Hidden landscapes of the ancient Maya: transect excavations at Arvin's Landing southern Belize

Bretton Michael Somers

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HIDDEN LANDSCAPES OF THE ANCIENT MAYA:
TRANSECT EXCAVATIONS AT ARVIN’S LANDING
SOUTHERN BELIZE

A Thesis
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Arts

in

The Department of Geography and Anthropology

by
Bretton Michael Somers
B.A., University of New Hampshire, 1994
December 2004
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Abstract

Transect excavations at Arvin’s Landing in southern Belize revealed evidence of ancient Maya settlement indiscernible from surface inspection. The synthesis of archaeology and geography in field and laboratory methods and analysis provided the framework for this thesis. This study involves a transect survey with systematic shovel tests. Artifacts were recovered and recorded in the field and analyzed in the LSU archaeology laboratory in Punta Gorda, Belize. The entire survey area was mapped by transit and measurements and coordinates were combined with artifact data in a GIS. Prior research at Arvin’s Landing had revealed a Postclassic mound on the bank of Joe Taylor creek at Arvin’s Landing. The present surrounding landscape is forested with secondary growth devoid of artifacts mounds or other surface features indicative of settlement. In this transect survey extending away from the creek and mound a rich artifact assemblage of obsidian, chert and ceramics was recovered. The presence of such an expansive artifact assemblage suggests a much larger settlement area than previously known. Analysis of artifact densities in GIS revealed hotspots in the data set indicative of concentrated cultural activity and settlement locations. In addition to the single mound, evidence suggests up to two more households and a lithic tool production area are located within the survey area. This research serves as a point of departure for future research exploring the extent and patterns of hidden ancient Maya settlement. Future research including mobile GIS technology will increase efficiency of research in the field and allow better use of time and resources during limited field seasons.
Chapter 1

Introduction

The Study

Arvin’s landing is a site in south coastal Belize, which has exhibited evidence of ancient Maya activity. The site is located on the southern bank of Joe Taylor Creek approximately two kilometers north of the Punta Gorda town center in the Toledo district of southern Belize (Map 1). Arvin’s landing is an ancient Maya site and consists of a single mound approximately one kilometer from where the creek empties into the Caribbean Sea in southern Belize.

Previous research at Arvin’s Landing has consisted of surface collections, shovel tests and subsurface excavations (McKillop 1994, 1995, 1996; Steiner 1994). The investigations yielded ceramics, lithic artifacts and faunal remains. Analysis of this material suggested that there was a small group of rural, non-elite Maya subsisting on plant, animal and marine resources. The relative abundance of obsidian and to a lesser degree chert, suggests the settlement was actively involved in long distance trade (Steiner 1994). An abundant artifact assemblage suggests long term Maya activity at the site. Surface collections from the nearby sites of, Foster Farm and Izuzu bog (Steiner 1994; McKillop 1996) indicate a wider dispersal of Maya activity. Apart from artifacts, the one mound at Arvin’s landing serves as the only definitive location for Maya settlement in the immediate area. My research investigated whether or not there was ancient Maya settlement beyond the single mound at Arvin’s landing. For the most part, current methods employed for identifying archaeological settlement remains in the Maya area overlook non-mound evidence.
Map 1. Map of Belize showing locations of Punta Gorda, north of which is located Arvin’s Landing (www.lib.utexas.edu/maps/americas, 2003).
I sought to employ a methodology to search for settlement lacking visible mounds or surface features. My research included shovel testing along survey transects which, departs from the traditional transect survey that focuses on surface inspection for mounds. This methodology has been successful on the cays and in the sea of the Port Honduras area of southern Belize impacted by sea level rise (McKillop 2002; McKillop and Winemiller 2004).

Geography

The ancient Maya lived in a vast area of what is now called Mesoamerica (Map 2). The Maya area includes the entire Yucatan peninsula of Mexico in the north to as far south as modern day El Salvador and western Honduras and includes all of Guatemala and Belize (Map 2). The landscape of this area is diverse in topography, geology, climate, flora and fauna (West 1964). This landscape diversity is further expressed in the cultural variety of the Maya people with thirty-one languages (Coe 1999; McKillop 2004). The majority of contemporary scholars of the Maya region divide the area into three distinct regions. The dryer, subtropical northern lowlands comprise the northern tip of the Yucatan. The moist, tropical southern lowlands include Belize and the Peten of northern Guatemala. The Caribbean Sea forms the eastern border of the southern lowlands. The southern highlands include the volcanic regions of southern Chiapas, Mexico, Guatemala, El Salvador and western Honduras (Map 2). The Maya area receives a seasonal variation in rainfall with a pronounced wet season between May/June through November/December. There is a general north to south increase in average annual rainfall for the Maya area (McKillop 2004).
Map 2: Map showing the location of Mexico, Guatemala, El Salvador, Belize and Honduras with Mesoamerica and the Maya area outlined in black and red respectively (www.lib.utexas.edu/maps/americas, 2003).

Rainfall amounts vary from 1200-500mm in the northern Yucatan peninsula to over 2000mm in the southern lowlands (West 1964). Although average annual rainfall may be abundant in parts of the Maya area water can become scarce for two main reasons. The pronounced dry season requires intensive management of any wet season water surplus. Secondly, the bulk of the Yucatan peninsula, which comprises the northern and southern lowlands, is a porous limestone shelf. This karst terrain allows rainwater to drain freely into the underlying bedrock making it difficult or impossible to
access (Dunning et al. 2002). Annual variation in the seasonality of rainfall occurs
temporally and regionally, further complicating the availability of water resources.
Furthermore, without water accumulating on the surface, sedimentation occurs very
slowly if at all. The lowlands tend to have thin soils requiring extra attention for
agricultural production. Vegetation tends to follow the trend in precipitation amounts
with rainforest occurring in the south and gradually fading to savanna and scrubland in
the north (West 1964).

The northern and southern lowlands characteristically have little variation in
topography. The Puuc Hills in the northwest of the northern lowlands (Coe 1999), a belt
of lakes and seasonal swamps (bajos) across the northern border of the southern lowlands
(Dunning et al. 2002), and the Maya mountains in southern Belize of the southern
lowlands are the only exceptions.

This region of karst bedrock provided the ancient Maya with building materials
for large urban structures and dwellings. Some areas had access to chert but much of the
region is deficient in hard stones. Hard stones are necessary or at the least preferable for
grinding maize, a staple in the ancient Maya diet. Hard stones also hold blades better and
are best used for cutting implements. The presence of hard stones from non-local sources
at ancient sites such as obsidian from the volcanic highlands, granite from the Maya
mountains and chert from various locations within the lowlands, with the highest quality
chert in northern Belize, indicate their importance in the ancient Maya livelihood (Shafer
and Hester 1983).

A daily dietary requirement for humans is salt. Most of the lowlands are lack
local sources of this essential requirement (McKillop 2002). In order for the ancient
Maya to survive, let alone settle this region, they would have to procure this dietary supplement from elsewhere. Salt occurs in abundance along the coasts of the Yucatan Peninsula and Belize (McKillop 2002).

The apogee of ancient Maya civilization occurred in the southern Maya lowlands during the Classic period, between A.D. 300 and A. D. 900. The Classic Maya cultural fluorescence coalesced amid this region of seemingly inconsistent access to water, cutting and grinding stones, soils and salt resources (Dunning et al. 1999; McKillop 2002; Netting 1977a; Rathje 1971; Sanders 1981). At the peak of ancient Maya civilization the region supported a population estimated at around three million people (Houston and Stuart 2001). Such urban centers such as Tikal and Caracol were able to control populations of 425,000 (Culbert et al. 1990; Rice and Culbert 1990) and 122,000 (Chase et al. 1990) respectively during the Late Classic (A.D. 600 – 900). These population estimates are debatable and can vary greatly in size depending on the scholar. In general, the Maya population of the Classic period far exceeds the contemporary population in most of the Maya lowlands.

The distinctive cultural adaptations, which allowed the ancient Maya to harness the environment and etch their imprint upon the landscape, encountered yet to be determined pressures forcing significant decline on a once thriving population by A.D. 900. Climatic change, political upheaval, economic decline and anthropogenically induced ecological destruction and widespread disease all have been indicted as possible culprits in initiating the collapse (Brenner et al. 2002; Culbert 1977; Dunning et al. 2002; Lowe 1985; Netting 1977a; Rathje 1973; Sharer 1977; Webster 2002).
Arvin’s landing is located in southern Belize (Map 1), which is considered part of the southern lowlands, even though its features make it a distinct sub-region. Richard Leventhal (1990) called the sub-region the “southern Belize laboratory,” noting its distinction from the rest of the Maya area. The Maya mountains protrude into the southern lowlands, separating southern Belize from efficient land travel north and east to the rest of the southern lowlands. The area is bound by the Caribbean Sea to the immediate east and the major river drainage of the Sarstoon, Rio Dulce and Rio Motagua, flowing from the Guatemalan highlands to the south. These obstacles bound the sub-region physically for human settlers.

Geologically, the region hosts igneous rock uplifts from the Maya Mountains in addition to the karstic bedrock common to the greater Maya area. Additionally, the temporal and cultural development of southern Belize further distinguishes the sub-region from the rest of the southern lowlands (Hammond 1975, 1977, 1981; Leventhal 1990). Although in semi-permeable isolation from the rest of the ancient Maya culture area, the southern Belize sub-region affords many advantages, making it attractive for settlement. The relatively close proximity of the Maya mountains allowed for the procurement of hard stones for tools. The floodplains draining the southern slopes of the Maya mountains have rich fertile soils that are still agriculturally productive today (Hammond 1975, 1981).

The coast provides access to marine resources, salt production and extensive long distance trade networks featuring obsidian, chert and ceramics (Hammond 1975, 1977, 1981; McKillop 2002). The most efficient means out of isolation for ancient Maya of southern Belize would appear to be a marine-based lifestyle. There are several large
Classic Maya inland centers at Lubaantun, Nim Li Punit, Uxbenka, Xnaheb and Pushila, (Hammond 1975, 1977, 1981; Leventhal 1990). These larger sites are all situated in the foothills of the Maya mountains and the floodplains that drain them. The inland area of southern Belize is understudied compared to the coast, but draws more attention than the coast because inland sites are large cities, including some with carved stelae. Evidence for Maya occupation of the south coast of Belize and extensive participation in long-distance trade has been revealed in both underwater and onshore excavations carried out under McKillop’s direction since 1982 (McKillop 1989; 2002; Braud 1996; Magnoni 1999; Steiner 1994). Apart from the Classic and Postclassic trading port at Wild Cane Cay and Frenchman’s Cay, most of the other coastal sites have no mounded remains (McKillop 1989, 1996, 2002; McKillop et al. 2004). Many of the coastal sites are hidden from modern view due to sea level rise, which has obscured them in a mangrove landscape.

Since the last glacial maximum sea level has risen on a global scale (Dunn and Mazzullo 1993; James and Ginsburg 1979; McKillop 2002; Williams et al. 1998). Archaeological investigations in south coastal Belize have documented this sea level rise through the dated stratigraphy of archaeological deposits found in excavations of submerged coastal Maya sites (Brandehoff-Pracht 1995; Magnoni 1999; McKillop 1995, 2002). Sea level rise for south coastal Belize during ancient Maya occupation has been estimated at the rate of one meter per one thousand years (McKillop 2002). This sea-level rise has impacted coastal Maya settlements by reducing the coastal area available for settlement and possibly leading to abandonment of some sites (McKillop 2002). In addition to submerging coastal regions, sea-level rise can also impact the coastal plain by
raising the water table and increasing its salinity. A change in salinity can vastly affect coastal vegetation, marine life and those dependent on these species.

The trend in study of ancient Maya civilization away from monumental ceremonial centers and toward more diverse settlement pattern studies examining the variability in ancient Maya settlements, from the ruling elite to the common farmer. My thesis research will be a contribution to understanding these small, and as will be explained in later chapters, sometimes hidden landscapes.

**Significance**

My research used shovel tests along transects to search for the extent of settlement at a known mound site beyond the area of the mound. In this way, my research contributes to community settlement patterns. The use of shovel testing along transects as a discovery technique to search for settlement evidence has proven successful elsewhere on the south coast of Belize, showing traditional transect surveys focus on surface features under represent settlement. Settlement pattern study in southern Belize, as a sub-region of the southern Maya lowlands, is limited. In the past, study of the ancient Maya has been concentrated on the larger ceremonial centers to the north and the west of southern Belize (Hammond 1975; Dunham et al.1989; Leventhal 1990), and on the coastal adaptations of Port Honduras and the Punta Ycacos Lagoon (McKillop 1989, 1996, 2002). The Maya Mountains to the north and west, the Caribbean Sea to the east, and the Rio Motagua drainage to the south are natural obstacles limiting access to the rest of the Maya area (Hammond 1975; Leventhal 1990). This understudied sub-region of the Maya area may reveal a different manifestation of the ancient Maya culture with a greater focus or more adapted concentration on long distance exchange with the greater Maya
realm. Any further study will prove to be an invaluable contribution to the growing body of knowledge of the ancient Maya and their interaction with this unique environmental situation. Understanding the ancient Maya experience and the implications it may have on future development in the region will be useful in the decision making of the present day inhabitants.
Chapter 2

Settlement Pattern Research

The study of settlement patterns examines the distribution of human activity over the landscape through time and space with emphasis on the relationship between humans and the land. Understanding the processes of the natural world, as well as the cultural world, is necessary to understand how this interaction manifests itself through time and how this interaction is represented in the landscape. Human activity can take the form of landform modifications, buildings, monuments, artifacts and middens (Ashmore and Willey 1981; McKillop 2004; Willey 1953). Additionally, human activity can include deforestation, agriculture, mineral extraction, water diversion and plant and animal selectivity (Denevan 1974; Glacken 1967; Marsh 1867; Mikesell 1967; Netting 1977b; Sauer 1981). Humans tend to organize activity toward an efficient means of exploiting their social and natural environment (Kurjack 1974). The study of settlement patterns is useful for understanding the relationship of humans with each other and their environment. Settlement pattern studies have a long history of scholarly applications with contributions from the disciplines of both geography and anthropology. This research will consider the contributions of both fields in the development of a cross-disciplinary approach.

Settlement pattern studies have a long history of research in geography and anthropology. In this thesis, I will trace the history of anthropogeography, developed in geography, as it pertains to settlement pattern studies in geography and anthropology. From this comparison it is evident that although settlement pattern studies were carried
out independently in each discipline, the shared goals make a more holistic approach, combining aspects of geography and anthropology, a useful framework. For the purpose of grounding this research project in an academic context, it is necessary to define and briefly discuss the origins of anthropogeography, its development and its pertinence to settlement pattern research.

**Anthropogeography**

Anthropogeography is the study of human/environment interactions and how it comes to be expressed and distributed across the landscape through culture. Anthropogeography as a concept and practice has enjoyed a long history of development. Throughout its development the contributions of a great many scholars have rendered anthropogeography into a dynamic, holistic approach for understanding the interrelationship between humans and their environment. The study of this interrelationship is the guiding principle. Intimate knowledge of both the physical and cultural environment are necessary components. Considered a sub-discipline of geography, anthropogeography offers one of the few opportunities where it is possible to synthesize the ideas of social theory and the laws of physical science. The complex nature of anthropogeography has led to the concept and practice falling in and out of favor through misinterpretations, mis-associations, vocational voguishness and theoretical progress. Today in the intra-specialized world of academia, the term anthropogeography is a rare association despite its continued relevance.

What are the origins of Anthropogeography? Certainly the idea of anthropogeography was not born in a vacuum. Central to anthropogeography is the concept of humans and their relationship to the Earth. Throughout history and perhaps
prehistory, scholars have expressed this relationship differently. Various ideologies have
guided this discussion among humans through time.

Friedrich Ratzel coined the term Anthropogeography in 1882 as
*Anthropogeographie*, the title of the first of two volumes. *Anthropogeographie* directly
translated means human geography. Ratzel’s background was in natural history and early
in his career he was greatly influenced by Darwinian ideas. *Anthropogeographie* marked
a movement toward a more humanistic approach for Ratzel (Bassin 1987). His
*Anthropogeographie* included three major discussions, the regions of the earth and human
distribution, human migratory movements with emphasis on their dependency on the
land, and the effects of the environment on humans physically and mentally (Bassin
1987). This introductory piece in anthropogeography exhibited a very strong
environmental determinist perspective. This is partially reflective of the dominating
paradigm of the era.

Coinciding in proximity and contemporaneity with Ratzel’s efforts in
anthropogeography were other German scholars of geography. Much of what is known
as modern geography originated among German geographers during the late nineteenth
and early twentieth centuries. The legacy of Ferdinand von Richthofen, a founder of
modern geography, adapted the earliest strategies of settlement pattern studies and
focused on the human and land relationship in geography. Richthofen was known as a
field geographer and was perhaps the first to look beyond geologic landforms to include
soils, climatic conditions and hydrography. He also noted the differences of human
distribution based on the natural setting (Kolb 1983). His basis of study was somewhat
environmental deterministic in nature; however, he viewed the field of geography as a
of anthropogeography coming from the German tradition. Schluter defined the concrete phenomena from which geographic and especially anthropogeographic studies must originate. Schluter proposed *Landschaftkunde* or landscape science as the study of the “form and arrangement of phenomena on the earth’s surface, as far as they are perceived spatially through vision and touch” (Schluter quoted in West 1990:61).

Schluter identified two kinds of landscape, the *Urlandschaft* or natural landscape, untouched by humans and the *Kulturlandschaft*, the landscape modified by human cultural activity (Martin and James 1993). This attention to *Kulturlandschaft* was an attempt to draw emphasis away from the predominant focus on physical landforms within geographic study at the time. This diversion marked a movement toward humans as agents of landscape modification in geographical thought. Schluter preferred the historical approach to understanding how landscapes were modified from their earliest untouched state to the present day observable human-induced manifestation (West 1990).
A quick glimpse of anthropogeography could be seen early on in American geography through the work of George Perkins Marsh. Marsh focused on humans as agents of change and their ability to modify the environment. In Man and Nature, 1867, Marsh provides a far-reaching description of human modifications of plant and animal species, the woods, the waters, the sands and projected landscape modification projects of that period. Marsh is critical of these endeavors with explanation of possible advantages and consequences of these actions. Marsh was outspoken regarding the destructive nature of human agency on the landscape during a period where the political minds of the industrial revolution and westward expansion in America were not interested. Marsh’s work, although ahead of its time, was not embraced by his contemporaries and was not fully appreciated for almost sixty years.

The works of the Germans and George Perkins Marsh had a profound effect on American geography in the twentieth century particularly with Carl Sauer, founder of the University of California at Berkeley school of geography. Carl Sauer’s The Morphology of Landscape, 1925, very closely mirrored Schluter’s study of Landschaftkunde, with his division between natural and cultural landscapes. Carl Sauer and John Leighley’s An Introduction to Geography, 1929, heavily reference the work of earlier German geographers and emphasizes a divergence in the field of geography between physical geography and the more humanistic anthropogeography. Sauer was also quite outspoken regarding Marsh’s contributions to the human agency concept (Sauer 1938, 1941, 1944, 1981).

At Berkeley the influence of anthropology played a large role in the further development of anthropogeography. Alfred Kroeber and Robert Lowie, Sauer’s
colleagues in anthropology at Berkeley, had a profound influence on this adaptation of anthropogeography (Sauer 1925, 1936; West 1979). What cultural historical geographers observed of the cultural landscape at this time was further enhanced and expanded by the collaborative efforts with anthropologists at Berkeley. Drawing from this influence, Sauer coined the term archaeogeography for the employment of archaeological field methods to look for evidence of former occupation in the landscape (Sauer 1941; West 1979).

The intellectual exchange between the departments of geography and anthropology at Berkeley during this period sparked an awareness of the advantages of multi-disciplinary cooperation in research. Stemming from similar origins, geographers and anthropologists were finding considerable sharing and overlapping in research endeavors (Denevan 1974; Mikesell 1967; Steward 1950). The two fields operating independently drew from one another where the shortcomings of the respective fields occurred. Cultural historical geography, in its focus on human landscape modification, began to find it necessary to explore the concept of culture with greater emphasis. Anthropology with culture as its core concept found a need to understand the environment to explain the spatial distribution of culture and the limits and advantages inspiring cultural adaptations and change (Binford 1962; Mikesell 1967; Steward 1955).

Gordon Willey’s settlement pattern study of the Viru Valley in Peru was trend-setting research for settlement pattern studies. Gordon Willey is considered the leading pioneer of settlement archaeology (Chang 1968). Some of his research in the Maya area will be discussed in further detail in later pages.
Willey recognized a preoccupation of archaeologists with artifacts and not the larger context of the settlements of which they were a part. Particularly, many archaeologists were focused on the ceremonial manifestations of ancient cultures. In turning toward the study of settlements as artifacts themselves, Willey sought to see a larger picture where settlement features were viewed as “adaptations to natural-environmental, social, and ideological factors (Willey 1968:225).” In positing his approach to his settlement study of the Maya Willey writes,

How were the ancient Maya distributed upon the land? And how do these distributions reflect the former relationships of man to nature and man to man? An examination of these questions is, we believe, one important starting point in any attack on the difficult questions raised above. If we can answer these basic inquiries about settlement arrangement we will be staking out some of the reference points for the interpretations of class structure and the socio-economic components of past Maya society. For in settlement man has etched upon the landscape the bolder outlines of his design for living (Willey et al. 1965:5).

This excerpt follows very close to the basic fundamentals of settlement geography. The “man to nature” and “man to man” relationship conjure the principles of German settlement geography and Sauer’s Berkeley school. Willey’s settlement archaeology was influential to American Archaeology as a whole with a concentration among Maya archaeologists of whom the more relevant to this study will be later discussed.

With this attempt at a brief background of the last one hundred and twenty years of anthropogeography studies, the reader is probably interested to know where this research lies. This study will employ both the fundamentals of settlement pattern studies
in geography, as well as those from archaeology. There are many shared fundamentals between the two approaches but the differences stem from the methodology employed. Settlement geography relies on observable features, which can be contemporary, historical or even prehistoric, as long as they can be observed. Settlement archaeology relies on observations of the cultural remains of the past, including those below the ground surface. Cultural features are not always visible from the surface and often require archaeological methods of subsurface survey, excavation and recovery. It is the position of the author that once exposed, analysis and interpretation of ancient cultural material has relevance comparable to any other visible criteria used in any settlement pattern study whether in geography or archaeology. As an archaeo-geographic study, my thesis research at Arvin’s landing attempts to develop a methodology using subsurface cultural evidence to conduct a settlement pattern study where visible surface features are non-existent. In the following chapters of the thesis I report how archaeological laboratory analysis of the subsurface cultural material at Arvin’s Landing reveals the nature of cultural activity over the study area, while a Geographic Information Systems (GIS) analysis reveals the spatial distribution of cultural activity over the study area.

The following discussion will focus more closely on settlement pattern studies in the Maya area of Central America. A brief background on the contributions of others to settlement pattern studies in the context of the Maya area will illuminate how this research will contribute to this body of knowledge.
The State of Settlement Pattern Studies in the Maya Realm

The work of Gordon Willey (Willey et al 1965) is attributed to having the most influence on the origin of settlement pattern research in the Maya area. The approach developed in Willey’s background work in the Viru Valley of Peru (Willey 1953) was equally suitable in the archaeological conditions of the Belize River Valley. Willey’s research, although cutting edge at the time, was not the first settlement research in the Maya area.

Earlier settlement research in Central America included the extensive Ricketson and Ricketson (1937) investigation at Uaxactun from 1926 – 1931 as part of a Carnegie Institution of Washington project. The dominant view of the time suggested that large ceremonial centers of the ancient Maya were vacant and used as gathering places for the people in the countryside to convene at religious ceremonies and markets like in the modern villages of Solola and Chichicastenango (Ricketson and Ricketson 1937). Earlier observations by Tozzer (1913), Thompson (1892), Joyce (1926), Gann (1925) and Lothrop (1924) identified numerous small mounds widely distributed throughout the Maya lowlands and suggested they were domestic in nature. The Ricketsons also noted the presence of house mounds at Uaxactun but took these observations a step farther. Their study estimated the number of individuals per household at five, a figure still used in contemporary estimates. The Ricketsons attempted to extrapolate a population estimate for the entire Maya lowlands based on the number of mounds at Uaxactun (Ricketson and Ricketson 1937).
Another member of the Carnegie Institution’s project at Uaxactun was Robert Wauchope. Wauchope’s (1934, 1938) research focused on the shape, form and composition of house mounds. Wauchope also looked to contemporary examples of Maya house mounds to gain ethnographic insight into domestic practices of the ancient Maya (Wauchope 1934 and 1938). Wauchope recognized the problem with focusing research entirely on ceremonial architecture and paraphernalia at the ruins of major centers.

Although this concentration on the main ruins of Maya cities is entirely justified by its important results regarding migrations, chronology, religious customs, architecture and art, it has furnished us with knowledge of the customs of only the very highest social stratum, the priests and the chieftains, who always form a very small percentage of any population.

We know very little of the great residue of the Maya, the people who were numerous enough to provide sheer man-power that made possible the pyramids and the palaces. The conditions under which they lived, their wealth, if any, in personal possessions, the type of pottery they used and the kinds of weapons and implements they made, are practically unknown except for the scanty information gleaned here and there from casual references by early writers, pictures on wall-frescoes, graffiti, a few archaeological details, isolated finds of sculpture, and some archaeological excavations (Wauchope 1934: 113).

Wauchope’s research at Uaxactun was based on the excavation of five house mounds. In Modern Maya Houses, Wauchope (1938) focused on modern house types of the Maya in order to make inferences about ancient dwellings. This work offered insight into differences in Maya house types with a suggestion toward status and access to resources as factors (Wauchope 1934, 1938). In the modern Maya house study Wauchope offers a cautionary note in that not all Maya house types of today are representative of ancient house types. Geographical rearrangement since the European
occupation and increased diffusion have influenced house building throughout Central America (Wauchope 1938). Wauchope cites an example from Chichen Itza where the local modern Yucatecan Maya build their homes on mounds and evidence of mounded substructures are absent in the surrounding archaeological record (Wauchope 1940). Wauchope’s work, although lacking strong spatial vision, remained the only attempt at a comprehensive study of ancient Maya domestic structures until the late 1950s. Later studies, particularly of the Carnegie Institute of Washington, continued to acknowledge the presence of house mounds but their full attention in settlement studies came with Gordon Willey (1956 and Willey et al. 1965) and William Bullard (1960).

Gordon Willey introduced a different way to study settlement patterns to archaeology in the 1940’s with his work in the Viru Valley of Peru and later in the Maya lowlands (Willey 1956, Willey et al. 1965). Willey, like Wauchope, realized most prior research of the Maya area focused on large centers with monumental architecture, rich burials, hieroglyphic inscriptions and other expressions of the elite. The cultural expressions of the elite, although often elaborate and prominent in the landscape, are not representative of the greater populous. For this reason Willey’s settlement pattern research turned its focus on “house mounds” as the starting point for understanding the greater ancient Maya society (Willey et al. 1965). Willey’s settlement pattern study focused on the house mound as the smallest unit of settlement evidence. In doing so, Willey hoped to answer the major problems yet to be answered by research of the ancient Maya.

These problems are, to repeat: the relationship of aboriginal occupation to natural environments; the nature and function of buildings composing habitation communities; and the form, size, and spacing of these communities with
reference to each other and to ceremonial centers. Fundamental to all this is, of course, the consideration of all of these problems in chronological perspective.

On higher levels of inference these problems lead to larger questions of land utilization, agricultural potential, population densities, urbanism, the districting or zoning of ancient settlement, and the interdependence or independence of communities or community assemblages. And, perhaps, ultimately, the data bearing on these problems and solutions of them will help resolve the mystery of the apparent abandonment of the southern Maya lowlands at the close of the Classic Period and the “fall” of Maya civilization (Willey 1965:15).

Willey’s recognition and proposal to approach these issues in Maya studies suggested a very “man and land” approach to the study of the ancient Maya similar to the cultural ecology approach of Julian Steward and the anthropogeography and cultural/historical approach of the Berkeley and LSU schools of geography. The introduction of this new settlement pattern study to the ancient Maya area was an important milestone. No longer were rural habitation sites incidental to the study of ceremonial centers. House mounds became the basis for ancient Maya research. The results of his influential Belize valley survey continued to focus on visible mounded remains.

William Bullard Jr. was also integral in the formulation of house mound settlement study. Bullard worked with Willey on the Belize valley survey, as well as conducting a settlement pattern survey of the northeastern Peten of Guatemala following chicle trails throughout the area (Bullard 1960).

The study of ancient Maya settlement patterns has become a popular approach, especially in the central Peten region of Guatemala and northern Belize and Mexico (Hammond 1981; Leventhal 1990). This region has a high concentration of evidence for
ancient Maya settlements, ceremonial centers and the larger, more sophisticated manifestations of ancient Maya civilization. This region is considered the Maya cultural core area and has received the most research attention.

Until the last twenty-five years, study of ancient settlement pattern studies in the vicinity of Arvin’s landing and much of south coastal Belize remained largely overlooked (Map 1). Field work at inland sites in southern Belize also has been limited until recently, although there are large sites of Lubaantun, Nim Li Punit, Uxbenka, Xnaheb and Pusilha (Dunham et al. 1989; Hammond 1975, 1981; Leventhal 1990). These sites, although very significant, have been underscored by the grandiose centers of the Core area to the north and west. Research since 1981 under McKillop’s project in coastal southern Belize have studied Maya trade centers and salt making sites (Ascher 2000; Brandehoff-Pracht 1995; Braud 1996; Ensor 1994; Magnoni 1999; McKillop et al. 2004; McKillop 1989, 1996, 2002, 2004; McKillop and Winemiller 2004; Steiner 1994). This settlement pattern study at Arvin’s Landing will contribute to the growing body of knowledge for the ancient Maya settlement of the south coastal Belize region. The following pages will narrow the discussion to the problems associated with the continued limited scope of ancient settlement studies in the Maya area. In fleshing out these limitations the discussion will further refine the purpose of the study at Arvin’s Landing.

The House Mound Issue

There is little argument that in widening the scope of settlement research in the Maya area to include smaller domestic studies we have vastly expanded our understanding of life among the ancient Maya. However, there are still limitations inherent in the approach to ancient Maya settlement studies. This hindrance includes the
focus on the house mound and other visible surface features as the defining features or unit of measure for ancient Maya settlement.

Before any further discussion on house mounds in settlement pattern studies, it is important to understand exactly what is considered a house mound as defined by contemporary research. The diversity and uncertainty contributes to the limiting nature of contemporary settlement pattern studies of the ancient Maya. As mentioned above, Robert Wauchope’s study of house mounds at Uaxactun in 1934 was one of the first attempts at a comprehensive examination. His later study in 1938 on modern house mounds examined the many different house types visible in 1937 among the ethnic Maya and attempted to bridge the gap between the modern and ancient. Wauchope explains,

Perhaps a word should be added here in explanation of just what is meant when we refer to the “house mounds” at Uaxactun. The term has been used in speaking of any of the low, inconspicuous mounds (4 to 10 feet, 1.22 to 3.05 meters, high) which are scattered, singly and in clusters of two to four and five, or inhabitable (non-bajo) land and in the vicinity of major groups of ruins. It is by no means certain that all of them were used as substructures for perishable houses, for many may have been burial mounds and some may have served other purposes. Only excavation can reveal their individual functions.

In cutting a way through heavy bush, one can easily pass across low house mounds without being aware of their presence. They vary in length from about 20 to 70 feet (6.1 to 21.34 meters) and from about 15 to 30 feet (4.57 to 9.14 meters) in breadth: they are usually much longer than wide. (Wauchope 1934:132).

This explanation of house mounds appears to have had the most impact and persistence in settlement pattern studies in the Maya area as reflected in further work of the Carnegie Institution and in countless citations, including the work of Bullard (1960) and Willey et al. (1965). One key element to note is that Wauchope did note he was
referring to the house mounds at Uaxactun, and in particular the five he excavated. In his follow up research, Wauchope exposes the vast diversity in house substructures, ranging from non-mound to earth and masonry mound components as rectangular, square, having rounded corners, apsidal, or round in form (Wauchope 1938, 1940). These differences appear to vary regionally and depending on available building materials. Wauchope, mostly referring to modern examples, also cites many archaeological examples of domestic ruins.

Somehow observing differences in content, form and size of Maya domestic structures was lost to future scholars. Settlement surveys have become dependent on measuring and inventorying only the remains of features visible from the surface. The Belize valley survey of Willey et al. (1965), Bullard’s survey (1960), Tourtellot et al.’s survey at Sayil (1990), Puleston’s Tikal survey (1983), and Anabel Ford’s survey (1990) to name a few, all involved systematically recording and mapping features visible on the surface. From some of these more famous survey projects were derived interpretations of settlement patterning for the suburbs and rural communities of ancient Maya cities and estimates on populations of the Maya lowlands. Of these visible remains of domestic features, some differences have been noted beyond the earlier work of Wauchope.

Mounds have been found to occur alone, or in groups ranging from two to four (Willey et al. 1965). These groups of mounds, referred to as plazuelas, have been studied to determine the number of households associated with them to get a better idea of population assessments (Webster and Fretter 1990). Plazuelas consist of more than one mound arranged around a quadrangular court (Ashmore and Willey 1981). The assumption that all cultural presence can be measured and interpreted by what features
remain visible on the surface has skewed the assessment of ancient Maya settlement and has left a large portion of the ancient population understudied (Kurjack 1974; Wilk and Wilhite 1991). Scholars are willing to recognize some level of diversity in domestic structures based on mounded remains. Dwellings not constructed on mounds and composed of perishable material leave very little to no visible surface indication of their ancient presence making them “hidden” or “invisible.”

Accounting for the possibility of hidden settlement evidence in the Maya area has been slow to become a consideration in ancient Maya settlement studies. The concept of hidden settlement evidence in the Maya area is not new, yet it only is included as anecdotal mention in most research discussion. In some of the earliest settlement studies of the ancient Maya the presence of non-mound or hidden settlement evidence was noted. In Robert Wauchope’s follow up discussions of his house mound research, he explained that not all Maya houses are constructed on substuctures or platforms. He uses the evidence at Chichen Itza where house mounds are “conspicuously absent” as an example (Wauchope 1940). In comparison to the platforms constructed by the nearby contemporary Yucatecan Maya, Wauchope offers a word of caution. He suggests modern house types may not be a clear reflection of ancient house types (Wauchope 1940).

William Bullard noted in his 1960 survey in northeastern Peten, Guatemala using chicle trails that “in nearly all areas explored there were some ruins which were so low and indefinite that no plan could be made out. Bullard later downplays this evidence suggesting very few ancient houses leave no surface trace (Bullard 1960).
Gair Tourtellott recognizes a presence hidden house remains in a survey of Seibal and at Sayil, but this remains anecdotal to the overall studies (Tourtellot 1970; Tourtellot et al. 1990). Tourtellot does admit these are problematic in population reconstructions.

Peter Harrison tested for invisible house mounds at Pulltrouser swamp, but found only evidence of five structures in 500 test excavations. He concluded these findings were not significant enough to warrant further study (Harrison 1990).

Dennis Puleston’s Tikal survey project did not report any hidden domestic structures, because the design of the survey made it impossible to do so. Puleston does caution that the “best map based on surface features is only an approximation of Prehistoric reality” (Puleston 1983:2).

More recent research has recognized the problems with excluding hidden settlement evidence from the ancient record and a few attempts have been made at qualifying and quantifying the presence of the hidden element. Edward Kurjack has long supported a need to consider hidden house remains in settlement pattern studies. His research at Dzibilchaltun discovered the ancient remains of simple, inexpensive dwellings. Kurjack believes most ancient Maya lived this way and the variety of domestic architectural types among the Maya is related to their complex social system (Kurjack 1974).

Diane Chase (1990) found most domestic constructions at Santa Rita Corozal were invisible on the surface. Through extensive area-wide excavation Chase was able to find very low platforms in otherwise considered vacant terrain. Chase cautions attempts on population reconstructions without intensive excavation of vacant terrain (Chase 1990).
Anne Pyburn (1990) includes post-hole testing in her research design to search for invisible features. Her tests revealed artifacts and buried floor features in areas lacking mounded remains. Within an area ½ km long and ¼ km wide Pyburn found evidence of up to eight additional structures of non-platform design where surface inspection had revealed nothing (Pyburn 1990).

At Copan, Webster and Fretter attempted a population reconstruction based on domestic structures. As a compliment to surface survey, Webster and Fretter found that test pitting revealed 17% more occupation sites than the surface survey indicated. Additionally, with large-scale rural excavation, Webster and Fretter’s estimate revealed 38% more settlement in the area (Webster and Fretter 1990).

Wendy Ashmore (1988) found evidence of “invisible” architecture at Quirigua, Guatemala. After surface survey and remote sensing revealed no settlement evidence, inspection of a series of drainage ditches revealed substantial buried settlement remains. Although the nature of the excavation prevented Ashmore from determining distinct household units, she was able to report their presence and suggest a broader range in architectural types than previous research revealed.

Through ethnographic evidence Richard Wilk (1988) reported variation in Maya house construction in both material and form. In the example of the modern Kekchi homes are constructed of perishable materials and replaced every five years (Wilk 1988). Wilk does not propose that the modern Maya homes are a direct reflection of ancient house-types but suggests the realization of diversity in modern house types should have bearing on such diversity in past structures.
If house mounds alone were to form the basis for assessing the ancient population and settlement of south coastal Belize, there would be very little to account for the ancient presence there. The one mound at Arvin’s landing, three at Frenchman’s Cay, three at Green Vine Snake, six at Wild Cane Cay are the only known mound locations. Any visitor to the southern coast of Belize would soon discover the ancient settlement of the region was far more extensive just from surface finds alone. Dr. Heather McKillop’s regional settlement survey and excavations in between Punta Gorda and Punta Negra (Port Honduras Marine Reserve and Paynes Creek National Park), Belize used shovel tests along transects, excavations and isolated shovel tests to discover sites in areas without mounds and often without any artifacts on the surface. The work has included a number of graduate theses in the Department of Geography and Anthropology at LSU. Shovel testing along transects was used to discover settlement in areas without mounds at Frenchman’s Cay (McKillop and Winemiller 2004), in the offshore area around Wild Cane Cay (McKillop 2002), at Pelican Cay (McKillop 2002), Tiger Mound and Green Vine Snake (McKillop 2002). Excavations in the sea were used at Pork and Doughboy Point (Brandehoff-Pracht 1995; McKillop 2002) and Punta Ycacos Lagoon (Braud 1996; McKillop 1995, 1996, 2002). Further evidence of settlement is “recognized in the Port Honduras region by the distribution of household middens, often including thatch-impressed clay” (McKillop et al. 2004:1).

Current research by Dr. McKillop and LSU students has continued to find numerous submerged sites along the coast of southern Belize, on the off-shore islands and in the sea (McKillop 2002, 2004; McKillop et al. 2004). Sea-level rise has added most of these sites to the inventory of hidden settlements (McKillop 1995, 2002). Former
LSU graduate student Edward Steiner (1994) excavated at a site at Foster Farm, which has no known mounds on the property adjacent to Arvin’s landing (Steiner 1994). Ancient settlement in southern Belize was far more extensive than mounds will reveal.

The original intention of turning the focus of settlement pattern studies away from the ceremonial/urban centers and toward the countryside was to gain a greater understanding of the general populous of ancient Maya culture. The house mound has become the flagship for gauging this manifestation. This research suggests that the current confinements of research in the ancient Maya realm must again be loosened in order to include a more comprehensive examination of the entire ancient population. In doing so, we need to expand our understanding of Maya house types to include non-mound forms. In consideration of further diversity of house types, sensitivity to variation through time and space should be a concern. Researchers should consider the possibility that not all of the greater population built their homes on platforms but instead built more modest homes of perishable materials, which have not lasted in the record. Any number of inferences can be drawn from this variety of domestic structures, class, status, access to resources, permanence of occupation and mobility of population to name a few. This project is a test to find an efficient methodology to find and account for the presence of hidden settlement and an analysis to determine the nature of that landscape.
Chapter 3

Methodology

With members of the 2003 In Search of Ancient Maya Sea Traders LSU Field School directed by Dr. Heather McKillop, under permit from the Belize government Institute of Archaeology, we set out to further research the ancient Maya occupation of the Arvin’s Landing site. The crew of 14 was divided among four separate projects and workers alternated among projects. The crew working on the survey transect, including me, ranged daily from three to seven.

The only access to the property is by boat up Joe Taylor Creek or by a trail, which has long since grown in from lack of use. To access the property we chose the latter and hiked down the back roads from Punta Gorda town and re-cut the trail to Arvin’s Landing using machetes. Travel was slow as the trail was overgrown and numerous trees had blown over the trail from the most recent hurricane, Iris in 2001. The main property on the creek’s edge had been cleared for a lawn and occupied by a house, shed, dock and boat shelter. The house mound, the focus of past research (Steiner 1994; McKillop 1996), is situated on the southwestern edge of the cleared portion of property.

Transect Logistics

The original plan was to set up two or more transects, one parallel to the creek connecting Arvin’s landing and Foster Farm, the other extending perpendicular from Joe Taylor creek. Also included in the original plan was to measure and test along 50 meter side trails to the left and right of the main transect. In consultation with my advisor, I chose to use the main access trail as the initial transect based on the dense vegetation on all sides of the property, the small labor force and only a month of field time. The main
access trail proved to be a good choice since part of the trail ran parallel with the creek and then veered off of its course to a more perpendicular direction from the creek. This meandering of the trail provided the opportunity to look at settlement distribution both close to and far away from the creek.

To begin the transect, a second datum was established at the trailhead located 39.1 meters, 98 degrees west of north from the main datum near the Arvin’s Landing mound. Perpendicular to the main axis of the transect, 30-meter trails were cut with machetes and measured with 100m steel tape to the left and right of the transect. These trails were cut off the main axis of the transect every ten meters for the entire length of the transect. Ten-meter intervals had proven useful elsewhere in the Port Honduras region, such as Tiger Mound, Frenchman’s Cay, Wild Cane Cay and Green Vine Snake (McKillop 1996, 2002). As the trail meandered, problems with perpendicular trails developed. To prevent crossing of the side trails and to allow for even coverage of the area, the side trails were cut parallel to the first trail using a Brunton sighting compass.

Even with the slow progress in clearing the dense secondary vegetation from each side of the trail we extended the survey 180 meters. The result was a series of 18 parallel lines covering a swath 180 meters by 70 meters for a total of 12,600 square meters. Within this swath, shovel tests were excavated every 10 meters on the transect and along each side trail for a total of 126 shovel tests. Given the forested conditions of the study area, shovel tests were the best choice as a discovery method.

**Shovel Tests**

Although better results have come from surface inspection for site discovery (Shott 1985), the study area provided zero visibility of the actual ground surface and
numerous obstacles (trees). Shovel tests allow for samples to be taken more easily from difficult to access areas, eliminate the need to clear excessive vegetation and allow for larger land coverage in a relatively short time period. Shovel tests have been found to be a useful field method in the woodlands of North America for the afore-mentioned advantages. Shovel testing as a field method has been employed with success by several archaeologists in North America (Krakker et al. 1983; McKillop and Garrad 1991; Plog et al. 1978; Schiffer et al. 1978; Shott 1985). Shovel tests have been found to be a useful technique “where the ground surface is obscured by leaf litter, pine duff, low vegetation or geologic deposition” (Schiffer et al. 1978:7). These conditions are similar to those at Arvin’s landing with a thick leaf litter, layers of decomposing forest materials and thick vegetation from ground to canopy.

Apart from Dr. McKillop’s Port Honduras research, shovel testing in the Maya area has not been reported, yet the field conditions would often make this test method advantageous. Anne Pyburn (1990) in her settlement pattern research at Nohmul employed systematic “posthole” testing to locate “invisible” features. The posthole testing revealed artifact concentrations and was used to determine where to locate further excavation.

Shott (1985) and Kakker et al. (1983) have suggested the more intensive the sampling pattern, the more effective are the results of a shovel test survey. Unfortunately, this decreases the efficiency in time and labor. To further increase the effectiveness and efficiency of shovel testing for the purpose of site discovery, Krakker et al (1983) has suggested instead of sampling on a grid, shovel test samples should be staggered from row to row on a survey transect. Most of Krakker et al. (1983) and
Shott’s (1985) suggestions are based on searching for circular sites. The optimal strategy in searching for circular sites is to stagger shovel tests in a hexagonal pattern, but this becomes increasingly less effective for elliptical sites (Krakker et al. 1983). For the purposes of the Arvin’s Landing Transect survey, shovel tests were simply staggered from row to row as the true shape of ancient Maya house sites, according to previous research, tend to vary from circular to elliptical (Wauchope 1934; Willey 1965; Kurjack 1974). The staggering was easy to achieve as the transect axis meandered along its route throwing rows off from the preceding row. With shovel tests measured 10, 20 and 30 meters from the main transect, shovel tests lined up in an irregular pattern throughout the survey area. Each shovel test was dug to the bottom of the cultural layer, determined by a cessation in artifact recovery. This was found to be between 40 and 50 cm in depth accompanied by a change in soil color. Each shovel test was sifted through ¼ inch mesh screen. Recovered artifacts were bagged for inventory and laboratory analysis and all holes were backfilled.

**Laboratory Analysis**

The recovered artifacts were transported to the LSU Maya Archaeology Laboratory in Punta Gorda. In the lab, artifacts were washed, labeled, weighed and subjected to diagnostic analysis, including Type Variety Analysis for the ceramics. Dimensions and characteristics were recorded and artifacts were packaged for transfer to the Belize government.

**Mapping and GIS**

Upon completion of the cutting, digging and screening, the main transect and side trails of the survey area were mapped with a Lietz™ Sokkisha Model 116 transit, stadia
rod and 100 meter steel tape. Distance, elevation and bearing were recorded in a field journal. Following the mapping, GPS coordinates for the datum and all shovel tests were recorded using a Pharros GPS-CFT™ receiver with a Dell Axium™ handheld computer. The computer was equipped with Arc Pad™ GIS by ESRI™. All points were recorded into an Arc View™ shape file accompanied with a database file. The data were transferred from Arc Pad™ data into Arc View 3.2™ by ESRI™ for analysis. At this point, errors in the GPS data were discovered. Some points were recorded accurately; however, due to the forest canopy, many of the points plotted over shovel tests were skewed due to interference with the signal. To correct for this error, it was necessary to use the transit data. Using the accurate GPS coordinates for Datum 1, all points were replotted according to bearings and distances using Microstation™ software. The replotted data was then transferred into Geomedia 5.1™ by Intergraph™ and converted to a shape file. All attributes of the points including name, elevation, number of obsidian pieces, ceramics, chert and other items were entered into a Microsoft Excel™ file and joined to the datapoint shape file in Geomedia 5.1™. Spatial analysis of the data was conducted using both Geomedia Grid™ and Arc View Spatial Analyst™.

To determine density area locations, the kernel density calculation method was chosen. Kernel density is a statistical method used to analyze the spatial distribution of data. Information is used to generalize a continuous surface density for a surrounding location (Levine 2002; O’Sullivan and Unwin 2003). The output of a kernel density is a grid theme with an estimated value of data per grid cell within the area of study, based on the values from data points. The grid theme for this survey area contains 149 rows and 323 columns for a total of 48,127 individual grid cells. The kernel density output is
estimated by summing the value of the data from each datapoint within a specified search area around each grid cell and dividing by that area (Levine 2002; O’Sullivan and Unwin 2003). The user for optimal representation of the data set can modify search area, expressed as search radius in Arc View Spatial Analyst™. For this analysis, search radii of 20, 25 and 30 meters were used. By using three different sized search radii, relationships of small density areas in the smaller search radius could be compared to the larger density conglomerations of the larger search radius. This tests the strength of smaller density areas with estimation over larger areas.

The output of the kernel density calculations will have an estimated distribution of data values per grid cell throughout the area of study. In this study, the values will be converted to standard deviations from the data mean. Density areas will be classified into 2 and 3 standard deviations from the mean data value. In this analysis, kernel density values above 2 standard deviations will show the upper 5th percentile of density locations. Above 3 or more standard deviations the density areas will be in the upper .3 percentile. These density areas in the upper percentiles have the highest number of estimated occurrences of artifact values for each grid cell within the survey area. This method is useful for estimating a continuous surface of data values from which hotspots in the dataset can be determined (Levine 2002; O’Sullivan and Unwin 2003). For this project, these density areas of peak data values are expected to indicate the locations of the most intense ancient cultural activity in the survey area. This method will reveal the locations of ancient Maya settlement activity at Arvin’s Landing where no surface evidence is available. Additionally, by examining the artifacts themselves from these areas of intensity, the nature of that cultural activity can be determined.
Chapter 4

Results

Lay of the Land Exposed

The Arvin’s Landing transect survey included 127 shovel tests. Each shovel test was dug to a depth between 40 cm and 60 cm depending on contact with the sterile layer. The sterile layer was associated with a lighter color soil where artifact recovery was determined to cease. The shovel tests were in 17 rows, 10 meters apart, extending 30 meters from each side of the main axis of the trail, covering an area of 10,200 square meters. With datum (point d1 in Figure 1) set at zero, change in elevation within the study area was 6.77 meters with a low of –2.39 meters below datum to 4.38 meters above datum. The lowest point of the transect area occurred in the northeast corner, on the edge of the transect closest to Joe Taylor creek. The shovel test d2c was in the mangroves fringing the creek approximately 10 meters from the main channel. From this point, the creek continued upstream in a west/northwest direction. The rest of the transect from this point steadily departed from this course moving toward a perpendicular direction from the creek.

The highest point on the transect occurred at shovel test st13a with an elevation of 4.38 meters above datum (Figure 1). Elevation contours indicate st13a marks a peak to a low mound previously unnoticed in the thick vegetation (Figure 1). The base of the mound is difficult to determine, but if the first closed 10 cm contour line at 3.9 meters is used as the base, the mound is approximately 48 cm in height from that contour (Figure 1). In using the same contour elevation of 3.9 meters to mark the base of the mounded area the area is 38.50 meters across its east/west axis and 37.00 meters across its
north/south axis (Figure 1). In the study area, 118 datapoints out of 127 datapoints are above the datum elevation zero (Figure 1).

**Figure 1:** Arvin’s Landing Transect: Datapoints and Elevations.

The plan, which developed as the transect progressed, was to keep performing shovel tests in rows until we found more than one row in succession with no artifact remains. That did not happen. Every row of the transect uncovered artifacts (Figure 2). Out of the 127 shovel tests, 81 (64%) contained artifacts. Although, artifact quantities and artifact types differed from one shovel test to the next and from row to row, the artifact presence was continuous throughout the study area. This leaves the extent of the culture area associated with Arvin’s Landing yet to be determined.
Artifact Recovery

Among the 81 shovel tests containing artifacts, 454 artifacts were recovered. The minimum number of artifacts recovered from a shovel test was 1, as was the case for 22 separate shovel tests. The maximum number of artifacts recovered in one shovel test was 68 from st13 (Figure 2). In datapoints containing artifacts, 72% had more than 1 artifact and 12% had more than 10 artifacts per datapoint. The artifacts recovered consisted of 295 ceramic pieces, 109 pieces of obsidian, 50 pieces of chert and 1 ceramic sinker weight.

Although continuous throughout the study area, the shovel tests containing artifacts appear to occur in greater frequency in two different areas of the transect. A triangular wedge of little to no artifact recovery occurs between st7f and st14f northward into the study area (Figure 2). This wedge of weak artifact recovery appears to separate the study area into two distinct areas of ancient cultural presence. In Figure 2, an uninterrupted zone of shovel tests with artifacts occurs from st10 to st10c westward to st13 and st13c. This makes up an area of 900 square meters of artifact occurrence. This area of frequency is not limited to the st10 to st10c X st13 to st13c area. Artifact recovery occurred with decreasing frequency for another 20 meters east of this area and 30 meters south and west of this area (Figure 2).

A second less organized area of artifact frequency appeared in the eastern portion of the transect. Northeast from a line connecting st6c and st6f, 34 out of 49 shovel tests contain artifacts. This area does not have as large of a homogenous zone of occurrence as the western area of concentration, although an area of high frequency occurs southward from a line between st6b and st1d.
The artifacts present are all representative of cultural material used for domestic and trade purposes by the ancient Maya. The following discussion of results describes the distributions and concentrations of artifacts separately. By looking at the patterns of these distributions and concentrations, it may be possible to determine the nature of ancient Maya activity in this settlement area.
Ceramics

The 295 pieces of ceramics consisted of Middle River Unslipped (Image 1) and Punta Ycacos Unslipped (Image 2), both associated with the Late Classic time period A.D. 600 – 900 (McKillop 2001).

Image 1. Middle River Unslipped. Photo taken by Dr. Heather McKillop January 2004

Image 2. Punta Ycacos Unslipped. Photo taken by Dr. Heather McKillop January 2004
Additionally, three previously unnamed pottery types were discovered, Flour Camp Unslipped (Image 3), Barranco Unslipped (Image 4) and a yet to be named fineware (Image 5). The unnamed fineware requires further analysis for classification.

**Image 3.** Flour Camp Unslipped. Photo taken by Dr. Heather McKillop January 2004

**Image 4.** Barranco Unslipped. Photo taken by Dr. Heather McKillop January 2004
The single ceramic sinker weight recovered is round and notched (Image 6). This style of sinker weight is consistent with the Postclassic period between A.D. 900 - 1500 (McKillop 2001).
All ceramic types recovered in the transect are general-purpose utilitarian wares associated with cooking and storage. Dr. Heather McKillop and Marsha Hernandez conducted identification of the established ceramic types and establishment of the newly classified types with collaboration by the author (See McKillop 2001).

Figure 3 shows locations of datapoints containing ceramics with quantities in the transect area. The presence of ceramics with lithic artifacts indicates a diversity in cultural activity within the transect study area. Usage of ceramics differs from the tasks accomplished with blades and hard stones, like obsidian and chert. Ceramics are used for storage and carrying food, water and cultural commodities.

Figure 3: Arvin’s Landing Transect: Datapoints Containing Ceramics.
It is important to consider the distribution of ceramic artifacts separately from the lithic artifacts recovered to examine if the use of domestic space was specialized among the ancient Maya of Arvin’s Landing.

With 295 ceramic pieces recovered from 50 shovel tests, ceramic artifacts have the highest density of concentration in the study area. There were no intact vessels recovered and each of the ceramic pieces recovered are fragments of varying size. The highest yielding shovel test was st13, with 54 pieces (Figure 6). In the 50 shovel tests containing ceramics, 35 had more than one piece with 17 shovel tests having 5 or more pieces. Ceramics are also well-distributed over the study area. Out of the 127 shovel tests in the transect 50 (39%) contained ceramics. The shovel tests containing ceramics occupy two distinctly separate zones of the study area. One zone is located on the western portion of the study area (Figure 3), where a continuous zone of collective artifact presence was noted earlier (Figure 2). Ceramic occurrence in shovel tests is more prevalent in the western and southern portion of this artifact occupation zone (Figure 6). An arc of 21 shovel tests containing ceramics nearly encircles an area of higher elevation in this southwestern area of distribution. St13 with 54 ceramic fragments is approximately central to this zone (Figure 3).

A second zone of continuous ceramic recovery is located in the southeastern portion of the transect. From a line connecting st4a, st5a and st6a, an arc of nearly continuous ceramic recovery occurs in shovel tests along a southeastern sweep. This arc of nearly continuous ceramic recovery contains 17 shovel tests, 9 of which yielded five or more ceramic fragments. In st2f thirty-three ceramics were recovered, the second highest ceramic-yielding shovel test for the entire transect. A smaller concentration of ceramic
distribution occurs in the northwestern shovel tests of the transect. A small fan of continuous ceramic recovery extends in a northwest direction from st2a. With 25 ceramic pieces, st2a is the third highest ceramic yielding shovel test on the transect.

**Obsidian**

Obsidian is volcanic glass. Obsidian occurs naturally in the highlands of Guatemala and Mexico where volcanic activity is prevalent. Obsidian can be found throughout the Maya area in association with ancient settlement. Obsidian was valued and imported by the ancient Maya for its ability to be fashioned into razor-sharp blades. Obsidian cutting implements were used for a variety of household and ritual purposes among the ancient Maya. The presence of obsidian at Arvin’s Landing in the ancient context shows an abundance of this trade commodity, indicating a strong connection to the greater Maya realm.

For obsidian, 109 fragments were recovered in 53 shovel tests (Figure 4). In the transect, 41% of all shovel tests contained obsidian making it the most widely distributed artifact in the study area. Out of the 53 shovel tests with obsidian present, 23 contained more than one piece of obsidian. The highest number of obsidian recovered from one shovel test was in st6d, with 13 pieces (Figure 4 and Image 9). In Figure 4, the most continuous zone of obsidian distribution can be seen to occupy the west central portion of the transect. This zone of distribution remains similar, although with smaller concentrations per shovel test to that of the artifact distributions in Figure 2.

Of the 109 obsidian pieces recovered, 6 were partial blades (Image 7) and 103 (94%) were debitage associated with production, including flakes and cortexes (Image 8 and 9).
Figure 4: Arvin’s Landing Transect: Datapoints Containing Obsidian.

Image 7: Obsidian Prismatic Blades. Photo taken by author.
**Chert**

Chert is a metamorphic stone occurring as nodules in limestone. Chert, like obsidian, was valued by the ancient Maya for its ability to be fashioned into sharp blades. Chert can be acquired in the vicinity of Arvin’s landing, but is generally of poor quality.
and unlikely to be worked into effective cutting tools. The chert recovered at Arvin’s landing is of poor local quality and further analysis is required to determine the extent of its significance as a cultural artifact. In the Arvin’s Landing transect, chert occurred in the least abundance. When separated from the collective artifact-containing shovel test data (Figure 5), the distribution of chert appears widely scattered.

![Figure 5: Arvin’s Landing Transect: Datapoints Containing Chert.](image)

Chert was recovered from a total of 26 shovel tests. These shovel tests are scattered throughout the study area, without any homogenous zones of occurrence. Unlike the obsidian data, the chert distribution is much more sparse than the large continuous zones of artifact distribution, seen in Figure 2. Among the 26 shovel tests
containing chert, 50 pieces were recovered. In 10 shovel tests more than one piece of chert was recovered, with the highest recorded at st13, containing 10 individual pieces.

From the GIS map displays in this chapter, the results of the Arvin’s Landing transect show a varied topography and a wide distribution of artifact recovery throughout the study area. By viewing the artifact recovery collectively and separately, patterns in their distribution can be observed. Examining density distributions of artifacts and taking into account their qualitative cultural significance will help illuminate patterns in cultural activity. The mission of the following chapter is to examine in more detail these patterns and draw conclusions regarding the nature of ancient Maya activity in the area tested.
Chapter 5

Analysis

The results of the survey transect at Arvin’s Landing revealed an extensive and diverse artifact scatter throughout the study area. Throughout this artifact scatter, different artifacts occur in variable frequencies and concentrations. To determine patterns in these relict deposits, the database of results from the shovel tests were examined using Arc View Spatial Analyst™. Using the kernel density calculation, patterns in artifact densities have provided insight into the nature of settlement throughout the study area. Taken into consideration with the diagnostics of the artifactdebitage found in the survey area, an evaluation of the distribution of ancient cultural activity in the survey area is made possible.

Artifact Weight Versus Count

The two criteria for assessing the density of artifact debitage are the number of artifacts recovered from individual shovel tests and the weight of the artifacts recovered from individual shovel tests. Considering the condition of the artifacts recovered, this study will show how using the number of artifacts recovered can be misleading in determining settlement distribution. Cultural items through the action of deposition and time can be broken into countless pieces. By using the count of un-intact cultural items to determine settlement features, the presence of cultural hotspots can be misinterpreted by the sum of multiple pieces of a single artifact. A data point with one artifact would appear equally as representative of cultural presence as another data point with one artifact, regardless of size parameters.
Individual bits and pieces of artifacts can vary widely according to weight. For instance, a single potsherd could weigh less than a gram, whereas another could weigh multiple grams. When dealing with artifact fragments, it can be assumed the larger of the two weights would be a more representative sample of cultural material. The following discussion will illustrate how data is skewed using artifact counts versus weights.

Figures 6, 7 and 8 illustrate the misleading nature of using artifact counts instead of weights as an indicator of ancient cultural activity. Figures 6 and 7 are kernel density grids of obsidian distribution for the Arvin’s Landing Transect using a 20-meter search radius for estimation of concentration by weight and count respectively. The areas, demarcated by green and yellow in both displays, represent data over 2 standard deviations from the mean. In both Figures 6 and 7, a hotspot of obsidian density occurs for both examples in the area of Shovel test 6d (st6d). The density area around Shovel Test 6d is similar in size in both Figures 6 and 7. The heaviest sample of obsidian (13.3 grams) and greatest number of obsidian pieces (13) were recovered from Shovel Test 6d, allowing for this shared density hotspot in the two examples. Other surrounding shovel tests also contributed higher counts and weights similar in value to the density distribution in both estimations. Contributing to this density area were st5d with 3 pieces weighing 1.8 grams, st6c with 3 pieces weighing 1.25 grams, st6e with 2 pieces weighing 2.1 grams, st6f with 7 pieces weighing 6.8 grams, and st7d with 3 pieces weighing 3.3 grams.

The differences between the density estimations occur in the secondary hotspot areas of the survey transect. In Figure 6, a secondary weight density in obsidian recovery is revealed in the vicinity of Shovel Test 7b (st7b). Shovel Test 7b alone contained 4
pieces of obsidian weighing 9.3 grams. Nearby shovel tests had fewer pieces of obsidian recovered but relatively higher weights attributed to them. Shovel tests, st6a contained 1 piece weighing 1.5 grams, st6b contained 1 piece weighing 1 gram, st6c contained 3 pieces weighing 1.25 grams and st8a contained 1 piece weighing .3 grams supporting a low density by count, but a high density by weight.

Another small obsidian weight density area more than 2 standard deviations of the data mean occurs at Shovel Test 2b (st2b). This shovel test contains 1 piece of obsidian weighing 7.2 grams, which is the third heaviest obsidian recovery weight from the survey area.

Figure 6: Kernel density of obsidian by weight with 20 meter search radius.
Figure 7: Kernel density of obsidian by count with 20 meter search radius

Figure 8: Obsidian density contours showing weight values versus count values.
The high density areas around Shovel Test 7b and Shovel Test 2b do not occur in the density estimation by count (Figure 7). The only other area of obsidian density by count more than two standard deviations of the data mean occurs around Shovel Test 10b. A relatively high number of small pieces of obsidian were recovered from this area. Shovel Test 10b itself contained 3 pieces of obsidian weighing 1.10 grams. Nearby shovel tests, including st9b, contained 1 piece of obsidian weighing .01 grams, st9c yielded 4 pieces weighing 2 grams, st 10a contained 2 pieces weighing .9 grams, and st10c contained 2 pieces weighing .7 grams. Although 12 pieces of obsidian were recovered in this density area, their combined weight is only 4.71 grams.

The contours in Figure 8 represent the density areas of both the obsidian weight estimation (in blue) and the obsidian count estimation (in red). Although both estimations suggest a high density of obsidian in the area around Shovel Test 6d, they also suggest differences in secondary concentration areas. Both secondary density areas suggested by the weight estimation contain more cultural artifact material in fewer pieces than the density area suggested by the count estimation. Kernel density by weight value provides a more representative sample of artifact material when considering the location of cultural areas. Considering the location of cultural areas based on count data does not provide the same results as weight data and can suggest a different and less likely density area.

Artifact count data may be useful in situations where intact artifacts such as vessels, blades and bifaces occur in abundance. The condition of the artifact material recovered in the Arvin’s Landing Transect was well worn and fragmented. The poor
condition of this material is not conducive for using artifact counts for density estimation. Further discussion of this research will use artifact weight data to draw conclusions regarding the distribution of cultural activity within the Arvin’s Landing Transect study area.

**Kernel Density Interpretation**

For each artifact in the kernel density analysis, 20, 25 and 30-meter search radii were selected to determine the strength of density areas for these 3 artifact types. In addition to the 3 search radii the artifact densities were observed according to density areas above 2 standard deviations of the mean and above 3 standard deviations of the mean. The following Figures 9 - 14 show the locations of these densities according to the respective search radii and standard deviation allowance. The contour lines for the individual artifact density areas, starting with the outer concentric ring, represent the area of the transect with density values 2 standard deviations and above for Figures 9, 10 and 11 and density values 3 standard deviations and above for Figures 12, 13 and 14. The innermost ring of the contour lines represent the estimated area of highest recorded artifact values in excess of 3 standard deviations.

Most striking in all of the figures below are the distinct areas of concentration for each artifact type. Each artifact in each search radii above 2 and above 3 standard deviations occupies a separate density area, with no overlap present. The absence of overlap among the different artifact density areas suggests spatially distinct areas of intense artifact usage. These distinct zones of artifact density are evident of a specialization in cultural activity.
The display of artifact densities in Figure 9 shows multiple density locations for the different artifact types over 2 standard deviations and at a 20-meter search radius. The only artifact type with two density areas above 2 standard deviations in the 25-meter search radius is ceramics (Figure 10). With a 30-meter search radius and all density observations 3 standard deviations above the mean and greater, the density areas of smaller values disappear from the display (Figures 11 – 14). These multiple density locations 2 standard deviations above the mean at the smaller search radii suggest potential secondary locations for cultural activities, whereas the persistence of the larger density areas provides a more definitive indication of cultural activity. The lesser density values of these secondary locations suggest a spatial variation in intensity of cultural activities. These secondary areas are important when considering whether these density areas represent multiple domicile locations or the activity areas of a single domicile.

**Ceramic Density**

The mean value of ceramics by weight per grid cell in the 20, 25 and 30-meter search radius is 0.016 grams. For ceramics, two density areas (in red) are apparent within 2 standard deviations of the data mean for search radii of 20 and 25 meters (Figures 9 and 10). The estimated value of ceramic weight above 2 standard deviations for the 20-meter search radius is in excess of 0.066 grams per grid cell within that density area. The estimated value of ceramic weight per grid cell in the density area above 2 standard deviations in the 25-meter search radius is 0.059 grams.

The ceramic weight density area in the middle of the western half of the survey is a weak density area. Its value as a density area is spread too thin to be within 2 standard deviations for a 30 meter search radius which requires a value of 0.053 grams (Figure
The distance between the two ceramic weight density areas is 80 meters. These areas do not share grid cells in 20, 25 or 30-meter search radii indicating these two density areas are from distinctly separate cultural activity areas.

The estimated value of 3 standard deviations above the mean for ceramic weight in the 20-meter search radius is 0.091 grams, in the 25-meter search radius it is 0.080 grams and in the 30-meter search radius it is .072 grams. The second ceramic density area on the eastern end of the transect indicates a much larger area of denser ceramic concentration. With a consistent presence above 2 and 3 standard deviations for all search radii, this density area is a stable example of a likely ancient cultural activity area involving ceramics.

**Obsidian Density**

The obsidian densities (in black, Figures 11 - 14) are located just east of the transect center. The mean weight of obsidian for all search radii is 0.005 grams per grid cell. The obsidian weight value per grid cell for density areas above 2 standard deviations are 0.018 grams for the 20-meter search radius, 0.016 grams for the 25-meter search radius and 0.015 grams for the 30-meter search radius. At 3 standard deviations and above, the obsidian weight density values per grid cell are 0.025 grams for the 20-meter search radius, 0.022 grams for the 25-meter search radius and 0.020 grams for the 30-meter search radius. Like ceramics, there are two obsidian density areas above 2 standard deviations in the 20-meter search radius. The two obsidian weight density areas are much closer together than the ceramic weight density areas. The two density areas are within 20 meters of each other and share common grid cells in the larger search radius calculations. The smaller obsidian density area to the north is weaker than the larger
density area to the south. The presence of the northern density area is undetectable above 2 standard deviations in the 25-meter search radius and higher. The larger obsidian weight density area to the south maintains a constant presence above 2 and 3 standard deviations for all search radii. In the 30-meter search radius 2 standard deviations and above, the density estimation of the larger obsidian weight density to the south grows in areal extent to encompass much of the northern density area (Figure 11). This northward growth in areal extent suggests a relationship where the two density areas are peaks in a continuous zone of obsidian occupation, rather than two distinct density areas.

**Chert Density**

The mean chert weight density value for all grid cells is 0.018 grams for all three search radii. The chert weight density values for 2 standard deviations from the mean and above are 0.105 grams for the 20-meter search radius, 0.088 grams for the 25-meter search radius, and 0.077 grams for the 30-meter search radius. At 3 standard deviations from the mean and above the value of chert weight densities per grid cell are 0.149 grams at the 20-meter search radius, 0.124 grams at the 25-meter search radius, and .106 grams at the 30-meter search radius.

The expression of chert weight density (in blue) is similar to that of ceramic weight density. The 50-meter distance between the 2 density areas in the 20-meter search radius, 2 standard deviations and above, is significant enough to conclude that the 2 density areas are distinct and unrelated (Figure 9). The smaller chert weight density area only appears in the 20-meter search radius calculation for 2 standard deviations and above. The larger of the 2 chert weight density areas is visible at all search radii, at both 2 and 3 standard deviations from the mean.
Density Implications

In order to understand the implications of these density areas it will be helpful to briefly describe the culturally significant characteristics of the different material types present in the Arvin’s Landing transect area. As mentioned above, the artifact assemblage at Arvin’s Landing contained fragments of ceramics, obsidian and chert. Each artifact type differs in function, acquisition and manufacture. Considering these differences in function, acquisition and manufacture is helpful in interpreting the distribution of the different artifact density areas.

Figure 9: Kernel densities of artifacts ≥2 standard deviations with a 20-meter search radius.
Figure 10: Kernel densities of artifacts ≥2 standard deviations with a 25-meter search radius.

Figure 11: Kernel densities of artifacts ≥2 standard deviations with a 30-meter search radius.
Figure 12: Kernel densities of artifacts $\geq 3$ standard deviations with a 20-meter search radius.

Figure 13: Kernel densities of artifacts $\geq 3$ standard deviations with a 25-meter search radius.
Although, ceramics among the ancient Maya are most commonly manufactured from local materials, differences in style can have foreign influences and occasionally foreign material inclusions (eg; volcanic ash temper). The ancient Maya used ceramics for storage of food and water, food preparation and consumption, as fishing net weights and occasional ornamentation. Ceramics are more commonly associated within household and midden contexts and have been found in burial caches. The ceramics discovered within the Arvin’s Landing transect area are common domestic wares of locally available manufacturing materials. The ceramic assemblage recovered in the survey area provides the time context for the ancient occupation of the area. As mentioned in previously the ceramic material suggests the period of occupation between the Late Classic A.D. 600 and the end of the Postclassic A.D. 1500.
Obsidian is a trade good manufactured by the ancient Maya into cutting implements for both utilitarian and ritual purposes. Finished obsidian tools are commonly found among household items of the ancient Maya. Obsidian productiondebitage in the form of flakes, cortexes and cores are found outside of household areas and in midden deposits. The obsidian discovered within the transect survey is predominantly composed of flakes and cortexes with only a half dozen partial blades. The high content of flakes and cortexes in the Arvin’s Landing transect indicates that the ancient inhabitants were engaged in large-scale tool manufacturing. The presence of obsidian, places the ancient inhabitants of the Arvin’s Landing transect area in the sphere of the long distance trade relations of the ancient Maya.

Chert is found locally in southern Belize, but is often of poor quality. Higher quality chert is believed to be a likely import from a foreign source such as northern Belize. The chert assemblage at Arvin’s Landing is mostly of poor local quality with few higher quality fragments. Although chert material was recovered in abundance from the Arvin’s Landing transect, cultural modification could not be substantiated at the time of writing.

The relationship between the artifact weight densities and the artifact diagnostics provides compelling insight into the nature and extent of ancient Maya cultural activity at Arvin’s Landing.

The prevalence of domestic ceramic wares within the survey area suggests a permanent settlement engaged in household activities was present. The presence of Late Classic and Postclassic ceramic forms suggests a long-term occupation. The large stable ceramic weight density area on the eastern end of the transect is a strong indication of a
possible house site. The smaller ceramic weight density area in the western portion of the transect suggests with less confidence the site of another possible home. The presence of a low mound in association with the smaller ceramic weight density area lends additional suspicion to the presence of a second domiciliary area.

With 95.66 total grams of obsidian recovered from the transect, there is irrefutable evidence the ancient Maya were there and were engaged in long distance trade. The diagnostics of the obsidian material indicate a high level of production. The Ancient Maya of the Arvin’s Landing transect were manufacturing obsidian tools. The site of this obsidian tool manufacture was just east of the transect center. Two peaks in value occur in an apparent zone of obsidian density spanning the northern and southern edges of the survey area with the highest density to the south.

Of the three artifact types, chert occurs in greatest abundance by weight with 372.4 grams recovered from the transect area. The highest density of chert occurs in the northern center of the transect. The presence of chert should indicate its use as cutting tools. However, diagnostics of the chert material are inconclusive as to the function, manufacture or acquisition of the material. Most of the chert appears to be of local origin and poor in quality. It is difficult to determine whether the stone is worked or if chipping was incidental. From this study, chert lends the least conclusive evidence of cultural expression.

The purpose of this exercise was to test an area devoid of visible surface features indicative of ancient Maya occupation for evidence of ancient cultural presence. The evidence uncovered has produced overwhelming confirmation that the ancient Maya were in fact present in a settlement level capacity. The distinctly separate densities of
artifact types suggest specialized cultural activity within the sphere of an integrated settlement. The presence and density of household ceramic wares suggest that this area was occupied by a permanent settlement. The Ancient Maya of Arvin’s Landing were involved in long distance obsidian exchange. A high density of flakes and cortexes suggests the inhabitants obtained unfinished obsidian material and manufactured their tools locally.

Essentially, the kernel density analysis shows the areas of highest artifact density. The intent is to describe the artifact high-density areas as evidence of past cultural activity areas taken as specialized use zones and as an integrated settlement. It is important to understand the cultural debitage recovery was far more expansive than the kernel density areas suggest. These kernel density areas serve to show where the highest values by area occurred, which supports the strongest argument for likely areas of cultural activity such as household occupation or tool manufacture.
Current assessments of Pre-Columbian population and settlement patterns in the Maya area of Central America are largely based on visible expressions of ancient settlement in the landscape. Ruins of urban centers with monumental and ceremonial architecture have drawn the most research attention. This is limiting in that these features are expressions of the elite, only a fragment of the ancient population. More recently attention has turned toward the more common house mound. A house mound is a low mound of earth or masonry upon which the ancient inhabitants would build a perishable structure of pole and thatch. The perishable structure does not survive in the archaeological record but the mounds do and can be seen dotting the contemporary landscape. The study of the house mound has expanded our knowledge of ancient Maya settlement patterns, yet still falls somewhat short in the assumption that all Maya lived on house mounds.

Compelling evidence has been documented that more modest settlement features remain hidden within or beneath the surface of the modern landscape. If these hidden settlement features prove to be significant in number, current assessments of Pre-Columbian population and settlement patterns are still limited.

The intent of this research was to develop a test methodology to account for these hidden settlement features. The methodology incorporated both field and laboratory methods, with results and analysis generated in a GIS.

The area chosen for study was on a property called Arvin’s Landing outside of Punta Gorda, on the coast of the Toledo district in southern Belize.
Past research on the property by Dr. Heather McKillop and Edward Steiner of LSU revealed a single low house mound. The one mound at Arvin’s Landing is the only definitive evidence of settlement for the Punta Gorda area despite local reports of widespread artifact finds in disturbed areas. With the exception of a small lawn encompassing the main house, boathouse and the area where the house mound is located, the property is densely vegetated with thick secondary forest growth. Beyond the lawn where the one house mound is located, there is no visible evidence of ancient Maya occupation. With only the one mound as a definitive ancient settlement location and a seemingly larger ancient areal presence based on the local reports of artifact finds, this property seemed a likely point of departure for this research.

The presence of artifacts was encountered throughout the study area. Analysis of the artifacts revealed abundant potsherds. Obsidian was found most predominantly in the form of production material, flakes and cortexes. Chert was also found of poor local quality.

The presence of artifacts occurred in varying concentrations, suggesting a variation in ancient cultural activity over the survey area. A closer look at these variations in artifact density was necessary to determine the patterns of cultural activity across the study area. To observe these patterns in artifact density, a kernel density analysis was conducted using Arc View™ Spatial Analyst™. Kernel density is an analysis used for finding hotspots in data sets.

A problem encountered in performing the kernel density analysis was whether to use artifact counts or weight attributes to determine density areas. By using counts of artifacts, sheer numbers of pieces or fragments are used to observe density. The problem
with using counts is that the sizes of individual artifact pieces vary greatly in size. A single pebble sized fragment of ceramics will have the same value as a 3cm square fragment or that of an entire vessel. Weight seemed a better choice for gauging artifact presence based on the very fragmentary nature of the artifacts recovered. If intact artifacts such as complete pottery vessels or lithic tools were present, perhaps using artifact counts would be a more valuable consideration for density areas, but not in this case.

In observing the artifact densities by weight, patterns in cultural activity emerge. With kernel densities, the diagnostics of the artifacts and what we know of cultural activity associated with the artifacts, some conclusions can be drawn. The highest densities of different artifact types occurred in distinctly separate locations, indicating a specialization in activity. Culturally, ceramics are associated with food and water storage, preparation and consumption. These are household activities and the higher ceramic density areas would indicate likely household locations. In this survey transect two such areas occur.

The obsidian found in this transect was in the form of flakes and cortexes, thedebitage associated with blade and biface production. Lithic production is not an activity associated with a domestic area. Finished obsidian blades and bifaces are commonly found in household areas, but production material is not. The high density of obsidian found in this transect is the likely location of an obsidian tool manufacturing area. Obsidian does not occur naturally in this region and its presence further indicates that the ancient Maya of Arvin’s Landing were engaged in long distance trade with other parts of the Maya realm.
The cultural activities associated with chert are similar to those of obsidian. Chert does occur naturally in the area, but is generally of poor quality. In this survey, the chert found is of poor quality and it was difficult to determine if it was culturally significant. The actual diagnostics of the chert recovered provides negligible support for its use in tool production. Its density near the obsidian density areas suggests a possible link to larger lithic tool manufacture area.

In conclusion, this research has found that settlement at Arvin’s landing was much larger than previous evidence revealed. The site now likely includes two more households. The combination of archaeological and geographical methods used in this research was useful in finding evidence of ancient settlement hidden in the landscape. In addition to revealing hidden settlement evidence, this research also provides evidence of additional cultural activity beyond the household. By understanding the relationships the Pre-Columbian inhabitants of the Maya area had with their environment, we can better understand how to conduct ourselves with future redevelopment of the region.

This research serves as a point of departure for future research exploring the extent and patterns of hidden ancient Maya settlement. Future research including mobile GIS technology will increase efficiency of research in the field and allow better use of time and resources during limited field seasons. More tests need to be conducted in order to develop a means of extrapolating evidence of hidden settlement into the settlement pattern and population assessments of the greater ancient Maya realm.
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**Vita**

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He received the William G. Haag award in the Department of Geography and Anthropology at LSU for best graduate student conference paper in 2004. Bretton is currently a doctoral student in the geography program at LSU and holds the Maya Archaeology Graduate Assistantship.