MAYA USE AND PREVALENCE OF THE ATLATL: PROJECTILE POINT CLASSIFICATION FUNCTION ANALYSIS FROM CHICHÉN ITZÁ, TIKAL, AND CARACOL

by

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ABSTRACT

Multiple scholars have briefly discussed the Maya use of the atlatl. Yet, there has never been a decisive encompassing discussion of prevalence and use of the atlatl in the Maya region with multiple lines of support from iconographic and artifactual analyses. This thesis explores the atlatl at Chichén Itzá, Tikal, and Caracol Maya sites to prove that atlatl prevalence can be interpreted primarily based on projectile point "classification function" analysis with support from iconographic and artifactual remains. The classification functions are derived from creating mutually exclusive groups of dart points and arrow points by using discrete functional analysis. Discerning between dart and arrow points can be completed with a high degree of accuracy based on maximum shoulder width of lithic points in an assemblage. Because the atlatl and bow complexes have been primarily constructed of perishable materials, the best method to determine the prevalence of atlatl use is by identifying the launcher based on projectile point identification. Using a cross-site comparison of projectile point size, the Maya use and prevalence of the atlatl will be elucidated.

Dedicated to my Friends and Family,

Those who have inspired and encouraged my quest for knowledge

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CHAPTER ONE: INTRODUCTION

The atlatl's role for the Maya has been briefly discussed by multiple scholars (Freidel 1986:231-241; Hall 1997:109-118; Hassig 1992:73,97,205; Sharer and Traxler 2006:322,739-740). Yet, there has never been a comprehensive discussion of prevalence and use of the atlatl in the Maya region (Figure 1). The questions of how and when Maya cultures used the atlatl, both as a dynastic ritual feature and as a hunting and military weapon; and what was the prevalence of atlatl use remains unresearched. Further investigation of Chichén Itzá, Tikal, and Caracol Maya sites will be explored to prove atlatl use can be interpreted primarily based on projectile point "classification function" analysis with support from iconographic and other artifactual remains. The classification functions used in this thesis are derived from creating mutually exclusive groups of dart points and arrow points by completing a discrete functional analysis. Discerning between dart and arrow points can be completed with a high degree of accuracy based on maximum shoulder width of projectile points in an assemblage.

Archaeologists can produce better interpretations of atlatl remains when the physics of the weapon are clearly understood. There is still some confusion as to how the physics of the atlatl work. Many scholars claim the atlatl spurred the invention of the bow because of the erroneous idea that both weapons store flexing spring power (Farmer 1994:680; Lyons 2004; Perkins 2000). There have been tentative assertions regarding the overlapping histories of the atlatl and bow in the Maya region (see Aoyama 2005:294; Hassig 1992:162,197).

A region containing a bimodality of projectile points both large and small has been interpreted to be evidence of those cultures having used both the bow and atlatl (Fenenga

1953:321). Reasons for the retention of the atlatl when the bow was introduced include the atlatl's use as a symbol of power, and the numerous advantages of the atlatl as a weapon. Atlatl advantages consist of increased penetrating power over the bow (Raymond 1986:165), the atlatl can be launched with superior control from a single hand (Howard 1974:104), and in addition, the length of the dart can inhibit movement of a struck target (Yu 2006:209). A further discussion regarding the intricacies of the atlatl and its position relative to the bow will be discussed in this thesis.

Typically, the majority of the atlatl complex is made out of perishable materials. Archaeologists rarely find atlatl remains, but when they do the nonperishable pieces of the atlatl complex can be easily misinterpreted or overlooked (Ekholm 1962:185; Figueredo 2010:38; Johnson 1971:190-191; Raymond 1986:159). A better awareness of the atlatl in general with an emphasis on nonperishable atlatl accessories will be heightened from a compilation of atlatl archaeological discoveries discussed in this thesis. Better atlatl awareness will enable future researchers to more readily identify artifacts and correctly analyze archaeological contexts in which preserved remains of atlatls may be found.

Because archaeologists rarely find atlatl remains, the majority of interpretations regarding the Maya atlatl have been formulated from iconography (see Hassig 1992:15). Yet, iconographic representations of the atlatl have not always been readily identifiable (Nuttall 1891:17) or properly understood (Stuart 2000). Maya use of the atlatl was widespread both spatially and temporally (Hassig 1992:15,48,126); which is why Maya atlatl iconography had a widespread spatial distribution found in Tikal, Ucanal, Naranjo, Caracol, Uaxactun, and Chichén Itzá; and temporally from A.D. 378 through the Spanish contact period (D. Chase and A. Chase 2002:43; Hassig 1992:126,196,205; Schele and Freidel 1990:156-157).

The Maya of the Late Postclassic Period (and probably before) used the bow-and-arrow; yet, iconography of this period primarily depicts the atlatl (LeBlanc 2003:283). It has been suggested that the Maya iconography highlighted the atlatl more than the bow-and-arrow because the atlatl was a ritualized symbol of power (Freidel 1986:237; Hall 1997:110; Hassig 1992:73). The iconography indicating the atlatl as a symbol of power can be supported by lithic data analysis. Atlatl iconography is an excellent source of data for interpretation but it must be supported by archaeological analysis.

Because the atlatl and bow have been primarily constructed of perishable materials, the best method to determine the prevalence of atlatl use is by identifying the launcher based on projectile point identification (Browne 1940; Fenenga 1953; Kidder 1938; Shott 1993, 1997; Thomas 1978). In addition, lithic remains are better analyzed when microwear analysis is completed (see Aoyama 2005). However, microwear analysis is a lengthy process and only available if the lithic artifacts are obtainable. Lithic artifacts were not obtainable for this thesis, but accessible lithic data of projectile point size was used to bolster iconographic and other archaeological interpretations. Classification function analysis of projectile point size allows atlatls' and bows' use and prevalence to be assessed and interpreted.

Discerning between dart and arrow points can be completed with a high degree of accuracy based on maximum shoulder width of projectile points in an assemblage (Shott 1997; Thomas 1978). Using a cross-site comparison of projectile point size, the Maya use and prevalence of the atlatl will be elucidated. Forming a complex argument by means of iconographic representations in conjunction with lithics classification function analysis is a comprehensive method to determine the use and prevalence the atlatl. One of the superlative utilities regarding the classification function analysis described in this thesis is that it can be easily carried out by archaeologists in the field or any researcher without access to recovered artifacts. Once multiple levels of analysis have been made, sound inferences with complex levels of support can be discussed.

CHAPTER TWO: BACKGROUND

The typical atlatl - about an arm's length of wood (approximately 60 centimeters) with finger holes, pegs, or loops on the proximal end and a hook on the distal end (Figure 2) - locks into the nock (butt-end or proximal end) of a flexible two meter long shafted dart. The atlatl is a military weapon and a hunting tool; it was also utilized by some cultures as a symbol of power. Many other names are used to refer to an atlatl such as throwing-stick, woomera, dart-thrower, and spearthrower (Howard 1974:102). The name spearthrower is a misnomer because a true atlatl uses flexible darts as projectiles, which is different from a rigid spear. The name atlatl is derived from the synthesis of Aztec words; *atl* meaning water, and *tlacatl* meaning men or alternatively *tlatlacani* meaning thrower "water-thrower" (Nuttall 1891:12-13). Interestingly, the water-thrower description may be a misleading term because marine hunters more commonly use a true spearthrower with a rigid projectile - unlike the flexible darts used with atlatls (Whittaker 2010:196-197). This thesis will refer to a launcher of flexible shaft dart projectiles as the term "atlatl."

An Overview of the Atlatl

The atlatl's initial archaeological finds are credited to Lartet and Christy, two French archaeologists who were unsure of what they had actually found (Whittaker 2010:197). In 1891, the archaeological finds of Lartet and Christy were recognized as atlatls through comparison with modern Australian atlatls (Whittaker 2010:197). Specimens of atlatls have been found in Europe (primarily France) and the Americas (Whittaker 2010:200). Many of the data regarding the prehistoric use of the atlatl comes from ethnographic and ethnohistoric sources from the Arctic, Australia, and New Guinea (Whittaker 2010:200).

The earliest known archeological evidence of an atlatl comes from the Upper Solutrean archaeology site Combe Saunière located in Sarliac-sur-l'Isle, France, radiocarbon dated to approximately B.C. 15,500 (Cattelain 1997: 214). Other evidence indicates that by about 40,000 years ago, the atlatl was being used for hunting in Eurasia (Farmer 1994:681). There is evidence of hunter-gatherers using atlatls on every continent except Antarctica and Africa (Raymond 1986:153). Evidence of atlatl usage in Africa has yet to be found, or at least properly identified (see Shea 2006).

Australia is frequently associated with the atlatl. Even Charles Darwin wrote about Australian aborigines throwing darts at a hat to entertain him during his expedition in 1836 (Whittaker 2010:196-197). It is strange that Australia, with its dry climate that preserves artifacts well, and a history of thousands of years of atlatl wielding hominids has based most of its prehistoric atlatl use from rock art. Yet, evidence suggests the atlatl has a relatively recent history in Australia of only about 5,000 years (Farmer 1994:679).

The contemporary Australian Arunta tribe creates their atlatls with a broad slightly curved wooden shaft that is wide enough to be used as a bowl when needed. On the proximal end of the atlatl, a cutting tool is fashioned out of a sharpened piece of flint. The edge of the Arunta atlatl is used as a fire starter by creating friction by rubbing it against a wooden shield (Hall 1997:109). For the Australian Arunta tribe the atlatl is truly their “Swiss army knife.”

It is believed that humans migrating to the Americas brought the atlatl with them (Chard 1955:168). In the cold northern latitudes of Siberia and Northern America, the atlatl has multiple advantages. A contemporary atlatl or spearthrower is still used in many cold climates and marine locations because there is the ability to row and balance a kayak with one hand while simultaneously having a readied weapon in the other hand. Marine hunting often leaves one with greasy hands and it is easier to use an atlatl or spearthrower than other weapons, specifically the bow, under such conditions (Whittaker 2010:197).

Cold weather and kayaking conditions are not the only advantageous situations in which to use an atlatl. Large game is hunted more effectively with weapons that can penetrate through tough skin from a distance. The Atlatl has a significant advantage over the hand-thrown spear when discussing thrust and penetration ability. Most Folsom and Clovis points were used as dart points thrown with atlatls to hunt large game (Frison 1989; Ahler and Geib 2000). The ability to throw a heavy deeply penetrating projectile with one hand while the other hand holds a shield or different weapon is another advantage the atlatl has over two-handed weapons such as the bow-and-arrow.

As an advantageous weapon, the atlatl was dispersed and used throughout the Americas. Use of the atlatl in Mesoamerica and South America emerged roughly 15,000 years ago (Farmer 1994:681). Because of the perishable nature of the atlatl complex, there is no consensus among researchers if there was continuous use of the atlatl in Mesoamerica, if independent invention played a role, or if the atlatl concept was abandoned and then reintroduced from neighboring cultures. In the Americas, there is very limited archaeological evidence of the atlatl - and the sparse evidence of atlatls has made the technology “mysterious” to many researchers.

Nuttall (1891) spurred interest in researching atlatls by exploring codices, extant specimens, and historical records. Iconography and linguistic evidence for atlatls were key elements that Nuttall (1891) explored and she provided some of the best evidence for determining cultures that utilized atlatls. Because wood does not preserve well in the archaeological record, iconographic and ethnohistoric sources became the primary indicators for the prevalence and use of the atlatl. Recently, projectile point discriminant function analyses have been applied to aid in inferring the frequency of atlatl use culminating in classification functions that can be applied to particular cultures (see Thomas 1978; Shott 1997).

Identification of weapon technology based on projectile point classification has been problematic (see Browne 1940; Fenenga 1953; Thomas 1978; Shott 1997). Atlatl dart points can easily be classified incorrectly as spear or knife points (Aoyama 2005:297; Fenenga 1953:319). Because of their morphological similarities, arrow points are frequently categorized erroneously as dart points (Fenenga 1953:318). However, a high degree of accuracy at discerning between dart and arrow points can be obtained from classification function analysis (Aoyama 2005; Shott 1997; Thomas 1978). The bow and atlatl have overlapping histories throughout humanity - and through archaeological inference, iconographic analysis, and lithic classification function analysis, the prevalence and use of each technology can be determined.

The earliest definitive evidence of the bow-and-arrow complex dates to approximately B.C. 8,500. At Stellmoor, in northern Germany, a cache of arrows was found, and bow specimens were recovered nearby, dating roughly to the same period, in Holmegaard, Denmark (Collins 1973:23). In the Americas, the era of major replacement of the atlatl in favor of the bow-and-arrow took place only 1,500 years ago (Blitz 1988; Hall 1977:109; Shott 1993:425). There is scarce evidence for both atlatl and bow in the Americas (Whittaker 2010:199), but ethnographic evidence points to the distribution of the atlatl being far more extensive than that of the bow (Farmer 1994:680).

As bow technology spread throughout the Americas, the atlatl was not completely abandoned (Chatters et al. 1995; Shott 1997:86). Because certain conditions favor atlatls over bows, the atlatl was retained as a weapon. There is also a long history of the atlatl having been used as a fierce and powerful weapon. A ritualized atlatl has been retained in some cultures because of its secondary function as a symbol of power (Freidel 1986:237; Hall 1997:110; Hassig 1992:73). The secondary function of the atlatl as a symbol of power must not to be overlooked.

To understand the archaeological evidence that can be used to determine which regions employed the atlatl and the prevalence of its use, the physics of the atlatl must be understood. Because there is more of a historical record and recent observed usage of the bow than the atlatl, experimentation has played a larger part in understanding archaeological data concerning the atlatl (Whittaker 2010:196). Recent experiments have even highlighted the physics of the atlatl with slow motion photography (Whittaker and Maginniss 2006).

Many scholars still make the mistake of claiming that the invention of the bow came as a result of atlatl inspiration because of the erroneous idea that both weapons store flexing spring power (see Farmer 1994; Lyons 2004; Perkins 2000). There is no flexing spring power used in the atlatl, which is an important concept to understand because weapon physics relate directly to the weight and size of projectiles used.

Physics of the Atlatl

The correct description of how an atlatl works is an increase of force from lever action (Baugh 2003; Butler 1975; Cundy 1989; Hutchings and Bruchert 1997; Whittaker 2010). By creating a lever, using the wrist as a fulcrum, there is an increase of force applied to the projectile. The advantage of slow-motion film has elegantly displayed the lever action of the atlatl in use (Whittaker 2010:203). The motion is very similar to throwing a baseball with the difference being a flick of the wrist rotates the atlatl. By flicking the wrist a short distance, the distal end of the atlatl moves a large distance quickly, acting as a lever transferring energy to the dart.

Other opinions on how the atlatl might work include the extended force hypothesis (Howard 1974:102-103, Krause 1905:619; Mason 1885:280; Webb 1957:21) and the flexing spring hypothesis (Farmer 1994:680; Perkins 1995, 2000; Perkins and Leininger 1989). The extended force hypothesis states that the atlatl increases the amount of force applied to the dart by extending the amount of time force is applied to the dart (Howard 1974:102). This concept is partially correct in that the atlatl is in contact with the dart for slightly longer than the hand would be with a hand-thrown spear. However, throwing a dart with an atlatl without flicking the wrist will not increase the force applied to the projectile significantly. The extended force hypothesis also implies the atlatl hook never reaches a height greater than that of the handle and that the atlatl is not a flicking device. However, ethnographic photos demonstrate atlatls swung up vertically as the dart launches (Whittaker 2010:203-204). In addition, modern day atlatl experimenters understand how important the flicking motion of the wrist is and how it enables the atlatl to effectively act as a lever.

The flexible spring hypothesis is discussed by atlatl enthusiasts frequently. Bob Perkins (1993, 1995, 2000) argues that the flex of the atlatl pushes on the flexible dart storing energy, releasing that energy by both the atlatl and dart pushing off each other as the dart is propelled. Atlatl bannerstones, or weights (**Error! Reference source not found.**), have been suggested to dd increase flex to the atlatl by attaching near the distal end, which supposedly adds more energy to the projectile (Butler and Osborne 1959:223; Perkins 1993; Webb 1957). At first glance, the flexible spring hypothesis seems to be a credible model.

There are, however, a number of reasons why the flexible spring hypothesis cannot be supported. Interestingly, Raymond (1986:169) used high-speed motion cameras to discover that the atlatl does flex as it sweeps through the arc during a throw. Raymond also suggests adding a weight will increase the speed and force of the atlatl flex recoil, but further states that “film speeds of over 400 frames per second would be required to measure accurately the acceleration of the atlatl as it recoils in the last few milliseconds before releasing the dart” (Raymond 1986:169). Whittaker and Maginniss (2006) completed a number of experiments with film speeds over 400 frames per second. With the advantage of high-speed photography, it is easy to see that the small amount that atlatls flex during a throw does not spring forward until after the dart has departed (Whittaker and Maginniss 2006:4). For a different experiment proving the flex hypothesis incorrect, place an atlatl in a vice and launch a quarter off the atlatl; only a small amount of flex is attainable and the quarter does not go very far. In addition, the majority of ethnographically known atlatls are rigid (Whittaker 2010:204). Thus, atlatl flex does not assist significantly with launching a dart.

It is easy to feel and see dart flex; but, the stored energy of the flexing dart is released through latitudinal oscillations and not through pushing itself off and away from the atlatl (Baugh 1998; Cundy 1989; Whittaker and Maginniss 2006:7). Try pushing a dart into the ground so it flexes, release your hand, and see how far it springs off the ground; there is very limited distance achieved from spring force in this experiment. The flexing spring stored energy is minimal at best.

However, there is no doubt efficiency, accuracy, velocity, and distance of an atlatl throw is improved by using a flexible dart. Whittaker and Maginniss (2006:8) compared launching rigid spears to flexible cane darts. The experiment proved that an extra 15 degrees of atlatl rotation can be applied to a flexible dart, which increases velocity by adding to the time the atlatl is in contact with the dart. Dart flex adds to the amount of time that atlatl is in contact with it, which increases the force of the throw.

The necessity of a flexible dart is irrefutable, not because of stored energy but rather, because the atlatl must swing above the projectile point while not sacrificing aiming accuracy. If thrown for a distance using a rigid spear instead of a flexible dart, the proximal end (nock) of the rigid spear is pulled downwards while the projectile point rises, misfiring consistently (Whittaker and Maginniss 2006:7). Dart flex vastly improves atlatl accuracy, efficiency, velocity, and distance but does not contribute to spring force, which is completely absent from the atlatl complex.

However, not all projectiles thrown by an atlatl are flexible, when an atlatl launches a rigid spear the launching device should be correctly termed as a spearthrower. The typical circumstance in which a rigid spear is actually used with a spearthrower is during marine hunting

(Nuttall 1891:7). If the rotation of the throw is halted, short distances of accurate projectiles are easily launched, especially at the downward angle used for harpooning in marine hunting (Whittaker and Maginniss 2006:7).

Advantages of the Atlatl

Once there is an understanding of how the atlatl works, there is a necessity to explore the advantages of the atlatl. Using primitive materials, the world record for an atlatl throw is 177 meters; for the world record javelin thrower, using an aerodynamically modernized javelin, the distance achieved is about 98 meters (Whittaker 2010:214). A 70 to 80 percent increase in distance of a launched projectile appears to be a big advantage. However, projectile distance does not matter as much as thrusting power because the average range for ethnographic hunters using a projectile is approximately 10 to 30 meters, regardless of the weapon (see Cundy 1989; Hutchings and Bruchert 1997:78; Whittaker 2010:213). Using the atlatl for hunting or as a military weapon the wielder seldom attempts targets that are 177 meters away.

Measuring projectile distance is a much easier experiment to design than figuring out the velocity and force impact of darts. However, the distance a dart travels is an indirect measurement of velocity and the force of impact, so it is not a bad experiment to execute (Raymond 1986:161). Butler (1975:106) used principles of mechanical physics to prove the greatest velocity of the atlatl is at the point on the radius furthest from the axis of revolution. The radius point on the atlatl with the highest velocity is the distal end hook that engages the nock of the dart. A few researchers have measured velocity (Butler 1975:106; Hutchings and Bruchert 1997:79; Raymond 1986:167). Butler (1975:106) calculates velocity of the atlatl increases 1.7

times over the velocity of the arm alone. The 1.7 times increase in velocity closely matches the 70 to 80 percent increase in throwing distance achieved with the atlatl.

Thrust is relative to velocity, but slightly more important when discussing projectile weapons. Thrust equates to the ability of the weapon to pierce flesh or armor. Howard (1974:104) calculates ancient hunters obtained about 60 percent additional thrust from an atlatl-thrown dart compared to a hand-thrown spear. Typically, darts are lighter than spears because of their flexible nature. Because darts have less mass than spears usually, there is only a 60 percent increase of thrust compared to a 70 to 80 percent increase in projectile distance of the atlatl over the spear.

Distance, velocity, thrust, and force of impact are not the only advantages of the atlatl. The atlatl also greatly increases accuracy compared to the spear because of the superior grip and control of the dart obtained from the atlatl (Howard 1974:104). During a typical atlatl throw, the dart is released from the finger grip before the atlatl becomes disengaged from the dart. Last second adjustments are very easy to make because a slight turn of your hand will adjust the dart’s position greatly due to the extension of the atlatl.

Many atlatl experiments have been conducted, but more are needed because of disagreements over functional design performance. Some scholars argue that variations in point size, shape, and weight have little effect on the quality of launching a projectile because human error can overwhelm small variations such as point weight and size (Couch et al 1999; Whitaker 2010:211). Still others will argue projectile point weight is a very important variable (Fenenga 1953; Perkins 2000). Throwing the atlatl uses a complex series of levers and muscles in the body. Because there is so much more of the human body used in an atlatl throw, a larger sample size with multiple throwers is the only way to obtain a data set similar to a smaller sample size when using a gun, a crossbow, or even the bow-and-arrow. Until an atlatl experiment is designed that eliminates the human thrower, researchers will continue to obtain inconclusive or contradictory results, making it difficult to evaluate certain aspects of the atlatl complex construction and use.

CHAPTER THREE: HISTORY OF THE ATLATL IN THE MAYA REGION

Historically the greatest concentration of atlatl use south of the United States is in the northwestern sections of Mesoamerica (Figure 4) (Ekholm 1962:184). The history of atlatl use in Mexico is known both ethnohistorically and archaeologically - and is especially well documented during the time of Cortez and the Spanish contact period (Hall 1997:109). Besides documented sightings of the atlatl, extant specimens of complete atlatls also highlight the prevalence of its use during the Spanish conquest (Ekholm 1962:184). The effectiveness of the atlatl to pierce Spanish iron chain mail was unparalleled by any other Mesoamerican weapon (Hall 1997:109). The velocity and distance an atlatl dart can be hurled gave it a distinct advantage over many weapons available to the defending Mesoamerican natives during battles with the Spanish (Butler 1975:106).

After the Spanish conquest of Mesoamerica, the Spanish learned more about how the Maya used the atlatl. Diego de Landa reported the Maya of the Yucatan learned the art of warfare with an atlatl from Mexicans (Nuttall 1891:10). For the Maya of the 16th century, Diego de Landa (1937:38) describes the atlatl complex as "a certain way of throwing darts by the aid of a stick as thick as three fingers, hollowed out for a third of the way, and six palms long; with this and cords they threw with force and accuracy." The description of the atlatl darts with cords attached indicates harpooning, one aspect of how Yucatan Maya learned to hunt utilizing the atlatl or more appropriately with the spearthrower. However, the atlatl in the Maya region dates well before the Spanish contact period.

Household and farming tools were the initial Mesoamerican weapons and are found as early as B.C. 4000 (Hassig 1992:13). Hassig (1992:13) suggests that during the period of use of unspecialized weapons indicates that warfare was unorganized and aimed at raiding rather than conquest and looting. The major expansion of the Olmec culture appears to have been coupled with the adoption of obsidian projectile points after B.C. 1150 (Hassig 1992:15). The Bliss Collection at Dumbarton Oaks in Washington D.C. has two examples of Olmec atlatls and an iconographic portrayal of an atlatl appears on Stela D at Tres Zapotes (although it is still debated if it is truly an Olmec stela) (Hassig 1992:184). The atlatl is not adapted from a tool; which means that when the atlatl is present, so too is a complex level of hunting and warfare.

While the atlatl was certainly in use in the Americas prior to A.D. 100 (Farmer 1994:681), perhaps, because the atlatl is not the most effective weapon in a tropical forest environment (Hassig 1992:73); in Mesoamerica, the atlatl was first heavily used as early as the Late Preclassic in Chupicuaro (Ekholm 1962:184). In the Copan Valley during the Terminal Preclassic Period evidence suggests that La Entrada was the initial site for the mass production of bifacial points (Aoyama 2005:301). Evidence of bifacial points being produced as Maya polities began to enlarge suggests warfare played a major role in the development of complex Maya societies.

Typical Mesoamerican atlatls are 60 centimeters long, with a central groove where a two-meter long dart was laid and guided up to the hook at the distal end of the atlatl (Figure 2). The proximal end of the atlatl, or handle, was fashioned with finger-loops, holes, or pegs approximately one fourth of the way up the handle (Figure 2). Flexible darts were frequently made of oak or reed with feathers fletched on the opposite (proximal end) end to the fire hardened projectile point (distal end) made of flint, obsidian, fishbone, and later copper (Hassig

1992:137). While the construction of the atlatl had slight variations across Mesoamerica, there is no doubt of the powerful effect that the atlatl had on Maya societies.

Multiple scholars (Schele and Freidel 1990:152; Harrison 1999:119; Hassig 1992:16) have argued that the atlatl had an important effect on the way warfare was conducted by making long distance deadly strikes possible for the first time, which would have greatly increased casualties. Mesoamerica may have experienced conventional armies with arranged formations for the first time when the atlatl was introduced, especially because a barrage of atlatl darts would have been very effective (Hassig 1992:48). Because the introduction of projectile weapons changes the nature of a battle, the atlatl would have been a decisive weapon for Maya regarding the outcome of warfare.

Few other projectile weapons were known to the Maya. Linguistically, slings date back to B.C. 1000, and blowguns were probably used for hunting, but not as military weapons (Hassig 1992:205). The issue with slings as a weapon is that they require more space to fire and are not as deadly or effective in war as an atlatl; an atlatl pierces opponents instead of just pounding them, as the sling does (Hassig 1992:49). Comparing the sling and the atlatl, there is a major difference of power and deadly force. The differences between the sling and atlatl created a divide between “commoner” and “elite” weapons, respectively. Slings were not depicted in Maya art nearly as much as atlatls, nor were slings represented in the hands of elite Maya in iconography (Hassig 1992:47).

Not only did Maya “commoners” take part in battles (A. Chase and D. Chase 1989:16), but also some portions of Maya society perhaps restricted to the elites, used atlatls for combat. Some Maya elite were also stone knappers, manufacturing bifacial points and weapons on a part-time basis (Aoyama 2005:294). At Aguateca, the numerous bifacial points, most of them broken or worn, that were excavated from every building in the epicenter, is a good indication of elites partaking in warfare (Aoyama 2005:297). Although, broken bifacial points found in epicenters could have been from an army of “commoners” attacking people in buildings. Classic Maya art depicts Maya elites involved in warfare largely with projectile points that were mainly spears, but atlatls are occasionally represented (see Miller 1999). Maya warriors favored the atlatl for its ability to capture and control land and resources, which enabled polities to expand.

While open urban areas and the desert-like terrain near Teotihuacan were ideal areas to use atlatls, they are not really effective weapons in lowland Maya regions that were engulfed in tropical forests (Figure 4) (Hassig 1992:73). Maya frequently used surprise raid attacks that were designed more for looting than killing, which made the atlatl not an ideal weapon choice in those instances (Hassig 1992:13). Most of the terrain and conditions in pre-Spanish contact Maya regions probably did not favor a practical use of the atlatl (Hassig 1992:97).

Many weapons were employed by the Maya and they all had their advantages and disadvantages depending on the region and the goal of their use. Shock weapons were the deciding factor in most Maya battles before the Spanish arrived. Spears, crushers, clubs, and maces were more effective than projectiles thrown from a distance (Hassig 1992:15). However, the atlatl still had some advantages over shock weapons.

Maya warriors, using the atlatl, were far enough back from the front of the line that they did not need to carry shields; and therefore could carry many more darts while staying out of harm (Hassig 1992:48). An effective limit of 46 meters, with an increase of 60 percent more thrust over the hand-thrown spear, gave the atlatl unmatched penetrating power (Howard 1974:104).

The pros and cons of the atlatl are intricate when figuring out the logistics and effectiveness during varied battle situations. When fighting away from home, logistics became a problem with atlatls because of the constant need for a resupply of darts (Hassig 1992:16). The atlatl's problems with dart resupply logistics was outweighed by the ability of the atlatl to disrupt enemy ranks before two opposing sides closed for hand-to-hand combat in an open terrain setting. The Early and Middle Classic Periods probably saw the rise of the atlatl as a dominant weapon for the Maya (Hassig 1992:47).

Hassig (1992:97) claims that the atlatl was not the most frequently used weapon, but rather served a secondary purpose. The atlatl was a symbol of power associated with central Mexico (Freidel 1986:237; Hall 1997:110; Hassig 1992:73; Nuttall 1891:27). Some extant Mexican atlatls have a serpent symbol prominently carved on them, indicating the power believed to be held by the atlatl (Nuttall 1891:21). The ceremonial atlatl also symbolized lightening and swift destruction (Nuttall 1891:27). Indeed, the K'awiil (god of lightening) scepter that symbolized accession of a Maya ruler may have been derived from the atlatl (Sharer and Traxler 2006: 326,739). Other ceremonial uses of the atlatl may have included blood sacrifice rituals (Freidel 1986:235). There are multiple meanings behind the image of the atlatl, but they all relate back to a central theme of symbolic power.

Atlatl Iconography

Familiarity with iconographic representations and the physical structure of the atlatl enables researchers to more readily identify the atlatl or parts of the atlatl complex when analyzing archaeological and iconographic data. Recognizing the atlatl in iconography has been routinely troublesome because the atlatl is often overlooked or misidentified by researchers (Nuttall 1891:6). The "shroud of mystery" surrounding the Maya use and prevalence of the atlatl will be cleared only by bringing a better awareness of the atlatl and its possibilities to researchers.

An initial dramatic event in Maya history occurred in A.D. 378 and was recorded at both Tikal and Uaxactun (Harrison 1999:119; Proskouriakoff 1984:164). Stela 5 at Uaxactun (Figure 5) supposedly depicts a foreign warrior from Teotihuacan Siyaj K'ak', who helped Spear Thrower Owl's son Yax Nuun Ayiin, also from Teotihuacan, become the new Tikal Ruler (Harrison 1999:81; Stewart 2000). The individual depicted on Stela 5 at Uaxactun carries an atlatl and wears a puffball helmet and garters of a foreign design (Freidel 1986:237). Stela 5 at Uaxactun is the earliest best documented iconographic presence of the atlatl in the Maya region (Freidel 1986:235). The atlatl can decisively be placed in historical context in the Tikal region at the end of Jaguar Paw I's reign and was used as a symbol of power by his successor Yax Nuun Ayiin (Schele and Freidel 1990:155-156).

Freidel (1986:237) argues that the atlatl is traditionally identified with highland Mexico and Teotihuacan, but that it is better represented as a dynastic ritual feature in the lowland Maya region. A dynastic ritual feature is indeed all the atlatl may have been during the Classic Maya Period because there is a scarcity of atlatl depictions and even fewer extant specimens during this era (Hassig 1992:205). Alternatively, identification of atlatl use from lithic remains points to a possible different conclusion regarding the prominence and use of the atlatl; this will be discussed later.

Tikal Stela 31 (Figure 6) depicts a portrait of a warrior in Teotihuacan dress holding an atlatl and a rectangular shield. The event recorded on Stela 31 of Yax Nuun Ayiin succeeding to the throne is debated (see Freidel 1986, Nielsen and Helmke 2008; Stuart 2000); however, the atlatl is evidently a focal point and a symbol of power on both the Uaxactun and the Tikal stelae. Yax Nuun Ayiin has been suggested to be the son of Spearthrower Owl; whose name glyph contains a hand holding an atlatl (Stuart 2000:473). There was a clear break in the father-to-son pattern of rulers at Tikal - and, the atlatl represents the symbol of power that caused, or supported, the political change.

Another connection between Tikal, Teotihuacan, and owl iconography, is a unique ballcourt marcador, found in Structure Sub 4B in Group 6C-16 at Tikal. The ballcourt marcador is dated to A.D. 378 and portrays an owl crossed by an atlatl. Harrison (1999:81) has suggested that new war methods were introduced to Tikal during this time of conflict with Uaxactun. The owl and atlatl are strongly associated with the military at Teotihuacan (Nielsen and Helmke 2008). Spearthrower Owl is a Teotihuacano and most likely the father of Yax Nuun Ayiin, who introduced the atlatl to the Maya, or at least enforced the atlatl as a symbol of power through iconography (Nielsen and Helmke 2008:463). The connection of the introduction of the atlatl as a symbol of power to a highland Mexico origin is not in doubt (Nielsen and Helmke 2008; Stuart 2000:482). Early Maya iconographic depictions of the atlatl do appear to have a Mexican highland foreign connection.

The Mexican influence and introduction of power using the atlatl should not be in question. On the Ucanal Stela 4, the protagonist holding an atlatl has a Mexican name (A. Chase 1985:111). In a Copan burial, there was a male wrapped in a bundle with supposed Teotihuacan adornments that included shell goggles and atlatl darts (Sharer 2003:153). In addition, in central Mexico the handle of a two-finger-loop atlatl was the symbol for the day Ollin (Movement or Earthquake), which corresponds to the Maya day Caban, which may be a depiction of an enlarged atlatl hook (Hall 1997:112). The atlatl has been associated with snakes, lightning earthquakes, destruction, and land - all of which are symbols of power.

One of the best iconographic representations of the atlatl, where the dart groove and hook are distinctly visible, is in the lintels from the Upper Temple of the Jaguar at Chichén Itzá, which date to the Late to Terminal Classic Periods (Schele and Freidel 1990:371) (Figure 7). When the lintels from the Upper Temple of the Jaguar and other atlatl iconography at Chichén Itzá were first described, researchers misinterpreted the atlatl depictions, believing that bundles of spears or quivers of arrows were held while simultaneously ignoring the actual atlatl (Nuttall 1891:17). Chichén Itzá atlatl iconography was only recognized as containing atlatl warriors once an experienced researcher, who was fully aware of the atlatl and its iconographic representations, was able to analyze the atlatl depictions (Nuttall 1891:6).

There is no question the atlatl had a large influence over the Maya at Chichén Itzá. There are two atlatl warriors depicted on the gold Disc F recovered from the Chichén Itzá cenote (Coggins 1984:42-43). An atlatl and darts are also depicted on a jadeite plaque recovered from the Chichén Itzá cenote (Coggins 1984:52). There are multiple iconographic representations recovered at Chichén Itzá indicating the symbolic importance of the atlatl.

In addition, the murals in the Temple of Jaguars at Chichén Itzá contain multiple examples of warriors using atlatls (Schele and Freidel 1990:373-374). The murals contain warriors in a canoe and on foot, attacking with atlatls (Wray 1945:26). Some of the warriors in the murals have mosaic headdress, breast ornament, round back shields, and decorated bands below the knee (Wray 1945:25). A lot of the warriors' attire was first identified to be of Mexican origin, including the atlatl, but by the Late Classic Period, besides the turquoise regalia, all of the clothing and weapons had been fully integrated into Maya cultural tradition (Cobos 2006:179). The supposed Mexican regalia and atlatl weapon is one of the reasons Chichén Itzá was misdated and incorrectly determined to have been influenced, or even taken over, by Toltec warriors (see Andrews et al. 2003; Cobos 2006).

The atlatl had been present in the Maya region as an iconographic symbol for quite some time before Chichén Itzá was at its height of power around A.D. 900. Besides the initial depiction on the Uaxactun stela dating to A.D. 378, atlatl darts also are found on Naranjo Stela 2 dating to A.D. 716 and on Ucanal Stela 4 dating to A.D. 849 (Hassig 1992:219). Thus, the Maya use of the atlatl in iconography was widespread spatially and temporally. The atlatl was known as a symbol of power for hundreds of years, spanning a number of different Maya sites prior to the Terminal Classic Period.

Extant Atlatl Specimens

Iconography must be ground-truthed by archaeologists to fortify assumptions made regarding the atlatl. While iconography is an initial way to recognize which Maya sites were influenced by the atlatl, artifactual evidence is needed to aid in the interpretation of relationships over time. Atlatl artifacts can help determine if the atlatl was just a symbol of power or if it was truly used as a hunting and military weapon as well.

When an object, such as the atlatl, is primarily made of wood, unless you have exceptionally rare conditions, other non-perishable pieces of the artifact must be looked for in the archaeological record to aid interpretation and identification. The Maya atlatl was constructed in numerous ways accompanied by mostly perishable variations of accessories except for possibly fingerloops (Figure 8), hooks (Figure 9, Figure 10) (Ekholm 1962:185), possibly cruciform adornment pieces (Figure 11) (Johnson 1971:190-191), and, doubtfully in the Maya region, bannerstones (Figure 3) (Raymond 1986:159).

The cenote at Chichén Itzá held a treasure trove of Maya artifacts that were preserved exceptionally well due to low amounts of oxygen and minimal disturbance. A few atlatls, darts, and lithic points were dredged from the bottom of the cenote (Coggins 1984:46,47,100,103, 104,108). Serpentine carvings on the back of the atlatls have traces of blue pigment on the feathered serpents and spaces for red inlays indicating symbolic power and importance (Coggins 1984:103,104). The abundance of atlatl artifacts from the cenote has been used to demonstrate the significance of the atlatl, at least as a symbol of power, to the Chichén Itzá Maya.

Identification of atlatls based on finger-loop artifacts is possible. In the Mesoamerican region, shell was the most commonly used material for constructing atlatl finger-loops (Ekholm 1962:184). Light-colored soft stone was another source used in Mesoamerica for making finger-loops (Ekholm 1962:184). An atlatl with gold finger-loops was supposedly looted by Cortez from Tenochtitlan in 1519 (Saville 1925:43). Other perishable materials such as wood and leather were also likely used in the construction of atlatls in pre-Spanish contact Mesoamerica as they are used today.

A few examples of atlatl finger-loops have been archaeologically found in Central Mexico. Only one clear-cut Maya specimen made from shell was found at Uaxactun (Kidder 1947:66). Wooden atlatl finger-loops were found in the Chichén Itzá Sacred Cenote (Coggins 1984:108). At Tikal, Hattula Moholy-Nagy (2003:124) reports that atlatl finger-loops were possibly found, but she offers alternative identifications as well. Finger-loops are problematic because they could be used for body decoration (jewelry) or for utilitarian functions not related to the atlatl (Harrison 2003:124). Archaeological context is very important, and the misclassification of atlatl finger-loops is an excellent reason to reanalyze archaeological data.

While fingerloops can resemble jewelry pieces (Figure 8) finding an atlatl hook by itself, or out of context, can also have multiple interpretations. The hook of the atlatl has been fashioned in many forms, often anthropomorphic in nature (Figure 9, Figure 10) (Figueredo 2010:38). The hook can easily be misidentified as eccentrics or pendulum jewelry (Figueredo 2010). In addition, it is possible atlatl hooks have been incorrectly identified as fish netting hooks (Whittaker 2010:214-215). All angles of possibilities should be explored when interpreting archaeological data, especially items with extreme similarities.

Caracol supplies a very interesting example of a possible atlatl artifact with a carefully analyzed archaeological context. The artifact (Figure 10) was excavated from the Special Deposit C117F-1, located beneath the courtyard of the Northeast Acropolis dating between A.D. 300 and 350 (A. Chase and D. Chase 2011:14). The elaborately carved shell, possibly an atlatl hook, was found in an Early Classic Caracol cremation S.D. C117F-1 (A. Chase and D. Chase

2011:11). The cremation indicates there was at least long distance trade with central Mexico because of the green obsidian knives and points found in the archaeological context. Interestingly, the internment is unlike Maya burial practices of the same period, but has multiple similarities to burial practices of high status individuals at Teotihuacan (A. Chase and D. Chase 2011:13). The cremation containing an individual, in some way related to Teotihuacan, provides evidence of an atlatl with a central Highland Mexico origin that predates the earliest Maya atlatl iconography.

Other artifacts possibly associated with the atlatl that can be easily misidentified are cruciform objects (Figure 11). The placement of numerous cruciform objects recovered from burials in Mesoamerica are situated in such a way that they could have been part of an atlatl laid beside the body (Johnson 1971:190-191). Perhaps binding and inlay techniques were used to attach inlaid stones and cruciform objects to atlatls such as the ones mentioned during the Spanish Conquest Period (Johnson 1971:191). The preserved material of the cruciform object initially attached to the perishable wooden atlatl may be all that is found in a grave cache and, thus, easily misidentified.

Another reason to carefully interpret and analyze archaeological data is the presence of atlatl bannerstones (Figure 3). Bannerstones were most likely not used by Maya on their atlatls. The United States is the only location where extant atlatls having attached bannerstones have been found (Raymond 1986:159). No one has reported on a bannerstone Maya artifact or classified an object as a bannerstone. The lack of Maya atlatl bannerstones could be the result of atlatl artifacts that are not so readily identifiable, because bannerstones look very similar to jewelry pieces, totems, and other utilitarian objects.

Bannerstones are a North American cultural aspect and may not be as linked to atlatls as initially thought. There are only ten extant atlatls with attached bannerstones, all found in North America (Raymond 1986:159). Multiple North American grave caches with possible atlatl bannerstones and hooks have been found (see Moore 1916). However, a bannerstone and a hook can also be used as a netting hook and sizer; modern experiments prove the items work in both instances (Whittaker 2010:214-215). In most cases, without closely analyzing artifactual context without the physical atlatl it is hard to positively identify atlatl accessories.

One of the best examples of *in situ* atlatl use comes from Tikal. The only example of an atlatl from over 50 years of excavation at Tikal was found in Tikal palace structure 5D-51, located in Court 5D-4 of the Central Acropolis (Harrison 2003:105). The discovered atlatl has bone finger-loops, carved with decorative notching; and was found deposited in a thin layer of burnt soil; the atlatl was abandoned possibly because it was damaged (Harrison 2003:106). The occupation of the building the atlatl was found in, represented two stages - a final use and an abandonment (Harrison 2003:107). The collapse of Tikal fittingly included the abandonment of this extravagant atlatl.

Tikal’s rise to power began with the depiction of an atlatl on Stela 31 (Figure 6), claiming political change that possibly granted Tikal its dominance over surrounding polities. The end of Tikal included abandonment of an atlatl during reuse of some buildings, possibly as makeshift prisons featuring cannibalism (Harrison 2003:107). The extent of the atlatl’s use during the Classic period continues to be a mystery. Further excavation and analyses need to be completed to document the use and prevalence of the Maya atlatl.

A goal of this thesis is to create a better awareness of atlatl accessories, which enables future archaeologists to accurately identify and catalogue artifacts from previous and forthcoming excavations. Only through atlatl awareness - and further examination of archaeological context - can sound arguments be made for artifact interpretation. An education regarding artifacts associated with atlatls and the archaeological contexts in which they may be found is an important goal of this research.

Because of the scarce finds of actual atlatls in archaeology, the degree to which the atlatl was used in the Maya region is still in question (Hassig 1992:205). If the atlatl was such an important weapon in warfare - and not just a symbol of power - there should be evidence of this in the archaeological record.

The Role of Projectile Technology in Maya Collapse and Warfare

Warfare definitely played a role in the struggle for power and collapse of certain Maya lowland polities (A. Chase and D. Chase 1989). At Caracol during the Terminal Classic Period, numerous projectile points were recovered from the archaeological record; constructed monuments exhibit bound prisoners and even warriors with atlatls that are presenting prisoners occur on modeled-carved pottery during this time (D. Chase and A. Chase 2002:43). At Copan, a decrease of obsidian atlatl dart points is overtaken by chipped stone points, indicating an increase in warfare and a decrease in the power to control interregional trade for obsidian (Aoyama 2005:300). Aguateca excavations dating to the Terminal Classic Period uncovered a large proportion of chert chipped-stone artifacts that were bifacial points, interpreted as indicating a decline due to warfare intensification (Aoyama 2005:298). In the Northern Maya lowlands during the Terminal Classic Period, Chichén Itzá indicates this same trajectory in warfare. Atlatls and barbed dart points (used to prevent extraction) have been recovered by archaeologists at Chichén Itzá (Coggins 1984:47,100; Hassig 1992:126).

Changes in military tactics were encouraged when new projectile weaponry was introduced to a Maya polity. Decreasing levels of centralized political authority has been suggested to be a result of the Maya adapting to greater military sophistication (utilizing the atlatl) and new weapons such as the bow-and-arrow (D. Chase and A. Chase 2002:46). Both the atlatl and bow had significant effects on increasing the possible kill zone range for Maya warriors with effective projectile weapons (Hassig 1992:173). Deadly projectile weapons imply certain changes to military strategies, such as, killing, rather than capturing, and the building of defensive walls (D. Chase and A. Chase 2002:34). The atlatl, as a weapon, had a decisive impact on the Maya, but so did the bow-and-arrow. Yet, for the Maya, the atlatl was a symbol of power that the bow never replaced.

An Overview of the Bow-and-Arrow

Bows and a cache of arrows have been found in Germany and Denmark providing the earliest decisive evidence dating to approximately B.C. 8500. Earlier tentative bow-and-arrow evidence comes from microlithic puncture wounds dating to approximately 14,000 years ago in early Caspian cultures of Sudanese Nubia (Clark 1970:160). However, the atlatl has a much longer history than the bow predating it by possibly 26,000 years (Farmer 1994:681). Globally, the replacement of the atlatl by the bow has been very thorough; yet, the atlatl has not been completely abandoned (Shott 1997:86). However, the replacement of the atlatl has been so exhaustive that in contemporary United States culture, almost everyone can identify the bow-and-arrow, but few can recognize an atlatl.

The atlatl has been used in North America for at least 11,000 years (Hall 1997:109). North of Mexico, Native Americans replaced the atlatl with the bow-and-arrow around A.D. 500 (Hall 1997:109). The physical replacement of the atlatl by the bow encouraged the mental replacement of the atlatl in myths and folktales as well (Hall 1997:109). In Spanish-conquest period Mexican manuscripts, the atlatl has increasingly incorrect representations, followed by pictures of the bow-and-arrow, which signify the cultural and oral historical decline of the atlatl (Nuttall 1891:29-30).

In the Maya region, there is still a debate regarding when the bow-and-arrow complex made its first appearance (see Aoyama 2005:300; Hassig 1992:162). The technique of complex arguments based on iconographic representations and archaeological evidence, which includes classification function analysis of projectile points, have been applied to the bow-and-arrow (Aoyama 2005). There is certainty that the bow was used during the Late Postclassic (Hassig 1992:162; Porter 1981:407; Rice 1986:340) (and probably before); yet, interestingly, iconography of this period still depicts the atlatl (LeBlanc 2003:283). The lack of bow-and-arrow iconography confirms that elite Maya warriors of the Postclassic never accepted the bow-and-arrow as a symbolic weapon of power. Even the conquering Spaniards feared the atlatl more than the bow because of the prevailing force and kinetic energy of the atlatl that could easily pierce Spanish armor (Raymond 1986:173).

Evidence of small projectile points possibly indicate that the bow was around in the Middle Preclassic Period in Mesoamerica, but there is no substantial evidence of iconography or artifacts (other than small projectile points) to confirm this idea (Hassig 1992:197). There are however, depictions of atlatls, spears, clubs, and slings in sculptures, murals, and on ceramics (Hassig 1992:197).

Classic Period Maya art is virtually absent of bow or arrow depictions (Aoyama 2005:294). Prismatic blade points account for a very small portion of obsidian assemblages in the Classic Maya Lowland sites; instead, spear or dart points seem to have been more integral to Classic Maya warfare (Aoyama 2005:294). A Terminal Classic Period introduction of the bow by the Chontal Maya (Rice 1986:340) or by Mexican mercenaries from Tabasco (Porter 1981:407) has been assumed.

With other Maya sites, such as Santa Rita Corozal, evincing a prevalent occurrence of small projectile points (D. Chase and A. Chase 2002:35), it is hard to deny the bow was a large part of increased militarization after the Terminal Classic Period. Winning and losing a war was shared by not only the elite but also the general populace as well (A. Chase and D. Chase 1989:16). The bow could have changed military strategies by requiring defensive walls; its use could have also decreased the power of the elite, partially explaining the destabilization of elite control systems that is seen in the archaeological record at the end of the Terminal Classic period (LeBlanc 2003:283). Either new sophisticated military strategies involving the atlatl or the introduction of the bow could have been key reasons for a restructuring of Maya centralized elite control. Regardless of the key weapon causing political change, effects of warfare seem to have been more extensive than previously believed (A. Chase and D. Chase 1989:16).

However, there are issues with this reconstruction of a Terminal Classic Period introduction of the bow. At Copan, a prismatic blade point was "recovered from a secondary context of the Early Classic Period at Group 9M-19, located 300 m northeast of the Principal Group in the Las Sepulturas ward," it was corner-notched with a stem indicating it was attached to a thin arrow shaft (Aoyama 2005:300). Both notched and unnotched small prismatic obsidian blade points were present in the Copan Valley during the Early and Late Classic Periods. Probable arrow points have been recovered at Aguateca dating to the Late Classic Period (Aoyama 2005:294). Aoyama (2005:294) was able to determine that Early and Late Classic small points in the Copan valley and at Aguateca were used primarily as arrow points; this interpretation was based on microscopic traces of projectile impact damage in conjunction with classification function analysis of lithic points. Aoyama's (2005:300) experiments indicate the bow-and-arrow was present in the Maya Lowlands earlier than had been previously been assumed. Further evidence from other Maya sites, with carefully analyzed archaeological contexts, should bolster the conclusion of an Early Classic introduction of the bow-and-arrow.

CHAPTER FOUR: DISCERNING DART AND ARROW PROJECTILE POINTS

The atlatl, as well as the bow-and-arrow, were both certainly used at the same Maya sites in various regions (Aoyama 2005:291; Diane Chase and Arlen Chase 2002:35). In areas where there is a bimodality of large and small projectile point distributions, the best interpretation of such evidence is that these regions used both the bow and atlatl (Fenenga 1953:321). There are a few reasons the atlatl may have been retained while many Maya adopted the bow-and-arrow. The penetrating power of the atlatl is about five times greater than that of the bow-and-arrow (Yu 2006:208). The length of the atlatl dart inhibits movement after the target has been struck, particularly important when hunting arboreal, swimming, or flying animals (Yu 2006:209). In addition, the ability of atlatl darts to pierce armor was unmatched by any other weapon (Hall 1997:109). However, in many instances there was certainly overlap by Maya in the use of atlatls and bows.

The questions of which Maya sites used the atlatl and bow and what the prevalence of use for each kind of weapon remains unresearched. Most lowland Classic Maya cities were gradually abandoned and Maya presumably carried away a large portion of their weapons, meaning there are seldom instances of Maya weaponry in primary contexts (Aoyama 2005:291). In addition, because both the atlatl and bow are primarily made of perishable materials, the easiest way to determine the prevalence of atlatl use, in certain Maya regions, is by identifying the launcher based on projectile point identification (Kidder 1938:156).

Three categories of projectile points based on function are: arrow points (small and lightweight stemmed bifacial points); dart points (mostly medium-width stemmed bifacial points); and, spear points and knives (mostly wider and longer leaf-shaped bifacial points)

(Rovner and Lewenstein 1997:27-28). Indeed, when analyzing Caracol lithic data from the archaeology lab at the University of Central Florida I noticed most leaf-shaped bifacial points were greater than 90 mm, which exceeds the length of any known positively identified atlatl dart point (see Table 1, Shott 1997:87). The Length of Positively identified dart points range from 21.8 to 85.3 mm with an average of 53.3 mm, while the shoulder widths range from 14 to 32 mm with an average of 23.1 mm (Table 1, Shott 1997:87).

To determine use-wear patterns, which assists with lithic point identification, one of the best methods involves using microwear analysis. An excellent microwear analysis of chert bifacial points at Aguateca revealed many were used as dart or spear points, but some were also used for bone, shell, and wood craft production (Aoyama 2005:294). At Aguateca, 50% of tapered-stem points and stemmed points, were used exclusively as spear or dart points; 62.5% of laurel-leaf points were used as spear points and knives and 37.5% of laurel-leaf points were used as spear or dart points (Aoyama 2005:297). Microwear analysis is very useful for increasing identification accuracy of lithic points, but is not very applicable for research analysis when the physical specimens cannot be obtained or for on-site field analysis.

When determining discrete classes of lithic points, there is the problem that some of the large points may be knife points or thrusting spear points and not actually projectile points (Fenenga 1953:319). Lithic knife points can usually be identified based on edge wear resharpening and beveling (Fenenga 1953:318) – as identified with microwear analysis (see Aoyama 2005:294). In the archaeological record, spear points are usually fewer in number than atlatl dart points because spear points are less likely to break since there is less force behind the striking blow and because atlatl darts were designed to be thrown for a longer distance and were sometimes not recovered (Fenenga 1953:318).

Discerning between dart and arrow points can be done based on the maximum width of the point; this can be done in the field or with analysis of most lithic reports (Shott 1997; Thomas 1978:470). The bow launches a projectile much lighter and shorter than the atlatl, so it was natural to assume the projectile point would be lighter and smaller on the arrow than that of the atlatl dart. The transition from large, broad projectile points to smaller narrower forms is often cited as a change in weapon technology from the atlatl to the bow (Whittaker 2010:201; Shott 1997:87; Yu 2006:201; Elston and Zeanah 2001:107). There is the possibility that large Folsom lithic points were being used as arrow points, but if this is the circumstance then they should not have been replaced, and exclusively used, by the small point tradition cultures of the same region in later times (Kidder 1938:156).

Variation in lithic points may differ due to a variety of reasons. An analysis completed on northeastern North American projectile points displayed arrow points that were typically reduced from flakes whereas dart points were reduced from cores (Yu 2006:201). Regional stylistic variation is something to consider, but there is still a difference between the typical large (dart) and the typical small (arrow) projectile point, creating mutually exclusive bimodality categories (Fenenga 1953:313-314). Some lithic point variability is due to cultural transmission of stylistic choices, but the majority of projectile point variation is explained by: new hafting techniques; a need to control breakage and resharpen; and, most importantly, a change in weapon technology (Zeanah 2001:107).

Using intrinsic characteristics in an attempt to separate lithic points into discrete types has been a focal point of many researchers (Browne 1940; Fenenga 1953; Shott 1993, 1997; Thomas 1978). Weight and size of lithic points has been thought to be determining characteristics of dart and arrow projectile points because of the presence of stratigraphy that contained numerous large lithic points in lower horizons with a prevalence of smaller lithic points in the upper level horizons (Fenenga 1953:315-316).

Summary of Previous Attempts at Projectile Point Identification

To understand how projectile point characteristics aid in identifying the launching device, previous research attempts will be summarized. Browne (1940:211) tested both bows and atlatls with large and small projectile points, claiming Folsom points made good arrow points and that the bow was not introduced as late as expected in the Folsom point region. However, Browne (1940:212) admits that he was not a good enough atlatlist to make such an evaluation by stating that “any close degree of accuracy is impossible with the atlatl.” Browne (1940:212) admitted that after six months of practice that he “wouldn't be sure of hitting a buffalo at thirty yards once out of ten shots.” A modern atlatlist would scoff at Browne’s pitiful accuracy, as would any pre-Spanish contact Maya hunter or warrior.

A few attempts at using weight to discriminate between dart and arrow points have been attempted; however, they used archaeological specimens of unknown status or undocumented points (see Fenenga 1953; Van Buren 1974). Fenenga (1953:315) analyzed 884 chipped stone points from sites in the western United States and determined that gross weight was the best indicator of projectile function because there is more bimodality produced than when using thickness, width, length, or a combination thereof. Fenenga (1953:314) noticed that there were distinctly small and large mutually exclusive categories, indicating projectile point manufacturing traditions where modal weight of large lithic points is approximately ten times greater than the modal weight of small lithic point categories.

Weight is one of the possible distinguishing characteristics to help discern projectiles points (Fenenga 1953:322). However, there are multiple problems in attempting to design an experiment using weight to determine what Maya regions used the atlatl. First, there is an issue with obtaining a control group because most extant dart and arrow points that can be entered into a control group are still hafted to the dart or arrow shaft; and the projectile point removal would damage the dart or arrow specimen (Shott 1997:98). Second, resharpening a projectile point not only changes the length dramatically but also alters the overall weight of the projectile point, which makes weight an unreliable source (Shott 1997:94). Third, there is not a standardized form for reporting lithic points and many archaeological reports do not provide information regarding weights for recovered lithics (Coggins and Ladd 1992; Moholy-Nagy 2003).

Using multiple variables other than weight, Thomas (1978:468) analyzed still-hafted museum specimens positively identified as arrow and dart projectile points. The use of traditional classification functions were calculated using an algorithm supplied by Klecka (1980:43) used in a discriminant function analysis. The discriminant function analysis determines which variables maximize Mahalanobis distance between groups (Thomas 1978:469). Maximizing Mahalanobis distance allows classification functions to be determined which place new cases with unknown memberships in the most closely related category (Thomas

1978:470). In other words, because large and small lithic points have variables with distinct means they can be categorized into mutually exclusive groups.

Discriminant analysis of identified dart and arrow points enabled Thomas (1978:478) to formulate classification functions. The dart point classification function is: C = 0.188 length + 1.205 width + 0.392 thickness - 0.223 neck width - 17.552; the arrow point classification function is: C = 0.108 length + 0.470 width + 0.864 thickness + 0.214 neck width - 7.922 (Thomas 1978:470). The function that gives a larger C value places the lithic point in the determined category. The previous discriminant analysis identified almost all of the 132 positively identified arrow points but only 70 percent of dart points. However, Thomas (1978) only used ten dart points, and a sample size of ten creates wide confidence intervals. In addition, experiments using multivariate functions are prone to error (Shott 1997:98).

Using neck width as the sole discriminator has been proposed by multiple researchers (Chatters et al. 1995; Corliss 1972; Thomas 1978). However, using neck width as a threshold value of 9-10 mm has approximately less than 50 percent accuracy at identifying arrow points (Shott 1997:98). Using neck width and obtaining a control group is also problematic because this technique would often encourage the removal of a projectile point from the larger archaeological specimen, damaging it in the process.

Shott (1997:88) measured various still-hafted dart projectile points from a range of museums, expanding Thomas' (1978:466) sample size of confirmed atlatl dart points from 10 to 39. Shoulder width threshold has been determined to be near 20 mm (Shott 1997:98). Using 20 mm as a threshold value, Shott (1997:98) correctly identified 92.4 percent of arrow points but only 76.9 percent of dart points, which is better than any multivariate solution. However, using shoulder width in a one variable classification function analysis instead of a threshold value allows a more than ten percent increase in accuracy at identifying atlatl dart points (Shott 1997:98).

Using shoulder width in a single variable classification function analysis is the least problematic function used to analyze lithic points. Shoulder width alone is a less problematic variable compared to length because resharpening reduces length much more than shoulder width (Shott 1993:434). In addition, not using length as a variable allows commonly broken tipped lithic points to be analyzed (Thomas 1981:14-15). The discriminant function analyses completed on dart and arrow points have determined shoulder width as the single most important variable when discriminating between dart and arrow points followed by length, thickness, and then neck width (Shott 1997:95; Thomas 1978:470). Shoulder width, as the single variable discriminant, also produces results more accurate than any multivariate function (Shott 1997:99). In addition, shoulder width allows still hafted specimens to be measured, creating a decisive control group.

Because discriminant analysis determined shoulder width as the single most discriminating variable of known dart and arrow points, Shott (1997:93) was able to formulate projectile point classification functions. The defined classification functions are Dart: C=1.40(shoulder width) - 16.85 and Arrow: C=.89(shoulder width) - 7.22 (Shott 1997:93). Again, the function that gives a larger C value places the lithic point in the determined category. Using the above function, Shott (1997:93) noticed arrow points form a discrete category, whereas dart points are slightly more dispersed, yet still discretely identifiable to a high degree of accuracy in mutually exclusive groups. Using shoulder width as a single variable discriminant in a classification function, archaeologists in the field can distinguish lithic projectile points with an accuracy of 85 percent or better (Shott 1997:99).

Data, Discussion, and Interpretation

This test applies Shott's (1997:95) classification functions onto specific Maya sites. Hopefully, identification of projectile points will occur at the same accuracy level when Shott's (1997:95) classification functions are overlaid upon Maya lithic data. The sites that were tested with the classification function analysis are Chichén Itzá, Tikal, and Caracol because all three have atlatl iconography and physical remains of atlatls (see A. Chase and D. Chase 2002, 2011; Coggins 1984; Freidel 1986; Nuttall 1891; Schele and Freidel 1990; Stuart 2000; Wray 1945).

The shoulder width of analyzed lithic points were measured at the widest point just above the corner or side notches on the point (see Figure 12 a, e). The shoulder width is usually the widest section of the lithic point just above the stem. Locating the area where there are corner notches or barbs, helps determine where to measure the lithic point's shoulder width. The Tikal lithic points were measured from half scale drawings using digital calipers to the closest millimeter. The lithics from Chichén Itzá and Caracol were measured in the field and reported in the lithic reports and catalog cards. When possible, archaeologists in the field should use digital calipers for best accuracy in measurement of lithic points hopefully with a standardized method of measuring lithic dimensions. It has been assumed reported lithic measurements from Chichén Itzá and Caracol were recorded with the best accuracy in the manner discussed above.

The tables (Table 1, Table 2, Table 3, Table 4, Table 5) included in this thesis report as many of the variables of the lithics as were available. However, the only measurement used in this experiment was the width values. Width values were inserted into the classification functions: Dart: C=1.40(shoulder width) - 16.85 and Arrow: C=.89(shoulder width) - 7.22 (Shott 1997:93). Numbers on the lithic tables listed under dart and arrow headers are the completed classification function C values using the catalogue number specimens shoulder width measurement. The classification function with the largest C value determines the probable category of the unknown lithic point indicated under the designation header.

Chichén Itzá

Chichén Itzá has yielded multiple iconographic depictions of the atlatl (see Coggins 1984:52; Nuttall 1891; Wray 1945). The Sacred Cenote contained the preserved remains of a number of partial and nearly complete atlatls (see Coggins 1984:46,47,100,103, 104,108; Coggins and Ladd 1992). Importantly, a cache of lithic points was recovered from the Sacred Cenote, one of which was (catalogue number C6748) still hafted to the original dart foreshaft. Unfortunately, the hafted dart cannot be used in the control group because the lithic point's measurements were not available at the time of research. However, the rest of the cache from the cenote provides sixteen units for an atlatl dart point control group (n=16) (Table 1). All of the control group projectile points are positively identified as dart points by the classification function analysis (Table 1).

The next test was to run the same classification function analysis on the remaining lithic points from the Sacred Cenote at Chichén Itzá (n=54) (Table 2). These data were obtained from *Artifacts from the Cenote of Sacrifice, Chichén Itzá, Yucatan* (Coggins and Ladd 1992). Based on the data generated from the classification function analysis on the lithic remains from the

Sacred Cenote at Chichén Itzá, there appear to be only two arrow projectile points out of the 54 lithic points that were tested. There is an 85%, or better, chance for the correct identification of these lithic points (Shott 1997:99). Given the difficulties of archaeological inference, identification with an 85 percent confidence interval is not a bad average. The results match with the expectations that there would be numerous dart points recovered from the Sacred Cenote at Chichén Itzá because of the recovered atlatls and widespread atlatl iconography at the Maya site.

There are a few other inferences that can be made from the Chichén Itzá lithic analysis. It is logical to assume the artifacts found in the depths of the Sacred Cenote were of great meaning to those who cast them because Maya made long distance pilgrimages to ritually destroy offerings in the Sacred Cenote (Sharer and Traxler 2006:565). The prevalence of atlatl points in the Sacred Cenote confirms that the atlatl was a symbol of power or great meaning for those who deposited the projectiles. Iconographic and lithic projectile point analyses further provide supporting evidence that Chichén Itzá relied heavily on the atlatl as a weapon. The next analysis will compare Sacred Cenote lithics with Tikal lithic data recovered from proveniences that were not specifically areas where symbols of power would have been ritually destroyed.

Tikal

Tikal has multiple iconographic representations of atlatls (see Proskouriakoff 1984; Stuart 2000). There is an atlatl depicted on Stela 31 (Figure 6) (Proskouriakoff 1984:164). There is a ballcourt marker with an atlatl depiction on its hieroglyphs (Harrison 1999:81). In addition, there is an actual atlatl found archaeologically at Tikal (Harrison 2003:105). Thus, the Tikal data should show a prevalence of atlatl use by the Maya at Tikal.

The majority of probable dart and arrow points fall under the lithics category of "thin biface" which refers to artifacts frequently categorized as projectile points or knives (Moholy-Nagy 2003:17). It is generally agreed thin bifaces were hafted. (Moholy-Nagy 2003:17). Analyzing the stemmed and unstemmed points from various Lowland Maya sites has determined that some were definitely used as projectile points (Moholy-Nagy 2003:17).

Roughly, 92 percent of the Tikal lithic points were recovered from general excavations (Moholy-Nagy 2003:17). Most lithic points were found in the center of Tikal from general excavations and surface collection (Moholy-Nagy 2003:20). A portion of thin biface points had a secondary ritual function in addition to their primary use as a weapon point (Moholy-Nagy 2003:18); which presumably indicates the high degree of symbolism attached to the points or the weapons that launched them. Date ranges for Tikal lithics points are primarily from Early Classic to Late Classic Periods (Moholy-Nagy 2003:17).

Moholy-Nagy (2003:20) agrees that small points are generally regarded as evidence of new weapon technology. There were a total of eight small chert points, six of which were complete, customarily they have been identified as arrowheads due to their shape and small size. (Moholy-Nagy 2003:19-20). One small chert point 10A-290/26 (Figure 12,c) was recovered from a test pit 75-100 cm below datum yielding a possible Late Preclassic or Early Classic date (Moholy-Nagy 2003:18). Three complete small obsidian points were also archaeologically recovered. The obsidian and chert small points were all present by at least the Late Classic Period (Moholy-Nagy 2003:30).

Lithic points exceeding 90 mm were excluded from the analyses because it has been assumed that smaller thin biface points were used as projectiles and larger ones as knives, or thrusting spear points (Moholy-Nagy 2003:29). In addition, no known, positively identified atlatl dart point exceeds 90 mm (see Table 1, Shott 1997:87). Excluded from this analysis were many leaf shape points because many of them were identified as knives. In addition, leaf shape points do not have a true shoulder width, which means measuring shoulder width would be at an arbitrary point. Length measurements that include an asterisk indicate the lithic point's distal end was missing. The partial lithic points included in this analysis were missing only a fraction of the distal end, indicating that if the original complete point were to be measured it would measure less than 90 mm (e.g. Figure 12, d, e). The included Tikal lithics were measured from the half scale illustrations found throughout *The Artifacts of Tikal: Utilitarian Artifacts and Unworked Material: Tikal Report No. 27, Part B* (Moholy-Nagy 2003). The Tikal lithic data supplied a sample of 118 lithic points (n=118) (Moholy-Nagy 2003).

There are evidently two distinct categories of bimodal distribution, large and small lithic points at Tikal, which can be seen in the Tikal lithic point's histogram (Figure 13). The results of the Tikal lithics analysis, located under the designation header (Table 3) revealed ten probable arrow points (8.5%) of 118 analyzed lithic points. The remaining 108 lithic points were categorized as probable atlatl dart points. The results of this test are very interesting because they display how common the atlatl was even in non-ritualized proveniences. In addition, the prevalence of small projectile points categorized as arrow points provides evidence for Maya using the bow during the Classic Period. The data from the Tikal analysis provides an interesting view that the bow-and-arrow was possibly used much earlier than most Mayanists believe (Rice 1986:340; Porter 1981:407). In addition, the Tikal data provides a bold contradiction to Wray's

(1945:26) claim that the atlatl was a foreign element introduced initially at Chichén Itzá.

Caracol

Caracol was also selected for a lithic analysis for multiple reasons. Caracol does contain iconographic images of warriors with atlatls on ceramics (D. Chase and A. Chase 2002:43). Additionally, a possible atlatl hook has been recovered from an Early Classic context (Figure 10) (A. Chase and D. Chase 2011:11). There are also a number of small projectile points found in Caracol's archaeological record, possibly indicating the presence of the bow-and-arrow. Testing Caracol's lithic remains should provide evidence for the use of both the bow and the atlatl.

Caracol data was obtained from the card catalogue at the University of Central Florida's archaeology lab (Table 4). Lithic points of lengths greater than 90 mm were omitted from this analysis because they are most likely spear points. There have been no recorded positively identified dart points with a length greater than 90 mm (see Table 1, Shott 1997:87). While analyzing lithic data from Caracol a number of questionable lithic points were excluded from this analysis due to the length restriction.

The length cutoff for analysis is not the only determining factor that excluded some Caracol lithic points. Six green obsidian lithic points recovered from Caracol's Special Deposit C117f-1 (discussed previously) (Table 5) were used to poke or stir the cremation fire (A. Chase and D. Chase 2011:10). A flexible dart is not the ideal tool to stir a cremation fire with; instead, rigid spears were probably used. The six green obsidian points from Special Deposit C117f-1 are all well over the imposed 90 mm length cutoff for analysis (Table 5). Ranging from 120 mm to

130 mm in length, the six green obsidian points also all weigh more than any positively identified dart point (see Table 3 Thomas 1978:466). While weight is a problematic variable for determining projectile function (Couch et al 1999; Whitaker 2010:211), Fenenga (1953:318) believes the outside limits of atlatl dart point's weight range from 4.5 grams to about 20 grams. The suggested atlatl dart point weight range is much less than the 32-36 gram range for the six green obsidian points from Special Deposit C117f-1. Because the six green obsidian points far exceed the ideal length and weight for an aerodynamic atlatl dart point, it has been presumed they are most likely spear points, or at least problematic enough to be excluded and not analyzed with the classification function analysis in this thesis.

The Caracol data supplied a sample of 79 probable dart or arrow lithic points (n=79). Classification functions are suitable to apply to data that distinctly has a bimodal distribution. Caracol's bimodal distribution of lithic point shoulder width is easily seen in the Caracol lithic point's histogram (Figure 14). There are clearly small and large lithic point making traditions at Caracol, most likely correlated with arrow and dart points. Applying the dart and arrow classification functions to the Caracol lithics data (Table 4), eleven probable arrow points out of the sample of 79 lithic points were revealed. Thus, 14% of analyzed Caracol lithics were determined to be arrow points compared to 8.5% at Tikal. For a visual comprehension, selections of three probable Caracol dart points (Figure 15) and selections of two probable Caracol arrow points are illustrated (Figure 16). The results of the Caracol analysis show that the bow was probably in more frequent use at Caracol than Tikal. However, this could be a date range issue, if the bow-and-arrow was introduced near the Terminal Classic then we would expect to find more arrow points present at Caracol than Tikal because Caracol dates to a later time frame than Tikal.

The Caracol data is in stark contrast to Hassig's (1992:205) claim that Tikal abandoned the atlatl and the weapon was not adopted by other Maya sites. Hassig (1992:205) also believed the atlatl was just a dynastic ritual feature and not a significant weapon to the Classic Maya. However, with a prevalence of broken and use-wear indications on analyzed projectile points (Figure 15, Figure 16), the Tikal and Caracol lithics analyses data proves that the atlatl was used for more than just a symbol of power. Hassig's (1992) error was using iconographic representations alone to make assumptions regarding the prevalence of the atlatl.

Utilizing iconography alone to determine prevalence and use of dart and arrow points has been proven problematic. Alternately, forming a complex argument by means of dissecting iconographic representations in conjunction with archaeological context examination that includes classification function analysis is a more suitable method to determine the use and prevalence of the atlatl and bow. For an on-site test, one of the superlative utilities regarding the classification function analysis described in this thesis is that it can be easily carried out by archaeologists in the field or any researcher without access to artifacts or the ability to use microwear analysis on recovered lithic points.

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

The procedures to produce projectile points and the necessities of the projectile itself create a similarity between dart and arrow points. However, similarity is not identity, and dart and arrow point variables form discrete mutually exclusive categories (Shott 1997:99). Mutually exclusive categories enable discrete function analysis to determine classification functions to aid in identifying projectile weapons from lithic points with a high degree of accuracy. This thesis argues for projectile weapon inferences based on multiple lines of data analysis that include iconography, archaeology, microwear analysis, and classification function analysis.

Analysis of iconography is an element in the procedure to determine which Maya sites were heavily influenced by the symbol of the atlatl. However, iconography needs to be "ground-truthed" in terms of archaeological context and analysis. The relationships of Maya and their weapons can be interpreted with a high degree of accuracy using classification function analysis alone (Thomas 1978; Shott 1997), but including other archaeological and iconographical analyses increases the level of support for the argument being made. A complex argument with supporting iconographic and archaeological data is the best method for determining the use and prevalence of projectile weapons.

This thesis has described multiple aspects of the atlatl that can be found in the archaeological record in an attempt to create a better awareness of the atlatl, which, in turn, hopefully will enable archaeologists to more readily identify and catalogue such artifacts. Hooks (Figueredo 2010), finger-loops (Ekholm 1962), and bannerstones (Butler and Osborne 1959:223) are easily misidentified by archaeologists. Interpretations and inferences are best suited when archaeological data is correctly identified and analyzed.

Microwear analysis has helped determine that there was an early adoption of the bow in the Maya lowlands (Aoyama 2005:300); this assertion is supported by classification function analysis of lithic points from Tikal and Caracol in this thesis. Hassig (1992:197) admits that the presence of small lithic points could indicate that the bow was being used in the Middle Preclassic Period in Mesoamerica, but notes a lack of iconography to support this claim. However, the bow was definitely used during the Terminal Classic Period, even though the Maya elite never replaced the atlatl as a symbol of power with the bow. Maya iconography continued to feature the atlatl, rather than the bow, through the Late Postclassic Period (LeBlanc 2003:283). If Maya atlatl iconographic depictions have always been predominant over the bow and, yet, the bow was utilized as a weapon, then inferences based solely on iconography are problematic and should be reassessed.

The bow appears to have been relatively frequently used by the Caracol Maya. The Caracol lithics displayed a higher prevalence of arrow points than was found in the collections from Tikal and Chichén Itzá. The evidence of bow-and-arrow use at Caracol supports D. Chase and A. Chase's (2002) assertion that the bow increased militarism and encouraged the building of defensive walls during the Terminal Classic Period. From the lithic analyses in this thesis the bow-and-arrow appears to have been used prior to the Terminal Classic Period, but was in less frequent use than the atlatl.

By the time that the Chichén Itzá Temple of Jaguars murals were painted, the atlatl was fully integrated by Maya both as a symbol of power and as a weapon. The use of the atlatl was not a new introduction at Chichén Itzá, as Wray (1945:26) claimed. The Early Classic stelae at Tikal and Uaxactun, combined with lithic analyses at Chichén Itzá, Tikal, and Caracol reported in this thesis, demonstrate the full integration of the atlatl by several Classic Period Maya societies as both a weapon and symbol of power.

The Maya were first introduced to the atlatl as a symbol of power from central Mexico, most likely Teotihuacan as early as the Late Preclassic Period (Freidel 1986:237; Hassig 1992:205; Nielsen and Helmke 2008). To most Maya the atlatl was a strong symbol of dynastic power (Freidel 1986:237; Hall 1997; Hassig 1992), as demonstrated by the Tikal Stela 31 (Figure 6) (Proskouriakoff 1984) and Uaxactun Stela 5 (Figure 5) (Stuart 2000). The atlatl was such an important symbol of power that it plausibly became the K'awiil scepter indicating the ruler of some Maya polities (Sharer and Traxler 2006:326,739). The atlatl, as a symbol of power, has been supported by the lithic data analysis from Chichén Itzá because atlatls and darts were ritually terminated in the Chichén Itzá cenote indicating the importance and power of the atlatl to the Chichén Itzá Maya.

The Sacred Cenote at Chichén Itzá was a ritualized terminal site for objects with great meaning and value (Sharer and Traxler 2006:565). The prevalence of dart points found in the Sacred Cenote provides supporting evidence for the atlatl being a more significant symbol of power than the bow. The Maya use of the atlatl has been claimed to be only a symbol of power (Hassig 1992:197), but evidence derived from this thesis shows the atlatl was used by several Maya sites as a weapon and not just a symbol of power.

Contra to Hassig's (1992:205) assertion about the uniqueness of the atlatl at Tikal, the number of used atlatl dart points found at Caracol and Chichén Itzá prove that the atlatl was adopted as a weapon by other Maya polities. Iconographic and lithic projectile point analyses provide supporting evidence that the Chichén Itzá Maya relied heavily on the atlatl as a weapon.

The Tikal and Caracol lithic analyses provide supporting evidence for the atlatl being used as a weapon well before it was at Chichén Itzá. There are also conquest period Spanish documented reports of the Maya employing their most terrifying weapon, the atlatl (Nuttall 1891:10). The atlatl was certainly used by more than just the Tikal Maya.

In summation, there was an earlier adoption of the bow-and-arrow by some Maya polities indicated by small projectile points dating to the Classic Period at Tikal and Caracol. There was a Terminal Preclassic use of the atlatl as a weapon by Maya indicated by from the mass production of bifacial points in the Copan valley (Aoyama 2005:301). The atlatl was certainly in use as a weapon during the Early Classic Period ascertained from the atlatl hook found at Caracol in Special Deposit C117F-1 and the numerous atlatl dart points found at Tikal and Caracol with use wear marks. In addition, the introduction of the atlatl as a symbol of power came from a central Mexican origin, most likely Teotihuacan. The introduction of the atlatl as a symbol of power can be determined from the iconography at Tikal and Uaxactun. The continued use of the atlatl as a symbol of power is supported by the iconography and lithics found at Chichén Itzá. The Maya sites mentioned in this thesis are in vastly different regions presumably occupied by different kinds of Maya groups and cultures; but with the support of the data and analyses in this thesis, there should now be an understanding that prior to the arrival of the Spanish, the atlatl was used as both a symbol of power and as a decisive weapon by Maya for well over a thousand years.

APPENDIX A: IMAGES AND DRAWINGS

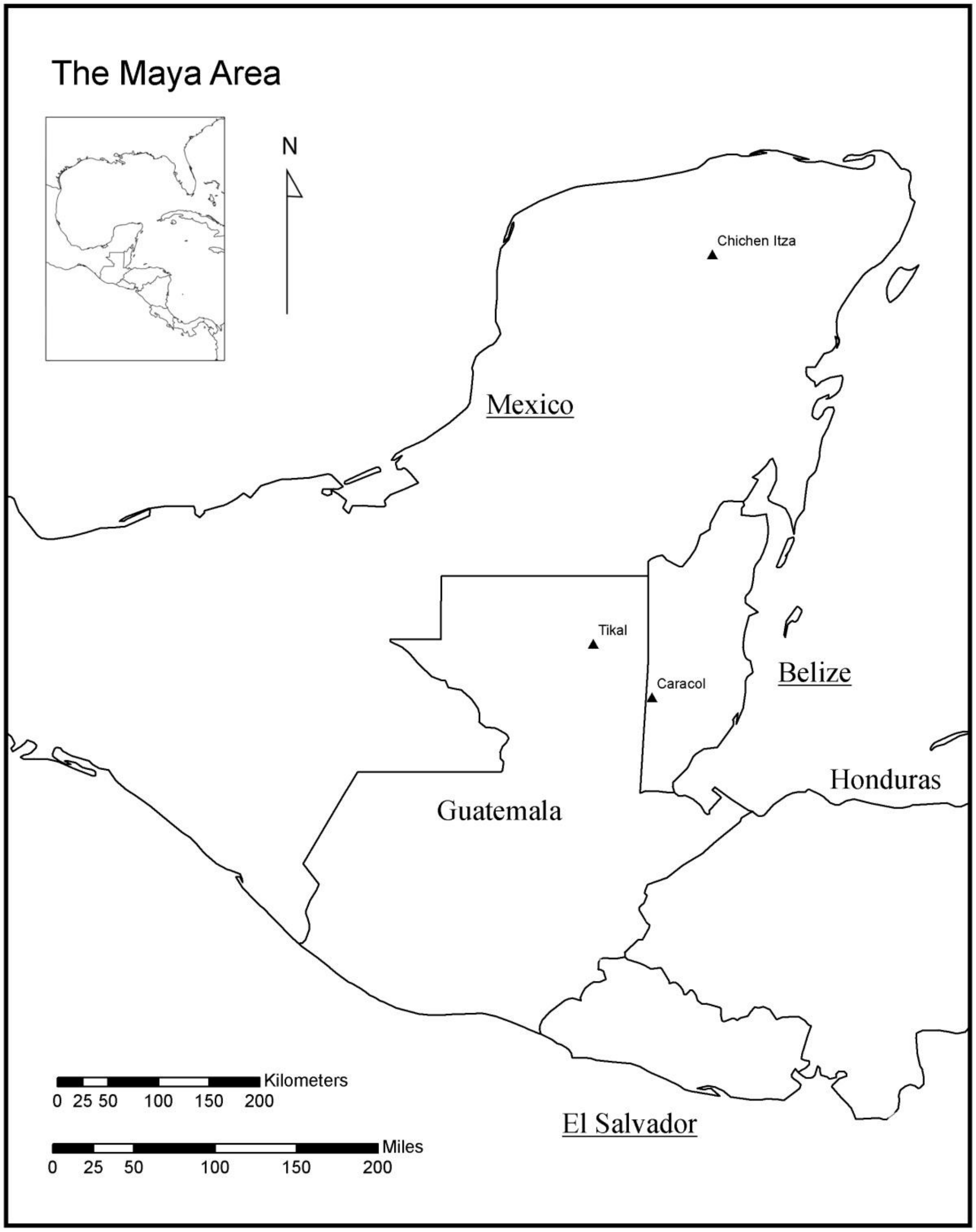
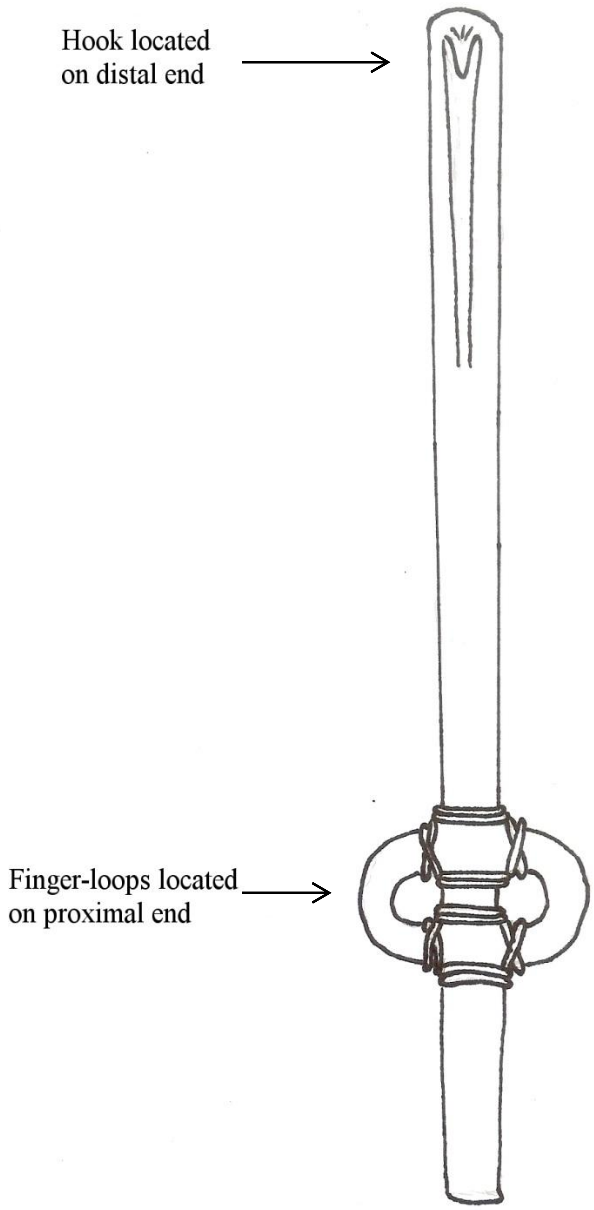
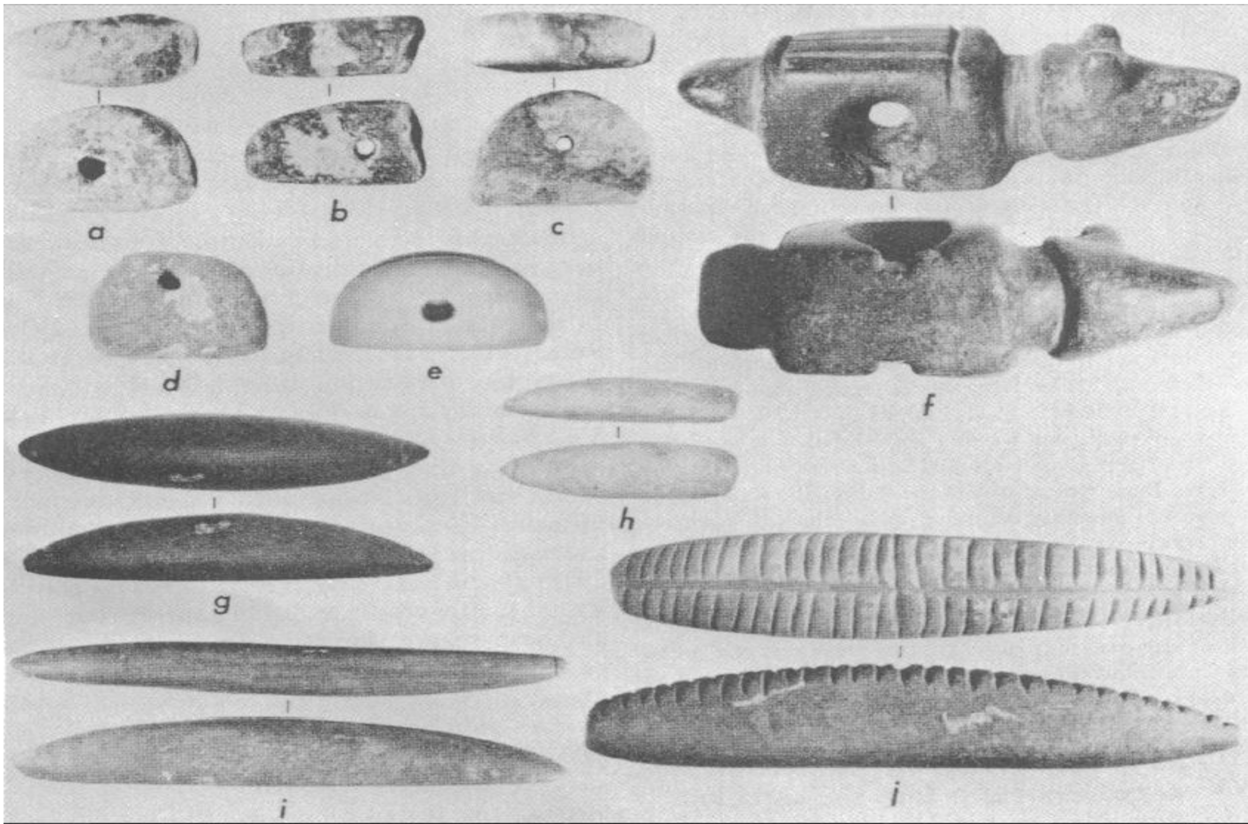


Figure 1: Overview Map of Maya area-Discussed Maya sites highlighted



(Drawn by author)
Figure 2: Atlatl Illustration



(Butler 1959:216)
Figure 3: Atlatl Bannerstones found in the United States

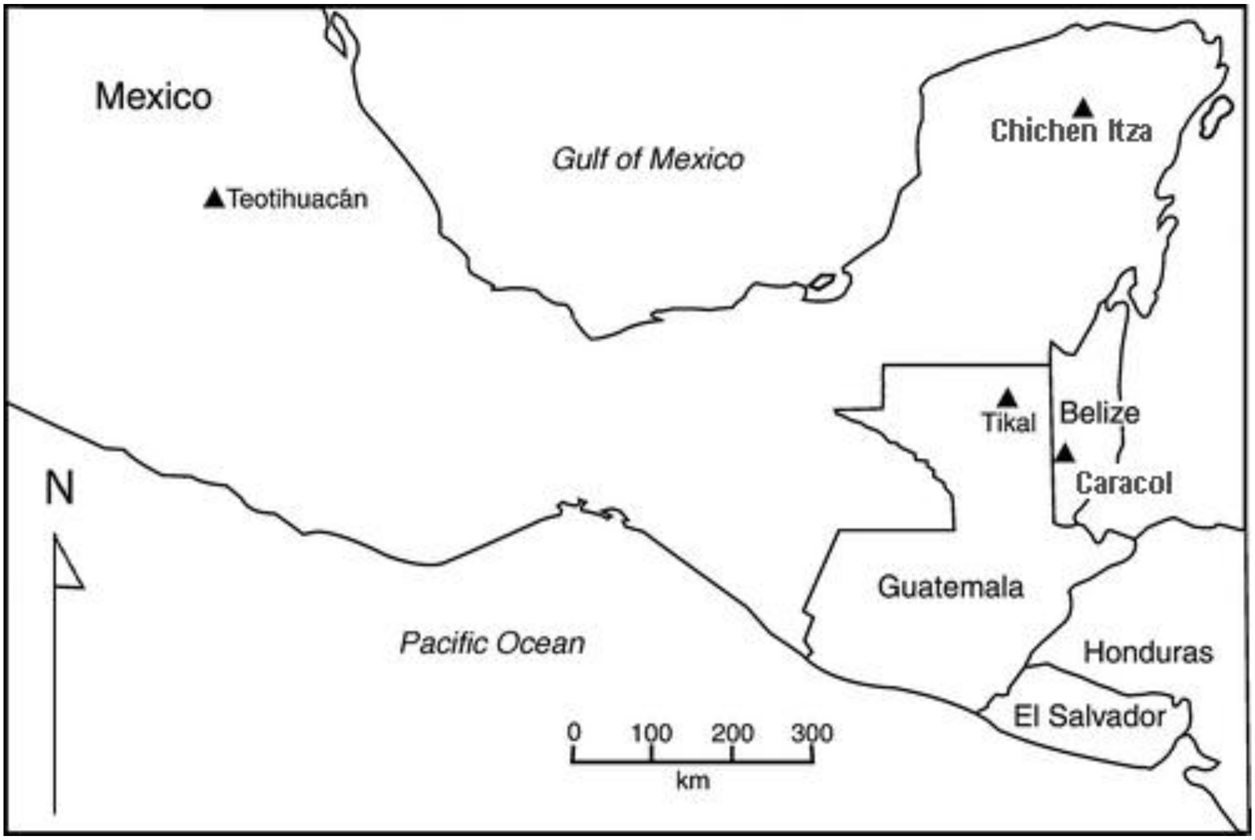
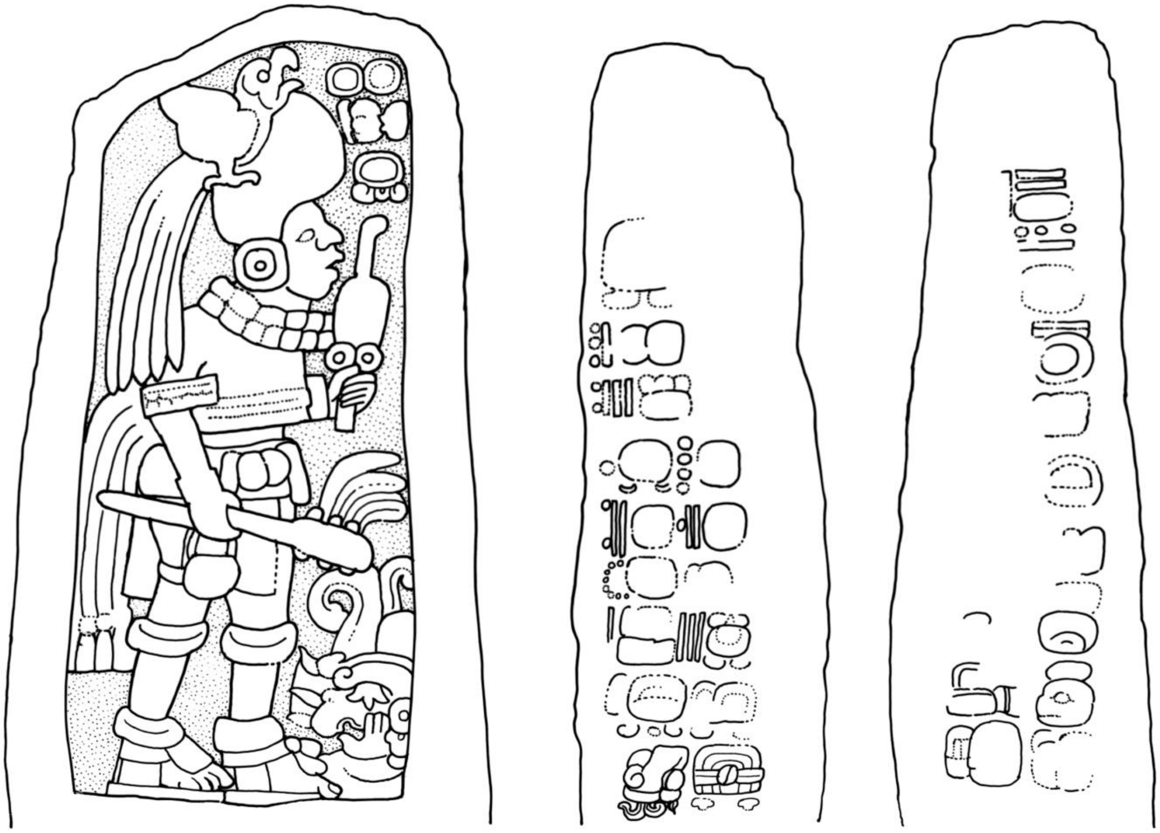


Figure 4: Overview Map of Mesoamerica-Discussed locations highlighted



(Drawing by Linda Schele, © David Schele, courtesy Foundation for the Advancement of Mesoamerican studies, Inc., www.famsi.org)
Figure 5: Uaxactun, Stela 5.

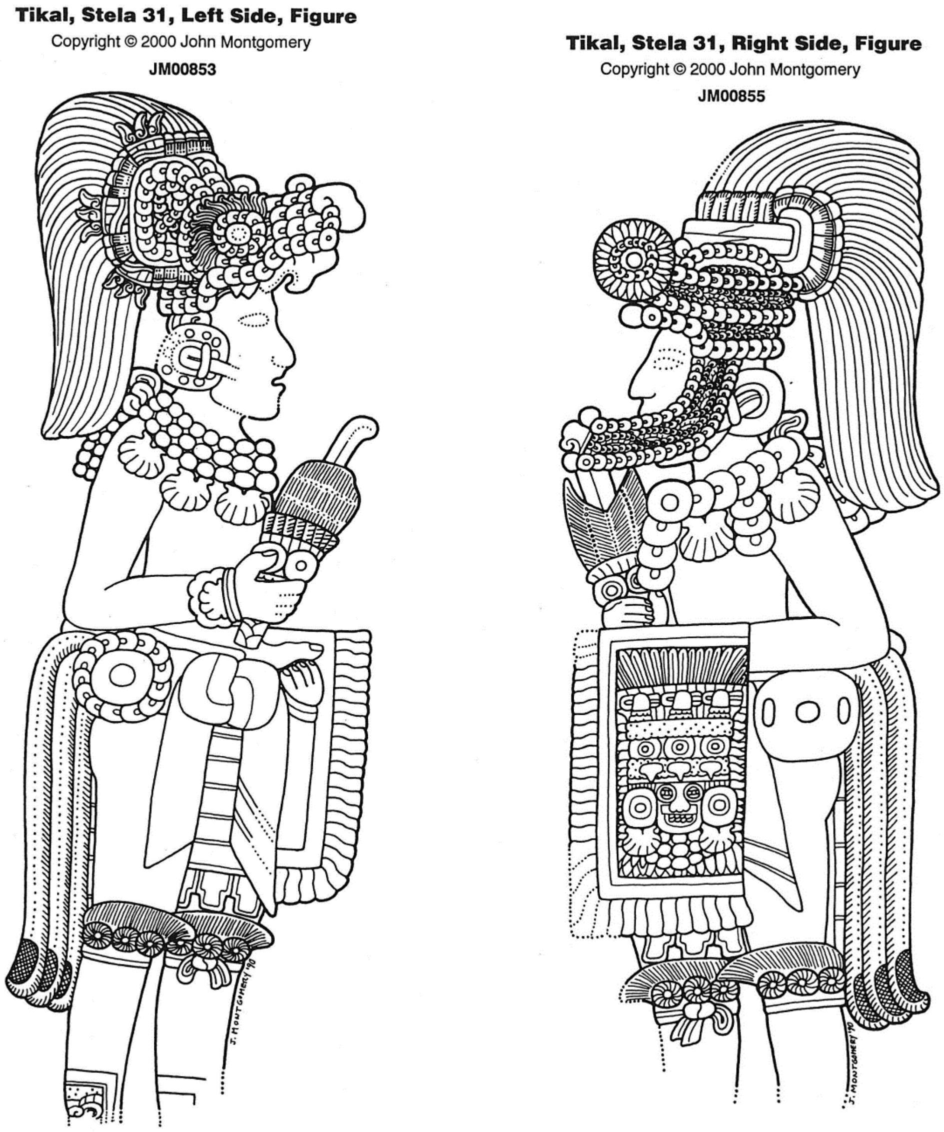


Figure 6: Tikal, Stela 31, left and right sides figures

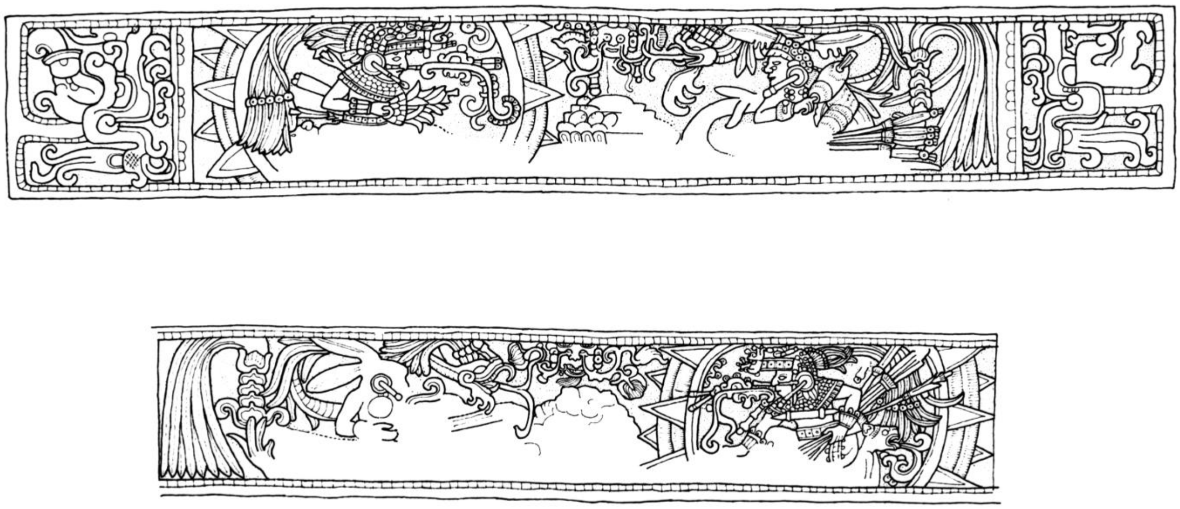
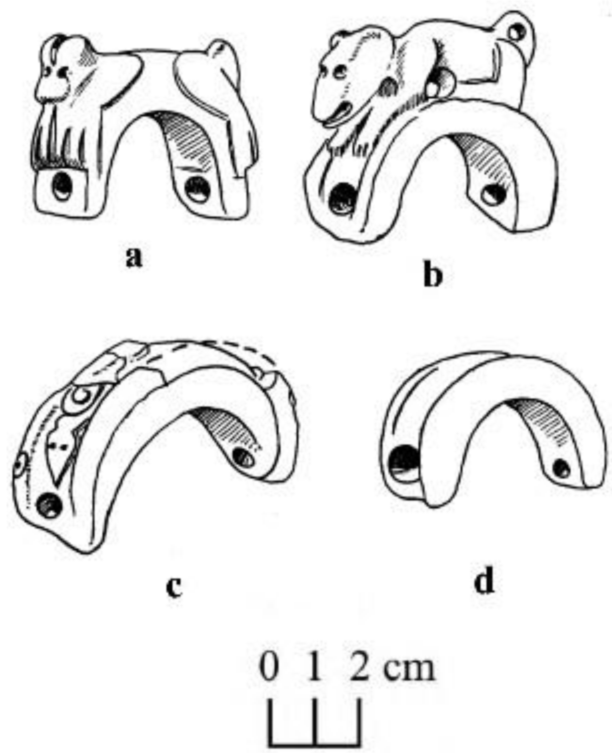


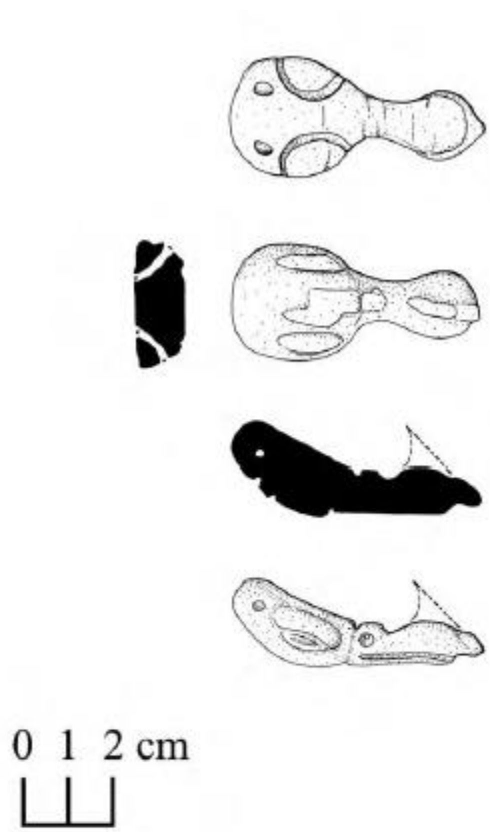
Figure 7: Wooden lintels from door leading to inner sanctum, Upper Temple of the Jaguar at Chichén Itzá showing Captain Sun Disk and Captain Serpent. Each figure carries darts and an atlatl ("spearthrower") suggesting warfare.



After Ekholm 1962:182

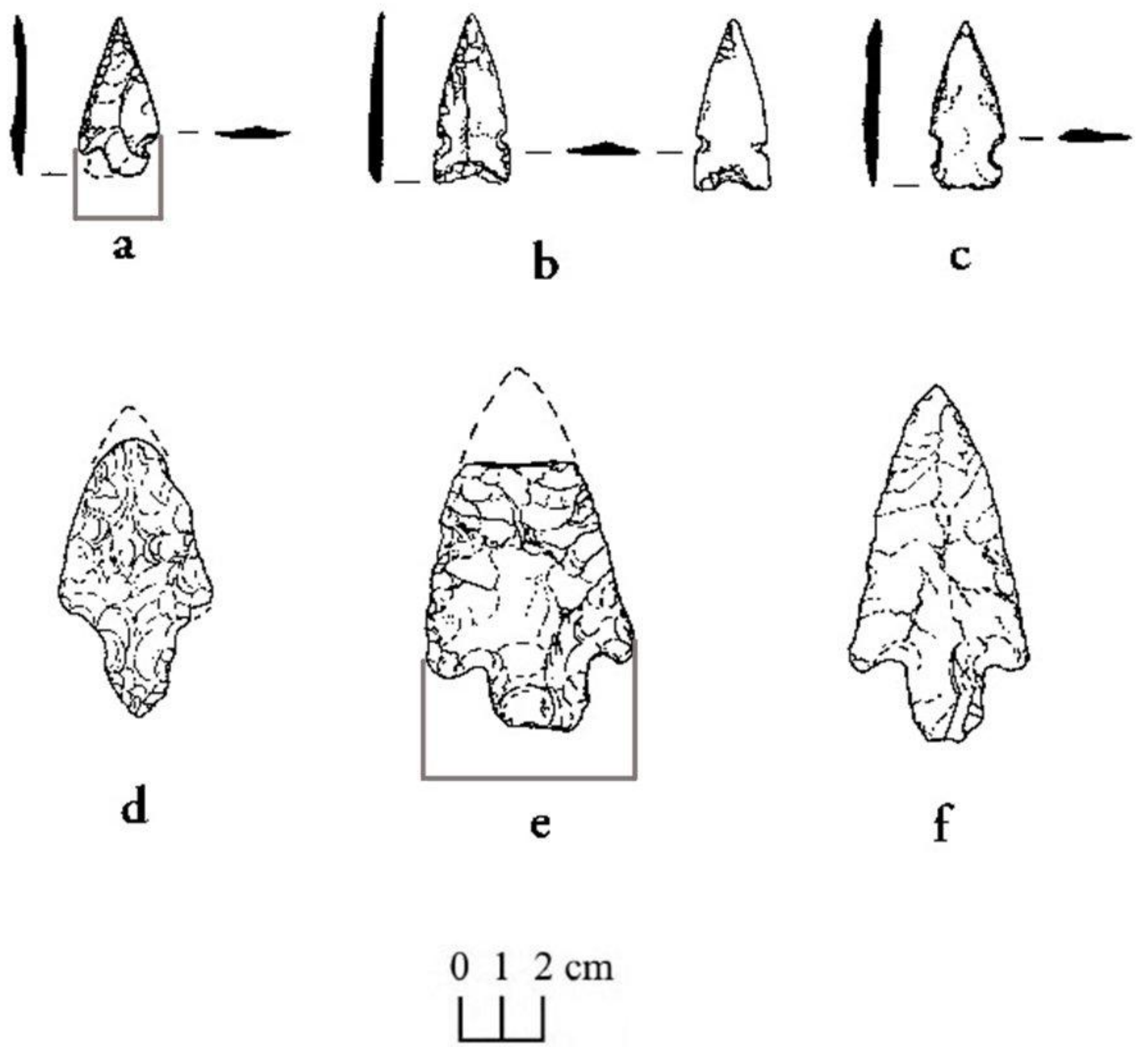
Figure 8: Finger-loops carved from shell and stone. a, b, proveniences unknown, soft red stone and shell. c, San Nicolas, Chapala, shell and soft green stone; d, Coscoyula, Guerrero, soft gray stone; All in American Museum of Natural History.

Figueredo 2010:40
Figure 9: Atlatl Hooks from Puerto Rico, illustrated by Chanlatte Baik and Narganes 1980.



A. Chase and D. Chase 2011:11
Figure 10: Shell Atlatl hook from Caracol, Belize

After Johnson 1971:192
Figure 11: a, An atlatl adorned with cruciform objects. b, Quetzalcoatl holding an atlatl. c, Tepictoton representing Quetzalcoatl.



After Moholy-Nagy 2003 Tikal Report No. 27, Part B
Figure 12: Selection of illustrated Tikal arrow and dart points. a, 43E-8/6 (distance of shoulder width measurement highlighted in gray) b, 11B-39/1 c, 10A-290/26 d, 68I-41/18 e, 42F-43/12 (distance of shoulder width measurement highlighted in gray) f, 45G-59/25

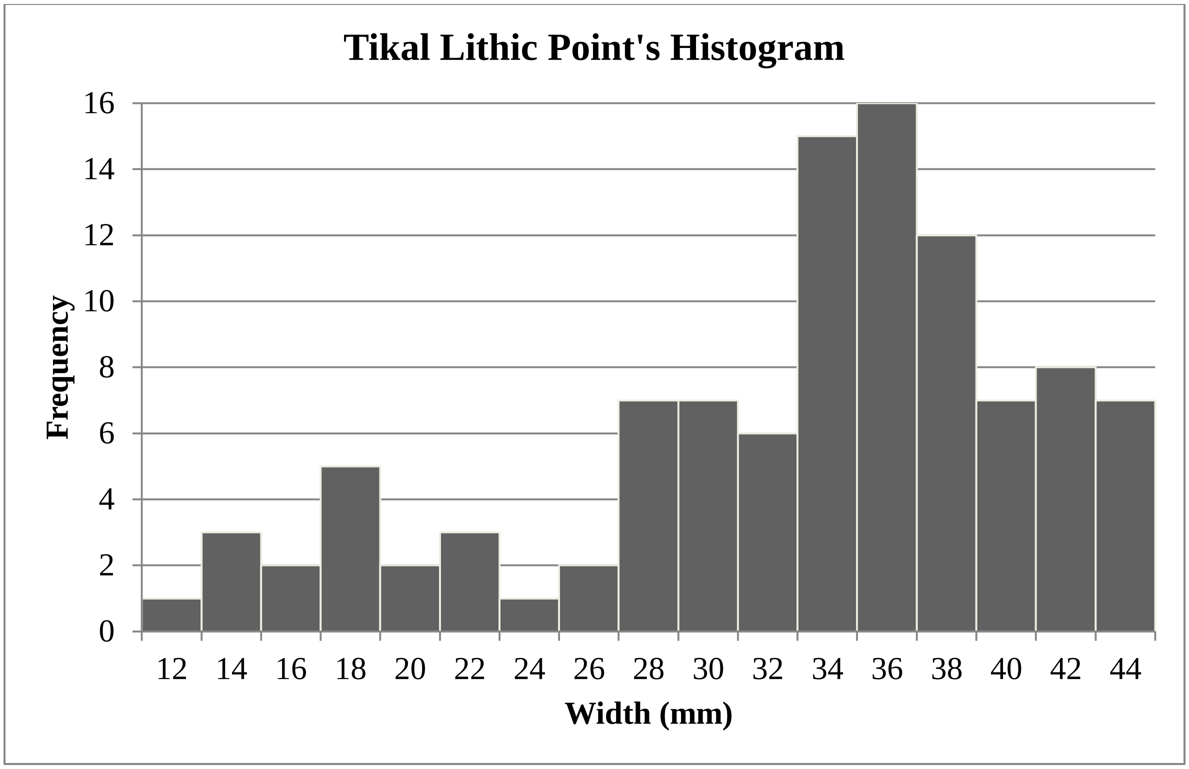


Figure 13: Tikal Lithic Point’s Histogram

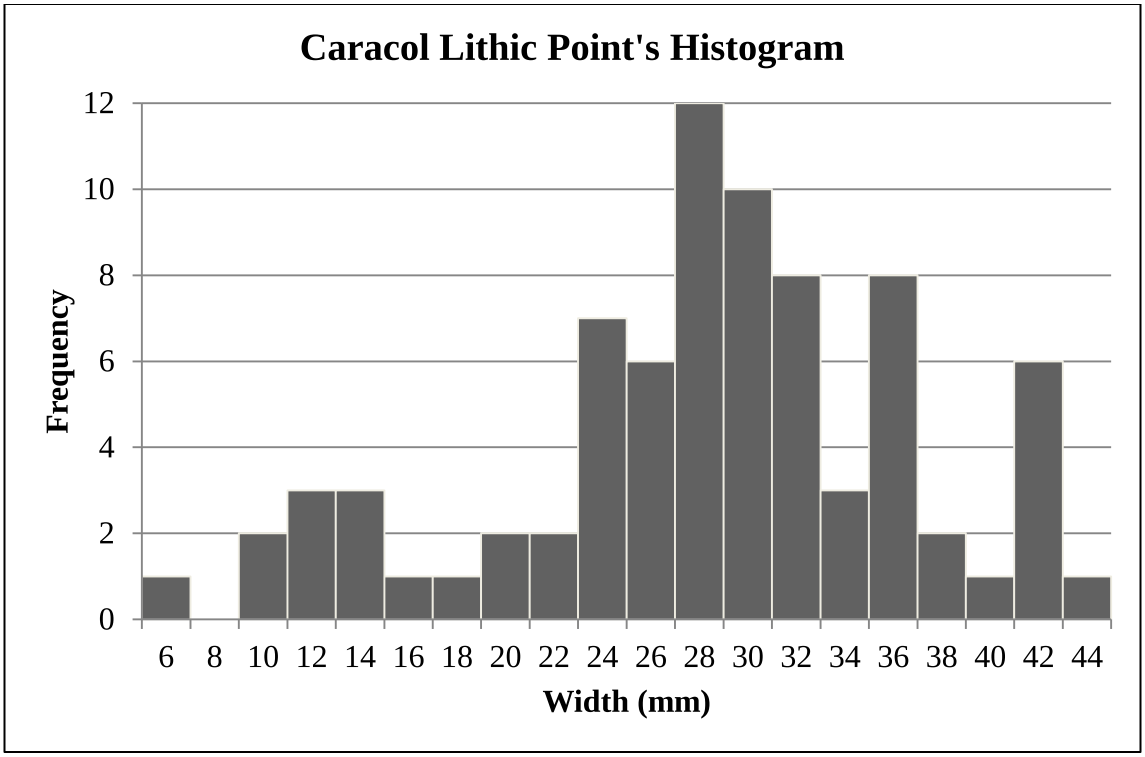
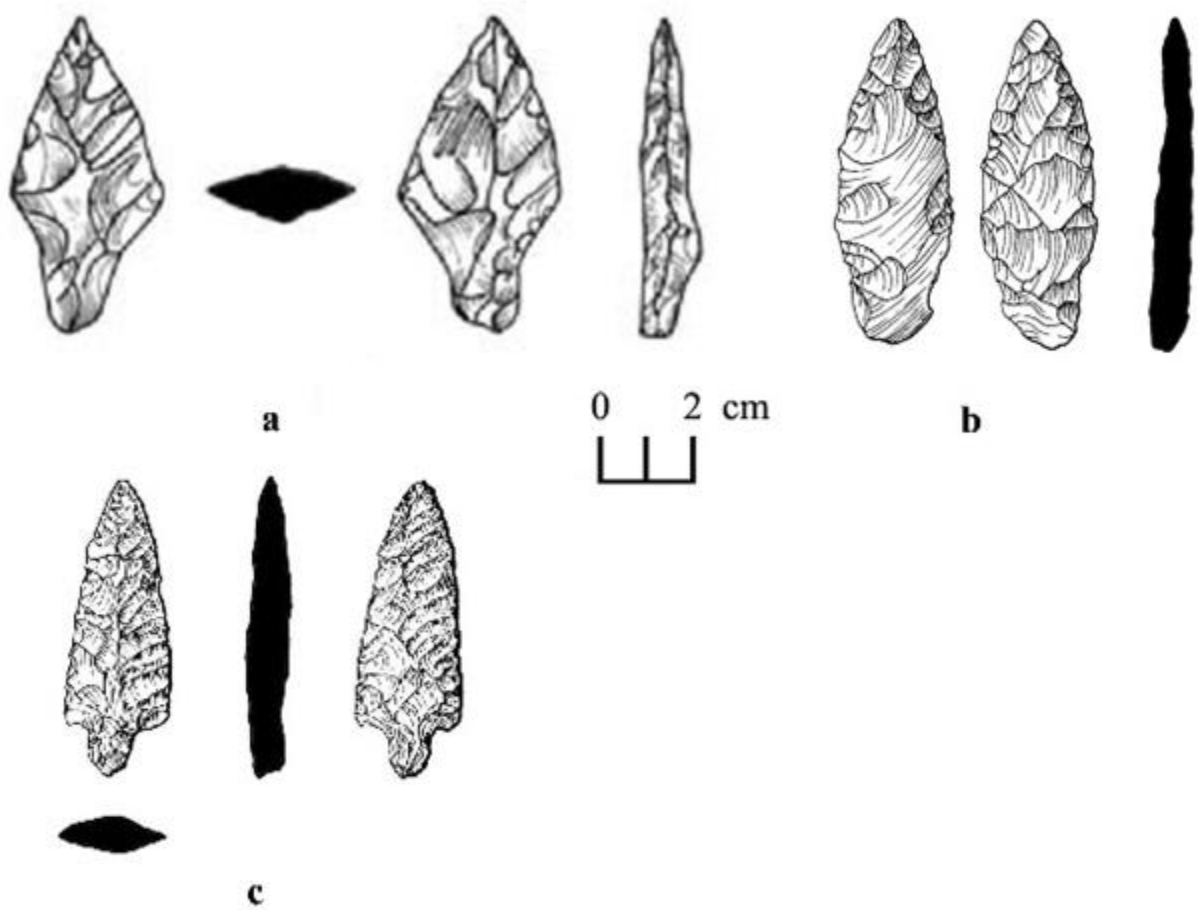
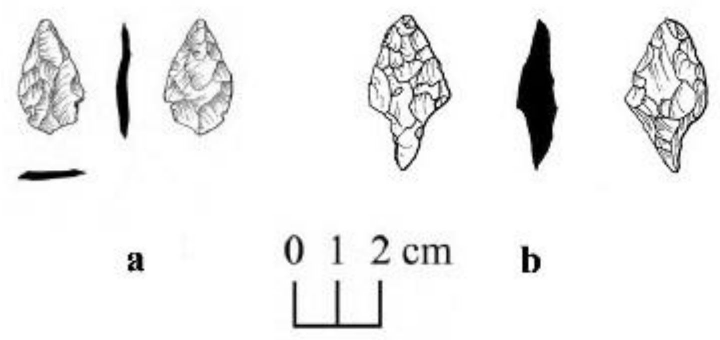


Figure 14: Caracol Lithic Point’s Histogram



Used with permission of Caracol Archaeological Project
Figure 15: Selection of illustrated Caracol dart points. a, C164B/17-4 b, C177B/2-4 c, C179D/11-3



Used with permission of Caracol Archaeological Project
Figure 16: Selection of illustrated Caracol arrow points. a, C182E/30-2
b, C180D/29-7

APPENDIX B: MAYA LITHICS TABLES

Table 1: Chichén Itzá Control group of positively identified atlatl points

Catalogue	Length	Width	Thickness	Dart	Arrow	Designation
C4897	**62**	**27**	**4**	**21**	**16.81**	**Dart**
C4899A	**41**	**23**	**5**	**15.4**	**13.25**	**Dart**
C4899B	**44**	**25**	**3**	**18.2**	**15.03**	**Dart**
C4900A	**53**	**28**	**3**	**22.4**	**17.7**	**Dart**
C4900B	**49**	**29**	**3**	**23.8**	**18.59**	**Dart**
C4901A	**55**	**30**	**5**	**25.2**	**19.48**	**Dart**
C4901B	**55**	**31**	**3**	**26.6**	**20.37**	**Dart**
C4901C	**54**	**31**	**4**	**26.6**	**20.37**	**Dart**
C4901D	**49**	**28**	**3**	**22.4**	**17.7**	**Dart**
C4903	**51**	**23**	**5**	**15.4**	**13.25**	**Dart**
C5932A	**55**	**27**	**3**	**21**	**16.81**	**Dart**
C5932B	**57**	**28**	**5**	**22.4**	**17.7**	**Dart**
C5932E	**52**	**29**	**3**	**23.8**	**18.59**	**Dart**
C5932G	**52**	**30**	**3**	**25.2**	**19.48**	**Dart**
C6032	**50**	**29**	**4**	**23.8**	**18.59**	**Dart**
C6038A	**53**	**25**	**3**	**18.2**	**15.03**	**Dart**

(Coggins and Ladd 1992)

Note: Data from Chichén Itzá; all dimensions in mm.

Table 2: Previously unidentified lithic points from the Sacred Cenote at Chichén Itzá

Catalogue	Length	Width	Thickness	Dart	Arrow	Designation
30576	48	24	2	16.75	14.14	Dart
C4897	62	27	4	20.95	16.81	Dart
C4899A	41	23	5	15.35	13.25	Dart
C4899B	44	25	3	18.15	15.03	Dart
C4900A	53	28	3	22.35	17.7	Dart
C4900B	49	29	3	23.75	18.59	Dart
C4901A	55	30	5	25.15	19.48	Dart
C4901B	55	31	3	26.55	20.37	Dart
C4901C	54	31	4	26.55	20.37	Dart
C4901D	49	28	3	22.35	17.7	Dart
C4902	60	24	6	16.75	14.14	Dart
C4903	51	23	5	15.35	13.25	Dart
C5291B	43	21	3	12.55	11.47	Dart
C5291E	45	22	3	13.95	12.36	Dart
C5401H	41	23	3	15.35	13.25	Dart
C5401I	40	26	3	19.55	15.92	Dart
C5932A	55	27	3	20.95	16.81	Dart
C5932B	57	28	5	22.35	17.7	Dart
C5932E	52	29	3	23.75	18.59	Dart
C5932G	52	30	3	25.15	19.48	Dart
C6032	50	29	4	23.75	18.59	Dart
C6038A	53	25	3	18.15	15.03	Dart
30577	74	23	4	15.35	13.25	Dart
C5291C	76	21	4	12.55	11.47	Dart
C5291D	67	21	4	12.55	11.47	Dart
C5291F	62	24	4	16.75	14.14	Dart
C4911	65	35	8	32.15	23.93	Dart
C5291G	72	28	4	22.35	17.7	Dart
C9254H	68	26	8	19.55	15.92	Dart
C4921A	30	13	2	1.35	4.35	Arrow
C4921B	26	20	2	11.15	10.58	Dart
C4921C	26	26	4	19.55	15.92	Dart
C4921D	25	26	5	19.55	15.92	Dart
C4898B	40	21	6	12.55	11.47	Dart
C4904	41	22	5	13.95	12.36	Dart
C4918	70	30	6	25.15	19.48	Dart

Catalogue	Length	Width	Thickness	Dart	Arrow	Designation
C4909	55	31	4	26.55	20.37	Dart
C5291A	45	19	3	9.75	9.69	Dart
C5932C	55	28	3	22.35	17.7	Dart
C5932D	62	28	4	22.35	17.7	Dart
C5932F	54	29	3	23.75	18.59	Dart
C6038B	55	28	4	22.35	17.7	Dart
C6038C	58	29	3	23.75	18.59	Dart
C9253A	54	25	4	18.15	15.03	Dart
C9253B	60	27	4	20.95	16.81	Dart
C9253C	59	29	3	23.75	18.59	Dart
C9253D	60	29	4	23.75	18.59	Dart
C9253E	54	29	3	23.75	18.59	Dart
C9253F	55	30	4	25.15	19.48	Dart
C9253G	59	30	4	25.15	19.48	Dart
C4895	21	15	4	4.15	6.13	Arrow
C4896	48	25	8	18.15	15.03	Dart
C4898A	42	20	5	11.15	10.58	Dart
C4959	64	38	7	36.35	26.6	Dart

(Coggins and Ladd 1992)

Note: Data from Chichén Itzá; all dimensions in mm.

Table 3: Lithic points from the Tikal database

Catalogue Number	Length	Width	Thickness	Dart	Arrow	Designation
Chert Lithic Points						
1C-33/12	72	28	not listed	22.4	17.7	Dart
10A-290/26	38	17	3	6.95	7.91	Arrow
10E-86/2	44	38	not listed	36.4	26.6	Dart
11A-12/2	86	52	12	56	39.06	Dart
11B-39/1	38	16	3	5.55	7.02	Arrow
12A-119/2	40	18	not listed	8.35	8.8	Arrow
20A-1201/54	86	34	9	30.8	23.04	Dart
20A-1202/54	56	30	7	25.2	19.48	Dart
20A-1258/58	85	56	10.5	61.6	42.62	Dart
20A-461/60	48	18	6	8.35	8.8	Arrow
20A-464/40	85.5	35	12	32.2	23.93	Dart
20A-465/60	86	38	12	36.4	26.6	Dart
20A-561/5	56	28	not listed	22.4	17.7	Dart
20A-705/75	26	17	2	6.95	7.91	Arrow
20F-90B/23	50	40	10	39.2	28.38	Dart
20K-125/32	62	42	12	42	30.16	Dart
20K-195/61	89	36	8	33.6	24.82	Dart
20K-273/83	78	52	12	56	39.06	Dart
20K-286/12	68	34	not listed	30.8	23.04	Dart
20K-388/47	67	52	12	56	39.06	Dart
20L-31/4	88	39.5	12	38.5	27.94	Dart
24L-14/1	44	20	4	11.2	10.58	Dart
24X-25/5	82	48	12	50.4	35.5	Dart
27G-29B/5	56	44	4	44.8	31.94	Dart
30C-7/8	88	36	not listed	33.6	24.82	Dart
31A-10/3	80	32	not listed	28	21.26	Dart
36U-11/6	56	34	8	30.8	23.04	Dart
37H-12/13	58	35	4	32.2	23.93	Dart
37W-1/2	88	44	12	44.8	31.94	Dart
43C-51/20	50	36	9	33.6	24.82	Dart
43D-13/4	56	30	10	25.2	19.48	Dart

Catalogue Number	Length	Width	Thickness	Dart	Arrow	Designation
43E-8/6	37	18	3	8.35	8.8	Arrow
45E-21/5	86	40	not listed	39.2	28.38	Dart
45E-49/10	80	44	12	44.8	31.94	Dart
56B-13/7	68	46	10	47.6	33.72	Dart
66A-1/2	52	32	10	28	21.26	Dart
67A-122A/52	89	41	8	40.6	29.27	Dart
67A-122B/52	66	43	8	43.4	31.05	Dart
67A-134A/53	90	42	12	42	30.16	Dart
67A-161/57	58	46	10	47.6	33.72	Dart
67A-180/58	34	40	6	39.2	28.38	Dart
67A-191/59	33	46	8	47.6	33.72	Dart
70F-28/12	74	28	10	22.4	17.7	Dart
73D-41/18	71	52	8	56	39.06	Dart
77A-16/7	86	43	12	43.4	31.05	Dart
79A-8/3	71	38	not listed	36.4	26.6	Dart
80A-36/1	68	42	15	42	30.16	Dart
86A-21/4	58	38	6	36.4	26.6	Dart
96H-16/1	82	28	8	22.4	17.7	Dart
97A-212/38	67	38	not listed	36.4	26.6	Dart
97B-24/4	84	40	11	39.2	28.38	Dart
98A-19/4	70	40	not listed	39.2	28.38	Dart
98A-37/6	76	36	14	33.6	24.82	Dart
98F-25/6	88	52	8	56	39.06	Dart
98L-101A/9	78	36	8	33.6	24.82	Dart
98L-101B/9	76	38	10	36.4	26.6	Dart
98L-101C/9	58	38	not listed	36.4	26.6	Dart
98L-101D/9	58	42	not listed	42	30.16	Dart
98M-3/4	90	30	10	25.2	19.48	Dart
98Q-8/3	50	36	6	33.6	24.82	Dart
98R-28/17	60	40	not listed	39.2	28.38	Dart
98V-2/2	76	52	not listed	56	39.06	Dart
100A-8/5	58	32	not listed	28	21.26	Dart
100L-2/4	60	30	10	25.2	19.48	Dart

Catalogue Number	Length	Width	Thickness	Dart	Arrow	Designation
106A-65A/5	88	36	not listed	33.6	24.82	Dart
106A-65B/5	62	42	8	42	30.16	Dart
125B-8A/3	76	34	10	30.8	23.04	Dart
128D-1/1	23	16	3	5.55	7.02	Arrow
129C-15/1	28	20	6	11.2	10.58	Dart
129D-11/20	76	22	8	14	12.36	Dart
135K-5/3	90	36	12	33.6	24.82	Dart
Obsidian Lithic Points						
3G-44/20	58	30	10	25.2	19.48	Dart
11B-3/6	30	13	6	1.35	4.35	Arrow
12D-14/4	76	46	8	47.6	33.72	Dart
12H-192/27	64	34	12	30.8	23.04	Dart
15A-13/11	64	34	not listed	30.8	23.04	Dart
16B-2I/3	88	36	8	33.6	24.82	Dart
17B-4/2	70	32	7	28	21.26	Dart
20A-254/29	46	34	not listed	30.8	23.04	Dart
20K-146/49	64	26	8	19.6	15.92	Dart
23L-6/1	64	34	not listed	30.8	23.04	Dart
24C-352/139	66	38	not listed	36.4	26.6	Dart
24W-6/4	64	28	not listed	22.4	17.7	Dart
36U-9/19	68	29	not listed	23.8	18.59	Dart
37C-9A/2	58	42	13	42	30.16	Dart
42F-39/5	90	36	6	33.6	24.82	Dart
42F-43/12	61	28	not listed	22.4	17.7	Dart
43E-2/4	58	34	not listed	30.8	23.04	Dart
43F-110/23	44	34	not listed	30.8	23.04	Dart
43F-45A/17	78	34	not listed	30.8	23.04	Dart
43F-45B/17	74	34	8	30.8	23.04	Dart
43F-45C/17	52	28	not listed	22.4	17.7	Dart
43F-46A/17	88	34	8	30.8	23.04	Dart
43F-46B/17	60	36	8	33.6	24.82	Dart
44D-4/3	65	38	12	36.4	26.6	Dart
45G-59/25	84	42	not listed	42	30.16	Dart

Catalogue Number	Length	Width	Thickness	Dart	Arrow	Designation
56F-4/3	50	32	12	28	21.26	Dart
66H-26/12	98	34	12	30.8	23.04	Dart
67A-102A/50	58	36	10	33.6	24.82	Dart
67A-169/57	40	22	8	14	12.36	Dart
67A-28B/25	78	32	8	28	21.26	Dart
67C-5/3	50	37	not listed	35	25.71	Dart
67L-1/1	40	38	not listed	36.4	26.6	Dart
68I-41/18	64	34	not listed	30.8	23.04	Dart
70F-27A/12	26	36	not listed	33.6	24.82	Dart
70F-27B/12	40	26	not listed	19.6	15.92	Dart
70F-31/9	68	38	8	36.4	26.6	Dart
73B-37/45	54	12	28	-0.1	3.46	Arrow
80A-9/4	60	43	not listed	43.4	31.05	Dart
97E-8/5	46	30	8	25.2	19.48	Dart
98F-18/6	48	22	8	14	12.36	Dart
98F-9/7	52	46	not listed	47.6	33.72	Dart
98K-78/31	56	24	10	16.8	14.14	Dart
100B-13B/2	40	36	not listed	33.6	24.82	Dart
105B-1/7	82	43	9	43.4	31.05	Dart
128E-13/7	52	46	9	47.6	33.72	Dart
136W-3/2	48	13	not listed	1.35	4.35	Arrow
138A-32/32	32	14	not listed	2.75	5.24	Arrow

(Moholy-Nagy 2003 Tikal Report No. 27, Part B)

Note: Data from Tikal; all dimensions in mm.

Table 4: Caracol Lithic Points from Caracol Data

Catalogue Number	Length	Width	Thickness	Weight (Grams)	Dart	Arrow	Designation
C1B 23-1	17	11	not listed	0.5	-1.45	2.57	Arrow
C2A 11-6	83	27	16	29.9	20.95	16.81	Dart
C2A 11-7	36	13	4	2.2	1.35	4.35	Arrow
C4F 6-1	86	35	10	26.5	32.15	23.93	Dart
C5E 10-1	83	32	11	27.9	27.95	21.26	Dart
C8A 8-1A	71	29	5	15.1	23.75	18.59	Dart
C8B 12-1A	50	28	11.5	not listed	22.35	17.7	Dart
C8B 12-1C	64	31.5	8	not listed	27.25	20.815	Dart
C8B 102-1	74	30	9	20	25.15	19.48	Dart
C8N 1-2	96	34	11	27.6	30.75	23.04	Dart
C8Q 6-2	52	39	8	not listed	37.75	27.49	Dart
C8R 2-1	54	25	10	12.4	18.15	15.03	Dart
C8R 3-33	20.5	6	3	0.3	-8.45	-1.88	Arrow
C8S 3-3	58	36	6	17.1	33.55	24.82	Dart
C8T 3-2	70	25	10	6.6	18.15	15.03	Dart
C12B 2-3	65	30	9	not listed	25.15	19.48	Dart
C12C 6-1	51	31	10	19	26.55	20.37	Dart
C12F 8-4	50	40.3	7.4	10.65	39.57	28.647	Dart
C17D 9-1	78	27	5	9.8	20.95	16.81	Dart
C17D 14-1	27	10	3	0.7	-2.85	1.68	Arrow
C17D 21-2	58	28	14	21.3	22.35	17.7	Dart
C17G 2-1	71	24	9	14.5	16.75	14.14	Dart
C18C 14-1	65	41	8	19.2	40.55	29.27	Dart
C18G 5-1	70	36	10	22.9	33.55	24.82	Dart
C18G 6-1	82	35	12	33.1	32.15	23.93	Dart
C18H 12-1	65	27	9	18.4	20.95	16.81	Dart
C40A 3-13	18.5	10.5	3	0.5	-2.15	2.125	Arrow
C62A 1-3	39	24	6	5.6	16.75	14.14	Dart
C70C 3-1	46	25	8	9.4	18.15	15.03	Dart
C71E 19-7	33	29	17	6.7	23.75	18.59	Dart

Catalogue Number	Length	Width	Thickness	Weight (Grams)	Dart	Arrow	Designation
C73B 9-1	85	27	8	20.4	20.95	16.81	Dart
C73B 23-5	45	12	2	2	-0.05	3.46	Arrow
C75C 5-3B	49	30	5	10.6	25.15	19.48	Dart
C76H 8-13	53	26	10	13.9	19.55	15.92	Dart
C76J 3-13	15	9	3	0.3	-4.25	0.79	Arrow
C76L 2-2A	76	28	6	16.8	22.35	17.7	Dart
C76L 2-2B	68	29	8	15	23.75	18.59	Dart
C76U 9-1	71	29	7	19.2	23.75	18.59	Dart
C76U 9-13	60	32	8	18.5	27.95	21.26	Dart
C77B 10-1	69	30	7	17.2	25.15	19.48	Dart
C77B 12-4	76	28	9	17.3	22.35	17.7	Dart
C81O 5-1	54	23	8	8.2	15.35	13.25	Dart
C88D 6-6	48*	32	8	14.6	27.95	21.26	Dart
C90A 3-1	49	41	10	19.1	40.55	29.27	Dart
C90B 20-1	65.75	28.35	5.4	14.1	22.84	18.0115	Dart
C90C 4-5	79	42	10	32.4	41.95	30.16	Dart
C96A 3-1	74	31	7	19.6	26.55	20.37	Dart
C117B 10-3	59	34	9	20	30.75	23.04	Dart
C158D 2-3	41	32	6	6.6	27.95	21.26	Dart
C158E 1-4	44	23	6	6.6	15.35	13.25	Dart
C160L 9-8	53	28	7	11.6	22.35	17.7	Dart
C160L 11-3	54	21	7	8.3	12.55	11.47	Dart
C160L 11-4	56	21	6	6.4	12.55	11.47	Dart
C160L 9-8	53	28	7	11.6	22.35	17.7	Dart
C160L 11-26	32	20	8	4.7	11.15	10.58	Dart
C164B 17-4	71	35	11	25.8	32.15	23.93	Dart
C171C 4-16	46.5	18	9	6.3	8.35	8.8	Arrow
C172C 11-1	72	38	6	13.5	36.35	26.6	Dart
C173C 5-18	50*	23	6	4.7	15.35	13.25	Dart
C173C 7-1	60	28	6	11.4	22.35	17.7	Dart
C173C 9-5	62.8	24.9	7.6	14.6	18.01	14.941	Dart
C177B 2-4	69	24	7.2	11.9	16.75	14.14	Dart
C179B 4-1	78	42	11	46.2	41.95	30.16	Dart

Catalogue Number	Length	Width	Thickness	Weight (Grams)	Dart	Arrow	Designation
C179B 5-1	59	19	3	13.7	9.75	9.69	Dart
C179D 11-3	63	23	7	10.1	15.35	13.25	Dart
C180E 13-2	66	26	8	17.5	19.55	15.92	Dart
C180D 29-7	32	16	7	29	5.55	7.02	Arrow
C182E 30-2	26	13	2	1.2	1.35	4.35	Arrow
C182E 32-1	43*	38	18	16.3	36.35	26.6	Dart
C183C 2-1	24	14	3	1.3	2.75	5.24	Arrow
C186B 2-1	71	31	8	not listed	26.55	20.37	Dart
CD3A 5-3A	76.5	27	7.5	16.2	20.95	16.81	Dart
CD3A 5-3B	40	33.5	9	10.5	30.05	22.595	Dart
CD3A 11-2	71	30	7	17.3	25.15	19.48	Dart
CD3A 31-3	63*	35	6.5	18.2	32.15	23.93	Dart
CD4A 22-6	88	35	9	29.7	32.15	23.93	Dart
CD4C 1-6	69*	44	8	37.7	44.75	31.94	Dart
CD4C 4-4A	73	36	9	23.2	33.55	24.82	Dart
CD4C 9-1	44*	42	8.5	14.3	41.95	30.16	Dart

(University of Central Florida Archaeology Lab)

Note: Data from Caracol; all dimensions in mm. (*) in length indicates point was broken and proximal end was measured.

Table 5: Caracol Special Deposit C117f-1 Lithic Points

Catalogue Number	Length	Width	Thickness	Weight
C117F 8-24	125	37	8	32.2
C117F 8-25	124	35	8	34.2
C117F 8-26	130	38	8	33.6
C117F 8-27	127	35	8	33.9
C117F 8-28	127	38	9.5	36.4
C117F 8-29	120	38	7	34.2

(University of Central Florida Archaeology Lab)
Note: Data from Caracol; all dimensions in mm.

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