Lithic Production and Settlement Patterns:  
The Emergence of Social Complexity in the Río Parita Valley, Panama

by

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The development of social complexity in Panama has been a central point of analysis amongst archaeologists and ethnohistorians for centuries. The analysis of material remains from archaeological sites such as Sitio Sierra, Sitio Conte, La Mula-Sarigua, and El Hatillo have provided an abundance of data that has enabled archaeologists to develop a more clear understanding of social complexity and cultural evolution in the region of Western Panama. Mortuary and household data can provide a detailed background of the day-to-day lives of those who inhabited pre-historic Panama, but more specific information is required to produce a holistic interpretation of archaeological evidence. Lithic production can provide insight into many aspects of social organization including the level of social, economic, and political complexity based on the analysis of reduction techniques, access to resources, trade, division of labour, and the control of production. By examining the lithic information from Dr. Mikael Haller’s (2004) investigations of the Río Parita Valley, Panama, more concise information on the social complexity of the region can be produced, regarding the manufacture and use of stone tools throughout the region.
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PREFACE

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1. Introduction

Lithics have been studied by archaeologists for over 200 years (Andrefsky 2005:1); stones, however, have been used by humans to aid in human and hominid lifeways for millions of years, likely beginning as an aid in food procurement and possibly as well for small scale hunting. In fact, stones have been used by humans since before the invention of fire (Andrefsky 2005:41; Ember et Al. 2002:129). Due to its extensive presence in the archaeological record – evidence suggests that lithics have existed in the archaeological record for a minimum of 90% of human existence – stone technology is thought by some to be the most important raw material in human history (Andrefsky 2005:41).

Some have argued (Sanders 1981) that one of the most important aspects of social complexity is economic interdependence reflected in a division of labour and as a product of controlling resources and their production (Marx 1844/1964). Burials and settlement patterns offer the most significant evidence for social complexity (Haller 2004:110). Through the analysis of burial goods, one can argue for the presence of social status based on the quality, type, and quantity of goods included in the burial (Binford 1979; Saxe 1970). Typically, the way in which a person is treated in death is a direct reflection of their treatment in life; therefore, the more valuable the goods one was buried with in death, the more valuable the goods they acquired during life. Burial goods can also provide valuable insight into the daily activities of the culture under examination; while a plain metate and manos might indicate a traditional agricultural lifestyle, a burial adorned with decorative pieces such as jewellery, intricately carved metates, and precious stones might indicate a life of luxury and material wealth.

Settlement patterns can also indicate social complexity. The analysis of labour and the control of resources and production can yield information about the economy and labour force of a society, and thus, the level of social complexity. Evidence of particular activities in specific areas or households results in
support for a theory of social complexity based on the division of labour is possible. For this study, it is important to analyze lithic reduction techniques which offer valuable insight into the degree of social complexity of a society and can provide information where ethnohistoric accounts and a highly organic archaeological record might leave blanks.

Social ranking appears to have emerged in the Río Parita valley by the Macaracas phase (AD 900-1100) based on evidence from both burials and settlement patterns (Haller 2004: 110). Evidence of social differentiation in Central Panama during this phase comes from burials from Sitio Conte and Cerro Juan Díaz; those that were buried at Cerro Juan Díaz were suspected to have been commoners because they were buried with household and invaluable goods, while those buried at Sitio Conte were found with elaborate grave goods and mass wealth (Briggs 1989; Lothrop 1937; Haller 2004:85). It is during the Macaracas phase that the first order site of He-4 dominates the site size hierarchy in the Río Parita Valley, although nucleation around the region begins to diminish (Haller 2004:85).

The research in this paper focuses on the collection of lithics, both chipped stone and ground stone variations, from the Río Parita Valley in Central Panama. Primarily I am interested in examining the relationships between: 1) lithic production techniques and social complexity at a regional scale; 2) local production areas and access to resources; 3) access to resources and control of production; and 4) local production areas and the division of labour. Investigation of these aspects will be done through the statistical analysis of various lithic assemblages I have investigated in order to determine the differences between these factors. The analysis of site rank, tool type, and soil productivity data will verify if different activities were taking place in different areas of the Río Parita Valley. Conversely, the data may indicate that all types of activities were occurring throughout the survey area. This will be examined based on the presence or absence of specific types of production by site type and by soil type.

The investigation of lithic data in my study will focus on economic activities such as tool production, the division of labour, and the control of production and resources. The results of the lithic data analysis will determine the differentiation of activities occurring in the Río Parita Valley. Production and activities throughout the valley may vary by site type; if so, this will confirm the previous claims for
social complexity in the region. Alternatively, production may be organized based on another factor, such as soil type. Or it is possible that it is not organized in a differentiated manner at all. Both of the previously mentioned alternative options oppose previous claims regarding social complexity and investigation into this opposition may be necessary. If social complexity was present in the Río Parita Valley, then evidence will be provided from the lithic assemblage based on a site-rank division of labour, rather than a soil-type division of labour. Thus, it is not that I am testing the previous claims of social complexity in the Río Parita Valley, but I am trying to better understand the nature of social complexity. The result of the lithic analyses can be applied in a general understanding of social complexity in the rest of Central Panama, as well as other areas in the world that have experienced chiefdom development.

Lithic manufacturing techniques not only reveal basic levels of social complexity, but also division of labour, craft specialization, gender roles, access to resources or resource control, and regional and long distance trade. Hansell (1988:107) demonstrated the association between certain lithic tools and female roles by comparing tools from the Sitio Sierra female burials with the tools from her own collection. Ground stone tools, which I will only examine minimally, provide evidence for craft specialization based on their level of complexity and the amount of time invested in them; legged metates, for example, are considered the product of craft specialists because they require a high amount of labour investment and are standardized in manufacture, while slab metates appear to be more common and do not require the large investment of time for the manufacture (Haller 2004:145). This is further demonstrated in burial contexts at HE-4 during the Macaracas phase where two particular individuals who were buried with elaborate grave goods, including gold, beads, pendants, decorative vessels, and three individuals placed each upon a four-legged metate (Haller 2004:104). The time needed and the standardization of these artifacts along with their association with high status burials demonstrates the relationship between low status goods and commoners, and high status goods and elites.
2. The Study of Lithics

The longevity of lithics in the archaeological record, as mentioned by Andrefsky (2005:41) and Cotterell and Kamminga (1987:675), make the study of lithics one of the most dependable and frequent method of analysis of archaeological remains (Cahen et Al. 1979:661). Due to the interdisciplinary cooperation between archaeology and other professions, such as geology in particular, new methods to analyze stone tool artifacts should be regarded as an important technological advancement in the study of prehistory which can be used to further the understandings of prehistoric human lifeways (Cahen et Al. 1979:661).

2.1. Studying Lithics

Archaeological evidence suggests that hominids have used stone tools even prior to the modern human existence and some argue that the use of stone tools have been the most important technological advancement in human history, perhaps even as important as the invention of fire (Andrefsky 2005:41; Ember et Al. 2002:171). Weathering, human and environmental disturbance, and natural processes such as biodegradation, can cause other artifacts, especially those of the organic nature, to decompose and disappear from existence; however, stone tools do not usually falter under these influences. Because of the characteristic longevity of lithics in the archaeological record, stone tools are often the only artifact left for examination by archaeologists and also are the most common at archaeological sites (Cotterell and Kamminga 1987:675; Cahen et Al. 1979:661). The extensive presence of lithics in the archaeological record can allow for the development of typologies by archaeologists based on classifications witnessed in changes in lithic styles over time (Hayden 1984:81). Typologies of different levels of complexity of stone tool technology are used by archaeologists as an effective means of determining the level of social complexity of the population being studied. Bamforth (1986:38) places stone tool technology on a continuum from curated to expedient. Curated technologies require pre-meditated manufacture and are
typical to mobile groups, whereas, expedient technologies are quickly made, used, then thrown away, and are typical of more sedentary populations. Based on the different production techniques of lithic artifacts, archaeologists can recreate reduction techniques and determine the expenditure of resources into the artifact to determine its associated level of social complexity. The characteristics typical to lithics, as mentioned above, make the analysis of the lithics from the Río Parita Survey a reliable and extensive assemblage to examine.

Humans originally might have used stones in the context of tools as a way to bash open nuts and fruits for consumption, which would be one of the most primitive uses of stone tool technology as no modification to the tool would have been necessary. Additionally, the natural cleavage planes of certain stone types would have allowed for some tools to be used although their manufacture occurred through natural processes (Grayson 1986). This characteristic of lithics makes it difficult to determine the first humanly modified stone tool, such as a stone with a human-made scraping surface, as opposed to a naturally made scraping surface (Grayson 1986). Human stone tool modification allowed certain tasks to be performed more efficiently, making daily life more productive for ancient humans. For instance, the procurement of food sources would have become more efficient with the development stone tools for killing (of animals), cutting, and scraping. Shelter could also have been made more efficiently and effectively with the advancement of stone axes to gather larger, sturdier trees to construct more stable residences. This advancement in technology, however, likely would not have begun happening in noticeable quantities until some form of sedentism was reached due to the time invested in tool production. These processes have been studied by archaeologists for over two hundred years (Andrefsky 2005:1) and continue to evolve as new technologies are developed to analyze lithics in previously unknown ways.

Lithic analysis, however, has not always been present to aid in the analysis of the archaeological record. Lithics among the archaeological record were a significant discovery in the eighteenth century when most of the educated and scientific population of the world believed the Earth was created only 6000 years before by the hands of God (Chazan 1995). The discovery of lithics stratigraphically below
animals remains that were known to be extinct was proof of human existence prior to 6000 years before the 18th century (Andrefsky 2005:3). This presented an issue in the establishment of human history and its associated time periods: the Iron, Bronze, and Stone Ages (Chazan 1995: 457). When John Lubbock suggested that the Stone Age should be divided into the Old and the New, categories were needed to define the two: the Old Stone Age, or Paleolithic, was characterized by anatomically modern humans living amongst extinct fauna, while the New Stone Age, or the Neolithic, was characterized by more stone tools requiring more precision, variance, and often polish (Chazan 1995: 457).

Lithic manufacture began as simple, direct percussion using a hammerstone and occasionally an anvil (Ranere 1980:119). A flaking force is applied to a nucleus by an indenter, usually causing flakes to be removed until the desired shape and size of tool is attained; this usually takes numerous steps of shaping and reshaping (Cotterell and Kamminga 1987:676). Overtime, however, knapping techniques and platform preparation became more complex and increasingly advanced, which allows for lithic tool typologies to be created (Ranere 1980:118, 127). These typologies are believed to be confident indicators of technological advancement due to laboratory and experimental replication of stone tool manufacturing techniques (Ranere 1980:128). Tool typologies actually seem to devolve, rather than evolve, having more complex tools earlier in the archaeological record, and less complex tools occurring further along in the development of social complexity. This is because mobile groups would have had to rely on a more complex toolkit because of the unreliability of raw material sources. Sedentary groups, which occur later in history, would use a simple toolkit with single-function tools, due to knowledge of local resources for raw materials.

Lithic analysis is advantageous to the study of humans because the original goals of lithic analysis, which was initially developed by Holmes and is still used today, can help in providing a chronological scale for an archaeological site (Andrefsky 2005:4; Ember et Al. 2002:33; Hayden 1984:81-82). The analysis of lithic assemblages includes the development of typologies by using stone tools as chronological markers by understanding the how the form and function of stone tools evolves,
and through the understanding of the development of stone tool production and use (Andrefsky 2005:4; Cahen et al. 1979:661).

Tools are often difficult to identify in the archaeological record, however, due to a general misunderstanding of flake mechanics and flake scarring by archaeologists, which often results in an overrepresentation of certain types of tools, while others are completely neglected (Cotterell and Kamminga 1987:675). This is exemplified by the fact that confusion between the identification of tools from flaking debitage is commonplace with archaeologists who do not have a strong education in flake scarring and flaking mechanics (Cotterell and Kamminga 1987:675). Stages in stone tool manufacture can be seen in the finished tools that are available for analysis, the flakes that are expelled from the tools, along with mistakes or “workshop rejects” that can represent manufacturing stages (Ranere 1980:128). Furthermore, certain manufacturing techniques can suggest trade among cultures, or the dissemination of knowledge between settlements in the sharing of manufacturing technology (Ranere 1980:128). The presence of unusual tools, or materials not present in the region of the Río Parita, could help in the detection of long distance trade, and a more complex economy in the region. Additionally, the identification of certain tool types in the Río Parita lithic assemblage can not be examined for misrepresentation since the collection is not accessible in the time frame of this research.

Lithic assemblages from pre-ceramic sites in tropical climates, such as the Río Parita, have been criticized for being amorphous, unvarying, and insensitive indicators of chronological phases (Ranere 1980:118; Cotterell and Kamminga 1987:676). The collections of chipped stones associated with these sites are usually generalized cutting and scraping tools that elaborate typologies do not accommodate well (Ranere 1980:118). Cotterell and Kamminga (1987:675-676) argue that it is possible that flake tools are simply being overlooked by archaeologists who have collections with a high number of formally shaped tools and that this can be seen within collections where the identification of several hundred tools are identified by lithic specialists when only a few tools had been identified by the excavator. The criticism of lithic typologies also negates the only link usually found to correlate the histories between pre-ceramic and ceramic periods (Ranere & Cooke 1996: 50); therefore, the lithic assemblage should be examined
diversely and meticulously in order to provide a resolution, rather than a distraction. This can be achieved through the examination of stone tool characteristics (Ranere & Cooke 1996:51; Cotterell and Kamminga 1987).

Criticisms of lithic assemblages also arise when discussing stylistic characteristics versus ones resulting from technological and/or functional constraints because of a number of variables that can and do affect the selection and manufacturing of stone tools (Ranere & Cooke 1996:51). It is argued that these stylistic characteristics are not significant in conveying any real social messages, as the individuals who manufacture the tools likely do not intentionally carve socially related messages into their tools, making it difficult to extract any cultural meaning from lithic analysis (Ranere & Cooke 1996:51). Social identity is not necessarily totally absent from these collections, however, it is simply not consciously manufactured to express that information (Ranere & Cooke 1996:51; c.f. Weissner 1983). As Bamforth (1986:738) states, “all technical systems result from a design process,” and that design process has social messages subconsciously embedded in it.

Sedentism is an important factor in the development of complex societies because increased complexity in socio-political and economic affairs, such as hierarchical social structures, differential access to wealth and resources, and craft specialization, often takes place in conjunction with sedentism (Andrefsky 2005:224; Ranere & Cooke 1996; Ranere 1980; Bamforth 1986; Bleed 1986:738). Evidence of the shift to sedentary living can be witnessed in the archaeological record through the examination of lithics based on the way stone tools are manufactured along with their purpose, or use, which result in particular stylistic differences between tools used by nomadic hunting and gathering groups and those groups that become sedentary (Ranere & Cooke 1996:51, 59). These changes include introduction of new tools, and alterations of previously existing tools, such as tool thickness or thinness, convex or concavity, flaking techniques, shape, presence or absence of fluting, retouch techniques, and platform size (Ranere & Cooke 1996:61-62). Tools such as manos would not have been as prominent in the archaeological record during nomadic times due to their use in processing plants such as palms and tubers, which Ranere and Cooke (1996:59-60) relate to agrilocality and, consequently, at least partial sedentism.
The relationship between tool complexity and mobility is also proposed by Ranere (1980:124) in his study of lithic production in Western Panama. As the tool technologies change over time to become more complex, difficult to produce, and exceedingly time consuming (in non-functional types of ways), evidence becomes clear that social structures, too, were also progressing to more complex stages of craft specialization and division of labour in association with increased sedentism (Ranere 1980:124-134); however, this took a long time to develop in Panama (Haller 2004:56). While chipped stone and various other lithics were originally produced as part of the household industry, as tools became more specialized, they also became part of the more advanced specialist industry (Ranere 1980:123). This advancement began with bi-polar reduction techniques and advanced to the production of blades and trifacial points, and also to ground and polished stone, which require a much greater technological understanding of stone tool production, (Ranere 1980:123).

2.2. Lithic Production

Lithic manufacture appears on the surface to be a simple process: find the raw material, modify it into a usable shape, and utilize the tool for whatever purpose it was intended to have. This process, however, is much more complex than first imagined and involves a number of premeditated steps in order to produce a tool that is functional for its intended purpose. While the time and effort expended in stone tool manufacture does vary, the initial steps remain largely the same regardless of location, settlement pattern, or raw material availability. In order to create stone tools, one must first locate an outcrop of raw materials that is of a particular quality. Most frequently, sparse outcrops of high quality materials result in the production of formal stone tools by mobile populations, while sedentary populations that surround these outcrops would rely less heavily on formal tools, and more heavily on informal ones due to the relative proximity and availability of the resource, which would allow for more wasteful production of stone tools (Andrefsky 1994:29, 2005:227; Haller 2004:139; Bleed 1986; Bamforth 1987; Gramly 1980).
Frequent allocations of quality raw materials throughout a region appear to allow for the impartial selection of production techniques by both sedentary and mobile populations (Andrefsky 1994:29; Gramly 1980). Raw materials of a lesser quality that are found frequently throughout a region with occasional high-quality outcrops seem to result in both sedentary and mobile populations creating tools of the expedient nature from the low-quality raw materials, and more formal tools from the high quality outcrops (Andrefsky 1994:28; Gramly 1980).

Stone tool raw material is most often chosen for its fine-grained texture, homogeneity, and hard composition (Andrefsky 2005:41; Cotterell and Kamminga 1987:677). These characteristics allow for increased ease of production of chipped stone tools due to the natural fracture mechanics of those types of lithics. These types of rocks include obsidian, rhyolite, andesite, quartz, chert, and many other fine-grained, homogenous, brittle stone variations (Andrefsky 2005:50-58; Cotterell and Kamminga 1987:677-678). Chert most frequently occurs as nodules within parent rocks, such as limestone, which is thought to precipitate under conditions of low pH; however, bedded chert can also be found in large layers that are attributable to sedimentary rock strata and volcanic deposits (Andrefsky 2005:54).

Lithic manufacture differs from other forms of culturally manufactured artifacts because it requires a subtractive process, while ceramics or residence building is considered an additive process (Andrefsky 2005:30). Chipped stone tools begin as a core, or unmodified piece of raw material that will have pieces removed from it until it has reached the shape, size, and sharpness desired by its manufacturer, known as an objective piece (Andrefsky 2005:12) or nucleus (Cotterell and Kamminga 1987: 676). The subtraction of detached pieces, or flakes, can be done through either percussion flaking or pressure flaking, the latter having the highest accuracy for production (Andrefsky 2005:12; Cotterell and Kamminga 1987:676). Pressure flaking is done by removing chips of stone from the objective piece through the application of pressure downward and inward on the objective piece without striking it – this is usually done using the tip of an antler or sharpened bone (Andrefsky 2005:12). Percussion flaking involves removing flakes form the objective piece by striking it with a percussor or hammer, which is
usually a cobble or pebble - although hammers may be made of bone, antlers or wood - and is known as a hammerstone or billet (Andrefsky 2005:12; Cotterell and Kamminga 1987:685).

In producing chipped stone tools, flakes can be removed from a core in many different ways. Three modes of flake removal, or initiation, are presented by Cotterell and Kamminga (1987:685-691) including Hertzian (conchoidal), wedging, or bending. Hertzian flake removal often results in a cone-shaped crack surrounding the contact zone between the indenter and the nucleus which creates the characteristic bulb on the conchoidal flake (Cotterell and Kamminga 1987: 685-686). Wedge initiation is done by either wedging into an already existing flaw on the surface of the nucleus or by using a very sharp indenter on the nucleus (Cotterell and Kamminga 1987:688). Bending initiation occurs when a soft indenter is used and the flakes are characterized by a clean, concave scar on the initiation face (Cotterell and Kamminga 1987:690). Percussion flaking can also be done in an indirect way, where the percussor never touches the objective piece, by using the percussor to “strike a punch that is placed on the surface of the objective piece” (Andrefsky 2005:12).

Flakes can be removed with different intentions based on the amount of force used in the removal of such flakes (Andrefsky 2005:13-14; Cotterell and Kamminga 1987:679). If larger pieces are desired to be removed, a hammerstone would likely be the choice form for application of pressure on the core due to its ability to produce a greater application of pressure, while fine details such as serrating the edge of a knife would be better achieved through precise pressure flaking using an antler tine (Andrefsky 2005:14-15). Flakes can be removed from cores to shape and sharpen a tool repeatedly, in the process forming many different tool types, or variations of the same tool, until the core is exhausted (Andrefsky 2005:16). The majority of flakes removed with any type of controlled manner result in a conchoidal fracture, producing a concavity on the core and a convexity on the flake removed from the core (Andrefsky 2005:16).

Cotterell and Kamminga (1987) argue the high prevalence of conchoidal flakes in the archaeological record are a direct result of the overemphasis of conchoidal flakes being used to counter the “Eolithic Age” debates (see Clark and Parry 1987). Larger flakes can then be modified to create tools,
or they may simply become part of the debitage associated with stone tool reduction. Once a flake is removed in the conchoidal technique, it is identifiable by a dorsal and ventral surface, a proximal and a distal end and a percussion platform (Andrefsky 2005:19; Cotterell and Kamminga 1987:681). The identification of these characteristics and techniques are important in order to properly qualify the finished lithics that we as archaeologists study. Without the knowledge of chipped stone production techniques it would be theoretically impossible to make a correlation between mobility and tool production, and thus social complexity; this would greatly hinder the ability to identify the level of social complexity at pre-historic sites.

2.3. Lithic Analyses

The identification and classification of lithic artifacts is the first step of lithic analysis (Andrefsky 2005:62; Cotterell and Kamminga 1987:675). While lithics are used as a means to compare collections in order to generate questions about the data, such as which activities took place at a site, or what method of production was used in creating the stone tools, this examination and comparison can not be done without first identifying and classifying the lithic artifact (Andrefsky 2005: 61-62; Cotterell and Kamminga 1987:675).

Lithics can be separated into classes based on similar characteristics, which can then be systematically arranged within a population to create a typology in which the most similar items are grouped together and the least similar are kept apart (Andrefsky 2005: 62-63; Hayden 1984; Chazan 1995). There can be as many types in a population of artifacts as there are artifacts themselves, and there can be as few as one, despite the size of a population of artifacts (Andrefsky 2005:63). The number of types is therefore dependant on the reasons for creating a classification scheme and the needs of the researcher (Andrefsky 2005:64; Hayden 1984:80, 82). Typologies must also be replicable in order to maintain any significance; otherwise it would not be possible to compare populations in order to draw any
meaningful conclusions (Andrefsky 2005:63; Hayden 1984:82). The characteristics that lithic typologies are built on are considered attributes of specimens, and can be recognised based on four types of scales: nominal scale attributes are characteristics such as raw material type, or colour; ordinal scales involve the relative ordering of attributes along a continuum with unequal or unknown measures between each, such as the measurements of small, medium, and large; interval scales are similar to ordinal scales, but have equal distances between states, such as temperature scales; and finally, ratio scales are comparable to interval scales, but have a fixed zero point, such as weight or length (Andrefsky 2005:65-66).

Typologies are developed based on the attributes the researcher has selected to characterize the types (Andrefsky 2005:66; Hayden 1984:80). Several approaches can be taken when creating typologies from attributes of a population including monothetic, polythetic, agglomerative, divisive, dissentional, modal, associative, and disassociative (Andrefsky 2005:67-72). A dissection typology can be used to classify scraper angles, based upon what Andrefsky (2005:68-69) refers to as the “artificial deviation of a variable”.

Many characteristics are desirable in the raw material one chooses to create the proper conditions for a good stone tool including small or microscopic grain size, smooth texture, very hard and brittle composition, and homogeneity (Andrefsky 2005:41; Cotterell and Kamminga 1987:677). Lithics, or rocks, are defined by Andrefsky (2005:42) as “masses of solid minerals, and minerals are combinations of chemical elements”. For instance, quartz, a common type of lithic used for stone tools, is a combination of the chemical elements oxygen and silicon (Götze et Al. 2005:13; Andrefsky 2005:42). Characterizing lithics by their many qualities, however, can be difficult, often due to an inconsistency in lithic definitions used by archaeologists and geologists, along with their local and regional variations and a general lack of understanding regarding the importance of certain lithic characteristics (Andrefsky 2005:41). Characterization can be accomplished using macro- or microscopic techniques, and while microscopic techniques are more precise, macroscopic are more commonly used in the field due to their sole dependence on the human eye, or hand lens no stronger than 10 x (Andrefsky 2005:42; see Haller’s field techniques for identifying tool types 2004:49).
Determining the lithic material is important because it allows archaeologists to establish a point of provenance, or “source location”, of the artifact, which is done through the process of geochemistry (Andrefsky 2005:42). While macroscopic techniques are initially helpful in determining an artifact’s provenance, geochemical techniques, where the elemental composition of the lithic sample is determined, are used to determine the source location with the highest precision (Andrefsky 2005:43). Geochemical techniques include X-ray fluorescence spectrometry (XRF), particle induced X-ray emission analysis (PIXIE), electron microbe analysis (EMPA), instrumental neutron activation analysis (INAA), inductively coupled plasma emission spectroscopy (ICP), and atomic absorption spectroscopy (AAS) (Andrefsky 2005:44-45). These processes involve determining three categories of stone composition: major elements, which must compose 2% or more of the sample; minor elements, which count for 0.1% to 2% of the sample; and trace elements, which occur in less than 0.1% of the sample (Andrefsky 2005:43). Radiation is used in these techniques and allows for the identification of the composition of the sample by measuring the amount of “radiation emitted or absorbed by atoms when the nucleons or electrons move between various energy levels” (Andrefsky 2005:43). Trace elements most frequently lead to the deciphering of source materials, due to their relative distinctiveness compared to major and minor elements (Andrefsky 2005:43).

In addition to source location, identification and classification of lithic materials are important to the study of lithics and the archaeological record in general due to the ability to use these classifications as diagnostic markers of prehistoric cultures, and as a means of identifying functional or behavioural traits of the cultures from which they came (Andrefsky 2005:62). Based certain characteristics of the tool, one can categorize a tool based on the amount of effort that was used to produce the specimen (Andrefsky 1994:22; Binford 1979; Bamforth 1986). Resharpening was often performed on lithic tools in order to create a new tool from one that has been exhausted. Resharpening can be done on tools whose cutting edge has become dull or ineffective where the tool manufacturer retouches the tools’ edge to provide a new, sharp cutting edge; however, when a tool breaks and is remade into a new functionally equivalent tool, it has been rejuvenated (Towner & Warburton 1990:311). Formal, or “curated” tools (Binford 1979),
which fall at one end of a production continuum, require increased effort and time investment to create, either over an extended period of time through numerous re-sharpening or hafting events, or through one event of production from raw material to finished tool (Andrefsky 1994:22, 2005:226; Bamforth 1986:38). These tools are often considered to be flexible in the sense that they frequently are designed to be reshaped, redesigned, and rejuvenated for future use with various functional options (Andrefsky 1994:22, 2005:226; Bleed 1986). Formal tools are often associated with mobile settlements with short-term site occupations due to their transportability (Andrefsky 1994:22). Conversely, if raw materials were available at necessary locations along a migratory route, mobile populations might not rely on formal tools, but would easily survive using tools made through the expedient process (Andrefsky 1994:23; Parry and Kelly 1987).

Informal, or “expedient” (Binford 1979), tools require considerably less expenditure of time and energy in order to create them and are unstandardized in regards to form (Andrefsky 1994:22, 2005:227). Expedient tools are regarded as being manufactured, used, and discarded within a relatively short period of time due to their use for specific, or situational tasks, rather than the anticipatory tools of the formal production toolkit (Andrefsky 1994:22, 2005:227; Bamforth 1986:38). Sedentary populations are thought to have produced stone tools in the expedient manner because of their lack of anticipation of tool use needed due to their long-term occupation of sites and ability to use a tool once or a few times, then throw it away and create a new tool because of fixed subsistence resources (Andrefsky 1994:22, 2005:227; Binford 1979:35). This supports the theory that sedentary living arrangements rely more heavily on expedient processes as settlement in the region during this time is assumed to have been sedentary. Andrefsky (1994:23) argues that this pattern can only hold true in the event that raw materials are readily available for stone tool production; if lithic raw materials are not available at close hand to sedentary populations then expedient tools might not necessarily be the popular choice for stone tool manufacturing.

Raw material availability, therefore, is potentially equally as important as the way in which raw materials are converted into stone tools. This is made evident in the study of Pinon Canyon, Colorado in which the examination of formal and informal cores, and formal and informal tools, do not follow suit
with expectations for sedentary and mobile populations (Andrefsky 1994:26). In this study, there is no significant difference in formal and informal core production, or in formal and informal tools, at sedentary versus mobile population sites (Andrefsky 1994:26). This unexpected pattern is mirrored by the site of Calispell Valley, Washington, where Andrefsky (1994:28) notes that although the site was occupied for three out of the four seasons each year, 85% of tools and cores from the site were made using formal production techniques. At Rochelle in Wyoming it was found that the relatively high quantities of low-quality materials resulted in the expedient production of stone tools even by mobile hunter-gatherer populations in the region, while any formal tools were made from raw materials found outside the region (Andrefsky 1994:28). Based on the availability of raw materials in this comparison, it can be seen that the types of tools produced by both permanent and mobile settlements depend on the availability of quality raw materials.

Lithic production techniques can be one of the most reliable indicators of general lifeways and social complexity in a pre-historic region (Ranere 1980:118; Andrefsky 2005:1). Although lithics may not intentionally carry any indicators of social complexity (Wiessner 1983:258), the insight they provide into prehistoric ways of living are held in the deduction methods used to create the tool, of which, the creator was probably not even aware of (Ranere & Cooke 1996:51). Because of the “innateness” of lithic information, conclusions regarding social complexity can be made with even a small sample of lithic material, as seen in the results from this study (see Haller 2004).

Lithic analyses are important in the study of social complexity as it relates to the production of lithics in a region. As lithics are more closely examined through a variety of new technological methods different information becomes available (Andrefsky 2005:43). The determination between curated and expedient tool types provides a means for analysis of social complexity that is of considerable importance to this study. By considering the factors set forth by Binford (1979), Andrefsky (1994, 2005), Bamforth (1979), and others (Parry and Kelly 1987; Bleed 1986), the examination of the lithic assemblage will maintain a holistic interpretation of raw material procurement, production techniques and tool use in the Río Parita Valley. These factors will be interpreted along with the data set as presented from Haller’s
2004 survey of the Río Parita Valley in considering the level of social complexity associated with the presence of lithic materials throughout the region.
3. Literature Review

Panamanian chiefdoms are considered by many specialists to be the archetype for ranked societies in the scheme of cultural evolution (Steward and Faron 1959:224-231). Based on ethnohistory (Andagoya 1865, 1994; Balboa 1994, Espinosa 1873, 1994a, 1994b; Las Casas 1986; Oviedo 1853, 1944, 1995) and mortuary remains (Cooke, et al. 2003a; Lothrop 1937:46), social ranking and socioeconomic stratification were both evident in the area as deliberated by the differentiation in settlement organization and size.

3.1. Archaeology in the Río Parita Valley

The study done by Haller (2004:1), based in the Río Parita Valley (see Figure 1), Panama, focuses on population clustering, determining how such nucleated sites came to be, and how social ranking emerged. Additionally, the study increased the information available on the emergence of chiefdoms prior to the sixteenth century in Central America. (Haller 2004:1). The elaborate wealth of chiefly societies in Panama was recorded by conquistadors during the Spanish conquest in the sixteenth century (Haller 2004:2). Wealth, however, was not shared equally among the residents of the area, as seen by the lack of equality in the socio-political relations recorded by the Spanish (Haller 2004:2). Additionally, the graves of Sitio Conte (Lothrop 1937) illustrate wealth accumulation, such as large quantities of gold, precious stones, textiles, weapons, and various other goods (Cooke, et al. 2000, 2003a).

The development of Panamanian chiefly societies has been debated by scholars based on different interpretations of archaeological information, though three main models are used to explain the establishment of political power (Haller 2004:6). The first model is The Control of Esoteric Knowledge Model by Helms (1979), the second is The Control of Local Resources Model which is supported by a number of archaeologists (Cooke and Ranere 1984, 1992a; Cooke, et al. 2003a; Hansell 1988; Linares 1977), and the third is the Warfare Model focused proposed by Carneiro, Redmond, Steward and Faron (Haller 2004:6-9). Haller’s investigation (2004:10) focused on five factors to evaluate these models:
demography, warfare, long-distance trade, local exchange and craft production, and control of subsistence resources. These factors are considered in terms of their timing, presence, and intensity, in order to properly analyze their effect on each of the models. While each of these factors can influence the interpretation of social complexity in Panama, none directly analyze the location and dispersion of lithics in the Río Parita Valley and how the location and distribution can relay information regarding social complexity in the region.

Figure 1. Central Region of Panama with the archaeological sites mentioned in the text (After Lange and Stone 1984:Figure. 1.1 and Linares 1977:Figure 3) From Haller 2004:15
The study of chiefdoms by archaeologists is important because chiefdoms do not exist in a contemporary context, and therefore, they must be studied to determine the catalysts and processes of social change and increasing social complexity (Menzies 2006:C-1). In order for chiefdoms to be examined in Panama the study of their development is necessary at the regional scale. This must be done because investigations in the Central Panama region thus far have focused mostly on specific sites. By only focusing on certain sites, a diversity of regional scale can not be interpreted because of the lack of interrelated information between specific sites (Haller 2004:17). The Central Region, has been determined by combination of ceramic and lithic artefacts that share a common style (Cooke and Ranere 1992a:248), along with a locality that shares in similar language and iconography, all of which are restricted to an area larger than a community whose peoples interact through social, political, and economic exchange (Haller 2004:17).

The period of time in which the Central Region is studied includes sites recorded as early as the Paleoindian period (11,200 – 10,000 BP) up until the first nucleated settlement at La Mula-Sarigua (200 BC – AD 250) and continues through to the emergence of first chiefly centre (He-4, occupied up until the sixteenth-century AD) (Haller 2004:18). The Paleoindian period is divided into the Early Occupation Sequence (9200-200 BC) and the Late Occupation Sequence (200 BC – AD 1522), however, the Río Parita area had little occupation until 200 BC when La Mula-Sarigua emerged. This study focuses on the Late Occupation Sequence following La Mula-Sarigua’s development, which is one of the most refined chronologies in Lower Central America (Haller 2004:32). By focusing on this time period, although it is quite extensive, I intend to discern the activities occurring throughout the Río Parita Valley in order to supplement or contradict previous claims for social complexity in the region.

By the time the Spanish arrived in the sixteenth century, ethno-historic records suggest that there were five main “chiefdoms” surrounding the Parita Bay area, each of which had a main town in which a regional chief would reside, but would travel throughout the settlements of his chiefdom (Helms 1979:53). Parita, or Antatará, was a prominent chief who had two river valleys under his control in the sixteenth century, in addition to having influence over nearby chiefdoms, of which two large chiefdoms
have been archaeologically identified (Helms 1979:59-60). Spanish references to the area and surface and sub-surface features imply ritual and economic activities (Haller 2004:18-19). This level of social complexity should typically require an extensive period of time in order to develop to a chiefly level; therefore, the emergence of complexity should be evident in the examination of indicators of social complexity in earlier sequences, including lithic production techniques and the division of labour.

The Río Parita area, today, is well-known for its seasonal precipitation and stable temperature (27°C on average per annum) with post-Columbian activities having made use of the land through extensive agriculture using European tools, resulting in a land characterized by forest patches, savannas, and pastures (Haller 2004:20). In the unspoiled Holocene conditions, however, the area could have been a tropical dry forest with four basic physiographic zones: [1] the mangrove-estuary zone that makes up 7.3% of the total survey area and is characterized by constant inundation, offering poor residential conditions, but wide varieties of natural resources; [2] the salt flats, which make up 10.6% of the total survey zone, are characterized by their level elevation and barren surface and reside on either side of the mangrove-estuary zone; [3] the floodplain zone makes up 12.4% of the total survey zone and provides two useful products for agriculture: a predictable water source, and fertile soil; and [4] the Lower Central Plain, the most productive land for agriculture and residence due to its rolling hills and pastureland, consists of 69.8% of the total survey area (Haller 2004:22, 24). The Lower Central Zone is further broken down into high, medium, and low productivity zones (Haller, personal communication).

Previous regional surveys, recent methodological approaches, and methods pioneered by Sanders, Parson, and Santley, along with the work done in the Basin of Mexico, and methodological refinements developed in Colombia and China, were influential in the field methods used for Proyecto Arqueológico Río Parita (PARP) (Haller 2004:24). A full-coverage survey was used to provide comprehensive information to identify settlements, settlement densities and hierarchies, inter-settlement conflict, differential craft production, and site catchments – a “traditional” settlement pattern methodology (Haller 2004:25). This was done using a systematic surveying technique which enabled the highest likelihood of site identification based on surface visibility and artifact density (Haller 2004:35). Surface visibility is an
extremely important factor in finding lithic artifacts because the ability of lithic artifacts to blend into their surroundings provides another difficulty in the collection of this type of data. The frequency of artifact finds is also important because it can be indicative of the size of the settlement in a particular area.

The use of this data in reconstructing demography is useful in combination with the number of dwellings found, number of sherds found, site size, and ethnohistorical, or historical, census data, but can be skewed if used alone to determine the demography of the area (Haller 2004:35-36). In order to correct this distortion in calculation the demography based on the number of sherds (proposed debitage), Drennan, et al. (2003:38) developed the Density/Area Index (DAI/C) that takes into account the number of centuries a ceramic phase spanned in order to produce a more reliable result that takes area, density, and length of time into account (Haller 2004:39). As stated by Haller (2004:44) “the close correspondence between the site-size histograms and rank-size plots based on different threshold distances suggests that the “site” is a meaningful analytical unit for the Río Parita data set, as originally defined in the field with a 100 m separation criterion”. Additionally, as DAI/C only uses collection units, it evades the concerns of critics regarding the use of “site” as an analytically uncritical (Haller 2004:42, 44). This is particularly important in my research as the investigation of social complexity will be determined based on the relationship between tool production and activities and site rank; therefore, the meaningfulness of site rank is an important factor in the reliability of my results.

3.2. Pre-historic Occupation and Lithic Production Techniques

3.2.1. Early Period Occupation

The Early Occupation Sequence, which consists of the Paleoindian/Early Preceramic Period and the Late Preceramic/Early Ceramic B Periods, ranges from 9,200 – 200 BC (Haller 2004:45). The settlement and subsistence trends for this time were particularly important because they created the foundations and influenced the development of settlement and subsistence trends in later periods (Haller 2004:45). These
trends are representative of a rapidly expanding population throughout the Americas, based on the notable similarities in manufacturing and tool styles in many Clovis sites throughout North America to Central Panama (Ranere and Cook 1996:58). This rapidity of movement and homogeneity of technology is likely due to the environmental factors that influenced the subsistence methods of Pleistocene hunter-gatherers, making them rely on the more easily attained and processed faunal resources, rather than floral resources, which may have been vulnerable to the equally rapid changing environment (Ranere and Cook 1996:58). The consideration of these factors must occur in the analysis of lithics from the region in order to properly date and typify them.

During the Paleoindian/Early Preceramic Period (9,200-5,000 BC), which is associated with the “Clovis” technological tradition, the distinctive technique of “removing large, transversal thinning flakes from opposite margins which travelled beyond the preforms’ midline” (Pearson 2002:44) using bimarginal retouch to reach the desired shape, the earliest archaeological sites in the area were found ranging across all ecological zones and the inhabitants of the area are usually associated with hunting as their primary means of subsistence (Haller 2004:45-46). It is suspected that at least small-scale horticulture was being practiced at three Central Panamanian sites (Carabalí, Vampiros, and Aguadulce) before 5000 BC at three Panamanian sites, due to the evidence of clearing and burning forests, the presence of some ground stone tools, and phytoliths of domesticated plants (Piperno and Pearsall 1998). It is not likely this practice occurred in the Río Parita Valley, although plant cultivation was possible (Haller 2004:46-47). The possibility of different activities taking place throughout the region can provide a starting point for tool analysis for researchers attempting to construct a better understanding of social complexity in a region, making analysis more efficient and effective.

The Late Preceramic Period (5,200-2,900 BC) ushered in major changes in the subsistence base, technology, hunting techniques, and settlement patterns such as the increase in cultivation through slash-and-burn techniques and an increase in grinding implements (Piperno and Pearsall 1998:287) and advanced tool manufacturing known as “core reduction” (Ranere and Cooke 1996:61). The higher yields from domesticated crops allowed for the growth of the population, which is indicated by a 15-fold
increase in the number of sites (Piperno and Pearsall 1998:287). Additionally, occupation near the coast increased in both size and number and there is an increase in the clearing of coastal vegetation and the frequency of edge-ground cobbles and millstone bases which could have taken place due to the declining fertility of hill-slope soil and the destruction of upland forests (Cooke and Ranere 1992a:273; Piperno and Pearsall 1998; cf. Cooke). This trend continued and the reliance on cultigens that were more receptive to human intervention became staples (maize, manioc, a variety of yam) and instead of edge-ground cobbles and milling stones, metates and manos appear and are accompanied by polished axes, and finer, more detailed pottery (Ranere and Cooke 1996:67). This shift continues, and by the third millennium BC the different ecological zones were exchanging goods including utilitarian and prestige goods (Cooke, et al. 2003; Hansell 1988). At this time populations were dispersed throughout the Río Parita Valley and the population by 200 BC at La Mula Sarigua had grown 7-fold (Hansell 1988:200). Coinciding with this shift, we should notice an increase in certain tools and goods associated with settlement dispersion in the lithic assemblage from Haller’s (2004) Río Parita survey zone.

Figure 2. Bifacial Thinning Flake < 5,000 B.C. (photo by Georges Pearson) From Haller 2004:30.

Although the Late Occupation Sequence (200 BC – AD 1522) was relatively short compared to the Early Occupation Sequence, the majority of the archaeological record comes from one of the eight ceramic phases (each 200 years in length) from this time period (Haller 2004:54). Some major changes
occurred during this phase including the emergence of social ranking including chiefly hierarchies, and site nucleation (Haller 2004:54). The majority of this data comes from mortuary remains (Haller 2004:54-55), which is why more investigation into the lithic assemblage is needed.

### 3.2.2. Late Period Occupation

The La Mula phase (200 BC – AD 250) saw an increase in site size and numbers including La Mula-Sarigua, Cerro Juan Díaz, and Sitio Sierra in conjunction with major changes in subsistence practices (Haller 2004:57). Agriculture became more valuable based on the increased findings of polished stone axes, legless metates, manos, and special extraction sites (Cooke and Ranere 1992a:277; Hansell 1988:231; Piperno and Pearsall 1998). Mortuary activity also increased; burials contained a variety of artifacts including tools suggesting wood-working and axe manufacturing activities, lithics and ceramics, decorative objects, and imported breadboard metates, which signify that there was likely some sort division of labour and variations in social status in the Central Region of Panama during the La Mula Phase (Haller 2004:58-59). La Mula-Sarigua dominated the area in the site-size hierarchy and was likely the largest and earliest formative village in Panama, containing up to 72% of the population of the region (Haller 2004:61-62). Not only was La Mula-Sarigua’s size impressive, but the standardization of lithics and ceramics (Hansell 1988:245), differential access to cryptocrystalline silicates (tool raw material), and exchange of local and foreign products through a controlled, fixed authority also suggests a complex social organization (Haller 2004:63; Figure 3). This hypothesis will be further examined in chapter 4 of this paper with the analysis of the lithic assemblage from the Río Parita survey from Haller (2004).
The Tonosí Phase is characterized by many of the same features and sites present in the La Mula Phase as well as an increase in status and wealth disparities (Haller 2004:66-67). Although Tonosí Phase sites grew in size, they were still small, and usually re-occupied previous La Mula Phase sites (Haller 2004:67). Social complexity at sites in the phase varied, as suggested by the remains found in mortuary sites in the area. In El Indio, the mortuary goods reflected individualistic social identities through less standardized grave goods while burials at El Cafetal show a higher level of social complexity through the status associated with various grave goods along with the amount of grave goods (Haller 2004:67). Dispersion throughout the Valley occurred during this phase, with the Upper Survey Zone becoming populated for the first time, possibly due to geomorphological changes that made the resources upriver more appealing (Haller 2004:68, 71). The effects of this migration may become evident after the analysis of the dispersion of the lithics throughout the region.

The most recently defined Ceramic Phase in Central Panama is the Cubitá Phase (AD 550-700) which is characterized by wider distribution of ceramic styles, increased habitation of the floodplain and piedmont, sociopolitical change, wider social and economic exchange, and the “dawn of the chiefdom era” (Haller 2004:73). These changes could affect the types of activities done in particular regions, which would be recognizable in the distribution of lithics throughout the region. The sociopolitical changes that
occurred include increased social division based on wealth, sex, and occupation, intense population increase, and the further development of formal cemeteries (Haller 2004:73-75). A three-tiered site size hierarchy also develops in the Cubitá Phase in the Río Tonosí Valley, with 66 third-order sites, nine second-order sites, and the only first-order site of He-4, which was a Tonosí hamlet (Haller 2004:78). This type of site ranking is also apparent in the Río Parita Valley and appears to have influenced the type of activities associated with sites in the region.

The Conte Phase, named after the elaborate interments at the cemetery at Sitio Conte, represents the defining moment of social rank in the region (Haller 2004:79). The burials at Sitio Conte show evidence of achieved military status, ascribed status, wealth, and division of labour (Haller 2004:80-81). Although there was a 25% decrease in overall population, population continued to nucleate near He-4 during this phase, and the number of third-order sites increased to 75, second-order sites, however, only account for five sites (Haller 2004: 82). Mortuary activity throughout the Río Parita Valley is minimal, and next to none occurs at He-4, with other mortuary activities dispersed throughout the region (Haller 2004: 83). These alterations would change the presence of lithics throughout the region, resulting in a different interpretation of lithic data.

Although there is little information on the settlement patterns of the Macaracas Phase (AD 900-1100) from elsewhere in Central Panama, it seems that population in and around He-4 continues to decrease and an increase in the size of second and third-order sites occurs, with third-order sites making up the largest population and area (Haller 2004:85-86). There is evidence of social complexity through the widespread trade of Macaracas ceramics and through the findings in burials at Sitio Conte and Cerro Juan Díaz (Haller 2004:85). The large quantity of burials in the He-4 region for this phase provides further evidence for social ranking within the survey area and implies that very high status, wealthy persons were buried there (Haller 2004: 90-91), but it also suggests that individuals had greater access to status and wealth (Haller 2004: 94). This might have been achieved through part time craft specialization at third order sites in the surrounding regions of the Río Parita Valley (see Chapter 5.0).
The Parita Phase (AD 1100-1300) boasts the second highest population density in the Río Parita survey zone (Haller 2004: 94). He-4 becomes repopulated, five second-order sites are present and 89 third-order sites are identified (Haller 2004: 95). The Parita Phase is very similar to the Macaracas in regards to rank-size distribution and disparities in social class based on burial information (Haller 2004: 99). This suggests that the production and social organization in the region was reliable and stable enough to last several hundreds of years; social stability of this intensity would presumably be due to a high level of social complexity and managerial organization and would be evident through the type of tools and distribution of raw materials throughout the region.

The El Hatillo Phase, named after the site of He-4, which is also known as El Hatillo, is characterized by a widespread distribution of ceramics with spatial or temporal variability (Haller 2004: 99-100). There is little to no change in settlement patterns from the Parita phase, and although He-4 is still prominent it is likely El Hatillo is beginning to be replaced by site 363 and other sites are also beginning to rival He-4 in size (Haller 2004: 102). There is still elite mortuary activity occurring at He-4, especially considering the drop in population, which suggests that it was still an important site for elite mortuary ritual (Haller 2004: 106). The Spanish chronicled many of the sites in the region during their first contact throughout this phase (Haller 2004: 106) providing first-hand accounts of social complexity to substantiate previous claims based on archaeological evidence such as lithic production and distribution.

During the Colonial Period (AD 1522-1821), however, Spanish conquistadores demolished most of the Native population of Panama, with only a few groups surviving, including Natá (Cooke, et al. 2003:3). In 1581, the town of Parita was founded by colonialists in an area that was not often inhabited before colonialism, and is thought to have been to reflect different socioeconomic relationships with a focus on the capital (Castillero Calvo 1995:63, 92-94, 434). Records from this period are the only known ethnographic accounts of Panamanian societies and are often used to extract information regarding previous settlements in the region, although this method of analysis could impose settlement patterns that are not congruent to the settlement patterns of the past. For this reason, it is important to analyze as much
material as possible from pre-historic settlements in the region, including lithics, in order to fully understand the complexity of pre-historic settlements in the Río Parita Valley, Panama.

Social ranking, settlement pattern changes, the beginnings of chiefdoms, and increased economic complexity are all factors that differ from the Early Occupation Sequence and make the Late Occupation sequence one of drastic change and growth for the Central Panama region (Haller 2004:113). Lithic collections from this period and the distribution of said artifacts provide supporting evidence for proto-chiefdom settlements in the region and will be further discussed in Chapter 5.0 of this thesis.

The Warfare model plays a key role in the development of economic interdependence and social complexity (Haller 2004:114). While populations began to grow in Central Panama, possibly due to increased use of agriculture, access to limited resources began to decrease due to increasing demand (Cooke and Ranere 1992:274; Ranere and Cooke 1996:75). The disparities in wealth and social status caused increased conflict between neighbouring areas (Linares 1977:31), but also increased cooperation and trade between different ecological zones for access to restricted goods (Cooke and Ranere 1992:275). This can be seen by the wide distribution of chert from the areas large 10 ha outcrop, which was within the boundaries of La Mula-Sarigua (see Chapter 5.0). Demographic centralization is also thought to be a product of increased conflict (Haller 2004: 114-115).

Before any conclusions can be drawn regarding the influence of conflict on settlement patterns, an estimate of the carrying capacity of the Río Parita Valley to determine if population growth would put enough pressure on resources to cause conflict (Haller 2004: 115). The most accurate demographic information, however, is a product of the Proyecto Río Santa Maria and from the Volcán Barú area just north of the Río Parita Valley, which revealed a population of 2,432 persons in the region based on five persons per household for the 2500m2 area in A.D. 600 (Haller 2004: 116). Many of these estimates do not account for spatial or temporal differences in population densities, making them substandard for proper evaluation of settlement densities, and therefore, should be incorporated with the DAI/C information available (Haller 2004: 119). The carrying capacity of an area can be determined by its crop yield which can be helpful in understanding the agricultural productivity of an area (Haller 2004: 119).
Maize consumption is a common way to detail ethnographic estimations of population; it is often calculated at one metric tonne of maize per year per five-person peasant household (.458 kg per person per day) (Haller 2004: 120). Focusing on one crop, such as maize, to determine carrying capacity disregards other important resources that contribute to ones diet that have the potential to contribute as much as maize (Haller 2004: 121). Additionally, soil productivity needs to be assessed in the same manner due to the fact that inhabitants of the Río Parita Valley did not rely purely on agriculture for subsistence, but rather relied on many resources such as wild fauna, flora, and marine resources (Haller 2004: 124). Hence, soil productivity is examined in my investigation of the lithic assemblage from the Río Parita, but is not a sole indicator of household activity (see Chapter 5.0).

3.3. SUMMARY

Many changes occurred in the evolution of civilization in Panama which was partially influenced by the changing Pleistocene environment as glacial sheets retreated north as temperatures and sea levels rose. Over time this resulted in changes in subsistence and mobility strategies, leading to new lithic production techniques as well as the introduction of new tools and the abandonment of other types that were previously used. The swiftly growing populations of the America’s required these new technologies not only to procure subsistence in a changing environment, but also to more efficiently produce food for their expanding bands and tribes. The changes in settlement patterns and technology that resulted allowed for the movement toward a more socially complex society in Central and Western Panama.

Over time, Panamanian settlements emerged to a state of chiefly society – sedentary settlements showing the beginnings of social complexity and a managerial elite. In the Río Parita, lithic assemblages contribute to the large conglomerate of information, including burial information, ethnohistoric accounts and household archaeological data. Information based on lithics, however, is based on manufacturing techniques, distribution of artifacts, raw material availability, and resource access and control. Although access to the large chert outcrop in the region is thought to have been unrestricted, prime agricultural land
surrounding the outcrop was likely restricted to craft specialists, due to archaeological evidence supporting the area as the only region with significant evidence of specialized craft production (Haller, personal communication). It is likely that warfare in the area was based on the accumulation of slaves, territory, and tribute, to increase a chief’s prestige, rather than being needed to acquire resources for survival (Haller 2004: 129). It is thought that higher social ranking could also be achieved through specialization in craft production, which could have occurred in the third order sites as a recreational activity while agriculture was the primary activity. This will be further examined through the lithic analysis of the data from Haller’s (2004) lithic assemblage. The results from this analysis will further substantiate the claims for social complexity in the region and provide a more complete analytical base for further research.
4. Lithics in Panama

The evolution of lithic production and their associated production techniques can provide a typology that tells a story of the evolution of a society from hunter-gatherers to chiefdoms and beyond. By examining the history of lithic production in the Central and Western regions of Panama it is possible to create hypotheses regarding the socially evolutionary paths of those regions. The examination of specific collections enables site-specific analyses to substantiate current claims for social complexity which can then be related on a local and regional level. First, a history of lithic manufacture and use throughout the region must be attained to properly analyze the collection in question.

4.1. Lithics from Central and Western Panama

The earliest and strongest evidence of stone tool manufacturing in Panama comes from the Paleoindian period in the Chagres River basin near the Panama Canal where eight fluted points were recovered (Ranere & Cooke 1996:53). One of the points resembles the Clovis tradition of the “waisted” variation, while the other seven are of the stemmed “fishtail” tradition originating in Northwest Colombia (Ranere & Cooke 1996: 54). The first Clovis point (not from the Canal Zone) was not seen as very significant upon its finding because its precise origin is not known (Pearson 2002:33). Since then, however, dating of Clovis-like points to the Paleoindian period have been found throughout the region including Panama, Colombia, Belize, and Mexico (Pearson 2002:34). Further evidence includes a specimen form the shore of Lake Arenal, Los Tapiales, and the Chajbal localities in the Quiche Basin (Pearson 2002:34).

First discovered in 1937, fishtail points were dated to antiquity based on their proximity to an extinct horse and giant ground sloth dating back to as early as 12,400 $^{14}$C years BP (Pearson 2002:10). This tradition differs from most because rather than using a bifacial reduction technique, fishtail points are manufactured by thinning large, flat, flakes through a series of bi-marginal percussion and pressure techniques (Pearson 2002:10). The description of “fishtail” refers to many point types with “constricted or
stemmed bases” making the inclusion of some types of fishtail points in the assemblage open to discussion (Pearson 2002:35). The distribution of these points throughout the region suggests that the fabrication of fishtail points occurred between the isthmuses of Tehuantepec and Panama and consists of possibly as many as 30 specimens (Pearson 2002:35).

Other Paleoindian projectile points include up to 58 Folsom points, two possible Cody points, and two potential El Jobo points (Pearson 2002:35). In addition to the aforementioned collections, stemmed points, and La Elvira points have also been discovered (Pearson 2002:36). These assemblages support a widespread communication or movement of peoples throughout Panama and South America (Pearson 2002:36). Fluted points from La Mula-West, Panama, were discovered in relative proximity to a 11,350 ± 250 ^14^C year old hearth, while rock shelters from the region boast findings from bifacial industries as early as 10,440 ± 650, 10,725 ± 80, and 10,529 ± 184 ^14^C years B.P. (Pearson 2002:37).

Also during this time new technology such as concave scrapers, steep scrapers, perforators, gravers and flake-knives were appearing in the lithic assemblages, along with edge-ground cobbles and boulder milling stones (Ranere and Cooke 1996:59). The emergence of these is indicative of at least partial agrilocality, which is the spatio-temporal pattern of specialized domestication by specific groups, possibly based on root- and tree-crop subsistence resources (Ranere and Cooke 1996:59). This hypothesis is indicative of a significant change in the settlement patterns of Panama. It is evidentiary of the shift from hunter-gatherer societies to one that is at least partially reliant on semi-domesticated crops that could lead to the complexity level of a chiefly society.

4.2. Lithics from the Río Parita Valley

Research conducted by Haller (2004) provides a substantial lithic assemblage for analysis and debate consisting of a large variety of lithic tool types as well as materials (see Figure 3). Information such as household activities, craft specialization, and agricultural activities can be extracted from this material
based on a number of analytical criteria which will be further explained in this, and the following, chapter. This information will aid in the development of theories of social complexity in the region based on settlement patterns and the differentiation of activities throughout the valley. Specifically important to this region, is the chert outcrop that is in close proximity to the regional centre of La Mula-Sarigua in the Río Parita archaeological survey which is the primary source for most of the chipped stone raw materials in the region (Haller 2004:137). This type of stone is formed by chemical precipitates in sedimentary rocks when silicon and oxygen – the two most common elements on the planet – combine to create silicon dioxide, one of the hardest minerals on Earth, and the stone microcrystalline quartz, or chert (Andrefsky 2005:53). The importance of this resource, however, was not always demonstrated or utilized; for instance, the first order site of La Mula-Sarigua was not always a large site at the forefront of the site hierarchy in the valley, but rather, emerged as a reflection of the change in importance of the resource (Haller 2004:148). Hansell (1988:245) proposes this change was possibly due to the increased craft specialization at La Mula-Sarigua, due to its proximity to the chert resource, resulting in the site gaining status as the central place in a regional trading system. This is emphasized by the presence of ground stone tools such as metates or polished stone tools, for which the material is not present in the region (Hansell 1988:214, 248-250). Their presence in the archaeological record is then highly indicative of inter-regional trade (Hansell 1988:214, 248-250).

Scrapers retrieved from the Río Parita Archaeological Project have been categorized dissectionally, based on a range of three scraper plane angles (Haller 2004:152; see Table 1). Scraper plane angles, as seen in Table 1, included scraper types A ($< 30^\circ$), scraper type B ($30^\circ < x < 60^\circ$), and scraper type C ($> 60^\circ$). Presumably, the variance in scraper plane angle reflects a differentiation in tools use or activity associated with each tool type. Polythetic approaches are also used in the survey done by Haller (2004:139-140, 142) in order to categorize tool types including scrapers, points, tools, flakes, and cores.
Table 1. Scraper planes from the Río Parita survey (not including multi-plane scrapers).

<table>
<thead>
<tr>
<th>Angle</th>
<th>Width</th>
<th>Length</th>
<th>Depth</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30°</td>
<td>3.4 cm</td>
<td>2.6 cm</td>
<td>.8 cm</td>
<td>1.6 cm</td>
</tr>
<tr>
<td>30° &lt; x &lt; 60°</td>
<td>4.0 cm</td>
<td>2.6 cm</td>
<td>1.3 cm</td>
<td>1.9 cm</td>
</tr>
<tr>
<td>&gt;60°</td>
<td>4.0 cm</td>
<td>2.7 cm</td>
<td>1.5 cm</td>
<td>1.5 cm</td>
</tr>
</tbody>
</table>

La Mula-Sarigua (Hansell 1988: Tables 8,9; n=190) 6.0 cm 6.4 cm 3.7 cm n/a

From Haller 2004:152

Hansell collected a large number of tools from Western Panama with there being diminutive accounts of prepared cores or platforms (Hansell 1988:105-112). Unifacial points, however, showed evidence for standardized bases, therefore it is possible that hafts were standardized and great care, accuracy, and control were used when producing these tools (Hansell 1988:105-112). Haller’s collection of almost 1300 lithic artifacts also produced many of these chipped stone tools, including La Mula unifacial points, which are manufactured carefully from prepared cores and were often used as scrapers, knives, perforators and gravers; scraper planes, either having an angle of < 30°, 30° < x < 60°, or > 60°); wedges, knives, choppers, flakes, and rejuvenation tablets, as well as some bifacial materials were also recovered (Haller 2004:150; see Figure 3). The Río Parita assemblage is mainly comprised of a selection of red/yellow jasper, chert, quartz, and petrified wood (Haller 2004:151). It is proposed by several archaeologists working in Panama that the majority of chipped stone tools from the region would have likely been used in woodworking activities (Hansell 1988:112; Ranere 1980:124-125; Haller 2004:150; see Figure 3) such as chopping, shaving, carving, or chipping.
Macroscopic analyses of stone tools at the Río Parita revealed their source location within the site boundaries of La Mula-Sarigua within a 10 ha chert outcrop (Haller 2004:137). Tools from the entire survey zone appear to have come from this outcrop and have been dispersed throughout the region; this suggests that access to the large resource was unrestricted. Restricting access to such a large resource would have required a significant amount of managerial control and a large number of people to either patrol the area, or to build some sort of containment wall, in order to protect the resource from outsiders, which would have been evident in the archaeological record. Thus, access to the chert outcrop, through both lithic distribution evidence and common sense, was undoubtedly unrestricted, although Cooke and Ranere (1992) suggest that access to the outcrop was managed according to corporate group affiliation.

In the Río Parita, it is generally thought that the expedient process of manufacturing, which was focused on the 10 ha chert outcrop outside of La Mula-Sarigua, was used when it came to chipped stone tool production (Haller 2004:139). This is likely due to the sufficient availability of quality raw lithic
material in the region, which usually results in the production of expedient tools because users can simply return to the source to create new tools as they are required, as mentioned by Andrefsky (1994:22). Although this behaviour is typically associated with sedentary populations, it has also been noted in mobile populations where raw materials become readily available (Andrefsky 1994:23). The strength associated with raw material availability and sedentary populations is a likely reason why the site hierarchy in the Río Parita Valley would have concentrated to La Mula-Sarigua. This was likely due to the change previously noted in this volume regarding the increase in importance of lithic tools and production during the La Mula ceramic phase in Panama (refer to Chapter 3.0).

In addition to chipped stone tools, ground stone tools, 86 in total, were also recovered from the Río Parita survey zone (Haller 2004:145). These included manos, metates, and celts or stone axes, although many of these were not collected due to their weight (Haller 2004:145). Metates came in the form of legged, slab, or breadboard, and often were made from volcanic tuff, which can be found locally, along with the manos associated with them (Haller 2004:145). Axes, both polished and not, were also found in the Río Parita survey zone and were either pear or trapezoidal in shape (Haller 2004:159). Stone axes, however, were not found to be manufactured at La Mula-Sarigua and as suggested by Hansell (1988:124) they were likely imported from elsewhere in the region. The stone axes from the survey zone, which were usually made from a fine-grained andesite or basalt, or a dark igneous basaltic rock, were likely used to clear forests for both cultivation and woodworking, or perhaps to butcher meat from captured game, as suggested by Einhaus (1980:463). The presence of ground stone tools is indicative of specific activities such as the procurement of grains and the clearing of land, and therefore, the presence of these tools at specific sites can indicate a division of labour which is typically associated with a complex societal composition. The analysis of the presence of such tools in the record from the Río Parita will clarify this hypothesis.
5. **Analysis and Discussion**

The analysis of the information regarding social complexity in the Río Parita Valley is based on data analyses from a lithic data set gathered during field seasons conducted by Dr. Mikael Haller in the Río Parita Valley, Panama (2004). Statistical analysis of the data can make patterns of production and consumption more visible, and can help to more accurately represent the information contained within the data through standardization of data, and statistical tests of strength and significance. Statistical analysis of the lithic data from the Río Parita Valley will aid in the examination of the nature of social complexity in the area based on lithic production and use; therefore, either supporting or rejecting the previous claims of social complexity from Central and Western Panama. The lithic assemblage, unfortunately, could not be quantified based on chronology as the information necessary to do so is not currently available.

5.1. **Statistical Methods**

I have organized the data to conduct rank size analyses by soil type through a determination of the site rank hierarchy and allocating a numerical coefficient to represent it. Site order was quantified as first-order sites (Rank 1), second-order sites (Rank 2), and third-order sites (rank 3) in order to run statistical analysis between tool types and site rank. Site ranks are based on the site rank determinations made by Haller (2004) and are based on population density, with first-order sites having the highest population density and third-order sites having the lowest population density. The lithic data included points, all scrapers, scraper types, celts, metates, flakes, and tools and needed to be quantified in many different ways a number of times. Tool types (points, scrapers, celts, metates, flakes, and tools) and scraper types (A, 1=<30°; B, 2=>30°, <60°; and C, 3=>60°) were quantified in order to run statistical analysis on them using Systat.
After quantifying the lithic data (see Table 2), tool totals per site rank were calculated and standardized by the number of lots per site rank. Tool totals per rank were, therefore, divided by the number of lots per rank to provide a standardized measurement of the number of tools for each tool type per rank (see Table 3). This was done to assure equal representation of artifacts based on the fact that there were a significantly larger number of third-order site lots in the survey than there were first- and second-order sites. Scraper type totals were also calculated and standardized in the same way in order to make sure that over-representation of tool totals in certain ranks is avoided due to a significantly higher number of third-order sites.

Table 2. Tool Type Totals per Site Rank

<table>
<thead>
<tr>
<th></th>
<th>SCRAPER (all)</th>
<th>POINTS</th>
<th>TOOLS</th>
<th>METATE</th>
<th>CELTS</th>
<th>FLAKES</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANK 1</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>107</td>
<td>133</td>
</tr>
<tr>
<td>RANK 2</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>10</td>
<td>31</td>
<td>55</td>
</tr>
<tr>
<td>RANK 3</td>
<td>30</td>
<td>5</td>
<td>66</td>
<td>6</td>
<td>45</td>
<td>441</td>
<td>593</td>
</tr>
<tr>
<td>TOTAL</td>
<td>38</td>
<td>11</td>
<td>76</td>
<td>13</td>
<td>64</td>
<td>579</td>
<td>781</td>
</tr>
</tbody>
</table>

Table 3. Tool Percentages per Site Rank per Total Lots

<table>
<thead>
<tr>
<th></th>
<th>SCRAPER</th>
<th>POINTS</th>
<th>TOOLS</th>
<th>METATE</th>
<th>CELTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANK 1</td>
<td>4.0%</td>
<td>6.7%</td>
<td>6.7%</td>
<td>5.3%</td>
<td>12.0%</td>
</tr>
<tr>
<td>RANK 2</td>
<td>4.1%</td>
<td>0.8%</td>
<td>4.1%</td>
<td>2.5%</td>
<td>8.3%</td>
</tr>
<tr>
<td>RANK 3</td>
<td>2.8%</td>
<td>0.5%</td>
<td>6.2%</td>
<td>0.6%</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

The second method of standardization used to determine the association between tool type and site rank was by the total area (ha) of each site rank. This was done by determining the total number of tools per tool type for each rank and dividing that total by the total area (ha) of each site rank (see Table 4). This method of standardization was also performed on each type of scraper to determine the standardized value of each scraper type per site rank (see Table 5).
Table 4. Tool Totals per ha per Site Rank.

<table>
<thead>
<tr>
<th>RANK</th>
<th>SCRAPER (ALL) POINTS</th>
<th>TOOLS</th>
<th>TOOLS (NO SCR) METATE SLAB</th>
<th>METATE LEG</th>
<th>CELTS</th>
<th>FLAKES</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.04273</td>
<td>0.07121</td>
<td>0.07121</td>
<td>0.02849</td>
<td>0.08546</td>
<td>0.04273</td>
<td>0.12819</td>
</tr>
<tr>
<td>2</td>
<td>0.06455</td>
<td>0.01291</td>
<td>0.06455</td>
<td>0.00000</td>
<td>0.05164</td>
<td>0.05164</td>
<td>0.12910</td>
</tr>
<tr>
<td>3</td>
<td>0.05608</td>
<td>0.00935</td>
<td>0.12338</td>
<td>0.06730</td>
<td>0.02056</td>
<td>0.00187</td>
<td>0.08412</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.16336</td>
<td>0.09347</td>
<td>0.25915</td>
<td>0.09578</td>
<td>0.15766</td>
<td>0.09624</td>
<td>0.34141</td>
</tr>
</tbody>
</table>

Total number of tools per ha per site rank

Table 5. Total Scraper by Type per ha per Site Rank.

<table>
<thead>
<tr>
<th>RANK</th>
<th>SCRAPER A</th>
<th>SCRAPER B</th>
<th>SCRAPER C</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANK 1</td>
<td>0.00000</td>
<td>0.02849</td>
<td>0.01424</td>
<td>0.04273</td>
</tr>
<tr>
<td>RANK 2</td>
<td>0.01291</td>
<td>0.02582</td>
<td>0.02582</td>
<td>0.06455</td>
</tr>
<tr>
<td>RANK 3</td>
<td>0.00561</td>
<td>0.03365</td>
<td>0.01122</td>
<td>0.05047</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.01852</td>
<td>0.08796</td>
<td>0.05128</td>
<td>0.15775</td>
</tr>
</tbody>
</table>

Total number of scrapers per ha per site rank

Next, tool totals and scraper type totals were calculated again, but rather than standardizing them by total number of lots per site rank, they were standardized by the total area per site rank (ha). Soil types were also considered in the analysis of tools from the Río Parita Survey. The total number of tools per soil zone was then calculated using AutoCAD. Standardization of the totals was required in order to accurately represent the data due to the variance of each soil zone’s total area (km²). This was done by dividing the total tool types per soil zone by the total area (km²) of each soil zone. Analyses based on these results were then performed by site type and soil type and are included in the sections below.

Results of the analysis of the information from the lithic assemblage aim to give evidence for, or against, geographic division of labour, which would support or oppose, and clarify, the nature of social complexity in the Río Parita Valley, Panama. I will focus on the statistical analyses of scrapers found during the Río Parita Survey in respect to how the scraper types, are related to their geographic location both geologically (based on soil type) and spatially (based on rank size). As stated in previous chapters, by determining the distribution of tools throughout the region, patterns can be extracted that suggest a division of labour based on either site type, or soil type. The result of these patterns then influences the
hypothesis about the nature of social complexity, by either supporting or rejecting the claims for social complexity in Panama.

5.2. Analysis by Soil Type

Soil fertility was based on maps prepared from CATAPAN 91971 and were quantified as Soil Fertility Level 1 (Floodplain), Soil Fertility Level 2 (Lower Central Plains [High Fertility]), Soil Fertility Level 3 (Lower Central Plains [Medium Fertility]), Soil Fertility Level 4 (Lower Central Plains [Low Fertility]), Soil Fertility Level 5 (Mangrove Swamp), and Soil Fertility Level 6 (Salt Flats) (see Figure 4, Table 6). Soil type is important in the analysis of tool types because certain activities are associated with particular soil types. For instance, you would not attempt agriculture in the swamps (level 5); therefore, one would not expect to find tools associated with farming in that location. Soil ranks range from high productivity, to medium, to low, to non-arable (Haller 2004:135) and each layer can be associated with a particular productivity level. Soil layer 1 and 2, the Floodplain and the Lower Central Plains, are considered to be the most productive regions to live in the Río Parita survey zone; soil layer 3, also in the Lower Central Plains, consists of a region with medium soil productivity; soil level 4 comprises a low productivity zone within the Lower Central Plains; and soil levels 5 and 6, the Swamp and Salt Flats, are considered completely non-arable (Haller, personal communication).
Fig. 4. Physiographic zones of the Río Parita survey area (based on data from Haller’s [2004] AutoCAD dataset)

Table 6. Physiographic Soil Layer, Soil Zone, and Fertility Level

<table>
<thead>
<tr>
<th>SOIL LAYER</th>
<th>SOIL ZONE</th>
<th>FERTILITY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Floodplain</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Lower Central Plains</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Lower Central Plains</td>
<td>Medium</td>
</tr>
<tr>
<td>4</td>
<td>Lower Central Plains</td>
<td>Low</td>
</tr>
<tr>
<td>5</td>
<td>Mangrove</td>
<td>Non-arable</td>
</tr>
<tr>
<td>6</td>
<td>Salt Flats</td>
<td>Non-arable</td>
</tr>
</tbody>
</table>

Tool type totals were standardized by dividing the number of tools in the soil layer by the total area of the layer (km$^2$). The total area of Soil Level 1 is 5.5093 km$^2$; Soil Level 2 has a total area of 15.4121 km$^2$; the total area of Soil Level 3 is 35.0892 km$^2$; Soil Level 4 has a total area of 7.3970 km$^2$; the total area of Soil Layer 5 is 9.2708 km$^2$; and Soil Level 6 has a total area of 11.3086 km$^2$ (see Table 8). The tools that were analyzed in this data set include chert cores (COC), total petrified wood
(PWTOT), total quartz (QuartzTOT), Scraper A, Scraper B, Scraper C, total scrapers (ScraperTOT), and total tools (TTOT).

### Table 8. Physiological Zones with Area

<table>
<thead>
<tr>
<th>SOIL LAYER</th>
<th>SOIL ZONE</th>
<th>TOTAL AREA (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Floodplain</td>
<td>5.5093</td>
</tr>
<tr>
<td>2</td>
<td>Lower Central Plains</td>
<td>15.4121</td>
</tr>
<tr>
<td>3</td>
<td>Lower Central Plains</td>
<td>35.0892</td>
</tr>
<tr>
<td>4</td>
<td>Lower Central Plains</td>
<td>7.3970</td>
</tr>
<tr>
<td>5</td>
<td>Mangrove</td>
<td>9.2708</td>
</tr>
<tr>
<td>6</td>
<td>Salt Flats</td>
<td>11.3086</td>
</tr>
</tbody>
</table>

There was a very weak correlation, however, between presence of tools and soil fertility ($r_s = 0.143; p = 0.787$). In other words there does not appear to be a meaningful relationship between the presence of chipped stone tools and soil type. This correlation suggests that the examination of soil fertility has little effect on the likelihood of finding specific tool types; therefore, the primary focus of this data will be site rank analysis, which will provide the means to emphasize the relationship between tool type and site rank. The relationship between tool type and site rank will allow the distinction to be made of whether certain activities were occurring based on the type of site one lived in, rather than the type of soil one lived on.
### Table 9. Lithic Assemblage Totals per Soil Zone

<table>
<thead>
<tr>
<th>SOIL LAYER</th>
<th>COC</th>
<th>PWTOT</th>
<th>Quartz TOT</th>
<th>ScraperB</th>
<th>ScraperC</th>
<th>ScraperA</th>
<th>Scraper TOT</th>
<th>TTOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.5445</td>
<td>0.1815</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.1815</td>
<td>0.3630</td>
</tr>
<tr>
<td>2</td>
<td>0.5191</td>
<td>0.1947</td>
<td>1.2328</td>
<td>0.4542</td>
<td>0.1947</td>
<td>0.0000</td>
<td>0.6488</td>
<td>0.6488</td>
</tr>
<tr>
<td>3</td>
<td>0.2280</td>
<td>0.1710</td>
<td>0.4275</td>
<td>0.4560</td>
<td>0.2280</td>
<td>0.0570</td>
<td>0.7410</td>
<td>0.9690</td>
</tr>
<tr>
<td>4</td>
<td>0.2704</td>
<td>0.0000</td>
<td>0.4056</td>
<td>0.4056</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.4056</td>
<td>0.9463</td>
</tr>
<tr>
<td>5</td>
<td>0.0000</td>
<td>0.0000</td>
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<td>6</td>
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<td>0.4421</td>
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<tr>
<td>TOTAL</td>
<td>1.2827</td>
<td>0.4541</td>
<td>2.9641</td>
<td>1.6741</td>
<td>0.5111</td>
<td>0.1454</td>
<td>2.3306</td>
<td>3.3693</td>
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#### 5.2.1. Chert Cores (COC)

Chert cores are commonly associated with production areas because they are the product of primary reduction techniques, therefore, it can be assumed that many areas where cores are found should be associated with main areas of production. As can be seen by Table 9, chert cores are found most frequently in Soil Layer 2 (Lower Central Plains – high productivity). Cores were also found, at less frequency, in Soil Layer 3 (Lower Central Plains – medium productivity), Soil Level 4 (Lower Central Plains – low productivity), and Soil Level 6 (Salt Flats – non-arable) (see Table 9). With no apparent production occurring in the floodplain (Soil Level 1), in association with the low frequencies of cores in the areas of He-4 in Soil Level 4 and also Soil Level 3, it is unlikely that production of tools was occurring in these regions (see Table 9). The high frequency of cores in Soil Level 2, however, does coincide with the location of the chert outcrop in the region. This supports the suggestion that most tools were begun at the chert outcrop to create performs, and then were reduced further once the specific task for the tool was chosen upon return to different sites throughout the area.

#### 5.2.2. Petrified Wood (PWTOT)

Petrified wood is not typically a common material used for tool manufacture due to its tendency to flake only in one direction. This is because the fracture planes of petrified follow the grain of what used to be wood, making it a poor quality material for generalized tool-making. For quick tasks that require a non-specialized tool, however, petrified wood can suffice (Menzies, personal communication). Due to its poor
quality, one would not expect a high presence of petrified wood in the collection from the Río Parita Valley, especially considering the large 10 ha outcrop of chert, which is a much more effective and efficient material in the region. This assumption is held true when examining the frequency of petrified wood, with only one tool for every 2.25 km² of the entire survey zone. It is most frequently found in Soil Layer 2 and Soil Layer 3 at respective frequencies of 0.1947 and 0.1710 per km², which comprise the majority of the Lower survey zone. In Soil Layer 6, petrified wood was found at a frequency of 0.0884 tools per km² (see Table 9).

Petrified wood would have been used for specific tasks that needed to be completed without a specialized or high quality tool. The ease of manufacture and disposability of these tools makes them ideal for quick tasks, but does not support a high frequency in the archaeological record. The large and easily accessible chert outcrop in the Río Parita Valley would have also reduced the need for other tool materials, making petrified wood almost obsolete.

5.2.3. **Quartz (QuartzTOT)**

Quartz is one of the main materials found in the Tertiary volcanic rock fractures in the region (Haller 2004:20). Quartz was the second most highly distributed tool type in the analysis having occurred at a frequency of 2.9641 tools per km²; its wide distribution throughout the region, in all but one soil zone, supports that the resource was highly available and not restricted. It occurred at its highest frequency in Soil Layer 1, closely followed by Soil Layer 3 and Soil Layer 4 (0.5445 per km², 0.4275 per km², and 0.4056 per km² respectively; see Table 9). This is unexpected considering the large, uncontrolled outcrop of chert in the region and could be indicative of craft production of specialty items such as trinkets, which might indicate some sort of increased social status based on the aesthetic qualities of quartz.

5.2.4. **Scrapers (ScraperTOT)**

Scrapers occurred at the third highest frequency (although the highest frequency rate – TTOT – includes scrapers in its measurement making the frequency of scrapers the second highest, in reality) throughout the survey zone at a rate of over 2 scrapers per square kilometre and were found in all zones except the
Mangrove Swamp. Scrapers occurred primarily in Soil Level 2 and Soil Level 3 at a frequency of 0.6488 and 0.7410 per km$^2$, respectively (see Table 9, Figure 5). These regions did not participate highly in agriculture, but were more diverse, specializing in craft production as well. Additionally, scrapers did not occur at a substantial frequency in Soil Level 1 (Floodplain), reaching a frequency of only one artifact every six square kilometres. In consideration of these factors, it is likely that scrapers were not primarily used for agricultural purposes, but were likely used for other activities that were taking place in the river valley. This is similar to the hypothesis presented by Hansell (1988) which proposes the main use of scrapers was woodworking. If scrapers were primarily used for woodworking, then they would be more commonly found in regions specializing in craft production, and not areas designated for agriculture. The items that are created from woodworking, however, do not often preserve due to the tendency for organics to decompose. For this reason, it is unlikely that direct evidence will ever be found to link scrapers to woodworking, although that is the most logical function, as supported by the dispersion of scrapers throughout the valley. It is possible, however, to hypothesize the differentiating functions of each of the different scraper types.

Scrapers with planes <30° (ScraperA) were found in only Soil Layer 3 (Lower Central Plains – medium productivity) and Soil Layer six (Salt Flats – non-arable). These delicate scrapers were likely used for intricately detailed craft production activities, and were probably not associated with agricultural activities in the region. Their presence in the medium productivity zone and the salt flats was low in both instances, occurring at a rate of 0.0570 artifacts per km$^2$ and 0.0884 artifacts per km$^2$ respectively, suggesting that work done using this type of tool was not commonplace among the inhabitants of the Río Parita Valley, but was possibly only the work of specialists (see Table 9).

Scraper B (scraper plane angle = >30°) type scrapers were found everywhere but the wetlands, but most commonly were found in Soil Layer 3 (Lower Central Plains – medium productivity) (see Table 9, Figure 5). This distribution implies that this tool was likely used for a number of activities throughout the region. The lack of scraper B in the floodplain, however, suggests that these tools were not likely to have been used for agriculture since the floodplain would have been prime agricultural land in the Río
Parita Valley due to its natural fertility from seasonal flooding. Scraper B was found fairly evenly distributed between Soil Layer 2, Soil Level 3, and Soil Level 4, which also supports the conclusion that scraper B type scrapers were not used for agriculture, since Soil Level 4 has such poor soil quality and would likely not have been used for growing purposes. These scrapers, because of their medial scraping angle, were likely used for a variety of cutting and scraping activities and can possibly be thought of as the multi-tool of the three scraper types.

Scrapers with a scraper plane angle $>60^\circ$ (ScraperC) were found in Soil Layer 2 (Lower Central Plains – high productivity), Soil Layer 3 (Lower Central Plains – medium productivity), and Soil Layer 6 (Salt Flats – non-arable) (see Table 9, Figure 5). They were most frequently found in Soil Layer 3, however, at a rate of 0.1947 scrapers per km$^2$, followed by Soil Level 2 (0.1947 artifacts per km$^2$), and then at a frequency of 0.0884 artifacts per km$^2$ in Soil Level 6 (see Table 9, Figure 5). If scraper C type scrapers were associated with agricultural activities, one would expect them to have a high frequency in both the floodplain and Soil Level 2; conversely, the opposite occurs where none are found in the floodplain and only the second highest frequency of scraper C type scrapers are found in the high productivity agricultural zone. This likely implies that scraper C type scrapers were also not used for agricultural purposes, but were possibly used for more intensive specialized activities in the region, due to their obtuse scraper plane angle, which would be ideal for strenuous activities.
5.2.5. Tools (TTOT)

Tool totals include the frequency of tools such as axes, polishing stones, chisels, stone-axe-bit scraper, and all scrapers previously discussed. These tools could be used for a wide variety of activities. Medium to low productivity land was usually on hills and was not of high quality in nutrients or moisture – tools were found at their high frequency in these regions. Their low frequency in Soil Layer 1, which is the most fertile, supports the idea that these tools may have been used in poor agricultural land because agriculture in these regions would be more difficult and might need a more diverse toolset to efficiently work the land (see Table 9). Consequently, floodplain agriculture was probably much easier, and therefore perhaps little or no tools were needed to aid in the process of floodplain agriculture. If there was agriculture occurring in the floodplain, the rich soils would have required little to no tending and the soils softness would not have necessitated heavy or diverse toolsets. The relative toughness and sterility of higher ground, such as is found in Soil Layer 3 and 4, compared to the floodplain and high fertility zones, could have required more extensive tending in order to reap a comparable crop, which would have been facilitated by a diverse and hefty toolkit.

These results could indicate that two different types of agricultural production were occurring in the Río Parita Valley. Or, perhaps the tools were used for non-agricultural activities. It is not likely that
these tools were used in craft production, however, because they are not present in the record in the soil layer containing La Mula-Sarigua or He-4, where the majority of craft specialization is thought to have taken place. This is evident also at the site of Cero Juan Diaz where shell ornaments and shell craft production was done at the large site and was characterized by large scale manufacturing in a shell workshop; it was not taking place in hamlets or as a part-time craft (Mayo 2004). Therefore, it is possible that these were utilitarian tools due to their use in regions consisting mostly of hamlets in medium to poor agricultural land. Perhaps these individuals who were in more marginal areas (i.e., 3rd order sites medium to low productivity zones) were using certain craft products, or activities, to supplement their agricultural production. Douglass (1996) found that the majority of craft production in the Naco Valley, Honduras, was at marginal centres and could have reflected social mobility; this could be done while one was working in the field. In the Río Parita, an agricultural labourer could produce crafts in their spare time and might use that skill as a means for bettering themselves socially, similar to how adult males in Panama could use warfare to increase their social status.

5.3. **Analysis by Site Type**

Tool association with site type can tell us a lot about the level of social complexity of a region. If variance occurs between the types of tools that are associated with one site rank, as opposed to another, one can presumably conclude that different activities were taking place at different sites. This also enables the conclusion that craft specialization and labour was divided by site rank. The presence of tool dispersion by site type would further support the previous conclusions regarding the level of social complexity found in the Río Parita, Valley, Panama. Conversely, if there is no noticeable differentiation between tool type and site rank, this would suggest that people in every part of the region were participating in the same tasks, which would propose a more egalitarian and less socially complex way of life in the region. If the results propose an opposition to the theories currently suggested by a number of researchers from Central
and Western Panama (e.g. Haller 2004; Menzies 2006; Ranere 1980a, 1980b; Cooke 2003; Cooke et Al. 2003; Cooke and Ranere 1992; Ranere and Cooke 1996; Hansell 1988).

Statistical analysis of the lithic assemblage will determine the association, or lack thereof, between tool type and site rank, and the association, if any, between individual scraper types (A, 1=<30°; B, 2=>30°, <60°; and C, 3=>60°) and site rank. It is possible, due to the relatively high number of third-order sites, that an over-representation of third-order data will skew our results and therefore might misrepresent the results of the statistical analysis. For this reason it is necessary to standardize the data prior to the interpretation of the results of the analysis.

5.3.1. Scraper

Scrapers from the Río Parita lithic assemblage appear to have been manufactured in similar ways, then modified to suit a particular activity based on the high level of uniformity of length and width in the assemblage (Haller 2004:151). Each type of scraper from this assemblage was found in each site rank, suggesting that the associated activities were not limited to a particular settlement type (Haller 2004:151). Although the activities associated with these tools have not been conclusively determined (Ranere & Cook 1980:124-125; Haller 2004:151), they are presumably associated with woodworking based on experimental archaeological results and use wear as determined by Ranere’s Central Panama lithic assemblage (1980:124-125). In general, scrapers were most commonly found at second order sites in the Río Parita survey; however, scraper type B was most commonly found scraper type at all site ranks, followed by scraper type C, then scraper type A (see table 5).

Upon viewing the standardized data for each scraper type per rank, one can clearly see certain patterns emerging. To begin with, first order sites do not contain any scrapers with a scraper plane <30°. Although the exact activity associated with scrapers is still inconclusive, one can assume that the wider the scraper plane the more strenuous the activity associated with it. Based on that assumption, it is unlikely that any finely detailed activities, which are associated with scrapers with a scraper plane <30°, were associated with first order site settlements. Scrapers with planes >30°, but <60° are most commonly found at first order settlements out of the three scraper types (0.0428/ha). These scrapers, because of their
average scraper angle, are assumed to be a multi-purpose tool (Haller, personal communication), and therefore, their high presence at first order sites does not necessarily provide us with any further information regarding the activities associated with this type of scraper. Finally, scrapers with a scraper plane of >60°, presumably used for heavy duty activities, were found at a frequency of 0.01424 per ha in the Río Parita survey zone, suggesting that there were more heavy duty activities occurring at first order sites than there were finely detailed activities, since there is no evidence of scraper type A at first-order sites, while there is presence of scraper type C (see Table 5). There is, however, not much evidence for either at the present time because the frequencies for all scraper types are still low, having only a fraction of a tool for every hectare of survey zone (see Table 5).

At second-order sites, the distribution of scraper types seems to be fairly even, with the frequency of scraper types B and C occurring at an identical rate (0.02582 per ha), and the frequency of scraper type A occurring at a rate of 0.01291 per ha. A relatively even distribution of scraper types suggests that all types of activities were being done at second order sites; specialization is not suggested by these results. Scraper type B was most frequently found scraper type at third order sites (0.03365 per ha), followed by scraper type C at a frequency of 0.01122 per ha, and then scraper type A which occurred at a rate of 0.00561 per ha. The presence of every scraper type at third-order sites, which consisted of isolated farmsteads in the hills around the Río Parita (Haller 2004:62), suggests that they would have been providing the majority of their own items for production and consumption. Their relative distance to certain resources, such as the 10 ha chert outcrop and highly productive soils, would make it more difficult for them to use specialized services that were potentially being undertaken at the first-order site of La Mula-Sarigua or second-order site of He-4.
5.3.2. Points

While projectile points are typically associated with hunting, the points recovered from the lithic assemblage at the Río Parita are not really points, but appear to have been used for scraping, cutting, graving, and perforating (Hansell 1988:235). Since La Mula points are more finely detailed and carefully produced than other tools such as scrapers, along with serving a number of uses, it is likely that they were used for craft production and female activities (Cooke and Ranere 1984:10; Hansell 1988:107). The highest frequency of points in the Río Parita survey zone occurs at first order sites (0.07121 per ha), followed by second and then third order sites at 0.01291 per ha and 0.00935 per ha respectively.

This pattern suggests that craft production associated with this type of tool was more a more common activity at first order sites, and became less common as one moved to second and then third order sites. Considering that third order sites were typically known to be farmsteads, this presumption is acceptable in this context since it is unlikely that farmsteads would be participating in specialized craft production. This suggests that there was craft specialization at the first order site of La Mula-Sarigua that did not occur at lower rank sites in the region.

5.3.3. Tools

Other tools included in this category are a chisel, two polishing stones, a used stone-axe-bit scraper, and a ground stone axe (Haller 2004:170). The majority of these tools occurred in third order sites (0.06730 per ha), while a tool was located approximately every 35 hectares, and none were found at second order sites. The small sample size in this case, also impedes the development of any substantial conclusions, other than that tools were most frequently found at third order sites due to their agricultural context and use. I attribute their inexistence at second order sites to the small sample size, having only 0.09578 tools in the entire survey area, rather than conclude that no activities associated with such tools were performed at second order sites. It is possible that more tools to support differentiated activities simply have not been found yet.
5.3.4. Metates (Slab)

Slab metates are large boulders that, previous to their use by humans, had little distinguishable shape and are used for the processing of various agricultural resources, particularly the grinding of maize (Haller 2004:156). Of the 29 identifiable metates recorded from the survey (see Figure 6), 21 (72.4%) were of the slab metate design (Haller 2004:145). Although slab metates occurred in all parts of the survey zone, they were primarily reported within the first order sites at a frequency of 0.08546 per ha, while presence of slab metates at second order sites occurred at a rate of 0.05164 per ha and at third order sites at 0.02056 per ha.

Agricultural activity primarily occurred in the area of third order sites, but because of the low population density at third order sites (Haller 2004:118), high numbers of processing tools would not be expected because they would only process the goods they would need for their own families. Similarly, the moderate population density at second order sites (see Haller 2004) would suggest a moderate amount of processing tools in order to provide for the number of consumers in the area. The higher number of slab metates at the first order site of La Mula-Sarigua, however, provides a slightly different position due to the lack of agricultural land and production in the area. Perhaps the higher number of slab metates is simply relative to the higher population density. Or, the disparity between metates and agricultural production in the settlement could suggest that agricultural goods, such as maize, may have been brought into the area from the third order farmsteads to provide subsistence to those living in the first order sites. If the inhabitants of La Mula-Sarigua were not producing their own food because they were specializing in craft production, then it is possible that subsistence was brought to the settlement from smaller hamlets seeking items to trade. This was likely done in a way that would minimize effort and maximize efficiency by removing maize from the cob prior to bringing the goods from the third-, to the first-order sites, which would leave no archaeological footprint.
5.3.5. Metates (Legged)

Legged metates were more time intensive grinding platforms that usually were built with either three or four conical or tapered pecked legs (Haller 2004:156; Figure 7b). While four-legged metates were typically rectangular in shape, three-legged metates were more circular in shape and were characteristically made from either local andesite or vesicular basalt (Haller 2004:156). Legged metates are possibly symbolic of ritual (Haller 2004:156) and have also been suggested to have been used as seats or thrones (Cooke 1998c:103). Legged metates were also found within the survey zone, although their presence is clearly distinguishable between the three survey zones.
Third order sites comprise the lowest frequency of legged metate in the entire survey zone with only 0.00187 occurring per ever square hectare. While it is possible that some ritual activity might have occurred at third order sites, it is unlikely, and this is reflected in the low frequency of ritually related artifacts such as legged metates. Second order sites have the highest frequency of legged metates, although only slightly higher than first order sites at a rate of 0.05164 per ha as opposed to 0.04273 per ha. This discrepancy, however, could be due to the relatively small sample size from the region, although it is more likely that ritual processing of maize, or the use of legged metates as seats or thrones, most frequently occurred at He-4 during this period. This is because He-4 is the one of the only areas in the region with evidence supporting ritual activity (Haller, personal communication); whereas La Mula-Sarigua would have been more focused as a site of craft specialization and trade.

5.3.6. Celts and Manos

Manos were made from similar materials as metates and were generally bar shaped (Haller 2004:156; Figure 7). Manos were found throughout the survey zone, which is understandable based on their
association with metates as the “pestle” of the “pestle and mortar” relationship, which are also found through all zones of the survey. Celts, which were made from non-local materials, were likely imported from somewhere in the Cordillera Central, where several quarries and processing areas seem to reside (Cooke, et al. 2003:115; Figure 7). Celts were also found throughout the survey zone and Haller (personal communication) speculates they may have been used to clear land in the region for a growing population and the need for agricultural space by fastening a celt to a coa, or digging stick, in order to create some kind of hoe or axe-like tool. Or, they could have also been used in the production of canoes for use on the Río Parita transporting warriors or trade goods (Einhaus 1980:466).

Figure 7. Edge-ground cobble (left) and chopper/axe/edge-ground cobble (right) from the survey zone (from Haller 2004:49).

In the survey zone, celts were found in identical frequencies at first and second order sites at a rate of 0.12819 per ha, while they are found at a frequency of 0.08412 per ha at third order sites (see Figure 9). If they were used to clear land in addition to being used as a woodworking or canoe building tool, then one would expect much greater frequencies of celts to occur at first order sites for a rapidly growing population needing more space and resources to build housing, and canoes to support their trade
relationship with the neighbouring regions. As previously noted, however, this incongruity could be due to the small sample size from the region. Additionally, further examination of the tools for use wear cannot be performed; due to the weight of the tools, the majority of the celts that were found during the survey were examined and photographed on site, but were not collected (Haller 2004:155), and therefore microscopic analyses of these tools is not possible to more conclusively determine the activities associated with manos from the Río Parita Valley site survey.

![Figure 8. Distribution of utilized stone axes in the Río Parita survey zone (Haller 2004:161).](image)

5.3.7. **Flakes**

Flakes are the manufacturing debris created when stone tools are produced and make up the majority of the lithic assemblage collection (Haller 2004:153). These lithics were primarily retrieved from La Mula-Sarigua, or the area in and around the chert outcrop nearby (Haller 2004:153). The expedient nature of the tools in the region accounts for the substantially higher frequencies of flakes compared to all other tools, especially near the chert outcrop. First order sites experience the highest frequency of flakes among the three site ranks in addition to the highest frequency of any tool type for any site rank (1.52400 per ha). While the number of flakes found at second and third order sites are significantly lower than those found
at the first order site, they are still noticeably higher in frequency than any other tool for those site ranks, with frequencies of 0.40021 per ha and 0.82441 per ha, respectively.

This suggests strongly that a particular production method was used by in the region. Tools and other flakes that are identified as having come from this outcrop occur throughout the region (Haller 2004:153). This suggests that there was no control over the chert outcrop and the resource was available to everyone living in the region. The significant frequency of flakes in and around the chert outcrop suggests that it is likely that inhabitants from the second and third order sites came to the outcrop. They would have then created preforms or fully manufactured their tools. Finally, they would have taken the tool back to their initial location to either put the tool to use, or to alter it into the finished tool product they had begun at the outcrop site. By creating tool preforms at the chert outcrop, tool manufacturers would lighten the load they had to carry back to their settlements, making their voyage for materials easier and faster than attempting to carry full-sized cores back to their settlements and producing the tools there. This type of production also creates more debitage at the production site, which accounts for the high frequency of flakes near the 10 ha chert outcrop; it also supports the presence of tools from the outcrop being found throughout the valley.

5.4. Summary

Chipped stone tool production and use occurred throughout the Río Parita Valley, but was centered on the abundant resources provided by the 10 ha chert outcrop in the area of La Mula-Sarigua. Analysis of site rank and soil type data with lithic tool data revealed much information regarding social complexity and settlement patterns in the region.

Although soil type seems to have little to effect on the type of tools used in a soil zone, statistically, a correlation between soil type and tool use can be seen based on the activities one can draw from tool presence in one soil zone as opposed to another. It appears as though most tools were used in
zones that had medium to low soil productivity, which could indicate that agricultural techniques varied from the floodplain to these less productive sites, likely due to more intensive agriculture occurring in the less productive regions due to decreased soil fertility levels. The lack of agricultural fertility would have required the users of the land expend more effort to produce similar results to those from higher fertility soils, which presumably would have been through the use of intensive agricultural tools. Unexpectedly, a large frequency of quartz was recovered in the survey, which is possibly indicative of craft specialization in the form of trinkets at larger site that would have specialized in craft production. The evidence for craft specialization at La Mula-Sarigua, because of its proximity to the chert outcrop and the abundance of quartz, supports Hansell’s (1988:245) claim that La Mula-Sarigua became a settlement for craft specialization and centre of regional trade. It is possible, through these lines of evidence, that La Mula-Sarigua gained strength in population and control through the utilization of the chert outcrop to develop trade relationships and power.

Site rank analysis shows a clear indication that the majority of tools were being made in and around the first order site of La Mula-Sarigua, near the chert outcrop, however tools from this site can be found throughout the survey zone. This type of unrestricted access to a resource implies a less socially complex organization, such that is found in egalitarian societies. The large size of the outcrop, however, would make it difficult to control and therefore this result is not a strong indicator of social complexity in the Río Parita Valley. While most of the tools were initially created, usually as performs, at the chert outcrop, many of the tools were then taken back to individual sites throughout the valley in order to meet the needs of a specific task. The tasks being done throughout the valley appear to be differentiated based on site type, as many utilitarian tools can be found at third order sites, while tools associated with craft specialization are more frequently found at the second and first order sites. Tools associated with craft specialization and trade mentioned previously, such as points, scrapers with scraping planes < 30°, and polished stone axes are more frequently found at the sites of He-4 and La Mula-Sarigua. Utilitarian tools, specifically, scrapers with scraping planes > 60°, which could be indicative of agricultural activities, mostly occur at the less agriculturally productive third-order sites.
The differentiation of tool presence between site ranks in the Río Parita supports the theory that social complexity was present in the region. The settlement hierarchy in the region was supported by a complex division of labour involving sites of all ranks. While third-order sites participated in small-scale agriculture, using utilitarian tools to increase their agricultural efficiency, first-order sites specialized in craft production and possibly settlement expansion. Second order sites seem to be an intermediate type of site, participating in both craft production and agriculture. Strength and significance for the soil data does not present any meaningful information, suggesting that it is site type, rather than soil productivity, that determines the activities a site is involved in. The results of the statistical analysis of the lithic assemblage data based on both soil type and site rank analysis supports the standing evidence for social complexity in the Río Parita Valley and the hypothesis that if there was social complexity in the Río Parita Valley, then it will be indicated by a division of labour based on what type of settlement one lived in, rather than the type of soil one lived on.
6. Conclusions

The study of lithics can reveal a lot to researchers based on the level of complexity of the tool, its position relative to other tools in a region, and its specific purpose. It has been noted by many researchers (Bamforth 1986:38) that as societies become sedentary, their lithic technology becomes less complex, and more expedient due to their ability to retrieve new materials for the creation of new tools at their leisure. Conversely, mobile populations require a more complex tool technology that can be resharpened or rejuvenated many times to prepare for the risk of not having access to a new raw material source for an extended period of time (Bamforth 1986:38). In addition to this, lithics can offer insight into the types of activities being done by the inhabitant of a region and can also indicate trade between regions, which has indications of social complexity on a large economic scale. Additionally, roles between sites and even between individuals (usually in mortuary contexts) can be examined in order to provide information on social relationships and gender roles within a society.

Lithic tools are multi-functional and are the primary production tools of many prehistoric societies and even those today, such as the !Kung San bushmen (Weissner 1983). By using new techniques to study lithics such as microscopic and macroscopic use wear analysis and tool replication, archaeologists can examine lithics more thoroughly to provide presumably more accurate information about the technology and how it was made and used. For instance, Hansell’s (1988) replication work with tools from Panama resulted in the suggestion that the majority of scraping tools were likely used in woodworking. With even further advancements in technology it is likely the analysis of lithics will only continue to expand into new avenues of discovery, opening new doors and providing new answers for archaeologists searching to complete prehistoric chronologies. This will allow archaeologists to draw more information from lithics than they have ever been able to before.

Historically, Panama has been an ideal place to study the rapid changes in social complexity from hunter-gatherers to complex, pseudo-chiefdom societies (Ranere and Cooke 1996; Ranere 1980; Hansell
This is because of a number of factors including the preservation of archaeological sites, the large cache of mortuary data, ethnographic accounts of the area, and the sequential settlement of certain areas over time allowing archaeologists to develop a clear chronology and associated typologies for the region. The changes that have occurred since the Paleoindian period have been the result of a combination of influential factors resulting in a change that required alternative modes of technology and production of lithic materials to best suit the most efficient form of resource procurement, from floral, to faunal, to maritime resources (Ranere and Cooke 1996:53-60).

Although lithic tools are generally multi-functional (Menzies, personal communication), in the Río Parita Valley, evidence from the analysis of the lithic assemblage data suggests that social ranking and division of labour was present based on the association of certain tool types with select site types. The previous research in the area done by Haller (2004), Steward and Faron (1959), Menzies (2006), Ranere (1980a, 1980b), Cooke (2003), Hansell (1988), and many others (Cooke et. Al. 2003; Drennan et Al. 2003; Einhaus 1980; Ranere and Cook 1996; Lothrop 1937) is supported by this result as well, confirming that there was a level of social complexity in Central Panama based on a division of labour and craft specialization.

Craft specialization and division of labour is based on site rank, rather than soil type, which is made apparent by the fact that all activities did not seem to be taking place throughout the valley. If this were the case, the presence of tools at every site type would have resided, regardless of site hierarchy, merely based on the fact that all tools would be needed to perform all activities associated with daily life. The opposite, in fact, was discovered by the differentiating presence of tools throughout the region, implying that different activities were occurring throughout the valley depending on site type. This result supports the idea that craft specialization was occurring site rank and that the division of labour depended on what type of settlement one lived in, rather that what type of land one lived on.

In the dominating settlements such as La Mula-Sarigua and He-4, more specialized activities were taking place, such as fine craft production, whereas the hamlets and peripheral settlements focused more on utilitarian activities such as intensive agriculture, or the clearing of land. While many of the tools
were likely used for woodworking activities (Hansell 1988: 112; Ranere 1980:124-125; Haller 2004:150), which were performed throughout the region, it is clear from the lithic data that specific activities were occurring at the site of He-4 and more notably at La Mula-Sarigua, by the presence of specific tools such as Scraper type C, points, and tools such as knives and chisels.

In this manner, it is apparent that the use of certain tools generally would have gradually concentrated themselves at certain site ranks based on an influx of population to that region. In the case of the Río Parita, this influx would have been influenced by the large chert outcrop on the outskirts of the site of La Mula-Sarigua having a pull effect on the population who were drawn there for the raw material abundance in order to produce lithic tools and/or crafts. Additionally, although it is not supported by the data, it is likely that the influx to La Mula-Sarigua was preferred due to its position in the Lower Central Plains (High Fertility) Zone which would have allowed for the practice of agriculture with ease both in regards to the amount of labour associated with agricultural production, along with the plenteousness of the harvest (Hansell 1988).
7. Recommendations

While this study did provide interesting information on the social complexity and the division of labour in the Río Parita Valley, Panama, the breadth of the analysis was limited due to both time constraints in respect to research and methods of analysis. While many analyses were performed on the data, issues such as the chronology of the lithic collection and the consistency of the lithic materials analyzed were limited to information readily available for interpretation; therefore, the changes in lithic technology over time could not be examined, nor could the same lithic data information be examined for both site rank and soil zone analyses. The lithic data for soil zones was a completely different set than the lithic data for site rank. Additionally, the ability to examine each of the lithic specimens was not available as they are currently in storage in Panama and it was impossible to have the assemblage shipped to Canada for further analyses. Furthermore, the lack of appropriate technology available for research would not have allowed for the examination of the lithics in any way that had not already been completed, and therefore, the importing of these artifacts would not have produced any information that was not previously known.

Ideally, the Río Parita lithic assemblage would have many scientific examinations performed such as microscopic analysis, testing for fibres in the use-edge of tools, and dating of the tools to provide a chronology of lithic tool technology. Unfortunately, this could not be done during this research, not only because the artifact collections are in Panama, or that such tests are time consuming in a program where time is restricted, but also because such tests are very expensive and often even those with funding for doctoral research would not have the financing to afford such rigorous tests. Funds given for research could easily be used elsewhere in research resulting in more influential outcomes than more specialized analysis of lithic tools for trace elements resulting in use identification.

Current studies in Panama aim to provide more information regarding craft specialization, division of labour, and social complexity in the Río Parita, such as that by Haller (PARP 2004, 2008-
2010), and Menzies (2006), and are fundamental to the development of a holistic and accurate understanding of prehistoric Panama. Not only do these studies aim to determine the activities of specific sites, but they also aspire to answer questions of regional settlement behaviours, such as regional and long distance trade, and how they relate to the development of chiefly societies in Central Panama (Haller 2004, Menzies 2006). Further research will benefit the complete understanding of the development of social complexity in the region of the Río Parita Valley, Panama, specifically, as well as adding to the overall understanding of the development of social complexity in lower Central America.
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