ALL NATURAL FAST FOOD:
AN INVESTIGATION INTO A POSSIBLE PALEOINDIAN MAMMOTH AND
MASTODON HUNTING STRATEGY WITH CLOVIS POINT WEAPONRY

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Last but not least, to the hunters past, present, and future…
Chapter 1
Introduction

When Paleolithic people painted on the walls of their caves, they didn’t paint grubs or baby birds, and they didn’t paint nuts, roots, or berries. No, they painted large mammals, mostly ungulates, many with projectiles sticking out of them. They were big-game hunters… [Thomas 2006:104]

Archaeology has shown that the Clovis style point was used by Paleoindians to hunt and kill the proboscidean mammoths and mastodons of the era in the New World (Brown 1973; Frison 1998; Gramly 1984; Sutton 2000). The Paleoindians used a number of other point types, some whose use overlaps Clovis, but Clovis is the only point found in context with proboscidean remains (Frison 1998). Several questions of Paleoindian hunting strategies are still ambiguous. What was the nature of the Clovis spear? Was the Paleoindian Clovis spear atlatl thrown, hand thrown, or hand thrusted? What kind of strategy did Paleoindians employ and where and when did they hunt these woolly elephants? The answers to the presented research questions are important because some larger inferences could be made for Clovis Culture as a whole. The nature of the Clovis spear can imply to the level of technological usage by the Clovis people and their access to geographically fixed resources, such as chert. This chert access question, along with clues to where and when Paleoindians hunted proboscideans could lead to ideas on the mobility of Clovis people. In addition to mobility, the locations of proboscidean hunting show Paleoindian use of environment and landscape. Finally, the strategy of Paleoindian
hunting and the manufacturing of hunting equipment can assist with views on the organization of labor within Clovis society by hinting to leadership and manufacturing specialist roles.

This thesis topic is related to New World archaeology. Specifically, it covers select artifacts from the Clovis Paleoindian hunting tool kit and ideas on hunting strategies that relate to a certain period, approximately 11,000 years ago. The research also touches upon specific megafauna of the era and region, mammoth and mastodon species. This topic is not attempting to provide any new ideas or hypotheses into archaeology as a whole, but it is an examination of specific questions within a smaller area of study. This research provides additional data and insights into an ongoing debate on the use of Clovis weaponry and the proboscidean hunting strategy of the Paleoindians.

The method for this thesis project involves using a multi-faceted approach to analyzing Clovis Paleoindian hunting strategy, ancient and modern proboscidean species, technology, and a possible spear delivery method. This thesis project includes more than one of the disciplines in anthropology and science; these disciplines are cultural anthropology, ethnography, archaeology, experimental archaeology, ethnoarchaeology, biology, and paleontology. Deductive and inductive reasoning are used in conjunction with ethnographic, archaeological, and experimental data to develop interpretative models. These efforts and results are presented in the text.

Middle range theory is used in this thesis as it offers the best way to answer the questions inherent in the research problem. The concept of middle range theory originally came from the field of sociology (Rabb and Goodyear 1984; Tschauner 1996). In archaeology, middle range theory was first developed and explained by Lewis Binford
Middle range theory first appeared in an archaeological text with Binford’s (1975) work (Tschauner 1996). The theory named “...bridges the epistemological gap between processual and postprocessual approaches,” (Tschauner 1996:1), linking low archaeological theory (Processual) with high archaeological theory (Post-processual). The main purpose of middle range theory is to attempt to explain the “why” and “how” of artifacts and their use. The theory’s use is evident in the comparison of Paleoindian archaeology against ethnographic evidence or the “why” of site formation with the “how” of recorded ethnographic behavior. The theory attempts to make visible that which cannot be observed in the archaeological record. Middle range theory helps to define the raw archaeological record to a more refined view of complex past cultures through creating analogies of behavior explanations for the material remains (Tschauner 1996). Middle range theory translates the code of the archaeological record and allows for a conceptual visualization of the past. Because of this, middle range theory can be used in approaches of studying societies of varying complexities (Rabb and Goodyear 1984). The principles of site formation have become one of the objectives of middle range theory (Rabb and Goodyear 1984). This looks at behaviors and activities that have caused certain characteristics of a site or artifact. The use of ethnographic data also assists with this visualization (Tschauner 1996). Articles from Binford (1968) and Freeman (1968) offered guidance for the use of archaeological and ethnographical data. Freeman’s (1968) work discusses the need to minimize analogies when building models that interpret archaeological data. He also states that patterns of behavior, reconstructed through preserved data, are easier to determine than the larger societal culture. Binford’s (1968) research examines the
relationship between modern ethnographic data and the archaeological record. He discusses that an archaeologist can build models for archaeological data from cultural systems investigated through ethnography. These models helped in defining similarities and differences in the archaeological evidence. The weaknesses to middle range theory are possible over exaggerations and misinterpretations of the conclusions (Trigger 1995).

The research presents evidence for the stated questions starting with a look at the Clovis Paleoindians, their environment, their hunting tool kit, and the animals they hunted. Ethnographic evidence of large game hunting, including modern elephants, in historic and contemporary hunter-gatherer groups is then examined to see what methods groups with similar technology to the Clovis Paleoindians were using. Ethnographic evidence helps to develop ideas for techniques that might have also been employed by the Paleoindians. This research is then compared against archaeological evidence on mammoth and mastodon kill sites. This comparison can give an indication where hunts took place and could allude to some of the hunting techniques. Experimental archaeology projects testing Clovis Paleoindian related practices, artifact reconstructions, and their results are discussed as well. This information gives clues to what the possible techniques of Paleoindians and the functionality of the actual artifacts could have been. These types of experiments can help to reconstruct parts of the past lifeways of the Clovis Paleoindians.

The expectation during the collection of data is that patterns will emerge in the archaeological record that can be compared to ethnographic models of behavior. The comparison of the archaeological record and ethnographic models can lead to sound
conclusions on site formation with arguments for possible Clovis Paleoindian proboscidean hunting strategies, mobility, and social organization models.
Chapter 2: Setting

The setting described in this chapter provides an overview of the contemporary Ice Age environment of North America, the Paleoindians, the Clovis tool kit, and proboscidean animals with their modern counterparts. This chapter helps to illustrate the setting in which Paleoindians hunted, these large, wooly creatures, and leads into the following chapters. A myriad of details and possible theories are discussed briefly. The intent is not to give the reader a comprehensive report, but to develop a common frame of reference for this research effort.

Environment

Ice Age North America during the time of Clovis was both climactically and environmentally different from the present. During the Wisconsin glaciation, massive glaciers of solid ice had pushed down from the Arctic through Canada, and into the northeastern United States. The overall climate was much cooler than the present with an arctic like environment near the ice sheets (Justice 2006; Tankersley 1996). Areas such as modern Wyoming could have had winter temperatures of -45° C (-50° F) (Jennings 1989). In the east, coniferous forests occupied the area south of the edge of the glaciers. Still further south, temperate deciduous forests grew. In the west, the edges of the glaciers were a mix of tundra and coniferous forest. The area that is now the Great Plains was a large savannah environment. These vast grasslands were mostly treeless, dry, and not inundated with snow (Lister and Bahn 2007). Near the Bering Land Bridge, and extending down through the un-glaciated portions of modern day Alaska and Canada, were dry, cold steppes (Jennings 1989). The glacial maximum was 20,400 to 16,800 B.
P., followed by the late glaciation period, 16,800 to 11,300 (Wilkins et al. 1991). This later period saw the glaciers receding, the climate changing, and the conifer and deciduous forests moving north, respectively, occupying new territory (White 2005; Wilkins et al. 1991). Mammoths and mastodons are the concentration of this research, but other species of megafauna also occupied this Pleistocene environment. A short sample of some of these animals can be found in Table 1. All of these species were extinct by 8,000 B. P. (Jennings 1989) except for caribou and musk ox, which now occupy parts of the far northern latitudes of North America. Additionally, groups of the ancient bison species survived in the South Dakota Black Hill until 8,000 to 5,000 years ago (Frison 1998). As with the animals, Paleoindians required specialized adaptations and technology to survive and flourish in such an environment.

*Clovis Paleoindians*

The Paleoindians are viewed as the ancestors of historical and modern Native American groups. Whether or not they were in fact the first people to enter the New World, they are the earliest well represented cultural group archaeologically (Jennings 1989). There are currently two ideas on how the Native American ancestors first arrived from the Old World to the New World. One idea is the established and accepted theory, and the other idea is a new and developing, but still controversial, hypothesis. This far from certain hypothesis is worth mentioning because of its repeated appearances in the course of the research (Bradley and Stanford 2004, 2006; Malakoff 2009; Tankersley 2002). The basis for the more recent hypothesis is on the manufacturing style of Clovis projectiles. Clovis point shape and its flake scars are similar to that of a European point variety called Solutrean. The hypothesis postulates that a people with the Clovis-like
Table 1: Contemporary North American Pleistocene Animals (Frison 1998; Fox et al. 1992; Justice 2006; Lister and Bahn 2007; Lundelius 1992; McDonald 1994)

<table>
<thead>
<tr>
<th>Name</th>
<th>Common</th>
<th>Binomial</th>
</tr>
</thead>
<tbody>
<tr>
<td>American bison</td>
<td>Bison occidentalis</td>
<td></td>
</tr>
<tr>
<td>American Lion</td>
<td>Panthera leo atrox</td>
<td></td>
</tr>
<tr>
<td>Ancient bison</td>
<td>Bison antiquus</td>
<td></td>
</tr>
<tr>
<td>Caribou</td>
<td>Rangifer tarandus</td>
<td></td>
</tr>
<tr>
<td>Dire wolf</td>
<td>Canis dirus</td>
<td></td>
</tr>
<tr>
<td>Elk-moose</td>
<td>Cervalces scotti</td>
<td></td>
</tr>
<tr>
<td>Flat-headed peccary</td>
<td>Platygonus compressus</td>
<td></td>
</tr>
<tr>
<td>Giant Beaver</td>
<td>Castoroides ohioensis</td>
<td></td>
</tr>
<tr>
<td>Glyptodont</td>
<td>Glyptotherium</td>
<td></td>
</tr>
<tr>
<td>Horse</td>
<td>Equus</td>
<td></td>
</tr>
<tr>
<td>Jeffersonian ground sloth</td>
<td>Megalonyx jeffersonii</td>
<td></td>
</tr>
<tr>
<td>Large camel</td>
<td>Camelops</td>
<td></td>
</tr>
<tr>
<td>Long-nosed peccary</td>
<td>Mylohyus nasutus</td>
<td></td>
</tr>
<tr>
<td>Musk ox</td>
<td>Ovibos moschauts</td>
<td></td>
</tr>
<tr>
<td>Saber-toothed cat</td>
<td>Smilodon fatalis</td>
<td></td>
</tr>
<tr>
<td>Shasta ground sloth</td>
<td>Northerriops shatense</td>
<td></td>
</tr>
<tr>
<td>Short-faced bear</td>
<td>Arctodus simus</td>
<td></td>
</tr>
<tr>
<td>Shrub ox</td>
<td>Euceratherium collinum</td>
<td></td>
</tr>
<tr>
<td>Spectacled bear</td>
<td>Tremarctos floridanus</td>
<td></td>
</tr>
</tbody>
</table>

Manufacturing styles came from Europe to the eastern United States. Upon arriving, pre-existing groups that had already arrived from Asia were encountered and the technology spread quickly through them (Bradley and Stanford 2004, 2006; Malakoff 2009). It should again be noted that this controversial hypothesis is one that is still developing and has some detractors (Straus 2000; Straus et al. 2005). The hypothesis requires more archaeological data in the form of additional pre-Clovis site discoveries. For the purpose of this thesis, the older and accepted theory of a Beringian migration and subsequent development of the Clovis point in eastern North America is used. A Jesuit missionary, Joseph de Acosta, first recognized the idea of the Asian origins of the Native Americans in 1589 (Jennings 1989). The current theory is that Paleoindian ancestors followed game
animals from Asia to North America over the land bridge Beringia approximately 12,000 B.P. Water trapped in the massive ice sheets worldwide exposed this landmass due to lower sea levels (Justice 2006; Malakoff 2009; Mehringer 1988; Spencer et al. 1977; Tankersley 1996). During the Wisconsin glaciation, there may have been an ice-free corridor for 80 percent of the years between 30,000 to 10,000 years ago (Jennings 1989). The corridor would have given both people and animals a route south into the interior of North America. This theory is the accepted paradigm.

Clovis Paleoindians were well adapted to difficult surroundings, living in small bands of around 20 to 30 individuals that were nomadic in nature, following animal migrations and moving camps as they went (Frison 1998; Jones and Johnson 2008; Justice 2006; Kellar 1983; Kelly and Todd 1988; Tankersley 1996). There is little archaeological evidence of permanent structures and well-used features at Paleoindian sites. The Clovis Paleoindians probably camped near chert sources, high ground, and animal gathering locations found near water (Jones and Johnson 2008; Tankersley 1996). These site types are described as, “…stone procurement and tool manufacturing sites, base camps, and food procurement and processing sites” (Tankersley 1998:7). The examination of fluted point concentrations shows irregular patterns geographically, so the people who used them may have also settled in irregular patterns. This study shows some areas were used and some were avoided. This evidence helps to reduce the generalized nomadic lifestyle model of the Paleoindians (Anderson and Faught 1998; Meltzer 1993; Tankersley 1996). The Paleoindians probably had exchanges with neighboring areas for marriage partners, trade in material, and information (Meltzer 1993; Tankersley 1996).
Hunting was an important part of food resource gathering for the Paleoindians. The term “hunter” in reference to Paleoindian hunters is a sex and gender-neutral term since this information so far cannot be recovered from the archaeological data (Waguespack 2005). Though well known for their megafauna hunting, Paleoindians used other flora and faunal resources. Paleoindians hunted a wide variety of large and small game, caught fish, and harvested easily obtained plant foods, such as, nuts, berries, roots, and seeds (Alexander 1963; Frison 1989, 1998; Kelly and Todd 1988; Tankersley 1996). Waguespack and Surovell (2003: Figure 4) analyzed the faunal remains found in 33 Clovis sites and recorded the total percentage of taxonomic representation for all the sites. The results are summarized in Table 2. Clovis Paleoindians may have been “opportunists” with megafauna and “generalists” with more reliable plants and smaller animals (Meltzer 1993:305). Moreover, proboscidean hunting was not universal for all Clovis point using Paleoindian groups (Boldurian and Cotter 1999; CSFA 2000a). Some sites in Maine were in environments that did not support large proboscideans. These groups may have relied on other prey (Jennings 1989). Due to their mobility, Paleoindians may have been unfamiliar with edible plants and their processing requirements in certain, unexplored regions. The lack of knowledge on consumable plants would have required them to rely on animal resources more. If the animals moved, then so would the Paleoindians (Kelly and Todd 1988). This animal hunting strategy was more specialized than generalized as Paleoindian hunters probably went after high reward prey, i.e. large meat payouts (Waguespack and Surovell 2003). Because of regional low population density, reducing reliance on neighboring groups, it seems that Clovis
Paleoindians depended on mobility and weapon technology, a very adaptable strategy (Kelly and Todd 1988; Seeman 1994; Tankersley 1998; Waguespack and Surovell 2003). The suggested “technology orientation” could be more transferable to new areas than “place orientation”. Animals would move, and hunting skills and techniques would remain the same, but plant resources may have changed (Kelly and Todd 1988:239). This also means that mobility was based on hunting not lithic procurement (Seeman 1994). In addition to hunting, Paleoindians may have had a dual strategy of storing meat while at the same time continuing to find other prey resources so as not be entirely dependent on the one source (Kelly and Todd 1988). The patterns seen in stone tool
collections show that Paleoindians had a mobility characteristic and subsistence strategy different from modern hunter-gatherers. In addition, the difference from modern hunter-gatherer groups is that these contemporary groups are fixed to geographic regions (Seeman 1994; Tankersley 1998). The best-preserved artifacts from sites, the Clovis point, epitomize this “technology” concept in their manufacturing procedure.

The venerable Clovis point was not the only cultural item associated with Paleoindians. Other assorted tools are found in Clovis Paleoindian sites. Additional stone tools include hammerstones, burins, gravers, endscrapers, choppers, and blades (Alexander 1963; CSFA 2000a; Haury et al. 1959). Clovis blades are curved flakes struck from prepared cores (Green 1963; Jennings 1989). These objects were used as knives and scrapers. Paleoindians made items out of perishable materials as well, but little of these artifacts survive (Justice 2006). These include tools and implements made out of plant fibers, wood, antlers, ivory, and bone (Tankersley 1996). Most of the Paleoindian tool kit was probably small enough for portability (Tankersley 1996).

Clovis Points

Clovis stone points are the crucial data that provide evidence for the existence of proboscidean hunting early Americans. The Clovis point is the most iconic artifact of this culture since nearly all other artifacts from the time have decayed completely. Paleoindians used Clovis technology between ca. 11,500 to 10,900 B.P. (Bamforth 1988; Frison 1998; Saunders 1992; Spencer et al. 1977). These dates are not precise as they are a statistical probability result of radiocarbon dating. It is thought that Clovis technology
developed as a way to adapt to changes in the climate and environment (Stanford 1991). Though the time of Clovis was relatively short, it spread over most of North America (Malakoff 2009). The Paleoindians use of Clovis has the only association of context with proboscidean remains (Frison 1998). The initial confirming evidence of this association came from New Mexico, at the Blackwater Draw site in 1932 (Boldurian and Cotter 1999; Malakoff 2009; Spencer et al. 1977). Clovis hunting did not focus exclusively on mammoths and mastodons as protein analysis of residues on Clovis point artifacts show a variety of other mammals as well (Kooymen et al. 2001). The thesis presented though, specifically examines proboscidean hunting.

The material for Clovis points was high quality cherts that cleave and fracture with a good amount of control. High quality chert materials result in tools that are more reliable and can be reworked (Kelly and Todd 1988). Cherts of this quality can include Wyandotte, quartz, obsidian, Onondaga, jasper, agate, and chalcedony (Anderson and Faught 1998; CSFA 2000a; Jones and Johnson 2008; Kelly and Todd 1988). Clovis points have sometimes been found 100 to 320 km away from the material source (Cantin 2005; Kelly and Todd; Tankersley et al. 1990). The information in this finding suggests that the Paleoindian users of the points had a wide nomadic characteristic or that the points and raw materials were exchanged over a trade network.

The hallmark feature of a Clovis point is its flutes or channels at the base of the point. The flute was most likely a development for the hafting of the points. The knapping technique of fluting is exclusive to and originated in North America (Jennings 1989; Kellar 1983; Morrow 2005). It is important to note that Clovis points have flutes, but not all fluted points are Clovis. A good number of fluted, lanceolate style points have
been misidentified as Clovis points over the years (Anderson and Faught 1998). The general description of a Clovis point is a large biface that is unnotched with an excurvate blade and a biconvex midsection with two flutes starting at the base on either side (Figures 1 and 2) (Malakoff 2009; Morrow 2005; Waguespack and Surovell 2003; White 2004). A more detailed depiction of Clovis is required, though, to help distinguish it from other fluted points. Clovis points are thin, with a width usually a quarter of the length, which is typically 7.6 to 12.7 cm (3 to 5 in) but have been recorded as up to 22.9 cm (9 in) (Jennings 1989; Mehringer 1988). These points were made from bifacial blanks and have flakes crossing the whole surface or start from the edges and meet at the center. They were knapped with pressure flaking and soft hammer percussion. The base of the point has only a slight curved-in shape at the bottom and the flanks are usually straight with the edges ground down closer to the proximal end. This dulling of the base edges keeps them from cutting the hafting binding. These straight edges gradually taper to a point on the distal end. On either side, extending from the bottom of the point to a third or half the point length is the distinguishing flute (Anderson and Faught 1998; Hall 2002; Kellar 1983).

Hall (2002) conducted an interview with the renowned flint knapper Gene Titmus, whose large range of knapping skills includes reconstructing Clovis points. Titmus says that the design of Clovis gives it specific attributes. The middle of the point is bowed out on both sides and solid, making it resistant to breaking. The point’s blade profile reduces resistance as it pierces animal hide. The flutes at the base of the Clovis point have a “V-shaped” structure that when hafted into a matching shaft, formed an impact resistant bond (Hall 2002:9). These features make Clovis especially useful as a lanceolate spear point.
Figure 1: Projectile point typologies (White 2004:5, Figure 2)
Titmus mentions that the hafting techniques of Clovis are still uncertain (Hall 2002). Possible ideas for hafting are discussed in the archaeology chapter of this thesis.

Clovis points are found all over the continental United States, parts of southern Canada, and northwestern Mexico (Mehringer 1988). The range of Clovis point finds shows a wide distribution and use of Clovis technology (Figure 3). The discovery of Clovis was in the west, but there have been more points found in the east (Anderson and Faught 1998; Jennings 1989; Malakoff 2009). These eastern points are mostly out of context and undatable (Kellar 1983; Malakoff 2009). Anderson and Faught (1998) conducted a survey of all fluted point types found within the United States. Of a total sample of 11,257 fluted points, 8,321 or 73.9 percent are east of the Mississippi River, and 2,963 or 26.1 percent are west of the Mississippi River, including Minnesota. There was no data available for Wyoming, Colorado, or South and North Dakota, and they were
not included in the study. The results of their study conclude that the origin of the technique of fluting points occurred in the east. Additionally, this technique may have moved west, but the people who started it may not have (Anderson and Faught 1998).

Generally, it was around the extinction of proboscidean species that Paleoindian point styles began to change (Malakoff 2009). Additionally, there was a switch to hunting the ancient bison species. Some of these fluted point traditions that follow standard Clovis point technology become more localized. A “stylistic diversity” seems to develop (Tankersley et al. 1990:310). These points include Folsom with dates of 11,000 to 10,000 B. P. (Bamforth 1988) and Goshen at 11,300 radiocarbon years ago (CSFA
2000a). Folsom and Goshen points are found in association with ancient bison prey. Additional points include Gainey dated at 11,000 to 10,700 B.C. (IPFW AS 2004; Morrow 2005) and Cumberland dated to 10,900 to 10,400 B.C. (IPFW AS 2004; Tankersley et al. 1990). Although, some of these latter points are similar to Clovis, Clovis, again, is still the only point found in association with proboscidean remains (Frison 1998). The duration of Clovis Culture lasted during the time of the ancient proboscideans and their extinction (Waguespack and Surovell 2003). It would seem that the Clovis point and the mammoths and mastodons shared the same demise.

*Mammoths and Mastodons*

The thought that North America was once home to woolly elephants intrigues many. The fact that early Americans hunted them is even more fascinating. The animals’ tusks and the large size of adults make a formidable defense against human and animal predator alike (Lister and Bahn 2007). Even some of the mythologies and legends recorded in historic Native American groups allude to the ancient hunting of mammoths and mastodons (Dragoo 1979). Of the order proboscidea, the name comes from the animals’ trunks (Dragoo 1979), there were six species in the North American continent at the arrival of the Paleoindian immigrants. The species included the Columbian mammoth (*Mammuthus columbi*), the Imperial Mammoth (*Mammuthus imperator*), the Jeffersonian mammoth (*Mammuthus jeffersonii*), the woolly mammoth (*Mammuthus primigenius*), the American mastodon (*Mammut americanum*), and the dwarf mammoth (*Mammuthus exilis*). The North American woolly elephants are similar to European and Asian varieties that existed at the same time. Paleoindian newcomers would have been
familiar with the woolly mammoth as it ranged Beringia and Siberia as well, but not the other mammoths and the mastodon. (Webb 1992).

The Columbian mammoth is the mammoth probably most though of when discussing Paleoindian proboscidean hunting. This association is perhaps because the majority of mammoth remains at Clovis kill sites are of the Columbian variety (Haynes 2002; CSFA 2000b). Columbian mammoths are related to the steppe mammoth (Mammuthus trogontherii) of Siberia. The steppe mammoth’s descendents evolved into the Columbian mammoth after it came into North America 1.5 million years ago. Some confusion as to the nature of the Imperial mammoth and the Jeffersonian mammoth in relation to the Columbian mammoth is still present. The Imperial mammoth is thought to be another descendent of the steppe mammoth, but is probably the same as the Columbian mammoth. The Jeffersonian mammoth (Mammuthus jeffersonii) may be an evolved species of the Columbian mammoths, but this is still unclear (Lister and Bahn 2007). The Jeffersonian type of mammoth was found in open prairie environments and its tusks were incurved (Kurtén and Anderson 1980; Lister and Bahn 2007). The Columbian mammoth is larger and had less hair than the woolly mammoth. It had large, curved and twisted tusks going upwards and outwards. It was 4 m (13 ft) tall, weighed up to 9,070 kg (10 t) (Lister and Bahn 2007). Its range was most of the United States extending into central Mexico (Lister and Bahn 2007; Saunders 1992). The woolly and Columbian mammoths’ range overlapped in northern latitudes, such as Hot Springs, South Dakota. The Columbian had a more diverse territory than the woolly, including the grasslands and savanna type environment with scattered trees. This range did not extend into the dense conifer and deciduous forests (Lister and Bahn 2007). The
Columbian ate grasses and tree and foliage material (Lister and Bahn 2007; Saunders 1992).

The woolly mammoth was the last mammoth species to enter the New World. This mammoth is a descendent from the steppe mammoth (Mammuthus trogontherii), like the Columbian mammoth, that remained in Siberia. It came into North America 100,000 years ago. It had a thick coat of hair, downward sloping back, small ears, a high single dome head, a pointed trunk tip, a short tail, and long, up-turned tusks. It was 2.75 to 3.4 m (9 to 11 ft) tall, weighed 3,630 to 5,440 kg (4 to 6 t) and had a life expectancy of 60 years (Lister and Bahn 2007). The woolly mammoth had a skin thickness of 1.25 to 2.5 cm (.5 to 1 in), similar to modern elephants. In addition, the animal had a fat layer of 8 to 10 cm (3 to 4 in) thick underneath the skin. Woolly mammoth tusks averaged 2.4 to 2.7 m (8 to 9 ft) long with a weight of 45 kg (100 lb) for males and 1.5 to 1.8 m (5 to 6 ft) long with a weight of 9 to 11 kg (20 to 25 lb) for females. The animal was well suited for cold climates. They lived in the grasslands of Alaska, Canada, and the northern parts of the United States down to Virginia where it ate mostly grasses (CSFA 2000b; Dragoo 1979; Lister and Bahn 2007; Mueller 2009a). More is known about this species than its fellow North American proboscidean because of preserved remains discovered in the permafrost of Asia, Alaska, and northern Canada. Notably, is the recent unearthing of a 40,000-year-old infant in Siberia. This is one of the best-preserved mammoth carcasses found yet (Mueller 2009a).

The American mastodon’s ancestors were of the family Mastodonoidea and were already present in the New World by the Middle Miocene, about 20 million year b. p. (Dragoo 1979). Mammoths and mastodons are related, but the mammutid family
diverged from mammoth ancestors 25 million years ago (Lister and Bahn 2007). One of the biggest differences between the two is in the structure of their teeth. All of the Mastodonoidea descendants became extinct in North America by the Pleistocene and only the American mastodon remained (Dragoo 1979). It had a straight back, possibly dense fur, a low single dome head, and a medium length tail. It was 2.4 to 3 m (8 to 10 ft) tall, with a weight of 3,630 to 4,540 kg (4 to 5 t), and it had 2.4 m (8 ft) long tusks that crossed near the ends (Dragoo 1979; Lister and Bahn 2007). This animal was well adapted to North America and their range encompassed the continental United States (Dragoo 1979). The mastodon’s population in the west was less numerous than in the east where it occupied the woodlands and ate leaves and twigs (CSFA 2000b; Webb 1992). The principle territory of the mastodon was Ohio and its northern Great Lakes region, eastern Indiana, western Pennsylvania, southwestern New York, and northern Kentucky (Saunders 1992). In Dragoo’s (1979) work, she argues against using “mammont” as in *Mammuth americanum* as this comes from a Russian word for mammoths. She prefers *Mastodon americanus* showing its proper distant relation to mammoths. She also notes that modern elephants are decedents of mammoth species, not mastodons (Dragoo 1979). This can present problems when trying to make a comparison between modern elephants and mastodons.

The dwarf mammoths were an isolate species occurring on the California Channel Islands, off the coast of Los Angeles. This smaller mammoth was a result of island dwarfism of larger Columbian mammoths. These mammoths lived on the islands between 50,000 to 13,000 years ago. They were 1.2 to 1.8 m (4 to 6 ft) high. Island dwarfism also happened to other mammoth species in the Old World on Wrangle Island
northeast of Siberia, and the on the islands of Crete, Malta, Sardinia, and Sicily in the Mediterranean Sea (Dragoo 1979; Lister and Bahn 2007). The hunting of these North American dwarf mammoths was not mentioned in the archaeological research and may not have occurred.

The mammoths and mastodons went extinct between 12,000 to 10,000 years ago. Reasons for extinction include many theories on over-hunting by humans, viruses, meteorite or comet strikes, wildfires, and environmental changes with the receding ice (Bryner 2009; Lundelius 1992; Mueller 2009a; Waguespack and Surovell 2003). A recent study shows that 90 percent of mammoth habitat disappeared in the Late Pleistocene (Mueller 2009a). Whatever the reason, the last remaining mammoths worldwide died off on Wrangle Island, northeast of Siberia, 3,900 years ago (Lister and Bahn 2007; Mueller 2009a).

Through modern scientific advances in the field of genetics and cloning, the idea to resurrect the mammoths has been raised (Lister and Bahn 2007). According to Hendrik Poinar, an ancient DNA expert, “This is going to happen,” in regards to mammoth cloning (Mueller 2009b:53). However, even the cloning of mammoths would not give researchers a behavioral model for the animals. The adult mammoths would teach some of this behavior to infant proboscideans. This is probably lost forever as archaeological and paleontological proboscidean sites offer little in the way of behavior. Sites may provide some evidence, however, that can be interpreted by examining modern elephants.
Modern Elephant Comparison

Modern proboscideans, the Asian elephant (*Elephas maximus*) and the African elephant (*Loxodonta africana*), can offer researchers a particular view on mammoth and mastodon physiology and behavior. Asian elephants are the closest living relative to the mammoths today (Saunders 1992). Elephants and mammoths do have similar anatomies, but mammoth behavior cannot be entirely equated from modern elephants (Frison 1989). “No modern analogy exists that could be claimed unequivocally as a behavioral model for mammoths or mastodons” (Frison 1998:14579). Some behaviors though, can be interpreted from the archaeological and paleontological records back to modern elephants (CSFA 2000b; Lister and Bahn 2007). Although ancient proboscideans “… may not have behaved like modern elephants at all times,” the value of examining modern elephants cannot be overlooked (Haynes 1992:119). It needs to be noted that behavioral models should be species specific. The Columbian mammoth, woolly mammoth, and American mastodon are different species. Though physically similar, behavioral models should not be universally assigned to all North America proboscidean. This is especially true of the American mastodon, which has a 25 million year evolutionary split from mammoths, and developed geographically separate. Caution should even be taken between the woolly and Columbian mammoths, though they are cousins, genetically speaking. Evidence for species-specific delineation can be made using a modern analogy between white-tailed deer and mule deer. White-tailed deer and mule deer, though related and similar in appearance, have different behaviors, inhabit different terrain, and require different hunting strategies (Frison 2004; Strung 1984). A majority of the
mammoth behaviors interpreted from archaeological and paleontological sites are of the Columbian variety.

The African savannah elephant is 3 to 3.4 m (10 to 11 ft) tall, weighing 3,630 to 5,440 kg (4 to 6 t). It has a saddle shaped back, very sparse hair, a low single dome head, large ears, gently curved tusks, and a long tail (Lister and Bahn 2007). Its skin is 1.2 cm (.5 in) thick with no fat layer underneath. African elephants also have poor eyesight (Frison 1989). According to Frison (1989), African elephant meat is tender and has an excellent taste. If this were the same for mammoth flesh, then it would be a prize for the Paleoindians (Frison 1989). The Asian elephant is 2.4 to 3 m (8 to 10 ft) tall, weighing 2,720 to 4,535 kg (3 to 5 t). It has a humped back, sparse hair, a double dome head, medium size ears, gently curved tusks, and a long tail (Lister and Bahn 2007).

More research on the behavior of African elephants was found than on Asian elephants. African elephants have a matriarchal-based herd, led by the eldest female. Adult females are very defensive against intruders (Frison 1989, 1998; Saunders 1992). Elephant culling actions in African parks have seen surviving herd members still fearlessly defending dead animals, refusing to leave them behind (Saunders 1992). These animals may spend several days near the body of a herd member, often trying to cover up the body with dirt or plant material (Lister and Bahn 2007; Saunders 1992). The death of the matriarch causes the entire herd to hold in place (Saunders 1992). If these behaviors were similar to mammoths, then Clovis hunters could have used a tactic of removing the matriarch or separating herd members for individual attacks (Frison 1989; Saunders 1992). However, it should be noted that whole herd attacks and matriarch elimination in culling operations are much easier with firearms. In addition, mature males do not
occupy these matriarchal herds. Young males are pushed out of the matriarchal herd when they reach adolescence (CSFA 2000b; Frison 1989). If this behavior was also exhibited in mammoth populations, then these young males would be without herd protection and would be easier to hunt. African elephants have seasonal migrations, but whether mammoths migrated to different areas seasonally or not is difficult to determine (Fox et al. 1992). Jones (1990) notes that seasonal migrations would require seasons, these may have be absent in the mammoth’s range due to the climatic characteristics of the Ice Ages. Proboscideans need to drink 132 to 190 liters (35 to 50 gallons) every day, though they can water every three days and still survive (Fox et al. 1992; Webb 1992). They require 225 kg (500 lb) of food per day and mostly eat grasses and shrubs, but also eat bark and foliage, spending up to 20 hours per day feeding (Lister and Bahn 2007). Mammoth needs were probably similar and they could have moved short distances between food and water sources. Individual males probably ranged greater distance than did matriarchal herds (Jones 1990). These ideas on behavioral models and their relation to possible hunting strategies are further examined in the archaeology chapter and developed in the Discussion section of Chapter 5.
Chapter 3: Ethnographic Evidence

This chapter considers documented hunting activities of historic hunter-gatherer groups hunting large mammals with primitive lanceolate weaponry. The purpose of this analysis is to use ethnographic/ethnohistoric analogy, the study of other cultures to create an idea or interpretation of a similar group’s behavior. This behavioral model is not used as a direct comparison against or analogy for the methods used by Paleoindian hunters considering their techniques will never be fully known. The examination of historical groups’ hunting practices helps to build a possible model of the strategy employed by Paleoindian groups in hunting mammoths and mastodons. Considering the length of time between Clovis Culture and the modern hunter-gatherer groups, there is no cultural connection, just a generalization. The model does run the risk of producing incorrect data, but it can provide a closer proximity to the answer to the research question verses an interpretation from the Clovis artifacts alone. Other works also voice this problem, “No easy ethnographic analogy for Paleo-Indians exists in the ethnographic record” (Kelly 1999:143). Moreover, “No analog exists among modern hunter-gatherers that can be applied to the Paleoindian case, and problems arise when such analogies are made” (Kelly and Todd 1988:239). The key point here is the problem with and need to avoid analogies. Analogies are exactly what Freeman (1968) warns against when building models that interpret archeological data. It is not an easy task drawing conclusions on an extinct culture and extinct animals using modern hunters and their prey.
The ethnographic sources used for this chapter focus on several different hunting accounts of cultures from Africa and North America. These sources are from actual historical observations and ethnographic writings detailing specifically the way in which these groups stalk and kill their large mammalian prey. These accounts come in the form of historical narratives, descriptions, and ethnographies of these cultures. The next sections analyze these sources and provide context for their examination. There are no prehistoric interpretations or archaeological findings used in this chapter since the focus is on historical records. Of particular importance is the use of big-game hunting strategy and employment of a lance, spear, or harpoon type weapon on these large animals.

Historic and prehistoric hunter-gatherer groups had strategies and methods for acquiring their quarry, some shared and some unique to a particular culture. There are certain personal talents which the individual or group of hunters must possess for a successful hunt to take place. These talents include, physical ability, understanding of prey behavior, understanding of terrain use by prey, and awareness of equipment performance restrictions (Saunders 1992). Even in the contemporary era, with modern firearms and archery equipment, these are still the requirements of hunters. Laughlin (1968) and Marks (1976) discuss the process of hunting in four stages: Scanning (finding out where and what to hunt), Stalking (the pursuit after the sighting of the animal), Killing (the dispatching of the animal), and Retrieval and Consumption (field dressing and distribution of the meat). The entire process is not the focus of the research as only the latter part of the “stalking stage” and the “killing stages” are the primary focus. Laughlin (1968) also mentions that stalking techniques and learning prey behavior can overcome lower technology weapon limitations. If a hunter can get close enough to the
prey for a close range strike, then there is no impetus to improve weapon range and performance (Laughlin 1968). The hunter’s physical abilities also become more important if the weapon used requires a closer range to be effective.

At this point, it needs to be noted that the term “primitive” in regards to contemporary and prehistoric hunter-gatherer weapons does not confer a description of crude, roughly made tools. Hughes (1998) best notes this caveat in her work on the development of prehistoric weaponry in North America.

…Prehistoric weapons were precision instruments. Years of experimentation, meticulous craftsmanship, and skill went into their design and manufacture to create the most efficient killing machine for that technology [Hughes 1998:397]

The term “primitive”, in the context of contemporary and prehistoric hunter-gatherer tools, means these are made of lower technological materials and design in comparison with modern industrially made implements. The ethnographic evidence presented begins with African groups.

African Groups

A number of hunter-gatherer cultures still occupy southern and central Africa. Some of these groups use spears similar to Clovis technology to bring down large game. The Mbuti (Bambuti) pygmies live in the Ituri Forests of the Democratic Republic of the Congo (Duffy 1996; Turnbull 1961). They use “short-shafted spears” for hunting large game such as elephants, giant forest hogs, and the African forest buffalo (Harako 1981; Turnbull 1961). The spear description includes dimensions of 130 to 160 cm (51.1 to 63
in) long with the shaft 100 to 120 cm (39.3 to 47.2 in) long. The blade is made of iron, 30 to 50 cm (11.8 to 19.6 in) long, and 15 cm (5.9 in) at the widest. The spear is either thrown or thrust based on the circumstances (Harako 1981).

Turnbull’s (1961) book mentions rare occasions where the killing of an elephant or buffalo occurs by the solitary hunter. The usual hunting of elephants occurs with a group of hunters maneuvering into an ambush position and an individual thrusting or sometimes throwing a spear into the abdominal cavity. Duffy (1996) says that the elephants have poor short distance eyesight, but a good sense of smell and hearing. This gives the single hunter a second or two to attack. He also mentions the importance of staying out of the range of the animal’s trunk. The elephant hunts are inherently dangerous and only practiced men, sometimes assisted by novice boys, participate (Harako 1981). The initial deep spearing does not kill the elephant right away and requires tracking the wounded animal until it succumbs to its injury or has weakened enough to dispatch at close range (Duffy 1996; Harako 1981; Tankersley 1996; Turnbull 1961). The Mbuti have some knowledge of their prey’s anatomy as evidenced by the attack on the weak spot of the animal. The following is an earlier account of Mbuti hunting an elephant with a modified, compound spear style as quoted in Tankersley’s (1996:25-26) work comparing Paleoindians and Mbuti hunting:

They use long…spears, like harpoons…The spear heads are fixed loosely in the shaft, and they are either indented, or provided with barbs like fishhooks, and are attached to the shaft with numerous coils of strong cord. The Bambuti…approach the elephant from the rear, and having hurled the spear at its belly, dart for cover
immediately. Maddened with pain, the elephant stampedes furiously ahead, and the shaft becomes detached from the barbed head which sticks fast in the animal’s belly, but is trailed along by the long coils of cord until finally it gets stuck fast in some shrubbery. The elephant plunges about to free itself, until at last the barbed head comes away, bringing the animal’s intestines with it. The elephant may still stagger about for some time, but the Bambuti trail it until it collapses at length from loss of blood [Schebesta 1933:155]

Duffy’s (1996) description says that with the spear left in the elephant after the thrust, the shaft catches on the underbrush, tearing it out, while the animal retreats. This would cause further trauma to the wound area. After an elephant has been killed, the entire village is moved to the kill site. A camp is then made to feast on and process meat (Duffy 1996). The Mbuti also hunt with bows, poison tipped arrows, and nets. Net hunting shows the retention of the thrusting spear to put down animals caught in the net (Duffy 1996; Turnbull 1961). These accounts show that the Mbuti are very capable of bring down large game such as elephants with primitive lanceolate weapons. They also show the use of communal hunting and anatomical knowledge of the animals they hunt.

The Bisa people live in Zambia and are both hunters and agriculturists. Although they now hunt with firearms, there are descriptions of elephant hunts with spears using three various methods. Two types of spears are described. The first is 2.3 m (8 ft) long with a .3 m (1 ft) long iron blade that is 7.62 cm (3 in) at the widest point and poisoned. The second spear, referred to as a “weighted spear,” is similar in dimensions, also poisoned, with the end of the shaft implanted in a heavy section of wood, weighing in
total to about 3.6 kg (8 lb). The leader of a hunting party would use the former weapon to spear an elephant while others in the group followed the animal with dogs. The attack would continue until the injured elephant would make a stand against its attackers. The hunters would arrange in two parallel lines on the path that they expect the elephant to charge. As the hunting party leader approached and the weakened elephant charged down the lines, the hunters, using the latter weighted spear, would attack it until dispatched (Marks 1976). The use of the weighted spear at this moment may have something to do with the design of the spear. As the spear stays in the elephant with the blade firmly planted in the flesh, it allows the shaft to flail around with the movement of the animal. The weight on the end of the spear’s shaft would cause further injury and widening of the wound. The second method of hunting involved a communal drive of the elephants down a path that had trees with branches overhanging them. The more experienced hunters would climb the trees prior to the drive and throw the weighted spears down on a passing elephant, aiming between the shoulder blades. The third method of hunting elephants again involved a communal drive of the animals down known elephant paths. Hunters would conceal themselves next to the elephant paths and as the animals passed, they would ambush from the rear, striking at the tendons with axes that had poisoned blades (Marks 1976). These accounts show that the Bisa employ a specific communal hunting strategy and a specialized spear to hunt elephants.

The !Kung (San), (Ju/wasi) of the Kalahari Desert in southern Africa, mentioned as using spears for a coup de grâce of an already weakened or wounded animal, employed the bow with poison arrows (Bleed 1986; Thomas 2006). These spears were about 1 m (3.3 ft) long with a shaft of strong hardwood and a blade of metal. The bow
and arrow was older and more important to the San as there was no prehistoric substitute for the metal spear point, acquired through trade. The San hunted communally the antelope, wildebeest, warthog, ostrich, buffalo, and giraffe. Typically, an ungulate shot with poison arrows fled, and after the hunters tracked down (at a running pace) their weak and exhausted prey, the hunters killed them at close range. Interestingly enough, the poison arrow is a sophisticated three-part design. The arrow shaft falls off the head of the projectile after striking the target. This prevents the antelope from reaching around and pulling out the poison arrowhead with its mouth, thus, inhibiting the poison from taking effect (Thomas 2006). Thomas (2006) notes the shooting of an attacking ostrich right through the heart, exactly where the hunter aimed his arrow. This shows knowledge of anatomy. The latter group mostly uses the bow and arrow, but it does show the retained use of a spear during hunting as a testament to its effectiveness.

A few other hunter-gatherer groups came up in the research, but did not have much detail in regards to stalking and killing techniques. The Twa (Batwa), another pygmy people, who live in the eastern part of the Democratic Republic of the Congo, described as having “javelins with broad strong iron heads capable of piercing the strong hides of elephants” (Schebesta 1936:189). The Babali use a type of deadfall spear trap in the forest for elephant. The spear’s iron point is around a 30 cm (11.8 in) long with a shaft 2 to 2.75 m (6.6 to 9 in) long. This spear remains suspended 4.5 m (14.8 in) the air, between two trees, over an elephant trail. An elephant traveling the trail steps on a cord that triggers the release of the spear. The spear kills the elephant immediately or seriously wounds it, is later tracked and dispatched. Also mentioned are trench traps for catching elephants and buffalo (Schebesta 1936). The Galla (Oromo) and Borana of
Kenya use a 25 mm (1 in) diameter ‘elephant spear’ at close range to their prey (Gramly 1984:113). An interesting observation of the Mboga region to the Banyora is that people there do not use the bow and arrow, having no knowledge of it. They rely only on the spear (Schebesta 1936).

*Inuits*

Several historical descriptions of North American aboriginal hunting methods detail the use of lanceolate weaponry on large mammals. The Tikigaq Inuit of northern Alaska hunt, in their sealskin-hulled boats, bowhead whales at sea. Their method of hunting requires a communal effort and coordination to be successful. Near the whaling camp, a lookout keeps watch on the shore ice for the whales. The launching of the skin boats occur upon sighting a whale. The boats usually consist of a harpooner, seven paddlers, and the boat’s owner who steers the craft. When the boat has closed the distance with the whale, the harpooner stands and takes aim while the boat owner keeps the vessel at a steady angle. The harpooner aims at the heart or cervical vertebrae. The harpoon has five parts; the wooden handshaft and foreshaft, the slate blade, a sealskin rope, and three inflated sealskin drag-floats that act like buoys. The harpoon’s foreshaft detaches from the handshaft after impact. Then the rope plays out while the drag-floats help keep the whale at the surface and mark its position. The first boat calls for help from other craft while they chase the whale out to sea. When the boats reach the whale, the crews throw additional spears and harpoons to dispatch the animal. These boats then link up and help tow the animal to a suitable location for butchering (Lowenstein 1993). The former hunting description shows the complexity of tools needed to hunt large sea
mammals. This description also shows the necessity of communal assistance when hunting in harsh environments and again the knowledge of prey anatomy.

The Copper Inuit live in the Inuvik Region of Canada’s Northwest Territories and use harpoons as well as bows for hunting. The hunting of caribou and deer consists of communal drives where the hunters are using imitations of predator calls to herd and drive the animals. A single person hunt was rare and drive techniques were preferred to stalking the animals. Hunters would imitate the animal’s behavior if they were approaching from a distance without concealment. The animals move through choke points in the terrain and concealed hunters ambush them with bows on the other side. Alternatively, the drive moves the animals into lakes and the hunters spear the swimming animals from kayaks. The construction of barricades helped in channelizing the animals into the water. The description for the dispatching of deer was by stabbing the animals in the back of the neck “with a short knife lashed on the end of a pole” (Jenness 1922:149). Musk ox were also driven and hunted though the author did not witness or describe this. The author also mentions polar bear hunting as being on foot, armed with harpoons or the long poles with knives lashed to the ends (Jenness 1922). This account again shows a communal hunting effort and the continued reliance on spears. The use of topographical features and strategic planning is important to a successful hunt.

Native Americans

The last source is a narrative of a young man’s experience growing up as a captive among the Kickapoo, Kansas, Pawnee, and Osage tribes of Native Americans from the Missouri and Kansas area in the early 1800’s (Hunter 1823). While some of these tribes at this time hunted with the bow and firearms, they were still using lances.
These lances were 1.5 to 1.8 m (5 to 6 ft) long, with a stone, iron, or bone point. The use of this lance is usually on horseback to apply a final blow to bison after failing to kill the animal outright with the bow. The author describes the hunters of these tribes as very familiar with the habitats and behaviors of their quarry sometimes using decoys and animal imitations. Hunting parties were not numerous and they elected a leader of the party prior to the hunt. The hunters typically approach from downwind using the terrain as concealment and ambush their prey with the element of surprise. Some tribes hunt on foot by surrounding herds of buffalo, elk, or deer and drive them into ravines or cliff edges. There, prepositioned hunters dispatch the animals with lances and bows. Watering places sometimes had blinds or holes constructed around them so hunters could ambush thirsty prey (Hunter 1823). While Paleoindians did not have use of horses as their later ancestors did, Paleoindians did employ a similar use of cliff drives on ancient bison after the extinction of proboscidean (Spencer et al. 1977).

Other Ethnographical Work

Hayden’s (1981) work delineates types of hunting as individual hunting, cooperative hunting, and communal hunting in his ethnographic research of selected hunter-gatherer groups. The characteristics of individual and communal hunting can be seen in Table 3, referenced from Hayden (1981:368, Table 10.9). Small group hunts would be “cooperative hunting”, with two to four people (Hayden 1981:368). These smaller groups of cooperative hunters are closer in relation to individual hunting than communal hunting. Larger group hunts would be “communal hunting” with five or more people (Hayden 1981:368). These larger communal hunts include women and children. This communal hunting is used in areas with fewer natural food resources. Communal
Table 3: Characteristics of Individual and Communal Hunting (Hayden 1981:368, Table 10.9)

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<td>More gathered per hour per person</td>
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<td>Fewer hours work per group</td>
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<td>Reduced results per day per group</td>
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<th>Characteristics of communal hunting</th>
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Hunting is seen in groups with a heavy reliance on meat, as this tactic has a better chance for success (Hayden 1981). Saunders (1992) adds the requirement of leadership to communal hunting. Hayden compares communal hunting with the nature of individual hunters who would have less chance for success, but would be able to cover more territory, and keep more meat for themselves (Hayden 1981). The individual hunter’s ability to cover more area for hunting (Hayden 1981) means that the group as a whole could be more sedentary. Animal resources, recovered from a larger area by the individual, could be brought back to a main camp. Given the lack of certainty with the individual hunter for a successful foraging patrol (Hayden 1981), this type of hunting would work best in an area with more resources available. Areas with few resources require a communal hunting strategy (Hayden 1981), that could create a more mobile group of people. The more people required for a hunt means less people left in a main camp. At some point, it would be a more efficient strategy to move with the prey animals.
and establish a camp near the location of the last successful hunt. This would especially be true with large drive hunts of herd animals that require every able bodied person to participate in order for a better chance of success. Large hunts would require some type of leadership (Saunders 1992). Large and complex hunts would require levels of organization and stratified leadership.

Churchill’s (2002) article studies the advantage of using a spear in a thrusting rather than a throwing motion. This can be an overhand or an underhand throw. Noted is that an underhand thrust is better for the defense of the body. Any spear held overhead leaves the chest and abdomen exposed (Churchill 2002; Whittaker 2006). The study shows that a thrusting spear’s best use would be underhanded, like a bayonet thrust.

Bleed’s (1986) work uses concepts of engineering and ethnographic examples to characterize weapon systems into two groups, “maintainable” and “reliable,” These characteristics are seen in Table 4, referenced from Bleed (1986:739, Table 1). Maintainable weapons would be used in situations of foraging for a multitude of annually available prey, with a specialized tool for each animal. Archaeologically, they would not be as large as reliable weapons and would have a multi-component trait. Sites would be more general in nature and a have a variety of faunal remains. Reliable weapons would be used in situations where animals are on a seasonal migration and success in the rare opportunity to hunt such animals means large rewards. Archaeological evidence of a reliable system artifact would be a robust design with a fallback contingency. Additional traits would include signs of storage and special tool oriented sites (Bleed 1986). Frison (2004) also discusses Bleed’s (1986) ideas of weapons system types. Frison emphasizes the notion of aesthetics that should be included in both systems. Aesthetics introduces
Table 4: Characteristics of Maintainable and Reliable Systems (Bleed 1986:739, Table 1)

<table>
<thead>
<tr>
<th>Characteristics of maintainable systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller with better portability</td>
</tr>
<tr>
<td>Components have a single function</td>
</tr>
<tr>
<td>Special repair kit with spare parts</td>
</tr>
<tr>
<td>Component based design</td>
</tr>
<tr>
<td>Can function in partial condition</td>
</tr>
<tr>
<td>Maintenance conducted in use</td>
</tr>
<tr>
<td>Maintained by user</td>
</tr>
<tr>
<td>Easy to repair</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics of reliable systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robust design</td>
</tr>
<tr>
<td>Designed for use under their full capability</td>
</tr>
<tr>
<td>Backup system</td>
</tr>
<tr>
<td>High quality manufacturing</td>
</tr>
<tr>
<td>Basic repair kit with raw materials</td>
</tr>
<tr>
<td>Different times for use and maintenance</td>
</tr>
<tr>
<td>Manufacture and maintenance by specialist</td>
</tr>
</tbody>
</table>

the concept of pride in the construction of the weapons, either by the hunters themselves or by specialists. Frison adds portability to the reliable system as well. A robust weapon still must be light enough to be carried long distances without fatigue. Frison also notes the addition of durability and use-efficiency by Margaret Nelson (1997:377) to both systems. Durability is the weapon’s ability to continue functioning under stressful use. Use-efficiency deals with the required amount of experience with the weapon in order to master its use. A group using maintainable weapons could have a more mobile subsistence strategy. Weapons of a maintainable system were designed for exploiting a wider assortment of faunal resources (Bleed 1986). The larger variety of animals would increase the different types of environments that these animals inhabit, thus widening the range of available hunting area. The maintainable weapon is also easy to maintain and repair by the individual hunter with a specialized repair kit containing spare parts (Bleed
The component based weapon is also designed to work in partial condition, such as in the case of component breakage or running out of spare parts. These characteristics make the maintainable weapon system ideal for a mobile hunting group. A group would use this weapon type when they do not have ready access to raw materials, such as chert, necessary for the repair and construction of additional weapons. Because of this, maintainable weapons would be more conservative in design and use. Groups using reliable weapons would not necessarily be sedentary compared with groups using maintainable weapons. The larger, reliable weapons (Bleed 1986) may correlate to a general proximity to raw materials and the ability to use this material supply to its full advantage. This general proximity may not always mean geographic closeness to a chert quarry, but could also include a consistent trade network bringing in routine supplies of chert. Bleed’s (1986) characteristics of a reliable system include a specialist who manufactures and maintains weapons and special tool oriented sites. A readily available supply of chert could further emphasize the rationale for a weapons specialist, or a type of armorer, who would design, manufacture, and repair the groups’ weapons. Weapon manufacture and repair knowledge would not be absent among the group’s hunters, simply, the armorer would be the subject master expert or master artisan when it comes to weapons. A hunter-gatherer group having a dedicated tool and weapon maker would show a defined organization of labor. Moreover, weapons can be cached under a reliable system (Bleed 1986). These weapon caches might be a long distance from their raw material source. The reason for storage could be to overcome a separation from the raw material supply. A group bringing a fair number of robust, reliable weapons as back-ups on a long distance hunt would be weight prohibitive. A more efficient strategy of
prepositioning extra weapons at places where they may be needed would be better. This strategy would make sense for seasonal hunting excursions on migrating animals. The large meat and resource payouts on such limited opportunity hunts could have been important enough to exclude the use of smaller, maintainable weapons and require robust, reliable weapons. If the reliable weapons on such a hunt were in need of repair or replacement, a weapon cache could be used for this purpose. These ideas are further examined in the Discussions section of Chapter 5.

*Trends*

This overview of the strategies and equipment of historic and modern hunter-gatherers provides us with some information on the variety of methods and tools employed to hunt big-game mammals. There are a few main themes from the ethnographic sources. One trend is the use of a lanceolate weapon either from an ambush position or as a *coup de grace* weapon to dispatch the animal in a weakened or vulnerable position. This initial ambush strike could be a spear hand thrusted or a hand thrown. The final strike with the spear was usually performed with a thrust. The trend makes it more probable that Clovis Paleoindians, regardless of the possession of an atlatl, may have used a Clovis point spear in a thrusting mode at least in part. The effective means of a hand thrusted initial or final strike should be considered when looking at the possible design of the Clovis weapon system (Appendix A).

A second trend is the commonality of the communal hunt with the involvement of five or more persons in a hunting party or animal drive. The employment of topographical features and prior hunt planning is also prevalent in the ethnographic
examples. These complex hunts require organization at different levels depending on the situation. The trend provides clues that hunting by Clovis Paleoindians may have also been communal in nature. If a large number of individuals were needed for a communal hunt, it may have been more efficient to move the entire group with the perused prey, creating a possible mobile group hunting strategy. Additionally, the Clovis Paleoindians could have used terrain as an advantage in hunting. Patterns that emerge in the archaeological evidence may support this idea. These patterns of terrain use can denote planning and strategy, and a need for leadership to facilitate this process. A need for leadership denotes the possibility of social organization in Paleoindian society. Depending on the level of complexity involved in the hunt, leadership roles may have been a prerequisite. Prior hunt planning may also mean that Clovis proboscidean hunting was not ad hoc in nature, but deliberate, strategic behavior.

A third trend is the complexity and design of some of the weapons, like the Inuit harpoon and the !Kung arrow, made from primitive materials. The complex nature of such primitive technology means that the possible design of the Clovis weapons system also may have a complex quality. Primitive materials do not mean a crude, rudimentary tool. In addition, complex, well made tools may require a specialist for construction and maintenance. A Clovis tool and weapon specialist within the Paleoindian group would show social organization.

A fourth trend is the knowledge of prey animal behavior and their anatomy by hunters. Knowledge of prey means a Clovis hunter can plan the hunt around what behavior the proboscidean prey is known or expected to do. This knowledge can include short-term behavior, like feeding times and defensive nature, or long-term behavior, like
mating season or times of migrations. Knowledge of the prey’s short-term and long-term behavior infers not only detailed, short-term hunting plans, but also long-term, yearly seasonal hunting plans. Behavioral knowledge allows for planning, planning requires leadership, leadership denotes social organization. In addition to behavior, anatomical knowledge of prey animals is useful in not only hastening butchering, but also means efficient butchering. Moreover, anatomical knowledge illustrates a prey animal’s weak areas. Weapons can be designed and employed to exploit these weak areas. Once more, this purposeful intent of exploiting prey weaknesses should be considered when looking at the possible design of the Clovis weapon system for proboscidean hunting.

Lastly, in regards to elephant hunting, the initial attack on an elephant usually wounds the animal, not killing it quickly, requiring tracking after the strike. Clovis hunters may have experienced the same results. The lack of an outright kill of ancient proboscidean prey means the initial attack on the animal and the final dispatch may be in different location. The next chapter looks at the archaeological findings and interpretations of Clovis Paleoindian sites and artifacts.
Chapter 4: Archaeology

This chapter looks at the archaeological and paleontological evidence of Clovis Paleoindian sites and associated proboscidean kill sites. The research gathered is on some of the current models and ideas researchers have developed as possible strategies for Paleoindian hunting methods. Not only does data come from Paleoindian artifacts and interpretations, but also a fair amount of information comes from the proboscidean remains. The thought of Paleoindian proboscidean hunting inspires the minds of scientist and layperson alike. These adventurous images of hunting have often been illustrated to offer a view into the ancient world. Frison (1998) warns against the problems with these illustrations. He says that artists often take creative excess in drawing Paleoindian hunting scenes. The portraits usually are images of proboscidean stuck in wet ground, chaotic bison drives over cliffs, and bear-hunter standoffs (Figure 4). “These artistic portrayals of prehistoric hunting have too often left inaccurate and false impression, which then foster erroneous interpretations” (Frison 1998:14578). When some of these are impressed upon Paleoindian hunters in reality, it can bias archaeologists’ view (Frison 1998). This caveat is included not to insult authors or artists whose works include these, but to mention the unintended results of some of these images.

The examination of experimental archaeology projects involving Clovis period-related tools completed by other researchers is included. This type of research can be used to build models for the possible form and functionality of Clovis technology that have not survived in the archaeological record. It should be noted, that successful experimental archaeology tests do not prove the actual intended use of an artifact. What
the tests demonstrate is that the artifact could have functioned as, or is capable of functioning in a particular way (Keith 1992). This demonstration can provide “…the link between human behavior and archaeological data,” (Huffman 2004:68).

Site Patterns and Hunting Strategies

This section looks at information generated from examining the kill sites of proboscideans, both by hunting and natural causes. Proboscidean kill sites are then examined for information on possible hunting strategies and the timing and selection of
proboscidean prey. This discussion provides a current view on the interpretation of Paleoindian hunting strategies and proboscidean behaviors. Following this section, an examination of Clovis weapon artifacts and their possible design and employment on proboscideans is presented.

_Proboscidean Kill Site Data_

A look at the numerous proboscidean kill sites across North America shows the wide geographic breadth of Clovis hunters harvesting mammoths and mastodons. Additionally, a pattern appears in the location of the sites. Haynes (2002) compiled a comparative sampling of North American proboscidean sites. There are 114 total sites listed. Of these, 56 list both the ancient terrain type and the nature of archaeological evidence linking humans to the site. All but two are some type of water source, i.e. pond, bog, marsh, lake, stream, or river (Haynes 2002). Tankersley’s et al. (1990) survey of fluted point localities in Indiana also shows that most are not found at random, but near certain types of terrain. Of the 400 documented fluted points in Indiana, 72 percent came from floodplains and 22 percent came from the overlooks of floodplains. The points are specifically near large rivers and their subsequent tributaries, especially near the Ohio River, marshes, lakes, ponds, and springs. Areas such as this is where prey would convene and could subsequently be observed and acquired (Tankersley et al. 1990). Spencer et al. (1977) also notes that Clovis kill sites in the plains are the locations of former ponds, bogs, and marshes, showing heavy associations with proboscidean sites and water sources. It is possible that Paleoindian hunting strategy relied on the ancient elephants frequenting of watering holes. However, not all proboscideans remains recovered were the result of Paleoindian hunting. This is the case with some of the
mammoths at the Lehner site (Haury et al. 1959). As with modern elephant behavior, there is a good chance of some accidental association between artifacts and natural proboscidean death at water sources (Waguespack and Surovell 2003). There are other examples of ancient elephant behavior patterns that can be interpreted from these natural kill sites. A site near Hot Springs, South Dakota used to be a treacherous ancient sinkhole. The remains of 55 individual mammoths have been found here. The remains are mostly of Columbian mammoths, but there are a few woolly mammoths as well. The oldest remains date to 30,000 years ago, well before any evidence of human activity. Juvenile males comprise most of the individuals. A reason for this finding may be that these individuals were probably newly removed from their herd and out on their own. As exampled in the Modern Elephant Comparison section of Chapter 2, African elephant juvenile males are pushed out of the matriarchal herds upon reaching adolescence. Adult male African elephants that survive this initial herd ostracization continue a solitary life. The young male mammoths might have become stuck because of lack of experience and herd support. This example would show mammoths as having some similar herd behavior to African elephants (Lister and Bahn 2007). Another site near Waco, Texas appears to an entire herd of Columbian mammoths that died in a natural mass-kill. The 15 mammoth herd had ages in years ranging from 2 to 4 to the early 50’s. The animals were positioned in a defensive formation, but the reason for their demise is unknown. The find gives evidence to a matriarchal led herd for this type of mammoth, same as seen in African elephants (Fox et al. 1992).

Interpreted Paleoindian Hunting Strategies
A number of different works on various Paleoindian sites and artifacts examined here show some interesting interpretations of Paleoindian proboscidean hunting practices. Hannus’ (1990) work looks at mammoth butchering sites and the uses of the bones of the animals with a list of possible hunting strategies. Mammoth butchering, based on the evidence at the Lang-Ferguson site, was a communal effort (Hannus 1990), this leads to the possibility that hunting too was a communal effort. Driver (1990) also voices the probable communal nature of proboscidean hunting. Communal hunts are more efficient and can provide better meat procurement in herd animals (Driver 1990). Some of the possible strategies Hannus (1990) suggested are: drive hunting using terrain, obstructing the animals with a marshy ground and striking them after becoming stuck, and wounding an animal in the abdomen and tracking it until it becomes weak enough to dispatch. He also noted that modern elephants would seek water after injury, an idea also supported in other sources as well (Jennings 1989; Saunders 1992; Waguespack and Surovell 2003), giving another reason for the frequency of proboscidean remains in former water sources. The author states in the conclusion that the current archaeological record offers little in the way of any firm clues to a specific mammoth hunting strategies (Hannus 1990).

Olsen (1990) expands the idea of attacking a proboscideans immobilized in marshy ground in his writing challenging the overkill hypothesis related to the extinction of megafauna. The hypothesis contends that proboscideans and other Ice Age megafauna were driven to extinction by human overhunting. A few of the sites examined in detail were of killed and butchered mammoths and mastodons that had become stuck in marshy ground. Noted is the fact that a majority of other sampled mammoth butchering sites are former environments of marshy and wet ground. The implication is that Paleoindians
could have purposefully drove mammoth and mastodons into such environments or found them already immobile by chance. The author proposes that the use of Clovis weapons were only as a hand thirsted spear. An attack with a hand thirsted spear requires the hunter to get close enough to the animal for an effective strike. Olsen (1990) believes that Paleoindian hunters would avoid such a situation for large and dangerous animals unless the mammoth or mastodon was already in a position of vulnerability. However, the ethnographic data in Chapter 3 does not reflect this aversion by contemporary hunter-gathers of close spear strikes on elephants (Duffy 1996; Harako 1981; Tankersley 1996; Turnbull 1961).

Spencer et al. (1977) and Jennings (1989) also voice this theme of a water source pattern in proboscidean kill sites. Spencer et al. (1977) discusses the idea of mammoths being accidently trapped or purposefully driven into muck by a communal drive to mire and immobilize the animals for dispatching and butchering (Spencer et al. 1977). Jennings (1989) suggested possibilities for association of mammoth kills around water or wet ground. First, is that Paleoindian hunters may have had overwatch of these sites for animals watering or bathing. Instead of tracking the animals, the hunters would wait for their appearance at water sources. The ambushing of proboscideans near these wet grounds is made more likely since they would probably need a large daily water intake, as seen in the Modern Elephant Comparison section. Second, Paleoindian hunters made use of mucky ground to slow animal movements or trap animals. Third, animals discovered trapped in such marshy ground were exploited. Lastly, wounded animals, searching for water, were ambushed and finished off at water sources (Jennings 1989). This last possibility could have had a two-team strategy. The first team wounds the
animal in open ground, but retreats and does not pursue the animal. The second team waits in proximity to the nearest watering site for the wounded animal, ambushing it in its weakened state. Saunders (1992) also presents this idea.

Saunders (1992) states a few hunting strategy models in his work. The first model is the “scavenger model” (Saunders 1992:133), which is the scavenging of dead or weak mammoths after a chance encounter with Clovis hunters. The model comes from evidence found at the Miami site. Here, the animals had died naturally and were later scavenged (Saunders 1992). The second model is the “Age–selective cull model,” which is the idea that young animals could be isolated and killed (Saunders 1992:133). The third model is the “herd stampede model,” where animals were driven over a cliff or into marshy ground (Saunders 1992:138). The forth model is the “herd confrontation model,” where whole herds are killed using the animals’ defensive behavior as an advantage (Saunders 1992:138). The last model is the “opportunistic culling model,” where a selected, individual animal was wounded and re-attacked later when it sought water (Saunders 1992:138). Saunders feels that the “herd stampede model” was the preferred strategy for Clovis hunters. Although, archaeological evidence for cliff drive and total family herd kills is lacking (Dragoo 1979; Frison 1998). Saunders also mentions that Frison (1988) likes the “opportunistic culling model”. Individuals driven to the same water source gives herd like results in the archaeological evidence (Saunders 1992). The Colby site has evidence for these single mammoth kills verses multiple mammoths. The site has the remains of several mammoths, but these were individual kills over time (Frison 1998). Frison (1998) defines faunal bone beds as “catastrophic” with many animals immediately killed, and “attritional” individual animals killed over time. As
mentioned before, this attritional bone bed could have been formed by a group using the same technique at the same watering hole on several different mammoths, all with successful results. This could lead to a pile up of proboscidean remains.

Frison does not like the idea of noisy, chaotic, community drive hunts pushing mammoths into bogy ground. The lack of stealth, patience, and discipline, “violate the rules of successful hunting strategies” (Frison 1989:738). Frison feels that attacking immobile animals stuck in wet ground is offensive to “true hunters,” who would be too proud to use this method (Frison 1989). Butchering an animal in such ground is difficult and may ruin the meat. His view of a better strategy is that mammoths were driven out of swampy areas and killed on solid ground. Modern elephants can free themselves from wet ground, so there is no sure expectation that the stampeding animals would be bogged down (Frison 1989, 1998). Frison’s model is that Paleoindians were hunting healthy animals, not finishing off the sick or the old. A small group of hunters, using both the atlatl thrown and thrusting variations of the spears, wound an individual mammoth with the atlatl thrown spear to separate it from the herd. Paleoindian hunters would need to wound this woolly elephant without alarming the matriarch. When the animal becomes weak and defenseless, attacking it a close range with a thrusting spear would be the final step. Single animal killing would have been the best strategy (Frison 1989).

Bison are another large mammal hunted by the Paleoindians. This bison hunting was during the Clovis period, but is predominantly seen after Clovis. Saunders (1992) feels that evidence of ancient bison hunting by Clovis descendants is a better model source than modern ethnography. Investigations of small-scale bison kill sites are the topics of McCartney’s (1990) and Landals’ (1990) works. These types of sites are the
main topics of the discussions as unconventional sites, which are then compared to the bison drive sites of large-scale mass kills (Landals 1990; McCartney 1990). Landals discusses how small-scale individual animal kill sites are harder to find than large-scale ones. These less visible sites can create a bias that large-scale kills were the norm (Landals 1990). These larger mass kill drive sites show that Paleoindians most likely did employ some type of communal effort in hunting their prey, as do historical and modern hunter-gatherers seen in the ethnographic sources. The fact that there are the remains of 200 MNI bison at the Jones-Miller, Horner, and Olsen-Chubbuck sites (McCartney 1990) implies a complex operation and a need for a cooperative effort. The Plainview, Folsom, Bonfire, and Olsen-Chubbock cultures also exhibit sites of bison mass kills using a cliff to drive the animals off or by trapping them in a three-sided canyon (Spencer et al. 1977).

**Animal Selection and the Timing of Hunts**

Jones (1990) discusses the highly selective process of mammoth hunting. He says that mammoth herds hunted for infants and juveniles could result in an easier gain of a large amount of meat. This is verses adult males and non-lactating females, which would have a higher fat content in their meat (Jones 1990). In Dragoo’s (1979) work, she mentions that modern elephants are hard to sex, so this latter type of ancient prey selection may have been a difficult practice. Dragoo notes that the meat of younger animals would be tenderer than adults would and thinks that hunters may have isolated and killed young animals (Dragoo 1979). Preferred hunting of solitary animals may be the reason for higher numbers of young male remains at sites (Hall 2000).

Meat yields were high for successful proboscidean hunts. A young mammoth may have had 1,500 to 2,000 kg (1.7 to 2.2 t) of harvestable meat, more than enough for
immediate use (Frison 1998). A Columbian mammoth from the Murray Springs site was estimated to have a living mass of 5,450 kg (6 t). This would give an estimated 2,100 kg (4,630 lb) of meat and fat (Jones 1990). If a band of 25 Paleoindians ate 1 kg (2 lb) of meat per person, per day, the supply would last about 90 days. Storage or preservation would be a necessity for this.

Autumn seems to be the season of mammoth hunting, as evidenced by tusk remains. Examination of the growth rings on tusks can show the sex and age, as well as, the diet and local climate for an individual proboscidean (CSFA 2000b; Fisher 1984; Fisher et al. 2003; Hofreiter and Lister 2006; Koch et al. 1989). Autumn is a time when the animals were preparing for winter. Fall and early winter hunts would provide animals with better hides and higher fat content in their meat after summer feeding (Driver 1990; Hall 2000; Mueller 2009a). Paleoindians may have stockpiled this food for the upcoming winter (Fisher et al. 1994, Hall 2000; Mueller 2009a). The stockpiling idea means that the high meat yield of proboscidean hunting could have made their pursuit seasonal. The only time that large quantities of this meat was needed and could be successfully stored was in the cold of winter. Additionally, the large hides of proboscidean could be used to create a shelter from a harsh winter. The Colby site has evidence of freezing mammoth parts and the Agate Basin site has evidence of freezing bison parts (Frison 1998; Jennings 1989). Ethnographic documentation shows this practice in the Arctic as well. Spoilage, of course, would occur when warmer weather approached and thawed the meat (Frison 1998).

A few interesting sites give evidence for another possible method of proboscidean meat storage and an additional reason for site patterning around water sources. The meat
storage interpretation comes from paleontologist Daniel Fisher (Hall 2000). The Heisler site in southern Michigan has mastodon remains of a single young male, in five groupings with evidence of butchering. Fisher says the evidence is not consistent with an animal naturally trapped in the mud (Hall 2000). Remains at the Heisler site were identified as mastodon intestines that had been filled with gravel and sand. Intestines could have been used to anchor down stored carcass pieces for later recovery. Charcoal was found with some bones in the pond sediments. There was also evidence of two trees placed top down into the pond bottom, possibly as marking posts (Hall 2000). The ponds would have been frozen and protected the meat from scavengers and decay, the posts marked the sites for return trips, and the charcoal could have been from a fire to melt the ice for storage or retrieval of meat. The discovered faunal remains at the site were either never recovered or the scraps that were left over. Both Fisher and Brad Lepper, think this and other similar sites were used for meat storage (Hall 2000).

The second site is the Burning Tree mastodon site in Ohio. The site is a pond with the remains of an individual male mastodon. Disarticulation evidence on the bones and their placement suggest that the mastodon was killed and butchered elsewhere. The mastodon was separated into “articulate carcass units” (Fisher et al. 1994:43) and placed in the pond soon after butchering. This rapid submersion is evidenced by the high level of bone preservation of the remains. Moreover, enteric bacteria were found in the sediment though to be the bulk of the stomach contents, providing more clues to a quick emplacement. Meat storage is thought to have been the reason for the carcass emplacement in the pond (Fisher et al. 1994).
The last site is in northwestern Pennsylvania. The Moon Mammoth site was discovered at the bottom of a lake by a scuba diver (Hall 1991). The remains of an individual young male mammoth that died in the autumn were recovered. The bones, in four clusters, have evidence of butchering and had rocks spread among them on the bottom. The sandstone rocks have evidence of human modification, grooves carved around the stones for securing a looped cord (Hall 1991, 1993). M. Jude Kirkpatrick, worked on the site and suggested the possibility of the rocks being “meat anchors” to stabilize stored meat, based on Fisher’s idea (Hall 1991). Kirkpatrick and Fisher say that the site has patterns to similarly suspected meat storage sites (Hall 1993). This hypothesis on interpreted meat storage sites is a debatable and controversial idea (Fisher et al. 1994). An idea like this requires further review and discussion among the greater archaeological community. The reason for the inclusion of the idea in the presented research is that it offers another possible explanation for the association of proboscidean remains and water sources. This meat storage idea gives an additional reason for the association other than the mired animal idea. There is more information on this topic in the Meat Storage paragraph of the Experimental Work section. An experiment testing the validity of this method of storage is detailed.

*Clovis Weaponry and Use*

This section covers what Clovis weaponry may have looked like and how it could have possibly functioned. Evidence for the nature of Clovis weaponry comes from a number of different sources. This covers details such as the repair of broken points, archaeological interpretations on spear propulsion methods, and point hafting. Also
discussed, are the probable target location on proboscideans that could have been exploited to bring down these animals with weaponry of this type and technology.

*Nature of Clovis Weaponry*

Clovis point repair and reuse is illustrated at the Murray Springs site (Huckell 2007:200, Figure 8.9). This is interpreted from points found in and near the site. Possible repair methods can be seen in Figure 5. At Murray Springs, Huckell (2007) feels that a thrusting spear was used on mammoths and a throwing spear was used on bison at the site. The idea is based on point breakage statistics around one of the bison kills. Broken points were more heavily associated with bison remains than mammoth remains. Throwing spears would result in more damage to the points (Huckell 2007). Damage can easily occur when a thrown spear misses its intended target and strikes or ricochets off unforgiving material, such as rocks. A thrusted spear’s intended target ideally should only be a relative arms-length away, resulting in rare misses and fewer damaged points.

Gramly (1984) discusses the Vail site in northwestern Maine. Vail is a kill site that is near a creek that flows into a pond, making it a good area to hunt frequenting animals. This kill site is 250 m (273 yd) to the west of a Paleoindian campsite. No faunal remains were found, but associations of some surrounding sites indicate caribou was the prey. Of six tip fragments found at the kill site, five matched fluted point base fragments found at the repeat use campsite. Some recovered fluted points show heavy resharpening and some broken points were reworked. Points had deep flutes on the base, and this may allow for the hafting point on the shaft to be narrower. The broken points show a relationship to the hafting method. The point of damage is always at an area after
Figure 5: Clovis point repair at the Murray Springs site (Huckell 2007:200, Figure 8.9)

the end of the fluting channel, this shows a weak point in the hafting. This damage point could mean that the hafted shaft extended almost the entire length of the flute and the cordage wrapping both point and shaft extended from the base of the biface, to just before the tip of the shaft. This length of reinforcement would prohibit breakage. The nature of the Vail site spears is interpreted on the width of the points’ fluting. Spears were 24 to 25 mm (.94 to .98 in) in diameter, corresponding with the flutes. A shaft of this size offers better handling as a thrusting spear than that of thinner dimension. Other points found on the site had fluting narrower than 24 to 25 mm (.94 to .98 in) and were not finished or
used. The interpretation of the unused points is that the flutes were too narrow to accommodate a properly sized shaft for use as a hand thrusted spear (Gramly 1984).

A design description of the Clovis weapon is presented in Tankersley’s (1996) writings on Paleoindian tools, settlement patterns, and sites. The model of the Clovis spear consists of a Clovis projectile hafted into a foreshaft that is detachable from, and fitted into, a mainshaft. A hunter can spear an animal with this weapon, withdraw the mainshaft, detaching the foreshaft, rearm the spear with another foreshaft, and reengage the target. The flute of the point may correlate to the width of the foreshaft. The “ears” of the point would extend wider than the foreshaft and may have acted as barbs. A thrust, reload, and reengage mode of operation description comes from the study of numerous Paleoindian foreshafts made from bone and ivory (Tankersley 1996). The description of the Clovis compound spear is interesting because it infers something of a complexity in its design and use. The design and use is similar to that of the Inuit harpoon and a type of Mbuti spear.

Boldurian and Cotter (1999) agree that a Clovis point could have been hafted either on a mainshaft for thrusting (Non-compound spear), or on a foreshaft socketed into a mainshaft and thrown from an atlatl (Compound spear) (Figure 6). The hafting attachment materials could have been sinew and pine resin or pitch (Frison 1989). Sinew and pitch were used on Frison’s (1989) reconstructed Clovis spears for his elephant experiment. Frison’s (1989) experiment is discussed in detail in the Experimental Work section in this Chapter. Cylindrical rods of mammoth tusk ivory have been located at the Blackwater Draw site. Two of these rod artifacts were comingled with mammoth remains (Boldurian and Cotter 1999:57, Figure 24). Additionally, a single rod artifact
Figure 6: Possible Clovis point hafting method [Boldurian and Cotter 1999:100, Figure 51; captions added by author]
was discovered *in situ* with a mammoth ulna (Bodurian and Cotter 1999:69, Figures 31-32) showing a projectile use and hunting association. Rod artifacts such as these could have been used as foreshafts. These cylindrical rods made of mammoth bone or ivory are found across North America. Finds have been recorded from Florida to Washington and California and from Alaska and Saskatchewan to New Mexico, with a wide distribution range (Cotter 1981; Haynes 2002; Jenks and Simpson 1941; Wilmeth 1968). Of organic artifacts from Clovis Culture, these rods are the most frequent (Haynes 2002). The rod artifacts usually have a beveled end and tapered end or two beveled ends (Cotter 1981). Similar rods have been found at the Anzick Cache site in Montana (Boldurian and Cotter 1999). Other Clovis caches show equipment in various points of construction and contained some of these carved mammoth ivory and bone rods (Frison 1998). Clovis caches give an equipment association that the rods may have been used as spear foreshafts (Tankersley 1996). Additionally, rod examples from Florida and Nevada have barbs on their sides, denoting a function for holding fast into some matter (Haynes 2002), again a hunting association. Historic Inuit groups have used similar artifacts as foreshafts (Boldurian and Cotter 1999).

Another possible function of these rod artifacts has been interpreted as bone spear points (Redmond and Tankersley 2005). At Sheridan Cave, in north central Ohio, these mammoth bone rods are also present. Two rods, referred to as “points” by the authors, were found. On both, one end is beveled and the other is tapered to a point. One rod has impact damage at the pointed end (Redmond and Tankersley 2005). A kill site near Sequim, Washington, on the Olympic Peninsula, has the remains of a bone spear point that had broken off in a mastodon rib (Dragoo 1979). This evidence is interesting
given the possible use of bone rods as foreshafts or as points. Both interpretations may be correct. If a Clovis point was not available for the foreshaft, the foreshaft’s already beveled end could be further sharpened into a chisel-like point. A foreshaft modified as such could still be used in the compound spear fashion, just without the Clovis point. Additionally, this foreshaft could be reversed. The beveled end could be fastened more permanently to a matching beveled mainshaft end and the tapered tip could be sharpened to a fine point. However, one technique should not be universally generalized as the standard practice for all Clovis Paleoindians. Both of these are probably solid ideas and may have been used. Redmond and Tankersley (2005) mention in their article the higher prevalence of these bone rods in eastern sites than in western sites. There may be evidence here of regional hunting practices and techniques in this distribution.

*Target of Clovis Weaponry*

Boldurian and Cotter (1999) discuss the importance of marksmanship with ancient hunters and the fact that weapon accuracy is not well preserved in the archaeological record. The idea implies to the target on the proboscidean’s body, the literal “bull’s-eye” where the Clovis hunters were aiming. The Lehner site, in Cochise, Arizona has 13 mammoths and 13 points on the former bend of a sandy creek (Haury et al. 1959; Saunders 1992; Spencer et al. 1977). Some of the Clovis points are comingled with the mammoth remains. Two points were found near mammoth rib fragments, one point was against a mammoth vertebra, two points were against a mammoth leg bone, and two points were near a mammoth ilium (Haury et al. 1959). An individual mammoth kill at the Naco site in Cochise, Arizona had eight points found comingled with it. This mammoth is thought to have escaped an attack somewhere else and then died later at this
site (Haynes 2002). One point was near the bottom of the skull, one was around the right scapula, five were by the ribs and vertebrae, and the remaining point was without provenance (Saunders 1992). Clovis points were also excavated in mammoth remains at the Blackwater Draw site, Roosevelt, New Mexico (Boldurian and Cotter 1999; Saunders 1992). One point was near a mammoth’s first vertebra, one was near leg bones, two were near the left scapula, and one was near the ribs (Boldurian and Cotter 1999). The positions of the points seem to give a general, preferred target area as between the base of the skull to the upper rib cage, to the lower shoulder. The top portion of the rib cage close to the spine is a likely target area according to Boldurian and Cotter (1999). The area corresponds to Frison (1998), who says that anatomically, the best location to strike a proboscidean would be the lungs, high on the rib cage, in front of the diaphragm. The heart has good protection from the ribs and may have been avoided. Frison also thinks that wounding the stomach and tracking the woolly elephant, an imitation of the Mbuti technique (Duffy 1996), is not a good model for ancient hunting (Frison 1998).

The problem with projectile points found within proboscidean bone remains is that exact, detailed accuracy to where the animal was struck cannot be entirely known. This is due to the natural processes of flesh decay, disarticulation of bones, and soil settling, that may shift the final depositing of the artifact. Even with points embedded in bone, preserving the provenance of the hit, one still does not know if that was the intended target or if it was a miss. The next section examines experimental archaeology tests and the results.
Experimental Work

The following section discusses work dealing with experimental archaeology of Clovis related topics. A few sources were found that went into enough detail in providing information on what might have worked for the Clovis Paleoindians. The first sources look at experiments to examine how Paleoindians were using Clovis spears and how they might have functioned. The second source has a possible solution to the missing atlatl problem of the atlatl thrown Clovis spear idea. The third and last source delves into an idea for Paleoindian proboscidean meat storage.

Clovis Weaponry on Elephants

Frison (1989) conducted an interesting Clovis reconstruction experiment with dead and dying elephants during a culling operation in an African park. Archaic age artifacts recovered from dry caves gave the assumed form of the compound spears for the experiment, similar to Figure 6. The reconstructed artifacts are compound spears comprised of a separate foreshaft and mainshaft with the foreshaft beveled to accept a Clovis point (Figure 7). Frison used wood to make the foreshafts for the experiment. Three socket types were tested, each with the smaller diameter foreshaft fitting inside a corresponding hole on the larger diameter mainshaft. Testing showed that a cone shaped taper preformed better than a square plug or a hybrid between the two. The foreshaft’s length dictates the depth of penetration because it is a smaller diameter than the mainshaft (Frison 1989). The point needs to be wide enough to allow the foreshaft to pierce through a wound (Frison 1998). Little thrust is required after the foreshaft point and haft binding have passed through the skin to continue pushing the projectile to the mainshaft’s
socket. A longer foreshaft for deeper penetrations also increases the chance of breakage at the socket connection. The binding on the point hafting needs to thin, allowing it to pass through the cut in the hide. The fluting on the Clovis point helps in this reduction. The tough elephant skin did wear off the pitch applied to sinew projectile bindings, loosening them after exposure to body fluids. The atlatl used had a spur to engage a cup at the end of the spear, with a long groove to help align the spear shaft. The spears were propelled by an atlatl thrown at 15 m (16.4 yd), 17 m (18.5 yd), and 20 m (21.8 yd). The first distance produced a crippling wound, the second a lethal lung hit, and the third could
have been lethal or crippling. On one throw, a point ricocheted off a rib, breaking the point, but the point continued penetrating, making a lethal hit. The experiment used seven replica Clovis points. These points had also been used on other experiments over a period of two years. Two points broke beyond repair, one in initial use against a rib and the other, accidentally. The other five survived the project, one without breaking. The others required reworking but were fully functional. The tip of the point received the most damage, but reworking the point repaired it. Even after multiple breaks and reworking, most of the points though reduced in size, maintained functionality. Frison notes that the use of atlatl thrown spears at short range on moving targets was possible. However, the motion of the hunter in the atlatl throw could create sudden movement of an alerted animal, allowing shot inaccuracy. Avoiding this sudden movement requires the animal to be dedicated to one course or another hunter distracting the prey (Frison 1989). Frison mentions that atlatl thrown and hand thrusted Clovis point spears are capable of causing fatal hits on all African elephants (Frison 1989, 1998). However, reconstructed Clovis weaponry is not strong enough to penetrate elephant skulls (Frison 1998). Frison notes that thick mammoth hair should not impede Clovis penetration. Hunters using Clovis weaponry would have to maintain their equipment in top shape if they were to be successful (Frison 1989).

*Clovis Atlatl*

The biggest weakness in the idea of a Clovis spear being thrown on an atlatl is the lack of archaeological evidence for this artifact. The origins of the atlatl in North America are unclear. Although, it has not been proven in the archaeology of northeast Asia, the atlatl was more than likely brought over from the Old World (Kellar 1955).
addition, there is a lack of artifacts from Paleoindians sites that can be interpreted as atlatl weights (Gramly 1984). Lack of atlatl weights does not necessarily mean a lack of atlatls, though. This absence of weight artifacts could suggest that the development and use of atlatl weights on spear throwers came later. Atlatl weights may have been important for lighter, fletched darts.

There was an interesting artifact recovered at the Murray Springs site (Figure 8). This artifact is the only specimen of this type that has been found anywhere in North America (Haynes 2002). The artifact, made of mammoth bone, was found 10 m (33 ft) to the southeast of mammoth remains. The bone artifact is 259 mm (10 in) long, 31 mm (1.2 in) wide at the midshaft, with a 21 mm (.8 in) thickness. The hole in the top of the artifact is oval shaped at a diameter of 25 mm (1 in) and 30 mm (1.2 in). The hole is beveled on either side by manufacture, not wear (Hemmings 2007). The beveling is also not polished or rounded off, which shows that it was not used to twist rope or strop leather thongs (Haynes 2002). The Murray Springs artifact is very similar to ones found in Europe and are often referred to as bâtons de commandement (Sticks of Command) or bâtons percés (Pierced sticks) (Haynes 2002; Hemmings 2007). Artifacts of this variety found in the Czech Republic and the Ukraine are almost copies of the Murray Springs artifact (Hemmings 2007). The exampled Old World bâton seen in Figure 9 was found at the Molodova V site near Molodova, Chernovtsy Province, Ukraine (Abramova et al. 1967:157, Plate XL). The Molodova V artifact has a length of 30.5 cm (12 in), a width of 3.2 cm (1.26 in), and a thickness of 2.5 cm (0.98 in) (Abramova et al 1967). These Old World bâton artifacts date from 23,000 to 12,000 years ago and are found from Russia to
Figure 8: Artifact from the Murray Springs site [Stanford 1991:8, Figure 6; original modified by author]
Figure 9: Bâton artifact from the Molodova V site [Abramova et al. 1967:157, Plate XL; original modified by author]
France (Comstock 1999; Cotter 1981; Kurtén and Anderson 1980). In Europe, these bâtons are thought to be a shaft straightening tool, a culturally symbolic item, symbols of authority, or sexual symbols (Comstock 1999; Hemmings 2007). Reproductions of the Murray Springs artifact in experiments have shown that it could have been used for shaft straightening. Shaft diameters of 14 to 17 mm (.5 to .7 in) would have been ideal with this tool, which correlates to Clovis points in the area of the Murray Springs site (Hemmings 2007). However, Jenness (1937) and Underwood (1965) feel that the shaft straightener interpretation is incorrect. The sharp edges produced by the beveled interior circumference on the holes make the artifact a poor choice for straightening shafts. These sharp edges would dent the wooden shaft, especially soft wood (Jenness 1937). Another problem with this interpretation is why would a shaft-straightening tool be dropped at a kill site? The artifact was found 11 m (36 ft) to the southeast of some mammoth remains. Associated artifacts with the tool were a few flakes, some charcoal, a well used cobble stone, and wolf remains (Hemmings 2007). The artifact associations and proximity to a kill site give evidence that the location of deposit may have been used as a weapon maintenance site. Straightening the shaft of a spear is a manufacturing process, so this artifact would be more appropriate in a campsite, than near a kill site.

Comstock (1999) has a different opinion on the use of these artifacts with his experimentation on reproductions of the European variety of this artifact. If one adds a leather thong to this device the user can accurately throw spears with it (Comstock 1999). The physics work the same as a Swiss arrow, where a cord, tied to a finger and wrapped around an arrow shaft, is thrown from the hand. This method uses the tension of the cord as an atlatl, which is released at the end of the throw by an overlapped knot. The use of
this method can throw arrows to distances of 183 to 274 m (200 to 300 y). The ancient Greeks used thong thrown spears in combat (Baker 1999) and there are ethnographic reports of thong thrown spears in Melanesia (Underwood 1965). Comstock (1999) bases his interpretation on archaeological evidence from Europe. A mortuary site in Russia has a bâton and ivory spears as grave goods. The spears have a diameter close in size to the handle of the bâton, but larger than the hole. This bâton could not have been a shaft straightener for these spears. Carvings on a bâton fragment found in France depict a hunter holding a spear over the shoulder as if ready to throw. The image shows the spear held towards the front, as the use of the bâton would dictate (Comstock 1999). A spear thrown like a javelin would be gripped in the middle, at the spear’s point of balance. A spear thrown with an atlatl would be gripped towards the rear. The engraved image on the bâton does not correlate with the latter two examples. Comstock (1999) notes that the bâton was used 9,000 years before the atlatl and it disappears from the archaeological record after the advent of the atlatl. The hole of the bâton is used to route the cord from underneath the bâton to over the spear shaft. The cord can be tied to the bâton handle or the hole itself. He feels that bâton holes were beveled to reduce wear on the cords. Comstock (1999) discovered he could throw a spear 62 m (68 y) with the bâton, but only 27 m (30 y) by hand, and 39 m (43 y) with just the cord. The same spear could be thrown 71 m (78 y) with an atlatl. He was also able to impale a 2.2 cm (.875 in) tree with a 97 g (1,500 grain) spear launched from a bâton, showing the increased leverage action of the bâton (Comstock 1999).

Another author, Underwood (1965), has a similar interpretation, although he believes that the Old World bâton was an early atlatl. The interpretation of the bâton as a
developing spear-thrower is based on cave painting around the time of the artifacts use and changes in the artistic depictions of hunting that correlate to an increase in weapon efficiency and range. The hole or holes in bâton artifacts are for fingers to grip into. The author was successful in reconstructing a bâton artifact and using it as a spear thrower (Underwood 1965).

Given the similarities of the Murray Springs artifact, especially to Old World bâtons found in Eastern Europe, could the Paleoindians’ ancestors have carried these across Asia and over the Bering Land Bridge? The antiquity of the Old World bâtons, 23,000 years ago, opens a window of opportunity for the artifact being a part of these ancestors’ tool kit. If then in fact both the Old and New world artifacts were used as spear throwers, then Paleoindians may have been using these items prior to atlatls. There was no date given for the Murray Springs artifact, but it was made of mammoth bone, giving its manufacturing date possibly near contemporary to proboscideans. Additionally, if the mammoth remains were deposited at the same time as the artifact the distance would be a good range to throw a spear. Could it have been dropped and never recovered? This is a radical idea that is based mostly on the artifact’s similarities to European varieties. Its weakness is in, as previously mentioned, it is the only artifact of this type in North America. If other artifacts of this type could be found in hunting associated context, a better argument could be made. What is known about the Murray Spring’s artifact is that in experimental archaeology testing it can function both as a spear thrower and to straighten shafts.

Meat Storage
An experiment conducted by paleontologist Daniel Fisher, looked at how hunters of the Paleolithic could store meat without it spoiling (Mueller 2009a). Using stone tools, he butchered a draft horse and stored 635 kg (1,400 lb) of meat in a frozen stock pond (Hall 2000; Mueller 2009a). This was done in a fashion similar to what he interpreted at archaeological sites (Hall 2000). Lactic acid produced by colonizing Lactobacilli microbes naturally preserved the tissue and the smell emitted prevents animals from scavenging the meat (Hall 2000; Mueller 2009a). The acidic environment also kept out pathogenic bacteria. The meat floated because of the carbon dioxide produced by the bacteria (Hall 2000). Archaeologically, this would explain the need for stone anchors. Upon recovery, the outside of the meat was discolored but it was fine on the inside. The meat was “…palatable, despite its strong smell and flavor” (Hall 2000:9). Fisher ate the meat without problems every two weeks for six months, from winter to summer (Mueller 2009a). Fisher believes that particular sites around the Great Lakes region could be interpreted as food storage sites (Fisher et al. 1994; Hall 2000). Again, this hypothesis is a debatable and controversial idea (Fisher et al. 1994), but gives an additional reason for the association other than the mired animal idea.

Trends

The presented research provides an overview of archaeological investigations of Clovis Paleoindian related sites and artifacts. Several trends and patterns seem to appear in the archaeological sources. One trend seen in the archaeological evidence is a pattern of proboscidean sites and fluted point finds in or near ancient water sources. Clovis hunters may have used these water sources to track and hunt frequenting proboscideans.
There is a possible occurrence of natural proboscidean death at water sources with the comingling of artifacts at some sites. However, Paleoindian and proboscidean interaction at water sources appears to be the overwhelming trend. A pattern of specific terrain use by Clovis hunters gives evidence to the hunters using both proboscidean behavior and the environment to their advantage. Additionally, proboscideans hunted by Paleoindians reportedly died around the time of autumn (CSFA 2000b; Fisher 1984; Fisher et al. 2003; Hofreiter and Lister 2006; Koch et al. 1989). The trend of autumn death could mean that proboscidean hunting was a seasonal occupation. The repeated use of terrain and animal behavior shows that a particular strategy of planning went into proboscidean hunting. Coordination of planning efforts may denote leadership. The possible seasonal hunting of proboscideans may denote to that this type of hunt was rare and important, requiring long term planning. The high importance of success in seasonal proboscidean hunting may increase the need for planning and good leadership to conceptualize and execute the hunt.

A second trend alludes to the behavior of Columbian mammoths. The majority of paleontological data on proboscidean sites and remains are of the Columbian species. A potential behavioral model for the Columbian mammoth could be similar to the African elephant. Columbian mammoths seem to be organized around matriarchal herds. Adult male mammoths are solitary, being ostracized from these groups at adolescence. While African elephants migrate seasonally, it is unknown if Columbian mammoths also exhibit this behavior. The research lacked sufficient evidence for behavioral models pertaining to the woolly mammoth and the mastodon.
Lastly, a trend is seen in the interpreted complexity of the Clovis spear design in the compound foreshaft-mainshaft model. The model proposes a harpoon like configuration of a Clovis point hafted to a beveled bone rod that is socketed into a mainshaft. The point and foreshaft disconnect from the mainshaft when the spear is employed on a target. Clovis point repair and reuse is also evidenced in the archaeological data (Huckell 2007). Bleed’s (1986) characteristics of weapon systems may place the presented model of the compound Clovis spear in the maintainable system. This classification is assigned in part due to the component base design and functionality of the system in partial condition. The ability of the Clovis spear model’s partial condition functionality is evidenced by spear use with the bone foreshaft as a point without the stone Clovis point. The use of a maintainable weapons system may infer a type of mobile subsistence strategy. The ideas presented in this trend are further evaluated in the discussion section of Chapter 5.
Chapter 5
Discussion and Conclusion

The following Discussion section considers the presented data and information on hunting strategy and Clovis technology. The ethnographic, archaeological, and experimental data researched give direction to an interpretation of a probable model. Possible hunting strategies are presented first, then ideas on Clovis technology. Additionally, questions that came up in the research, but were not addressed in the referenced material are discussed. This brings the research to an objective conclusion that can be related to a model of strategy and technique possibly used by Paleoindians on mammoths and mastodons. A final description in the Conclusion section of the main points of the thesis and its results are summed up. This chapter completes the research aims of the thesis.

Discussion

Ethnographic, archaeological, and paleontological evidence and interpretations have been presented. These interpretations offer ideas for possible Paleoindian proboscidean hunting strategies and the nature of Clovis weaponry employment. The interpretations are analyzed to look for the best possible answers. Evidence for some proboscidean behavior is taken from modern African elephant behavior. Models for this behavior relate to the Columbian mammoth. The Columbian mammoth was predominantly seen in the archeological and paleontological sites from where these models were developed. A common model of ancient proboscidean hunting is build from
this Columbian mammoth assumption. Realistically, it needs to be kept in mind that this behavioral model should not also be generalized for the wooly mammoth and mastodon species as well. Their behavior, especially the mastodon, was lacking in the researched material. Again, it is simply to follow an overall pattern in the evidence presented in this discussion for possible hunting strategies.

Proboscidean hunting was probably communal, five or more (Hayden 1981), in its execution. The ethnographic record shows this commonality of the communal hunt. This is the best way to achieve success in hunting large mammals. The archaeological record shows that the butchering of proboscideans required a communal effort (Hannus 1990). Additionally, the kill sites of bison with later Paleoindians would require a large communal endeavor. This requirement is especially seen in the large, mass kill sites of bison (Landals 1990; McCartney 1990). However, mass kills of proboscidean are lacking in the Clovis Paleoindian archaeological record. A more appropriate ethnoarchaeological model could be made linking the evidenced hunting behavior of later Paleoindians with earlier Clovis ancestors. Saunders (1992) voices this idea of ancient bison hunting by Clovis descendants as a comparative model to earlier Clovis hunting behavior. The evidence here increases the probability of a communal hunting requirement with proboscideans.

Archaeological and paleontological evidence shows that proboscideans can be found predominantly by water sources and were probably hunted near these too (Haynes 2002; Tankersley et al. 1990). Another reason for the association between proboscidean remains and water sources could be with the storage strategy proposed by Fisher (Hall 2000). A few proboscidean-hunting strategies were interpreted in Chapter 4 to have used
these water sources. Drive hunting was proposed as the pushing of herds into marshy
ground or over cliffs by using natural terrain features (Hannus 1990; Olsen 1990;
Saunders 1992; Spencer et al 1977). This is doubtful with cliffs given the lack of
archaeological evidence for it (Dragoo 1979; Frison 1998). This type of terrain based
drive hunting may have been more applicable and successful with bison and other
ungulates. Drive hunting into water sources to impede movement is unlikely with the
ability of modern elephants to extricate themselves from such situations (Frison 1989).
This is a seemingly chaotic, unplanned, and improvised method (Frison 1989).
Additionally, the nature of such a strategy does not necessarily guarantee wooly
elephants moving towards the water and being bogged down in the first place. Not all
water sources may have characteristics that would impede or mire proboscideans.
Another problem with the mired idea is that hunters would have to enter the ooze as well.
Hunters with thrusting spears would have to enter the muck alongside a trapped
proboscidean in order to use their weapons. Entering the water could only be avoided if
the hunters were only throwing their spears. Still, they would then also have to butcher
the animal in such a mess. Butchering under these conditions would prove difficult and
may spoil parts of the meat (Frison 1989). The rare stuck proboscideans probably were
not a result of human activity. If there was a chance discovery of a proboscidean trapped
in marshy ground and the animal was still in good condition, it might have been killed or
scavenged.

The use of water sources as ambush points by Paleoindian hunters is another
related hunting strategy (Jennings 1989; Saunders 1992). These planned encounters at
water sources with frequenting proboscideans are more likely. As with the hunters in the
ethnography chapter, Paleoindian hunters would have been very familiar with proboscidean behavior, anatomy, and terrain use. This knowledge means a strategic and well-planned hunting method can be afforded to them. A two-team strategy also proposed by Saunders (1992) could have been used. This strategy would be where one team stalks and attacks an individual proboscidean and another waits in ambush at the nearest water source. The two-team method would require the proboscidean to seek water after the injury like modern elephants. In another scenario, a cooperative group, two to four people (Hayden 1981), could have had a chance encounter with a proboscidean on a foraging patrol and attacked the animal. After the initial attack, the wounded animal would have been tracked back to a water source for a larger organized effort to bring the animal down and process it. The concept of wounding the elephant than tracking it down for final dispatch is also seen in the ethnographic chapter. Water source ambush strategies, as formerly mentioned, would be for single animal kills not herds.

In the ethnographic evidence, and as mentioned by Saunders (1992), modern hunters pursue individual elephants not herds of them. The archaeological record does not support the attacking and killing of whole herds (Dragoo 1979; Frison 1998). Even without the aforementioned ideas on its improbability, drive hunting herds into water sources still may not have been feasible. Given possible defensive nature of matriarchal herds, these types of attacks were probably very difficult (Frison 1989, 1998; Saunders 1992). The successful killing of an individual member within sight of the herd probably would not result in success. The lessened chance of success is given that ancient elephants would guard dead members, like with modern elephants (Saunders 1992).
However, a well-organized and perfectly executed Paleoindian attack on a proboscidean herd probably could have eliminated the entire group. This type of strategy would require tremendous effort, be too time consuming, and extremely dangerous. Moreover, it would leave the Paleoindian group with more animals that they could process or use.

Single animal kills as in the “opportunistic culling model” and “age-selective cull model” were probably the best strategy (Saunders 1992:138). This could be conducted on single males or by isolating and separating members of a herd without alerting the matriarch (Frison 1989). Paleoindian hunters probably would have tried to go after animals with the best tasting meat, i.e. fatty or tender. These animals would be older, single males and non-lactating females or younger animals in herds (Jones 1999). Single males would be easier to hunt and probably was a good strategy (Dragoo 1979). Although, according to Fisher newly ostracized juvenile males would be malnourished for the first couple of years (CSFA 2000b), and may not have been as desired as older males.

The initial attack on a proboscidean was probably from an ambush either with a thrown spear, atlatl or by hand (Frison 1989). If a hunter got close enough, the initial attack could have been with a thrusting spear. This thrusting attack is a possibility if the hunter was very knowledgably on prey behavior and stalking techniques (Laughlin 1968). Thrown projectiles give one safety and surprise; thrusting spears give one accuracy and penetration (Appendix A). The hunters, with their knowledge of anatomy, were probably aiming for the lungs (Boldurian and Cotter 1999; Frison 1998). A single hunter could have conducted this initial attack with the remaining group remaining hidden as backup. The possible poor eyesight of the proboscidean (Duffy 1996; Frison 1989) may have
given this single hunter attack the advantage. The wounded proboscidean would then seek a water source, if not already near one, and be tracked and re-attacked here or after it was too weak to continue. A thrusting spear was probably used when the animal was in a weakened and less dangerous state (Frison 1989; Olsen 1990). The wooly mammoth had up to 12.7 cm (5 in) of skin and fat (Lister and Bahn 2007) that would have to be overcome before reaching into any vital areas. This requirement of deep penetration to reach any vital areas may have been another possible reason for the use of foreshafts attached to mainshafts.

Probably the best time to hunt proboscideans was autumn. The growth rings on tusk remains at sites indicate this (CSFA 2000b; Fisher 1984; Fisher et al. 2003; Hofreiter and Lister 2006; Koch et al. 1989). Animals were also in the best condition at this time after preparing for winter (Driver 1990; Hall 2000; Mueller 2009a). Additionally, this is the time when it would be necessary for Paleoindians to store large amounts of meat. The upcoming cold weather helped to facilitate this. Next in the discussion, are ideas on the possible design of Clovis weaponry.

Archaeological evidence suggests that Clovis point spears were used in a compound fashion (Boldurian and Cotter 1990; Tankersley 1996). A point hafted to a foreshaft that would detach from the mainshaft when the point impacted and embedded into its target is the current model. This model could be the primary construction style of Clovis spears. What this does not mean is that all Clovis spears were hafted and employed like this. It is entirely possible that some points were permanently attached to a non-compound spear, with no detachability feature. The reasoning for this model is with the fact that not every hunting scenario or prey type would be best suited by using
the compound spear. With a charging animal or attacking predator, these situations dictate that the hunters use a spear as a defensive weapon, like a pike. A charging animal would impale itself on the presented spear. Moreover, said dangerous predator could be kept at bay or discouraged from attack with short jabs that do not leave the hands. A large Ice Age predator swiping or biting at a compound spear may knock the foreshaft and point out. In addition, a Paleoindian jabbing at the predator in a defensive move could penetrate the animal in a non-vital area. The compound foreshaft would then detach, leaving the hunter defenseless. The best weapon to have against a very dangerous animal that would not normally flee a hunter would be a non-compound spear with a permanently attached point.

If the compound spear, with a Clovis point hafted on a detachable foreshaft, was its primary mode of design, then it does not make sense to throw such a weapon either by hand or with an atlatl. The mainshaft needs to be retained in its employment as a propelling device for a quick foreshaft reload and re-engagement on the target. If a compound spear is used at a distance with a hand or atlatl throw, then the weapon system is entirely discharged and useless. If an atlatl was indeed the mode of propulsion, why would a hunter continue to load and employ an already reloadable device into their atlatl? Imagine taking a shot at a proboscidean with either of the two aforementioned thrown propulsion modes. You would then have to recover the mainshaft portion and it would require a replacement foreshaft before re-engaging the prey again. This recovery and reload operation would be an even more complicated task if the proboscidean was fleeing the attack at a rapid pace. What makes more sense is that these detachable foreshafts on the compound Clovis spears were used at close range with a hand thrust method. The
target is engaged, the foreshaft embeds and detaches, the mainshaft is reloaded, and the animal is further attacked. Attacks at this close range do have limitations. The proboscidean would have to be in a weakened state or distracted by something to preclude its violent defense towards the human hunters. Additionally, a thrusting spear would be difficult to use on a moving proboscidean.

Another reason that the Clovis compound spear would not be thrown deals with a moving proboscidean. The short foreshaft would not place much more stress on the wound area other than initial penetration damage. On a moving proboscidean, a permanently attached Clovis point on a long shaft would be more effective. This spear would also penetrate and embed in the animal, but it would have the weight of the shaft that could sway with the movement of the animal’s running. The sag and leverage action would cause further damage and trauma to the wound area. A similar effect was seen in Marks’ (1976) description of the Bisa weighted spear in the ethnography chapter. A more effective technique would be to use a non-compound spear in either a thrown or a thrusting way for the initial proboscidean attack. The longer spear shaft trailing the embedded point would cause further damage in its oscillation with the retreating animal’s movement. A compound spear could then be used later for close range work with thrusting attacks on a weakened animal until dispatch.

Another examination in Clovis design between compound and non-compound spears uses Bleed’s (1986) concept of “maintainable” and reliable “weapons.” The idea is that the foreshafts had a semi-permanent nature. On the compound spear, the foreshaft was not meant to detach until the point needed to be changed out due to wear and breakage. This description of a component-based system would be easy to repair by
simply replacing the foreshaft. The foreshaft could also be replaced with specific points and foreshafts for certain types of animals. The different parts of the compound spear all have one function. The illustrated characteristics could make the compound spear design a maintainable system (Table 4). The idea of partial functionality was mentioned in the Nature of Clovis Weaponry paragraph in Chapter 4. This idea was that a bone foreshaft could be used without the Clovis point simply by further sharpening the beveled end. If compound spears were a maintainable system, then a non-compound spear would subsequently be a reliable system. This non-compound spear may not have had the same method for hafting as proposed by (Boldurian and Cotter (1999) in Figure 6. The Clovis point may have been hafted directly to the shaft with a nock cut out in the center of the end. The point was then strongly bound to the hafting point. Damage to the point of this type would require more repair time, but its hefty design would make it a no-fail weapon. This could have been used as a backup to the compound spear. These ideas are only briefly covered here, as more research into possible Clovis spear design needs to be conducted to further this.

A possible cyclic model of a Clovis Paleoindian mobile subsistence strategy is presented in Figure 10. The concept of this model will incorporate some of the trends observed at the ends of Chapters 3 and 4. Additionally, the models of Hayden’s (1981) characteristics of individual and communal hunting and Bleed’s (1986) characteristics of maintainable and reliable weapons systems are used. Bleed’s model requires some adjustment and explanation in order to fit with the proposed cyclic model of mobile subsistence. The design of the Clovis spear for this model will remain similar for both the maintainable and reliable systems. This design is a Clovis point hafted to a bone
Figure 10: Possible cyclic mobile subsistence model [Figure by author]
foreshaft socketed into a mainshaft. The Clovis spear has a compound design and a non-compound design as with Figure 6 (Boldurian and Cotter 1999:100, Figure 51). Compound Clovis spears, with detachable foreshafts, are thrusted. Non-compound spears are either hand or atlatl thrown, but could also be hand thrusted if needed. The adjustment of Bleed’s model is by removing the “component based design” characteristic of the maintainable system. The point-foreshaft-mainshaft spear design has an inherent component basis description. Removal of the component characteristic allows the point-foreshaft-mainshaft model to be used by both maintainable and reliable systems in the proposed subsistence model. The remaining differences of the characteristics in the system models could then be applied to a standard point-foreshaft-mainshaft design.

The concept of the proposed model involves a mobile Clovis Paleoindian group moving from location to location (“Hunting and Gathering Areas A through D”). The group is using a combined strategy of following game herds or moving to areas with known and reliable floral and fauna resources. This “General Subsistence Strategy” includes any exploitable floral and fauna resources available to the group, including the chance proboscidean encounter. Area A (medium square) includes either a chert quarry or a trade meeting point (double square) where reliable supplies of chert are brought in by a trade network from an adjacent group. The availability of chert resources means the group can afford to use maintainable weapons in a more robust, full strength, reliable weapons-like mode. This chert availability would allow the group to have a specialist or armorer to make high quality tools and repair them when necessary. Repairs are made with the raw materials available at the chert source, preventing the hunters from resorting to hunting with their weapons in partial condition, i.e. using the bone foreshaft as a point
when the chert points are used beyond repair. Area A, in addition to the chert source, has a moderate supply of general floral and faunal resources allowing a medium sized area to be exploited by individual or cooperative hunting using robust, high-quality maintainable weapons. Areas B through D also have general floral and faunal resources, but do not have a readily available supply of chert. Maintainable weapons are used to conserve chert supplies on hand. Weapon points are smaller than in Area A and hunters have repair kits containing spare parts. The weapon specialist makes most of these spare parts while the group is still in proximity to the chert supply in Area A. Spare parts for weapon repairs allow the hunters of the group to maintain their weapons while the group is away from a chert source. The recycling of points, reworking broken and dull points, also causes the characteristic of smaller points of maintainable weapons in Areas B through D. Additionally, when points are used beyond repair, the bone foreshafts can be substituted as points on the weapon system. Area B has poor resources available, requiring a heavier reliance on meat. Intense communal hunting by the group on a smaller area is used for a better chance of success. This communal hunting creates a more mobile characteristic of the whole groups since the camp moves with the foraging patrols and is established at the location of the last successful resource gathering. Area C is matching in resources to Area A and the individual and cooperative hunting strategy is applied. The difference between Areas A and C is the availability of chert supplies in Area A. The removal from a reliable chert source requires the group’s hunters to use maintainable weapons to conserve chert supplies on hand. Area D has a rich and plentiful variety of floral and faunal resources, allowing for an individual hunting strategy that covers more terrain for a better chance of success. The group could have
reduced mobility in Area D because it could establish a central camp that individual hunters would return to after securing food resources. After Area D, the group would return to Area A in part to replace and repair weapons with the available chert source. The cycle explained, with the group moving from Areas A through D exploiting a variety of floral and fauna resources available, is a general subsistence strategy. The “Specific Subsistence Strategy” is employed by the group when needing to prepare for winter with large amounts of meat in addition to hide, bone, and sinew. Several large proboscideans can provide these resources and the group knows that Columbian mammoth herds are seasonally available only outside of the regular areas of general subsistence during this time of preparation. The assumption that Columbian mammoths have seasonal migrations is made for this model. The chance to hunt this reliable and seasonally available supply means a large payout of the mentioned resources and is the motivation for this seasonal hunt. For the example in Figure 10, the time of this seasonal specific subsistence strategy interrupts the normal cycle of Areas B and C. Communal hunting is used on the specific subsistence strategy because it offers the best chance of success on this important hunt. Moreover, reliable weapons are employed because of the vital nature of the seasonally available prey. Robust reliable weapons would offer a tested and dependable tool for this significant hunt. Reliable tools are manufactured and maintained near a chert source. To overcome the location of the seasonal hunt’s separation from chert supplies, caching of reliable weapons is required. Prepositioning of extra weapons as back-ups also reduces the weight load of the group when it treks to the distant hunting grounds. The prepositioning of weapon caches at strategic locations along the seasonal animal migration route originates from Area A. The chert source of Area A makes it the
location for the manufacture of robust weapons to be deployed in caches. This prepositioning of weapon supplies occurs well before the actual seasonal hunt. The group moves from Area B at the time of winter preparation and hunts the migrating mammoths along the seasonal migration route. Back-up and replacement reliable weapons are retrieved from the prepositioned caches in the hunting area when needed. Upon completion of a successful seasonal hunt, the group is in part prepared for winter. Spring returns the group to its normal cyclic general subsistence strategy.

This model was presented as a possible idea for mobile subsistence strategy used by Clovis Paleoindians. The model would vary among groups given the availability of chert supplies and different animal and plant resources, geography, and climate. The model illustrated shows a particular group’s strategy using the trends and models researched for this thesis. If, in fact, a group of Clovis Paleoindians practiced the illustrated model, then certain characteristics may be inferred from such a model. Mobility by Clovis Paleoindians may have been largely dependent on the resources available and not a consistent mode of behavior. The presented model allows for times and situations of variable mobility. Social organization within the model’s group is inferred by the need to seasonally plan movements, hunting, and logistically support such hunting. A mobile subsistence strategy would require leadership to plan, react to changes, and execute plans to the benefit and survival of the whole group. Additionally, the use of high quality, reliable weapons by the model’s group, would allow for a weapon specialist who manufactures and repairs such weapons. The presented model is just one of many probable ideas that can be used to help illustrate the realistic nature of the Clovis Paleoindians. The model was not designed to be an all-inclusive design, or a generalized
lifestyle for all of Clovis Culture. The model is simply used to help build an understanding of what might have been reality considering the presented information. Several uncertainties still require further research and work to help reevaluate and adjust this model. Furthermore, a few question were brought up in the course of research that need additional investigation.

A question that was not addressed in the researched materials alludes to the nature of Clovis points found comingled in animal remains. Why are these points still present? Paleoindian hunters seem to have not recovered their spears or foreshafts for reuse. Experimental archaeology shows that Clovis points can survive multiple uses (Frison 1989). Archaeological data shows that some points were reworked and reused, possibly after breakage or dulling (Gramly 1984; Huckell 2007). Why then were points not recovered after a kill? There are several possibilities: 1) Clovis foreshaft parts were disposable by nature, similar to a modern hunter’s firearm bullet; 2) As with the Naco site mammoth, the animal escaped with the points inside of it and died later (Haynes 2002), thus the points were never recovered; and 3) Some Clovis point hits on an attacked and killed mammoth were in non-butchered parts of the proboscidean’s anatomy, meaning that the entire carcass was not fully processed or used. This possibility could be because of time constraints, such as the appearance of dangerous scavengers and predators trying to steal the kill. Alternatively, this idea could mean that only certain parts of the animal were taken. Lastly, the animal may have simply died when it was in the water, but not mired down. When the animal collapsed in death, part of it lay submerged in water and mud, consequently making that part of the animal inaccessible or spoiled for harvesting. These are just a few ideas developed as possibilities that need further research.
Another question that was not discussed in the researched materials is in regards to the role of Paleoindian dogs in proboscidean hunting. Dogs have been an important part of human hunting since their domestication. Washburn and Lancaster (1968) studied hunting trends during the evolution of humans. They discuss the use of dogs in hunting, saying, “dogs were of great importance in hunting, for locating, tracking, bringing to bay, and even killing,” (Washburn and Lancaster 1968:294-295). A specific report included in their work shows that a Bushman with a pack of trained dogs obtained 75 percent of the meat, while the other six hunters provided only 25 percent of their camp’s meat (Washburn and Lancaster 1968). In Chapter 3, Marks (1976) discusses the Bisa use of dogs in elephant hunting. Though not included in the ethnography account of Chapter 3, Duffy (1996) mentions the Mbuti use of dogs in hunting smaller game.

Clovis Paleoindians more than likely had dogs with them (Fiedel 2005; Kooyman et al. 2001), though direct archaeological evidence is lacking. Wolpert (2002) writes about the work a group of biologists conducted who say that the DNA of New World dogs is closer to Old World dogs than the DNA of North American wolves. This would imply that dogs were brought over Beringia from the Old World at some point during the colonization of the New World (Fiedel 2005; Wolpert 2002). If Paleoindians did have dogs with them, then these animals might have been heavily relied on for survival in the new environment (Fiedel 2005). With this in mind, it is a curious question to address the possible use of such animals in proboscidean hunting. This is a very difficult research proposition and requires further work.
Conclusion

The ideas presented in this thesis offer possible models for understanding proboscidean hunting methods. Proboscidean hunting was probably communal. Hunting was probably strategically planned around water source terrain. The planned strategy was either by attacking proboscideans frequenting the water sources or re-attacking wounded proboscideans that sought water. Single animal kills were probably conducted on proboscideans for high quality meat and hides and took place in the fall. This was also the time that large quantities of meat could be stored without spoilage. These individual kills were on solitary males, or by separating a lone animal discreetly from a herd. The initial spear strike was probably thrown by hand or by atlatl. However, a non-compound, hand thrusted spear could be delivered first if the right situation was present. The wounded animal was then tracked and dispatched in a weakened state with compound thrusting spears.

Clovis spears had a compound design and a non-compound design. Compound Clovis spears, with detachable foreshafts, were probably thrusted. Whereas, non-compound spears were either hand or atlatl thrown, but could also be hand thrusted if needed. This makes the most sense with their functional design and the results of their employment. The compound design of a Clovis spear makes it unlikely that it would be either hand or atlatl thrown. The reason is because if a hunter throws the compound spear then the entire weapon system is now spent and recovery of the mainshaft must occur before it can be rearmed with an additional foreshaft. A non-compound spear could do more damage if left in a moving proboscidean. The biggest weakness behind
ideas of atlatl thrown Clovis spears is the lack of atlatls in the archaeological record. This artifact absence does not mean that Paleoindians did not have atlatls, as they may have been brought over from the Old World. The lack of information means that there is currently scant evidence to support atlatl use. The closest possible substitute is the Murray Springs bâton or shaft straightener, but this is a very radical idea. The possible future discovery of more of these artifacts found in Clovis Paleoindian proboscidean hunting contexts could offer additional support for this proposal.

The consideration of all this information is as an interpretative model and not as direct fact. The data researched gives direction to this interpretation and to a more probable model. A majority of this evidence is from sites in western North America with Columbian mammoth association. This research did not find enough information on eastern site interpretations, and the behaviors of woolly mammoths or mastodons. Mastodons tend to be grouped in with mammoths, but their distance relation to them needs to be given consideration. Behaviors for mammoths and modern elephants probably cannot be used on mastodons. Moreover, the lack of information on eastern Paleoindian sites means that the above interpretations should not be extended to these.

In the end, there is probably no generalized practice of Clovis Paleoindian hunting of proboscideans or standard design of Clovis weaponry. Paleoindians probably did not have one single hunting strategy. They were creative and intelligent like any other human group and probably had multiple strategies for different situations. Additionally, there were probably various techniques and tool designs over regional groups, and no “Clovis standard” of universality. The one item that does have some of this universality is the Clovis point itself. Even though there are slight variations in points designated as
“Clovis” under the classic definition, its typology and knapping manufacture is very similar. The nature of its hafting and employment on proboscideans, not to mention other animals, is the point of contention. Certainly, all the groups that were spread out over the North American continent using the same point probably had “reinvented the mousetrap” so to speak, in various ways. The best recommendation to remember is, “given the multitude of ways that weapons can be devised, including the ingenious use of foreshafts, any rigid ideas as to how Palaeo-Indian fluted points were hafted and propelled must be avoided” (Gramly 1984:113). Universal techniques and strategies could be assigned to regions, but this requires a thorough evaluation of all Clovis sites within a certain area. Not to mention, the requirement of proboscidean species-specific behavioral models is also needed. Research of this type requires much more breadth than what can be accomplished with this thesis. Such an investigation would require and in-depth study of all North American Clovis sites. Sites would need to be analyzed for their function; hunting camp, long-term residential camp, tool manufacturing camp, or kill and butchering site. Unfortunately, this site analysis also requires the sufficient discovery of interpretable sites to find a patterned sequence of behavior and site formation. The lack of preservation in cultural material from this time exacerbates such a study. The 13,000-year-old ocean coastline probably has a number of underwater Clovis sites (Malakoff 2009). However, finding underwater sites would be difficult and excavating them would be challenging and expensive. The hope is that as time passes the discovery of newer evidence provides archaeologists with a more solid model of Paleoindian life, especially hunting. Until then, the presented interpretative models give us a closer view to reality.
Appendix A

Weapon Simulation Test

This appendix covers a weapon simulation test examining the penetration of primitive weaponry simulations into a controlled matrix. The purpose of this test is to compare the performance of spear simulations in three possible propulsion modes: underhand thrust, overhand javelin throw, and atlatl assisted, in conjunction with an atlatl dart simulation. This additional part of the research is not intended to inform the overall discussion, but is a simple test on the performance of primitive weaponry in the three mentioned propulsion modes. The test compares how a particular spear simulation penetrates ballistic gelatin in the different propulsion modes. This test is not intended to investigate an exact Clovis spear reconstruction and its possible performance limitations. The purpose of this experiment is to compare the performance data of the specific projectiles in the three different propulsion modes. The conclusions about the results of the test are used to develop considerations on the research question of Clovis spear employment.

The simulated artifacts constructed for this project were made out of modern materials to simulate lanceolate weaponry. The simulations consist of spears, darts, and atlatls. The latter simulated artifacts may be the weakest part of the test since no atlatls have yet been found in context with Clovis Paleoindian sites. Because of this, the design is as simple as possible. The simulated artifacts were made with the assistance of modern tools. The artifact simulations were tested in a performance evaluation by using ballistic gelatin, measuring the depth of penetration. The point of using ballistics gelatin was not
to simulate the flesh of proboscidean animals or even to simulate average flesh density. This medium was used to bring more consistency to testing with the ability to create a uniform shape, size, and density for future tests. Additionally, this medium gave the test projectiles a standard material for penetration so consistent measurements could be taken. The result created a repeatable, controllable test verses using the characteristics of individual animal anatomy. The gelatin also removes the ethical issue of testing on live animals or waiting for a suitable animal to be culled and then gaining permission to test on it. The ballistics gel was created with generic, unflavored gelatin, creating a form of Jell-O™ with a thicker consistency. The spears were tested on penetration in three propulsion methods: underhand thrust, overhand throw, and atlatl assisted. The atlatl darts were also thrown into the gel to collect data for comparisons against the heavier spears. These methods were conducted at three varying ranges. Penetration results of the projectiles was recorded and compared. The data was then analyzed for its results and any patterns that emerged. This construction and testing process was documented so that another researcher could recreate it later. The documentation involves pictures, descriptions, measurements, and observations.

*Project Plan*

The methodology of this project was to create a simulation of the artifacts in question and recreate their use on a controlled level. This project used modern tools and materials to create the artifacts due to inexperience with correct period tools and materials. This use of these modern tools and materials accordingly does not qualify the project as experimental archaeology in the standards created by Dr. Errett Callahan (Wescott 1999b:4-5). However, the project was conducted in an experimental manner,
meaning that notes and data were presented in a written form at the conclusion of the project in such a way that another researcher could repeat the tests.

Two atlatls were created, one defined as male and another as female, as discussed by Krause (1905) and Whittaker (2006). The atlatl that was found easiest to use was exclusively used in the testing part of the analysis. The three darts created were fletched with steel arrow field points. The two spears created were non-fletched with a wide, steel knife blades, hafted into them. These knife blades simulated a biface point. The weight measurement in grains was included in the simulated artifacts’ descriptions in addition to the metric measurement in grams. Grains are used widely in archery and ballistics. This helps to create a point of reference with these subjects. One gram equals 15.4 grains. Weights were measured with a standard postal rate scale. The backstop for the target was a stack of three hay bales. The distance of the throws was determined for the testing part based on accuracy achieved during practice throw trials. The data gathering tests begin after enough proficiency was gained for three solid hits on the ballistic gel block with the four methods of propulsion mentioned above. The depth of penetration attained by three solid hits from the four types of impacts were noted and recorded.

Reference material for this project was taken from a variety of sources. Krause (1905) discusses ethnographic evidence of atlatl use in various areas worldwide. Krause defines atlatls by nock types: “male,” “female,” and “mixed” (Krause 1905). He also states that an atlatl can increase the effective range of a spear by three or four times than one thrown by the hand alone (Krause 1905; Whittaker 2006). Davis and Davis (2002), Myscienceproject.org (2006 ca.), Tacticalworks.ca! (2005) are separate instructional guides that offer directions on recipes, care, and use of ballistics gelatin. Standard off the
shelf, unflavored Knox™ brand gelatin can be used and is listed in the recipes by Davis and Davis (2002) and Myscienceproject.org (2006 ca.). Olsen (1981) teaches primitive technology in his book on outdoor survival skills. This includes examples on construction of atlatls and darts. Though this source is not as good as other references, it offers a good base from which to start. Whittaker (2002) wrote an informal manual on how to properly throw a dart with an atlatl. This includes several pictures of the motion of the body and extremities during the stages of throwing a dart on an atlatl. Pictures of improper throws and throwing stances are also illustrated. Wescott (1999a) edited a collection of “how-to” instructions on recreating prehistoric items, including a section on atlatls and darts. There are a number of articles on atlatl like spear throwing devices and how to achieve the best performance with an atlatl. Included in the latter volume is Wescott’s (1999b:6-11) own work that expands upon Callahan’s (1999) instructions on experimental archaeology and its proper levels and conduct. Callahan’s (1999) instructions on experimental archaeology precede the latter article. It provides a history on the development of experimental archaeology and gives definitions and terms used in experimental archaeology.

Construction

Seven total simulated artifacts were constructed for this project: two atlatls, three darts, and two spears. The male atlatl is 48 cm (18.9 in) long, 4 cm (1.5 in) wide, and 1.5 cm (.6 in) thick. The point of the hook is 2.7 cm (1 in) high and 1.2 cm (.5 in) from the board (Figure 11). Its weight is 12 g (185 grain). The concept for the design was from (Olsen 1981:132-133, Figure 151). The female atlatl is 60.5 cm (23.8 in) long, 3.7 cm (1.5 in) wide, and 1.8 cm (.7 in) thick. The handle extends downward at a slight angle. It
has a groove that is 1.6 cm (.63 in) wide, .5 cm (.2 in) deep, and runs for 52 cm (20.5 in) of the total atlatl length. The depression for receiving the posterior end of the dart was attached to the end of the atlatl above the groove. This hood is 2.4 cm (.9 in) high from the board, 3.7 cm (1.5 in) wide, and 1.3 cm (.5 in) thick with a tapered and centered circle extending to almost all the way through to the opposite side. The female atlatl weighs 14 g (216 grain). The idea for this design was an independent concept based off the definition of a female atlatl (Krause 1905; Whittaker 2006). Both of these atlatls were constructed out of treated pine board scraps (Figure 12). This data can be found in Table 5.

<table>
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<td>1.5 cm</td>
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<td>3.7 cm</td>
<td>1.8 cm</td>
<td>215.5 gm</td>
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Figure 11: Close up view of male atlatl hook [Figure by author]

Figure 12: Comparison of male and female atlatls [Figure by author]

The three darts were 121.9 cm (48 in) long and 1.27 cm (.5 in) in diameter. The darts are fletched with commercial arrow fletching made out of natural feathers. These feathers are 12.7 cm (5 in) long and have a right wing parabolic cut. This gives the
fletching a slight twist as it lays on the shaft, which in turn spins the projectile while it is in flight. The points are commercial steel arrow field points of the “bullet” variety. These points are 6.5 g (100 grain), .87 cm (.34 in) diameter, with a length of 1.5 cm (.6 in). This makes the total length of the darts 123.4 cm (48.5 in). The darts have a .5 cm (.19 in) deep socket in the posterior end of the shaft. These darts have flexibility in the shaft.

The two spears created are non-fletched with a 1.905 cm (.75 in) diameter and 121.92 cm (48 in) long shaft. The points are steel throwing knives that are 9.5 cm (3.7 in) long by 2 cm (.78 in) wide with a weight of 42.5 g (656.25 grains). These knives were used to simulate a biface style point. The hilt of the knives is 8.9 cm (3.5 in) long, which were hafted into the shaft. The blades were 9.8 cm (3.9 in) long and make the total length of the spears 131.72 cm (52.9 in). The spears have a 1 cm (.39 in) deep socket in the posterior end of the shaft. These spears do not have much flexibility in the shaft. The shafts for all of the projectiles are commercial dowel rods (Figure 13, 14, and 15). A hot glue gun was used to fasten the points and fletching to the shafts. Additional data for the darts and spears can be found in Table 6.

Figure 13: Comparison of spear and dart [Figure by author]
Figure 14: Close up view of spear and dart points [Figure by author]
Figure 15: Close up view of spear and dart sockets [Figure by author]

Table 6: Spear and Dart Data [Table by author]

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<th>Weight</th>
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<td>1.905 cm</td>
<td>229.6 gm</td>
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<td>1.905 cm</td>
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</tbody>
</table>

The target for testing was a block of ballistic gel 27 cm (10.6 in) wide, 15 cm (5.9 in) high, and 19 cm (7.5 in) thick, weighing 7.25 kg (16 lbs). The block was made using an on-line recipe (Tacticalworks.ca! 2005; Myscienceproject.org 2006 ca.), regular kitchen gelatin (Figure 16), and a suitable mold (Figure 17). The backstop for the target was a stack of three straw bales roughly 90 cm (35.4 in) wide, 110 cm (43.4 in) high, and 45 cm (17.7 in) long with the center bale as the target (Figure 18). This stack was rearranged after the initial practice throw trials for the actual test as seen in Figure 19. Length measurements of simulated artifacts and targets were taken with a standard ruler. The measurement bar seen in Figures 11 to 15, 19, 21 to 22, 25, 28, 30, and 32 to 43 is 1 cm for smaller sections, 5 cm for larger sections, 20 cm total length.
Testing

Practice with the projectiles took place over a period of a few hours. The testing spot was a wooded area. This day was purely for a practice and experience-gaining event. Three distances were measured out in front of the target. The distance of throws was taken by a foot pace count and later re-measured with a tape measure reel. These lengths were 3.6 m (3.9 y), 7 m (7.65 y), and 12 m (13.1 y). The distances were based off trees that were used a reference points for repeat throws. This conveniently gave distances that increased almost by two times the length of the previous spot. The spears
were thrown first in the javelin style from the 3.6 m distance. Due to a design flaw with the hafting, one spear’s point snapped out of the shaft on the first throw. The second spear repeated this same failure after three throws and no additional practice could continue with the spears. It seems that upon striking the target or ground there is an oscillation motion of the shaft of the spear as the residual forward motion dissipates. This pressure on the blade causes a lever action on the hilt of the knife that offers enough strength to snap the hafting out.

Throws were then conducted with the darts using the male atlatl at the 12 m distance. Dr. Whittaker’s short manual on use of the atlatl was the guide for learning how to throw spears and darts with an atlatl (Whittaker 2002). The middle of the center hay bale was targeted and a hit close by was scored after four throws. A double hit close to the center occurred after a few more rounds of throwing (Figure 20). The grip used in the throws is seen in Figure 21 with the hook and socket connection seen in Figure 22. The throwing style was adjusted as the rounds of throwing went on. It seems like one has to develop a comfortable style. Throwing an atlatl projectile is more akin to a golf swing with its collection of body movements all in harmony and timed just right. It has more of a “feel” to it than archery does where the motion is much simpler: pull, hold steady, and release. The darts flew with a flat trajectory and they did have a spin caused by the type of fletching used. The dart left the atlatl with some force and when a good wrist snap was timed right it would slam into the straw with a slight “thwack.” There was enough force and wear on the hand from the handle to tear off an old callus (Figure 23).

The male atlatl was put aside after a time and the female atlatl was tested. The throws with the female atlatl seemed smoother and more powerful. Interestingly enough,
the female atlatl seemed more accurate in throwing as two hits close to center were achieved after a few throws (Figure 24). The throws with this atlatl though caused an extreme up and down oscillation in the trajectory of the dart. The anterior and posterior ends would rise and fall rapidly. This caused the darts to land at an upward angle (Figure 24) compared to the male atlatl thrown darts which landed relatively flat (Figure 20).

Figure 20: Hits with darts from 12 m using male atlatl during practice phase [Figure by author]

Figure 21: Close up of grip used during male atlatl throws [Figure by author]

Figure 22: Close up of socket and hook connection on male atlatl [Figure by author]

Figure 23: Wear and tear of hand sustained during practice throws [Figure by author]
This oscillation was so extreme that on a few throws the dart would go vertical and stop midair before reaching the target, then fall straight down on its posterior end. The problem here may be with the hood attachment on the posterior end of the female atlatl. The socket was crudely made to be adaptable to the diameters of both the spear and dart. This larger recess may be causing the atlatl to “hold onto” the end of the dart longer giving the rear too much momentum. The oscillation observed could have been simply the result of “the end trying to catch up with the point” while in flight.

Throws continued until two of the darts had the points snapped out of the shaft due to weak hafting. Practice was halted at this point until repairs were made to the projectiles. The darts had their fletching re-glued in a more secure fashion. The dart points that had broken off were reattached with a stronger adhesive, Gorilla Glue™. The spears obviously needed a much stronger hafting in order to survive the testing portion of the project. These were re-glued in place with the same robust adhesive. The entire hafting point was then wrapped tightly with nylon masonry string wrapped over the glue-covered surface of the spear shaft down to the point where the hafting broke off (Figure 25). This modification worked excellent during the testing portion as both spears
survived numerous high stress impacts and were still in functional order. It is interesting that the spears’ hafting required reinforcement of this level. This is something to think about for future work with stone points that have longer hafting areas.

A few days later, the repaired projectiles were taken back to the same practice site for the testing phase. The male atlatl was used exclusively for testing of both the spears and darts. A few practice throws later and accuracy was quickly reacquired at the 12 m distance (Figure 26). The spears were thrown in the javelin style for a few practice throws at the 7 m distance. The balance point was found and marked on both spear shafts and was used as the grip point for the throws. The spears were then tried with the atlatl again at the 7 m distance. The results of the spear penetration of the straw bale seemed greater with the atlatl than hand thrown, this was promising (Figure 27).

Figure 25: Close up of hafting repairs on spear [Figure by author]

Figure 26: Hits with darts from 12 m using male atlatl during warm-up for testing phase [Figure by author]
The testing began after this initial warm-up. The spears were first thrust into the ballistic gel with a two handed, underhand thrust in a bayonet motion. The underhand thrust was conducted three times at close range with excellent results. The spears were then thrown from the 3.6 m distance with an overhand, javelin motion. Two hits were recorded and the distance was moved to 7 m. Three solid hits were recorded at this distance. There was enough “trauma” to the block of gel at this point to turn it around to the opposite side for further testing. It is interesting to note that as the spear oscillates after impact it causes the blade to move back and forth within the gel, further cutting and expanding the “wound,” In addition, the spear would sometimes sag under the weight of the shaft after motion had stopped. Had this spear hit been in an actual animal the motion would further inflict damage internally. A sagging spear could cause the end of the spear shaft to hit and bounce off the ground if the animal was fleeing. The movement would increase the damage of the wound.

The atlatl was used with the spears at this time and four hits from 7 m were recorded. It should be noted that during this part of the testing the spear or dart would sometimes impact on damage from a previous hit. How much this increased the
penetration of the point beyond what it should have “normally” achieved is unknown and should be considered. Atlatl spear throws from the 12 m distance were very inaccurate and no hits were recorded. The spears had no fletching and reacted wildly when thrown from this distance. The projectile was switched from spear to dart at this point. Starting at 7 m, three hits were recorded. It seemed more difficult to regain accuracy after switching from the heavier spear to the lighter dart. Three hits were also recorded at the 3.6 distance for comparison with the hand and atlatl thrown spears. Only one hit was recorded at the 12 m distance, as it was difficult to hit such a small target at this range. A complete list of data can be seen in Table 7.

Table 7: Projectile Hit Data [Table by author]

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Type Throw</th>
<th>Distance</th>
<th>Depth Penetration</th>
<th>Complete Penetration</th>
<th>Gel Condition at Hit</th>
<th>Figure</th>
</tr>
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<tr>
<td>Spear</td>
<td>2</td>
<td>Hand Thrust</td>
<td>Under 1 m</td>
<td>27.5 cm</td>
<td>Yes</td>
<td>Strong</td>
<td>None</td>
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<tr>
<td>Spear</td>
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<td>Hand Thrust</td>
<td>Under 1 m</td>
<td>27.5 cm</td>
<td>Yes</td>
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<td>Hand Thrust</td>
<td>Under 1 m</td>
<td>22.5 cm</td>
<td>Almost</td>
<td>Strong</td>
<td>28</td>
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<td></td>
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<td>13 cm</td>
<td>No</td>
<td>Strong</td>
<td>29</td>
</tr>
<tr>
<td>Spear</td>
<td>2</td>
<td>Hand Thrown</td>
<td>3.6 m</td>
<td>14 cm</td>
<td>No</td>
<td>Strong</td>
<td>30</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>13.5 cm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Hand Thrown</td>
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<td>10 cm</td>
<td>No</td>
<td>Strong</td>
<td>31</td>
</tr>
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<td>11.5 cm</td>
<td>No</td>
<td>Strong</td>
<td>32</td>
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<td>Spear</td>
<td>1</td>
<td>Hand Thrown</td>
<td>7 m</td>
<td>12 cm</td>
<td>No</td>
<td>Strong</td>
<td>33</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>11.16 cm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spear</td>
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<td>7 m</td>
<td>21 cm</td>
<td>Almost</td>
<td>Weak</td>
<td>34</td>
</tr>
<tr>
<td>Spear</td>
<td>1</td>
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<td>7 m</td>
<td>24 cm</td>
<td>Almost</td>
<td>Weak</td>
<td>35</td>
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<td>Atlatl</td>
<td>7 m</td>
<td>18 cm</td>
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<td>Strong</td>
<td>36</td>
</tr>
<tr>
<td>Spear</td>
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<td>Atlatl</td>
<td>7 m</td>
<td>16 cm</td>
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<td>Strong</td>
<td>37</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
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<td></td>
<td><strong>19.75 cm</strong></td>
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<td>14 cm</td>
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<td>Strong</td>
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<td>Dart</td>
<td>3</td>
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<td>9 cm</td>
<td>No</td>
<td>Strong</td>
<td>39</td>
</tr>
<tr>
<td>Dart</td>
<td>1</td>
<td>Atlatl</td>
<td>3.6 m</td>
<td>9 cm</td>
<td>No</td>
<td>Weak</td>
<td>39</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>10.6 cm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dart</td>
<td>1</td>
<td>Atlatl</td>
<td>7 m</td>
<td>10 cm</td>
<td>No</td>
<td>Strong</td>
<td>40</td>
</tr>
<tr>
<td>Dart</td>
<td>1</td>
<td>Atlatl</td>
<td>7 m</td>
<td>9 cm</td>
<td>No</td>
<td>Strong</td>
<td>41</td>
</tr>
<tr>
<td>Dart</td>
<td>2</td>
<td>Atlatl</td>
<td>7 m</td>
<td>8.5 cm</td>
<td>No</td>
<td>Strong</td>
<td>42</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
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<td></td>
<td></td>
<td><strong>9.16 cm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dart</td>
<td>1</td>
<td>Atlatl</td>
<td>12 m</td>
<td>12.5 cm</td>
<td>No</td>
<td>Weak</td>
<td>43</td>
</tr>
</tbody>
</table>
Figure 28: Results of third spear hand thrust test, from under 1 m [Figure by author]

Figure 29: Results of first spear hand thrown hit, from 3.6 m [Figure by author]

Figure 30: Results of second spear hand thrown hit, from 3.6 m [Figure by author]

Figure 31: Results of first spear hand thrown hit, from 7 m [Figure by author]

Figure 32: Results of second spear hand thrown hit, from 7 m [Figure by author]

Figure 33: Results of third spear hand thrown hit, from 7 m [Figure by author]
Figure 34: Results of first atlatl thrown spear hit, from 7 m [Figure by author]

Figure 35: Results of second atlatl thrown spear hit, from 7 m [Figure by author]

Figure 36: Results of third atlatl thrown spear hit, from 7 m [Figure by author]

Figure 37: Results of fourth atlatl thrown spear hit, from 7 m [Figure by author]

Figure 38: Results of first atlatl thrown dart hit, from 3.6 m [Figure by author]

Figure 39: (Forward dart) Results of second atlatl thrown dart hit, from 3.6 m.
(Rearward dart) Results of third atlatl thrown dart hit, from 3.6 m [Figure by author]
Results

The data indicates that in regards to the simulated spears, the thrust method is the most powerful followed by atlatl thrown and hand thrown methods. It seems that the atlatl adds more energy at the same range than a hand thrown spear. An idea that one could draw from this is that Clovis style spears were used at range with an atlatl to weaken a large animal and the hand thrust method was used at close up for the final blow when the animal was less mobile and not as dangerous. Frison’s (1989) strategy model discussed in Chapter 4 corresponds with this. However, this is if one takes the data at
face value. This test is by no means complete in its execution. Numerous other variables
could be looked at in a test like this, such as hafting techniques, foreshaft-mainshaft
configurations, and points that accurately simulate Clovis artifact variables.
Additionally, there are many weaknesses to this test. What the data does show is that the
hand thrust method does have its advantages, the atlatl does add greater energy to a spear
than a hand thrown spear does, and heavier darts perform better at closer range in
penetration. Mostly though, this test is a first step for the researcher that gave valuable
experience in the simulation of artifacts, practice with atlatls, comparison testing, and
experimental archaeology. Hopefully, in the future more detailed projects and tests can
be developed and executed within the guidelines of experimental archaeology.
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