IV.

Just below this plaster surface, between 133 and 145.5 cmbd, a packed earth surface composed of very dark grey silty clay loam was discovered. This layer was between 15 and 20 cm thick, with a slight dip in the northwest portion of the unit. Strata VI, along with strata VII, saw artifact deposition continue to decline.

The diagnostic ceramics found in this stratum were Preclassic Red and Black Matted, both of which are indicative of Chicanel styles.

Strata VII was a merging of Lots 9 and 10 and extends from 145.5 to 165 cmbd. This layer contained Sierra Red sherds of fairly poor preservation, all of which date to the Late Preclassic. Degraded bedrock was first exposed at 72 cmbs, and damaged but apparently unmodified limestone bedrock was reached at approximately 165 cmbd, at which point Subop B was terminated.

CONSTRUCTION HISTORY

The ceramic assemblage exhibits a long occupational chronology, with evidence suggesting multiple construction episodes associated with the area between Structure 1 and Structure 2. The first construction event is indicated by a packed earth surface in strata VI, which contained several Chicanel style ceramic sherds. However, there was not enough evidence to concretely state that this 15-20 cm thick layer was a living surface, instead of a base for the plaster surface just above it in strata V. This plaster floor (less than 4 cm thick) was poorly preserved, and possibly damaged by the construction fill placed above it. Due to its highly-fragmented nature, its true thickness is unclear. What is clear, is that occupants constructed a newer plaster layer (also under 4 cm thick) supported by a layer of construction fill approximately 18 cm thick, sometime after the original plaster surface's completion.

The construction fill of strata IV contained sherds of Achote Black, Tinaja Red, Late Classic Reds, Sierra Red, and Aguila Orange. The ceramic assemblage has temporal characteristics associated with Chicanel, Tzakol, Tepeu 1 and Tepeu 2 styles. The plaster surface of strata III is associated with the Tepeu 2 and 3 styles, with Achote Black and Late Classic Red ceramics found in relation to the floor. The strata above this plaster surface and below the packed earth surface appeared natural, and bore no evidence of modification.

METHODOLOGY NOTE

The excavations at the residential group located near N150E75 made frequent lot changes in order to avoid missing any potentially significant differences. This led to more lot changes than layers that were actually expressed in profile or in the unit. During post-field data processing, it was decided that in order to more accurately portray the findings from Subop A and Subop B, the changes in cultural and soil layers would be better expressed using strata, with some lots combined to form strata. The lots that correspond with each stratum are listed in the tables below:

Table 1. Op 1, Subop A, List of Lots.

Op 1, Subop A	**Lots Included**	**Distance Below Datum (cm)**
Strata I	1	46.8-71.3
Strata II	2, 3	71.3-90.1
Strata III	4, 5	90.1-101.5
Strata IV	6	101.5-110

Table 2. Op 1, Subop B, List of Lots.

Op 1, Subop B	**Lots Included**	**Distance Below Datum (cm)**
Strata I	1	91.4-108
Strata II	2	108-110.5
Strata III	3	110.5-114.4
Strata IV	4, 5, 6	114.4-128.6
Strata V	7	128.6-133
Strata VI	8	133-145.5
Strata VII	9,10	145.5-165

EXCAVATION GOALS FOR SUBOPERATION C

1. Investigate a large surface deposit exposed due to bioturbation caused by a large fallen tree's root ball
2. Gain information regarding the area's general chronology, focusing on ceramic typology
3. Recover diagnostic artifacts that would permit dating of construction, and perhaps use of the structures and the surrounding area.

Results

This surface collection was taken from the root ball of a fallen tree to the northwest of structure 1 and 2. This tree fall occurred sometime after the 2011 and before the 2012 field season. All visible diagnostic sherds were collected from the root ball, many of which were well-preserved lip/rim fragments. Most of the artifacts present were likely part of the construction fill of the adjacent structures and plaza floor. Ceramic types include various striated sherds, Lemonal Cream, and Cayo Unslipped, dating to the Late Classic or Tepeu 2.

PRELIMINARY CONCLUSIONS FOR OPERATION 1

The unnamed group at N150E75 was a small, four-structure group located to the south of the main transect. The excavation of Subop B on STR 2 uncovered evidence of multiple construction events, one dating to the Terminal Classic, the other to Late Preclassic, with some evidence of Preclassic occupation below a packed-earth surface beneath the lower plaster surface.

Subop A had two separate midden events, with one dating to the Late Classic and the other to Early Classic. Additionally, the prevalence of gilgai soil at multiple levels and the generally flat, linear dispersion of cultural material flowing east to west are indicative of flooding activity. Overall, ceramics analyzed date the group's use from as early as Preclassic through Terminal Classic. The use of this group is unclear, but due to the gilgai soil type, size, and proximity to the floodplain, it is very possible it was agricultural in nature.

OPERATION 2: 2011 AND 2012 REPORT

Sarah Nicole Boudreaux, University of Texas at San Antonio
Nicole Chenault, Humboldt State University
Jeff Bryant, Chico State University

Operation (Op) 2 is an area located at N250W75 along the DH2GC transect (Figure 1). The 2011 and 2012 goals and excavation initiatives for DH2GC were to establish two one by 1 x 1 m test units to ascertain chronology of the residential group and to gain an understanding of material culture around the area. Excavation units completed are referred to as Subops A and B. Subop A is located east of STR 12 and Subop B is located south of STR 8. Excavations for both subops were initiated and closed during the 2011 season. Artifact analysis was conducted during the 2012 field season.

The supervisors of excavations at Op 2 in 2011 were Sarah Nicole Boudreaux and Jeff Bryant. Staff members who participated in the excavation process were Desiree Thompson and Geraldo Castillo. Students involved in the research efforts included: Christina Bond, Alexandra Cox, Crystal Curtis, Jeff Grimm, Tiana Hacking, Brandy Hurtado, Brenda Pendarvis, Leslie Perkins, and Melanie Sparrow.

Suboperation (Subop) A is characterized as being a refuse area located on the eastside of STR 12. There were numerous types of artifacts found, including ceramic sherds, lithic debitage, obsidian blades, fire cracked limestone, and jute shells. Bedrock was found at 155 cmbd.

Subop B is located within a possible water management area, behind STR 8. There are three possible depressions within the landscape that may have been utilized for water management of refuse area. The unit was placed to test if the usage of this area could be established. Cultural material recovered from this unit included, ceramic sherds, lithic debitage, a chert biface, and jute shell. Soil samples were taken for further analysis.

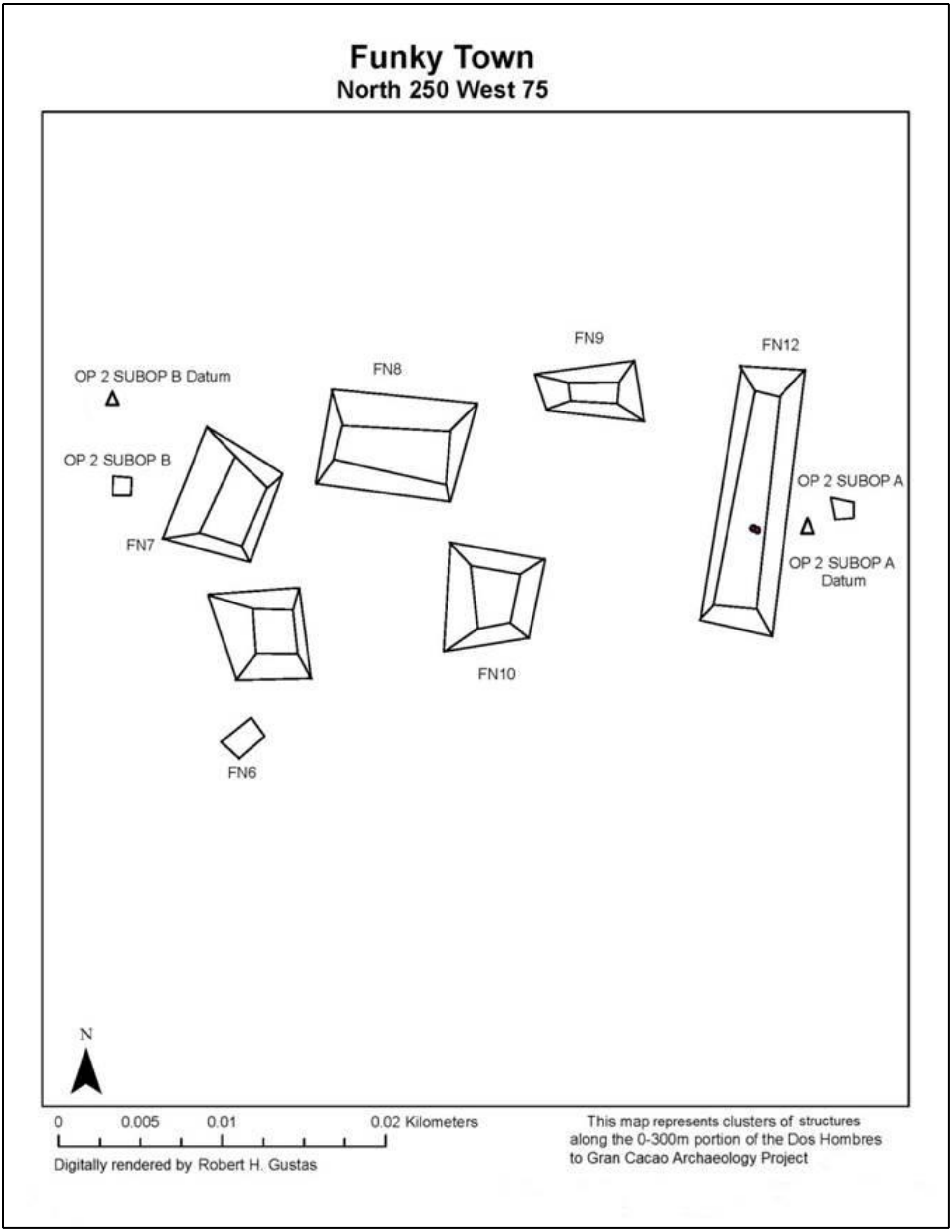

Figure 1. Map of N250W75 © DH2GC.

The 2011 field season at N250W75 was an exploratory effort to understand the chronology of the group. Analysis of the artifacts during the 2012 field season offer insight to that goal. In normal cases, a test unit would have been placed in the middle of the patio. However, there is a great deal of tree fall in the patio making it difficult to find an unobstructed area to place a test unit. The ceramics from this unit dated the earliest occupation during the Tepeu 2 phase and the latest in the Tepeu 2-3. There were a trace amount of ceramic sherds that dated to the Chicanel-Tzakol phase, but not enough to warrant an occupation period from that time.

The dates defined for this group are far later than originally postulated (Cortes-Rincon 2011). Preliminary analysis defined the group's initial construction phase during the Late Classic period and additional construction happened on the original facades of some structures at a later time (Cortes-Rincon, this volume). However, ceramic data indicates that there is a Chicanel-Tzakol trace within one of the units. This material may indicate the "older" construction side, or it was just material brought in from an off mound midden used for construction fill. However, the exact sequence of the construction history for this group will need to be determined through detailed excavations within the N250W75 area. Future investigations should be concentrated in the patio, despite the hampered condition of the area. These investigations would be able to provide more information on the construction history, and also more insight to the chronology of N250W75.

The following material is broken down into two main sections: excavation results and artifact analysis for Op 2 Subop A and Subop B. Excavation analysis includes, lot and unit descriptions, in addition to concluding remarks. Artifact analysis is a composition of analyses by multiple researchers associated with the DH2GC project. Lauren Sullivan (personal communication, 2011, 2012) contributed to the analysis of ceramics, ecofacts as well as lithics and miscellaneous rock samples. Sarah Nicole Boudreaux (Boudreaux and Sullivan, this volume) contributed to further analysis of ceramic materials, rock samples and ecofacts. Adam Forbis (this volume) contributed to the analysis of lithic tools and debitage recovered from Op 2. At the end of each section, an interpretation of the materials reviewed is given.

OPERATION 2, SUBOPERATION A

Subop A is located on the east side of the STR 12. This location was chosen as an area of interest because it is a probable refuse area. STR 12 is one of the largest of the six structures found at the N250W75 site. Dr. Cortes-Rincon (personal communication, 2011) hypothesizes that the site of N250W75 was constructed during two separate periods of occupation. The western STRs 6–9 were presumed to be from the Early Classic, where the eastern STRs 10, 11 and 12 would have been built by returning occupants of the site area in the Late to Terminal Classic (Cortes-Rincon personal communication, 2011). However, this result is the opposite. The structures on the western part of the group were built first and this area needs further investigation.

The 2011 excavation process was active for a period of 14 days, opening 24 May and closing 6 June 2011. Artifact analysis was conducted during the 2012 field season. Subop A is a 1 x 1 m unit tied into the secondary datum for the N250W75 site and is 94 cmbd, located 6.15 m and 83º from TMS station (STN) J. The unit is comprised of six lots, defined both arbitrarily and culturally; and was terminated once bedrock was found.

Excavation Goals for Suboperation A

1. Define stratigraphy, chronology, and determine cultural or arbitrary strata
2. Observe and collect recovered artifacts within possible refuse area pertinent for future laboratory analysis
3. Recover soil samples for future laboratory analysis.

Results per Lot

Lot 1 is defined as an arbitrary and cultural humic layer characterized by a very dark brown loamy surface soil with a Munsell reading of 10-YR. The lot is shallow, with a total thickness of 0.081 cm that is inclusive of artifactual evidence indicative of a midden deposit. Artifacts include a small amount of shell from common white and orange ground snails ranging in sizes between 2.12-2.43 cm in diameter. Minimal amount of small limestone inclusions are present in this lot's matrix. Pieces of small lithic fragments and ceramic sherds were collected. The ceramic sherds retained some of the original red and white slip surface treatment, and appear to be 1-2 cm thick. A large, fragmented jute shell was observed and collected, measuring 10.16 cm in length. Lot 1 was terminated with a change of the matrix, ending at an average closing elevation of 1.176 cmbd.

Lot 2 is a transitional matrix predominately comprised of humic soils and dark, hard-packed clay beneath removed stones. The humic soil of Lot 2 transitions to a more gravely, sandy-clay consistency with a dark grey-brown color. Three large limestone rocks were removed from the northwest corner, at a depth of approximately 17 cm. The largest of the three rocks measured 20 cm in diameter. There is evidence that some of the removed limestone had been fire treated by the presence of fire cracking. Crushed pieces of jute shell have been identified. The provenience of such refuse is predominately found beneath the removed rocks. The removal of a large tree root, protruding from the southwest corner and bisecting the unit to the northwest corner, revealed a concentration of ceramic sherds central within the lot. Fragments of a poorly preserved plaster floor were present at the depth of 22 cm. A plaster floor was revealed and was designated as feature 1 for Subop A. The termination of Lot 2 was due to a cultural shift in the matrix. The total thickness of this lot is 0.076 cm with an average closing elevation of 1.252 cmbd.

Lot 3 has great variability within the soil matrix. Large pieces of a plaster floor (Feature 1) defined the surface of this lot. The matrix is evident of a shift into predominately rubble construction fill that is mixed with common Maya midden artifacts. This lot is 50 x 100 cm, occupying the eastern half of Subop A. The purpose of bisecting the unit here is to further investigate plaster floor of Feature 1. The construction fill beneath the plaster floor is observed as a mix of small masses of limestone stucco, sandy-pebbled soil, gray-brown bichrome and monochrome ceramics sherds, and many lithic fragments. The paste of the ceramic sherds from this lot has evidence of atmospheric levels of oxidation and reduction techniques applied during firing – these common techniques are used to attain certain surface appearances of ceramic ware. A small concentration of fire-cracked limestone, a single jute shell, a small 2 cm obsidian flake, and greatly degraded limestone (initially thought to be pumice and recorded as such) were also present among the construction fill of Lot 3. Further analysis in the laboratory by Boudreaux determined that the piece of "pumice" rock was badly degraded limestone. Cementation could be identified by a hand lens, determining impossible to be pumice. Although the layer of construction fill is quite deep in comparison to its associated lots, there is no discernible consistency in the stratigraphic layers of Lot 3. The termination of Lot 3 came with a difference in soil texture, changing from the sandy-pebbled base into a fine, silty consistency. Lot 3 has a total thickness of 0.18 cm, with an average closing elevation of 143.2 cmbd.

Lot 4 was opened adjacent to Lot 3, or as an extension of Lot 3 in order for both lots to maintain equal closing elevations. Lot 4 is defined as a plaster floor with construction fill and midden refuse beneath. Collected materials included ceramic sherds, lithic fragments and an obsidian flake located in the central west section of Lot 4. The southwest quadrant was different in soil texture than the northwest quadrant – the southwest consisting of much looser soil, making it easier to excavate than in the northwest corner. The general soil texture for this matrix is similar to that of Lot 3, having mixed areas of dark brown clumps of clay in a base of ashy-gray sandy soil. Burnt limestone was also present in this lot, as well as broken plaster floor inclusions, recorded 40 cmbd. The total thickness of Lot 4 was 0.276 cm, with an average closing elevation of 150.6 cmbd. Termination of this lot was discerned by an arbitrary change of loose soil texture.

Lot 5 returned to a 1 x 1 m unit and continued to uncover more construction fill. The matrix of Lot 5 maintained a gray and light brown color with a loose sandy texture. The southwest corner of Lot 5 was dampened from rain, allowing the team to easily manipulate the soil and plaster chunks throughout the lot. Larger rocks were exposed in the southern half of the unit with a small cluster of rocks that were centrally located in the unit. Among recovered materials, a small piece of mica 1 cm in diameter, and an obsidian flake approximately 1.5 cm in diameter were collected – other collected materials included ceramic sherds, lithic fragments, shell and charcoal. The ceramic sherds continued to show the reddish-brown surface treatment (as has been noted in the previous lots). A circular piece of ceramic material, approximately 1 cm in diameter, was individually bagged for further analysis. Pieces of a broken jute and abalone shell were located and collected at 53 cmbs of the unit. Greater depths of the Lot 5 matrix revealed a dwindling return of collected materials, in comparison to the abundance of materials collected from shallower depths. A Munsell soil rating of 2.5y 5/2 has been noted for the lower portion of the lot. Lot 5 was terminated due a decrease of cultural materials and with a matrix change consisting more prevalently of rocky limestone.

Lot 6 opened with a poorly sorted matrix; large limestone pieces shifted into silty limestone grain, a precursor to approaching the limestone's parent rock. The collected and observed cultural materials still lacked in abundance within this lot. A large red-orange polychromatic ceramic sherd was observed and photographed. This piece was identified in the field by Boudreaux as a fragment from the lip of a vessel. This fragment was found protruding 6 cm from the northwest corner. It was not collected because the sherd extended beyond the boundaries of Subop A. Soil screening became more sterile with the majority being pebbles, irrelevant to data analysis. The final screens revealed a small amount of fire-cracked limestone as the total artifactual materials. Bedrock was exposed at a depth of 60 cm, having a higher elevation in the southeast corner. The terminating layer of bedrock encompasses the majority of the unit, and the southwest corner included fixed, limestone masses. A small amount of ceramic sherds were found directly on the bedrock at 155 cmbd. The bedrock denotes that Lot 6 is the terminus lot for Subop A.

Excavation Conclusions for Suboperation A

Subop A has proved that the area of excavation was indeed a region of refuse for the occupants of this site. This can be supported by evidence of rich organic humic soils, as well as organic soils identified in transitional Lots 1 to 3. The soils have also been identified and noted in the north and east wall profile maps associated with this unit (Figure 2). Collected and observed cultural materials are also indicative of common midden refuse. Artifacts reflecting the discarded waste of the Maya occupants in the Subop A area include: lithic fragments, pottery sherds, charcoal, fire-cracked limestone, obsidian flakes, and any floral and/or faunal remains that may be evident from soil samples. The location of this midden site, being "behind" STR 12, validates that Subop A was an area used for refuse.

The total thickness of the excavated unit amounts to 1.665 m below the secondary datum of Subop A, located east of STR 12, 6.15 m from the GPS point of N250W75 at 83º. Soil samples from the east wall, beginning with the humus, Lots 1 through 3 were collected for further analysis.

The 2012 field season will not need to re-open this unit because bedrock was found, terminating the unit. Prior to determining if Subop A should be extended to a 2 x 1 m unit, further analysis of our findings will need to be examined in the laboratory per collected materials. The same process will be necessary for the collected soils samples for floatation analysis. As for the closing of the 2011 field season, excavation results complied with the projected goals for the season. The next set of goals for the 2012 season will depend on conclusions and new hypothesis for the site after reviewing and comparing the data analysis.

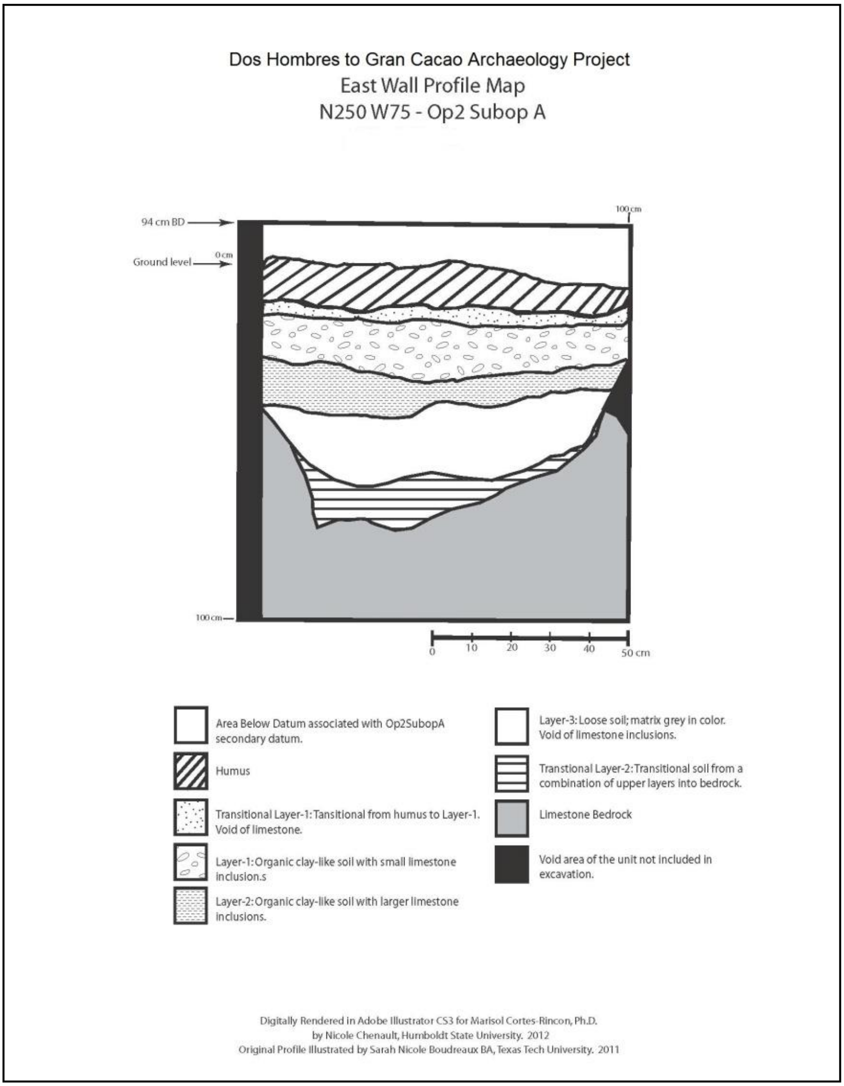

Figure 2. Op 2 Subop A East Wall Profile.

SUBOPERATION A: ARTIFACT ANALYSIS

Ceramics

Lot 1. Humic layer with no collected cultural materials.
Lot 2. Much of the collected ceramics were small and much eroded body sherds, with pitted surfaces. These sherds date the Late and Terminal Classic periods, Tepeu 2-3.
Lot 4. Early traces of the "older" dated occupational period appears in this lot. There are traces of Early to Late Classic sherds found here, defined as Tepeu 1-2. Surface finishes have been identified as Cubeta Incised, Tinaja Red, and Zibal Unslipped.
Lot 5. This lot included: Black and Red Modeled and Sierra Red. The Black and Red and the Sierra Red are from the Late Pre-Classic. This lot is defined as Tepeu 2-3 with a Chicanel trace.
Lot 6. This lot revealed sherds that were of undiagnostic conditions. They have been identified as Late Classic Tepeu 2-3, with the regionally common Belize Red surface finish.

Ecofacts: Shell and Charcoal

A total of three aquatic snails, known as jute, were found within Lots 2, 3, and 5. The internal meat of a jute snail are known to be a delicacy, or a revered food item for Maya of higher societal status. The few shells found here help to indicate the possible social order of the ancient Maya who occupied this settlement group. As for the charcoal-carbon sample that has been analyzed from this unit, only a single piece, with a weight of 0.1 g (this weight includes the tinfoil wrapping) was recovered from Lot 5. This charcoal found at this depth may be evidential of swidden agriculture among the area surrounding the settlement group.

Lithics and Miscellaneous Rock Samples

Specialized tools, like prismatic obsidian blades, were used for agricultural practices and food processing. Fragments of these blades have been found among multiple household groups in exploration along the DH2GC transect. Lot 5 of Subop A revealed one fragmented blade with a weight of 0.1 g. A miscellaneous rock sample included pieces of mica found in Lots 5-6, with a total weight of 3 g. Chert debitage is most prevalent in this unit, in comparison to the identified tools listed in Table 1. As for utilitarian chert tools, unifacial blade fragments, utilized flakes, and a drill/graver (all found in this stratigraphic order) have been identified and noted to be in good condition.

OPERATION 2 SUBOPERATION B

A 1 x 1 m test unit designated Op 2 Subop B was opened on May 27th 2011. This test unit was created and excavated to bedrock. Subop B is positioned 2 m west of STR 8 in a drainage depression that descends at a 302º azimuth. The measurement for the downhill orientation of the depression was taken off of a possible stone water management feature located 7 m from the northwest corner of the unit. The unit was placed at this location to collect refuse materials associated with STR 8.

Excavation Goals for Suboperation B

1. Define stratigraphy, chronology, and determine cultural or arbitrary strata
2. Observe and collect recovered artifacts within possible drainage area pertinent for future laboratory analysis
3. Recover soil samples for future laboratory analysis.

Results per Lot

Lot 1's surface of Subop B had a cluster of freshly sprouted vegetation near the center, perhaps indicating a high level of phosphorus in the soil. The humus was removed to expose the surface of Lot 1, revealing two distinct soil colors. The southwest corner of the unit contained a grayish, sandy clay loam that with a Munsell color code of 5 YR/2. The remainder of the surface of the unit was a dark sandy clay loam 10 YR/2. The southwest corner soil deposit about 5-10 cm deep. The possible flow appears to be originating from the gap between STR 8 and STR 7, leading into the patio. The material culture recovered in Lot 1 included ceramic sherds, lithic debitage, and shell. Most artifacts were small and fragmentary. The thickness of the lot was 18.4 cm and closed due to a soil change to very dark gray 5 YR/ 3/1.

Lot 2's matrix was much more gravelly and had less clay content than the previous lot. Fire-cracked limestone and a higher density of stone were excavated. The layer is possibly contemporaneous with the building collapse and contains ceramic and lithic artifacts. A plaster floor was encountered and Lot 2 was closed due to cultural change. A single flotation sample was taken in Subop

A upon the surface of a plaster floor at the termination of Lot 2. The plaster level was sparse suggesting erosion. Lot 2 closed at a thickness of 12.8 cm upon another soil change to packed soil and fragments of plaster.

A possible unfinished chert biface was identified on the surface of the start of Lot 3. The biface may have only been subject to a few percussion strikes before it was deposited. Lot 3 had a thickness of 17.4 cm and included construction fill comprised of small limestone pieces in lose gray soil. Very little cultural material was identified in comparison to Lot 2. Lot 3 closed when investigators reached either a plaster floor or bedrock. Upon the opening of Lot 4, investigators excavated into the soft limestone layer until concluding the soft layer of what appeared at first to be plaster transitioned to hard limestone. Bedrock was reached at 48.6 cm and the unit was terminated.

Excavation Conclusions for Suboperation B

Subop B was closed on June 2nd 2011, pictures were taken and profile drawings were made of the north and east walls (Figure 3 and 4). Profile soil samples were taken after the final photographs upon termination of the unit. Plan maps were made at the closing of Lots 1 and 2 (Figures 5 and 6). The excavated soils from each lot were screened through quarter inch mesh. Identified cultural material was collected and labeled in plastic bags, and then returned to the laboratory for analysis. A tarp was placed at the bottom of Subop B before backfilling to indicate to future investigators that this particular unit had been previously investigated.

Artifact Analysis for Suboperation B

Ceramics

Lot 1. Intermittent in the humic soils, Tepeu 2-3 body sherds were recovered from this lot. The sherds are very small and eroded with pitted surfaces. They have been dated to the Late Classic period at their earliest.

Lot 2. This lot carries over from Lot 1. Quality of preservation for sherds found within this lot is higher than Lot 1. A variety of Achote Black and Tinaja Red pieces were successfully identified which suggests Late Classic period occupation.

Lot 3. This is the final lot that recovered pottery sherds. Body sherds in this deposit were highly eroded. However, visible surface finishes were identified to most likely be Tinaja Red and Achote Black, which also date to the Late Classic period, Tepeu 2-3.

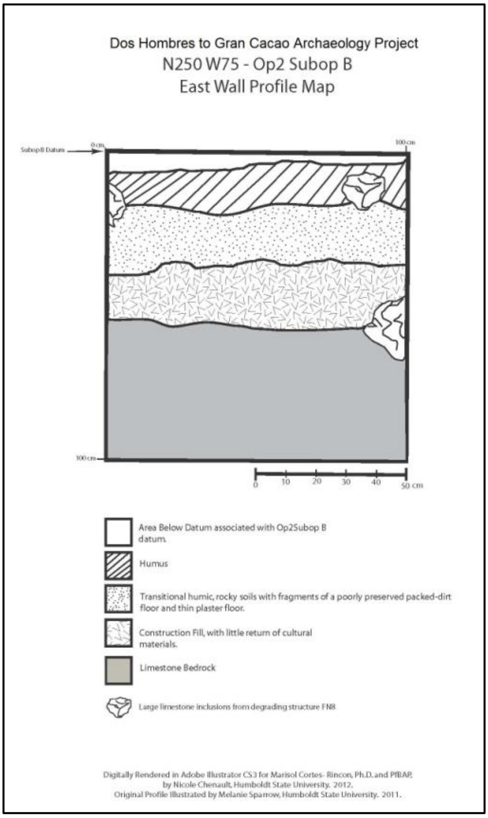

Figure 3. Op 2 Subop B East Wall Profile.

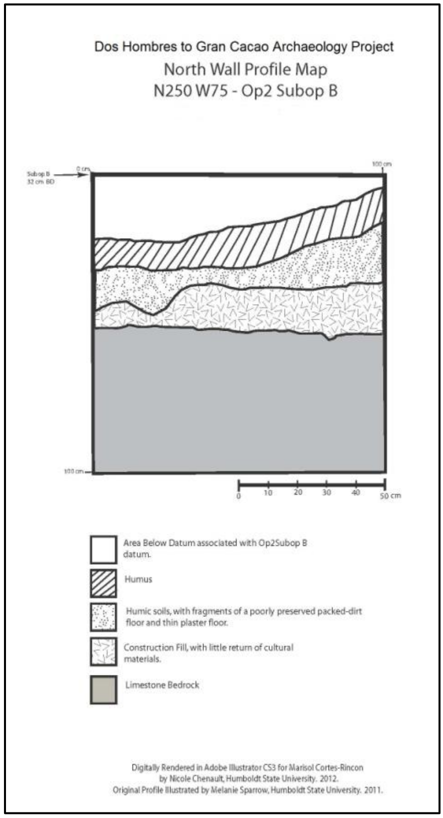

Figure 4. Op 2 Subop B North Wall Profile.

Ecofacts: Shell and Charcoal

Unlike Subop A, shell recovered from this unit were identified as land snail shells. Charcoal samples were also absent from this unit.

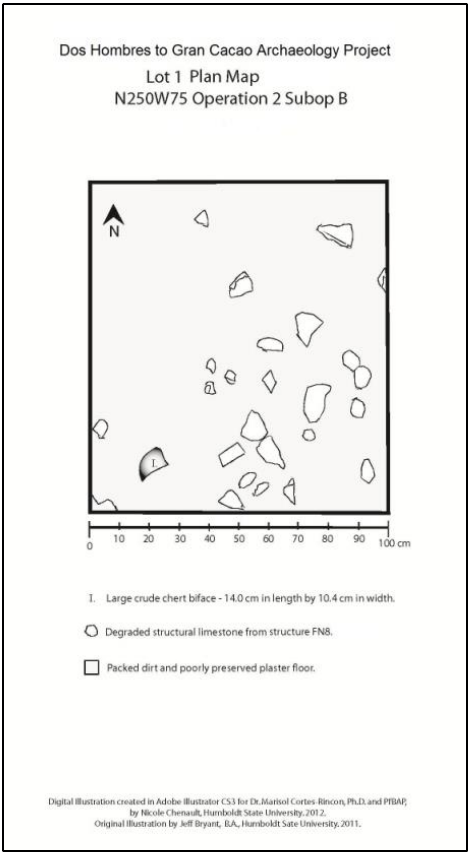

Figure 5. Op 2 Subop B Lot 1 Plan Map.

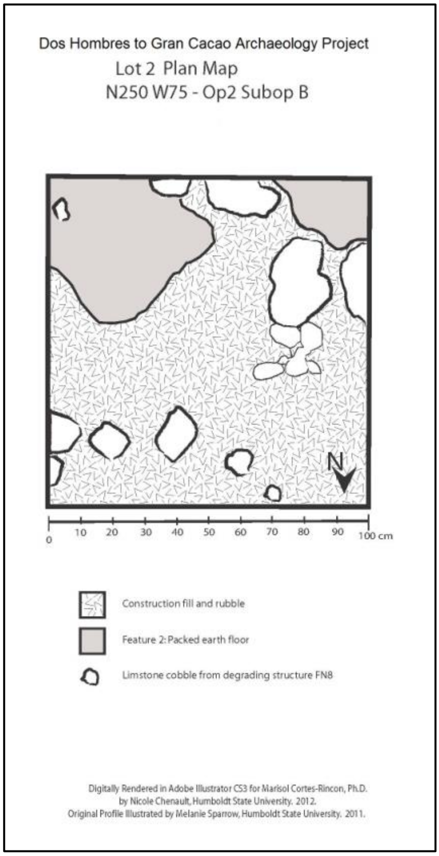

Figure 6. Op 2 Subop B Lot 2 Plan Map.

Lithics and Miscellaneous Rock Samples

The majority of samples analyzed from Subop A are comprised of chert debitage, but there are some considerable lithic tool samples inclusive of unifacial blades, utilized flakes, drills/gravers, scraper/drills, uniface fragments, and one thinly-constructed biface. All identifiable tools are made of chert, with a greater frequency of considerably "good" to "very good" quality artifacts. Many of these tools may represent a "new tool type" for this research area.

Preliminary Conclusions for Operation 2

Operations at N250W75 represent preliminary exploratory efforts to establish chronology and general activity in this area. Artifacts and data that were collected during the excavation process complement the overall goals of the DH2GC project. Ceramic analysis suggests that construction and occupation of this group dates to the Late Classic period, Tepeu 2-3.

Due to significant tree fall within the plaza of the N250W75 patio group, test units were positioned at the rear of structures to increase the likelihood of obtaining refuse materials. Despite the inability to excavate the plaza, examination of the artifacts collected from Subops A and B yielded sufficient information necessary to establish chronology.

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OPERATION 3: 2011 AND 2012 REPORT

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Sarah Nicole Boudreaux, University of Texas at San Antonio

Investigations at the N350W125 group began in the DH2GC 2011 field season and were completed during the 2012 field season. Research methods maintained the same order of operations and methods during both seasons. The primary reason for investigating this group is to understand its occupational history in order to gain comparative data for the broader Three Rivers region.

Operation (Op) 3 Suboperation (Subop) A is a 1 x 1 m test unit located within a group of Late to Terminal Classic (750-900 AD) superstructures at N350W125. A series of water management features and terraces are associated with this structural group. In 2011, Subop A was placed between superstructures STR 15 and STR 16, which are situated on a very well preserved basal platform. Subop A was situated in a probable refuse area, in the hopes of obtaining chronological diagnostic data. The unit was closed at the end of the 2011 field season and re-opened during the 2012 field season. Subop A reached an averaged depth of 60 cmbd and was closed after the bedrock surface was identified within Lot 5.

Subop B is located in *Aguada* 1, west of the N350W50 marker. This unit was also reopened in 2012, beginning with Lot 4, after a short season in 2011. A significant amount of cultural materials were recovered from this unit. Cultural materials included an array of ceramics, ecofacts, and some lithic artifacts. This unit terminated at bedrock, averaging a depth of 78 cmbd.

SETTLEMENT AND GROUP LAYOUT

Survey over the course of the 2011 and 2012 field seasons uncovered a grouping of eight superstructures atop an expansive platform. In addition to these structures, investigations located slope-terracing, cut-stones associated with water channels, as well as four small depressions presumably used for water catchment basins (Cortes-Rincon et al. this volume; Bryant this volume). This residential grouping is reflective of other settlement groups found along the transect; the neighboring site of N250 has similarly sized structures, but the layout is much less formal in nature.

OPERATION 3 SUBOPERATION A

Subop A is located 125 m west of the N350 baseline marker. It was opened on June 5th, 2011 and completed at the end of the 2012 season. The datum for Subop A was re-measured due to inadequate notation in the previous season. Lot termination was determined due to changes in soil composition and or cultural material deposits.

Excavation Goals for Suboperation A

1. To define stratigraphy and determine chronology.
2. Obtain refuse from FN 14 and 15.
3. Collect any pertinent cultural material and/or soil samples for analysis.

Results per Lot

Lot 1 of Subop A is a dense humus matrix with dark clay-loam humic soils. Total thickness for this lot was 13.2 cm. Minimal cultural materials were recovered. Lithic flakes first appeared near the center of the unit at approximately 70 cmbd, or 5 cm from the surface of Lot 1. Ceramic sherds, obsidian flakes, marine *jute* shells, and degraded stucco pieces and gravel are also inclusive of this lot. A Munsell reading was recorded at 2 SY 5/1. Large limestone protrusion from the southeast wall and north wall are marked at 30 cmbd. A shift in the matrix texture and color is the reason for closing Lot 1 at 68.8 cmbd.

Lot 2 increase of cultural materials that were obtained from this lot was recorded. Material included two prismatic obsidian blades, lithic flakes, ceramic sherds, and *jute* shells. The matrix content is made up of organic material, due to its sandy-clay-loam texture, and very dark grey-brown color; the Munsell reading is 10 YR 3/2. The type and quantity of cultural material found in this lot indicates that it is in fact a midden, fulfilling the goals of obtaining refuse from the southeastern rear of FN 14 and 15. Lot 2 was closed due to a decrease in material culture and a shift in soil color (no samples were collected for further analysis). This lot has a total thickness of 19 cm, with a closing elevation of 87.8 cmbd.

Lot 3 is evident of firmer, less organic soils with a significant decrease of cultural materials -- only small fragments of ceramic sherds and lithic flakes have been collected. Interestingly, the provenience of these artifacts is directly above an approaching plaster floor. The soil within the matrix maintained its sandy-clay-loam texture, with an increase in very malleable clay content, Lot 3 has a Munsell reading of 10 YR 5/2. The closing of the lot is due to a cultural strata change, by the presence of a plaster floor directly below. Lot 3 has closing elevation of 92 cmbd and a total lot thickness of 4.2 cm.

Lot 4 reveals much more cultural material and is defined as a very thick stucco-plaster floor, approximately 20 cm thick with some stone gravel ranging in various sizes from 3 cm to 10 cm in diameter. The lot was bisected in a north-south orientation upon finding the stucco floor for further investigation of the lot. Lot 4 was terminated due to time constraints. A 1 x 1 m tarp was placed in the lot before backfilling to aid in the lots re-opening in during the following field season.

Lot 5 was re-opened during the 2012 field season to identify the possible plaster floor. The "plaster floor" was determined to be bedrock. This bedrock surface was located approximately 40 cmbs which was similar to Op 2 Subop A and B.

OPERATION 3 SUBOPERATION B

Aguada 1 was rediscovered by Kyle Ports and Dr. Cortes-Rincon in 2011. This feature is considered to be one of three *aguadas* associated with N350W50. Subop B was a 2 x 1 m unit opened to investigate the limestone outcropping extending into the unit from the northeast corner. The unit is aligned at a 60° azimuth, and is tied into the N350W50 grid marker. The southwest corner of the unit is 11.43 m from the N350W50 point at a 25° azimuth.

Subop B was a very shallow unit with a total of three lots initiated on 6 June 2011. It located south of Subop A, at the base of the modified platform, and is displayed evidence of extensive erosion. The primary goal of this unit was to determine if *Aguada* 1 was a water management feature. Time constraints hindered thorough investigation of this unit. As a result, Munsell soil readings were not recorded. Subop B is tied into N350W50 as a secondary datum for Op 3, with an average opening elevation of 75.34 cmbd.

Excavation Goals for Suboperation B

1. Define stratigraphy, and chronology (if applicable)
2. Determine use of the feature
3. Obtain any cultural material for further laboratory analysis.

Results per Lot

Lot 1 is a thick humus deposit, which was thinner in the eastern section of the unit. This was a result of limestone outcropping in the northeast corner of the surface layer. Boudreaux notes that "the goal of the lot is to expose limestone in the majority of the unit" (2011). Lot 1 returned very few lithic fragments, ceramic sherds, and some jute shells. The termination of this arbitrary lot has been determined by finding limestone throughout the unit's initial humus layer, with a total thickness of 36.66 cm.

Lot 2 is determined by the increased amount of limestone inclusions in this transitional matrix, each approximating 6-7 cm. Transitional is defined by the humus-clay interface of this layer; the limestone inclusions are spread within the entirety of the matrix, with a reduction in stone size in the western end of the unit. The excavation supervisor recognized travertine (limestone) intermixed with the common limestone inclusions in Lot 2 (Boudreaux 2011) -- travertine is a geological indicator of the presence of steady water sources (Boudreaux, personal communication, 2011). There is not much of a return in findings of cultural material, yet the small amounts that have been obtained include larger pieces of ceramic sherds – some that can be fit together – lithic fragments, and few *jute* shells. The artifacts are concentrated primarily in the northwest corner of the unit's west end; termination of Lot 2, with a total thickness of 8.5 cm, is due to the prevalence and increased frequency of cultural material as digging continued.

Lot 3 is the final lot of this unit, defined as an interface layer, "the soil matrix changes in a horizontal direction, with limestone to the east and clay in the west" (Boudreaux 2011). The prevalence of material culture maintains the bulk of its concentration in the northwest corner of the west end of the unit. Lot 3 was bisected once the frequency of cultural material increased, but was then extended to the full length of the unit. Due to time constraints of the closing field season, this lot could not be investigated to its full potential. Having a total thickness of 1.5 cm, Lot 3 was terminated with artifacts to still in situ; bedrock has yet to be found.

Lot 3 was terminated during the 2011 field season; therefore, Lot 4 was opened in Subop B for the 2012 season. The north half of the unit had a high concentration of large limestone pieces that translates to construction fill or structural collapse.

There is a high probability that a retaining wall resided on the northern end in association with *Aguadas* 1, 2, and 3. The southern portion of the unit had a dense clay matrix. The goal of this lot was to find the dense limestone in the southern end that is associated with the northern end. There was very little cultural material that was found in the northern half. From the cultural material found in the unit, a refit vessel was recovered, along with a large amount of *jute* shells in the southwestern end. Lot 4 was terminated due to matrix change.

Lot 5 consisted of a clay matrix with small, degraded limestone inclusions. The Munsell reading for this particular matrix was 10YR 3/1. The cultural material in Lot 5 was significantly less except for the southwestern corner. More ceramic sherds and jute shells were found in this location. Carbon material and burnt limestone were also found in Lot 5, also concentrated in the southwestern portion of the unit. The specific location of the carbon was recorded as: 139 cmbd and 5 mm vertical distance from the datum in the southwestern portion of the unit. Lithic artifacts, which have been almost absent from Lots 1 through 4, were more prevalent in this lot. Lot 5 was terminated because large limestone rocks and construction fill were found throughout the entirety of the unit.

Lot 6 was almost sterile of cultural material. Only a few fragments of ceramics, lithics and shell were collected. The matrix is configured of large limestone rocks with loose (*sascab*) silty clay. The Munsell reading was 10 YR 6/1. Assuming that there is a cross-cut channel, or retaining wall, the limestone chunks in the northern end could be construction collapse. Bedrock was found at the close of this lot and the unit was terminated. Large limestone material was found near bedrock measuring 44.5 cm in width and 28 cm in length. Three stones were found that were near this size. More burnt limestone was found throughout this lot, along with carbon charcoal.

Discussion of Operation 3 Suboperation B Aguada 1

The initial goal in 2011 for the unit placement was to identify the edge and the midsection of the *aguada* in order to define its parameters. This *aguada* is associated with *Aguada* 2 and *Aguada* 3. In 2012, the area was cleared more thoroughly than the field season before. There is a retaining wall or cross-cut feature that is visible, adjacent to the northeast wall of Subop B. This water management feature connects *Aguada* 1, *Aguada* 2 and *Aguada* 3.

The depositional nature of the matrices corresponds with that of a typical *aguada* (Figure 1). The humus deposit was much deeper toward the south end of the unit. In relative terms (comparing this excavation with others along the DH2GC transect), there was little cultural material recovered in this unit. This finding is similar to the excavation of Op 4 Subop E and I, a 2 x 1 m controlled unit within an *aguada* associated with the N950 group, which has been regarded as occupied by those of a more elite status (see Moats and Boudreaux this volume, for information about the excavations at this group). Op 3 Subop B findings are similar to the N950 group's *aguada*, being that there was almost no cultural material found within Subop E and I. Of the most common artifacts to be recovered from excavations within water catchment features in the Maya region, ceramic sherds were the majority of cultural artifacts found. There is a common theme of finding much debitage at the base of such water management features, providing that the use of the feature would have changed from its primary use as water reserve, to a secondary use as one of many suggested options, such as a controlled area for catching debitage during the process of flint knapping or working with lithic tools (Cortes-Rincon, personal communication, 2012; Weiss-Krejci and Sabbas 2002). As for the ceramic data, there are several ceramic refits within the material recovered, so the minimum number of individual (MNI) complete ceramic artifacts for the data set is low. The second most abundant cultural material that came out of the unit is *jute* shell and carbon. Most artifacts were concentrated in the southwestern corner of the unit. With the concentration of artifacts in one locale, the high number of ceramic refits and the large number of *jute* shell collected, it is possible that a vessel was holding the jute and broke in situ. The vessel is identified as being a water vessel from the Tepeu 1 period (Lauren Sullivan, personal communicaiton 2011).

OPERATION 3 SUBOPERATION C

Subop C is a surface find, yet it was given a Subop reference due to its rarity within our project area. Midway through the 2012 season, the survey team located this artifact between STRs FN 51 and FN 52; it was collected by the excavation team working among the N350 site. This fragmented stone is made of granite, and is a considerably larger artifact than what is commonly recovered and collected among the project's various sites. The granite groundstone was first potentially identified in the field as a *metate* or mortar by the project's field director, Sarah Nicole Boudreaux.

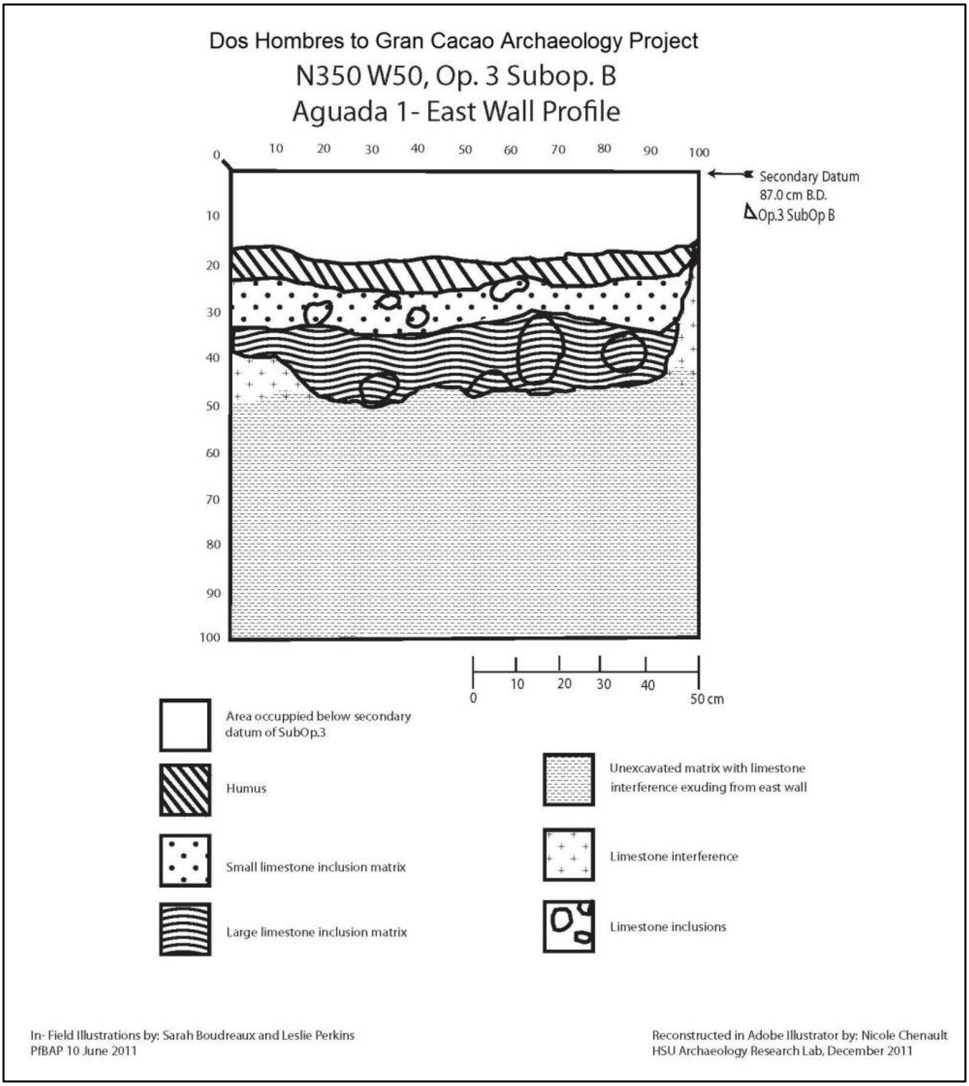

Figure 1. Op 3, Subop B, east wall profile.

The stone artifact was positively identified as a fragment of a granite *metate* by Dr. Grant Aylesworth in the PFB La Milpa Research Laboratory. Dr. Aylesworth and his associates had found a complete granite *metate* among the La Milpa region years prior; there has yet to be any conclusions produced on the source of the *metate*, although he has stated that these sources come from the Guatemalan coast and highlands (Aylesworth, personal communication, 2012). The location of the artifact has been recorded as a GPS point in the Mobile Mapper 10, and will be further analyzed and documented within a database. The analysis will correspond with project goals of studying settlement patterns and heterarchical trading networks among the occupants of these hinterland sites.

ARTIFACT ANALYSIS FOR OPERATION 3 SUBOPERATIONS A, B, C

Ceramics

The ceramic sherds recovered from excavations at Op 3 are predominantly from the Tepeu 2 and Tepeu 3 ceramic periods, these correlate with the Late to Terminal Classic (750-900 AD) periods of occupation (Table 1). Body sherds dated to Early Classic forms were highly eroded, yet capable of discerning surface finishes ranging from Sierra Red, Achote Red and Tinaja Red (Boudreaux and Sullivan, this volume). Overall, ceramic complexes identified between both Subops A and B included slipped wares reflecting an Early Classic to Late Classic occupation (250-750 AD).

Subop B revealed sherds dated to the Early-Late Classic, and Late Classic through the Terminal Classic periods. Two distinct smashed vessels were collected from Subop B, located within one of three water basins located 10 m to 30 m north of the N350 W50 marker. These forms of refit jar rims are dated from the Tepeu 1, early in the Late Classic period (Boudreaux and Sullivan, this volume). The second jar found deeper within the unit's stratigraphy (Lots 4 and 5) included an array of shattered sherds and refit striated body sherds with an intact rim; the refit sherds were large and in thirds. The shattered form has been identified as a Cayo Unslipped jar, dated in accordance with the Late Classic Tepeu 2 period. Zibal Unslipped forms found in Lot 3 have also been identified from this lot. Aside from the diagnostic sherds able to be positively typed, the majority of sherds from Subop B have been dated to the Tepeu 2 and Tepeu 3 Late and Terminal Classic periods. Many sherds were catalogued as undiagnostic and too eroded in form to discern any chronological data (Lauren Sullivan, personal communication 2011, 2012).

Fitting with the common theme of settlement patterns for the Three Rivers Region, the area was most likely revisited after the Early Classic hiatus ca. 534-

589 AD (Sullivan and Sagebiel 1999), and re-occupied due to an increase in population and resource specialization, including pottery production.

Table 1. Ceramics data per lot for Op 3.

Op 3 Subop A		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 2/Chicanel-Tzakol Trace	LPC-LC
Lot 3	Tepeu 2	LC

Op 3 Subop B		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 1	LC
Lot 3	Tepeu 2	LC
Lot 4/5	Tepeu 2	LC
Lot 6	Tepeu 2-3	LC/TC

Lithic, Obsidian and Miscellaneous Stone Tools.

The lithic material that was collected from Subops A and B were found in very minimal numbers. Subop A revealed undiagnostic debitage early in the excavation. Lot 2 consisted primarily of worked, or flaked chert that is common to the natural environment. Obsidian was also found minimally from this unit. The fragmented pieces collected were most likely from a prismatic blade commonly found in excavations within the project area; these are believed to be specialized for the purposes of gardening and the cultivation of plant crops. Lot 2 and below, became sterile of lithic materials, revealing features of a plaster floor, construction fill and components of limestone cobble and ceramic sherds.

Subop B was placed within a small depression, presumed to be a water management feature upon its opening in 2011. This depression is commonly referred to as *Aguada* 1 in various notes on this site. Chert debitage correlates with materials found between 10 and 40 cm within the unit; most lithic material decreased greatly at depths of 40 cm and below, with the exception with a few small pieces. Most of the remaining stone was collapse or limestone rubble from the perpendicular wall adjacent to the north wall of the unit. This alignment is believed to be a water channel directing water between *Aguada* 1 and the other two water management depressions close by. Worked lithic materials decreased considerably as the excavation moved through the clay deposits, and upon reaching a transitional layer and eventually to the degraded limestone bedrock at 169 cmbd.

Subop C has no correlation with both worked lithic materials and obsidian, because the Subop itself is the surface collection of the granite groundstone artifact (as explored previously).

Ecofacts, Shell, and Charcoal.
Between Subop A and B, significant amounts of shell ecofacts have been recovered from these units. The most significant of the combination of collected shell artifacts are the shells known to modern day Maya as *jute*, or the freshwater mollusk *Pachychilus* (Healy et al. 1990). Subop A and Subop B combined for a total 29 MNI of jute shells, 24 of which came from Subop B. Interestingly, the majority of *jute* collected from this unit, as well as the two to three shells that were observed *in situ* of the southeast wall, were associated in very close proximity to the Tepeu 1 refit ceramic jar found in Lot 5. The accumulation of these shells were located beneath the ceramic jar fragments; allowing us to postulate that the *jute* shells were contained within the jar upon the smashing or placement of the vessel within the basin of *Aguada* 1. Much of the carbon charcoal samples collected were also in direct association with these artifacts. The accumulation of *jute* in association with the sherds of the refit jar, may imply that these artifacts were placed within *Aguada* 1 as a ritual offering. Healy et al. (1990) notes that it was common for Classic Period Maya to gather *jute* as a ritual item. It was also noted that these snails survive in non-stagnate waters, which could also show a possibility that the snails were actively maintained in these water catchment basins in order to sustain clean, consumable water.

Analysis of Water Management Features -- *Aguadas* and Channels.
The water management features associated with the N350 settlement group reflects common characteristics of Maya Lowland *bajo* farming communities. The poorly drained, clay and karstic soil makeup of the DH2GC project area, would have required communities in the region to modify the landscape for personal consumption, resource harvesting, and water reservoirs. Aside from the three water basins off the N350W50 marker, there is also a visible channel placed centrally to the three *aguadas*, that is believe to act as an overflow feature between the water basins. Another series of irregular channels and a larger *aguada* feature

have been identified among the structural group at the N350W125 marker. These are located behind the structures, to the northwest of the structural platform. These water management features eventually run to a series of terraces that were most likely used with agriculture and any slope terraces that have yet to be identified (Bryant, this volume).

The volumes and estimated water capacities in Figure 2 are for the area below datum. The area from the surface to the datum has yet to be subtracted from each volume; therefore, these capacities are larger than what is presented here.

h **= Height** ***w*** **= Width** ***L*** **= length** ***pi*** **= 3.1415...**

Volume = [*h* (1/2) * (pi)] * [*L* / 2) * (*w* / 2)

Aguada **1:**
h= 1.65 m (average depth of depression)
w= 6.6 m
L =6.0 m

V= 25.65882 m3 estimated capacity: 6778.34 gallons (25,658.82 liters)

Aguada **2:**

h= 1.67 m
w= 8.48 m
L= 8.50 m

V= 94.41 m3 estimated capacity: 24,940.48 gallons (94,410.00 liters)

Aguada **3:**

h= 1.127 m
w= 6.2 m
L= 8.27 m

V= 22.683 m3 estimated capacity: 5992.21 gallons (22,683.00 liters)

Figure 2. Volumetric Data for *Aguadas* 1-3.

PRELIMINARY CONCLUSIONS OPERATION 3

Subop A produced a greater quantity of cultural material than Subop B -- these findings support the hypothesis that this is a residential group, and the location of a midden. The midden matrix reveals evidence of foods items, such as aquatic *jute* shells, that can be a predictive marker of higher social status. Other social status indicators include evidence of stonemasonry, the elevated location, the modified platform where the residential structures are located, and the close proximity of water management features to the residential group. The combined data can be interpreted as markers that this group had control over water, a salient notion of power by having greater influence among the community during the hardships of depleted resources of the Terminal Classic period of occupation.

There was little to no evidence of a plaster lining in the bottom of the feature. If there was, such a characteristic can conclude the modified, intentional use of the depression for retaining water. However, further investigation is needed in order to verify this hypothesized feature. For a continued discussion about the water features in this area, please see Chenault et al. this volume.

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OPERATION 4: 2011 AND 2012 REPORT

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The N950 group was first located in 2004 by Rigden Glaab (Glaab and Taylor 2004). It was subsequently relocated in 2010 and mapped the following year. Formal excavations at the N950 group began during the DH2GC 2012 field season. Located approximately 1.5 km from the main plaza of Dos Hombres, the N950 group is situated in an upland forest atop a modified knoll. This area is considerably higher than the preceding sections of the transect and contains various structural and cultural features. The natural landscape atop, and surrounding the knoll has undergone significant modification. The largest structure associated with the N950 group is a temple like mound, denoted FN 36. It is situated on the eastern side of the knoll and would have commanded a powerful view of the region during the time of the ancient Maya. Four additional structures are positioned atop the knoll and there are additional structures in close proximity at lower elevations. Additional features associated with this area include terraces, possible stairs, possible monuments, water management modifications, platforms, and caves.

Caves were a significant aspect of ancient Maya life. These features held ritual connotations and were associated with life and death. Additionally, they were believed to function as bidirectional connections to the underworld (McNatt 1996). Some specific functions of caves are sources drinking water, sources of "virgin water" for rituals, religious rites, burials, ceremonial dumps, or simple places of refuge (McNatt 1996). Water was also highly valued by the Maya for ritual purposes and as a basic necessity for life. *Aguadas* are one type of water feature utilized by the ancient Maya. These multifunctional natural depressions were used for water storage, and were sometimes modified to serve as clay mines, *sascaberos* or rock quarries (Ashmore and Knapp 1999). There are three possible *aguadas* at N950, along with other water features such as water basins, and the remnants of a water channeling system. Possible *chultuns* have also been observed. In the central Maya lowlands, *chultuns* have been documented as being used as latrines, limestone quarries, burial chambers, food repositories, and water cisterns (Weiss-Krejci and Sabbas 2002). This preliminary evidence may indicate that N950 operated as either a minor regional management center or a small ceremonial complex. A research design was created to outline excavation procedures at N950 for the 2012 field season.

EXCAVATION GOALS FOR OPERATION 4

The primary goals of the 2012 field season at N950, were to establish an occupational chronology for the area and to conduct preliminary investigations as to the possible roles that this group fulfilled within the region. Nine test pits were opened at strategic locations atop the main knoll and in the structure groups below the top of the knoll to the northeast. Four subterranean features, speculated to be either caves or *sascaberos*, were also investigated (See Ports this volume, for information regarding subterranean features in the N950 group). Provided below is a brief overview and interpretation of each Subop opened at the N950 group (Op 4).

RESULTS FOR SUBOPERATION A

Subop A was a 1 x 1 m unit on the southwestern side of FN 36. The unit was opened to determine occupational and constructional chronology for FN 36. Excavations began with the removal of a dark, organic humus layer that contained a thick root mat (Munsell: 5YR 6/1, gray). The total ceramic assemblage for Lot 1 was 286 individual pieces, with 80% of those being undiagnostic ceramic sherds. The remaining 20% consisted of various sherds dated to the Late and Terminal Classic periods Tepeu 2-3.

Below the humus layer (Lot 2), the soil became lighter brown, with a finer consistency (Munsell 7.5YR 5/2, brown). Large quantities of ceramics continued to be removed from the lot, as well as lithic and shell artifacts (Table 1). Several charcoal samples were taken from this lot. Lot 2 also contained medium sized collapse debris from FN 36. The termination of Lot 2 was the result of a soil change.

Lot 3 contained mainly collapsed debris from the adjacent FN 36. Ceramics and lithics continued to be collected as well as unworked marine shell fragments and one charcoal sample (Table 1). The lot was terminated when a deteriorated, light grey plaster floor surface was encountered. Ceramics recovered from Lot 3 were analyzed by Sullivan (personal communication) in 2012 and were dated to the Terminal Late Preclassic to Protoclassic periods, and were among some of the oldest ceramics recovered from the N950 group (Table 1).

The plaster floor encountered in Lot 4 was only preserved in the eastern portion of the unit and extended approximately 50 cm to the west before it became indistinguishable in the unit. The floor was heavily pitted and highly eroded. In order to further investigate the chronology associated with this area, the unit was divided in half and excavation continued in the western portion of the unit. Below the floor was a layer of subfloor fill, consisting of small dry laid cobbles approximately 8 cm thick. Subop A was terminated below the subfloor fill, following the discovery of the bedrock surface.

Ceramic analysis of material recovered from Subop A concluded that the majority of ceramics dated to the Late and Terminal Classic periods TR-Tepeu 2-3 (Table 1). This is consistent with other units investigated within the N950 group. However, a small portion of the ceramic assemblage was dated to the Terminal Late Preclassic/Protoclassic periods.

Table 1. Ceramic data for Subop A.

Op 4 Subop A		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 2-3	LC/TC
Lot 3	TLPC/Protoclassic	LPC-EC

RESULTS FOR SUBOPERATION B

Subop B was a 1 x 1 m unit placed on the northern side of FN 36. This unit was opened to investigate the chronology associated with this portion of the structure. Lot 1 contained a dark brown humus layer, which was similar to the topsoil seen during investigations of Subops A and D. Ceramic and lithic material recovered from Subop B Lot 1 were less abundant than quantities retrieved from Subop A Lot 1. There was a concentrated burned area in the southern portion of the unit; charcoal samples and burnt limestone samples were collected. An abundance of collapsed debris, consisting of large displaced stones from FN 36, were present in the unit. One stone became visible during excavation, which appeared at first to be insignificant. Further excavation revealed that this stone was a large boulder that occupied approximately half of the unit. The boulder's dimensions continued outside of the unit to the north, east, and west, inhibiting its removal. This stone exhibited a smooth face along its lower extent indicating possible architectural manufacturing. An insufficient amount of the boulder was revealed during excavation to allow for a conclusive analysis of its purpose. However, preliminary observations about its possible function can be postulated. A series of terraces descend the knoll to the east of FN 36. It is believed that a section of these terracing features could be a series of steps connecting the base of the knoll to FN 36. This stone may represent the initial finding of these steps. Lot 1 was closed after the soil changed from a very dark brown to a very dark gray (Munsell: 7.4 YR 3/1).

Lot 2 contained ceramics that were dated to the Tepeu 1-Tepeu 2 and Tepeu 2-Tepeu 3 ceramic spheres spanning a time from AD 550-950 (Table 2). Many of these sherds were large and appear to be possible refits. A fragmented, but complete Late Classic ceramic base was photographed and removed, as well as several large sherds that lay in close proximity to the base. Due to heavy rain and the inability to cross the Rio Bravo River because of flooding, Subop B was terminated before a probable plaster floor surface was encountered. A plan map and two profile maps were illustrated and then the unit was backfilled. There are plans to re-open this unit during the 2013 field season.

Table 2. Ceramic data for Subop B.

Op 4 Subop B		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 1-2/Tepeu 2-3	LC

RESULTS FOR SUBOPERATION C

Subop C was a 1 x 1 m unit located in a low-lying area between FN 30 and FN 32. The purpose of this unit was to investigate the chronology associated with this structure group. Lot 1 was comprised of a shallow humus layer of dark brown soil that was interspersed with subfloor fill. The presence of a subfloor at this depth suggests that the original plaster floor surface was shallowly buried. During heavy rain, water is channeled through this area. These factors contributed to complete erosion of the floor, leaving only the subfloor fill as an indication of its existence. Lot 1 was terminated when the subfloor fill/cobble debris changed in size.

Lot 2 contained medium-sized cobbles, a few ceramics sherds, and lithic debris. Burnt limestone cobbles intermixed with the subfloor fill were noted. A 2-3 cm thick floor was observed in the unit's profile, but due to poor preservation was not recognized during excavation. Another layer of cobble fill was discovered below this surface. This lot was approximately 11 cm thick and terminated on the natural bedrock surface. Ceramics recovered from Subop C were dated to the Tepeu 1-Tepeu 2 phases, between 550-850 AD (Table 3).

Table 3. Ceramic data for Subop C.

Op 4 Subop C		
Lot 1	Tepeu 2	LC
Lot 2	Tepeu 1-2	LC

RESULTS FOR SUBOPERATION D

Subop D was a 1 x 1 m unit located near the center of the main plaza area of the N950 group, to the west of FN 36. This unit was opened in order to better understand the occupational chronology of this area as well as investigate the construction episodes associated with the plaza area. Lot 1 contained a dark brown humus layer (Munsell: 10 YR 2/1, black) with a thick root mat that corresponded to Lot 1 in Subops A and B. Very few ceramics or lithics were recovered from this lot, and the ceramics that were removed were small and heavily eroded. Lot 1 was terminated due to a soil change.

Lot 2 was comprised of a highly organic sub-humus layer of dark brown soil. Some large stones were noted during excavation that appear to be collapse debris from surrounding structures. The discovery of bedrock established the opening of Lot 3. Lot 3 was unusually shallow, located approximately 30 cmbs. A thin patchy layer of plaster was present on the bedrock's surface. It appears that the bedrock was leveled by cutting the surface and adding fill where necessary. Then a thin layer of plaster was added on top of the bedrock to create a surface that served as the main plaza floor.

As mentioned, ceramics recovered from Subop D were heavily eroded (Table 4). This is likely due to the shallow nature of the unit. It was also noted during excavation that the area is ideal for water runoff during heavy rains. Sherds from Lot 1 were characteristic of Tepeu 2-3 styles of the Late to Terminal Classic periods (750-900 AD). Within Lot 2, one ceramic sherd was recovered that had heavy white inclusions and a light paste that is similar to ceramics found in the *Xunantunich* area to the south. While this anomaly is interesting, it does not give enough information to provide conclusive data.

Table 4. Ceramic data for Subop D.

Op 4 Subop D		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 2?	LC

RESULTS FOR SUBOPERATIONS E AND I

Contribution: David Sandrock

Subop E was placed with the intent of uncovering the top southern edge of an *aguada* designated FN 29. During excavation, a stair feature was uncovered, measuring approximately 25 x 20 cm. Preservation of the feature is fairly poor, due to heavy abuse from rainfall and tree root growth. The southern, eastern, and northern edges of the stair were revealed in Subop E, but it was necessary to open Subop I, a 0.5 x 1 m unit adjacent to the western edge of Subop E to fully expose the feature.

Subop I revealed the western edge of the stair, approximately 1 m west of the eastern edge of the stair feature in Subop E. The few cultural materials recovered from Subop I were poorly preserved. However, the shape and form of some ceramic sherds suggests a Late and Terminal Classic TR-Tepeu 2-3 phase (Table 5).

Table 5. Ceramic data for Subop E.

Op 4 Subop E		
Lot 1	Tepeu 2-3	LC/TC

The construction height of the individual stairs is approximately 20 cm. Use of the feature is unclear, but it appears to be a step-sided *aguada*, and possibly the start of a water catchment feature extending toward and down the hillside to the west and southwest.

RESULTS FOR SUBOPERATION F

See Ports this volume. See Table 6 for recovered ceramics.

Table 6. Ceramic data for Subop F.

Op 4 Subop F		
Lot 1	Tepeu 2-3	LC/TC
Lot 2	Tepeu 2-3	LC/TC

RESULTS FOR SUBOPERATION G

Subop G was a 1 x 1 m unit located approximately 45 m north-northeast from the northern section of the base of the N950 knoll. The unit was placed at the center of the *plazuela* between STRs FN 43 and FN 44. This unit was opened in order to investigate the chronology of an area within the vicinity of the N950 knoll.

Lot 1 contained a dark humus layer with a thick root mat that comprised of limestone inclusions as well as collapsed debris from the surrounding structures. Fifty-six well preserved ceramic sherds and 24 lithics were recovered from Lot 1. The lot was terminated when a plaster surface was encountered. This floor was labeled Lot 2.

The floor in Lot 2 was excavated to investigate earlier construction episodes, but due to time constraints from heavy rainfall, this unit was terminated before further surfaces could be found. There are plans to continue excavation of this area during future field seasons. Ceramics from this unit were diagnostic of the Tepeu 1-Tepeu 2 spheres, approximately 550-850 AD (Table 7).

Table 7. Ceramic data for Subop G.

Op 4 Subop G		
Lot 0	Tepeu 1	LC
Lot?	Tepeu 1-2	LC
Lot 2	Tepeu 1-2	LC

RESULTS FOR SUBOPERATION H

See Ports, this volume

RESULTS FOR SUBOPERATION J

Contributions: Adam Forbis and Nic Grosjean

Subop J is a 1 x 1 m unit located at N750. This area is composed of three structures that surround a small *plazuela*. Similar to Subop G, this unit was opened in order to collect data on a group within the vicinity the N950 knoll. Lot 1 consisted of a dark brown humus layer that contained ceramic sherds (Table 8), numerous lithic flakes, and one obsidian prismatic blade fragment. Lot 1 was approximately 11 cm thick and was terminated when the consistency of the soil changed.

Lot 2 contained a dark brown soil with numerous small limestone inclusions. This lot continued to yield large quantities of ceramics (Table 8), lithic debitage, and obsidian blade fragments. Burnt limestone was also noted within this lot. Two lithic bifaces manufactured of high quality chert and a nearly complete obsidian blade were retrieved from the southern portion of Lot 2. The bifaces displayed evidence of use wear. Lot 2 was approximately 28 cm thick and terminated with the appearance of limestone inclusions within the matrix.

Lot 3 was characterized by much larger stones than were encountered in the previous two lots. These stones were identified as collapsed debris from the surrounding structures, FN 23 and FN 24. Lithics were numerous within this lot and included chert and obsidian flakes as well as fragmented obsidian blades. Within this lot, the number of ceramics decreased (Table 8), although lithic materials remained consistent with previous lots. Lot 3 also yielded a polished, rectangular shell pendant with a beveled drill hole on its ventral side. Due to time constraints from heavy rains this unit was terminated before a formally prepared surface or bedrock could be encountered. The unit was well documented; photos and illustrations were taken and the unit was backfilled.

Table 7. Ceramic data for Subop G.

Op 4 Subop J		
Lot 1	Tepeu 2	LC
Lot 2	Tepeu 2	LC
Lot 3	Tepeu 2	LC

INTERPRETATIONS AND CONCLUSIONS BASED ON THE 2012 EXCAVATIONS

Based on excavations conducted during the 2012, several preliminary observations can be made pertaining to the function of particular locations within the N950 group. First, excavations centered on FN 36, the largest mound associated with the area, suggest that it could have functioned as a boundary, separating two activity areas surrounding the knoll on which the majority of the group rests. To the south of this structure, two units were placed at its base that revealed large numbers of broken ceramic sherds. The first unit, Subop A, was located on the southwestern side of FN 36 and included large quantities of broken ceramic sherds of various size coupled with some lithic debitage and a small amount of shell debris. Since very few of the sherds appear to be refits, this area is believed to be a midden where debris from FN 36 had accumulated. This is interesting since this area is on the southwestern periphery of the large plaza that spans much of the knoll. It is also interesting because, if this interpretation is correct, it would mean that FN 36 faced away from the plaza area, since middens are generally associated with the back or rear of structures. This would suggest that FN 36 is a small eastern facing temple, overlooking a minor configuration at the base of the knoll (FN 30 and FN 32). A structural protrusion exists on the eastern façade of the mound that could be a heavily deteriorated set of stairs. This will be further discussed in the proceeding paragraphs.

The second unit associated with FN 36 was Subop B, which was located on the northern side of the structure. Excavations in this area also revealed a large number of broken ceramic sherds coupled with lithic and shell debitage. In this instance, most of sherds recovered appear to be refits and included several *incensario* fragments. Also included within this unit were several burnt limestone pieces and some burnt ceramics suggesting a specific activity occurred within this location. Given these finds, this area shows characteristics of a possible termination event conducted at the base of FN 36. While it might be premature to call this accumulation of artifacts a byproduct of ritual activity, the concentrated placement of these items at the base of a temple like structure at the group seems noteworthy. Further research is required in order to ascertain the extent and purpose of this possible cache. To the east of Subop B there is a steep elevation change down the knoll towards FN 30 and FN 32. Evidence of stepped terracing was noted on this section of the knoll and it is believed that the large stone present in Subop B may be a remnant of a series of steps associated with FN 36, FN 30, and FN 32.

Excavations in Subop G and Subop J revealed information about two small *plazuela* groups within 200 m of the N950 knoll. The close proximity and comparable ceramic complexes created a preliminary association with the N950 group. Excavations at Subop G were prematurely closed due to weather conditions. As such, little interpretation can be provided until excavation resumes during the 2013 field season. Investigations of Subop J showed that the *plazuela* group likely served an elite function where lithic materials were heavily utilized. This included several lithic tools and tool fragments, made of high quality chert, that were found in large quantities throughout Subop J. In addition to this, obsidian blade fragments were also numerous. The formally prepared bifacial tools, the nearly complete obsidian prismatic blade, and the heavily polished and ornately made shell pendant were the first discoveries of their type documented along the DH2CG transect. These artifacts represent an association with elite activity, which reinforces the assumption that the N950 group was a significant area within the region.

Ceramic data recovered during the 2012 field season show that the earliest occupation of the area occurred during the Terminal Late Preclassic to the Proto/Early Classic (ca. 350 BC - 250 AD). Evidence for this occupation was concentrated in Subop A, on the southwestern corner of FN 36. Based on this data, it appears the earliest activities were small, and concentrated around FN 36. The area expanded considerably during the Late Classic, evident by Tepeu 1-2 ceramics found in Subops B, C, and D; three separate areas within the N950 group. This shows that by the Late Classic (ca. 550-850 AD) (Table 5.1), the area was expanding and becoming more heavily utilized. This expansion appears to be concentrated in the eastern portion of the area, given the location of the Subops containing Tepeu 1-2 ceramics. Construction continued in the area throughout the Late Classic period, manifesting in the form of Tepeu 2 ceramic types (ca. 700-850 AD).

During this time the *plazuela* group located at N750 was heavily utilized, since all ceramics recovered from Subop J date to this time. Ceramics from this period were also recovered from Subops C and D. The N950 group was most heavily occupied during the Late to Terminal Classic periods (ca. 700-950 AD) with over half the units excavated in the area containing Tepeu 2-3 ceramics (Subops A, B, D, E, and F). Three of these units (Subops A, B, and D) are located on the main knoll near FN 36, the fourth (Subop E) was associated with the largest *aguada*s in the area, located to the west of FN 28, and the fifth was inside SubT 3 (Ports, this volume).

The apparent significance of FN36 as well as the ritualistic nature of associated features, the commanding view of the natural environment, and its close proximity to Dos Hombres, implies the N950 group may have served as small-scale ceremonial or micro-regional administrative site. The eastern orientation of FN 36 and its presumed significance within the immediate region implies the need to employ a secondary or subservient interpretation to other structures atop the knoll. Additionally, future investigation must be guided with an aim towards understanding the roles of associated structures within the vicinity of N950 and its relationship to outlier communities.

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CERAMIC ANALYSIS FOR THE 2011 AND 2012 FIELD SEASONS

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This first written report on the DH2GC ceramic assemblage offers a preliminary analysis of the 2011 and 2012 data. These data come from excavations conducted within structure groups N150E75, N250W75, N350W125 and W50, N950 found along the DH2GC transect. Test units were placed within the courtyards and midden areas of these groups in order to establish chronology via ceramic typological analysis. Excavations within refuse areas typically yield a large amount of information by examining the nature of the depositional history, including construction history and chronological information. This paper briefly goes over the methods utilized for the ceramic analysis, results of the analysis, as well as a brief comparison of chronology within the transect and the broader Dos Hombres suburban area.

METHODOLOGY

The DH2GC completed the ceramic analysis of the 2011 and 2012 field season during July of 2012 with a considerable amount of help from Dr. Sullivan. Others involved were Sarah Nicole Boudreaux, Lindsey Moats, Nicole Chenault, Sophia Chorich, Marisol Figueroa, Dr. Marisol Cortes-Rincon, and Kyle Ports.

The initial analysis included traditional type-variety methodology in order to ascertain the chronology of each lot and to understand the chronology of the entire excavation unit. The DH2GC also utilized quantification methods within the ceramic collection to better understand chronological data as a whole in addition to diachronic trends.

The type-variety system was first used to analyze the ceramic assemblage at a site called Barton Ramie by James Gifford and PfBAP analysts have used this method to define and date ceramics in the RBCMA since 1992 (Gifford 1976). This system is useful for dating because of the consistency of the typology due to its long use history in the area and its consistent nature. Analysis using the type-variety method usually consists of recording a general time period that is defined by the most recent sherd present in the lot. Chronological sequences and definitions that are assigned to sherds and excavation lots come from Sullivan and Sagebiel (2003).

In addition to the type-variety method, the DH2GC added another layer of analysis by recording the counts of different ceramic types within each lot to conduct statistical analysis in the future. For example, diagnostic sherds were counted and recorded using specific artifact numbers in the project's database. If the sherds were larger than 6 cm, they received their own artifact numbers. If they were less than the size requirement, they were grouped with their own types, and given an artifact number as a group. For example, general chronological diagnostic sherds, undiagnostic sherds, and gunshot, were grouped separately and given their own artifact number[1]. When analyzing archaeological data, there is a difference between trace evidence and solid evidence. The project quantified the sherds by type to lessen the sample bias that is inherent in any type of artifact analysis. Instead of dating the lot to the youngest ceramic type found, a more convincing argument is to quantify that claim by counting and measuring the sherds in each time period present within that specific lot. Not using a quantifying methodology may skew results in the long term and will not answer questions about population and economic fluxes and trends.

Measurements of various sherds that qualified with the size minimum were also taken into consideration. These measurements potentially yield information about the usage, volumetrics, and depositional history of the ceramics. Construction fill and in situ broken ceramic vessels have very different wear patterns and signatures. Thus, analyzing the size and angularity can indicate the depositional history of the sherds or vessel. For example, large, angular sherds may indicate a vessel broken in situ, while small worn sherds could indicate sherds deposited in an area of heavy foot traffic.

Analysis of each lot's ceramic assemblage began with sorting the ceramics into small groups in order to type them. This was accomplished by splitting them into preliminary groups according to exterior surface decoration. These groups

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[1] General diagnostic sherds are sherds that have a certain chronologic marker such as shape, but cannot be identified by type. Undiagnostic sherds are counted and measured and only count toward the overall assemblage total for the statistics.

were: undiagnostic, striated, black slip, red slip, buff slip, and no slip. The groups were further broken down into previously defined ceramic types. Sullivan then reviewed each group to verify the sherds were correctly typed. After she confirmed and recorded data, diagnostic sherds were counted, measured, and recorded in the DH2GC database. Munsell readings were taken of the paste color for the diagnostic ceramics. Again, each diagnostic sherd and/or sherd group were given an artifact number in the database. All data observed about diagnostic elements, as well as type and time period, were recorded in the DH2GC artifact database. For future research efforts, Munsell readings were taken of the paste for the diagnostic ceramics, as well as the exterior.

CERAMIC ANALYSIS RESULTS: BRIEF OVERVIEW

Ceramic analysis in the Maya area is vital to understand the chronology of an area. Through analyzing the DH2GC ceramics from the 2011 and 2012 field seasons, a preliminary understanding of the occupation has been defined below.

Ceramic Findings: Group-By-Group

N150E75 (Operation 1). The North 150 was the first group encountered on the transect. It is also the most formally configured in reference to the structural layout. N150 may be the oldest courtyard group on the transect found so far and is contemporaneous with the Dos Hombres A plaza construction. There were ceramics found in a sealed context (under a floor construction) in Subop B that dated to the Chicanel sphere. This time period ranges from 400 BC to 300 AD in which the ceramics are most likely from the later part of that range. What this means is that the N150 group has been occupied since the Late Preclassic and was abandoned during the Late to Terminal Classic periods. This group is the one of the only groups found so far on the transect that has strong evidence of actual Preclassic occupation. It is apparent within Op 1 Subop B that there is nice transition from Chicanel to TR-Tepeu 2.

Places like the N250 and N950 groups have some traces of Preclassic ceramic data. But all groups analyzed indicate at least a Late Classic occupation. There was a presence of Late Preclassic ceramics found around the N950 area. However, the appearance of Preclassic ceramic sherds does not necessarily mean Preclassic occupation at these particular locations. These sherds came from mixed contexts or unsealed contexts. This may not indicate Preclassic occupation at that particular area, but it does indicate there are Preclassic occupation areas around -- we just have not found them yet.

N250W75 (Operation 2). The N250 group is a little younger than the N150 group. The chronology established by the ceramic data ranges from about 400-900 AD. This places the group within the Late to Terminal Classic periods. There was a trace amount of Chicanel style pottery, but not enough to warrant a chronological date. However, there was no test excavation opened in the plaza of this group due to a tremendous amount tree fall hampering access to the courtyard. The group's layout is somewhat unorganized and informal; Dr. Cortes-Rincon suggested this might be evidence for a reconstruction period during the group's history. A test excavation placed in the middle of the plaza would be helpful to confirm the chronology and to see the exact construction history and sequence for the plaza.

N350W50 and W125 (Operation 3). The N350 group is very similar to the N250 group. Looking at the ceramic data, it seems that the N250 and N350 groups were most likely contemporaneous with one another. There is terracing evidence in both groups and many water management features seen in N350 area. With more investigation into the nature of the N250 and N350 relationship, these two areas could prove to be cooperative areas. The two group's layouts are also very similar to one another. Although, both do not have a tight, definitive layout, they are defined as "informal clusters" (Cortes-Rincon, personal communication, 2013). With this level of informality, it is possible that both expanded and underwent reconstruction, contributing to their lack of cohesiveness and formality.

N750 and N950 (Operation 4). The N750 group is a smaller group near the N950 group. The chronology of this area was discussed in Perkin's paper (this volume). The unit was not excavated to termination due to time constraints, so more investigation is needed to establish the entire chronology for this area. However, Op 4 Subop J is one of only three groups found on the transect that did not have a Terminal Classic date. Typically, the first lot that is initiated will have Late to Terminal Classic ceramics, but not in this case. That means that this group may have been abandoned before the Terminal Classic period. The other groups that do not have a Terminal Classic date are Op 4 Subop G, located northwest of the N950 group and Op 4 Subop C, which is located north of the N950 group.

The N950 group was occupied from the Early Classic (ca. 400 AD) until the Late to Terminal Classic (700-900 AD). Again, it is the largest group investigated on the transect found so far. The Terminal Classic dates for this group are only found in the units on the knoll and around STR FN 36 and within the caves that Ports investigated. There are more groups with large architecture found, but they will be excavated and formally mapped next field season.

The most interesting ceramics found in the N950 group were the San Antonio Brown type and Sierra Reds found in Subop A. They are all Late Preclassic type, though the rims and shape of the sherds were Early Classic in style. Sullivan determined that they were Terminal Preclassic because of the qualities they possessed. In all, this group is defined as initially being an Early Classic site.

An interesting unit within Op 4 is Subop G. This particular unit is not terminated, and needs to be reopened next season, but the data already seems promising. The typical pattern for artifact age within excavated units is that TR-Tepeu 2-3/TR-Tepeu 2 ceramics are near the top excavated layers. Subop G does not have this hallmark. The lots excavated so far have been dated to TR-Tepeu 1/TR-Tepeu 1-2. This particular unit was placed within the plaza of a group near the edge of a steep elevation change; off of the N950 elevated rise. The N950 group is dated to be from the Late Classic (TR-Tepeu 2). This indicates that the group at Subop G was constructed before the major architecture was assembled at N950. It also implies that the group was probably abandoned before the entire N950 group was abandoned.

The most comparable data set that we have for the N950 group is found on Lohse's (2001) 'A' transect, surveyed for his dissertation project. This particular group is noted as Op 20 and Group B-V-1. It is an east focus group that is similar in size, chronology, and features as the N950 group. This group has four low mounds creating a courtyard with an east-facing temple (Lohse 2001). The N950 group has similar structural features with being an east focused group. There was a population influx during the beginning of the Late Classic period in the Dos Hombres area and according to Robichaux (1995), because of this, there was a need to manage the suburban area by establishing management centers. Lohse (2001) believes that the B-V-1 group is a management group. More investigations are needed to understand if the N950 group fits this role as well, although, the chronology, size and layout of the N950 group fits into that scenario.

As of now, the role of the N950 group within its area is not known, though the dates along the transect are similar to other findings around Dos Hombres. With that said, it would be interesting to excavate more of the N950 group to understand its function on the landscape.

In sum, the closest group found on the transect is the oldest group so far identified on the transect and many smaller structure clusters around the N950 knoll fell out of disuse prior to the Terminal Classic period. However, the statistical analysis of the N950 group and other groups found on the transect so far show that the occupational trajectory is similar to the rest of the Three Rivers Region. There was occupation during the Late Preclassic to Early Classic and then there was a population explosion during the Late Classic (Hageman 2004). Out of the current ceramic assemblage of the DH2GC, about 83% of the sherds date to the Late Classic.

CERAMIC ANALYSIS RESULTS PER OPERATION, SUBOPERATION, AND LOT

Below are definitions of each Subop by lot. Each lot is described with the time period it dates to and lists the diagnostic sherd types found within each lot.

Op 1

<u>Subop A:</u>

- Lot 2- TR-Tepeu 2; Tinaja Red, eroded Late Classic body sherds.
- Lot 3- TR-Tepeu 2-3; no rims, eroded Late Classic body sherds.
- Lot 4- TR-Tepeu 1; Cayo Unslipped, TR-Tepeu 1 style rims.
- Lot 5- TR-Tepeu 2; Achote Black, Cayo Unslipped, Subin Red.
- Lot 6- TR-Tepeu 2-3; Striated, Subin Red, Tinaja Red Achote Black, eroded Late Classic sherds; TR-Tepeu 2-3.
- Lot 7- TR-Tepeu 2/Tzakol trace; this was a mixed lot. Tinaja Red, Garbutt Creek Red, Cayo Unslipped, Tres Mujeres, Achote Black, Rio Bravo Red (or Z angle Red), Cubeta incised, Chilar Fluted, Tres Mujeres Mottled. Early Classic indicators: sherds and rims with Early Classic forms and Rio Bravo red, some sherds with light orange paste and lots of calcite inclusions similar to sherds at Xunantunich. One Cubeta incised sherd has a possible mat design.
- Lot 8- TR-Tepeu 2/Tzakol Trace; Striated, Tinaja Red and Dos Arroyos Orange Polychrome.

<u>Subop B:</u>

- Lot 2- TR-Tepeu 2; Lemonal Cream, Cayo Unslipped, Z-Angle base with no slip.
- Lot 3- TR-Tepeu 2-3; Achote Black, Late Classic Reds.
- Lot 4- TR-Tepeu 2; Striated, eroded Tinaja Red, eroded Achote Black, small body sherds.
- Lot 5- TR-Tepeu 2-3; Achote Black, Late Classic Reds.
- Lot 6- Chicanel-Tzakol; Aguila Orange, Sierra Red, striated.
- Lot 7- TR-Tepeu 1/Chicanel Trace; Types included in this lot cannot be identified. Though the forms of the rims and body sherds indicated a date from the Late Pre-Classic (TR-Tepeu 1) with a Chicanel trace and some possible eroded Preclassic sherds.
- Lot 8- Chicanel; Sierra red, Red and Black Modeled. The Sierra Red is dates to the Chicanel phase and the Red and Black modeled is from the Early Preclassic period.
- Lot 9- TR-Tepeu 1/Chicanel; Sierra Red and sherds with Late Pre-Classic forms.
- Lot ?- (no lot indication on artifact bag) TR-Tepeu 2 Achote Black, Cayo Unslipped, Tinaja Red.

<u>Subop C:</u>

- Lot 1- TR-Tepeu 2-3; Surface Collection; Types included in this lot: various striated sherds, Achote Black, Lemonal Cream, and Cayo unslipped.

Op 2

<u>Subop A:</u>

- Lot 2- TR-Tepeu 2-3; eroded Late Classic body sherds.
- Lot 2- TR-Tepeu 2; Cayo Unslipped, Achote Black.
- Lot 3- TR-Tepeu 2-3; Late Classic small eroded body sherds with pitted surfaces.
- Lot 4- TR-Tepeu 1-2; Cubeta Incised, Tinaja Red, Zibal Unslipped.
- Lot 5- TR-Tepeu 2-3/Chicanel Trace; Black and Red Modeled, Sierra Red, Belize Red, Striated, Late Classic Reds, Preclassic Reds.
- Lot 6- TR-Tepeu 2-3; Belize Red, eroded Late Classic. Dr. Lauren Sullivan notes that there was nothing very diagnostic in this particular lot.

Subop B:

- Lot 1- TR-Tepeu 2-3?; Late Classic, small eroded body sherds with pitted surfaces.
- Lot 2- TR-Tepeu 2; Achote Black, Tinaja Red.
- Lot 3- TR-Tepeu 2-3?; Late Classic eroded body sherds, Tinaja Red, and Achote Black.

Op 3

Subop A:

- Lot 1- TR-Tepeu 2-3?; eroded body sherds.
- Lot 2- TR-Tepeu 2/Chicanel Trace; Sierra Red, eroded Pre-Classic forms, Early Classic forms, Achote Red, and Tinaja Red.
- Lot 2- TR-Tepeu 2; Achote Red, Tinaja Red.
- Lot 3- TR-Tepeu 2; Tinaja Red, small eroded body sherds.

Subop B:

- Lot 1- TR-Tepeu 2-3; Late Classic eroded body sherds (?)
- Lot 2- TR-Tepeu 1; TR-Tepeu 1 jar rims.
- Lot 3- TR-Tepeu 2; Zibal Unslipped and undiagnostic sherds. Rim sherds in this lot matches rims from Lot 2.
- Lots 4 and 5- TR-Tepeu 2-3; These lots are associated with one another because there are ceramic refits found. The majority of the diagnostic sherds (and the refit sherds) are Cayo Unslipped, which dates these lots to the Late Classic.
- Lot 6- TR-Tepeu 2-3; small eroded Late Classic body sherds with no slip remaining.

Op 4

Subop A:

- Lot 1- TR-Tepeu 2-3; Chilar Fluted, various striated varieties, and Cayo Unslipped.
- Lot 2- TR-Tepeu 2-3; Achote Black, Tres Mujeres, Late Classic striated sherds, Cayo Unslipped, Little Black jar, Subin Red, Cubeta Incised, Late Classic rim sherds and a Miseria appliqué *incensario*. This lot also had 2 *incensario* feet that are associated with 1 *incensario* foot in Lot 3. There is one sherd with ash temper like those found in the valley. Lauren

Sullivan notes that this pottery looks later than the ceramics within Ops 1, 2, and 3.

- Lot 3- Terminal Late Preclassic/Protoclassic; Sierra Red, striated, San Antonio Brown. Transitional rims were identified as being from the Terminal Pre-classic.
- Lot 4- Chicanel trace/TR-Tepeu 2-3; Sierra Red sherds and TR-Tepeu 2-3 sherds in form.

<u>Subop B:</u>

- Lot 1- TR-Tepeu 2-3; Late Classic rim forms, Achote Black and Cayo Unslipped. *Incensario* fragment (same vessel as in Lot 2).
- Lot 2- TR-Tepeu 1-2/TR-Tepeu 2-3; Tutu striated, a Late Classic elevated plate, Achote Black, Encanto, Tinaja Red, Dolphin Head Red, Cayo Unslipped. *Incensario* fragment (same from the same vessel as in Lot 1).

<u>Subop C:</u>

- Lot 1- TR-Tepeu 2; Tinaja Red, Lemonal Cream, Achote Black, and various Late Classic striated varieties. Rim sherds confirm TR-Tepeu 2 phase.
- Lot 2- TR-Tepeu 1-2; Tinaja Red, Dolphin Head Red, Cayo unslipped, and small eroded polychrome sherd.

<u>Subop D:</u>

- Lot 1- TR-Tepeu 2-3; these sherds are badly eroded. The shape and form date the lot to TR-Tepeu 2-3. No rims in lot, one piece with light orange paste and lots of calcite inclusions similar to sherds at Xunantunich.
- Lot 2- TR-Tepeu 2; One sherd had heavy white inclusions and light paste that is similar to the ceramics found in the Xunantunich area (Lauren Sullivan, personal communication 2012). Achote Black, with possible ash temper and specular hematite.

<u>Subop E:</u>

- Lot 1- TR-Tepeu 2-3; the sherds are severely eroded, but the shape and form suggests they are from the TR-Tepeu 2-3 phase.

Subop F:

- Lot 1- TR-Tepeu 2-3; Achote Black, Cayo Unslipped and a Late Classic water jar. They are also badly eroded making the diagnostic process difficult.
- Lot 2- TR-Tepeu 2-3; Tinaja Red, striated varieties, and Achote Black. The sherds are badly eroded. This lot also included a probable burned sherd of an *incensario* with Miseria appliqué decoration.

Subop G:

- This Subop included: Belize Red, Tres Mujeres, Tinaja Red, Zibal Unslipped, Dolphin Head Red, Achote Black, and a polychrome from the Saxche group. These ceramic types date this particular unit as TR-Tepeu 1-2 though more toward the Early Classic side. The majority of the sherds collected were undiagnostic. The Zibal Unslipped is dated to TR-Tepeu 1, and several other sherds are dated to TR-Tepeu 1-2.
- Lot 0[2]- TR-Tepeu 1; Dolphin Head Red.
- Lot 0- TR-Tepeu 1-2; T1 unslipped water jar, Zibal Unslipped, Striated, Tinaja Red, Belize Red.
- Lot 2- TR-Tepeu 1-2; Dolphin Head Red, Subin Red, Tres Mujeres, Achote Black, striated, Saxche Orange-polychrome and Tinaja Red.

Subop J:

- Lot 1- TR-Tepeu 2; Garbutt Creek Red with mend hole.
- Lot 2- TR-Tepeu 2; Cayo Unslipped, Tres Mujeres Mottled, Mediation Black, Striated, Lemonal Cream, Subin Red.
- Lot 3- TR-Tepeu 2; Tinaja Red and Tres Mujeres Mottled.

Ceramic Statistics (Tables 1-)

- Total sherds in 2012 assemblage: 3,735
- Total diagnostic sherds: 1,845
- Percentage of Diagnostic out of Entire 2012 Ceramic Assemblage: 49.406%

[2] "Lot 0" denotes the specific lot provenience was not recorded on the artifact bags, though the specific unit is known.

Table 1. Percentage of Ceramic Types out of Total Diagnostic Sherds.

Sierra Red	4.90%
Aguila Orange	0.01%
Dos Arroyos	0.22%
Rio Bravo Red	0.49%
Subin Red	1.73%
Cayo Unslipped	2.87%
Chilar Fluted	0.11%
Cubeta Incised	0.27%
Dolphin Head Red	0.76%
Tinaja Red	21.25%
Tres Mujeres	1.68%
Achote Black	4.39%
Belize Red	0.16%
Garbutt Creek Red	0.27%
Encanto	0.22%
Lemonal Cream	0.60%
Late Classic Striated	3.36%
Saxche	0.22%
Red and Black Mottled	0.00%
Zibal Unslipped	5.15%
San Antonio Brown	0.11%
General Late Classic Sherds*	51.11%

Table 2. Percentage of Sherds in Each Time Period Out of Diagnostic.

Preclassic	7.54%
Early Classic	8.89%
Late Classic	83.57%

Table 3 is a simplified version of the data collected from the 2011 and 2012 field seasons. The abbreviations should be read as follows: LC-Late Classic, TC=Terminal Classic, EC=Early Classic, LPC=Late Preclassic, LEC=Late Early Classic.

Table 3. Ceramic data form the 2011 and 2012 seasons.

PROVENIENCE	CERAMIC PERIOD	TIME PERIOD
Op1 Subop A		
Lot 2	TR-Tepeu 2	LC
Lot 3	TR-Tepeu 2-3	LC/TC
Lot 4	TR-Tepeu 1	LC
Lot 5	TR-Tepeu 2	LC
Lot 6	TR-Tepeu 2-3	LC/TC
Lot 7	TR-Tepeu 2/Tzakol Trace	EC-LC
Lot 8	TR-Tepeu 2/Tzakol Trace	EC-LC
Op1 Subop B		
Lot 2	TR-Tepeu 2	LC
Lot 3	TR-Tepeu 2-3	LC/TC
Lot 4	TR-Tepeu 2	LC
Lot 5	TR-Tepeu 2-3	LC/TC
Lot 6	Chicanel-Tzakol	LPC-EC
Lot 7	TR-Tepeu 1/Chicanel Trace	LPC-LEC
Lot 8	Chicanel	LPC
Lot 9	Chicanel	LPC
Op1 Subop C		
Lot 1	TR-Tepeu 2-3	LC/TC
Op 2 Subop A		
Lot 2	TR-Tepeu 2-3	LC/TC
Lot 3	TR-Tepeu 2	LC
Lot 4	TR-Tepeu 2-3	LC/TC
Lot 5	TR-Tepeu 2/Chicanel Trace	LPC-LC
Lot 6	TR-Tepeu 2-3	LC/TC
Op2 Subop B		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 2	LC
Lot 3	TR-Tepeu 2-3	LC/TC

Op 3 Subop A		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 2/Chicanel-Tzakol Trace	LPC-LC
Lot 3	TR-Tepeu 2	LC

Op 3 Subop B		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 1	LC
Lot 3	TR-Tepeu 2	LC
Lot 4/5	TR-Tepeu 2	LC
Lot 6	TR-Tepeu 2-3	LC/TC

Op 4 Subop A		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 2-3	LC/TC
Lot 3	TLPC/Protoclassic	LPC-EC

Op 4 Subop B		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 1-2/TR-Tepeu 2-3	LC

Op 4 Subop C		
Lot 1	TR-Tepeu 2	LC
Lot 2	TR-Tepeu 1-2	LC

Op 4 Subop D		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 2?	LC

Op 4 Subop E		
Lot 1	TR-Tepeu 2-3	LC/TC

Op 4 Subop F		
Lot 1	TR-Tepeu 2-3	LC/TC
Lot 2	TR-Tepeu 2-3	LC/TC

Op 4 Subop G		
Lot 0	TR-Tepeu 1	LC
Lot ?	TR-Tepeu 1-2	LC
Lot 2	TR-Tepeu 1-2	LC

Op 4 Subop J		
Lot 1	TR-Tepeu 2	LC
Lot 2	TR-Tepeu 2	LC
Lot 3	TR-Tepeu 2	LC

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LITHIC OVERVIEW OF THE DOS HOMBRES TO GRAN CACAO ARCHAEOLOGY PROJECT

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This paper presents a summary of the analysis and results of all lithic artifacts gathered during the DH2GC 2011 and 2012 field seasons. Specific attention will focus on the distribution, materials, types, and use of lithic artifacts gathered. A thorough comparative study of lithic materials assembled throughout the transect, will provide insight into the diverse nature of these separate aspects of stone tool technology amongst varied socioeconomic areas. The total lithic assemblage from the 2011 and 2012 field seasons is comprised of 2075 individual pieces including, 59 obsidian artifacts, 161 flakes, 337 tools, and 1518 pieces of debitage.

METHODS

Laboratory analysis was conducted by Adam Forbis, Marisol Cortes-Rincon, and Jeff Bryant. Analytical and typological methodology was adopted from David Hyde's procedural methods and typology (2003, 2011), which is a modified version of Andrefsky's (1998) morphological typology flow chart and was specifically designed for the Three Rivers region of Belize. Lithic materials were divided into four categories; tools, flakes, non-flakes (debitage), and bifaces. Each category was assigned separate paperwork. There is also a separate section that contains the obsidian artifacts collected. Four measurements were taken for all lithic material categories; length, width, thickness, and weight. Due to the large amount of debitage gathered, each individual piece could not be analyzed. Debitage was grouped by size within each lot and the quantity and average size in millimeters was recorded. The raw material and overall material quality for all lithic categories, with the exception of debitage was recorded. With the aid of a magnifying glass, microscopic analysis was performed to identify use wear, pressure flaking, and retouch signatures.

OPERATION 1

Op 1 is located at N150 and contains two complete excavations, Subop A and Subop B (each being 1 x 1 m), as well as a surface collection of ground disturbance from a fallen tree (Subop C). Bioturbation uncovered a handful of artifacts at the base of the fallen tree including lithic debitage. There were a total of 23 obsidian lithics, 80 flakes, 66 tools, and 385 pieces of debitage. Obsidian will be covered in a separate section. The majority of flakes, tools, and debitage in Op 1 were made of chert. Subops A and B contained chert flakes that were secondary and tertiary in nature. Some of the more noteworthy tools include unifacial chert blade fragments and multidirectional chert cores from the N150 area.

OPERATION 2

Op 2 is located at N250 and contains Subops A and B (1 x 1 m units). These units contained a total of 8 obsidian lithics, 59 flakes, 238 tools, and 646 pieces of debitage. Almost all of the lithics collected from Op 2 were chert. They ranged from bad quality material to very good material based on Hyde's methods regarding material quality (2011). This is the most lithic dense area of the project to date. Multiple chert drills were recovered from Subops A and B. One tool type discovered initially appeared to be drills or gravers but upon further analysis it appears to be a different tool type. This new tool type will be analyzed and discussed in further detail later.

OPERATION 3

Op 3 is located at N350. This operation included Subops A and B. Subop A was located within a structure group and Subop B was positioned within a possible *aguada*.There are a total of three obsidian lithics, 20 flakes, four tools, and 74 pieces of debitage. This area contained the least amount of lithic artifacts.

OPERATION 4

Op 4 was located between N750 and N950. There are a total of nine Subops within this Op 4. Subops A through I, with the exception of Subop B which was located at N750, were placed at N950. There were a total of 25 obsidian lithics, zero flakes, 26 tools, and 310 pieces of debitage.

N750 (Suboperation B)

The N750 group is a *plazuela* group consisting of three structures. Subop B (1 x 1 m) was located in the middle of the *plazuela* group. A significant amount of lithic material was recovered from this unit, specifically from Lot 2, directly under the humus layer. Lot 2 started at an elevation of ~77 cm and ended at ~105 cm. The lithic assemblage from Lot 2 was comprised of chert, limestone, and obsidian artifacts at various levels of craftsmanship. Quality ranged from low/novice quality tools and flakes to much higher quality/masterful tools. There were a total of 10 tools, two bifaces, zero flakes, 19 obsidian artifacts, and 110 pieces of debitage. An interesting limestone flake/tool was recovered within this lot. It appears to be pressure flaked and possibly fluted. Some of the lithic artifacts recovered from this lot include; two very large, high quality chert flakes with evidence of use wear, a very nice complete chert oval biface, and a bifacially flaked chert scraper. There were also quite a few obsidian prismatic blade fragments and a complete prismatic blade from this lot as well. Debitage from Subop B ranged from an average size of 6 mm to 45 mm.

N950 (Suboperation A-I)

All nine Subops at N950 contained lithic materials. There were a total of 16 tools, zero flakes, one biface, and 6 obsidian artifacts. Subops H and F at N950 were focused on a cave feature. Subop H was located at the mouth and Subop F was positioned inside the cave. A chert hand axe or chopper was recovered from Subop H as well as obsidian prismatic blade fragments. The most notable lithic artifacts from the N950 area were recovered from Subops F and H.

OBSIDIAN

Obsidian analysis was conducted by Dr. Marisol-Cortes Rincon. There was a total of 59 pieces of obsidian recovered during the 2011 and 2012 field seasons. These included flakes, debitage, prismatic blade fragments and one complete prismatic blade. The distribution is as follows: 23 pieces of obsidian at N150, eight at N250, three at N350, 19 at N750, and six at N950 (Table 1). Higher quantities of obsidian were recorded at N150 and N750. These two areas contain 71% of the obsidian recovered during the 2011 and 2012 field seasons.

Table 1. Obsidian Distribution.

Location:	N150	N250	N350	N750	N950	Total
Obsidian:	23	8	3	19	6	59
Percentage:	39%	14%	5%	32%	10%	100%

NEW TOOL

What appears to be an unknown tool type was observed during analysis of the lithic assemblage from N250. This evidence may suggest unique specialization or tool production. After preliminary inspection these tools appeared to resemble chert drills and gravers that are common in the Three Rivers region. However, upon further analysis, dissimilarities between the N250 tools and the traditional drills and/or gravers within the region became apparent. These tools taper to a pronounced point at the distal end of the drill. Pressure flaking on the proximal end created a small fan-like edge. Another distinct characteristic of this tool assemblage was noted along the tools' edges. The edges on both sides of these tools have been flaked to a flat, near 90° angle instead of leaving the edge pressure flaked or natural. This may have been done to make the tool fit better in the workers hand or it may have had a more specific purpose. Experimental flint knapping techniques will help determine how these tools were made and will aid in interpretation.

LITHIC PRODUCTION

Evidence gathered during the investigations of N250 and N750 suggests that these areas may have supported some form of specialized lithic production. N250 is the most lithic dense area on the transect and the quantity of drills and similar tools hints at lithic specialization. There is an apparent focus on stone tool production evidenced by the quantity of lithic material located in relation to the size of the structure complex.

In addition to a lithic production area, N750 may have been an instructional flint knapping site. The following artifacts were recovered from Subop J; two large, high quality chert flakes, a nice chert scraper, a complete chert oval bifaces (Figure 1), rudimentary limestone flakes, limestone tools, and an obsidian prismatic blade (Figure 2). The presence of limestone flakes and tools alongside high quality chert tools and flakes suggests that flintknappers of varied skill levels were present at the location. It is possible that a skilled flintknapper utilized this area as an instructional locale. The use of limestone for tools is not very common due to the availability and strength of chert. This fact along with the presence of limestone flakes and tools implies that these artifacts were the result of inexperienced apprenticeship. Subop J was closed at the end of the 2012 field season prior to reaching bedrock. The unit will be reopened during the 2013 field season.

COMPARATIVE ANALYSIS

N150 and N750 contained chert debitage, evidence of flint knapping, indications of tool use, and similar quantities of obsidian. Similarly, a high quantity of debitage and chert tools were recovered from N250. However, the quantity of obsidian at N250 was significantly less than N150 and N750. In contrast to these three areas, N350 contains the least amount of lithic artifacts. This area does not appear to be an area of high tool use or production. Material quality and type were similar between all four areas of operation.

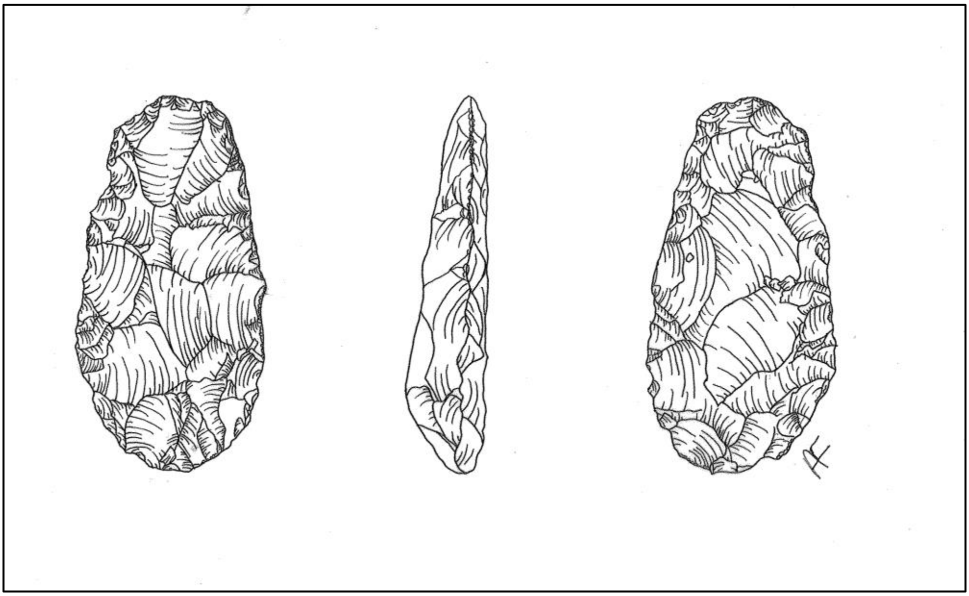

Figure 1. Oval Biface from Op Subop J Lot 2. Illustration by Adam Forbis

PRELIMINARY CONCLUSIONS

A heavy distribution of lithic artifacts were recovered at N150, N250, N750, and N950. N250 appears to be a lithic production and/or specialization area. A possible new tool was discovered from this area and noted for further analysis in future seasons. N750 revealed some more advanced lithic tools as well as rudimentary limestone flakes and tools suggesting a lithic teaching area. The quality of materials and tools located here suggests there may have been a connection between N750 and the N950 group. The lithic artifacts date from Late Preclassic to Terminal Classic based on associated ceramic dates.

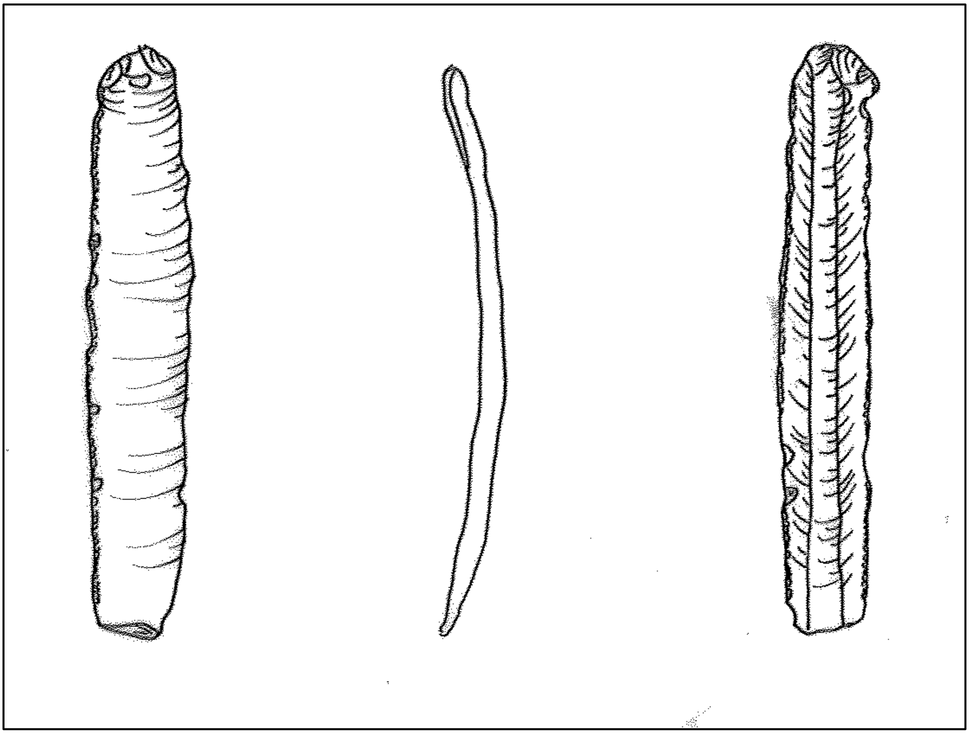

Figure 2. Obsidian Prismatic Blade from Op 4 Subop J Lot 2. Illustration by Adam Forbis.

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SOILS ON THE DH2GC PROJECT

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The inhabited area in ancient times compose the "cultural soilscape" which is defined by Wells (2006:125) as an area of the earth's surface that is the result of spatial, and "temporally variable geomorphic, pedogenic and cultural processes." Wells (2006:125) views the cultural soilscape as an invaluable "analytical domain" and argues that it reveals the "the complex and multilayered dialectic between human behavior and soil bodies over long periods." It is this analytical domain with which the DH2GC 2011 and 2012 soil investigations are grounded in and subsequently aids in the interpretation and synthesis of the data. This theory is characterized as a holistic interdisciplinary approach, drawing from varied perspectives including pedology, hydrology, geography, agronomy, ethnopedology and ethnography.

The chemical analysis of the cultural soilscape provides excellent information on the behaviors associated with archaeological sites. Sampling of available phosphorus (P) has allowed researchers in the past to identify refuse middens and areas associated with the consumption or preparation of foods (Middleton and Price 1996; Parnell *et al.* 2002a and 2002b; Terry *et al.* 2000; Wells *et al.* 2000). Concentrations of select heavy metal elements including zinc (Zn), iron (Fe), copper (Cu), cadmium (Cd), mercury (Hg), manganese (Mn), and strontium (Sr), have been utilized in identifying production spaces for lithic or other craft productions involving mineral based paints (Parnell *et al.* 2002a; Dahlin *et al.* 2007). Fe is often associated with specific types of sites such as, specialized craft production and kitchen activities like, butchering and processing (Manzanilla 1996; Pernell *et al.* 2002).

The nutrient analysis regiment is broad-based, consisting of the most common tests for determining agricultural viability. By this means the soil health can be assessed, enhancing our understanding of the ancient agricultural potential of the project area as well as anthropogenic changes effecting viability. These factors include intensive agriculture, irrigation, erosion, nutrient deficiencies, toxicities, fertilization, climate change and natural environmental constraints. Comparisons will be drawn from local sources, agricultural ethnographic and ethnopedographic, data, and from soils with similar elemental properties. These case studies will contextualize the data on the site scale, the regional scale, and beyond. The data collected and reviewed represents the initial survey of the soils on the DH2GC transects. The report will offer preliminary interpretation and discussion designed to raise questions the project may wish to answer upon retrieving more comprehensive data.

ETHNOPEDOLOGY

Some of the most important studies on ancient Maya agriculture and the study of cultural soilscape have come from collaborations between soil scientists, anthropologists and modern Maya (Jensen et al. 2007). When partially relying on ethnographic sources, however, it is important to acknowledge that cultures and traditions do not necessarily remain static over time.

Under early evolutionary theory, archaeologist made the assumption that all societies passed through stages and so there was nothing to be learned about behavior from archaeology that could not be learned from ethnology (Trigger 2006). These assumptions often carried racist connotations, as demonstrated during the period of salvage ethnography in the United States. In other cases, problems emerge from looking at societies as living in a vacuum apart from history.

A more recent example of these issues is demonstrated by the ethnographic work on the San of southern Africa. They were studied as an analogue for hunter gather society under the assumption that they had been living in a static "hunter-gather" lifestyle for thousands of years. Wilmson's *Land Filled with Flies,* offered a poignant critique of the ahistorical way in which the San are looked upon (Wilmsen 1989). Archaeology has revealed that many indigenous cultures such as the San were greatly changed by European contact long before written records were made (Alexander and Mohammed 1982; Cordell and Plog 1979; Ramsden 1977; Trigger 1981b; Trigger 2010; Wilcox and Masse 1981).

The San were also influenced by interactions with their pastoral Bantu and Hottentot contemporaries (Schrire 1980, 1984; Trigger 2010), and it may be the case that they moved in and out of "hunter-gather" life many times (Denbow 1984; Gorden 1992; Wilmsen and Denbow 1990). With these acknowledgments, in traditional societies there is often a great level of continuity with the past, making ethnography a powerful tool, if used with caution.

The study of "ethnopedology" or rather the ethnography of soil has been pioneered in Central America by Barbara Williams through the study of the contemporary Aztec soil classification system (Dunning 1990; Williams 1982; Williams and Harvey 1988; Williams and Ortiz-Solorio 1981). Dunning (1992) recorded the soil classification system used by modern Yucatec Maya in detail and connected the classification system and the organization of subsistence systems (Jensen et al. 2007). The Modern Itzá Maya soil classification is central to their agricultural system (Atran 1993; Reina 1967). The Yucatec Maya taxonomy contains more than 80 concepts for describing soil dynamics (Wells and Mihok 2010: 323).

The study of utilitarian traditional soil classifications during the last two decades has revealed that they operate in a very similar way to modern soil science (Martínez-Villegas 2007). A study by Wills (2007) demonstrated that soil color is a rapid and relatively reliable way to gauge organic content in soil. This supports the utiarian value of traditional systems that rely on qualities such as soil color or texture. Dunning (1990) points out that the Puuc taxa are not just descriptive categories but also dictate what maize most suitable for planting in each soil. Dunning (1990:241) asserts that folk taxonomies are indicators of "the relative stability and adaptive success of peasant farming systems."

The Itzá soil classification system divides soils into several classes and then subdivide these classes to account for differences such as texture, color, and depth (Jensen et al. 2007). The major classes in Jensen's study were defined by Itzá Maya informants from San José as: Saknis ("White Earth"), Ek Luum ("Black Earth"), Ek Luk ("Black Clay"), Chachak Luum ("Red/Colored Earth"), Ek Luum ("Black Earth") and Kan Luum ("Yellow Earth") (Moriarty 2002b), and Tierra Mezclada ("Mixed Earth") (Jensen et al. 2007:343). Saknis, Ek Luum, and Ek Luk soils were viewed favorably for traditional milpa maize agriculture. Of these, however, Saknis and Ek Luum soils were seen as more suitable than Ek Luk soils (Jensen et al. 2007).

The contemporary Maya have pantheistic belief system that extends to their biophysical environment (Vogt 1969; Wells and Mihok 2010). Subsurface soil is viewed as a womb, giving birth to humans and other life (Barrera-Bassols and Toledo 2005) as well as associated with the underworld and death. Soils are considered animated and inhabited by ancestors and that they must be petitioned to (Vogt 1969; Wells and Mihok 2010).

The richness of the soil taxonomy traditions, the reverence paid to soil in oral history as well as the creation story and the pantheism illustrate the value of studying the Maya relationship with soils in a holistic way that goes beyond classification. The ways in which soils are described by the Maya suggest that soils are heavily integrated into the way in which the Maya understand the physical world, and the creation of the universe. The relationship between the Maya people and their soil is one of mutualism and reciprocity that influences social actions (Wells and Mihok 2010). For each real-world function there are spiritual associations.

For example, the colors used to describe soils have functions within celestial systems (Tozzer 1941; Wells and Mihok 2010). Each color has an associated god: *Sacal* (white), *Chaak* (red), *Kan* (yellow), and *Hosan-ek* (black). Further associations are in directional orientation most likely associated with the sun cycle (Vogt 1992). South is associated with yellow or *Kan* (*Kimi*), white or *Sac* which means north, red (*Chac*) indicates east (*Chuwen*), and both (*kib'*), and black (*Ek*) are associated with the west (*Imix*) (Wells and Mihok 2010).

Ek Luum, Ek Luk, and Saknis soils are the classes that appear to be closest to the soil conditions on the transect. The two classes of Ek Luum and Ek Luk are considered difficult to distinguish because they have a similar texture and color, only differing by clay content. The Sakanis class, although referred to as "white earth" was measured by Jensen et al. (2007) as being 10 YR 2/1, consistent on color with the other soil classes.

Ek Luk is dark clay rich soil associated with *bajos* and contains few stones. Ek Luum is a slightly clayey soil that generally matches Ek Luk in color. Tierra Mezclada is not a discreet Itzá Maya soil class but it is what is referred to by Maya informants when the qualities of the soils are mixed between classes. For example, soils that are combinations of Saknis and Ek Luum qualities, located on relatively flat uplands, are the most productive of the regions soils (Jensen et al. 2007).

The soil at N150 Op 1 appears to be consistent with the qualities of Ek Luk, or possibly Ek Luum, while the soils at N250 Op 2 appear to represent the Tierra Mezclada or mix, of Sakanis and Ek Luum. The soils contain high clay content but are shallow, lighter and lower in density relative to the compact soils at N150. The clay content is high in both locations but the contrast in cation exchange capacity (CEC) indicates that the clay content is higher at Op 2 and lower at Op 1.

This indicates that from the perspective of the contemporary Maya farmers, the soil qualities exhibited on the transect are considered highly favorable for maize agriculture. What it is missing from the physical analysis are the complex variables of soil chemistry. Indicator crops can be used to gauge specific deficiencies and determine methods of amelioration through fertilizers (Juo and Franzluebbers 2003), so soil health can be more specifically instigated by traditional methods by planting crops and observing the results. For example, a deficiency in P is manifested on corn plants by purple patches on the leaves and stunted growth. K deficiency displays yellow patches on the leaves as well and a burnt look on the edges of lower leaves (Juo and Franzluebbers 2003; Figure 1). These indicators provide feedback on necessary cover crops or what soil amenities to add, for example, gypsum, lime, ash, food-wastes, vegetation (Wilken 1987).

Figure 1. Nitrogen (N) deficiency, Potassium (K) deficiency and Phosphorus (P) deficiency.

The sources of fertilizer in Central America are diverse including the ant nest material from the fungus grown by the leaf cutter ants (*Atta and Acromyrmex*) are prized by farmers (Haines 1978; Wilken 1987). The leaf cutter ant infuses the soil with organic matter and other soil nutrients N, P and K (Farji Brener and Silva 1995). Given the close relationship the Maya have with their soil and to plants it is reasonable to assume that some level of continuity remains that these tools were at the disposal of the Maya and that they were to some degree being utilized. The chemical composition therefore is part of the dialectic between people and the cultural soilscape. The role of the farmer and soil chemistry should be looked upon as an active rather than passive one. The results of modern chemical analysis will certainly reflect the interaction between soil and the social and cultural actions of the Maya.

FIELD METHODS

During the DH2GC 2011 field season two methods were utilized to collect soil samples: 1) from the floor surface for floatation and 2) from the profiles of excavation units for chemical analysis. Floatation samples consisting of 3.8 liters (l) were taken evenly with a clean trowel from the total surface of the collection area of a unit at a recorded depth. These were usually taken in association with floor surfaces. The samples were placed in a sealed 3.8 l plastic container and taken back to the laboratory. One cup of soil from the floatation sample would then be removed and placed in a plastic bag for chemical testing.

The second method of collecting soil samples was from the profiles of excavation units corresponding with different soil horizons in the stratigraphy. Measurements and pictures were taken to document where in the stratigraphy the samples were collected. The samples were collected using a device fashioned from a stainless steel canteen with the bottom cleanly sawed off to allow soil to be removed quickly and with less chance of cross contamination occurring. The collection device was cleaned in the field using water and bio-degradable soaps between each use.

Four floatation samples were taken during the field season. Three samples were taken at Op 1 Subop A and one was taken at Op 2 Subop A. The first floatation sample was taken in Lot 1 of Op 1 Subop A while the soil was mostly culturally sterile. The second sample was taken in lot two as the soil changed to contain higher clay content. A final sample for Op 1 Subop A was taken in Lot 3 on a culturally sterile level of sandy loamy clay with intermittent charcoal. A single sample was taken in Op 2 Subop A upon the surface of a plaster floor at the termination of Lot 2. The plaster level was sparse suggesting erosion.

The floatation samples were processed on 5/30/11 by field school students at Northwestern University using a Flote-tech model A1 flotation machine manufactured by Dausman Technical Services. Light factions were collected, dried and stored in plastic bags for future analysis. The hard factions were screened for cultural material. Artifacts, including ceramic and lithic, were only identified in the sample corresponding with Op2 Subop A.

Profile soil samples were taken during the final photographs upon reaching bedrock. Time constraints inhibited some soil samples to be taken at the end of the field season. Both Subops from Op 2 reached bedrock and soil samples were taken at each stratigraphic layer. All of the Subops at Op 1 and Op 3 failed to reach bedrock before the end of the season. Munsell color codes and soil texture were recorded on the lot forms for each change in soil that was observed by excavators. A total of 12 samples were exported the United States for analysis of basic nutrients.

During the DH2GC 2012 field season, a soil sampling regiment was designed to investigate the cultural soilscape associated with the structure groups mapped. Soil samples were taken to detect localized behavior, to better understand the attributes of the soils, and to attempt to isolate anthropogenic processes. Soil samples were taken from both the profiles of planned excavation units and in strategic shovel test pits (STPs). A total of 10 shovel test pits were excavated for a total of 19 soil samples at 5 loci. A total of 27 samples were taken from 7 select 1 x 1 m excavation units.

The STPs were placed strategically to gain more information about the soil stratification, general soil characteristics and cultural processes. The STPs were dug with a diameter of 30 cm and to a depth of either bedrock or 1 m. The STPs were mapped with a tape and compass. Each STP was geo-referenced with sub-meter accuracy using a Mobile mapper.

The initial questions raised by the surface investigations were:

- How healthy is the soil?
- What is the drainage strategy?
- How extensive is the system below the surface?
- What kinds of infrastructure are there for the drainage canals?

LABORATORY METHODS

Chemical analysis was conducted at The University of Massachusetts at Amherst Soil and Plant Tissue Testing Laboratory (UMASPTTL) using guidelines established by the Northeast Region Coordinating Committee on Soil Testing, NEC-67 in the 3rd edition of *Recommended Soil Testing Procedures for the Northeastern United States*.

Field samples were air dried at the Humboldt State University Archaeological Research Laboratory by Alexandra Cox. Once the samples were dry, they were shipped to the UMASPTTL for the testing of basic nutrients. The samples were tested for pH, buffer pH, extractable nutrients (P, K, Ca, Mg, Fe, Mn, Zn, Cu, B), extractable heavy metals (Pb, Cd, Ni, Cr), and extractable aluminum, cation exchange capacity, and percent base saturation.

For all tests, the initial processing of the soil is the same. The samples were pulverized to prevent breakdown of micronutrients. To cull material larger than soil particles (defined as 2 mm and less) the sample is sifted through a 2 mm sieve (10 mesh) (Horton 2011). Once a pulverized soil samples were sifted the sample is mixed with a glass rod to mix the aggregates and other particles that will have naturally arranged by size. Sub-samples of 5 g (measured at a precision of +/- 1%) were taken from the center of the dish after mixing.

To determine pH of each of the samples were 5 g of the dry, pulverized, and sifted soil into a 3-ounce paper with 5 ml of deionized water. The samples were left to sit for 30 minutes after having been thoroughly stirred. The readings were then taken on an electronic pH meter while the electrodes were swirled in the slurry solution. The pH meter is calibrated using a standard buffer solution.

The macronutrients P, Mg, K, Ca, Cu, Mn and Zn were extracted and measured using a reagent of dilute ammonium-based well-buffered acid solution using the

Modified Morgan system (McIntosh 1969). The soil tests used for measuring the water-soluble and exchangeable forms of Ca, Mg, and K using counter ions (NH4+) to replace the cations.

First, 2874 ml of glacial acetic acid were combined with 20 l of distilled water in a 40 l carboy. Next 1825 ml of concentrated NH4OH were added and diluted with an additional 20 l of distilled water to a pH of 4.8 +/- 0.05. A series of standard calibration solutions were prepared within the anticipated range of content in the soil.

In each 50 ml flask cm^3 air-dried, sieved and weighed soil were combined with 20 ml of the Modified Morgan extractant (0.62 N NH4OH + 1.25 N CH3COOH) (McIntosh 1969). The flasks were shaken at 180 oscillations per minute for a 15-minute period. The solutions were run through Whatman No. 2 medium porosity filter paper. The filtrate was then measured on the ICP for individual levels of P, K, Ca, Mg, Cu, Mn, and Zn.

The organic carbon was tested using the weight loss on by ignition method (adapted from Storer 1984). To estimate percentage of organic matter, 10 g of the sieved, pulverized dried soil for each sample was dried at 1050°C for two hours and weighed (+0.001). The samples were then dried at 360°C for two hours. After cooling to150°, the weight measurement is taken again.

The results can be reached using this simple equation:

LOI (%) = weight at 105° - weight at 360° x 100

LOI (%) = weight at 105° - weight at 360° x 100 weight at 105° / weight at 105°

The second weight multiplied by 100 times the first weight is subtracted from the first weight. This number is divided by the first weight.

PHYSICAL CHARACTERISTICS

The soils encountered at Op 1 and 2 are dark smectitic vertisols that may be some degree gypsiferus and Mg rich. The high content of smectite clay leads to shrinking during the dry season and expansion during the wet season. This makes the soil very hard to till during the dry season and sticky and hard to till during the wet season. The expanding and contracting does have the quality of increasing aeration and aggregation in the soil structure (Juo and Franzluebbers 2003). Smectite clays generally have good nutrient contents and can be some of the most productive soils in the world. The clays have a moderate to high cation exchange capacity and good water retention capacity.

Op 1 Subop A was placed behind a structure at the N250 group to catch midden refuse and sediment flow down the gentle slope towards a floodplain. The surface was dark and loamy; however the anthrosols were very dense dark clays that displayed shrink-swell cracks and possible gilgai pedoturbation. Plaster floors, midden and construction fill were excavated. The unit was not completed during the 2011 season and so chemistry samples were only taken in the surface levels.

Op 2 Subop A and B were placed behind a structures to catch refuse and possible midden deposit. The soils were loamy on the topsoil and became increasingly dense in the anthrosols. Plaster floors, midden and construction fill were excavated.

The darkness of the soils in both locations initially suggested a high organic content, and a good supply of N and P, essential for maintaining a balance of nutrients in the soil. The texture on the surface indicated that the soils were well structured and drained. These data represented the qualities that the Maya folk soil taxonomy may have measured in congruence with modern scientific classification, however, the soil chemistry analysis revealed a more complicated situation.

2012 FIELD PROCEDURES: SHOVEL TEST PITS

Shovel Test Pit Feature 1

STP feature 1 was investigated as a series of possible agricultural terraces and water management features. STP 1 and 2 were excavated as part of this investigation. The features and STPs were mapped using tape and compass and marked with a GPS. The structure group associated with STP feature 1 is located at N350 west 75 on the DH2GC transect. STP feature 1 is on the northern slope of this group. The local datum used to map the features was established 16.7 m from FN 17 at a bearing of 330 degrees.

Upon initial surface investigation a series of associated cut lime-stones were identified as water management, agricultural and soil conservation features. A portion of the stones were placed in pairs that were spaced apart with clear cut surfaces facing each other. These stones are likely check dams that served to regulate the flow of water. The trajectory of these paired stones indicated the channeling of water to other pairs of stones. The stones were aligned diagonally along the gentle slope perhaps in effort to slow water momentum inside canals and reduce soil erosion. Small depressions were identified which may have been associated with the other features. Water may have been channeled to these depressions to slow the flow, to pool, charge and to store non-stagnant water.

Another portion of the stones appear to be agricultural terraces. These stones are also aligned diagonally. The largest stones are clustered together and are labeled on the map as sub-feature A. One of the stones has two clear-cut surfaces on either side of a corner. The stone is limestone but contains large inclusions of good to intermediate grade chert. Lithic debitage was identified on the surface of the feature and on the down sloping soils. The initial questions that were raised by these observations were:

- Are the large stones of sub-feature 1 transports or are they a part of the natural outcropping of bedrock?
- Was the area used for flint knapping or quarrying?
- Is the STP placed inside an agricultural terrace?
- What was the drainage strategy, if any, below the surface?
- Was the overall strategy effective in conserving soil and maintaining the quality of soils for agriculture?
- Is the soil drainage deliberately calibrated for a specific crop?

The STPs were placed strategically to gather as much data relevant to the questions as possible within the limitations of a 30 cm shovel test pit. STP 1 was placed to collect soil samples for both paleo-botanical remains and basic nutrients. The basic nutrients along with observations on soil texture, color, density and drainage will help gauge to general health of the soil for agriculture. The paleobotanical remains may help to establish what specific crops were cultivated. During the excavation observations can be made to determine the subsurface drainage strategy. The depth of bedrock may aid in speculating on the likelihood that sub-feature A is a transport or an outcropping of bedrock.

STP 2 was placed directly downslope of the terrace platform on which STP 1 is located. At this location STP 2 can be utilized for comparison of soils collected by the terrace and those below. Both of the STPs can also be compared to the soils collected in the excavations at the N350 W75 structure group. Op 3 Subop A establishes a local baseline for the soil texture, color, density and chemical composition to evaluate the soils on and below the terrace platform.

The first layer of soils (Lot 1) is a humus layer of very dark greyish brown (3/2 10 yr) friable sandy clay. The soil contained many small roots and 3 cm limestone cobbles on the surface. The cobbles continued in the fill at a low density. Cultural material included lithics and poorly preserved ceramics. The surface observations may indicate that the anthrosols were encountered at or close to the surface.

The effects of bioturbation caused by the highly biotic tropical soils and pedoturbation from the high smectite content in the local vertisols may have been reduced by the drainage fill. These processes often contribute to an upward or downward movement (often sorted by weight and size), which can skew a vertical context. Another factor is that a terrace at capacity may fail to collect modern soils at the same rate as ordinarily expected. Based upon the lithic scatters concentration around sub-feature suggests primary deposition. This does not preclude the possibility some level of transport of cultural material via erosion and downward settling but the context of the surface scatter suggests the primary method of deposition was primary. A soil sample was taken for basic nutrients.

The lot was closed at 15 cm when soil density increased. In Lot 2 the soil color, cobble density and soil texture remained consistent with the previous lot. More ceramics were collected during the second lot. An extraordinarily preserved piece of tree bark at 22 cm was collected. This may represent a deposition event. A soil sample was taken for basic nutrients and another for paleo-botanical remains. The lot was terminated at 34 cm upon both a soil color and texture change.

The soil in lot 3 is a dark grayish brown (4/2 10 yr) sandy loam. This is a lighter shade than the previous lots however it is still dark. Cultural material density was consistent with the lot above. A general utility biface (GUB) on its possible

3rd use was identified. In its current form it appears to be a handheld scraper or chopper. The quality of the chert was good.

At 63 cm, a layer of possible bedrock or plaster was encountered. A lithic was found on the surface of the layer indicating the soils were anthropogenic at this depth. The layer was excavated to a meter before the STP was terminated and backfilled. No cultural material was identified in the last layer but the consistency had not changed in 37 cm. The layer appears to be highly weathered bedrock but cannot be determined to a 100 % certainty in a shovel test pit. If the layer is a plaster floor it is likely to be a very thick floor consistent with Preclassic occupation during a time of low resource stress.

The results of the excavation revealed that the soils are anthropogenic, from the surface to the assumed bedrock; filled with limestone cobbles for drainage and that lithic materials are present throughout. In addition to the lithic evidence of quarrying, the stones are stepped and form an intuitive seating area for flint knapping. The surface scatter of lithic material was concentrated at where a person's feet might have intuitively been located during the activity.

The soils appear to be healthy and workable for agriculture. They area is likely well aggregated providing good drainage and oxygen to the root structures of plants. The general utility biface provides evidence of agricultural use as general utility bifaces are commonly found in agricultural settings as a possible hafted tilling implement.

Shovel Test Pit 2

In contrast to lot 1 in STP 1, lot 1 in STP2 only has 4 cm layer of humus layer before the density changed. This appears intuitive as the terraces are soil conservation features. The soils should be thicker above the terraces than below. Soil texture changed from sandy clay to sandy clay loam. The color in the first lot are very dark grey brown (3/2 10 yr) consistent with lot 1 in STP 1. The second lot in STP 2 is constant in color and texture to lot 1.

In the third lot the texture and color both changed. The soil texture changed to sandy loam. As with STP 1, the color changed from very dark grayish brown (3/2 10 yr) to a dark grayish brown (4/2 10 yr). In opposition to STP 1 bedrock was reached at 30 cm rather than 63 cm. The presumed bedrock consistency was dense limestone rather than plaster-like as in STP 1.

The inconsistency in depth of termination is intriguing. The area may have been quarried for chert or weathered limestone for plaster. Another possibility is that if the plaster-like surface is a plaster floor it may have been a resource intensive means of stabilizing the bluff of the structure group against landslides. The ceramic chronology from the plaza at Op 3 Subop A includes Preclassic ceramics, which supports the possibility that the surface in question may be anthropogenic.

The platform of the terrace may also have been excavated into bedrock to increase soil-holding capacity. Quarrying limestone behind terrace is an intuitive idea as limestone was a heavily utilized resource and soil conservation was an imperative in cultivation in sloping fields.

With the available information is difficult to make interpretations with much definition, however, it appears the area of STP feature 1 may have been used for multiple activities, including terrace agriculture, drainage, limestone and chert quarrying and flint knapping.

Shovel Test Pit Feature 2

STP feature 2 was investigated as a series of possible agricultural terraces and water management features. STP 3, 4, and 5 were excavated as part of this investigation. The features and STPs were mapped using tape and compass and marked with a GPS. The structure group associated with STP Feature 2 is located at N350 west 75 on the DH2GC transect. STP Feature 2 is on the eastern slope of this group. The local datum used to map the features was established 19.6 m from FN 17 at a bearing of 173 degrees.

Upon initial surface investigation a series of cut lime-stones were identified as water management, agricultural and soil conservation features associated with each other. A portion of the stones was placed in pairs spaced apart from each other with clearly cut surfaces facing each other consistent with those found at STP Feature 1. These stones may be check dams that served to regulate the flow of water to terraces bellow and potentially an *aguada* such as the *aguada* excavated as Op 3 Subop B. The trajectory of these paired stones indicated the channeling of water to other pairs of stones in a complex system. The alignment of the stones revealed multiple canals including at least two larger canals leading down slope around 20 m eastward down slope before diverting south.

The larger canals are connected to a series of smaller canals with more diagonal trajectories perhaps in effort to slow water momentum inside canals and reduce soil erosion. Small depressions were identified which may have been associated with the other features. As with STP Feature 1 the water may have been channeled to these depressions to slow the flow, and to pool and to store non-stagnant water.

Another portion of the stones appear to be agricultural terraces. Along the largest chain of check dams there are two finely cut paired stones with near 90 degree angles. The local datum was measured off of the southwest corner of the smaller square stone. This datum stone is the most unique feature and so the STPs were planned to investigate the area adjacent to it. The initial questions raised by the surface investigations were:

- How agriculturally healthy is the soil?
- What is the drainage strategy?
- How extensive is the system below the surface?
- Was the soil calibrated for cultivation of a specific crop?
- How effective was the drainage strategy?
- How effective was the system in conserving soils?

The STPs were placed strategically to gather as much data relevant to the questions as possible within the limitations of a 30 cm shovel test pit. STP 4 was placed to collect soil samples for both paleo-botanical remains and basic nutrients. The basic nutrients along with observations on soil texture, color, density and drainage will help gauge to general health of the soil for agriculture. The paleo botanical remains may help to establish what specific crops were cultivated. During the excavation observations can be made to determine the subsurface drainage strategy. STP 3 was placed on the down slope side of the terrace to work as a comparison in the same strategy employed in STP Feature 1.

Shovel Test Pit 3

The first 10 cm of STP 3 was very dark grey (3/1 10 yr), less brown, grayer and darker than the humus layers at STP Feature 1. The soil texture is silty clay that is densely compacted and sticky. Limestone cobbles were present on the surface and in the fill as consistent with STP Feature 1. The surface also contains many small roots.

The differences indicate distinct soil conditions on the northern and eastern slopes perhaps due to the level on intensification of agricultural cultivation. This may be due to the favorable light conditions associated with eastern and western slopes. Conversely northern slopes are relatively deprived of solar energy.

The second lot was opened upon a change in soil density however; the color and texture remain consistent with the above lot. At 40 cm the lot was terminated upon reaching bedrock. No cultural material was collected.

Shovel Test Pit 4

The first lot of STP 4 is constant in color and texture to STP 3; however, the soil is markedly less dense and higher in moisture. At 10 cm a stone feature was hit that obscured half the STP. The soil was excavated another 10 cm around the feature before closure. Soil samples for basic nutrients and paleo-botanical remains were taken from Lot 2.

Shovel Test Pit 5

In effort to reach bedrock STP 5 was excavated 20 cm at 292 degrees from STP 4. Upon reaching 10 cm, the same feature was encountered once again covering half the surface. These two pits revealed that the feature is linear and likely a retaining wall associated with the channel, which would have directed the waters towards the next check damn. No samples were collected as they would reflect the same layer collected in the previous test pit separated by less than half a meter.

If the flow of the water was being directed to the retaining wall it may have been designed to break the momentum of the water or even to charge the water as is done in modern water treatment plants. As suggested previously, the associated depressions may serve to pool and store non-stagnant water and to slow down the flow of water. It is hypothesized that the main canal may lead to an *aguada* however investigations were halted by the presence of a deadly 1.5 m Fir De Lance that vanished before it could be dispatched.

The nutrient levels between the soils at STP features 1 and 2 are hard to compare until basic nutrient samples are processed, however, texture and color are excellent clues. The soil at STP Feature 2 is darker, which usually indicates fertility; also, it is greyer, which could indicate possible chemical differences that may be more important than organic content alone. The soil density and textures may be important in making a distinction. The soils in STP feature 2 are denser and less friable. This would restrict the amount of oxygen in the soil and would affect drainage and water holding capacity.

Shovel Test Pit Feature 3

STP Feature 3 was investigated as a complex system of step-terraces canals depressions and check damns on the southern slope of the elite group at N950. STPs 6 and 7 were excavated on a step-terrace as part of this effort. The group was mapped with tape and compass and each STP was marked with sub meter accuracy on a mobile mapper. The local datum is TMS STN P. On the N950 platform before the change in slope is a large complex stone feature several meters across with tunnels running through it in multiple directions and surrounded by depressions and possible canals. To the north and to the west are *aguada*s, which may be connected to this feature. The datum is located on top of this stone feature.

Upon the start of a 40 degree slope to the south are a series of at least three progressive step terraces with canals depressions and check damns on the platforms. The terraces may be cut out of the bedrock. The STPs are placed on the 2nd and 3rd terraces. STP 6 was placed on the surface of the platform of Terrace 1 and STP 7 is placed upslope of the convergence of two canals into a depression on the platform of Terrace 3. The initial questions raised by the surface investigations were:

- How healthy is the soil?
- What is the drainage strategy?
- How extensive is the system below the surface?
- Was the soil calibrated for cultivation of a specific crop?
- Is the aspect of the slope part of the selection process for the crops?

- How effective was the drainage strategy?
- How effective was the system in conserving soils?

Shovel Test Pit 6

The surface of STP 6 was a thick carpet of small roots and decomposing leaf litter (possible O horizon). This layer was 3-4 cm in depth. Small limestone cobbles (3-4 cm) covered the surface denser than at the terraces at N350 W75. The soil was very dark brown (2/2 10 yr) sandy clay loam. The cobbles were relatively dense in the very friable soils. At 10 cm the lot was ended upon reaching a layer of larger limestone pieces (8-10 cm).

The next lot under the larger stones was consistent in every way with the soil above the larger limestone. Bedrock was reached at 25 cm. Soil samples were taken at both lots. No cultural material was identified.

Shovel Test Pit 7

The surface roots and lime-stones cobbles and soil texture of STP 7 were consistent with STP 6. Though, the soil color is dark brown (3/2 7.5 yr). The STP was excavated in 2 lots with consistent soils. The layer of larger cobbles was encountered at 14 cm and bedrock was reached at 20 cm. Soil samples for basic nutrients were taken for each lot and no cultural material was observed.

The comparison between the two units shows consistency in drainage fill with small cobbles on the surface and through with a layer of larger cobbles around 10-15 cm. This may be deliberate or it could be the result of natural sorting during a process of anthropogenic smashing of stones. A portion of the small rocks will sort to the bottom followed by the heavier rocks and finally the portion of smaller rocks that would end up on top.

The soils are well drained dark and highly friable. The soils from the various N950 platform excavations under Op 5 reflect these excellent soils. The chemical samples may confirm a high level of soil quality in comparison to the smaller groups along the transect.

Shovel Test Pit Feature 4

STP feature 4 was investigated as a complex system of step-terraces canals depressions and check damns on the southeastern slope of the elite group at

N950. STPs 8 and 9 were excavated on a step-terrace in and adjacent to a drainage canal as part of this effort. The set of features are directly to the east of STP feature 3 and are part of the same system. The terraces appear to be cut from the limestone bedrock.

The group was mapped with tape and compass and each STP was marked with sub meter accuracy on a mobile mapper. The local datum is TMS STN P. On the N950 platform before the change in slope is a large complex stone feature several meters across with tunnels running through it in multiple directions and surrounded by depressions and possible canals. To the north and to the west are *aguada*s, which may be connected to this feature. The datum is located TMS STN O. The dominant feature of the landscape is a series of large stone check dams on the first terrace platform.

Shovel Test Pit 8

In the first lot of STP 8 ended in a layer of impenetrable limestone at 15 cm. The soil is very dark gray (3/1 10yr) sandy clay loam with heavy limestone fill. Soil samples were taken for nutrients. No cultural materials were identified.

Shovel Test Pit 9

The soil in STP 9 is constant with STP 8 except for the soil color is a very dark grayish brown. The bedrock was reached at 25 cm in a single to with no changes. No cultural materials were identified. Soil samples were collected for nutrients.

The change in gray hue between units may confirm that STP 8 was leeched from being in the canal and STP 9 was clear of it. The depth of reaching the possible feature in STP 8 and bedrock in STP 9 may indicate significant canal reinforcement infrastructure below the surface.

Shovel Test Pit Feature 5

STP feature 5 was investigated as a complex system of stepped basins connected by canals on a steep incline. The features are on the north slope of the group at N950. The group was mapped with tape and compass and each STP was marked with sub meter accuracy on a mobile mapper. STP 10 was excavated as part of this investigation. The local datum is TMS STN N.

Shovel Test Pit 10

To observe the sediments at the bottom of one of the basins a STP was placed in the center of a basin. The soil in Lot 1 was a very dark grayish brown (3/2 10 yr) sandy clay loam. The color is consistent with the soil color of the group above. The soil contained a dense fill of small limestone cobbles. After 20 cm a layer of sand was reached and the lot was closed. Soil samples were taken for basic nutrients.

The sand is likely associated with the cave being excavated above at the N950 group Op 4 Subop F. The layer of sand had a depth of 4 cm above impenetrable limestone that is either bedrock or anthropogenic stones placed as part of the feature. The soils are consistent with the 950 group in that they are friable sandy clay loam and they are very dark brown. The soils with more gray hues likely indicate leaching from the flow of water over time.

RESULTS AND INTERPRETATION

The soil samples taken during the 2011 season display signs of over-utilization and nutrient imbalance, the results contain extremely low essential nutrients including P and K (Figure 2). Organic content in the soils are adequate at both Op 1 and 2, with the highest levels measured at Op 2. The pH level is alkaline (7.5) at Op 1 and Op 2 with Subop A of Op 2 containing a highly alkaline subsoil (8.4), associated with a plaster floor. High levels of sulfur (S) may indicate heavy content of gypsum introduced as an agricultural additive while the unusually high levels of Mg and Ca may originate from the decomposition and leeching of plaster from stucco and paved surfaces.

Fedick (1994) found that upland terraces in the region were productive; however the valley bottoms were far superior. He suggested that the Maya lived on raised areas close to these low-lying areas to take advantage of their inherent fertility. The is consistent with the Maya soil classification system, as the Sakanis are fertile soils but limited by depth and susceptibility to erosion, and Ek Luk associated with *bajos* are considered less fertile than the Ek Luum associated with foot low lying foot-slopes.

Op 1 was placed on a gently sloping foothill leading to a nearby flood-plane. The placement and physical qualities suggest it is Ek Luum. It was expected that the deep soils in this a low-lying area would be more fertile comparative to the much thinner hilly soils near the structure group at Op 2, however, the Op 1 soils were found to be more heavily compacted and nutritionally deficient and the soil at Op 2 is likely a Tierra Mezclada of Sakanis and Ek Luum, considered very productive. The compaction and chemical analysis suggest that long-term intensive agriculture may have exhausted the soils at Op 1. The deep cultural deposits and presence of both pre-classic and terminal classic ceramics support this conclusion. Op 2 on the other hand contains potentially anthropogenicaly rooted nutrient imbalance and metal toxicity.

Soil Sample Analysis Results

Op 1																	Base Saturation %		
SubOp A	B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph	B Ph	CEC	%K	%Mg	%Ca
21 cm	0.2	0.3	0.3	0.1	0.2	165	0	45	10113	557	Low	9	5.2	7.4	7.4	55.5	0.3	8.6	91.3
30 cm	0.2	0.2	0.3	0.1	0	190	0	37	10720	543	Low	5	4.3	7.6	7.5	58.2	0.2	7.2	92.2
32 cm	0.1	0.3	0.3	0.1	0.1	189	0	34	11832	522	Low	5	4.4	7.9	7.5	63.6	0.2	4.3	93.2

Op 2																	Base Saturation %		
SubOp A	B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph	B Ph	CEC	%K	%Mg	%Ca
10 cm	0.9	2.1	0.3	0.1	0.1	258	6	75	29544	805	Low	0	9	7.5	7.5	154.6	0.2	4.7	95.7
20 cm	0.1	1.2	0.4	0.1	0.5	303	2	26	26977	458	Low	0	1.1	8.3	7.6	138.8	0.1	2.8	97.3
30 cm	0.3	1.6	0.4	0.1	0.2	286	3	37	26706	447	Low	0	2.4	8.1	7.6	137.3	0.1	3.4	97.3
36 cm	0.4	0.8	0.4	0.2	0.2	288	3	47	26436	565	Low	0	4.2	7.9	7.5	137	0.1	2.6	97.5
40 cm	0.1	1.2	0.4	0.2	0.2	317	2	38	27294	431	Low	0	1.4	8.3	7.6	140.1	0.1	2.5	97.5
55 cm	0.1	1.1	0.4	0.2	0.4	295	2	29	25424	394	Low	0	1.2	8.5	7.6	130.5	0.1	3	97

Op 2																	Base Saturation %		
SubOp B	B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph	B Ph	CEC	%K	%Mg	%Ca
10 cm	1	2.1	0.4	0.1	0	238	7	51	29517	855	Low	0	8.3	7.5	7.8	154.8	0.1	4.6	95.4
20 cm	0.6	1.5	0.3	0.2	0.1	236	4	32	30021	732	Low	0	4.8	7.8	7.5	156.6	0.1	3.9	96.2

CEC = Cation Exchange Capacity, OM = Organic Matter.

(B) = Boron, (Mn) = Manganese, (Zn) = Zinc, (CU) = Copper, (Fe) = Iron, (S) = Sulfur, (P) = Phosphorus, (K) = Potassium, (Ca) = Calcium, (Mg) = Magnesium, (Pb) = Lead, (Al) = Aluminum.

Figure 2. Soil Sample Analysis Results.

Phosphorus levels are far below the levels desirable for maize production (Wolf 1999) at both locations. The potassium results ranged from 45-75, which is very low on the normal scale for the growth of maize (between 50-800 ppm) (Wolf 1999). These P and K levels may have seriously stunted agricultural growth even with a high organic content. This may be explainable by examining the other nutrients. Magnesium is very high, and both calcium and sulfur are extremely high.

Copper (Cu) values above 0.6 ppm are optimum (Marx et al. 1996), however the Cu content in the soils at both locations are 0.1 ppm. At Op 2 Mn values are above the 1.5 ppm threshold, which is optimum, however, the levels at Op 1 are very deficient (Marx et al. 1996).

Boron (B) levels contrast between Op 1 and op 2. Op 1 contains 0.1 ppm B, a highly deficient level. At Op 2 the levels are 0.9 and 1 respectively, at slightly toxic levels. B toxicity is known to cause corn yield deficiencies worldwide. Anthropogenic sources of B are built from irrigation (similar to the process of salinization), surface mining waste and use of fly ash (Nable et al. 1997). Toxic B conditions are difficult to treat but may be ameliorated via heavy gypsum and lime use (Nable et al. 1997).

An organic content level of above 2 % is considered adequate (Marx et al. 1996; Espinoza 2011). The data from 28 profiles taken from depressions in the Three Rivers Region have an average organic matter content of 1.5 % (Dunning and Beach 2000). The surface values from the sample at Op 1 were 5.2 % while the values at Op 2 were 8.3 and 9 %. These values are substantially high for the region. Organic matter is also a good proxy for nitrogen levels. The high organic matter would suggest an ample supply of N.

Although the organic matter is high, zero P was detected at the N150, where more intensive agriculture may have been practiced. A P level of less than 16 ppm is considered very low and the phosphates range from less than 1 in Op 1 and no more than 7 ppm in Op 2. P is generally low in the tropics; however, the levels at both sites are exceptionally low.

Low P levels are usually corrected by adding organic content. Dahlin et al. (2007) made comparisons between P and zinc levels at archaeological sites and with ethnoarchaeological analysis of modern day marketplaces. The areas displaying higher P and Zn levels were found to be associated with food preparation areas while the walkways are marked by very low levels of phosphorus and Zn due to sweeping of floor preventing decomposition of primary refuse in place. Areas such as the playing surfaces of ball courts, plaza surfaces and patios floors are generally associated with low concentration of P. These locations were likely maintained and kept relatively clear of refuse, while areas behind buildings have high concentrations of P (Bair 2010).

The high organic content supports the assertion that the areas were high organic content middens. In the location of deposition of organic material, P levels should be elevated but in this case, are not. At Op 1, P levels were measured at zero paired with an organic content of a high 5.2 %.

A soil profile from a *bajo* near La Milpa was measured as having an organic content of 4.5 %, slightly lower than Op 1, yet the P levels were also measured at 60 ppm. The tests run for basic nutrients only detect available nutrients rather than insoluble forms. This paring of organic content and P was expected. The organic content levels suggest that there is P in the soil. However, the nutrients are not available to be consumed by plants. The high level of organic matter and the low phosphorus levels at Op 1 and 2 point to a problem with the ability of the phosphorus to change from insoluble forms into soluble forms that available to plants. This is called phosphorus-fixation.

The high levels of available Ca test and the percent base saturation tests illustrate the Ca excess. Soils that are naturally calcium-rich, agricultural soils with heavy clay content contain a little above 2,500 ppm of calcium (Espinoza 2011). Jensen et al. (2007) collected samples from 14 different modern Itzá Maya agricultural fields in Motul De San Jose Guatemala in Petén. The average of the surface Ca readings in this study was 28.65 ppm. The calcium average from 28 samples taken from trenches and test pits in and in close proximity to the three rivers region is 7824 ppm (Dunning and Beach 2000). The highest value of 11828 ppm was recorded at RB59 Sierra de Aguada. The data establish that the archaeological sites in the Three Rivers Region as having substantially high average Ca content.

At N150 Subop A, the levels of Ca at the surface were 10113 ppm placing it in the higher range for the area. In the hillier topography of the N250 structure group where Subop B is located, the Ca levels were nearly three times these levels. At the surface they were measured at 29544 ppm, and 29517 ppm respectively. These levels are nearly three times the average for the region, which are already substantially high.

The second metric we can use is percent base saturation, which is a ratio between Ca, Mg and K, and Sodium (Na). Percent base saturation of the soil Percent Base Saturation usually falls within the following ranges in calcium (Ca) rich soils (Mullen et al. 2005):

Table 1. Element Ratios.

Element	**Normal Range**
Potassium (K)	1-5%
Magnesium (Mg)	10-40%
Calcium (Ca)	40-80%

The ratios for the 2011 season show Ca as dominating the percentage, Mg low and K barely registering:

Table 2. Element Ratios continued.

Element	**Range of Results**
Potassium (K)	0.1-0.3%
Magnesium (Mg)	2.5-8.6%
Calcium (Ca)	91.3-96.2%

Calcium carbonate is an extreme base and in alkaline environments phosphorus is less available. The ideal range for phosphorus availability is 6.0 and 7.5. The pH in Op 1 in the deeper low-lying topography is 7.5. At Op 2 Subop A, subsoil is very alkaline (8.4). High Ca is to be expected in this environment due to the calcium carbonate bedrock, and general alkalinity, however, the levels appear to be anthropogenic based upon comparisons with other profile averages. The base saturation percentages indicate that the percentage of pore spaces in the soil is occupied by Ca, and preventing other nutrients to become available to plants. The chemical reactions that change the forms of nutrients in the soil are dependent upon the number of available surface colloids (surfaces that the nutrients can attach themselves to with the right magnetic charge). If the colloids are dominated by a single nutrient, the other nutrients will have less capacity to change and become available.

P fixation means that the phosphorus in the soil is being blocked from transforming into the salable form that plants can use and that our tests detect. It also causes the soils to be less responsive to P from fertilizers. P fixation happens most commonly in acid soils high in Fe and Aluminum (Al) oxides so smectite based clays like vertisols are generally considered to have low phosphorus fixation capacity (Juo and Franzluebbers 2003). Op1 soils are alkaline (7.5), and Op 2 are strongly alkaline. Both locations have negligible levels of Fe and Al. A less common phosphorus fixation occurs in alkaline soils with very high levels of Ca (Bear 1942: 49). Ca and Mg are usually the most dominant cations in smectite clay. The second less common P fixation based on excess Ca levels is likely present.

The relationships between Ca, K, and Mg are well established in soil nutrition (Agboola and Corey 1973; Terman et al. 1975; Ologunde and Sorensen 1982; FAO 1990). Increases in Ca to high levels interfere with K and Mg availability. These nutrient levels point to a significant soil nutrient imbalance that may have majorly impeded agricultural plant growth.

In this case, the causes for the phosphorus fixation may be high calcium Ca content, which is a direct result of plaster limestone leeching into the soils. The sulfur rate may be an indicator of the potential use of a specific soil amenity designed to amend this potentially ongoing challenge or a natural deposition of S or gypsum. The S levels in soil are usually very low (Table 3), however, S tests on the transect have revealed abnormally high levels (Table 4). The following are the normal ranges for S as defined by (Marx 1996).

Table 3. Normal Levels of S.

Normal Levels of Sulfur (S)	**Range in ppm**
Low	<2
Medium	2–10
High	>10

Table 4. DH2GC Levels of S.

Context	**(S) ppm**
DH2GC, Op1 Subop A	190
DH2GC, Op2 Subop A	303
DH2GC, Op2 Subop B	238

This may be evidence of long-term gypsum use as a soil additive to control pH. Gypsum is composed of Ca, O and S ($CaSO_4{\cdot}2H_2O$). The Ca leeched from plaster floors and stucco likely make up the majority of additional Ca in the already calcium-rich soil environment.

$CaSO_4{\cdot}2H_2O$ is applied to loosen clay, improves soil tilth and acidifies soil. Optimal conditions for most vegetables are lower than 7.5, so adding gypsum in such an alkaline environment is intuitive. For example, maize grows most effectively at a pH of 5.5 to 7.0 (Wolf 1999). The pH level on the transect is not ideal, but manageable with additives such as $CaSO_4{\cdot}2H_2O$. The samples taken at 30 cm at both Op 1 and 2 have a substantial spike in S, perhaps indicating a possible period of intensive fertilization or a flooding of the water table depositing natural S or $CaSO_4{\cdot}2H_2O$ layer.

A key factor is if the sulfur levels are anthropogenic or natural. The formation of gypsum accumulates by evaporation of mineralized groundwater (Kovda 1954; FOA 1990). $CaSO_4{\cdot}2H_2O$ is dissolved by the percolation of water leading to gypsum accumulation and salts on a perched water table. When the water table rises as was the case during the Preclassic period (Beach et al. 2009) $CaSO_4{\cdot}2H_2O$ may be deposited (FOA 1990).

The water sulfate levels in area between the Rio Bravo and Booths Rivers have been recorded at a 7,500 ppm (Beach et al. 2009), which is substantially high. The soils in this area were also described to be gypsic calcareous clays (Beach et al. 2009). Three models developed for understanding the development of wetland soils in the region including the Natural model, the Chan Cahal model and Birds of Paradise model include a rise in the water-table around the Preclassic that introduced high levels of $CaSO_4{\cdot}2H_2O$ into the soils through ground water precipitation (Beach et al. 2009).

These environmental factors may account for the higher levels gypsum suspected from the S levels in the samples, however, anthropogenic causes should be considered as well. The distribution of these levels relative to the water table may help determine if the $CaSO_4{\cdot}2H_2O$ levels in specific locations are due to regional percolation, anthropogenic manipulation, or both.

If the origin is percolation, then areas higher off the water table should contain less sulfur. The topography at Op 1 is closer to the water table, and should therefore be higher in S than the raised topography of Op 2. If areas that should naturally be proportionally less sulfuric contain heavy concentrations, then an anthropogenic explanation may be appropriate. If S rates rise in correlation with proximity to structures it may indicate that the distribution is anthropogenic.

The data from the soils collected at Guijarral, at the 25 cm level, indicates adequate K ratios as well as P, and with high Mg (29 ppm (P), (S) 353 ppm (K) 6276 ppm (Mg), 180ppm (S) 6.3 pH). At the Liwy group the nutrient levels are more than double that of Guijarral (335 ppm S, 1835 ppm K, 11226 ppm Mg, 342 ppm S, 42 ppm P, 6.5 pH). At the Barba group all of the nutrient levels were higher than at Liwy group. Mg and K were both higher by small percentages. Most significant is an exponential increase in P and more than double the S content (311 ppm P, 1912 ppm K, 18044 ppm Mg, 857 ppm S). Table summarizes the data.

Table 5. Other Site's Element Levels.

Site	(P) ppm	(K) ppm	(Mg) ppm	(S) ppm	pH
Guijarral	29	353	6276	180	6.3
Liwy	42	1835	11226	342	6.5
Barba	311	1912	18044	857	7.7

These data appear to reveal a possible positive relationship between high nutrient levels and sulfur levels. If higher levels of sulfur indicate higher levels of fertilization, this may indicate that the agricultural lands with the highest productivity were treated with significantly more fertilizers such as gypsum to regulate pH levels. Conversely, the higher levels of sulfur may represent areas where the water table may naturally deposit gypsum or sulfates in higher quantities.

The pH levels at Guijarral and the Liwy groups are slightly acid, which falls within the optimal growing range for corn (5.5-7) (Fischbeck 2001; Wolf 1999). This contrasts with the soils from the transect and the greater region which are strongly alkaline. By supplying the soil at Guijarral and Liwy Group with a constant supply of gypsum, the pH may have been regulated preventing the calcium from inducing phosphorus.

Table 6. DH2GC Unit Element Levels.

Site	(P) ppm	(K) ppm	(Mg) ppm	(S) ppm	pH
DH2GC Op1 Subop A	0	45	557	190	7.5
DH2GC Op2 Subop A	6	55	805	303	8.3
DH2GC Op2 Subop B	7	71	855	238	7.5

The S needs of plants are minimal and therefore less agricultural research has been done on S in relation to more economically essential nutrients. During the literature review, no case studies were encountered from modern agriculture where either Ca or S levels were both elevated to the extremes jointly as those recorded on this transect and in neighboring sites. S is an acid while Ca is a base, though both are present in large quantities, perhaps mitigating the mutual effects on the availability of other nutrients. It may be the case that in these unusual conditions, the ratio of Ca/S, rather than just the quantities may be an important factor governing pH and base saturation percentages. These factors may control if and to what degree P fixation occurs. Further research is necessary to investigate the effects of S and Ca ratios in former Maya urban areas.

Because the S is added in large quantities mainly for acidification rather than as a nutrient, and the absorption of S by plants is so low over time, the residual S levels may represent the buildup of excess. Analyzing the proportionality of these ratios on a regional scale may be useful in estimating what is natural and what is anthropogenic. If patterns emerge indicating anthropogenic application, the amount of capital that was invested in agricultural fields in terms of soil amenities may be estimated. In these terms, the amount of capital investment may present an opportunity to investigate social inequality recorded in the cultural soilscape.

$CaSO_4 \cdot 2H_2O$, or gypsum, is usually associated with positive effects upon aggregation of the soil and for acidification of alkaline soils however, high $CaSO_4 \cdot 2H_2O$ contents can be detrimental to soil health in high concentration. Barzanji (1973) defined five classes of gypsiferous soils based upon percentages of $CaSO_4 \cdot 2H_2O$. Soils with a content of 0.3-10 % $CaSO_4 \cdot 2H_2O$ are slightly gypsiferous and display no negative effects to plant growth. At 10-15 % the soil is moderately gypsiferous and root growth is inhibited. At 25-50 % the soil is highly gypsiferous, minimizing root growth, and becoming unsuitable for irrigation (FOA 1990). The effect that $CaSO_4 \cdot 2H_2O$ levels have on crops depends on the particulars of the crops. Studies have shown that corn is significantly affected by highly elevated $CaSO_4{\cdot}2H_2O$ (Boyadgiev 1974). Broad beans, and corn, are semi-tolerant to gypsum and will have significant drops if $CaSO_4{\cdot}2H_2O$ reaches 20 %. Cotton is semi-sensitive $CaSO_4{\cdot}2H_2O$, resulting in a significant drop in yield if $CaSO_4{\cdot}2H_2O$ levels reach 10 % (FOA 1990). Surface layers of gypsiferous soils are often poor in P, N (Dobroval'skiy 1965) Mn, Cu, Zn and molybdenum (Mo) (Minashina 1956; Van Alphen and de los Rios Romero 1971). It has also been shown that high levels of gypsum can contribute to P-fixation, reducing the effectiveness of P fertilization as it transfers into unavailable forms (FAO 1990).

Mg levels were very high at all Subops, but not approaching toxic levels. A soil content of 180 ppm Mg is considered high (Marx et al. 1996). High levels of Mg also become a contributing factor in P-fixation in alkaline soils above 7.5 (Bear 1942). In an EDS analysis of Maya plaster used for sculpture using all of the plaster samples contained major fractions of Ca, Mg, and trace amounts of Al, silicon (Si) and Fe (Villaseñor and Price 2007). This may account for the high levels of Ca and Mg. The sample size on the transect is currently very small, however, the high concentrations of Ca correspond with high values of Mg. Op 2 Subop A has the highest levels of Ca, and the highest pH.

High levels of Mg have been shown by Venkatesan and Jayaganesh (2010) to decrease K availability. They also concluded that Mg has a "synergistic" relationship with P in which Mg increases P levels substantially. The potassium levels are low, and phosphorus levels remain very low as well, but where the magnesium levels are the highest (Op 2) the phosphorus levels are also slightly higher. A floodplain adjacent to La Milpa showed comparable levels of Ca, similarly depressed levels of K and P, and very high Mg availability (11094 ppm Ca, 2894 ppm Mg, 49 ppm K, 14 ppm P) (Beach et al. 2006). These levels seem more or less consistent with the soils on the transect and may indicate that a high Ca and Mg content derived from plaster pollution is a common feature of soils in and around highly populated urban areas, especially in areas with naturally alkaline soils.

PRELIMINARY CONCLUSION

The initial observations made during mapping and excavation have been useful in bringing into focus the soil conditions associated with each group and the variations in color, texture and density that are associated with particular infrastructure and human activity (Figure 3). The results off the analysis of the basic nutrients in the soil will offer a great deal more definitive measurements and allow for greater potential for interpreting land use.

Op1 Sub Op A

B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph
Poor	Poor	Poor	Poor	Poor	V High	Poor	Poor	V. High	High	Poor	Poor	High	High

Op 2 Sub Op A

B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph
toxic	Medium	Poor	Poor	Poor	V. High	V. Poor	Low	Ex. High	High	Poor	V.Poor	High.	V. High

Op 2 Sub Op B

B	Mn	Zn	CU	Fe	S	P	K	Ca	Mg	Pb	Al	OC	Ph
toxic	Medium	Poor	Poor	Poor	V. High	V. Poor	Poor	Ex. High	High	Poor	V.Poor	High	V. High

CEC = Cation Exchange Capacity, OM = Organic Matter.

(B) = Boron, (Mn) = Manganese, (Zn) = Zinc, (CU) = Copper, (Fe) = Iron, (S) = Sulfur, (P) = Phosphorus, (K) = Potassium, (Ca) = Calcium, (Mg) = Magnesium, (Pb) = Lead, (Al) = Aluminum.

Poor= deficient, Harmful= Toxic high levels, V. High = Very High, V. Poor= Very deficient, Ex. High= Extremely High

Figure 3. Unit's Elemental Condition Report.

Very little previous data exists between the Rio Bravo and Booths River escarpments outside of Dos Hombres, on the soil conditions, so a comprehensive understanding of the local soils is yet to be established. The As such, the difficulty early in the process of building this knowledge base is in operating with a limited baseline. Comparisons between sites can help detect patterns that may become progressively more revelatory as a baseline can be established for what is "natural" or "normal. This is an especially large challenge when in a heavily populated region where it is so difficult to determine what areas are "pristine" rather than anthropogenic. Wood structures for instance do not survive the archaeological record and therefore a bias is formed for central sites.

The sampling strategy utilized during this field season is "strategic" which allows for a high level of control over the kind of data desired; increasing understanding the dynamics of variation in topography, presence or absence of archaeological sites and features. The weakness of the strategy is in building robust statistical data; however, the nature of soils data is so labor intensive per data point that it takes time to build a large number.

Strategic samples give a valuable window into the soil conditions to help direct future sampling. The utility of this data will be greatly enhanced when it can be combined with more systematic sampling either on a grid pattern or by random distribution. Both methods are more statistically grounded and will help build a baseline to determine what variation is significantly over or under a standard deviation. Another aspect of the sampling strategy is that the regular excavation units are placed with material culture and architecture in mind rather than soils data. Although these are not totally random as they are selected based upon features and archaeological interests, they add an element of randomness to the sampling, which may help to decrease individual bias in placement of shovel test pits.

The area is a micro-region that contains similar soils to those found in surrounding areas, however, the particulars of the environmental and topographic conditions warrant careful consideration. As the altitude decreases toward the Booths River the ecology changes and in tandem so does the soil. The vertisols give way to Grails, which are a soil type that is more associated with inundation and alluvial deposition in the flood plans adjacent to rivers.

As the project progresses into the area of soil transition and beyond comparisons can be made to agricultural and soil conservation, architecture, and social organization regiments employed on either side of the divide. These comparisons may help determine if different strategies were calibrated to adjust for the soil conditions. They may also help illuminate the way in which soils permeate the socio-economic realm. The results may have the potential to profoundly enhance our understanding of the relationship that the Maya had with their soil.

Soils collected during the 2011 and 2012 field seasons represent 54 samples over 20 loci and will greatly contribute to building a baseline, understanding local soil dynamics, and detecting behavior patterns. The soil characteristics have varied on the site level leading to questions about associations between site type and soil. Thus far, it appears that soil attributes such as texture and color appear to be associated with site rank, with larger groups and higher elevations featuring preferable soils. If the chemical data supports this hypothesis the challenge moving forward will be to determine if this is an anthropogenic process or natural and if anthropogenic, isolating the behavioral process responsible.

The soils appear on visual inspection to be rich and excellent for agriculture. The ethnographic sources suggest they would have been classified as, Ek luk, or Ek Luum at Op 1 and at Ek Luum Tierra Mezclada, which are favorable soils for agriculture. These soils are characteristic of the soils observed elsewhere on the transect suggesting the area was at one time a very productive agricultural zone. Under chemical scrutiny the soils appear less viable. The only nutrients that were not determined to be low or deficient were calcium, magnesium and sulfur; and the dominant exchangeable cation or calcium followed by magnesium, and potassium. A chemical imbalance exists that is invisible from the surface; otherwise the data on organic matter and texture suggest that the folk taxonomy would have been accurate.

This ranking is typical of gypsiferous soils (FOA 1990). The buffered pH levels in gypsiferous soil also range of 7.5 to 8.4 (FOA 1990), which is consistent with the samples. Boron is also at toxic levels at Op 2. The soil in both Op 1 and 2 are in poor condition to sustain agricultural growth without considerable investment of soil amenities to rehabilitate the soil.

The low levels of available P, K and the Ca-dominated base saturation ratios indicate an alkaline P-fixation. The available K was also likely reduced by an excess of Mg from the plaster. From the available data it appears that the Ca accumulated from erosion of limestone plaster (and possibly from the Ca component of gypsum) contributing to P-fixation. The high S levels provide some evidence for a significant presence of gypsum in the soil, but the levels of sulfates in the local water or percolation of $CaSO_4{\cdot}2H_2O$ during a water table rise may be the source. Gypsum was observed during excavation (and are common at other areas in the region) but it cannot be definitively determined to what degree is the soil gypsiferous unless $CaSO_4{\cdot}2H_2O$ percentage tests are performed. The potential $CaSO_4{\cdot}2H_2O$ content may either be a natural phenomenon due to a climate shift and water tables rise, or it was added to the soil as a fertilizer to reduce the Ca driven P-fixation through acidification.

Under the calcium driven phosphorus fixation, the capacity for soil amenities to effectively regulate the soil is greatly reduced. Ironically using gypsum as an amenity to P-fixation in a Ca-dominated soilscape may have further reduced the soils capacity to convert outside inputs of organic fertilizers into soluble forms. The soils at this location may have reached a point at which they were dependent on constantly ameliorating the soil with increasingly ineffective soil fertilization measures. Eventually a point may have been reached at which the soil was no longer economically viable, leading to abandonment.

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SETTLEMENT PATTERNS AND PRELIMINARY GIS ANALYSIS

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Several lines of evidence used on the DH2GC address topics dealing with the nature of ancient Maya settlement in regard to the socio-political relationships between settlement clusters, and how those relationships compare among different social and spatial scales. Much of the research undertaken in the past field seasons encompassed seven major activities: 1) establishment of the main and side baselines; 2) mapping of the new sites and informal clusters; 3) mapping of all cultural remains within the 150 m wide transect, including residential units (122 total), terrace areas, midden scatters, water features, and *chultuns*; 4) ecological survey on the baseline; 5) test excavation in middens; 6) test pits were also excavated in plazas and courtyards to identify the nature of rebuilding in open areas; and 7) the definition of land resource zones within the survey transect area. The excavation data collected from the 2011 and 2012 field seasons provide a baseline for dating the public and architectural activities in the study area.

On the current study area, we have recorded natural features that might help us in identifying settlement boundaries. We have recorded the edges of a *bajo* to the west of Dos Hombres. It is a partial *bajo* -- meaning that it was partially full of water and contained gilgai soils. The beginning of the partial *bajo* was recorded at 450 m from the zero point (transect datum) of the transect. At 700 m from the transect datum, this natural feature transitions from a partial *bajo* to a full *bajo*. The full *bajo* is continuous until 2 km away – roughly 2.5 km from the site core of Dos Hombres.

In this transect, some settlements are located in ecotones -- meaning at the junction of two or more environmental zones (Figure 1). These areas are rich with distinct resource types and enabled the inhabitants to exploit many of these resources -- such as upland forests and limestone deposits – especially for residential constructions. These areas usually slope into the *bajo* margins which are used for agricultural terracing, channels, clay sources, and water. The incorporation of diversity increases the strategies and choices available to cultures. Agricultural production is inherently interconnected with other cultural systems. It should be noted that the organization of intensive agricultural production is not yet clearly understood.

Rank size ordering is useful to reveal a distribution of settlement on the landscape. A quantified site ranking system for the Three Rivers Region was first developed by Adams (Adams and Jones 1981). The assumption behind these ranking methods is that the size and configuration of a site is related to the size of its population. By extension, the size of the population is a reflection of the political authority that a site possesses (Adams and Jones 1981).

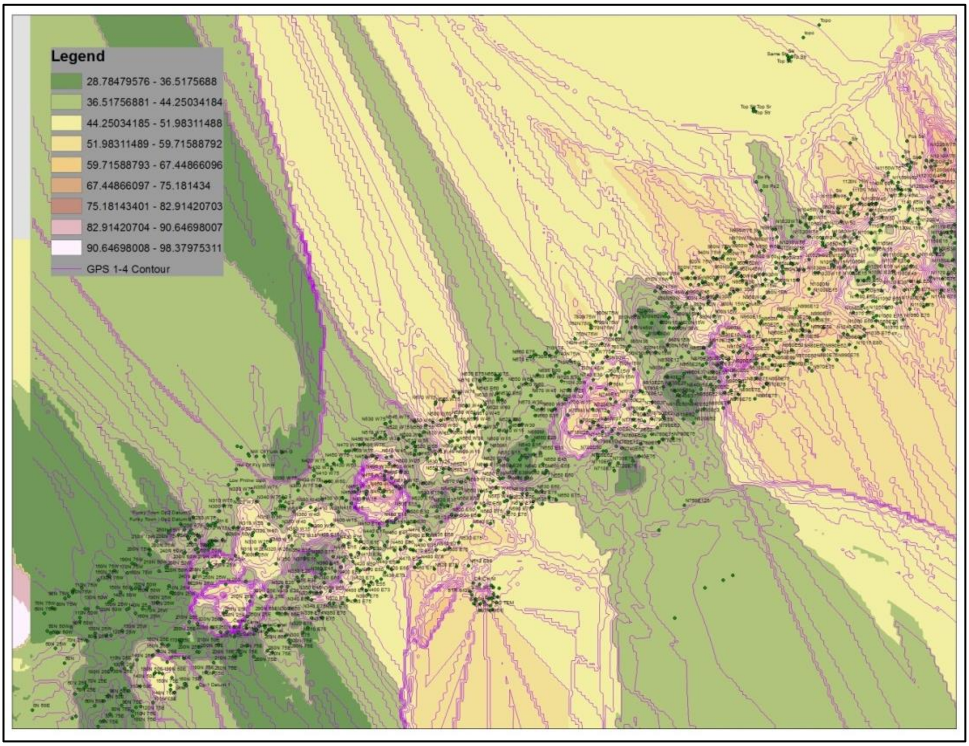

Figure 1. Dos Hombres to Gran Cacao Transect Contour. Data Digitized by Marisol Cortes-Rincon.

Adams' system is simple, one can essentially count the number of courtyards and add it to the number of acropolises and multiply it by two. This will provide the site score. This ranking method was later modified by Guderjan (1991). Guderjan (1991) modified Adams' initial technique because many indicators of power were not included. Added to the formula were signs of authority such as ball courts, *stelae*, and large monumental buildings. Both Adam and Guderjan's systems were combined to develop a settlement hierarchy for the sites used in this study (Table 1).

Table 1. Ranking List.

DH2GC	**DH2GC Project**	**Ranking Guderjan/ Adams**	**Environmental Zone (By Brokaw)**
N150E75	Informal Cluster	1	lowland
N250W75	Informal Cluster	1	floodplain
N350W125	Informal Cluster	1	upland
N500E75	Informal Cluster	1	upland
N675E275	Informal Cluster	1	bajo-partial
N750W10	Informal Cluster	1	bajo-partial
N750E100	Informal Cluster	1	bajo-full
N800	Informal Cluster	1	bajo-full
N950	Small Ceremonial Site	6.5	eco-tone (upland slope combined with other eco-zones)
N1270W40	Informal Cluster	1	upland
N1270E85	Informal Cluster	1	bajo-partial
N1270W90	Informal Cluster	1	upland
N1300W75	Informal Cluster	1	upland
N1400W330	Informal Cluster-elite	3	eco-tone

INFORMAL CLUSTERS

Informal clusters consist of an aggregation of structures undifferentiated in size and function (Hammond 1975). The structures are clustered around an informal patio or courtyard and lack monumental architecture, ball courts, and *stelae*. Most of the perishable structures were built atop of modified platforms -- except for the few solitary dwellings recorded on the transect. The average surface area of the platforms that surround these central patios is 8 to 10 m^2. These platforms are generally less than 1 m in height and blend in with the natural topography.

These clusters were probably used by a household unit or extended family members. Mound to mound variability within a cluster is thought to result from status distinctions within the family (Ferries 2002). The majority of settlement encountered on the transect so far is of the Informal Cluster Category -- approximately 80 percent.

RESOURCE SPECIALIZED COMMUNITIES

Scarborough and Valdez proposed three types of Resource Specialized Communities (RSC) for the Three Rivers Region: *bajo*, terrace, and *aguada* communities. All three categories are represented in the project area. N750W10, N750E100, N1270E85 and N1300W75 are all located in partial or full *bajo*s. These areas have gilgai soil present on the surface. N250W75, N350W125, and N950 all have evidence of agricultural terraces. The documented *aguada* communities are N350W125, N550E75, N675E275 and N950. These all have water catchment features as well as channels to funnel water to various areas.

EVIDENCE OF SPECIALIZATION

N250W75 has evidence of lithic production -- specifically the manufacture of drilling tool types. The N750 patio group also has evidence of lithic manufacture, as well as GUBs, which are commonly used for agricultural purposes. N950 appears to have a ritualistic function for its nearby community members.

SMALL CEREMONIAL SITES

Small Ceremonial Sites are sites at the top of the hinterland settlement hierarchy. These are distinguished by having a ceremonial function -- some form of political, religious, and/or economic control – marked by the presence of at least one non-residential structure, usually greater than 5 m in height, facing a formally defined plaza (Hammond 1975).

The N950 group is located approximately 1.5 km from the main plaza of Dos Hombres. It is situated approximately 55 m above sea level on top of a modified knoll. The group has a similar layout to a Plaza Plan 2 as defined by Becker (1971) -- which includes a shrine on the eastern side of the plaza -- STR FN36. Shrines are masonry, vaulted-roof superstructures with veneered stonework certainly requiring a skilled mason for construction. Other sites in the PfBAP that exhibit a similar Plaza Plan 2 layout are: Group D at Dos Hombres, Groups A and B at Betan Chinam, El Grupo Barba, La Milpa East and La Milpa South.

Interestingly, La Milpa West has a reversed Plaza Plan 2 layout –with a shrine on the west side of the plaza. Both Group D at Dos Hombres and N950 have Terminal Preclassic beginnings culminating with a Terminal Classic occupation. These smaller to medium size sites are more common in the Early Classic; most have an elaborate burial located within the shrine structure. It suggests that high status individuals were buried with their localized lineages in increasing numbers during the Early Classic, while the ruling elite were normally buried at the site center. This reflects a centrifugal process with a religious focus, supported by the ritualistic components of the site. In a sense, it is a reproduction of ideology at smaller sites, such as N950. The site has caves and subterranean features, which have archaeological evidence of ritualistic activities.

N950 has extensive landscape modifications that represent water-management efforts for residents' agricultural endeavors. There are three large water features on the southwestern part of the plaza and water basins interconnected by channels on the northeastern side of the plaza --funneling water to a small elite residential group at the bottom of the knoll. This group is located at 38 m above sea level. This group has a small round altar located on the west side of STR FN41. Settlement is concentrated around the knoll and several artificial water catchment features are nearby. Numerous terraces on the slopes below the settlement lead to drainage features that fed the floodplain on the southern part of the site. There is also a quarry on the western side of the knoll, which was probably quarried for limestone for building residences.

Based on preliminary ceramic chronology, it is probable that the site started as a separate shrine and residential center in the end of the Preclassic and retained a certain character of its own to merit consideration as a separate site. Additionally, the close proximity of this group to the *bajo* -- associated with agricultural activities (Harrison 2000) -- and the labor intensive structures, suggest that the settlement group may have provided preferential access to highly productive agricultural lands for a certain lineage (Durst 1996).

To the north of N1100, a linear feature (STR FN 78) was recorded – just 150 m away from the N950 group. Due to the lack of field time, we only documented a portion of this feature, approximately 60-70 m long and 2 m wide. Portions of the linear feature were mound-like, similar to a small household structure, while other sections consisted of cut stones set in a linear fashion. It would appear to be a *sacbe,* which needs to be investigated further. A similar feature was found at N1200W75 -- it is an intra-site *sacbe* connecting the patio group to another residential group. *Sacbeob* in the Three Rivers Region have also been documented near the Hill Bank area by Aylesworth and Suttie (2011).

SETTLEMENT DISCUSSION AND LABOR

For elites as well as non-elites, the amount of labor that can be controlled is a direct indicator of what can be channeled into a private residence. Consequently, labor invested in a residential unit can be equated with status. If there is variability in family size, labor availability, and resources, there should be variability among residential units. If, within a region, there is a recognizable pattern in the distribution of economic resources and there is unequal access to these resources, as has been demonstrated for the central Maya lowlands (Sanders 1977; Graham 1987), then that pattern should be apparent in the residential component. The elaborate development of monumental public architecture within the Dos Hombres and Gran Cacao centers are impressive and overshadow the public architecture of the study area, in the northeastern periphery of Dos Hombres thus far. This difference in the public administration center is mirrored in the private residential units as can be seen from the Informal Clusters mapped so far.

The categories of highest labor investment drop out as one moves from the Dos Hombres site core to the transect area. There is a correlation between labor investment in private residential units and that in public monumental architecture. These data on residential composition and wealth demonstrate a fundamental difference in the organization of the domestic unit, which should relate to differences in the general nature of the domestic economies as reflected in household inventories.

LABOR ESTIMATES BASED ON WATER CATCHMENT FEATURES

At the N350W125, a total of 32 people would have been needed over a 30-day period to construct the three water catchment features (Table 2). These three water features would have supported an estimated 406 people per year. The *aguada* at N950 would have only required an estimated number of 20 people over a 30-day period. This resource would have supported an estimated 216 people per year. Based on out structure count thus far (n=122), our population estimates indicate that there were 384 people in the mapped section of the transect (Table 3).

Table 2. Water Management Labor Estimates (Erasmus 1965; Rice and Rice 1981).

Aguada	**No. of Days to Move Soil and Limestone**	**Volume**	**Total Days per Volume**	**Number of People per 30 days**
I	4.5	95.567	430.0515	14
II	4.5	78.179	351.8055	12
III	4.5	38.4845	173.18025	6
IV	4.5	132.732	597.294	20
Total Number of people needed for 30-day labor:				52

Table 3. Population Estimates.

# of Structures	**Reduction by 16% (to account for ancillary STRS)**	**Total**	**75% Occupancy Rate**	**5 people per STR**
122	19.52	102.48	76.86	384.3

The Maya were not a homogenous society and therefore no single typological model can account for all settlement variability (Lichtenstein 2000). Instead, using the site ranking systems devised by Adams and Jones (1981) and Guderjan (1991), the sites separate out into a series of clusters, which correlate to a series of functionally diverse types that correspond to the sample of sites in this study.

Fundamental variances in settlement patterns in the study area suggest basic differences in household economics and community organization. It is increasingly apparent that the analysis of lowland Maya social complexity must include, as an integral part, an appreciation of local processes of development at the rural household level before the regional system can be comprehended. The understanding of artifact types and distributions will help clarify the organizational differences and similarities that exist within the area. The next step, which is currently under way, is the analysis of basic procurement, production, and distribution of artifacts. The results of these analyses will help expose the economic and political organization of the ancient Maya.

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A GEOSPATIAL HABITATION SUITABILITY ANALYSIS OF THE DH2GC

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This survey project called the Dos Hombres to Gran Cacao Transect Project (DH2GC) is part of a larger endeavor, the Program for Belize Archaeology Project (PfBAP), which is being conducted by the Belizean government in coordination with several universities to study Maya civilization from the Classic period. The purpose of this project was to conduct a geospatial analysis of an archaeological transect that is being surveyed between the Maya sites of Dos Hombres and Gran Cacao in northwestern Belize. The survey transect when finished will be 12 kilometers in length, currently the first ~2 km have been completed. During the last four field seasons, the DH2GC project has recorded a large amount of digital spatial data about different features along the transect.

Geospatial analysis allows for the data from this project to be organized, analyzed, and reported in new and interesting ways. GIS technology has long been used in archaeology and it is so powerful because, "... it can move many of the (admittedly common-sense) assertions we make in spatial archaeology from the domain of the intuitive to the realm of the quantifiable and mathematical provable (or at least statistically demonstrable)" (Ilan Sharon et al. 2004). An example of a Belizean archaeology project that has made use of GIS techniques in this way is the Sak Tz'i' mapping project conducted by Dr. Hernandez of the University of Calgary. His project used GIS based analysis to look at Mayan epigraphy in order to calculate regional spheres of interaction between major city-states (Hernandez et al. 2003).

The central hypothesis of this project was that the resources and characteristics of certain areas between Dos Hombres and Gran Cacao make some locations more favorable than others for habitation. If the factors that coincide with the known settlements can be quantified and settlement patterning established, then these patterns may be used to predict the likelihood and location of as yet undiscovered settlements. It was hypothesized that all favorable locations would be located in upland ecological areas, that these areas would have similar habitation chronologies, and that these favorable locations would be closer to manmade features than to naturally occurring features.

This GIS study was the first attempt to pull the digital data that has been gathered by the DH2GC project together into one place for habitation, chronologic, and ecologic analysis. Drs. Brett Houk, Hubert Robichaux, Jon Lohse, and Jon Hageman have all conducted research in the general area of Dos Hombres, but none of their projects have looked specifically at the area between Dos Hombres and Gran Cacao.

METHODOLOGY

Most of the spatial data used for this project was recorded using five GPS units with accuracy equal to ±10 m. GPS readings in the field were only accepted if they had a Positional Dilution of Precision (PDOP) value of three or less and as such, the minimum mapping unit of this project was three meters. The analysis used the Universal Transverse Mercator projection in zone North 16 using the NAD 27 datum. Ecological analysis was provided by Dr. Brokaw (Brokaw et al., this volume) of the University of Puerto Rico and pottery sherd analysis by Dr. Sullivan and M.A. Boudreaux (Boudreaux and Sullivan, this volume). Analysis of this data utilized several tools, including the ESRI ArcGIS 10.0 and Microsoft Office 2008 software packages. Analysis models were built and run in ArcCatalog and cartographic outputs composed in ArcMap.

Factors used in this analysis were the locations of Maya buildings and calculations of their proximity to micro-ecological zones, carved stone pillars (*stela*), underground storage chambers (*chultuns*), manmade caves, manmade water catchments (*aguada*s), terraces, and canals. Population density and structure cluster location were also calculated and factored in. Habitation chronology from pottery sherds was also calculated.

The work of Dr. Ron Store, a researcher at the Finnish Research Institute, was heavily used as a platform for structuring this project. Dr. Store made use of Multi-criteria Evaluation (MCE) and cartographic modeling techniques to use raster datasets to create habitation suitability indices for bird species. A simplified, four-step version of his MCE methodology was used in this analysis. This process encompassed identifying where the Maya target population liked to live and then evaluating the study area based on the presence of these identified factors (Store and Kangas 2001).

Techniques for determining site-catchment also proved to be very useful. Catchment analysis is a "methodology that relates an archaeological site to the surrounding physiography and simultaneously defines the 'limits of influence' of an archaeological site" (Hunt 1992). Using these methodologies developed by Dr. Elizer Hunt helped to define the catchment area, maintain the original categories data was recorded in, and allow for information from various sources with different scales and of different forms to be combined (Hunt 1992).

RESULTS

The results of this analysis show the location of 27 major structure clusters. It also shows estimated zones of influence for each cluster. In these zones (Figure 1), the distance between clusters was calculated and it is apparent that both the distances between structures and the zones of influence are larger on the peripheries of the transect baseline and smaller towards the center. We see that further from the transect centerline structures become more widely distributed.

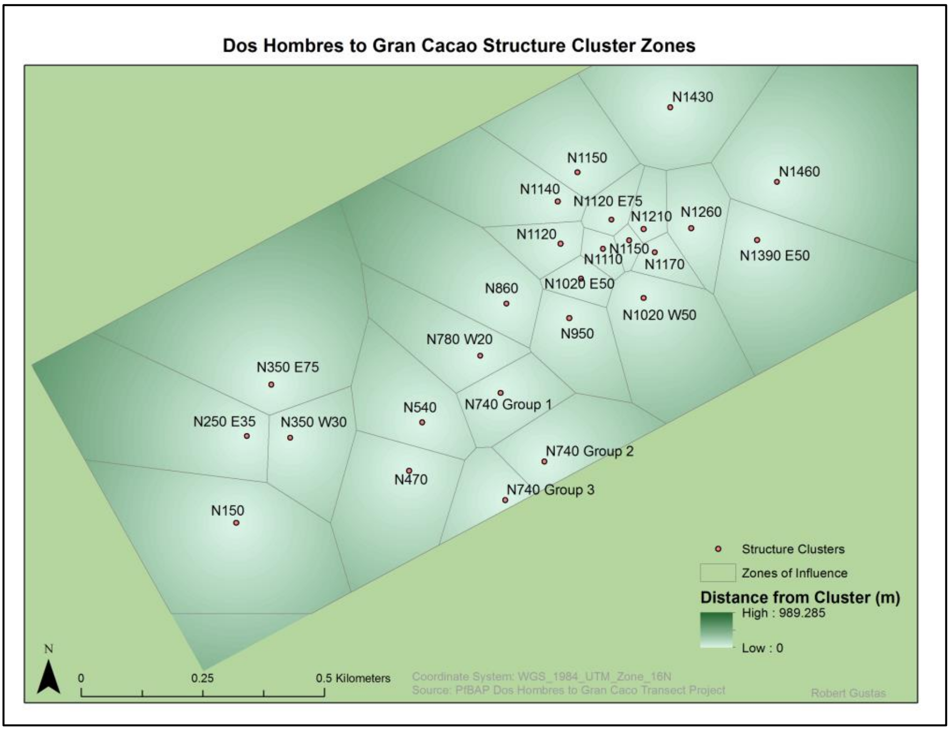

Figure 1. Structure Zone Clusters.

In looking at the different types of micro-ecosystems which were recorded in the transect area, it became apparent that a majority of structure clusters fall in the ecological zone that is the most desirable for habitation, upland hilltops, and only two clusters occur in the next most desirable habitation ecosystem, which is upland slopes. These two clusters are located at North 350 East 75 and North 350 East 25. No structure clusters are found on lowland slopes and only two structure clusters, those at North 740, are located in the least desirable, *bajo* (swampland), ecosystem (Brokaw et al. 2012). This supports the hypothesis that upland hilltops would be areas most desirable for habitation and that lowland and *bajo* areas would be the least desirable (Brokaw *et al.* 2012; Lohse 2012). The result of this finding is that researchers now know what ecological areas to focus their efforts on when looking for new structures. Areas further along the transect northeast of the 1000 m mark look particularly suitable for habitation from an ecosystem perspective and investigation of these areas should yield useful results (Figure 2).

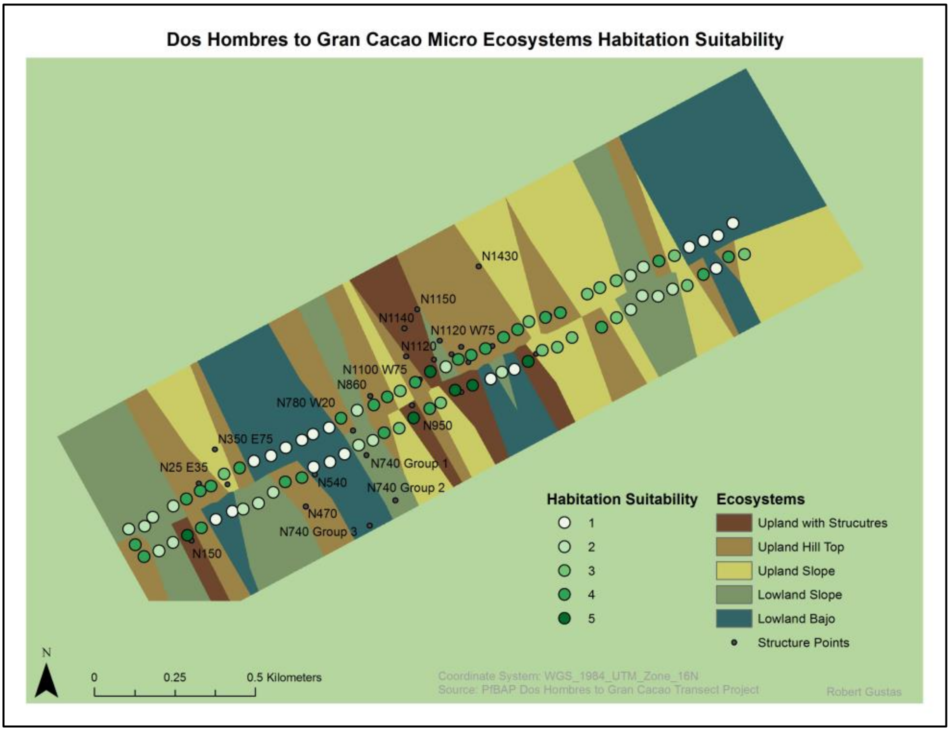

Figure 2. Micro-Ecosystem Distribution and Habitation Suitability.

The final suitability index revealed 9 areas most suitable for habitation, which received the maximum possible suitability ranking of 23. A majority of the remaining points have a suitability value falling between 21 and 19, with only three locations receiving the minimum value of 17. These values are derived from the summation of the ranking values in the input raster data sets. The most suitable structure clusters were located in two areas at approximately the 300 m and 1000 m points along the transect baseline. Here we see that structure cluster suitability decreases as clusters move away from the centerline and move towards the northeast along the transect (Figure 3).

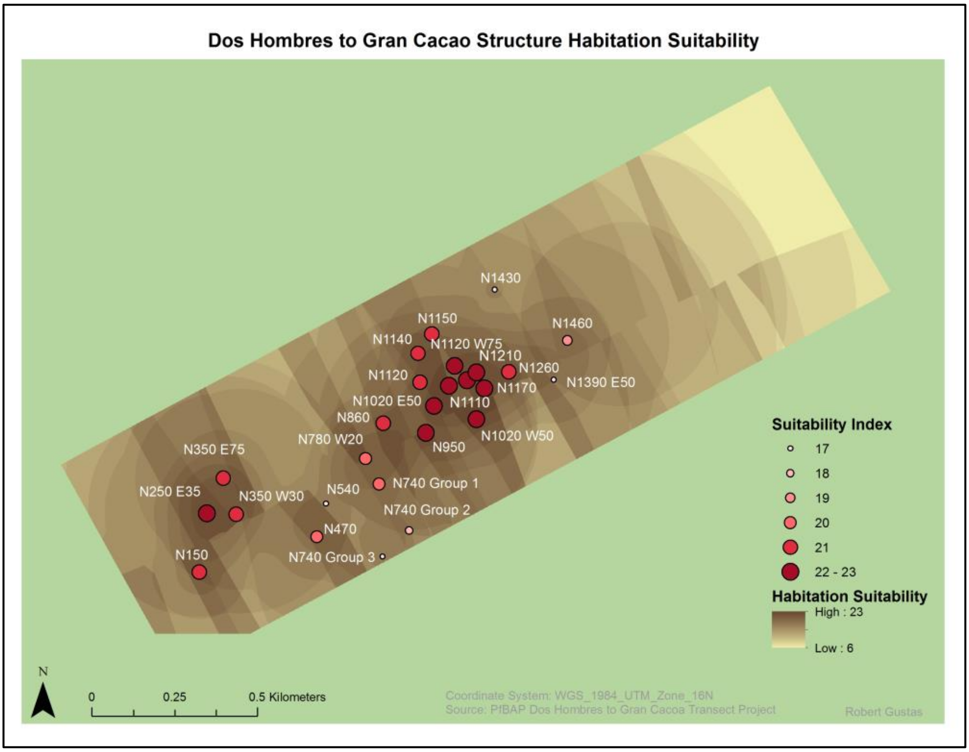

Figure 3. Habitation Suitability index.

From plotting the locations of DH2GC excavation units on top of the suitability analysis, we can see that excavations north of 1100 m along the transect might be warranted given the number of structure clusters in this area with high habitation suitability scores (Figure 4). The different sherds that were found in each excavation unit were identified and correlated to specific time periods based on style. This analysis initially indicated that the clusters in the vicinity of North 300 and North 1100 had the longest habitation history. This discovery is unsurprising when we see that these areas also have high habitation suitability scores. Pottery analysis by Boudreaux has revealed that the North 150 structure cluster had a longer occupation history (Boudreaux and Sullivan, this volume). Boudreaux has completed additional analysis of this area's pottery, which will be included in the next iteration of this model. Almost all structure clusters were inhabited during the Late Classic. The northern sites show a very strong habitation trend during the Tepeu periods with habitation decreasing as we move backwards in time (Figure 5).

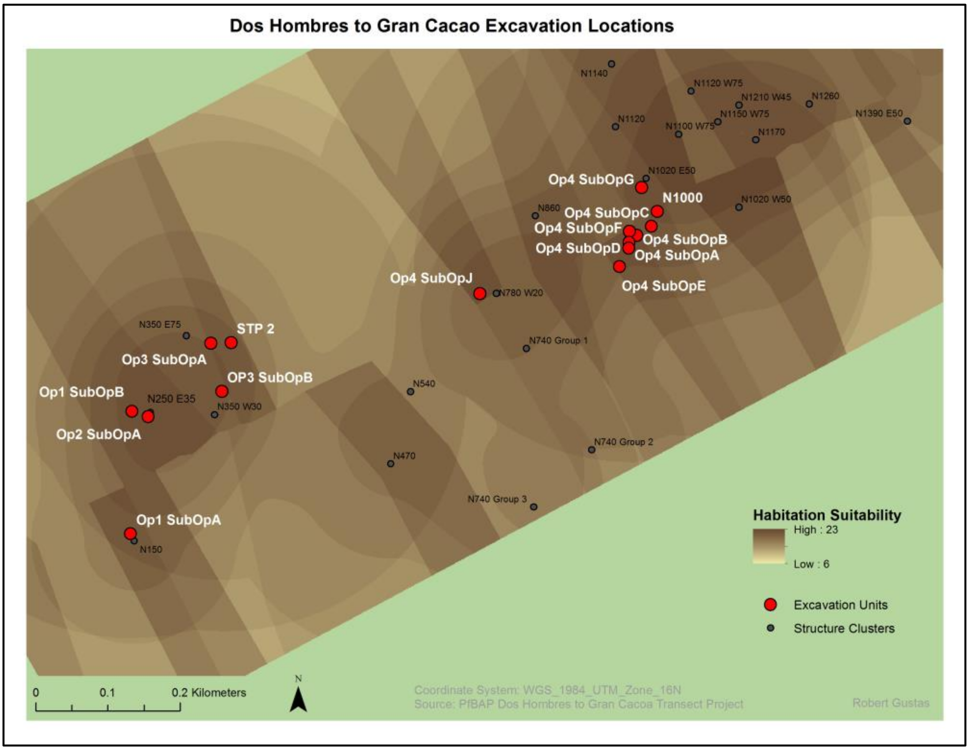

Figure 4. Excavation Unit Location.

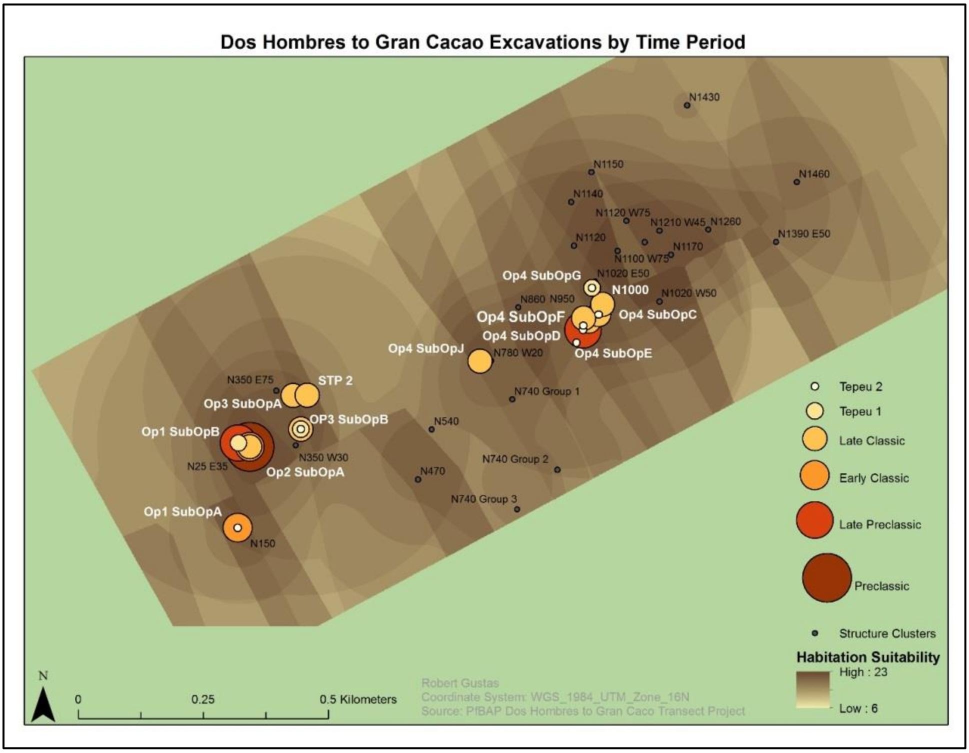

Figure 5. Excavation by Time Period.

Dr. Houk's research shows that the longer a particular family lineage lived in an area the more power they accumulated, this means that the long occupation histories at North 150, North 350, and North 1000 indicate that these three areas were probably the political centers of their respective parts of the transect (Houk 1996). It is interesting that the result of the zone of influence analysis does not reflect this, which indicates that another method should be adopted for calculating zones which can be weighted to account for a structure cluster's occupation history (Figure 6).

The chronology is consistent with data seen at Dos Hombres in other studies. Walling, Houk, and Robichaux also found that Dos Hombres and its peripheral areas slowly increased in population. Their research found that the greatest number of recovered pottery sherds came from the latter periods after which the number of sherds and presumably the population began to fall. We see this same pattern along the transect meaning that these more removed areas followed the same patterns as the major population centers (Robichaux 1995; Houk 1996). This implies a very high level of interaction and connection between the major sites and the outlying areas. It will be interesting to see if these patterns continue up the length of the transect or if they fade with distance from population centers (Robichaux 1995; Houk 1996; Walling 2004). The overall trend that was revealed in the DH2GC analysis supports these earlier findings and indicates that habitation started on the southwestern end of the transect near Dos Hombres and moved northeast along the baseline with time towards Gran Cacao. It looks like once an area was inhabited it remained so. Also, areas were not abandoned with exception of the Late Classic were we see a short-lived horizontal flowering of habitation on the transect peripheries, which subsided at the close of this time period.

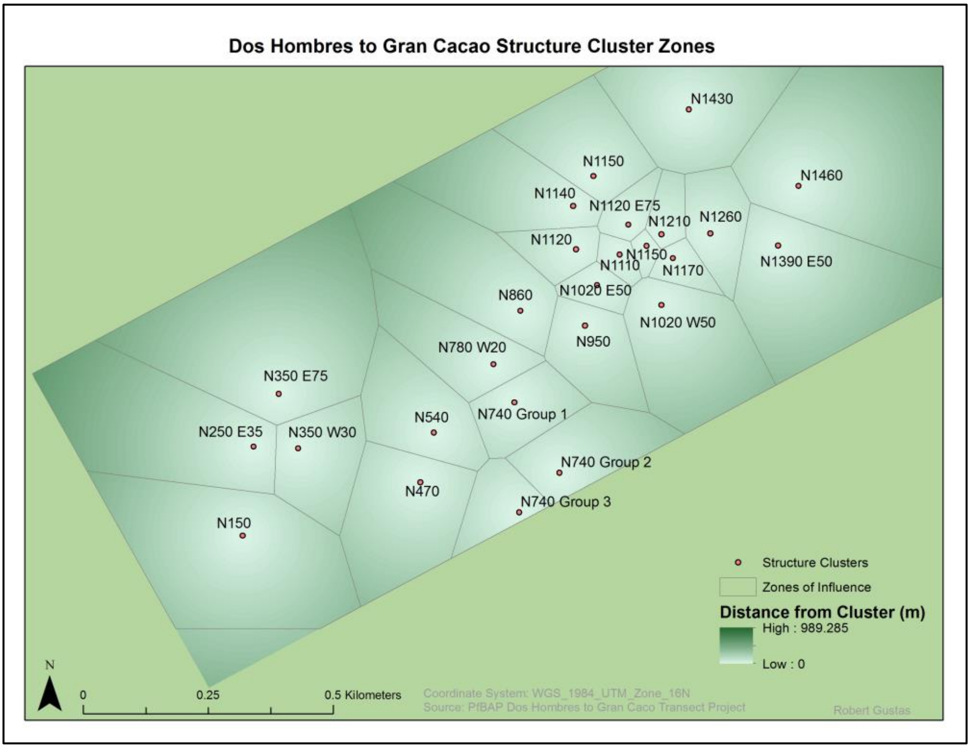

Figure 6. Structure Cluster Zones.

In looking at the population estimate for the transect area we see evidence to indicate that population between Dos Hombres and Gran Cacao was atypical when compared to the patterns for this area. Dr. Robichaux estimated the population of the peripheral areas of Dos Hombres at 480 persons per km^2 (Robichaux 1995). This project came up with a population estimate of approximately 210 persons for an area 0.3 km^2, which converts to 700 persons per km^2. This number was calculated off a structure based estimate using the formula $(n - 0.16n) \times 0.75) \times 5$, with n equaling the number of structures in a cluster. In this formula the total number of structures is reduced by 16% to account for nonresidential structures and a 75% occupancy rate is assumed for the remaining structures. Lastly, the occupancy is assumed at 5 people per structure (Robichaux 1995). The DH2GC estimate is interesting because it appears the population between Dos Hombres and Gran Cacao was much larger than that of the other peripheral areas of Dos Hombres as estimated by Robichaux. It is my belief that this higher population is due to the many areas with high habitation suitability rankings along the transect length.

DISCUSSION AND CONCLUSION

This GIS analysis was able to answer many questions about the distribution of people and resources between Dos Hombres and Gran Cacao. By using catchment analysis and Multi-criteria Evaluation techniques it was determined that there is a meaningful relationship between the location of structure clusters along the transect in regard to the surrounding major population centers, micro-ecological zones, and the terrestrial and aquatic resources. Nearest Neighbor analysis revealed a randomness score of 1.23, which indicates that there was a medium level of organization of structure placement in the survey area. This supports conclusions that have been made about the interconnection of various types of resources and structure placement for this area.

The analysis reported in this paper showed a tendency by the Maya to place structures along a straight line between Dos Hombres and Gran Cacao. Along with this we can see that proximity to large structure clusters, terrestrial resources, and aquatic resources are important factors to consider when analyzing geospatial relationships in Maya archaeology. The DH2GC analysis produced results that may be biased due to the linear nature of an archaeological transect. Many of the aforementioned analysis results showed patterns that grouped around the project baseline. Only further survey and research will indicate whether this linear pattern is due to a special relationship between Dos Hombres and Gran Cacao or more the more likely cause, which is that this pattern is due to the inherent nature of a linear survey.

In looking at how all of these trends come together in the form of the final habitation suitability index it becomes apparent that the raster overlay techniques are very effective in identifying the areas that were most suitable for habitation. Many of the structure clusters identified as being most suitable for habitation contain architecture associated with elite individuals, and logically it follows that the most powerful individuals would live in the most desirable areas (Cortes-Rincon, this volume). As such it is clear that areas with a high density of both terrestrial and aquatic resources in upland areas were the most desirable for inhabitation. It is my recommendation that future fieldwork focus on these areas. The centerline may have served to organize this area. This would have major ramifications for our understanding of the political and economic organization of this area. However, at this time it is unclear whether maximal desirability clustering on this line is due to survey bias and the use of this as a decision making factor in field work should be treated with caution at this time. In looking at the final suitability index it becomes apparent that a full understanding of this area can only be efficiently accomplished by looking at various spatial factors in a way that only GIS technology can provide.

In conclusion, this project provided meaningful and applicable results about an area that has never been examined in this way. This analysis has confirmed suspected trends in population and resource distribution and caused new questions to be asked about these topics. This project has served as a pilot of methodologies, which should greatly increase efficiency in the field by allowing researchers to make better-informed decisions about where to allocate precious time and resources. Most importantly it has resulted in original research, which reveals important information about the Maya of this area and why they lived where they lived.

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PRELIMINARY SURVEY RESULTS: 2011 AND 2012 DH2GC FIELD SEASONS

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Marisol Cortes-Rincon, Humboldt State University
Marisol Figueroa, Humboldt State University

Survey has revealed a series of adaptations to the terrain by the ancient builders that add to our understanding of the flexibility and responsiveness of ancient Maya builders to environmental challenges. At N150E75, there is a residential group with four structures arranged around a small courtyard located on a modified platform. The larger range structure is located on the eastern side of the group and has two possible rooms with a height of 2 m. The structure on the western side is very similar but slightly smaller. At N160E10, there is a very small cobble platform with an estimated height of 0.5 m.

There is larger residential group located atop a hill at N250W75; the upper portion of this rise appears to have been modified. It is a very peculiar group as there is no formal structure placement. STRs 7, 8, 9, and 10 are arranged around a courtyard and these have been heavily damaged by numerous tree fall. There are two structures outside of this group, which are not aligned in any particular way. These structures may be part of a later expansion on this residential group. These two structures are better preserved than the rest of the group.

Northwest of N250W75, there is another residential group at N350W125, which is slightly larger and located on a natural rise. The structures are atop a large basal platform with masonry architecture and nicely cut stone. Nearby by are three water basins and a small quarry area. Ecologically, it is located within a transitional forest of *bajo* and upland forest, therefore, there is a presence of gilgai soil beginning at the N450 marker and ending at the N750 marker. According to Dr. Brokaw (Brokaw, personal communication, 2012), gilgai is a microrelief of heavy clay soils with a high shrink-swell capacity in a horizontal or weakly inclined clay plain that frequently consists of alternating micro-elevations (mounds), micro-depressions (depressions), and even sections (shelves). Gilgai develops in areas where the soil matrix is primarily made up of clay in which there is a propensity for rapidly changing conditions, especially inundation and drying within the subsoil.

There are several structure groups that were recorded along the transect during the 2011 and 2012 field season, including the areas between the N250 marker, and up to the N950 group. At N550E50, there is a large L-shape structure with big limestone boulders, constructing the base of the structure. There is also a fairly well preserved residential group within the bajo (or gilgai zone) composed of four structures located at N715W20. This particular group's arrangement is more formalized by creating a courtyard in the middle of the structures. At N775, there is a very large structure located on the main baseline of the transect with a series of smaller structures around it. From this point, the elevation of the landscape starts to increase at a steep elevation grade until the N850 marker. This sheer-elevation-change leads to a modified knoll that defines the N950 group.

2012 SURVEY GOALS AND METHODS

The goals for the DH2GC 2012 season were to map the structure groups previously encountered at N150E75, N750, and N350W125, to georeference between N150- N300 and N950-N1000, and to relocate structures between N550-N700 E75-300 using data from 2009. Furthermore, the project intended to relocate structure groups between N1200-N1450 and georeference the datums of all open excavation units throughout the transect between N150-N1000. Finally, another goal was to relocate and map the "new elite group" located 500 m northwest from N1000. All mapping was done through pedestrian survey focused on the location of structures, water features, subterranean features, and any other cultural resources encountered.

2012 SURVEY RESULTS

The 2012 season began with the remapping of the N350W125 structure group. As a result of further investigation in the area, the sample universe was expanded to include possible terracing as well as possible *aguadas* and a channel with a large cut stone. During the revisit and remapping, a stairway was discerned between superstructures (SP_STRs) 51 and 52. A *mano* was also found and collected on the surface of one of the steps of the stairs. The stairs were 50 cm wide and 50 cm deep. Structures mapped in the site area were STRs 13-17 on the east side of the site, STR 53 (a platform on the west side of the site), and SP_STRs 51, 52, 54 on top of the platform.

Continuing along the transect, STR 61 (1 m tall) and one *aguada* at N500E75 were mapped. At N500E125, a group of three structures were mapped. Two of the three structures (STR FN 58 and 59) were 50 cm tall and STR 60 was 2 m tall. A depression at the southeast corner of STR 60 had a probable capstone and was recorded as a *chultun*. STR FN 57 and one associated *chich* mound were mapped at N550E50. Also, two small structures, FN55 and 56 were mapped at N600E75.

From N600E75, a reconnaissance team initiated a survey finding settlement to the northeast of group. These structures were denoted FN 68, 69, and 70 and were subsequently mapped. The structure layout created a formalized courtyard arrangement. There were cut stones between STR 68 and STR 70. Heading northeast from the N600E75 group, another group containing four structures was mapped (STRs 62, 63, 64, and 65). STR 62 was the largest of the four structures while the remaining structures were ancillary in purpose. 25 m north of this group at N675E275, there is a limestone quarry and a *chich* mound (STR 66), another structure (STR 67), and an *aguada*s that contains extensive channeling features. Further investigation of the channeling feature revealed cut stones ranging in size from 0.3 x 0.3 m to 1 x 1 m.

Continuing the survey after the N675 marker a pair of small structures (75 and 76) was mapped at N750E100. At N750E55, one structure (77) was recorded with no associated features. At the N800 marker, a group of structures located on the main *brecha* were noted, including two 1.5 m tall SP_STRs (80 and 81) positioned on top of a pentagonal platform (STR 79).

The next task involved the remapping of the N950 group. Datums were tied into the grid system and feature numbers were reassigned. Features that have new name designations and were remapped include: four subterranean features (two *sascaberos* and two caves), four *aguadas*, a channeling feature at the south end of the group, a terracing feature just south of the channeling, shovel test points, and one *chultun* located by FN 25. Just north of the water basins by N950, two SP_STRs and a platform were mapped including: a U-shaped SP_STR 83 with an approximate height of 2 m x 2 m north of SP_STR 83, a smaller square structure that was approximately 0.5 m high (SP_STR 84) was mapped. Both of these SP_STRs sat on a platform labeled STR 82.

To the north of STRs 82-84, cut stones with dimensions ranging from 0.5 x 0.5 m to 1.5 x 1.5 m were noted. The largest of the cut stones, measuring about 3 m tall, was located 1 m south of the southwest corner of SP_STR 85. Just north of

SP_STR 85 is a 5 x 5 m *plazuela*. Enclosing the north end of the *plazuela* is a set of three SP_STRs (SP_STRs 87-89). SP_STRs 87 and 88 are rectangular and approximately 1.5 m in height. SP_STR 89 is a smaller square structure approximately 0.5 m high. All of these SP_STRs sat on a platform (STR 86). Two structures, a single rectangular structure (STR 94) and a small structure (STR 96), were mapped at N1100. A linear feature, approximately 50 x 2 m, located north of STR 94 and STR 96 was denoted STR 78. Portions of STR 78 were mounded like a household structure, while other sections consisted of cut stones set in a linear fashion.

At N1200W75 two SP_STRs (100 and 101) and a platform (STR 103) were mapped. SP_STR 100 (height of 2 m) appeared to be an angled variation of the L-type structural style with a small extension or ancillary room on the east end. The west end of SP_STR 100 borders a 6 x 3 m *plazuela*. To the south of the *plazuela* is a level area that is a possible extension of the *plazuela* leading to an ancillary room to SP_STR 101. SP_STR 101 is 10 x 3 m in diameter and 2 m in height. The ancillary room has a 0.5 x 0.5 m cut stone in the northwest corner. Another cut stone of the same size is located at the northwest corner of SP_STR 101. Both structures sit on an extensive platform (STR 103).

Further investigation to the southwest revealed a string of cut stones leading to the southwest and ending at a platform (STR 103) and an L-shaped SP_STR (104). The line of cut stones was identified as a possible *sascab*. At N1200W90 STRs 94, 97, 98 and a subterranean feature (possible cave, SubT 6) were mapped. A linear feature at N1210W20, labeled STR 99, was mapped. Initial investigations revealed a rectangular structure about 15 m long and 1 m high. Another linear feature was discovered west of the N1210 group. This feature was linearly aligned with STR 99 and separated by a 2 m gap. The evidence suggests that the gap between these two features was a result of erosion. Therefore, this 60 m extension was designated as a continuation of STR 99. At the west end of STR 99 is a 1 m extension to the west that is oriented towards a group of STRs at N1200W75. This extension could be a collapse, but the orientation and linear fashion of this group of stones warranted notation.

A square structure (STR 115) was mapped that included an ancillary room to the west. A large amount of tree fall made it difficult to delineate an extension of cut stones to the north. At N1250W50 two structures were mapped, STRs 105 and

106. At N1270E85 we mapped two small square SP_STRs (112 and 113) and a platform (STR 114). Both SP_STRs had a height of 1 m and were oriented north to south. A structure group at N1275W40 was mapped. The structures in this group included: SP_STRs 107, 108 and 111 and a platform (STR 116). SP_STRs 107, 108 and 111 each had a possible ancillary room next to them. We also mapped the bottom corners of the ancillary rooms. At N1300W15, we mapped an L- shaped SP_STR (110), which sat on a platform (STR 109). A 2 x 2 m extension of cut stones juts out from the east end leading towards a depression with possible water management characteristics.

The "new elite group", included the mapping of STRs 90-92, subterranean feature 5 (a possible cave), and water features 1 and 2 (possible *aguadas*). Topographical points were also taken around STRs 90, 91 and 92. In addition, two large elite structures (STRs 117 and 118) were mapped. STR 117 is rectangular and approximately 3 m tall with a possible extension/collapse along the northern of its edge. Approximately 60 m to the southeast of STR 117 is STR 118, a 4 m tall L-shaped structure. *Jute* shells were also found on the surface. Bottom points were taken but due to time restraints we were unable to take top points. The project team also mapped SP_STRs 119, 120 and STR 122 and a platform (STR 121). SP_STRs 119, 120, and STR 122 were small structural mounds, so we were only able to map the four bottom corners. After doing further pedestrian survey at this group, it was found that STR 122 did not sit on the basal platform where SP_STRs 119 and 120 were located.

PRELIMINARY ANALYSIS OF CAVE INVESTIGATIONS: 2011 AND 2012 DH2GC FIELD SEASONS

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Caves were ascribed great significance within the cosmology, political ideaology, and cultural beliefs of the ancient Maya. These features served a variety of utilitarian and ideological functions including: 1) sources of drinking water; 2) sources of "virgin water" for religious rites; 3) religious rites; 4) burials, ossuaries, and cremations; 5) art galleries; 6) ceremonial dumps; 7) and places of refuge (Thompsons 1959, 1975).

During the DH2GC 2011 field season, a few small caves, or SubTs, were discovered at the N950 group. Two of these caves, SubT 1 and 2, are located on a slope off the northern side of the knoll while a possible third cave, SubT 3, is located to the north of FN 36. SubT 1 and 2 are smaller than SubT 3. An examination of photographic data suggests that the mouths of SubT 1 and 2 are approximately 1 m in diameter. The width and depth of SubT 3 is estimated to be between 2 and 3 m. The features were mapped using Mobile Mapper GPS units. The close proximity of SubT 3 to FN 36 may suggest a possible ritual area.

Similar features have been identified in the vicinity of the N950 group. Another subterranean feature is located to the west of the N950 knoll and another on a similarly modified natural limestone deposit at N1650. To the west of N1650 there are a few additional cave like features that are positioned on a slope near some terraces. Reconnaissance survey at this area of the transect has identified nine caves and *chultuns*. However, at this time we are unsure of the existence of additional caves located at this section of the transect. More extensive investigation is warranted to develop a comprehensive understanding of the function and usage of caves found at and within the vicinity of N950.

DESCRIPTION OF CAVES INVESTIGATED

Subterranean Features 1 and 2

Two small openings, denoted A, B, situated in the northern slope of the N950 knoll comprise probable exterior mouths of SubT 1. The dimensions of the feature and heavy collapse prohibited effective investigation to verify this hypothesis; therefore no unit was placed within SubT 1. Furthermore, SubT 2 is located 3.88 m east of SubT 1. A preliminary survey of the mouth was conducted. SubT 1 and SubT 2 are a connected cave system according to the survey results.

Operation 4 Suboperation H. Subop H was a surface collection located at the mouth of SubT 2. This included the removal of collapse, limestone debris and the humus layer. Cultural material was exposed and collected within the humus layer. The depth of the cave was exposed as the debris was cleared, extending to the north, about 140 cm out of the cave. Approximately 40 ceramic sherds and 10 pieces of chert debitage were found. A large worked chert stone was also collected and identified as a hand axe or chopper (Forbis, this volume).

Subterranean Feature 3

SubT 3 is located approximately 10 m northwest of structure FN 36 at the N950 group. It is the largest and best preserved of the subterranean features found at this group. The mouth of the cave measured 188 cm in length with a width of 77.3 cm. The initial chamber depth is approximately 416 cm. A baseline was established within the cave in relation to a known datum and was utilized to create a profile and plan map of the interior surface area. There is a small chamber located at the rear of the cave that was too small to measure using the same procedure, thus only preliminary measurements were taken. The chamber's length is 120 cm, the height is 30 cm and the depth is 124 cm.

Operation 4 Suboperation F. A 1 x 0.5 m excavation unit was placed inside SubT 3 towards the rear of the cave. The unit's east wall parallels the rear ledge of the cave. The goal of this unit is to define stratigraphy and chronology.

Lot 1, which included an initial surface collection, retrieved approximately 40 highly eroded ceramic sherds and various faunal remains. The faunal remains have yet to be analyzed. Ceramic analysis, conducted by Boudreaux and Dr. Sullivan (this volume), concluded that the erosion was too significant to permit comprehensive examination. Erosion is the result of decomposing limestone, due the undulating wet and dry nature of the cave. Ceramic sherds recovered from Lot 1 included Achote Black, Cayo Unslipped and a Late Classic water jar.

Lot 2 began 20 cmbs level. A variety of ceramic types were found in Lot 1 including Tinaja Red, striated varieties, and Achote Black. The sherds were badly eroded. This lot also included a probable burnt *incensario* sherd with an appliqué decoration. In that same layer, large chunks of charcoal, four obsidian blade fragments, and a possible broken core of a ground stone were found. At about 50 cmbs level, three obsidian blade fragments and an appliqué decorated ceramic sherd were unearthed. The color of the obsidian ranges from grey to grey-black. An increasing presence of charcoal and a darker colored soil was noted in Lot 2.

Subterranean Feature 4

SubT 4 is approximately 24 m south of STR FN 36. After clearing much of the flora debris, the feature's circular shape and lack of visible chambers is more consistent of a quarry or a water catchment feature.

INTERPRETATION

The presence of elite architecture and caves at N950 is in stark contrast to the small-scale household groups, agricultural areas, and natural resource zones that characterize the project area thus far. The close proximity of a civic core or ceremonial area to caves is an indication of strategic placement. Ceramic analysis established an occupational chronology at N950 dating from the Terminal Preclassic through the Terminal Classic.

Much of the cultural material, including lithics and limestone, observed and collected in SubT 2 had the appearance of being burned. Evidence of a recent burning episode was observed and recorded on a tree located in the east wall of SubT 2. This may account for some portion, or all, of the evidence of burnt material found during the surface collection. However, until further analysis is conducted it is unclear as to the degree of contamination.

SubT 3 contained the most cultural material of all the subterranean features investigated. Artifacts recovered include 47 total ceramic sherds, obsidian, a burnt *incensario* sherd, a L.C. TR-Tepeu 2 water jar sherd, and a possible vase. While there was a relatively low quantity of ceramic sherds recovered from SubT 3, 60 percent of them were diagnostic. Ceramic analysis established a preliminary chronology of use to the Late and Terminal Classic periods Tepeu 2-3.

Many of the artifacts such as the burnt *incensario* sherd are indications of ritual practice. Sap from the copal tree was often used as a fuel source during burning rituals. At this time we have not tested any artifacts for traces of copal sap. However, evidence of burning on an *incensario* fragment and the presence of copal trees (Brokaw et al., this volume) in and around the vicinity of N950, are strong indicators that this feature was utilized for ritualistic purposes.

Although there was no presence of water in the cave, material evidence of a water jar and possible vase suggests that this feature may have been used to store water. It is believed that the cave may also have functioned as a water management system that would have included SubT 1, SubT 2, a series of water basins, and a channeling system located north of SubT 3. The majority of collapse in SubT 3 is concentrated at the north side of the mouth. This concentration may be the result of a previous opening that gave way. Water originating from the mouth of SubT 3 would have been guided north down the slope of the knoll, into the corresponding features, and eventually deposited at the foot of the knoll. Water is seen as a transcendent and cyclical element, symbolizing creation in the sky and journeys to the end of its earthly existence into the underworld by means of caves. Therefore, the flow of water from the ground and into a cave is a powerful symbol to the ancient Maya.

COMPARATIVE ANALYSIS

The caves at N950 resemble caves that were investigated at Maax Naa. Both cave features follow a north to south axis and are associated with possible ceremonial structures. The geology of the PfBAP area does not allow for favorable preservation of vast cave systems. SubT 3 is about half the size and depth of Spider Cave. However, the majority of the cave has collapsed. Consequently, determining the actual size of the cave is problematic. The caves at N950 may actually be one cave system, similar to what was uncovered at Spider Cave. The caves found at these two sites are relatively small when compared to caves found in the Belize Mountains or in Guatemala. King et al. (2012) suggests that the size of the cave does not affect the amount of power the cave is said to have, as long as it is able to serve the ritual function needed. A strong relationship with water is evident at all three caves. This inclusion of water at the N950 group may have been a calculated attempt to increase socio-political power and control of the region.

PRELIMINARY CONCLUSION

The notion of power is a concept observed in Maya cosmology and is symbolically reflected in site layout and settlement patterning. The integration of caves within community planning and settlement is regarded as a means to legitimize the power of the leader and the community itself (Brady and Veni 1992). While current evidence is inconclusive, the presence and use of caves at N950 appear to reinforce the political and spiritual power of the site. This would suggest strategic settlement patterning within the region and raises additional issues concerning exchange (political, social, and economic), the interdependent relationship of outlier communities within the hinterlands to regional site centers, and the management of household communities within the periphery of dominant polities.

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COMPARISONS BETWEEN THREE HOUSEHOLD GROUPS WITHIN THE DH2GC PROJECT IN NORTHWESTERN BELIZE

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The purpose of this paper is to compare excavation results from three different structure groups along the DH2GC transect in order to better understand the chronology and patterns of settlement within the project area. The three structure groups discussed here are all located within 200 m of a larger settlement. This shared attribute makes them ideal for comparison, allowing for the development of many questions that will direct future research about these settlements.

A series of 1 x 1 m units were set up behind structures, between structures, and within patio and courtyard groups in order to recover midden deposits that could provide occupational chronology without disturbing structure mounds. Variables that determined the selection of a unit location included the presence and quantity of surface ceramics and the spatial relationship and layout of architectural features within proximity (Cortes-Rincon, this volume). Two excavations discussed in this paper were set up in patio groups (Op 4 Subop J and Op 1 Subop B), one in a courtyard (Op 4 Subop G) and another behind a structure (Op 1 Subop A). Excavations were carried out by students from Humboldt State University, project staff members, and volunteers under the supervision of project director Professor Cortes-Rincon.

OPERATION 1: N150E75

Op 1 is a small household group consisting of three structure mounds built on a platform and organized around a small patio. During the 2011 and 2012 field seasons, two excavations and one surface collection were conducted at this group: Subop A, placed to the east of FN 4; Subop B, placed to the east of STR FN 2 in the groups patio; and Subop C, a surface collection taken from tree fall between STRs FN 2 and FN 3, roughly 8 m north of the patio center (Cortes-Rincon, this volume).

Subop A contained hard packed clay that permeated throughout most of the unit, making it difficult to excavate. The linear dispersion of cultural material throughout this unit may have been the result of natural water flow, which can be attributed to descending elevations in this area (Cortes-Rincon, this volume).

Preliminary ceramic analysis from both units was conducted by Boudreaux and Sullivan (Boudreaux and Sullivan, this volume). Their analysis of the ceramic assemblages recovered from these units showed evidence of Late Preclassic Chicanel types, which date between 400 BC and 100 AD (after Sullivan and Sagebiel 2003 as cited in Trachman 2007) as well as Terminal Classic types (TR-Tepeu 3). This establishes an occupational chronology 400 BC and 700 – 800/850 AD for this household group. The Late Preclassic occupation for this area represents the earliest occupation so far discovered on the transect. These dates also place this household group within the same occupational time frame as the nearby elite site of Dos Hombres. The latter has an occupational history dating from the Middle Preclassic ca. 800-600 BC to the Terminal Classic 800/850 or 900 AD (Houk 1996). This suggests that the household group at N150E75 was more than likely constructed shortly after Dos Hombres was settled. According to Houk (1996), Dos Hombres had enough of a population increase in the early Late Preclassic (400 BC – 100 AD) to form a village on the northern part of the site. Considering Op 1 is roughly 150 m from Dos Hombres, it is likely that during this population growth, inhabitants of Dos Hombres settled the location at N150E75.

Op 1 displays evidence of continuous occupation up until the Late Classic period. N150E75 is also one of the few sites around Dos Hombres that shared an occupational timeframe as far back as the Late Preclassic. N150E75 was contemporary to Dos Hombres, and from its founding, could have possibly provided a supporting role to Dos Hombres itself, whether agriculturally, or through production of goods and other services. More investigation is needed to fully understand the function of the N150E75 group.

OPERATION 4: SUBOPERATIONS G AND J

Subops G and J are located at two different groups along the transect. Subop G is located between STR 43 and STR 44 at N1000, while Subop J is located within the patio of the N750 group. Both Subops were 1 x 1 m units set up during the 2012 field season as part of a larger investigation of the North 950 group. N950 is situated atop a modified knoll, approximately 200 m from Subop J and 50 m from Subop G. The goal of these units was to establish an occupational history of both locations through the analysis of artifacts recovered. Subops G and J did not reach bedrock prior to the end of the 2012 field season. Results presented in this report are preliminary and will be expanded upon after future investigation.

N750 is a household group containing three structures built around a patio and situated on top of a modified platform. Subop J was positioned in the middle of the patio. Ceramics recovered from the unit so far have established a preliminary occupational history to the Late Classic period TR-Tepeu 2 700–800/850 AD (after Sullivan and Sagebiel 2003 as cited in Trachman 2007).

The N1000 courtyard group consists of three structures (FN 43, FN 44 and FN 45). Evidence of cut masonry architecture is present at this group, as well as a round stone that may or may not be a broken altar. There are also six water basins interconnected by channels that lead down from the N950 knoll, providing water to this group. It is possible that this household group is an extension of the N950 group. Subop G is located centrally, within the courtyard between FN 43 and FN 44. The ceramics collected from this unit consist of TR-Tepeu 1 and TR-Tepeu 2, which span the Late Classic period, placing the occupation of this site roughly between 600 – 850 AD (after Sullivan and Sagebiel 2003 as cited in Trachman 2007). Unlike the units at N150E75, this unit did not produce any evidence of TR-Tepeu 3 (Terminal Classic) ceramics. Therefore, this site was probably abandoned before 800/850 AD (after Sullivan and Sagebiel 2003 as cited in Trachman 2007).A fragment of unnamed orange polychrome ceramic, the only one of its kind found on the transect so far, was recovered from Subop G. This could mean one of a few things: the site was inhabited by elite residents, or those living in this location somehow obtained the ceramics after it served its purpose by those higher in status.

COMPARATIVE ANALYSIS

All three groups discussed are located within close proximity to an elite center, are built atop a platform, and are situated around a small patio or courtyard. The differences between the three groups become apparent after comparing the excavation data. N750 and N1000 did not produce any Preclassic or Early Classic ceramics. N1000 had both TR-Tepeu 1 and TR-Tepeu 2 ceramics. Excavation at N750 produced only TR-Tepeu 2 ceramic. This shows a shorter occupational history at N750 and N1000 in comparison to N150E75. These groups were both settled after N150E75 and abandoned prior to its abandonment period. This displays a possible outward settlement expansion from Dos Hombres, which culminated in the outlier communities being abandoned prior to the central settlements. The group at N750 is younger than that of N1000, but both groups appear to have been abandoned around the end of the Late Classic period (700–800/850 AD) (after Sullivan and Sagebiel 2003 as cited in Trachman 2007). Whether inhabitants of N1000 and N750 moved to other locations near N950, or relocated closer to Dos Hombres, is a question left to interpretation.

PRELIMINARY CONCLUSION

Preliminary analysis of artifacts recovered from Op 1 and Op 4 Subops G and J show that as a whole, these groups have occupational dates ranging from the Late Preclassic (400 BC–100 AD) all the way through the Terminal Classic (800/850–900 AD) (after Sullivan and Sagebiel 2003 as cited in Trachman 2007). Of all units examined, Op 1 (N150E75) shows evidence of the longest occupational history (Late Preclassic through Terminal Classic). As of this writing, the units at Op 4 Subops G and J show only Late Classic occupation.

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EXPLORING THE MODIFICATION, UTILIZATION AND CONTROL METHODS OF WATER MANAGEMENT FEATURES

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This paper will cover two aspects of research conducted at N350W125, during the DH2GC 2011 and 2012 field seasons. The primary goal of this report is to provide an overview of investigative procedures and results at this Late to Terminal Classic site and to discuss the role of small depressions as water catchment features within water management systems. Excavation and investigative analysis of these water catchment features was directed towards interpretations of agricultural functionality, regional sustainability, and secondary activity after the termination of their primary function.

THE PROJECT SETTING

N350W125 is a marginal residential community, consisting of eight structures that supported a small population. The control of natural resources, such as water was an integral function of this community. On average, the Three Rivers Region receives 1500 mm of annual rainfall (Dunning et al. 1999). Heavy seasonal flooding and extreme episodes of drought in the dry season pressured the Maya to engineer processes for growing crops within an *escoba-bajo* environment (Beach et al. 2002; Dunning et al. 1999, 2002; Dunning and Beach 1994; Scarborough 1998; Scarborough and Gallopin 1991; Scarborough et al. 1995). For the Classic period *escoba-bajo* farming communities, soils were fertile yet difficult to manage due to poorly draining vertisol clays (Dunning et al. 1999). On the ground level, this landscape is difficult to discern between the transitional changes of a rolling landscape and the *escoba-bajo* vegetation (Boudreaux 2013). Although occupants of this settlement area would have utilized seasonal rainfalls to their advantage – to this day, it would still be difficult to access natural water sources year-round due to the greater presence of the landscapes broken-ridge qualities (Boudreaux, personal communication, 2013). Therefore, the daunting task of satisfying water demands was countered by the commitment to engineer complex systems for controlling and managing seasonal watersheds (Scarborough 1998; Beach et al. 2002).

SURVEY AND EXCAVATION OVERVIEW: N350W125, N350W50

Over the course of the two field seasons, survey revealed a grouping of eight superstructures atop an expansive, well-preserved basal platform at the N350W125 locus (Figures 1 and 2). The main area of settlement for this site is approximately 100 m^2, and situated on a knoll with a mean slope of 5° (Brokaw et al, this volume). The natural landscape of the knoll and the surrounding area underwent extensive modification. This is evident from the existence of a complex water management system consisting of four small depressions, a single set of terraces, and cut-stone channels designed to control water flows (Dunning and Beach 1994; Walling et al. 2003).

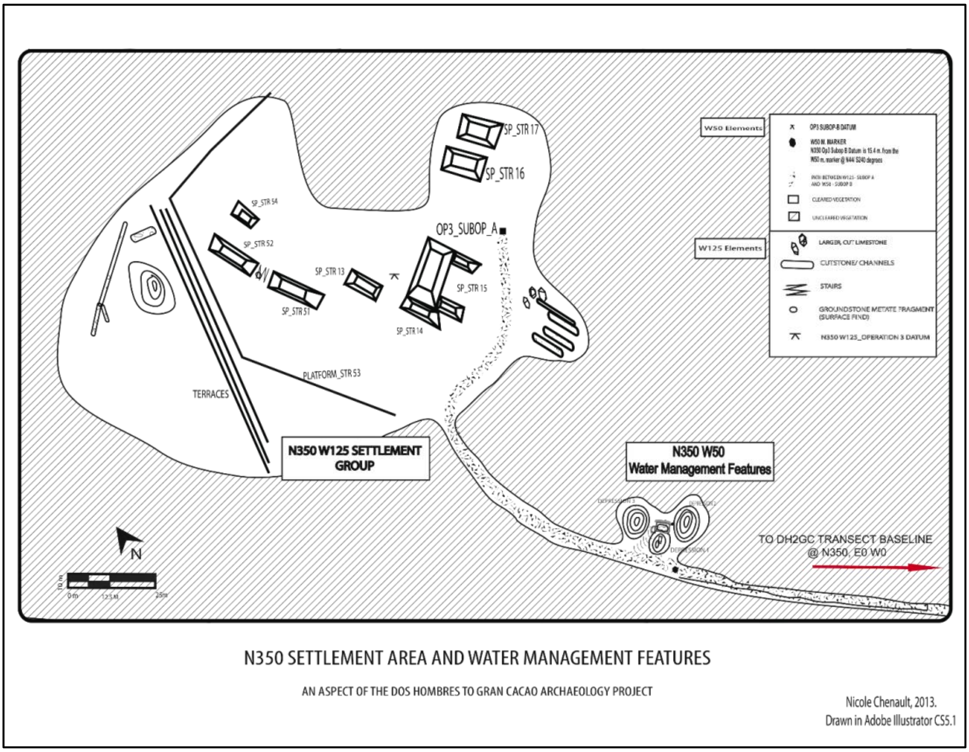

Figure 1. N350 Site Boundaries.

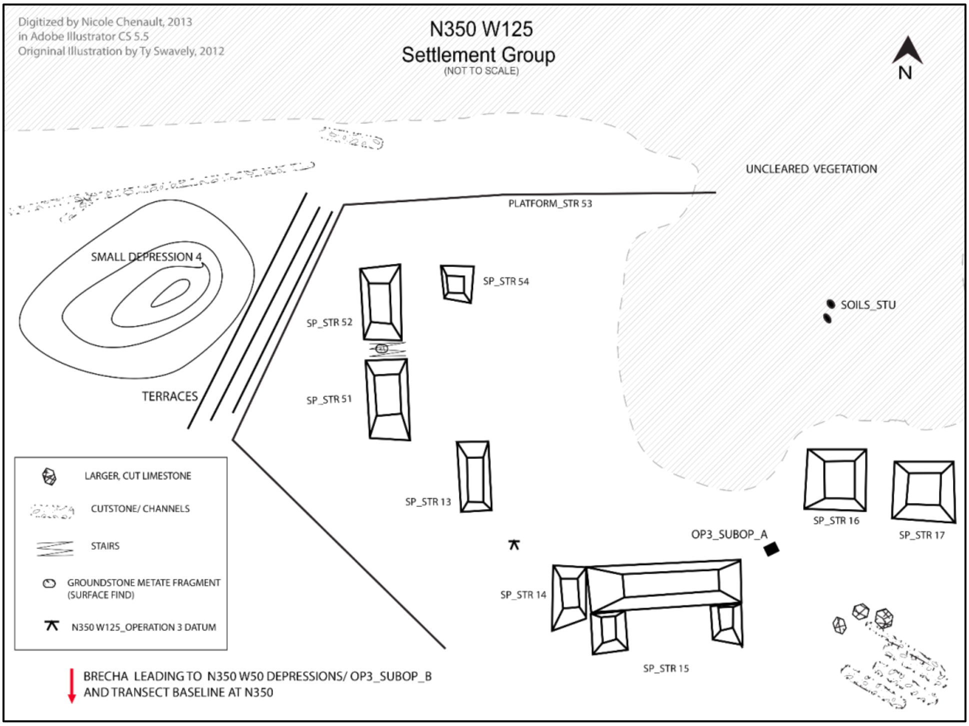

Figure 2. N350W125 Settlement Area.

N350W125: Operation 3 Suboperation A

Subop A was a 1 x 1 m unit placed between STRs FN 15 and FN 16 on the eastern quadrant of the structural platform (Figure 3). This unit was established to investigate the chronological context of the structural platform. Two thin, plaster floors as well as refuse composed of varying cultural materials were encountered in this unit. Ceramic refuse material analyzed established an occupational chronology to the Late to Terminal Classic periods (Boudreaux and Sullivan, this volume). Tepeu 2 and 3 (Boudreaux and Sullivan, this volume) pottery sherds collected from shallower strata have provided us with these later dates; although a small sample of sherds has also been dated to the Early Classic. These earlier dated sherds are a common aspect of materials used in subfloor fill; therefore they do not solidify hypotheses about Early Classic occupation at this site.

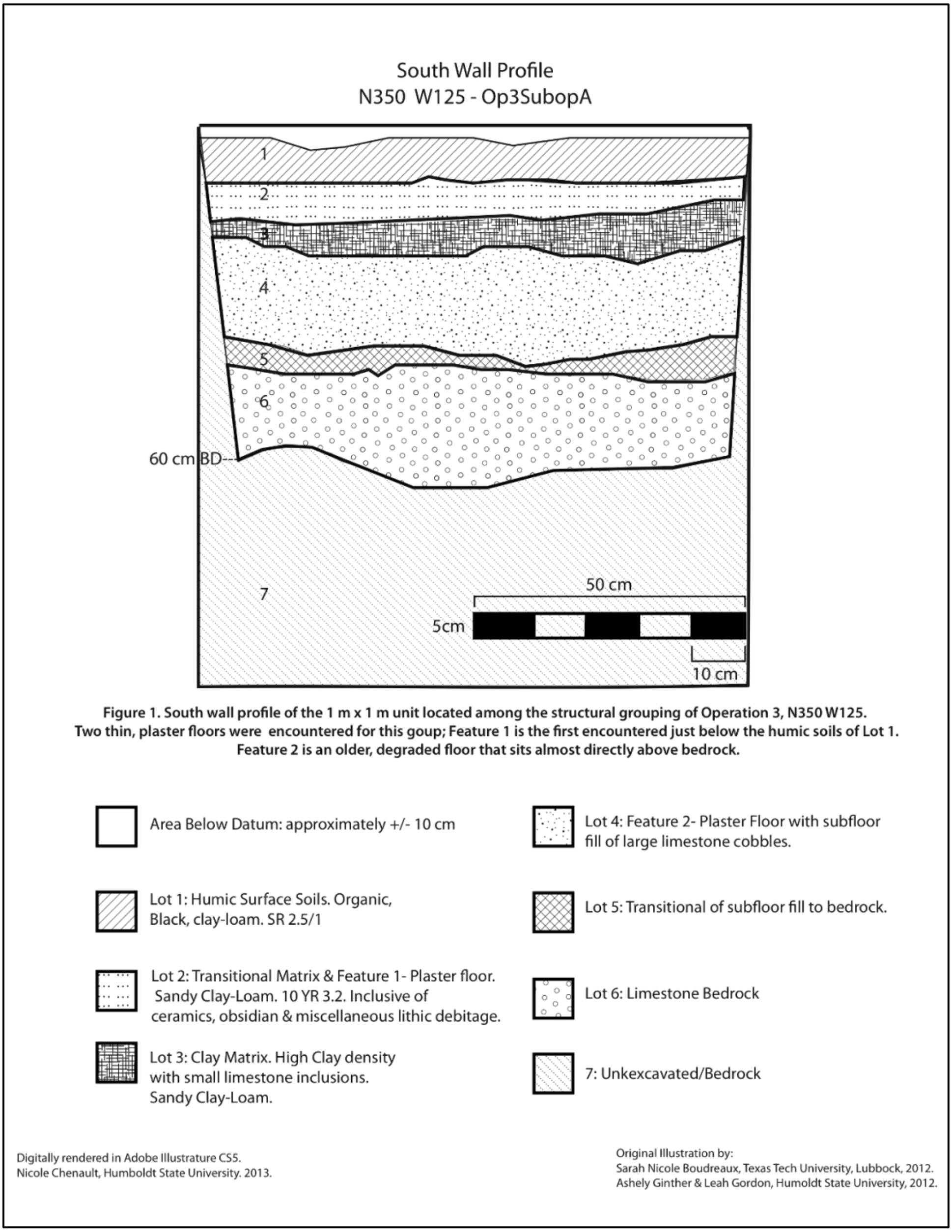

Figure 3. Op 3 Subop A South Wall Profile.

N350W50: Operation 3 Suboperation B- Depression 1

Subop B was 2 x 1 m unit located almost directly in the center of Depression 1 near the N350W50 marker (Figure 4). This unit was established in order to gather chronological information and to determine the existence of constructional modification. Our investigation of Subop B revealed six lots of varying content; the matrices were composed of dense clays and intervening inclusions of limestone cobble.

Data documented from Subop B supports the hypotheses that the water management feature was structurally modified. The large concentrations of limestone cobble were indicative of a collapsed, culturally modified wall belonging to both the basin and an adjacent small channel runs perpendicular to Depression 1, between Depression 2 and 3. The greatest concentration of artifacts was recovered from the southern half of the unit near the depression's center. All materials were impacted within dense vertisol soils. Materials pulled from the southern section of Subop B included a high assemblage of pottery sherds, *jute* shells, and woody carbon. The unit terminated with a transition into a thick layer of *sascab* and burnt limestone followed by limestone bedrock. These depressions appear to have functioned as a fluid system; where the collapsed materials at one time could have been a porous wall (Lucero 2002), allowing water to flow between depressions by way of the small channel (Dunning and Beach 1994).

Small Depressions

Estimated water yields and population estimates for the N350 area are depicted below in Table 1. The data collection process provided relevant information necessary to conduct volumetric and sustainability analysis. Measurements were taken in 1 m intervals, across two intersected axis that stretched across the greatest diameters observed for each depression. Once average depths and areas were calculated, the volume of each depression could be extrapolated. Due to the asymmetrical nature of water management features, the formula applied determines the volume of half an ellipsoid. The formula (Akpinar 2011: 46-47) applied to each depression is: $V= [h\ (.5)*Pi]*[(l/2)*(w/2)]$, where h= height; l= length; w= width. The volume for capacity yields were calculated in cubic meters, and converted to liters and gallons.

These small depressions had diameters ranging between 6 and 8.5 m. The three depressions at the N350W50 locus would yield lesser water volumes individually; but in total could have held 86.58 m^3. Depression 4 near the N350W125 settlement would have held 51.50 m^3 of water. The population for this group has been estimated between 24 and 30 individuals, requiring (Cortes-Rincon, personal communication, 2012) 2.4 to 4.8 liters of water per day. These figures would require the catchment features to support this small population, and possibly neighboring communities, throughout the bi-seasonal year. At the lowest rate for water demands, 8,640 liters would have been necessary to obtain during the wet season, and up to 34, 560 liters throughout the dry season; this provides an estimated total average of 39,420 liters of water required annually for this settlement area.

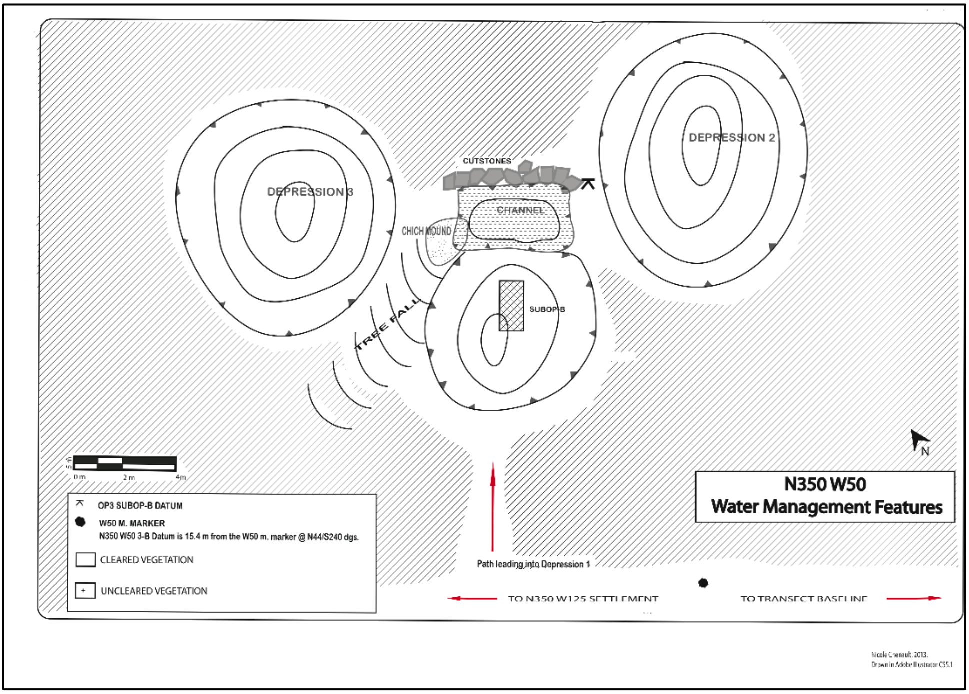

Figure 4. N350 W50 Depressions 1- 3. Plan Map Created by Nicole Chenault.

Table 1. Estimated Water Yields and Population Estimates for the N350 Area.

Estimated Water Yields and Population Density for the N350 Settlement & Water Management Area

Depression	Length (m)	Width (m)	Avg. Datum Height (m)	Height/ Avg. Depth (m)	Avg. Depth BD (m)
1	6.000	6.600	0.880	1.311	1.094
2	8.500	8.480	1.354	1.378	1.183
3	8.270	6.200	1.123	1.350	1.174
4	10.450	10.850	1.078	1.157	1.409
Weir Dam/ Channel	4.000	3.400	1.032	1.366	1.021

Maximum Estimated Volume Per Depression: Volume= [H(.5)*pi]* [(L/2)*(W/2)]

Depression	Cubic Meters	Gallons	Liters
1	20.38	5,385	20,384
2	39.01	10,306	39,013
3	27.19	7,182	27,188
4	51.50	13,606	51,504
Weir Dam/ Channel	4.29	1,134	4,292
Total volume for Depressions 1-4	138.09	36,479	138,089

Average Annual Water Requirement: N350 Population of 24-30 Individuals	Dry Season (8 Months) Water Requirements for 24-30 Individuals	Wet Season (4 Months) Water Requirement for 24-30 Individuals
39,420 liters/ 10,413.66 gallons	8,640 liters/ 2,282.45 gallons	17,280 liters/ 4,564.89 gallons
	to 17,280 liters/ 4,564.89 gallons	to 34,560 lt./ 9,129.79 gal.

Daily Water Allowance Available at Maximum Capacity Per Individual*

	Estimated population at 2.4 liters/ day	Estimated popluation at 4.8 liters/ day
Depression 1	2,123	4,247
Depression 2	4,064	8,128
Depression 3	2,832	5,664
Depression 4	5,365	10,731
Weir Dam	N/A	N/A

*This is the estimated amount necessary for one individual to manage daily living practices. These amounts are doubled for any unpredicted circumstance, possible to drought reserves and/or use by neighboring settlement groups.

Water Quality

In addition to water capacities and storage, water quality is also an important role of water management and control system. According to Lucero (2002), it is likely that these management systems would have been developed in such a way that water quality could have been sustained through the modification of depressions. To counter possible issues of unhealthy water reserves, studies have revealed the importance of specific plants – like the revered water lily (*Nymphaea ampla)* (Lucero 1999, 2006) – to prevent stagnant, harmful water sources; this could also be achieved by creating an active flow of water. Other water management features, such as channels and small dams, were common modifications affixed to depression features that could aid the maintenance of healthy, flowing water.

Channels, Terraces, and Agriculture

Channeling in the northwest and southeast quadrants of the settlement area is evident of cultural manipulations aimed at guiding seasonal rainfall caught in water basins. The intent of this was to divert flow to agricultural areas (Beach et al. 2002; Dunning et al. 2002) to avoid flooding that could have occurred at the settlement. In addition to the identified channeling features, reconnaissance has revealed a series of three terraces located behind and in close proximity to Depression 4. These terraces stretched 75 m south to north, by 10 m east to west. They are located on the eastern slope of the structural group's large platform.

The small channel adjacent to Depression 1 seems to be a mediating feature (Figure 3) that would have moved water between the three depressions. Any channels exiting the depression's boundaries that would have filtered water to areas where agriculture (Scarborough 1998, Scarborough et al. 1995; Walling et al. 2003) would have been active has yet to be discovered.

Postulates on Secondary and Tertiary Uses

Small depressions have been studied extensively and researchers have produced in-depth analyses on the evolutional utilization of water-management (Beach et al. 2002; Lucero 2002; Scarborough 1998; Weiss-Krejci and Sabbas 2002). Prior to the use of depressions as water management features, occupants of the southern Maya Lowlands often initially utilized these spaces for quarrying purposes (Dunning et al. 1999; Lucero 2002; Weiss-Krejci and Sabbas 2002). These spaces are also known as *sascaberos* (Lucero 2002). It is very possible that all depressions at the site may have been quarried prior to use as a water reserve and any secondary uses thereafter. Any evidence of a *sascabero* is indicated by the large *sascab* pieces and burnt limestone inclusions encountered upon termination of the unit. These particular spaces were necessary for harvesting the limestone primary to the construction of residential structures (Cortes-Rincon, personal communication, 2011). The N350 settlement would have needed plaster and stucco made from pulverized limestone for any building phases of the expansive basal-platform and the structures that sit atop this feature.

When small depressions outlast their ability to serve as water management features, the ancient Maya would typically redefine their function (Lucero 2002, 2006; Scarborough et al. 1995; Weiss-Krejci and Sabbas 2002). Small water basins are most commonly understood to have been transformed into areas of refuse.

High frequencies of lithic fragments found in depressions can also indicate a lithic tool production area. A very low frequency of chert debitage was discovered throughout the entirety of the unit, ruling out Depression 1 as a location for this secondary use. A greater catalogue of pottery sherds was collected from Subop B, supporting our postulate for a possible refuse area. Pottery production was a major aspect of craft specialization (Sullivan 2002) in the southern Maya Lowlands. The majority of sherds came from an area located approximately at the center point of Depression 1. The high volume of sherds – including a well-preserved Late Classic refit jar (Boudreaux and Sullivan, this volume) – was indicative of a Late Classic occupation and utilization for these depressions.

An interesting aspect about the artifacts was the provenience of the refit jar to the high frequency of 27 jute shells and 114 grams of woody-carbon. These observations suggest that the jute shells were contained within the jar at the time of its disposal. The question of whether the vessel was placed or thrown into the basin of Depression 1 only remains ephemeral. It has not been established whether or not this accumulation of cultural materials was just another act of discarding waste, or an offering for a ritual (Healy et al. 1990; Lucero 1999, 2006) of termination or possibly renewal.

Representative of Other Sites Within the DH2GC Archaeology Project

Although sites within the greater DH2GC transect contain water management features of varying size and scope, the overall function and necessity remain the same. The most definitive network of water management features is found at an elite settlement located at N950 (Moats and Boudreaux, this volume). N950 has an extensive series of channeling, terracing, and three large depressions. Excavation of a depression at N950 revealed similar properties and evidence of utilization. Engineered elements of the basin include two stairways leading into the depression, as well as very large cut-stones defining the periphery. Perhaps due to a likely difference in the socio-economic status between group populations, the constructive measures for these similar water catchment and management features vary between the Maya that once occupied the two settlements.

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ECOLOGY FIELD REPORT

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The guiding question of our research is: how has ancient Maya land use and its impacts on topography, hydrology, and soil affected the structure and tree species composition of present-day forests? To begin answering this question, in 2012 we carried out field-work on tree species composition and soils on the DH2GC transect and at Chawak But'o'ob.

METHODS

We added tree plots to the array of plots we had censused previously (2010 and 2011). At DH2GC tree 400 m^2 tree study plots were located at the 50 m points on the main transect and at the 50 m points on each of the east- and west-extending side transects. In each of the plots we identified two species, map, and measured the diameter at breast height (dbh), which was 130 cm above ground for all trees ≥ 10 cm dbh. We also measured forest height and classified the topographic situation (hill top, slope, etc.) in each plot. In 2012 we added six tree plots, for a total of 88 plots, on the DH2GC transect, and nine plots at Chawak But'o'ob, for a total of 85 at that site. We will census additional plots on the DH2GC transect in 2013. At both sites we will need to work on the identification of some unknown tree species and of some congeners that are hard to distinguish to the species level. In the meantime we will create a vegetation map for DH2GC, based on correlations between tree species abundance and topographic features.

At both DH2GC and Chawak But'o'ob we collected soil samples at 102 of our 193 tree plots. Five to seven ounces of soil was taken from 0-20 cm depth near the center point of each tree plot. The samples will be analyzed for nutrients and other variables that typically correlate with tree distributions. We will collect soil samples from the remaining tree plots in the 2013 field season.

RESULTS AND DISCUSSION: THE TREE COMMUNITY

We have recorded 3,300 trees ≥ 10 cm dbh in our 193 plots on the DH2GC transect and at Chawak But'o'ob. We identified about 3,200 of these trees, leaving about 100 to be identified later. The 3,200 identified trees represented 113 species; the unidentified trees represent about 25 additional species.

As is usual in tropical forests, there is a steep species dominance curve among trees. A few species are abundant, a large group are moderately abundant, and a large group are rare (Figure 1). Among the 3,200 identified trees at both sites the15 most abundant species at both sites combined were, in descending order of abundance: *Pouteria reticulata*, *Drypetes brownii*, *Brosimum alicastrum*, *Sabal mauritiiformis, Pseudolmedia* sp., *Trichilia minutiflora*, *Aspidosperma cruenta*, *Pouteria durlandii*, *Pouteria campechiana*, *Pouteria amygdalina*, *Alseis yucatanensis*, *Protium copal*, *Manilkara zapota*, *Simira salvadorensis*, and *Sideroxlyon foetidissimum*. These 15 species constitute 69% of the total stems ≥ 10 cm dbh (2,221 of 3,200 total stems). Among these most abundant species, those assumed to be used by the ancient Maya include *B. alicastrum*, *S. mauritiiformis*, *P. copal*, and *M. zapota*. Other species in this list of most abundant species are not reported as especially useful. Our results apparently belie the statement (at least for these Maya sites) that the forest in this region is dominated by useful species, a result of the ancient Maya favoring those species. The four *Pouteria* species, *Manilkara*, and *Sideroxylon* are all in the Sapotaceae, making this an especially important family at these sites.

We will conduct multivariate analyses of tree species presence, topography, soil, and ancient land use to determine the relationship between species distributions and those variables. It is clear from field observations, however, that there are certain species disproportionately found on Maya ruins and that species sort out according to topography. These observations promise more detailed understanding of how historical and environmental factors have affected the present-day forest. Analysis of the >100 soil samples taken in 2012 should help to explain aspects of tree species distribution and should provide linkages to land use as determined from the archeology and geo-archeology on these sites.

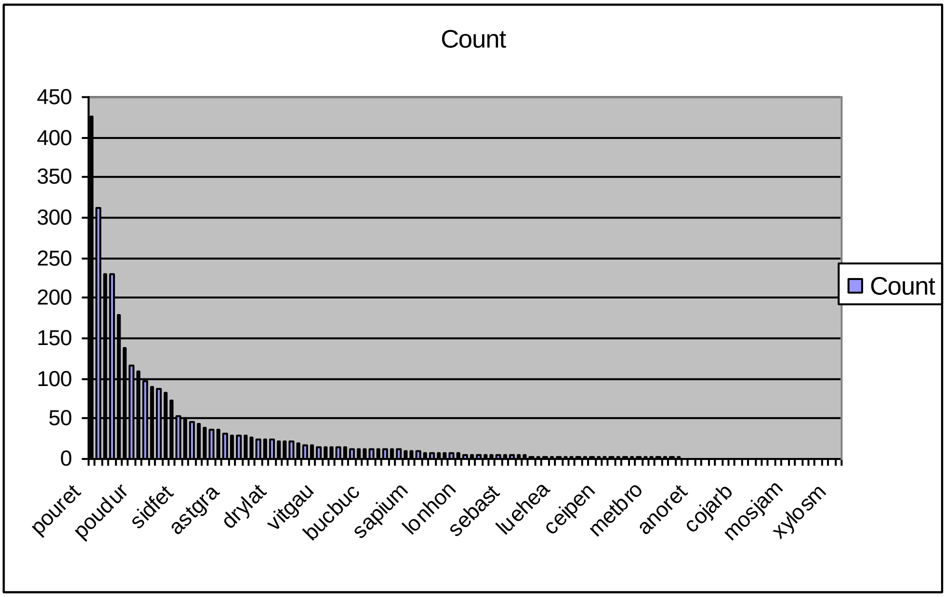

Figure 1. Stem abundances (vertical axis, stems ≥ 10 cm DBH) of 113 tree species (horizontal axis) at the DH2GC and Chawak But'o'ob study sites combined, arranged in order of abundance (horizontal axis). There were ca. 3,200 individual trees in the sample. Only a few species codes can be shown on the graph. See text for list of the 15 most abundant species.