INVESTIGATING THE EARLIEST HUMAN OCCUPATION OF MINNESOTA:
A MULTIDISCIPLINARY APPROACH TO MODELING LANDFORM SUITABILITY &
SITE DISTRIBUTION PROBABILITY FOR THE STATE'S EARLY PALEOINDIAN RESOURCES

Austin A. Buhta, Jack L. Hofman,

Eric C. Grimm, Rolfe D. Mandel, and L. Adrien Hannus

With Contributions By

Susan C. Mulholland and Stephen L. Mulholland

Archeological Contract Series 248

Prepared by:
Archeology Laboratory
Augustana College
2032 South Grange Avenue
Sioux Falls, South Dakota 57105

Prepared for:
The Minnesota
Historical Society
345 Kellogg Boulevard West
St. Paul, Minnesota 55102-1906

CLEAN WATER LAND & LEGACY AMENDMENT

This project was funded by the Arts and Cultural Heritage Fund of the Minnesota Clean Water, Land, and Legacy Amendment
as part of the Statewide Survey of Historical and Archaeological Sites

INVESTIGATING THE EARLIEST HUMAN OCCUPATION OF MINNESOTA: A MULTIDISCIPLINARY APPROACH TO MODELING LANDFORM SUITABILITY & SITE DISTRIBUTION PROBABILITY FOR THE STATE'S EARLY PALEOINDIAN RESOURCES

Austin A. Buhta, Jack L. Hofman,

Eric C. Grimm, Rolfe D. Mandel, and L. Adrien Hannus

With Contributions By

Susan C. Mulholland and Stephen L. Mulholland

L. Adrien Hannus (Co-Principal Investigator)

August 2011

Archeological Contract Series 248

Prepared by:
Archeology Laboratory
Augustana College
2032 South Grange Avenue
Sioux Falls, South Dakota 57105

Prepared for:
The Minnesota
Historical Society
345 Kellogg Boulevard West
St. Paul, Minnesota 55102-1906

CLEAN WATER LAND & LEGACY AMENDMENT

This project was funded by the Arts and Cultural Heritage Fund of the Minnesota Clean Water, Land, and Legacy Amendment as part of the Statewide Survey of Historical and Archaeological Sites

Cover Image (top to bottom): Pete Bostrom casts of Clovis projectile points from the Fenn cache (left and right), and Folsom projectile points from Blackwater Draw, New Mexico (left) and Barry County, Missouri (right)

ABSTRACT

This report presents the findings of an interdisciplinary pilot study intended to investigate early Paleoindian occupation and site distribution throughout Minnesota, with a particular focus on the southwestern part of the state. The collective application of archeological, geological, geomorphological, and paleoecological data is essential to developing a clearer picture of how the earliest cultural groups adapted to the dynamic climate and landscape that characterized the Pleistocene/Holocene transition in North America. Our understanding of early Paleoindian lifeways, the rapid evolution of late-Quaternary paleoecology, and geoarcheological research both in Minnesota, and in the surrounding Plains and Upper Midwest, are assessed. Information obtained from this assessment is collated and applied to the development of site locational probability models for early Paleoindian sites in the Southwest Riverine Archaeological Region; limited field testing of the models is also discussed. While the investigation did not identify the presence of intact, buried cultural deposits associated with early Paleoindian groups, it did confirm the presence of landforms capable of containing early Paleoindian sites, both surficially and possibly in buried contexts. New paleoecological data derived from a lakebed sediment core from Fish Lake near Windom are also presented. It is clear that both the Southwest Riverine Archaeological Region and surrounding areas of southwestern Minnesota would have offered a suitable environment and subsistence economy for even the earliest inhabitants of the region. The model is far from refined and requires additional testing in each of the nine Archaeological Regions before a meaningful appraisal of its significance is possible. While certain, finite changes based on intraregional landscape variation must be taken into account, many principles of these models should be serviceable in the future development of similar models for the state's other archaeological regions.

CONTENTS

CONTENTS (CONTINUED)

TABLES

HEADING **PAGE**

FIGURES

HEADING **PAGE**

FIGURES (CONTINUED)

HEADING **PAGE**

FIGURES (CONTINUED)

HEADING **PAGE**

FIGURES (CONTINUED)

HEADING **PAGE**

ACKNOWLEDGEMENTS

There are many to whom we are indebted for help in the completion of this work. Our most sincere gratitude is extended to Troy and Brad Ahrendt, Art and Woody Gnadt, Mark Emery, Dorothy and George Lass, Darlene Ruud, Arnold and Jesse Wenzel, and the staff at Blue Mounds State Park, who granted us permission to conduct survey and testing on their property at one of the worst possible times of year for such an exercise. Without their help, the field component of this project would not have been possible. For advice and assistance in directing us toward the numerous Paleoindian artifact assemblages existing in private collections throughout the state, we thank Kent Bakken, Jim Cummings, LeRoy Gonsior, Craig Johnson, Brian Korthas, Mike Michlovic, Sue and Steve Mulholland, and Dave Rambow. Special thanks are extended to Kent for providing a copy of his dissertation, to Jim for helping publicize the project, to Dave for covering our bases with respect to artifact collections in southwestern Minnesota, and to Sue and Steve for not only covering our bases with respect to artifact collections in the northern half of the state, but also for providing a summary of these collections as a contribution to this report. For sending us photographs of artifacts in his personal collection, we thank Tom Amble, and for sending us information on, and photographs from, the collection of the late Lloyd Dugstad, we thank Mike Bradley. For allowing us access to their personal artifact collections, we thank Gregg Nelson, Paula Nelson, Leota Silver, Molly Van Winkle, Harris Darling, Bruce Hess, and Arthur and Arlen Gnadt. Special thanks to Molly Van Winkle for actually bringing her collection to us for examination, and to Gregg for tipping us off about another promising collection from Rice County. For allowing us access to institutional collections, we thank the Staff at Myre-Big Island State Park in Albert Lea, Betty Mann at the Rock County Historical Society in Luverne, Larry Hutchings at the Carver County Historical Society in Waconia, and Ed Fleming at the Science Museum of Minnesota. Thanks to Curt Hudak and Ed Hajic for supplying information on past geomorphological studies of the Rock River valley and elsewhere in Minnesota, to Alan Knaeble, Minnesota Geological Survey and Charlie Trautwein, EROS, for assistance in researching the mysterious Rock County glacial lakebed, and to Joe Tiffany and Connie Arzigian for supplying various Paleoindian articles and answering random questions. We thank Beth Hobbs for providing in-state GIS data and for fielding questions about MN/Model. For help tracking down and/or providing out-of-state GIS data, we thank: John Broihahn and Sissel Schroeder (WI), Terri Bruce and Sheena Harms (SD), Brent Eberhard (OH), Steve Holen and Todd McMahon (CO), Damon Murdo (MT), Trish Nelson (NE), Chris Young (WY), Kerry Nichols (MO), and James Oliver and Nick Klobuchar (IL). For Minnesota files search help and the always cool-sounding *data dump*, we thank Tom Cinadr. Special thanks to Rich Berg for constantly helping us get the files we forgot to get the first time. Finally, we wish to acknowledge the efforts of Scott Anfinson, Pat Emerson, and Bruce Koenen, who, in addition to assisting us in most of the aforementioned manners, also administered the project, allowed us access to the collections at Ft. Snelling, provided site numbers, fielded stupid questions, and provided advice and support throughout. We sincerely appreciate your help. Thank you, one and all.

PROJECT OVERVIEW

Little is known about those who are the subject of this investigation – the earliest human inhabitants of Minnesota. When did they arrive and where did they choose to live? What were their subsistence strategies? Can evidence of these earliest groups be identified archeologically? Can trends or patterns of settlement distribution be discerned, and if so, can these trends be modeled? Is the archeological record even capable of affording us such answers? This pilot study attempts to address such topics, if only surficially, through a multidisciplinary collaboration that utilizes archeological, paleoecological, geological, and geomorphological data. It is first necessary to reassess our collective understanding of early Paleoindian lifeways, the dynamic environments that were inhabited, and where evidence of these cultural groups may have been preserved. The next objective is to use this information to formulate a site locational probability model for early Paleoindian resources. Finally, the model will be tested in the Southwest Riverine Archaeological Region.

Certainly this task involves a number of complex issues. Documentation of the presence of early Paleoindian people in Minnesota is based on a finite, albeit growing, number of technologically diagnostic artifacts that have been discovered in various areas throughout the state. Enough is known temporally/chronologically, in a general sense, to understand that these groups existed during a time of dynamic climatic evolution at the Pleistocene/Holocene transition. We also understand that the climate, landscape, and ecological communities of that period have no modern analog for comparison, and that much of the previous data obtained for the purpose of paleoclimatic reconstruction are flawed. Unfortunately, there is little else in the way of concrete evidence to rely upon. To date, nearly all of the data pertaining to early Paleoindians in Minnesota are based on avocational reports of isolated artifact finds in disturbed, surficial contexts. Those sites that have been professionally examined were found to lack integrity to such an extent that any further, meaningful evaluation was precluded. No buried, intact archeological sites of early Paleoindian age have yet been documented or dated in Minnesota. Consequently, nearly everything that archeologists profess to understand about the lifeways of early Paleoindians in Minnesota is surmised from: a) technological data obtained from perceived variations in the sequence and character of lithic tool manufacture – most notably that observed among projectile points; b) ethnographic accounts of modern hunter/gatherer groups and movement/migration patterns observed among prey animals; and c) radiocarbon dates and lithic toolsets associated with limited faunal assemblages from intact sites in other North American localities – the majority of which are hundreds or even thousands of miles away.

Despite these difficulties, there is also reason for tempered optimism. Increasing numbers of early Paleoindian-age bifaces are being identified throughout the state, and continuing efforts to more thoroughly document specimens from private collections are affording the archeological community an expanding dataset with which to compare and analyze future finds. Recent geoarcheological work conducted in the Central and High Plains (Mandel 2008) has demonstrated a marked patterning in the distribution of deeply buried, early Paleoindian-age landscapes in large-stream terrace fill, alluvial fans, and loess-mantled draws, suggesting that the perceived absence of early sites may have less to do with a limited human presence on the landscape than with our ability to discern their presence using traditional archeological field methods (e.g., shallow subsurface tests). Recent advances in the precision of radiocarbon date calibration (Reimer et al. 2009) have made it possible to more tightly refine the early Paleoindian chronology, and evidence obtained from lakebed cores in southwestern and southeastern Minnesota should provide a much clearer idea of the environmental conditions in these parts of the state throughout early Paleoindian times.

This study represents a preliminary effort in developing a regional statewide site locational probability model for early Paleoindian resources. While many issues remain to be addressed, it is hoped that this study serves as a stepping stone of sorts in facilitating future early Paleoindian research, both within Minnesota and elsewhere.

DESCRIPTION AND OBJECTIVES

On January 11, 2011, the Archeology Laboratory, Augustana College (ALAC), Sioux Falls, South Dakota, entered into a contract with the Minnesota Historical Society (MHS) to research and investigate the earliest human occupation of Minnesota. As detailed on page 2 of the project Request for Proposals (RFP), the objective of the investigation is "…to determine if fluted point-age sites or even pre-fluted sites can be found in Minnesota through a comprehensive analysis of environmental and archaeological records followed by intensive field survey…" (see Appendix A). Four primary tasks comprise the project:

1) Assess what is known about the early human occupation of Minnesota by reviewing site records and reports, examining institutional artifact collections, and interviewing local artifact collectors.
2) Develop a regional statewide model of early prehistoric site locations based on known locations in Minnesota, early prehistoric research in other states, and environmental reconstruction.
3) Conduct a limited field survey of one region that is already suggested to have high potential to contain early sites [the Southwest Riverine Region], utilizing methods that are efficient, safe, and cost effective.
4) Complete an analytical and descriptive report that summarizes the findings of the literature search, collections research, collector interviews, site locational model construction, fieldwork, and artifactual and geomorphological analysis.

These tasks, outlined by the MHS on page 3 of the RFP, served as the foundation for the research design that was ultimately constructed.

Research Design

The RFP states that the first task of the project is to assess what is known about the early human occupation of Minnesota through a review of site records, reports, and published literature, through an examination of both institutional and private collections of early Paleoindian artifacts, and through interviews with local artifact collectors. The desired outcome of an analysis of the results of the current study and other investigations is the recognition of potential trends or patterns in early Paleoindian site distribution both within and among the state's nine archaeological regions. Any perceived patterns would also be compared with trends observed among other early Paleoindian sites from the Plains, Upper Midwest, and Great Lakes areas.

Site records, reports, and institutional artifact collections were reviewed at the Minnesota Office of the State Archaeologist (OSA), Ft. Snelling History Center, the MHS State Historic Preservation Office (SHPO), and the Science Museum of Minnesota (SMM), St. Paul on January 24-28, 2011 by ALAC personnel L. Adrien Hannus and Austin A. Buhta. Artifact collections and archived records from the University of Minnesota, Twin Cities (U-of-M), MHS, and the Institute for Minnesota Archaeology (IMA), now curated at the OSA, were also consulted, as were resources available at ALAC and the Center for Western Studies (CWS), Augustana College, Sioux Falls, South Dakota.

Because of the scope of this project and the limited timeframe for completion, it was not possible to contact and visit all local, county and state museums and historical societies. Institutions of this nature that were consulted include: the Siouxland Heritage Museums, Sioux Falls, South Dakota; the Rock County Historical Society, Luverne, Minnesota; the Pipestone County Museum and Pipestone National Monument, Pipestone, Minnesota; Myre-Big Island State Park, Albert Lea, Minnesota (the Owen Johnson artifact collection); the Department of Anthropology, St. Cloud State University, St. Cloud, Minnesota; the Department of Anthropology, Minnesota State University, Moorhead, Minnesota; and the Minnesota Geological Survey (MNGS), U-of-M, St. Paul, Minnesota. Collections curated at Mille Lacs Kathio State Park, Onamia, Minnesota were previously examined and found to contain no early Paleoindian artifacts (James L. Cummings, Interpretive Naturalist, Mille Lacs Kathio State Park, personal communication 2011). Collections curated at the Lake of the Woods County Historical Society, Roseau, Minnesota; the Koochiching County Historical Society, International Falls, Minnesota; the Superior National Forest, the Duluth Archaeology Center (DAC), and the Department of Anthropology, University of Minnesota, Duluth (UMD), were examined by project contributors Susan C. and Stephen L. Mulholland.

A number of private artifact collections were also examined and limited interviews were conducted with the owners of these collections. Every effort was made to follow-up on viable leads; however, because of time and travel constraints, emphasis was directed towards collections with a known or likely provenience – at least to the county level. Information and leads obtained about collections that could not be examined during the course of the project were still included in the report in the hopes of facilitating future documentation (see Chapter 2).

The second task outlined in the RFP is the development of a regional statewide site locational probability model for early Paleoindian resources. The *regional* element to this model is based on Minnesota's nine existing SHPO archaeological regions (Table 1; Figure 1) as defined by Anfinson (1990, 2005:57; Anfinson and Peterson 1988). Segregation of the model into these predefined regions allows for a greater degree of ease in its future application. However, because many of the present political boundaries, such as state and county lines, neither constrained the movements of, nor defined the settlement patterns for, the area's earliest inhabitants, the model was developed via an interdisciplinary approach that focused on multiple factors, including late-Quaternary landscape evolution, paleo-climatic reconstruction, and known early Paleoindian-age archeological site distribution within Minnesota and from surrounding states.

Table 1. Archaeological Region Identification Key.

Southwest Riverine	**1**
Prairie Lake	**2**
Prairie Lake North	2N
Prairie Lake South	2S
Prairie Lake East	2E
Southeast Riverine	**3**
Southeast Riverine East	3E
Southeast Riverine West	3W
Central Lakes Deciduous	**4**
Central Lakes Deciduous South	4S
Central Lakes Deciduous East	4E
Central Lakes Deciduous West	4W
Central Lakes Coniferous	**5**
Central Lakes Coniferous North	5N
Central Lakes Coniferous South	5S
Central Lakes Coniferous East	5E
Central Lakes Coniferous Central	5C
Red River Valley	**6**
Red River Valley North	6N
Red River Valley South	6S
Northern Bog	**7**
Northern Bog East	7E
Northern Bog West	7W
Border Lakes	**8**
Lake Superior	**9**
Lake Superior North	9N
Lake Superior South	9S

Development of a single reliable site locational probability model that encompasses the whole of the early Paleoindian timeframe is likely not feasible due to both the substantial ecological transformations occurring during this time, and the varying ways in which different cultural groups adapted to these changes. Because of this, any *model* generated must actually consist of a suite of models divided into relevant cultural/temporal units. In addition, because the SHPO archaeological regions were intentionally delineated based on unique sets of environmental parameters, the site locational probability models generated as a result of this project should be developed along a similar vein. That is, each SHPO region should have its own suite of models because many of the factors involved in constructing the regions initially will also enter into the modeling equation. The models developed will need to address, at least minimally, the general geomorphological, paleoenvironmental, and known site distribution components of each SHPO Region (e.g., extent of glaciation, timing of ice retreat, natural and cultural filtering mechanisms, location of known sites). However, because these circumstances vary widely between (and oftentimes even within) particular regions and because time and budgetary constraints will only allow field testing in the Southwest Riverine Region, the development of a truly valuable model for the other eight regions was beyond the scope of the current investigation.

Instead, the efforts of this study concentrated on the development and testing of a model designed specifically for the Southwest Riverine Region (Figure 2). The Southwest Riverine Model is necessarily deductively-derived based on the paucity of good locational data associated with sites of early Paleoindian age in the region to date. A variety of variables were considered during model development; among these were: slope; elevation; aspect; freshwater proximity; viewshed; landform and landform sediment assemblages; lithic resource proximity; game trail proximity; and plant resource availability. These factors were then compared with existing data from early Paleoindian sites in Minnesota and beyond. Areas were selected for closer examination in Region 1 based on any perceived trends in the existing data. By testing the model through limited field investigations, it is possible to utilize the resultant data for further model refinement. Clearly, the more research that is conducted throughout the region and the more data that are obtained, the more refined the model will become. The overall framework of this model should be applicable to the development of models for the state's eight remaining regions; adjustments will simply need to be made based on the unique circumstances presented by each region as it is modeled.

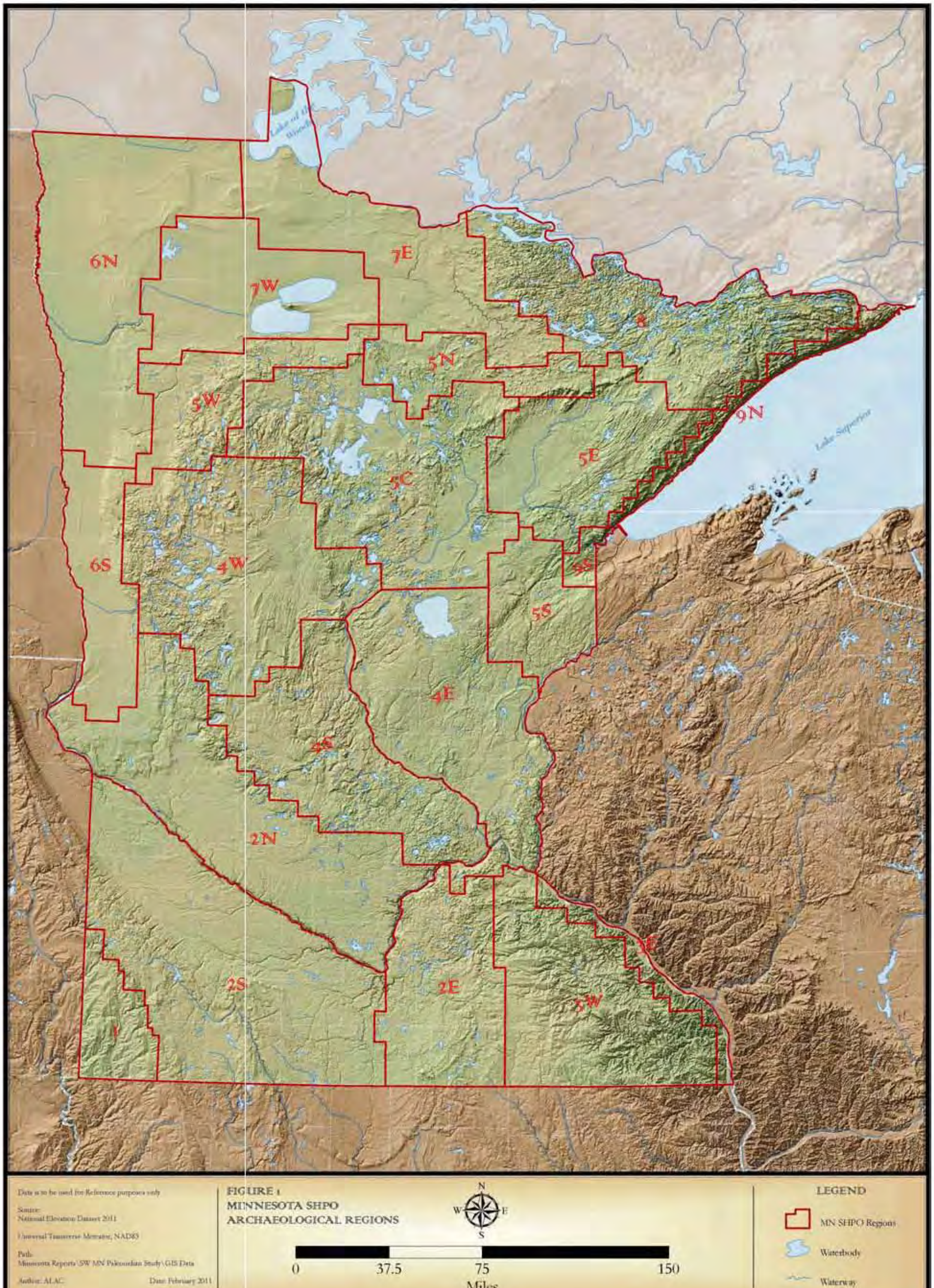


FIGURE 1
MINNESOTA SHPO
ARCHAEOLOGICAL REGIONS

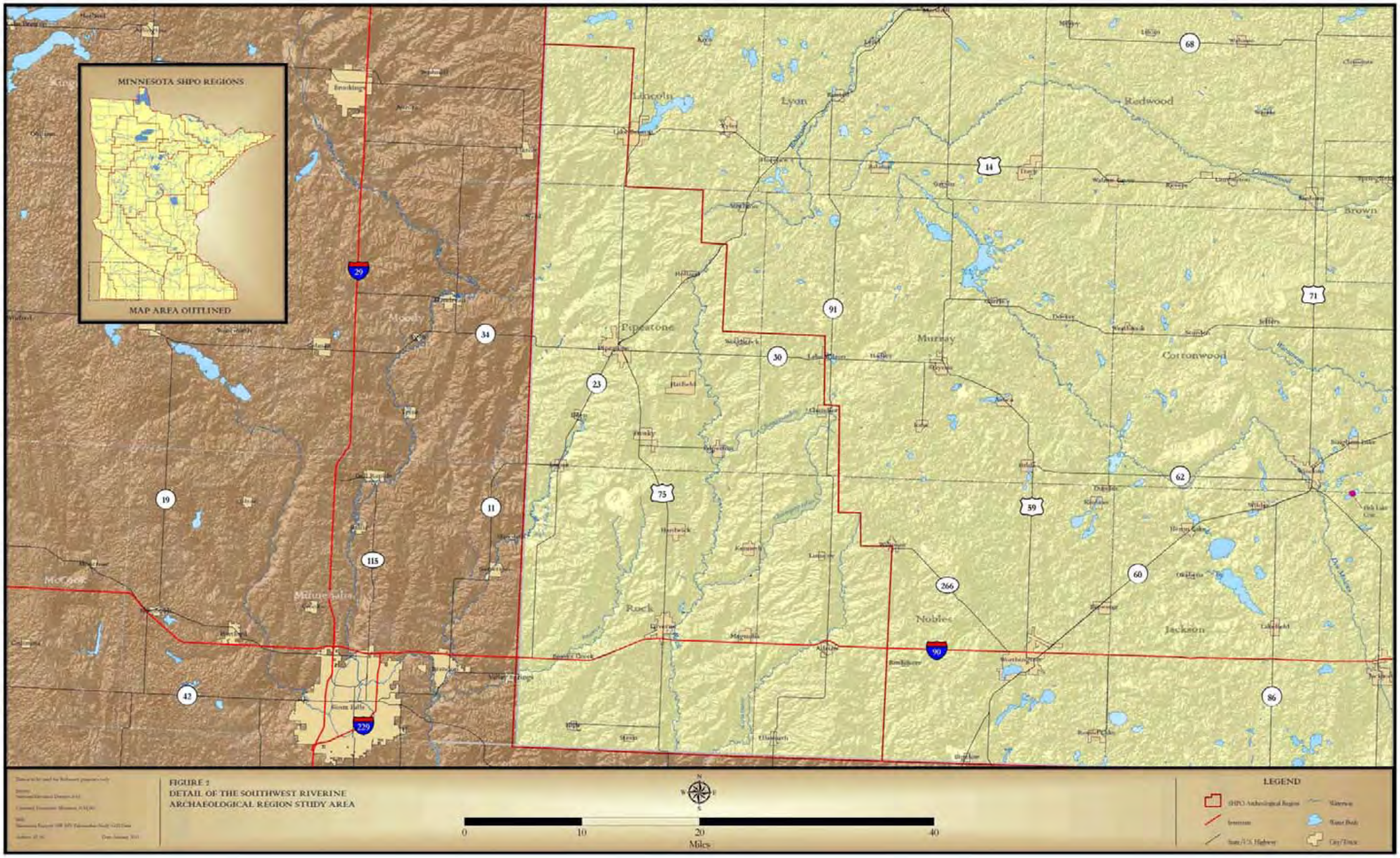


FIGURE 2
DETAIL OF THE SOUTHWEST RIVERINE
ARCHAEOLOGICAL REGION STUDY AREA

An additional component of the model development was the detailed analysis of a lakebed sediment core obtained during the 1990s from Fish Lake, near Windom, Minnesota. A basal date of 13,837-14,508 cal B.P. (2σ, IntCal09 calibration curve)[1] (Figure 3), well before the Clovis period, had already been obtained from this core. Only three pollen counts had previously been taken from this earliest zone, and the present study expanded this analysis. A more detailed analysis of macrobotanical remains was conducted for the more recent segments of the core that were concomitant with early Paleoindian occupation of southwestern Minnesota, and additional radiocarbon dates were acquired from these segments as well Analysis of this new data provided valuable insight into the paleoecological composition of the area, and this, in turn was utilized in the development of the probability model.

Fieldwork activities were conducted between March 21 and June 16, 2011, and were predicated largely upon available time, landowner permission, and weather conditions. Investigations consisted of complementary archeological and geomorphological components. The archeological component involved an examination of local artifact collections, both private and institutional, and a pedestrian surface survey conducted in conjunction with limited, shallow subsurface testing of various upland lake margin, stream divide, and river bluff landforms. The geomorphic component involved the mapping of surfaces and landforms and the describing and sampling of sections of alluvial fills in stream valley settings. An effort was made to locate natural exposures of late Pleistocene and early Holocene alluvium in stream banks; however, a lack of sufficiently deep exposures necessitated the use of a Giddings soil probe to augment this process.

Ultimately, the selection of survey/test areas was based on several factors, including previously documented early Paleoindian site location settings in both Minnesota and elsewhere, MN/Model Landscape Sediment Assemblages (LsSA's) data obtained from a previous geomorphological study of the Rock River valley, soil bore data obtained by the MNGS from the vicinity of a glacial lakebed in Rock County, review of soils and topographic maps, findings from previous geoarcheological research in other Minnesota, Great Plains, and Upper Midwest settings, landowner permission, and landform composition.

The final task outlined in the RFP is the compilation of a comprehensive investigation report detailing the findings of the study and recommendations for future research. The framework and components of this report are outlined below.

PERSONNEL AND ORIENTATION

As an interdisciplinary endeavor, this project included regional specialists in paleobotany, paleoecology, geology, geomorphology, statistics, geographic information systems (GIS), and archeology. The project was conducted under the overall supervision of L. Adrien Hannus, Jack L. Hofman, and Rolfe D. Mandel. Hannus and Hofman focused, primarily, on the archeological components of the project, including archival research and artifact collection examination, as well as model development and field investigations. Mandel focused on issues relating to the geology, soils, and geomorphology of the study area, as well as research on the history of geoarcheological studies in the Plains, Great Lakes, and Upper Midwest. Paleoecological project components, such as environmental and vegetational reconstruction and lake core pollen analyses, were overseen by Eric C. Grimm. One of the focal points of Grimm's study was the analysis of a lakebed sediment core from Fish Lake in southwestern Minnesota. GIS data management and map production were conducted by Austin A. Buhta. Buhta also assisted with archeological research, artifact collection documentation, model development, report writing, and field investigations. Also assisting in field investigations and collections documentation was Brendon P. Asher, University of Kansas, Lawrence. Susan C. and Stephen L. Mulholland, Duluth Archaeology Center, provided valuable information concerning early Paleoindian-age private artifact collections from northern and east-central Minnesota. Geomorphological background assistance was provided by Edwin R. Hajic. Lynette Rossum administered the project.

[1] Dates are herein reported in two manners: as uncalibrated radiocarbon (^{14}C) dates – labeled as *Radiocarbon Years Before Present*, or *RCYBP*; and as dates calibrated from CALIB 6.0 and the IntCal09 calibration curve (Reimer et al. 2009) – labeled as *Calibrated Years Before Present*, or *cal B.P.* For all purposes, the term *Present* denotes the calendar year A.D. 1950.

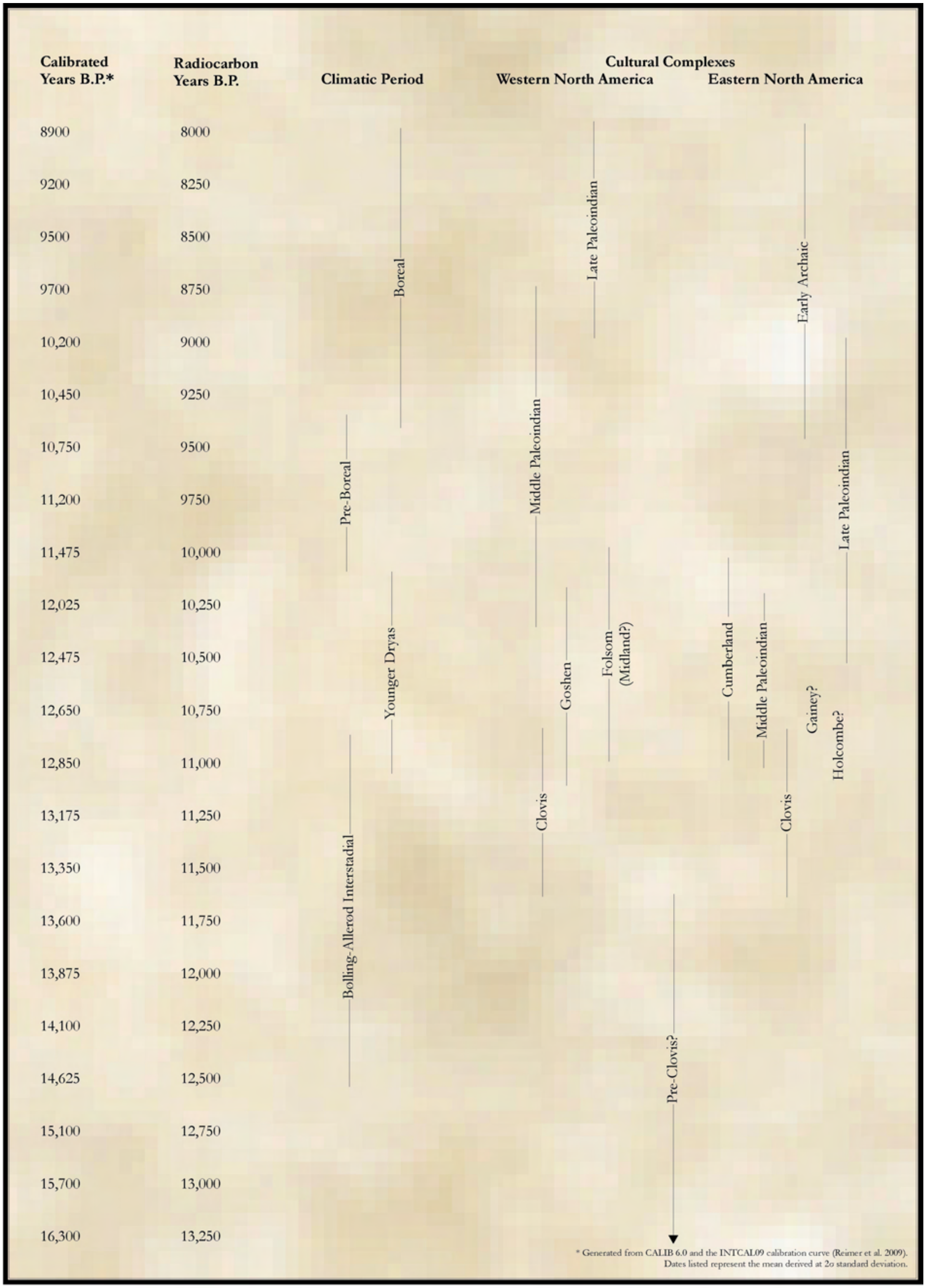


Figure 3. Radiocarbon calibration conversion chart detailing the Paleoindian period in North America.

REPORT FRAMEWORK AND ORGANIZATION

Seven chapters and the appended data comprise the report of this investigation. A brief synopsis of each chapter, followed by a list of appendices, is provided below.

Primary Chapters

1) **(Project Overview)** presents a general study overview, including the research objectives of the investigation, a description of the project area, project methodology and roles of personnel involved, and an outline of the framework and organization of the report (Austin A. Buhta).

2) **(Archeology & the Early Paleoindian Record)** details the extent of information concerning Paleoindian cultural groups both regionally, and within the more local Minnesota context. Though elements of later Paleoindian traditions are discussed, the focus is largely directed towards the earliest known Paleoindian groups, or for the purposes of this study, those defined on the basis of their hallmark projectile point fluting technology.[2] Perceived patterns and variations among these earliest groups, in terms of subsistence strategies, spatial and chronological distribution, and technological characteristics, are addressed. An assessment and overview of previous research conducted on early Paleoindian sites and collections from the state is also included (Austin A. Buhta and Jack L. Hofman).

3) **(Geomorphological Context)** provides an overview of the role of geomorphology in Paleoindian studies and demonstrates its significance in successful applications throughout the Plains and Midwest. Also presented are a geomorphological assessment of the Southwest Riverine Archaeological Region, an overview of previous geoarcheological work conducted there, and a preliminary inventory of landforms capable of housing intact deposits of early Paleoindian age (Rolfe D. Mandel).

4) **(Paleoenvironmental Context)** presents an overview of the regional and local paleoenvironmental parameters at the time that the earliest Paleoindian groups occupied the landscape. Topics include glacial geology, landform evolution, and climatological transition from pre-Clovis times onward and the resultant changes observed among the floral communities. Highlighted are the complications inherent in paleoenvironmental reconstruction. The results of a pollen analysis of a deep lakebed sediment core obtained from Fish Lake near Windom, and its implications on paleoenvironmental reconstruction at a more localized level are also presented (Eric C. Grimm).

5) **(Probability Modeling & Field Testing)** details the model development process, the methodological strategy implemented during the course of model testing in the Southwest Riverine Archaeological Region, and the results of this testing. A brief background on archeological probability modeling is provided and some of the more cogent theoretical issues are discussed in relation to the proposed early Paleoindian model. Details concerning the proposed model are presented together with an explanation of its utility and limitations, and results of model testing in four localities are highlighted (Austin A. Buhta and Jack L. Hofman).

6) **(Synthesis & Recommendations)** presents a discussion of the project research results and evaluates its merits and shortcomings. Data from the paleoenvironmental and geomorphological studies are here amalgamated and the state of Paleoindian archeology in Minnesota is reevaluated based on these findings. The accuracy and precision of the regional probability model is then explored and avenues for future research and model refinement are posited (Austin A. Buhta, Jack L. Hofman, Eric C. Grimm, and Rolfe D. Mandel).

7) **(References Cited)** provides a comprehensive list of sources cited in the report

[2] Recent evidence, however, indicates that even this definition presents difficulties (see Chapter 2 for further discussion)

Appendices

A) REQUEST FOR PROPOSAL: FINDING MINNESOTA'S EARLIEST ARCHAEOLOGICAL SITES

B) MINNESOTA EARLY PALEOINDIAN ARTIFACT COLLECTION DATA

C) ARCHEOLOGICAL SITE FORMS

D) FISH LAKE CORE MACROBOTANICAL DATA

E) RADIOCARBON DATA

ARCHEOLOGY & THE EARLY PALEOINDIAN RECORD: WHAT WE (THINK WE THOUGHT WE KNEW?) KNOW

CHARACTERISTICS, DISTRIBUTION, AND DIFFERENTIATION: EARLY PALEOINDIANS IN A BROADER CONTEXT

The area recognized today as Minnesota is situated in a strategic geographic position with regard to the activities, economies and dispersion of the earliest occupants of the New World. From the time of the last glacial maximum of the Wisconsin glacial period some 18,000-22,000 RCYBP until the close of the Pleistocene about 11,000 RCYBP, Minnesota was a region where part of the irregular southern margin of the Laurentide glacial ice sheet advanced and retreated. As the ice sheets retreated during the end of the Wisconsin, there were dynamic and dramatic changes in the environment and ecology of Minnesota. These changes would have presented key challenges and opportunities for the earliest human groups who inhabited the region.

Minnesota is also positioned between two distinct and important regions that have been the focus of considerable archeological research concerning New World Paleoindians: the Great Lakes region to the east (Storck 2004) and the northern Great Plains to the west (Kornfeld et al. 2010). Archeologists have identified different cultural and technological complexes for these regions during latest Pleistocene and early Holocene times, between roughly 12,000 and 9000 RCYBP (Figure 4). However, the potential relationships between these regions and technological complexes or archeological 'cultures' have not been well or fully explored. Information from the Minnesota Paleoindian record can contribute significantly to understanding these relationships and to addressing general concerns about Paleoindian adaptations in Peri-glacial tundra and early post-Pleistocene environments as well. The adaptations of early Paleoindian people in the region have been argued to represent specialized big game hunters focusing on species such as mammoth, mastodon, and caribou, or to reflect a generalized foraging economy with many diverse and smaller species playing important or critical roles in the adaptation. These models are not necessarily mutually exclusive as they could reflect different economic strategies that varied on a seasonal or situational basis; however, these adaptations do have significant implications for the formation of the archeological record and they were likely linked to the dynamic environmental circumstances that pervaded this period. The stability, geographic scale, and rate of change in tundra or tundra-like environments and adjacent northern boreal forest habitats would have imposed limits on the types of technologies, economies, and overall adaptations that would have been successful in the region. Groups would likely have used both kinds of environments depending upon access and mobility patterns. Contemporary groups may also have had distinctive economic orientations within the region. The Minnesota archeological record for Paleoindians should eventually contribute to addressing these and related issues.

Although Minnesota occupies a pivotal geographic position, Minnesota Paleoindian research has not played a central or substantive role in the investigation, discussion, or our understanding of the varied issues concerning the First Americans or Paleoindians. The early discovery and documentation of the Browns Valley burial and associated artifacts (Jenks 1937) has not been followed with substantive newer discoveries. The Browns Valley artifacts, however, may be indicative of the relatively poorly understood early archeological record in the Minnesota region. To date, there has not been another well documented or excavated occurrence of Browns Valley-type artifacts in the region, and the potential cultural-historical relationships between Browns Valley and other poorly understood types such as Frederick, Angostura, and Allen remain undetermined.

It is not unusual, however, for substantial gaps to occur between the time of first documentation of early archeological complexes and the subsequent discovery of significant intact additional finds. At the Hell Gap site in eastern Wyoming (where the Frederick type was defined), in the Rocky Mountain foothills at the edge of the Northern High Plains (Larson et al. 2009), the Goshen type was first recognized in the mid-1960s. Despite intensive regional research, it was not until two decades later that another intact archeological deposit yielded a second Goshen assemblage, this time at the Mill Iron site in southeastern Montana (Frison 1996). To the east in southwestern Ontario, the Crowfield complex was defined two decades ago based on a significant, albeit shallowly buried, artifact assemblage (Deller and Ellis 1984). At present, no further assemblages have been documented and the age of the complex remains uncertain. In Minnesota, the absence of additional Browns Valley assemblages likely reflects the limited archeological activity concerning the Paleoindian record in the region (but see Dobbs and Anfinson 1993; Harrison et al. 1995; Higginbottom 1996). The expectation that further related finds will occur is reflected in the archeological literature by continued reference to the Browns Valley "type" (e.g., Wormington 1957).

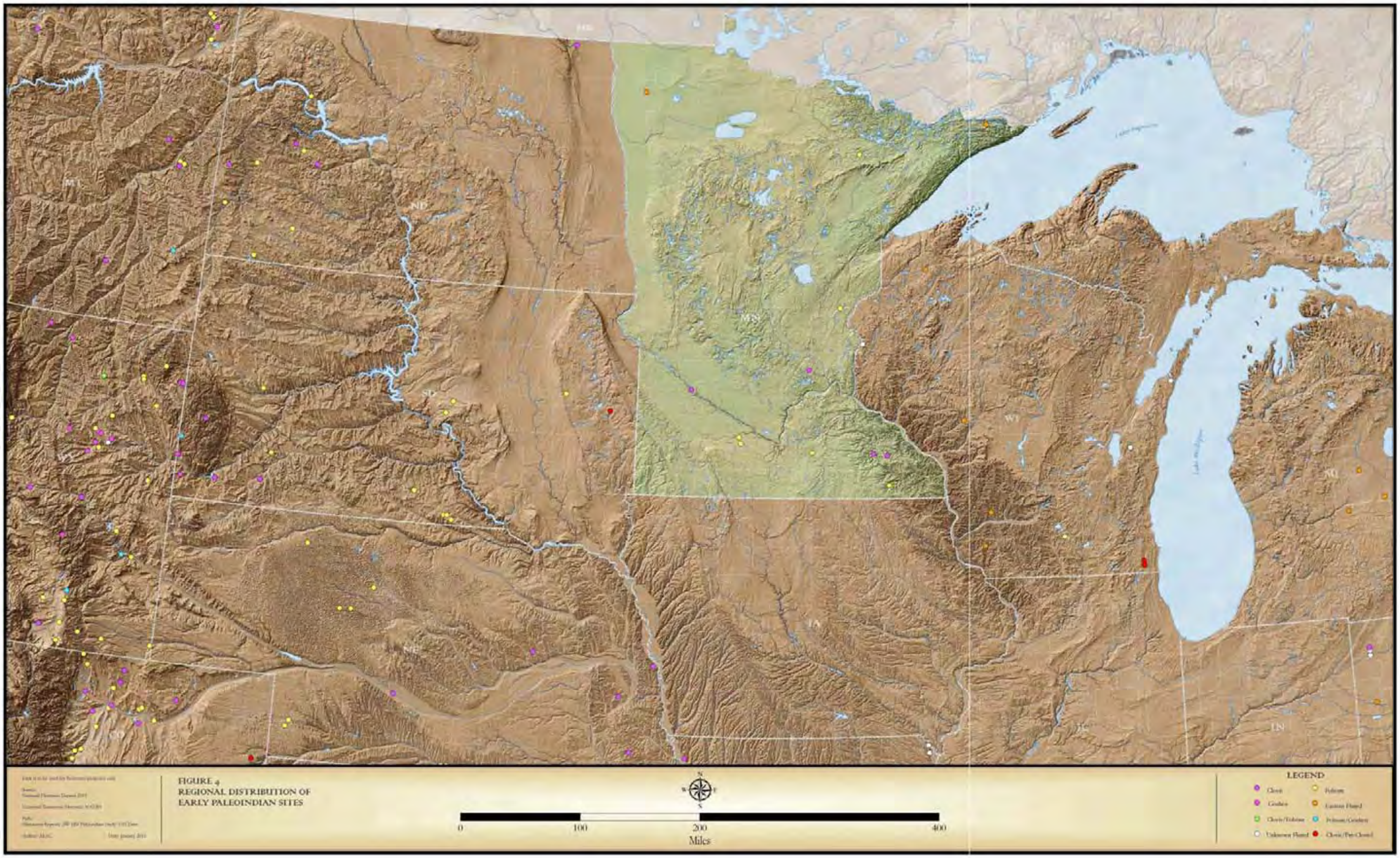


FIGURE 4
REGIONAL DISTRIBUTION OF EARLY PALEOINDIAN SITES

Some of the pieces in the Browns Valley type-site assemblage represent last stage preforms, or more likely, thin bifacial knives (Jenks 1937: Figure 2c, Plate 6c, Plate 7A). Chronology remains poorly defined for this type, but AMS dates on the associated skeleton indicate an age of 9049 and 8700 RCYBP (Owsley and Jantz 2005; Smith et al. 2005; Stafford et al. 1990; Steele and Powell 1994). The younger Pelican Rapids skull or "Minnesota Woman" is dated to 7900 RCYBP, but there are no associated artifacts. The available ages for the Browns Valley skeleton support the interpretation that Browns Valley represents an Early Holocene cultural group who occupied the western Minnesota area not long after the Wisconsin glacial ice had retreated northward into Canada. The Browns Valley dates indicate an age closely comparable to the Allen complex in the central and northern Plains region (Hofman 2010; Kornfeld et al. 2010; Pitblado 2003). The economic focus of Browns Valley people and the full range of their technological assemblages remain undocumented. This is generally true for all Paleoindian complexes in Minnesota and our best current evidence concerning economies and chronology is derived from both nearby and more distant regions.

The Case for Pre-Clovis

The first documented and unequivocally accepted sites associated with human groups in the Plains and Upper Midwest had been assigned to the Clovis complex. However, in light of recent evidence from a growing number of sites throughout the country, the notion of cultural groups that pre-date Clovis continues to gain acceptance within the archeological community (Bonnichsen et al. 2005; Holen 2008; Lepper and Bonnichsen 2004; Stanford 2008) (Figures 5 and 6). Some possible pre-Clovis sites in the central High Plains include La Sena in southwestern Nebraska (Holen and May 2002), Kanorado in northwestern Kansas (Mandel et al. 2005), and the Dutton and Selby sites in northeastern Colorado (Stanford and Graham 1985). Radiocarbon dates from these sites range from 13,000 to 18,000 RCYBP (ca. 13,176-19,664 cal B.P.), and the purported evidence for human association is based largely on fracture and disarticulation patterns of bone from mammoth and other extinct Pleistocene megafauna. On the Plains, stone implements and manufacturing debitage have not been clearly associated with pre-Clovis dated bone or sediment thus far. Holen and May (2002:35-36), however, point out that bone modification patterns at these sites *do* closely match those of well-documented Clovis assemblages from the High Plains.

Some of the more intriguing evidence obtained thus far, both in terms of age and geographic proximity, is from a series of mammoth sites in Kenosha County in southeastern Wisconsin (Overstreet 1998, 2004, 2005; Overstreet and Kolb 2003) and from a site along the Upper Big Sioux River in northern Brookings County, South Dakota (Fosha and Donohue 2005a, 2005b; Fosha et al. 2004; Fosha and Woodside 2003). Two of the Wisconsin sites, the Schaefer and Hebior sites, have been professionally excavated and radiocarbon dated, and include stone tool assemblages in association with mammoth remains. At the Schaefer site, radiocarbon dates obtained from spruce samples produced dates ranging from 12,220 ± 80 RCYBP to 12,790 ± 80 RCYBP. Bone collagen samples from the site produced radiocarbon dates of 12,310 ± 60 RCYBP, 12,320 ± 50 RCYBP, 12,390 ± 40 RCYBP, 12,290 ± 60 RCYBP, and 12,440 ± 40 RCYBP. Bone collagen samples from the mammoth at the nearby Hebior site yielded dates of 12,480 ± 60 RCYBP, 12,590 ± 50 RCYBP, and 12,520 ± 50 RCYBP (Overstreet 2004:43). The Chalk Rock mammoth site in Brookings County (39BK100), in the Inner Coteau des Prairies, contains three stratigraphic components from which radiocarbon dates have been obtained. The uppermost component produced a date of 9010 ± 40 RCYBP and the middle component produced dates of 10,880 ± 40 RCYBP and 10,910 ± 40 RCYBP. The lowest component contained mammoth remains possibly associated with a lithic flake and two potential features. AMS dates of 12,458 ± 50 RCYBP and 12,500 ± 50 RCYBP were obtained from charcoal samples within the two possible features, respectively (Fosha and Donohue 2005:3). Unfortunately, landowner constraints have precluded any further investigation of this site (Michael Fosha, personal communication 2011).

Only as recently as 2004, with the discovery of the Walker Hill site (21CA668) in Cass County (Olmanson and Wells 2005, 2006), has Minnesota become immersed in the pre-Clovis debate. Identified on the southeastern edge of the town of Walker near Leech Lake, the Walker Hill site (21CA668) was originally identified by the presence of a pit feature believed to be associated with early Euroamerican presence in the area (Olmanson and Wells 2005). Additional testing of the feature was conducted the following year (Olmanson and Wells 2006), during which time a

The Figure 4 site distribution map on the previous page was generated with the use of multiple GIS datasets supplied by SHPO offices and State Historical Societies from eight different states in the region, as well as from locational information in the Paleoindian Database of the Americas (PIDBA) (Anderson et al. 2005) and the literature. Unfortunately, it is *not* comprehensive. For instance, GIS data was not available for sites in Illinois, Montana, or Wisconsin, and was not provided for the states of Indiana, Iowa, or Michigan. All sites depicted in these areas were identified solely from the literature.

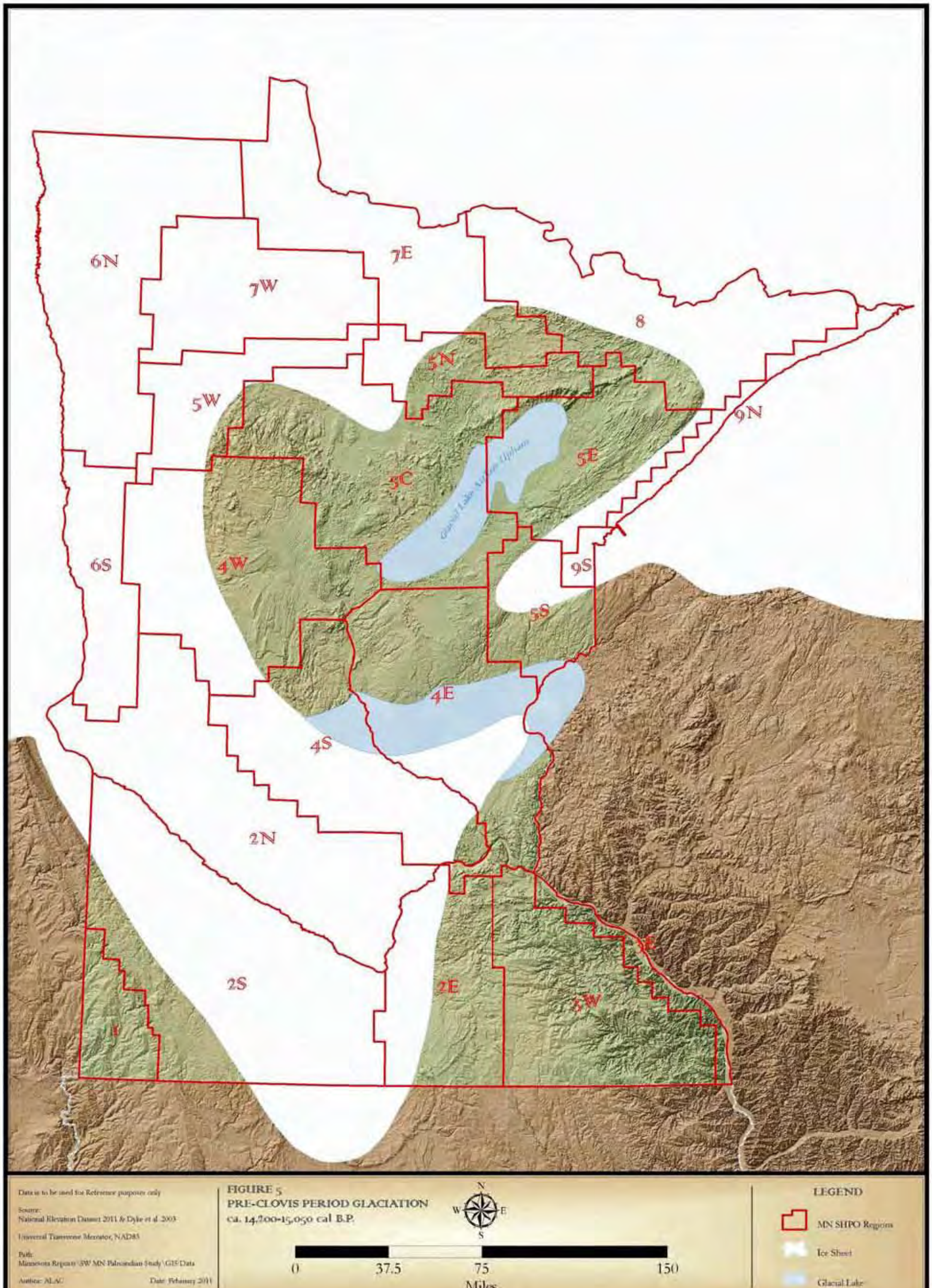


FIGURE 5
PRE-CLOVIS PERIOD GLACIATION
ca. 14,700-15,050 cal B.P.

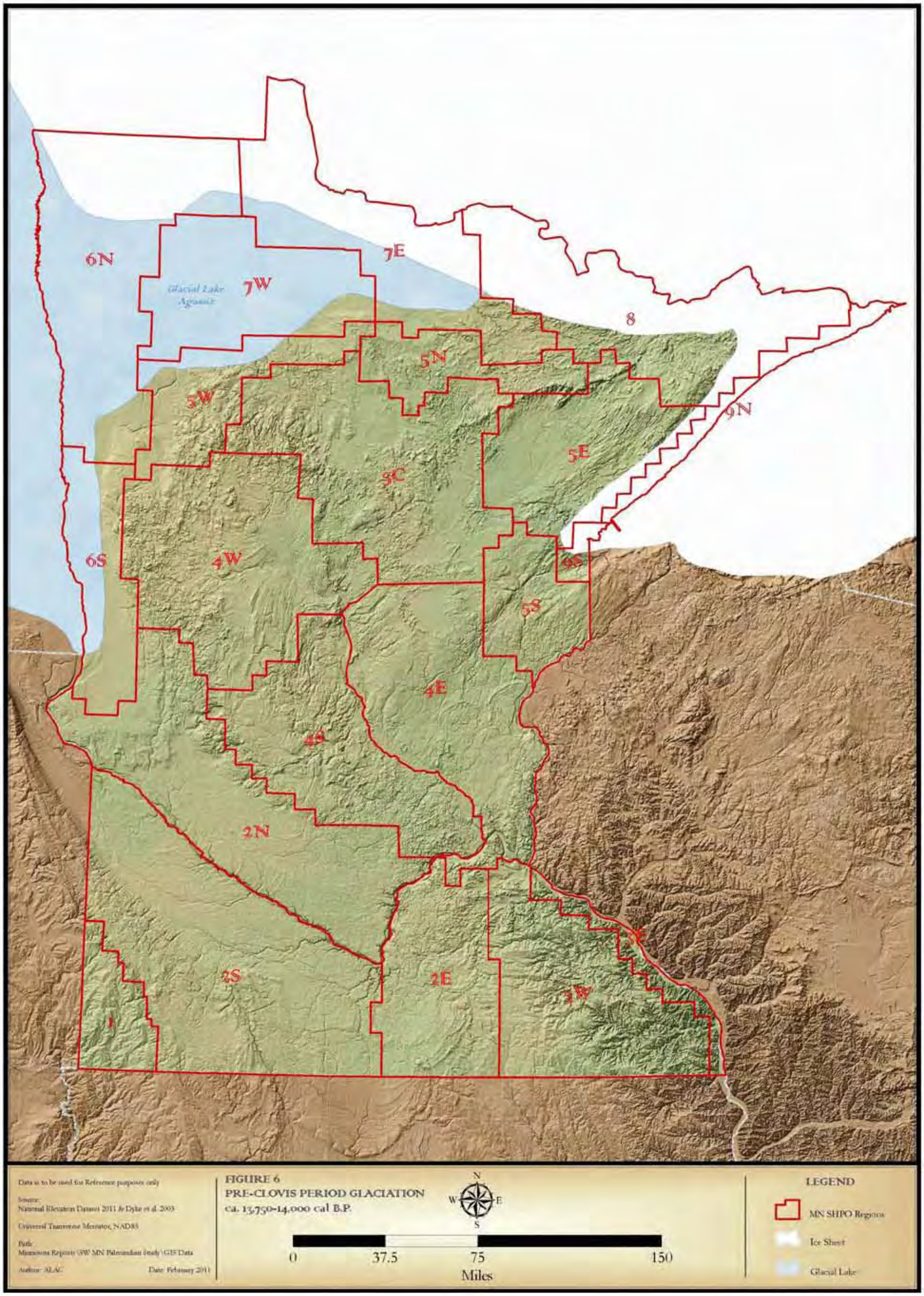


FIGURE 6
PRE-CLOVIS PERIOD GLACIATION
ca. 13,750-14,000 cal B.P.

small number of lithic *artifacts* were reportedly discovered from an intact buried deposit believed to be of late glacial age (Anfinson 2007). Phase III excavations were conducted at the site in 2006 and initial findings were presented in February of 2007 at the Council for Minnesota Archaeology symposium in Mankato, Minnesota (Anfinson 2007). The general consensus among the local archeological community was, however, one of skepticism, and at the time, the only evidence produced from the excavations of what appeared to be a legitimate lithic flake was derived from a context that also included artifact material dating to the mid-twentieth century (Anfinson 2007:4). A final report detailing the Phase III excavations remains to be submitted; however, interim reports were provided for the work conducted through the 2007 field season at the site (Olmanson 2007, 2008). Field investigations during the 2007 season culminated in the discovery of two small hearth-like features and two small lithic tools at a depth of between 30 and 60 cmbs (Olmanson 2008:16-17). Soil samples were collected from each stratigraphic level excavated (Olmanson 2008:16); however, no absolute dates were reported. The validity of the Walker Hill site continues to be debated; however, it is noteworthy that the area around Leech Lake *was* ice free as early as ca. 15,000 cal B.P., and the ice sheets had retreated from all but the northernmost areas of the state by ca. 13,750 cal B.P. (Dyke et al. 2003; Figures 5 and 6). Thus, it remains wholly plausible that archeological sites of late glacial-age are present within the state.

Typology and Classification

Issues of artifact typology and assemblage definition remain key problems in Minnesota area Paleoindian research. These problems are exacerbated by the nature of current evidence, which is composed, primarily, of surface occurrences of diagnostic artifacts. Typological assessments are more problematic when dealing with isolated or unassociated artifacts as opposed to assemblages (Bamforth 2009). Nevertheless, typology of projectile points from surface contexts provides most of the current evidence regarding the presence, activities, and patterns of land use for Minnesota's Paleoindian peoples. This is true for many regions and such evidence must be utilized to its fullest potential. This often requires that we expand the scale of investigations to include not only sites, but regions as well. Thus, we may expect to see patterning in the archeological record of Paleoindian evidence at multiple levels.

Paleoindian projectile point types documented in Minnesota include Clovis (Figure 7), Eastern Clovis or Gainey/Clovis, Gainey, Folsom (Figure 8), Agate Basin, Browns Valley, Holcombe, Cody (Scottsbluff and associated types), and a variety of other unfluted lanceolate types probably representing a number of distinctive technologies (Anfinson n.d.; Dobbs and Anfinson 1993; Florin 1996; Harrison et al. 1995; Higginbottom 1996; Magner 1994; Mulholland et al. 1997, 2008; Shane n.d., 1989). Arguments for specific types that are not well documented or common in the region are generally problematic due to the dual issues of lack of assemblage control for surface finds and the substantial variability that occurs within specific types when samples are found in controlled context (e.g., Frison 1974, 1996; Frison and Stanford 1982; Lopinot and Ray 2010; Wilmsen and Roberts 1978). Several types are of particular note in this regard for the Minnesota region. Surface finds of projectile points that share morphological similarity or technological attributes with types identified as Holcombe, Chesrow, Hi-Lo, Midland, and other unfluted lanceolates, may collectively reflect very early prehistoric activity in the region even though specific typological (or chronological) assignments of these are often neither realistic nor feasible.

Figure 7. Clovis projectile points demonstrating the range in variation within the complex (ALAC comparative collection).

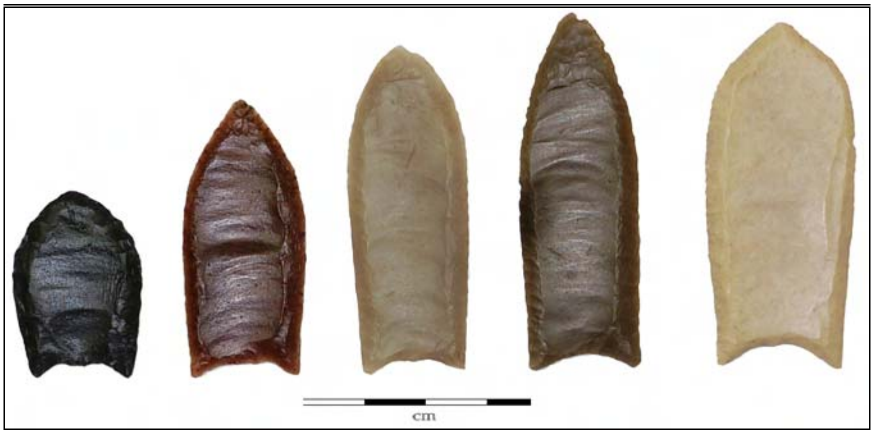


Figure 8. Folsom projectile points demonstrating the range in variation present within the complex (ALAC comparative collection).

Lepper (1999: Figure 7) illustrates three Paleoindian points from Minnesota in his review of early Paleoindian evidence in the midcontinent of North America. These specimens provide a starting point for discussing problems in the area's Paleo-indian record with specific reference to point typology. First, a more general issue concerns Clovis typology for the Great Lakes and northeastern portion of North America. The terms Eastern Clovis, Gainey, and Gainey/Clovis are used by Lepper and others to refer to the variety of presumably early fluted points found in the northeast and Great Lakes region. Stanford et al. (2005) classify all of these types as variants of Clovis. The Gainey type, defined based on specimens from the Gainey site in Michigan as reported by Simmons et al. (1984), is similar to Clovis and is therefore believed to represent the earliest of a series of fluted point types from the Great Lakes region (Deller and Ellis 1988). Gainey point characteristics, which are argued to distinguish the type from Clovis, include its usually thinner size, deeper basal concavity and distinctive fluting process (Morrow 1996; Morrow and Koldehoff 2005; Sandstrom and Ray 2004:36-37). This complex remains relatively poorly dated but is repeatedly argued to represent the early portion of the fluted point record for the Great Lakes and upper midcontinent regions. It may overlap with or follow Clovis in time. Gainey points are documented from sites in Illinois, Iowa, and Missouri (e.g., Morrow 1996; Morrow and Koldehoff 2005; Lopinot et al. 2000). In the current study, we have not attempted to distinguish Gainey points from Clovis. Such an effort may be beneficial in the future and should enable comparisons between lithic material type utilization and overall distribution of these closely related types. The small narrow specimen illustrated by Lepper (1999: Figure 7-2) was considered by Shane to represent a Clovis point. This small artifact is asymmetrical in form, has a broken tip, and is made on a flake blank. "Face a" exhibits a remnant area of the flake blank surface and has slight basal thinning. "Face b" has a more pronounced flute or thinning flake and exhibits oblique flaking. The lower blade edges are ground, and the remaining portion of the blade is asymmetrical with irregular edges. The specimen may represent a small hafted knife of Paleoindian or later age. The diminutive size of this artifact falls outside the common range for Clovis points and the flake blank remnant is not a common feature on finished Clovis points. The artifact does fall within the range of small Folsom and Barnes points, which are more commonly made on flake blanks. The problem in classification of this artifact as to a specific established type is typical of the problems encountered when studying isolated or unassociated surface finds.

The fluted points illustrated by Lepper (1999: Figure 7-1) include a large specimen which was reportedly collected in the Rock or Pipestone County areas of southwestern Minnesota in the early twentieth century and donated to A. E. Jenks (Higginbottom 1996). The lithic material identification suggests that this specimen is made of regionally local material, Grand Meadow chert. The source area for this chert is in Mower County, southeastern Minnesota. This is a large, nearly complete point with prominent outward flaring ears or basal corners that give the point a constricted or "waisted" appearance near the base. The morphology and technological attributes are distinct from both Folsom and Clovis, but the point's attributes conform to the southeastern Cumberland type, or Barnes as they are recognized in the Great Lakes region (Justice 1995:25). The size of this point is within the documented variation for Barnes and many specimens from the Parkhill site in southern Ontario exhibit similar outward flaring basal ears (Ellis and Deller 2000: Figures 5.1, 5.2, 5.3).

If Barnes represents a technological complex used by caribou hunters, as has been repeatedly argued, it should not be surprising to find such evidence in Minnesota during the late Pleistocene. The presence of Barnes points could also simply indicate interactions between Barnes people and contemporary groups such as Folsom (which are technologically very similar and presumably contemporary). The probable local material identification for the large Barnes point from southwestern Minnesota suggests that it was not simply an exotic specimen traded into the area from further east. Assuming that the Grand Meadow chert identification for this point is correct, the specimen could reflect movement of a Barnes group from southeastern to southwestern Minnesota. It is likely that additional examples of Barnes points will be documented in Minnesota as Paleoindian research in the area continues. A specimen reported by Landon and Flaskerd (1945b; see Higginbottom 1996: Figure 21) may also represent a Barnes point.

One problem is that examples of Barnes and Folsom points commonly share identical attributes, and isolated artifacts may often be difficult to distinguish. This is especially true for preforms, and heavily reworked and fragmentary pieces. The potential occurrence of Holcombe points in Minnesota (Mulholland and Mulholland 2008) might also correspond to caribou hunting in Minnesota, as this type is believed to be associated with caribou at the Holcombe Beach site in Michigan (Cleland 1965; Fitting et al. 1966). Unfortunately, the identification of individual unfluted lanceolate points to specific types can be very problematic due in part to stage of production or reworking, and situational variation due to knapper ability and lithic material types. This problem seems especially troublesome regarding Holcombe and Chesrow points.

Folsom points, as illustrated by Lepper (1999: Figure 7-3), are relatively common in Minnesota. The specimen shown by Lepper is one of two Folsom points from Cottonwood County in southwestern Minnesota which were donated to A. E. Jenks early in the twentieth century. Folsom points and preforms are the most common single type of fluted point known in Minnesota (Higginbottom 1996), and occur in several counties in the southern half of the state. Higginbottom (1996: Figures 30 and 41) describes and illustrates a fluted point preform from St. Louis County in northeastern Minnesota and a complete point from adjacent Itasca County, which appear to represent Folsom artifacts from northern Minnesota. The common occurrence of Folsom points relative to other fluted point types in Minnesota is also true for nearby regions to the west. Folsom points are significantly more common in North and South Dakota, Wyoming, and Nebraska than are Clovis points (e.g., Hofman et al. 1999; Holen 2003; Williams and Hofman 2010). One contributing factor may be the highly distinctive character of fluted Folsom points which makes them easy to recognize. Distinguishing between Folsom and the closely related Barnes type in Minnesota collections will be an important but challenging problem given the many shared attributes of these types.

The strong association between Folsom technology and bison hunting throughout the Plains suggests that Folsom artifact distribution in Minnesota may correspond to early bison hunting in the region (cf. Munson 1990). Folsom people did not live only on bison (e.g., Davis et al. 1987), but this technology is associated with bison hunting and processing from Texas and New Mexico to Montana (Hofman and Graham 1998). Folsom artifacts in Minnesota may correspond to the initial expansion of bison populations into the area during the close of the Pleistocene and earliest Holocene. This possibility, as well as the case for the possible correspondence between the Barnes technology and caribou hunting, should be considered hypotheses worthy of further evaluation rather than foregone conclusions.

EARLY PALEOINDIANS IN MINNESOTA: A REGIONAL PERSPECTIVE

Of paramount significance to the inception of this project was the noted paucity of early Paleoindian research and site data from throughout the state. Minnesota SHPO files contain only 11 records of sites specifically designated as early Paleoindian in cultural affiliation. Three of these sites appear in the records as Clovis (Cl) (Figures 9 and 10), six appear as Folsom (Fo) (Figures 11-14), and one appears as an Eastern Fluted variety (EF) (Figures 15-18). Three of the six Folsom sites are described as being of *suspected* Folsom affiliation rather than confirmed, as is one of the three Clovis sites. Furthermore, one of the sites identified as *Folsom*, 21YM104, has since been reclassified as *Clovis* following a reexamination of the artifact (Higginbottom 1996). These records, of course, are not the only evidence of early Paleoindians that has been discovered in Minnesota, and numerous additional finds have been reported and documented in various collections throughout the state (Figure 19). The records are, however, illustrative of one of the problems involved in identifying and researching sites of early Paleoindian age: individual archeologists may classify cultural complexes differently, which, in turn, affects the way in which they are entered into the records database. For example, a fluted projectile point fragment recovered from the Bearskin Point site (21CK18), attributed to an Eastern Fluted complex (Mulholland et al. 2007; Okstad et al. 2000; Peters 1990), is designated in the SHPO database as simply *Paleoindian* (PI). Other sites reported to have contained early Paleoindian materials, such as the Long Lake site (21HE100) (Flaskerd 1945; Landon and Flaskerd 1945a), have not been assigned a PI designation in the database. In addition, many reports of early Paleoindian artifacts by the avocational community or collectors have no precise site locational data. Even those specimens reported to have good/reliable provenience, unless confirmed through artifact examination and field-checking of the find spots, many times go unlisted in the database. With these issues in mind, the following regional synopses of early Paleoindian archeology are presented. Attempts were made to highlight documented sites and reported finds from as comprehensive and current a range of sources as possible, though undoubtedly, some omissions exist. A more detailed overview of the nine archaeological regions, beyond the scope of early Paleoindian resources, is available in Anfinson (1990, 1997) and Anfinson and Peterson (1988).

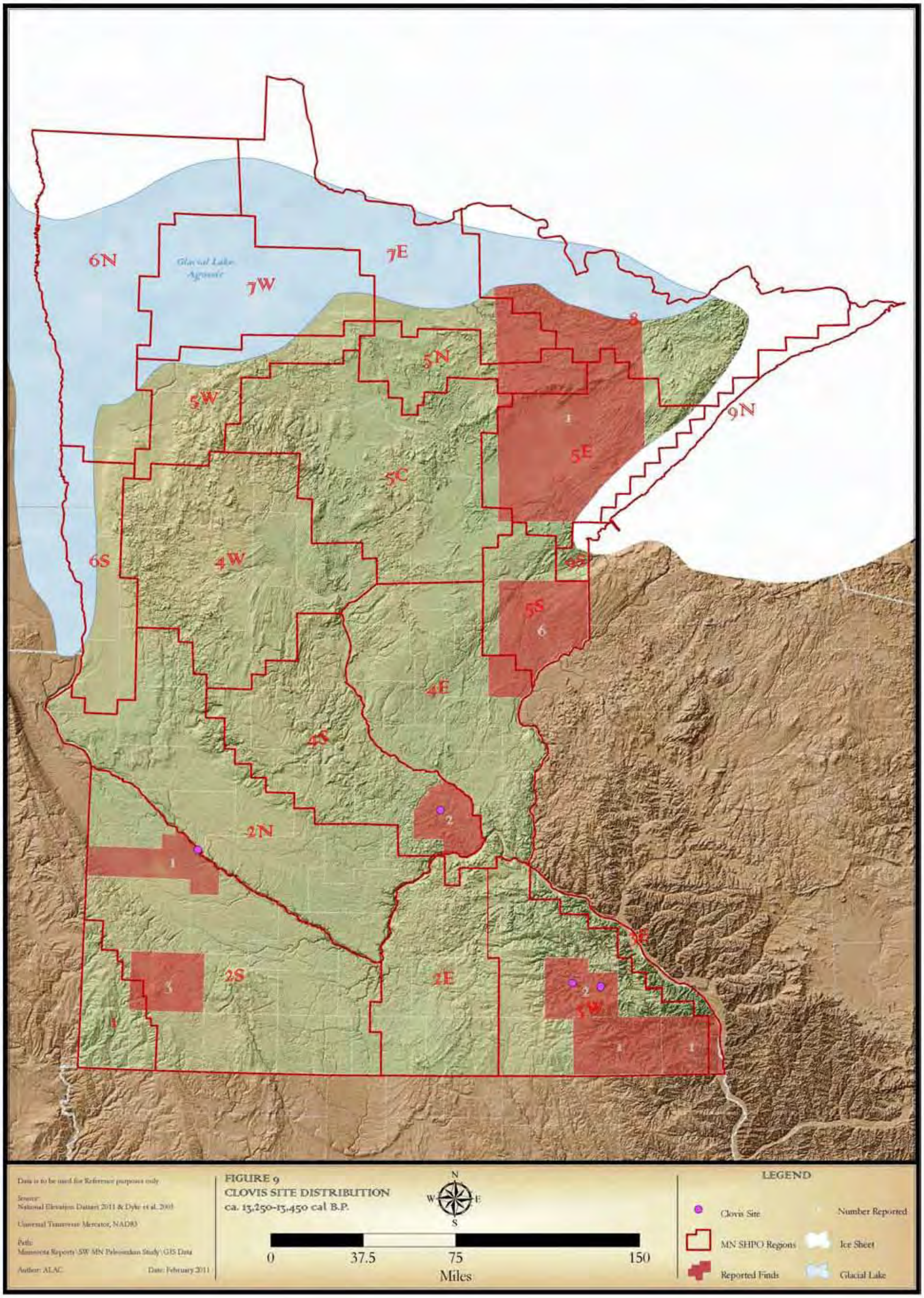


FIGURE 9
CLOVIS SITE DISTRIBUTION
ca. 13,250-13,450 cal B.P.

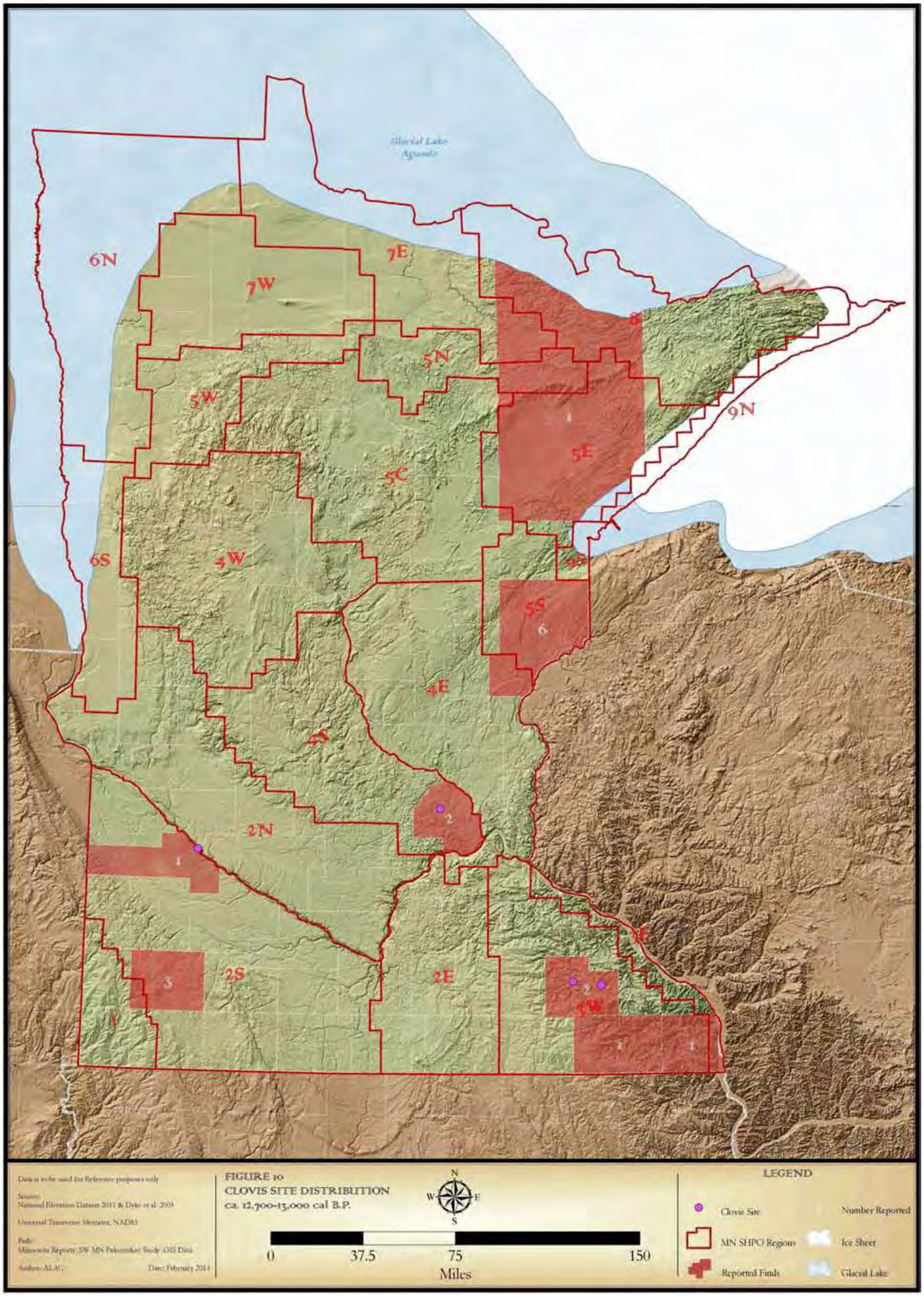


FIGURE 10
CLOVIS SITE DISTRIBUTION
ca. 12,700-13,000 cal B.P.

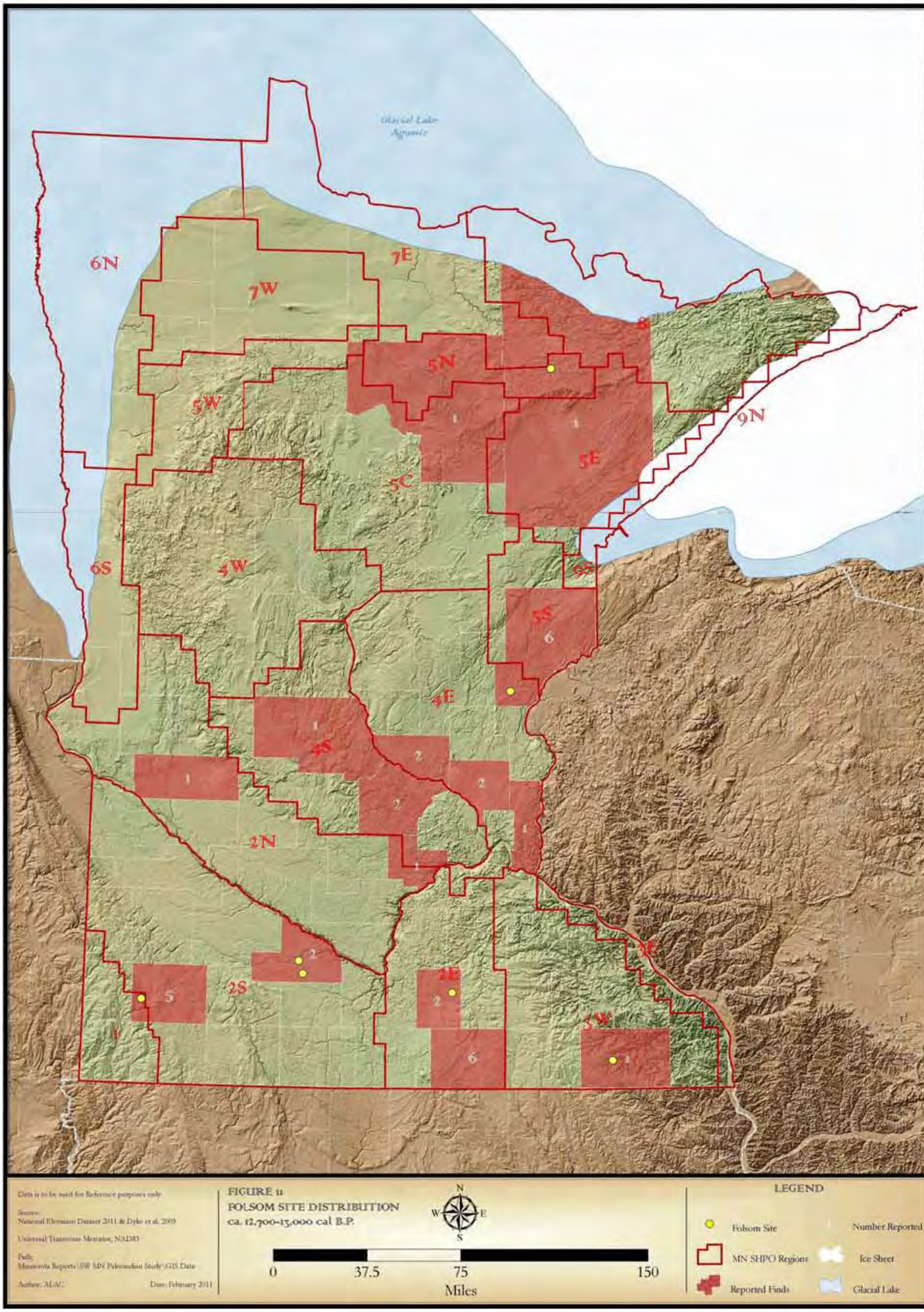


FIGURE 11
FOLSOM SITE DISTRIBUTION
ca. 12,700-13,000 cal B.P.

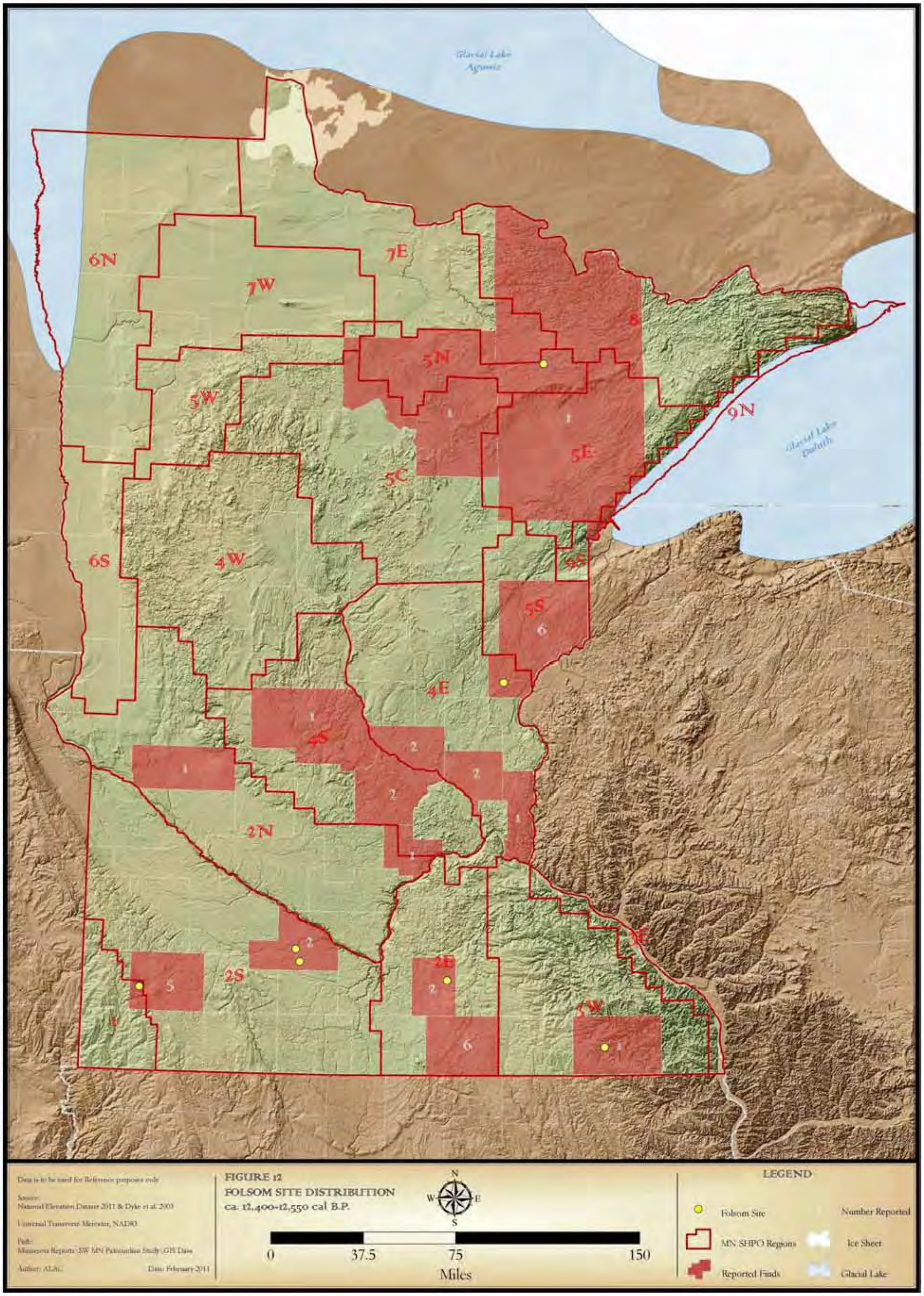


FIGURE 12
FOLSOM SITE DISTRIBUTION
ca. 12,400-12,550 cal B.P.

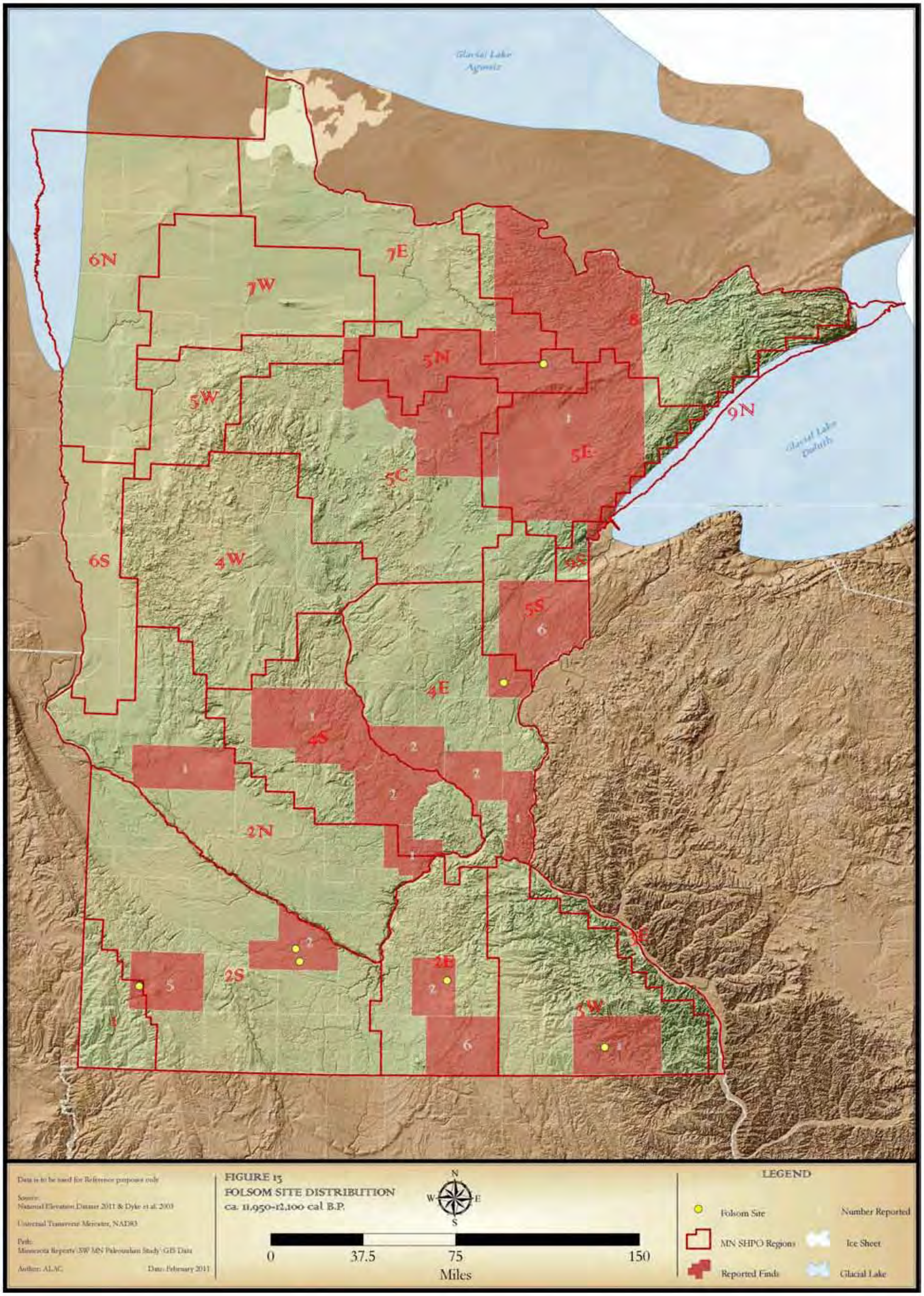


FIGURE 13
FOLSOM SITE DISTRIBUTION
ca. 11,950-12,100 cal B.P.

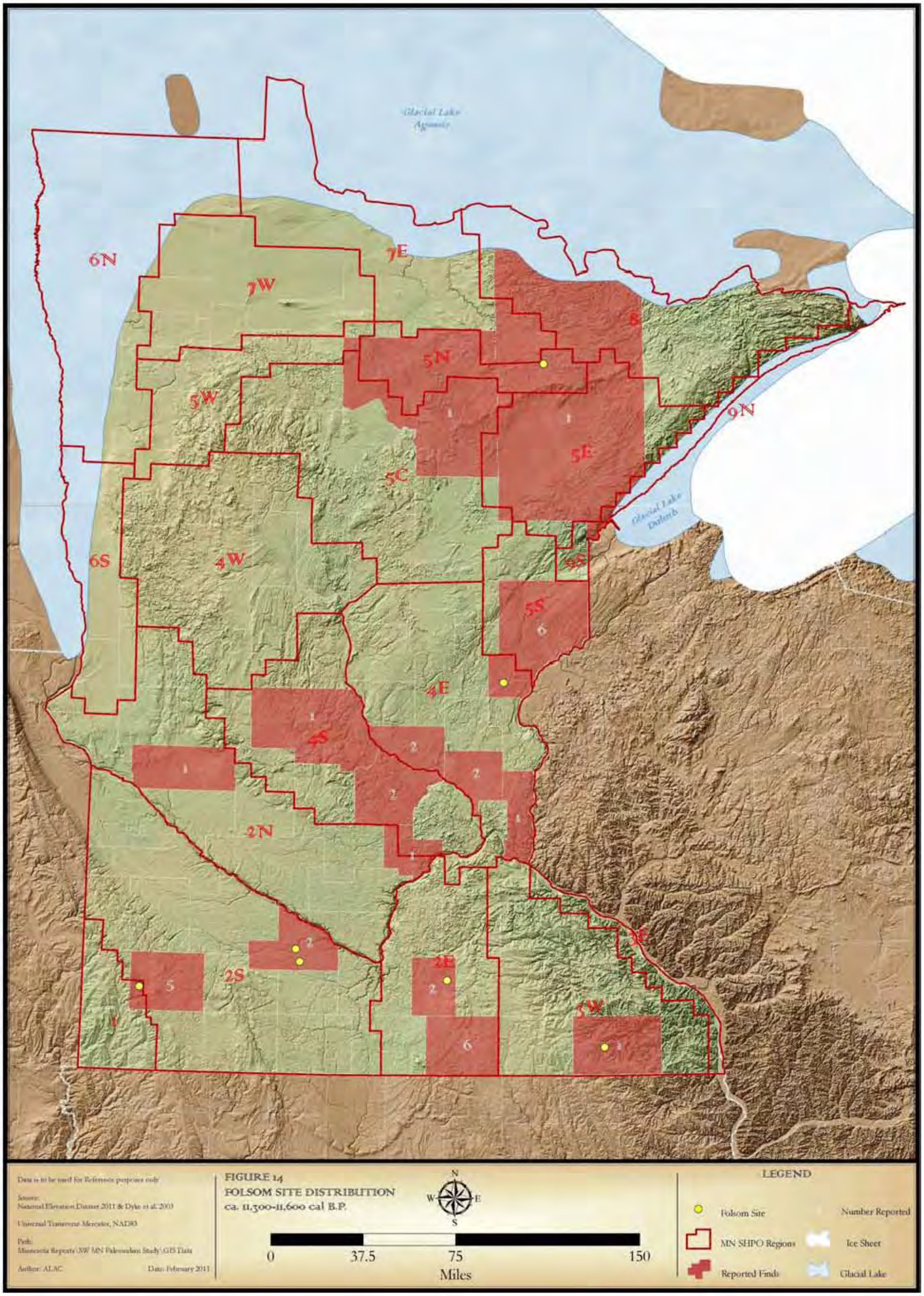


FIGURE 14
FOLSOM SITE DISTRIBUTION
ca. 11,300-11,600 cal B.P.

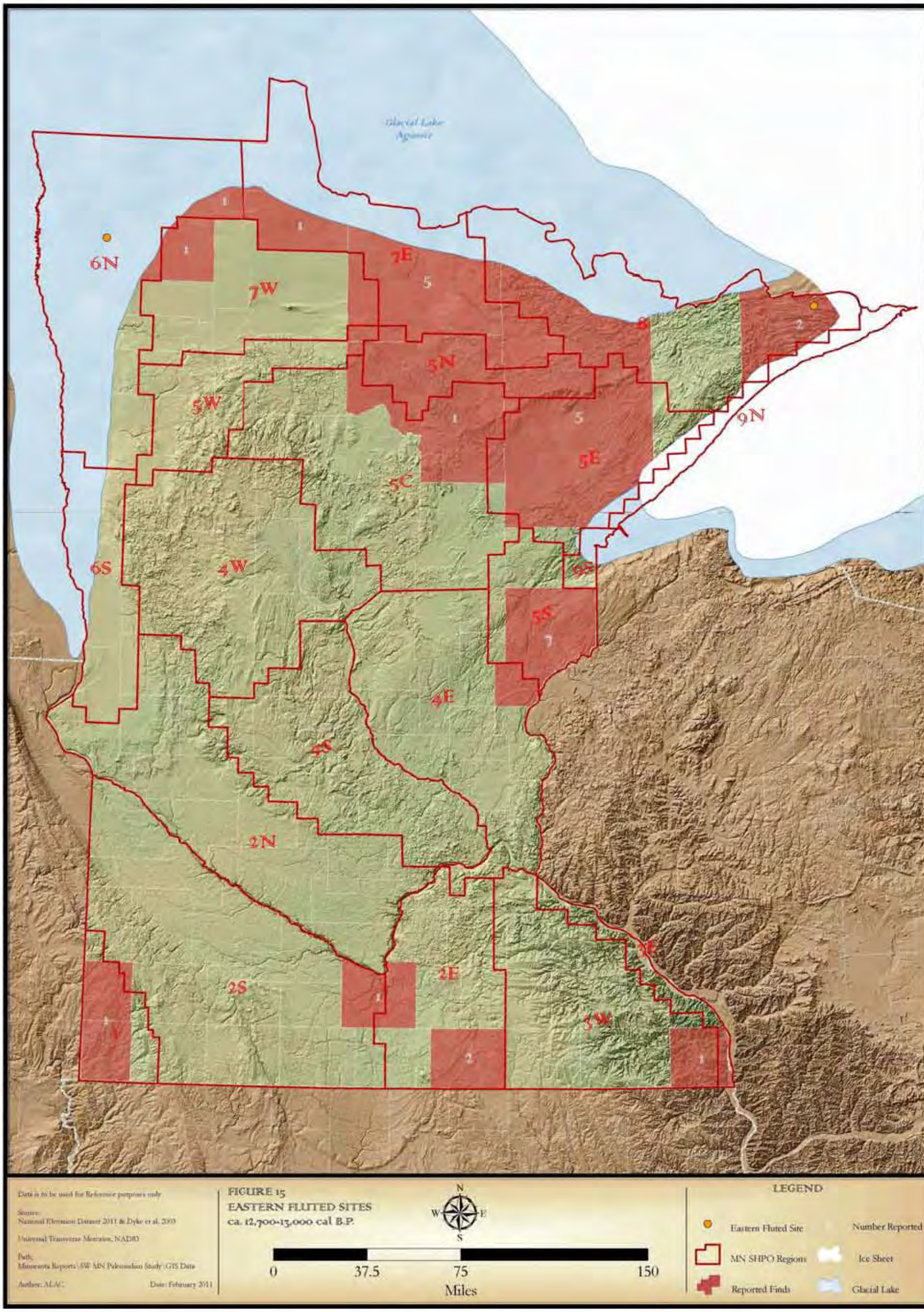


FIGURE 15
EASTERN FLUTED SITES
ca. 12,700-13,000 cal B.P.

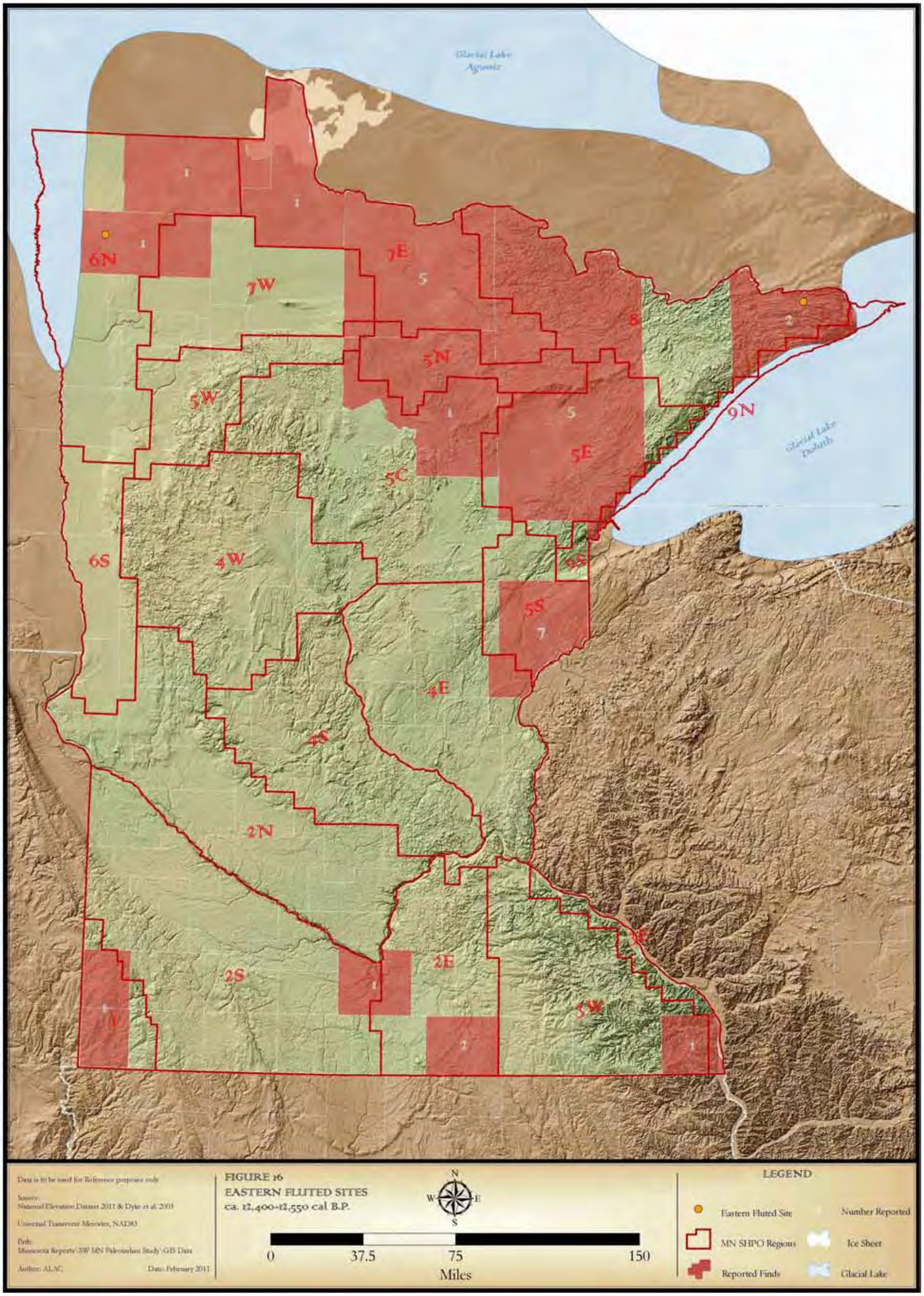
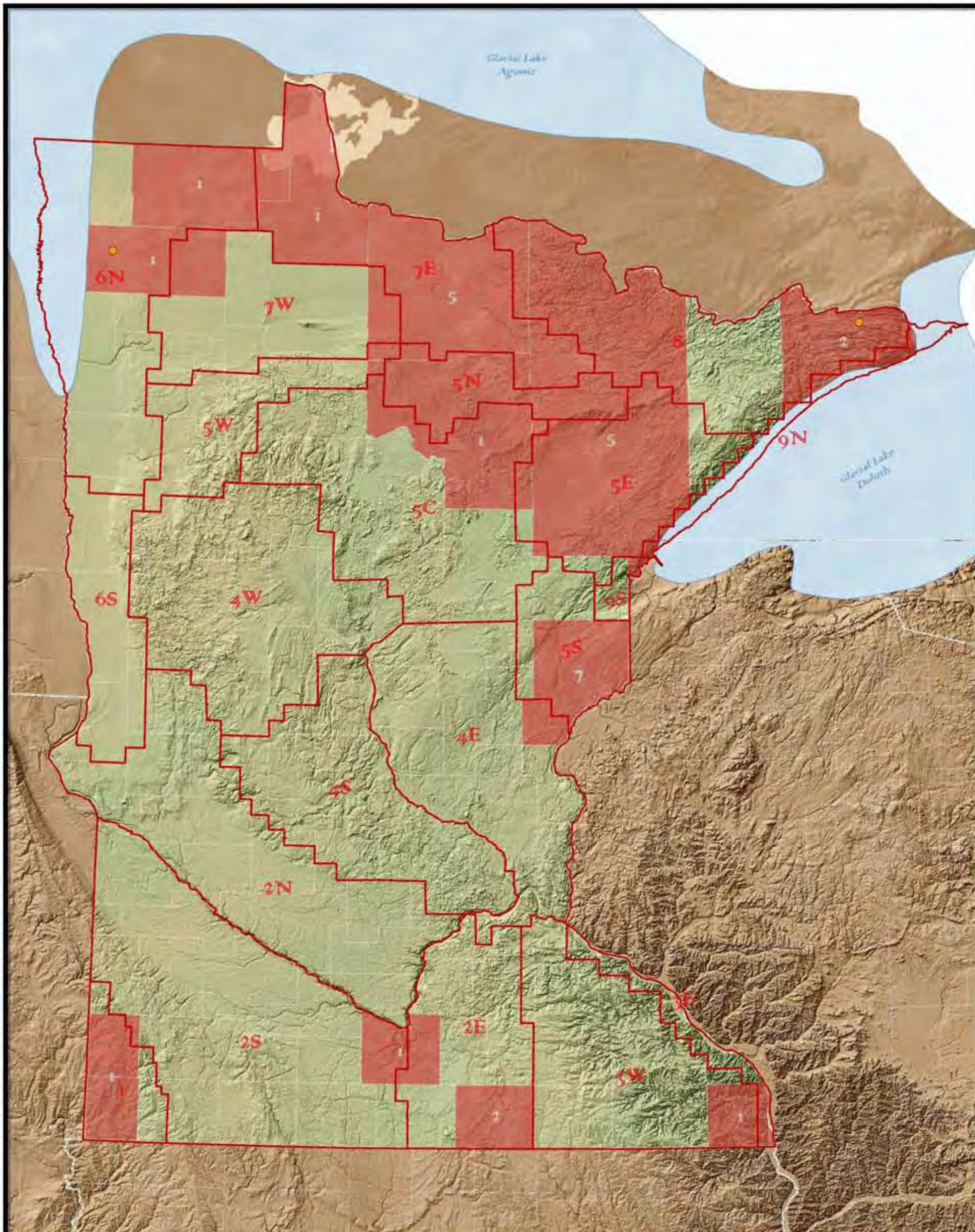


FIGURE 16
EASTERN FLUTED SITES
ca. 12,400-12,550 cal B.P.



Data is to be used for Reference purposes only

Source:
National Elevation Dataset 2011 & Dyke et al. 2003

Universal Transverse Mercator, NAD83

Path:
Minnesota Reports\SW MN Paleoindian Study\GIS Data

Author: ALAC Date: February 2011

FIGURE 17
EASTERN FLUTED SITES
ca. 11,950-12,100 cal B.P.

N W E S

0 37.5 75 150
Miles

LEGEND

Eastern Fluted Site
Number Reported
MN SHPO Regions
Ice Sheet
Reported Finds
Glacial Lake

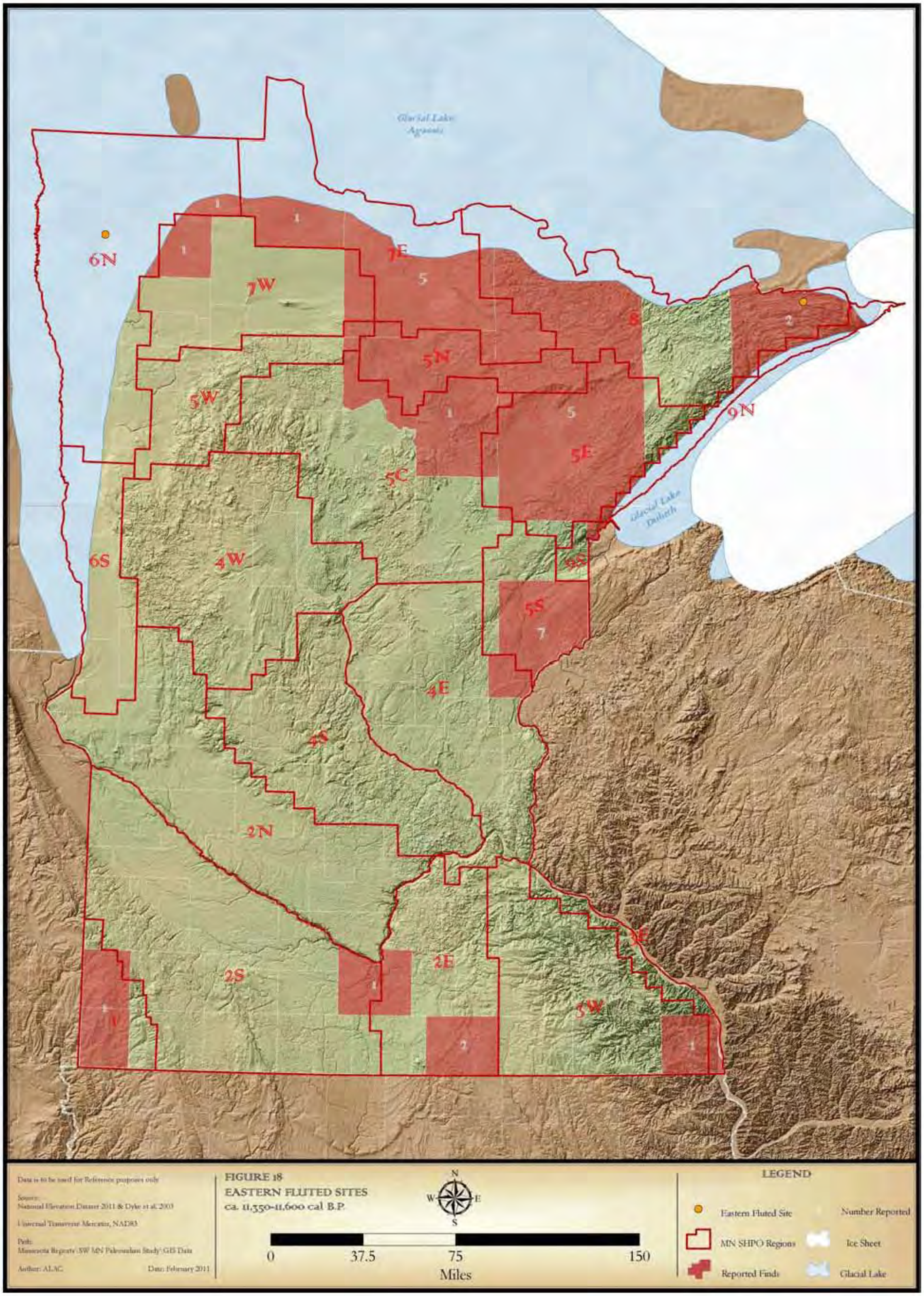


FIGURE 18
EASTERN FLUTED SITES
ca. 11,350-11,600 cal B.P.

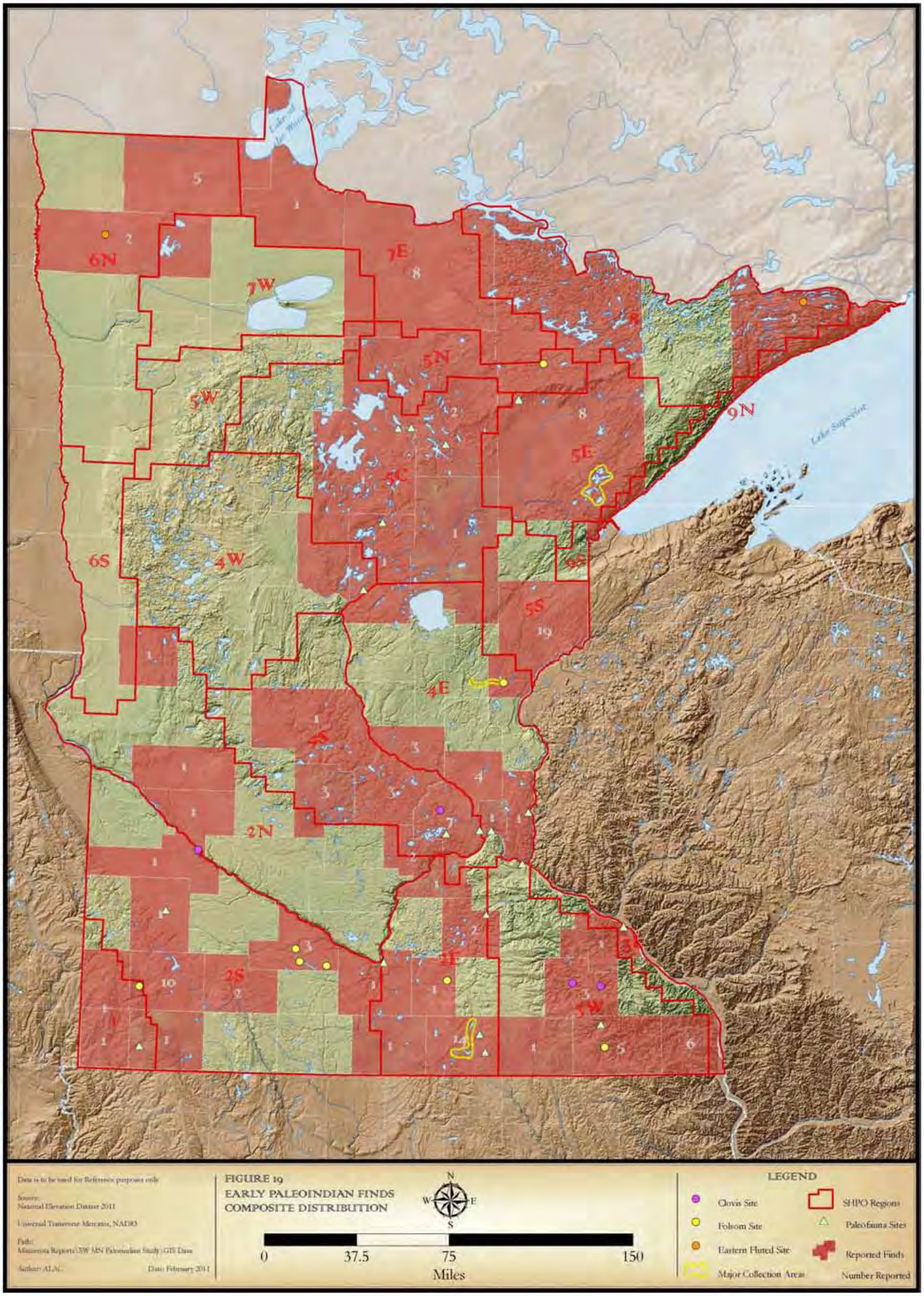


FIGURE 19
EARLY PALEOINDIAN FINDS
COMPOSITE DISTRIBUTION

Region 1: Southwest Riverine

The Southwest Riverine Archaeological Region is located in the southwestern corner of Minnesota and includes all of Rock County, as well as portions of Pipestone, Lincoln, Murray, and Nobles counties (see Figures 1 and 2, above). Geographically, southwestern Minnesota is dominated by two contrasting features, the Coteau des Prairies and the Minnesota River Lowlands. The Coteau des Prairies is a north/south-oriented, low-lying, trough-shaped plateau that is approximately 200 miles long and 100 miles wide (Flint 1955; Gries 1998:42; Malo 1997; South Dakota Geological Survey [SDGS] 2008). Extending from the North Dakota/South Dakota border south and east into southwestern Minnesota and northwestern Iowa, the Coteau is an uplift composed of thick glacial deposits underlain by a small ridge of Cretaceous bedrock known as Pierre shale (SDGS 2008).

The Coteau des Prairies plateau formed as a result of multiple, pre-Wisconsinan (> ca. 60,000 RCYBP) glacial episodes. Cumulative deposits left as a result of these glaciations currently reach thicknesses in excess of 900 feet atop certain portions of the Coteau (SDGS 2008). During the latter portion of the Pleistocene (ca. 60,000-12,000 RCYBP), this thick accumulation of deposits prevented additional glaciation of the Coteau, and instead, the Des Moines and James River lobes of the Laurentide ice sheet moved around the raised landform to the east and west, respectively (Anfinson 1997:10). Marking the extent of the last ice sheets is the high crest of the Bemis Moraine, or Buffalo Ridge, which extends along the Coteau in a northwesterly-to-southeasterly orientation. It is the portion of the Coteau within the Bemis Moraine, that is, south and west of it, that delimits the boundary between the Southwest Riverine Archaeological Region and the neighboring Prairie Lake Region.

The topography and hydrology of southwestern Minnesota is largely a product of Late Glacial-era processes; however, Deglaciation models indicate that Region 1 was almost entirely unglaciated during Late Wisconsinan times (Dyke et al. 2003). Most of the counties are former glacial plains that were blanketed with loess during the terminal Pleistocene. Susbsequent erosion dissected the landscape, creating a well drained topography characterized by very gently rolling valleys and hills and virtually no lake development. The loess is thicker in valleys and generally thinner on sloping areas and uplands where glacial till and/or bedrock is frequently exposed. Bedrock outcrops of Sioux Quartzite and Catlinite are present within the region. No outcrops of high-quality, knappable lithic material have been documented in the region to date, although deposits of Tongue River Silica and a material identified as Gulseth Silica have been reported among the glacial till (Bakken 2011:89-91). Soils in the project area are typically highly organic, forming in loessic and loamy till in the uplands, and in alluvial and æolian silt along stream terraces and valley floors (Diers 1988; Hokanson et al. 1976). The region is drained, primarily, by the Rock River and its respective tributaries. Originally developing as a glacial river, the Rock is a tributary of the Big Sioux River which, in turn, flows into the Missouri River in northwest Iowa about 100 miles south-southeast of the region. Although the Rock River valley is fairly well-defined, its many low-order subdrainages are not deeply incised; rather, they are bounded by low rolling uplands or nearly level floodplain or T-1 (first) terrace landforms.

Archeologically, no sites of early Paleoindian age have been documented in the Minnesota portion of the Southwest Riverine region, and prior to this investigation, only one artifact was reported to have come from within its confines. Unfortunately, the provenience of the specimen is ambiguously identified by Shane (1989, n.d.) as "Rock or Pipestone County," and Higginbottom (1996), citing a personal communication from Scott Anfinson, indicates that it may actually have been collected from further east, in Jackson County. To further complicate matters, the photograph in the OSA collection identifies the piece as "Jackson Co. Clovis/U of M/Nobles Co.?" The specimen, a complete fluted projectile point decidedly eastern in style (Figures 20 and 21), was originally acquired from a collector by Albert E. Jenks for the University of Minnesota (U-of-M) archaeology collections, although the identity of the collector is unknown. Originally believed to have been produced from a non-local material identified as Dover chert (Shane n.d.), the specimen has since been reevaluated and is now believed to be produced from Grand Meadow chert, a material that was quarried in southeastern Minnesota near the town of Grand Meadow (Bakken 1995, 2011:109-110; Higginbottom 1996). Although the line drawing of the specimen included below is from Shane (n.d.), Higginbottom (1996) also illustrated the piece, and notes that additional images of it are provided by both Johnson (1988) and Wilford (1960).

The current investigators documented several fluted projectile point specimens in the private collection of Arthur Gnadt of Lake Wilson (see pages 54-56, below). Although a total of five fluted point fragments were documented in

Gnadt's collection, only three were collected from his farm in Region 1, just west of Lake Wilson below the Buffalo Ridge. The remaining specimens were collected from the Lake Shetek and Current Lake areas north and west of the farm in the Prairie Lake Region. The Chalk Rock site in Brookings County, South Dakota (21BK100), though outside of the state, is technically within the Inner Coteau des Prairies, and therefore, is also within Region 1 (see Figure 4, above).

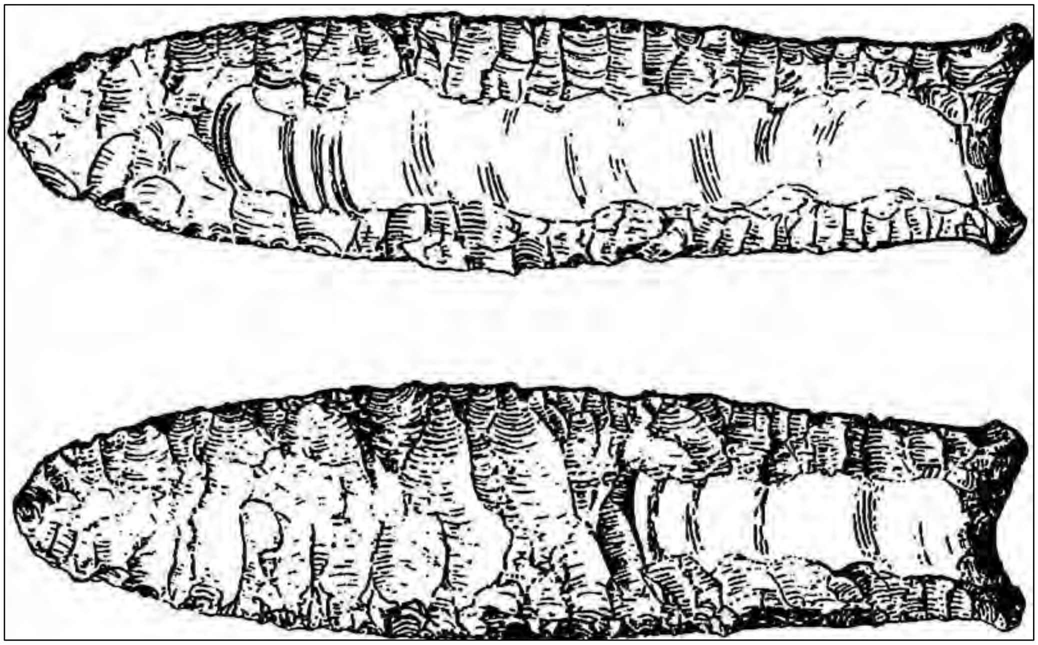


Figure 20. Scale line drawing of Specimen No. 547-1 (from Shane 1978:42).

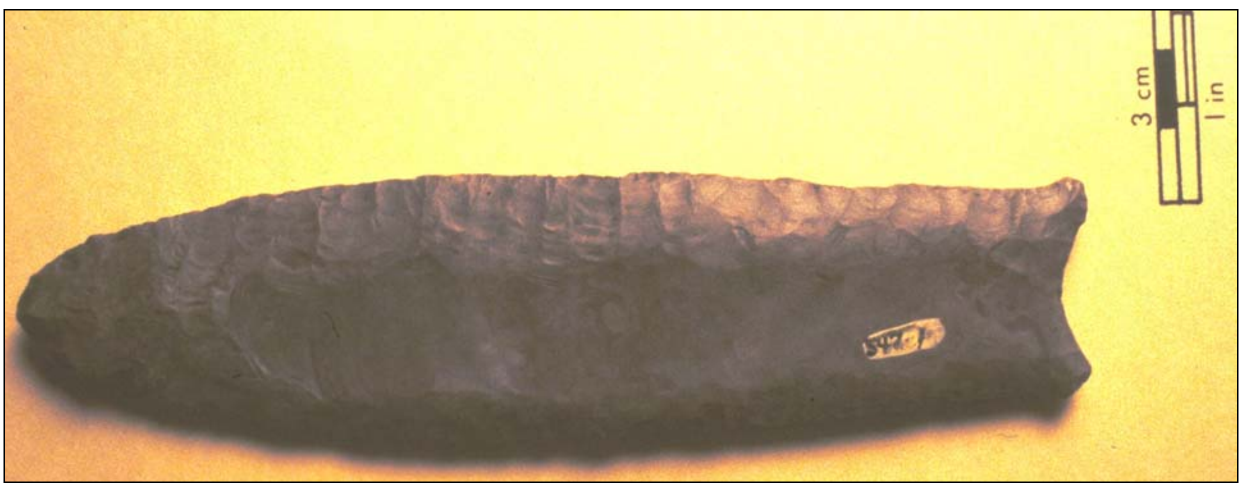


Figure 21. Specimen No. 547-1, *Jackson Co. Clovis/U of M/Nobles Co.?*, courtesy of the OSA.

Region 2: Prairie Lake

The Prairie Lake Archaeological Region comprises the majority of southwestern and south-central Minnesota. Counties wholly included within the region are: Big Stone, Blue Earth, Brown, Carver, Chippewa, Cottonwood, Faribault, Freeborn, Jackson, Lac qui Parle, LeSeuer, Lyon, McLeod, Martin, Nicollet, Redwood, Renville, Scott, Sibley, Stevens, Swift, Watonwan, and Yellow Medicine. Counties partially included within the region are: Douglas, Grant, Kandiyohi, Lincoln, Meeker, Nobles, Otter Tail, Pipestone, Pope, Rice, Steele, Traverse, and Waseca (see Figure 1). The entirety of the region was glaciated during the late-Wisconsinan maximum, but the ice sheets had retreated prior to ca. 14,000 cal B.P. (Dyke et al. 2003; see Figures 5 and 6, above). Major portions of the region would have been potentially inhabitable shortly thereafter.

Remaining in the wake of the retreating ice sheets was a low, gently undulating landscape characterized by an abundance of shallow, non-alkaline lakes and a poorly developed drainage network (Anfinson 1990:146, 1997:1). Greater topographic relief occurs along the northern, southern, and eastern boundaries of the region – a result of the presence of glacial end moraines in these areas (Anfinson 1990:146). The outer slopes of the Coteau des Prairies form the southwestern portion of the region. The expansive, deeply incised Minnesota River valley bisects the region in a southeasterly direction from Big Stone Lake until it turns sharply northeast at Mankato. It exits into Region 4 near the town of Shakopee southwest of the Twin Cities. The valley, reaching five miles across in some places, was originally carved by a gigantic glacial river that served as an outlet for Glacial Lake Agassiz following the retreat of the ice sheets (Minnesota River Basin Data Center 2004). This river, known as Glacial River Warren, actively drained Lake Agassiz twice subsequent to the lake's formation around 11,700 RCYBP (ca. 13,500 cal B.P.). Although accurate dates have not been obtained for the opening of the spillway, it is believed to have initially opened prior to 11,000 RCYBP (ca. 12,850 cal B.P.). Radiocarbon dates indicate that the spillway was abandoned by 10,800 RCYBP (ca. 12,800 cal B.P.) (Fisher 2003:273). From 10,800 RCYBP, the outlet remained abandoned until some time between 9900 and 9400 RCYBP (ca. 11,300-10,700 cal B.P.), when it briefly reopened. By 9400 RCYBP, radiocarbon dates indicate that Lake Agassiz's southern outlet was abandoned for the final time (Fisher 2003:273).

Approximately 40 early Paleoindian-age artifacts have been reported from 14 different counties in the Prairie Lake Region (see Figure 19, above). Over one third of these specimens (n=14) were collected from the lake shores around the Albert Lea area; all but two of these are part of the Owen Johnson collection presently curated at Myre-Big Island State Park in Albert Lea (see pages 40-44, below). Only five of the specimens, however, have been attributed to a specific archeological site in the region. Artifacts associated with sites 21BW8, 21BW10, 21BW21, 21WE78, and 21YM104 were all initially assigned to the Folsom complex. However, no images, illustrations, or other documentation of the specimen from site 21BW8 have been located and its whereabouts are presently unknown. It is mentioned in Trow's (1978) field notes as being in a private collection, and Dobbs (1989:60) and Dobbs and Anfinson (1993) note 21BW8 as a Folsom site; however, it is not discussed by Trow (1979) in his final survey report. The specimen from site 21YM104, since reclassified as Clovis (Higginbottom 1996), was originally found in the bottom of the Minnesota River valley – suggesting that, in all probability, it was deposited there from an unknown point of origin further upstream. The only specimen discovered by archeologists is a projectile point midsection recovered from site 21WE78 (Mulholland 2008). This specimen (Figure 22), now in possession of the current landowner, was located in a cultivated field near Waseca; however, subsequent Phase II excavations revealed that the site was wholly confined to the plowzone (Stephen Mulholland, personal communication, 2011). The fluted specimens from sites 21BW10 and 21BW21 were reported by Trow (1979) and illustrations were available (Figure 23). However, the actual pieces were discovered by private collectors and are presently unaccounted for. It was recently discovered that the individual who last owned the piece from site 21BW21, Elmer Fischer, is now deceased. The pieces are described by Higginbottom (1996), although the descriptions are based solely on an examination of the line drawings originally produced by Lee Radzak (Trow 1979: Figure 10a). The Freeborn County Historical Society presently holds a Folsom piece collected from near Albert Lea Lake and a Clovis specimen with unspecified provenience. Additionally, a Clovis specimen produced from Burlington Chert was observed in a private collection that was obtained near the town of Hollandale (Michael Bradley, personal communication 2011).

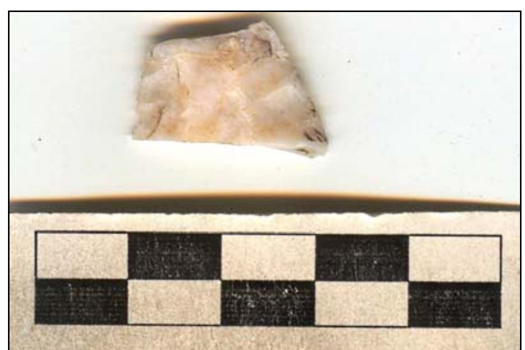


Figure 22. Fluted point midsection from site 21WE78, Waseca County (courtesy of Duluth Archaeology Center).

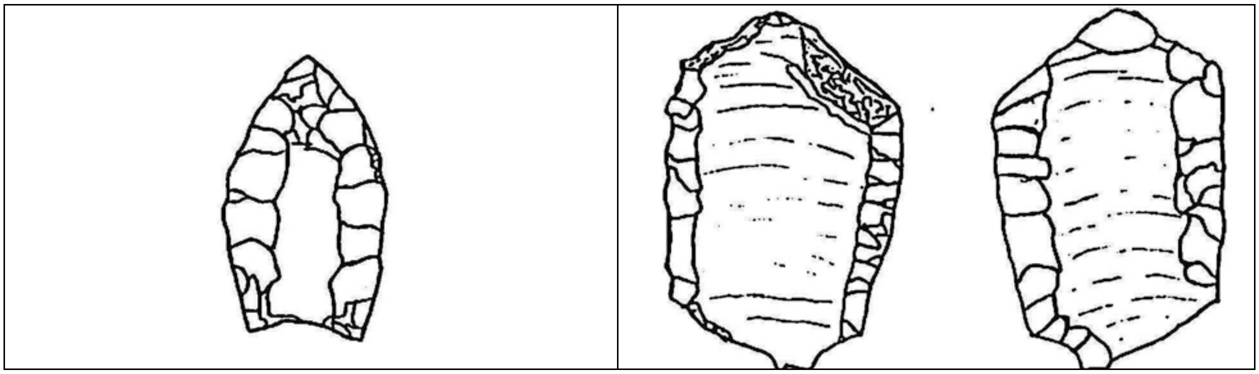


Figure 23. Scale line drawings of fluted point specimens from sites 21BW10 (left) and 21BW21 (right) (from Higginbottom 1996, reproduced from illustrations by Lee Radzak in Trow [1979]).

Region 3: Southeast Riverine

The Southeast Riverine Archaeological Region occupies extreme southeastern Minnesota. It contains all of Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha, and Winona counties, as well as portions of Dakota, Freeborn, Rice, and Waseca counties (see Figure 1). It is bounded to the west by Region 2 and the north by Region 4. To the south and east, the region extends beyond the state lines into southeastern Wisconsin and northeastern Iowa.

Region 3 is a heavily dissected landscape with considerable topographic relief and a noted absence of lakes in its interior. It was unglaciated during Late Wisconsinan times. The region has numerous bedrock outcrops, some of which contain high quality materials suitable for flintknapping. It is drained by the Mississippi and three primary tributaries: the Cannon, Root, and Zumbro rivers (Anfinson 1990:147).

A number of early Paleoindian finds are reported from Region 3. One Clovis projectile point base was reported from Houston County in 1994 (Higginbottom 1996). A Holcombe-like point and a Plainview-like point were documented in a private collection from near the Kulas II site (21HU40), also in Houston County, and two other Plainview-like points were observed in a private collection from near the town of Hoka (Florin 1996:58-59). A fourth Plainview point was discovered during a surface survey of the Root River Valley at the Mindrum site (21HU123) (Florin 1996:58; Withrow and Rodell 1984). One complete Clovis specimen was documented from a private collection in Wabasha County (Higginbottom 1996). In Olmsted County, a Clovis point was recently documented in association with the Hruska site (21OL39) (Vermeer 2005), and a stone tool cache technologically attributed to Clovis was identified at site 21OL44 (Carr et al. 2008a, 2008b). In Fillmore County, a Midland point was recovered from the surface of site 21FL107 during a survey of Forestville State Park (Vernon et al. 1979), and a Plainview specimen, reported in Jenks (1937:43), was found by a collector on a high bluff overlooking the Root River Valley (Florin 1996:54). A Clovis specimen collected in Fillmore County from near the town of Rushford and a Holcombe specimen collected from near the town of Spring Valley have also been documented in the collection of the late Lloyd Dugstad (Michael Bradley, personal communication 2011; see below).

Region 4: Central Lakes Deciduous

The Central Lakes Deciduous Archaeological Region is located in central and east-central Minnesota. Included in the region are the counties of Anoka, Benton, Cass, Chisago, Crow Wing, Hennepin, Isanti, Mille Lacs, Morrison, Ramsey, Sherburne, Stearns, Todd, Wadena, Washington, and Wright. Also included are portions of Becker, Dakota, Douglas, Kandiyohi, Kanabec, Meeker, Otter Tail, Pine, Pope, and Swift counties (see Figure 1). It is bounded to the north by Region 5, to the west by Regions 2 and 6, and to the south by Region 2 and a small portion of Region 3. The eastern boundary of the region extends beyond the St. Croix River into west-central Wisconsin.

Region 4 is characterized by high concentrations of deep lakes and a glaciated topography consisting of outwash plains, till plains, and moraines. Bedrock outcrops are uncommon and are confined largely to the eastern edges and the central parts of the region (Anfinson 1990:147-148). Although much of the western and southern portions of the region were glaciated at 12,500 RCYBP (ca. 14,200-15,050 cal B.P.), the northern and central portions remained ice free (Dyke et al. 2003). The region as a whole was ice free by 12,000 RCYBP (ca. 13,750-14,000 cal B.P.).

A number of early Paleoindian-age finds have been reported from Region 4; however, these finds are, at present, confined to the eastern and southern sub-regions. Approximately 30 specimens have been reported from the region, as well as at least 11 additional Plainview-like pieces. Specimens have been reported from nine different counties; however, the most notable concentration, consisting of 19 pieces, is from Pine County. All but three of these specimens are presently in the collection of Joseph Neubauer, Sr. of Pine City, and all but one were found surficially along the Snake River valley from Pine City west to Fish Lake. Two of the specimens not in the Neubauer collection are a Midland-style point that reportedly came from a surface collection near the Stumne Village site (21PN4) (Caine 1969; Florin 1996:74) and a broken probable Folsom piece in a MHS collection (cat. no. 3715) from the Northwest Company Fur Post site (21PN11) (Kent Bakken, personal communication 2011). Although both of these specimens are curated in the collections now housed at the Ft. Snelling History Center, neither could be located for further documentation during the current investigation. The third specimen not in the Neubauer collection was reportedly discovered in northern Pine County at the Timberline Campground near Sturgeon Lake in Region 5 (see below). The private collection of Joseph Neubauer, Sr. contains 16 fluted point specimens, including five that have been identified technologically as Clovis, five as Folsom, three as Gainey, and three as Holcombe. These specimens, which have been previously examined to varying degrees (see Higginbottom 1996; Mulholland and Mulholland 2010:125-127; Shane n.d.), have recently been subjected to a comprehensive examination by DAC archeologists (Mulholland, S. C. and S. L. Mulholland 2011; Mulholland, S. L. and S. C. Mulholland 2011) and are addressed in greater detail below.

Florin (1996:38-39) identifies one Plainview-like specimen in association with the Cedar Creek site (21AK58) in southwestern Aitkin County (Allan 1993). The site is located on a beach ridge of Glacial Lake Aitkin. In Anoka County, two Folsom specimens and one Plainview specimen were reportedly collected from the immediate vicinity of the Anderson site (21AN8) (Anfinson n.d.; Dobbs and Anfinson 1993; Flaskerd 1943, 1945; Florin 1996:40; Higginbottom 1996). Two additional Plainview points are reported from Anoka County: one is a collected specimen with no provenience (Caine 1969); the other is part of a private collection believed to be associated with the Dupre site (21AN49) (Florin 1996:41). Florin (1996:76) reports a Plainview-like specimen from along the Mississippi River floodplain across from downtown St. Paul in Ramsey County and three additional Plainview specimens from Meeker County (Florin 1996:69-70). Two of the specimens in Meeker County have no provenience (Caine 1969) while the third was documented in a private collection that was obtained from near the Lake Koronis site (21ME1). In Sherburne County, a Folsom base was collected from the surface of a plowed field near Sherburne National Wildlife Refuge (BRW, Inc. 1994:3-23). One incomplete Folsom specimen was documented in the collection of the late Nicholas Wenner. This Stearns County specimen was reportedly collected from Krays Lake approximately 1.5 miles southwest of Cold Spring (BRW, Inc. 1994:3-23). The specimen is presumed to still be in the possession of the Wenner family; however, Higginbottom (1996) reports that it was unaccounted for at the time of his 1996 inventory study. One Folsom base was collected in extreme western Washington County by a Mr. B. W. Thayer. This specimen, presently in the collection of the Science Museum of Minnesota, was reportedly located on the surface very near the Anderson site (21AN8) in Anoka County (see page 45, below). It is reported in Flaskerd (1943), Higginbottom (1996), and Shane (n.d.). Two Folsom points are reported from Wright County. One, from an unknown provenience, is reported in Flaskerd (1945). The other, apparently from a farm east of Schmidt Lake, was observed by Craig Johnson in a photographic display at the Wright County Heritage Center (BRW, Inc. 1994:3-23). Neither of these specimens was accounted for at the time of Higginbottom's 1996 inventory study. Flaskerd (1945) also reports a Plainview specimen collected from an unknown locale in Wright County. Higginbottom (1996) notes that seven fluted points are reported in Hennepin County. Four of these specimens were reportedly recovered from the vicinity of the Long Lake site (21HE100); however, all were unaccounted for as of 1996. These were originally identified and documented by Flaskerd (1945:32-33) and Kammerer 1942:145, 147), and Higginbottom (1996) suggests that the specimens are perhaps currently in the private collections of these individuals. Landon and Flaskerd (1945b:47) report another fluted point, also unaccounted for, from a garden in Orono near Lake Minnetonka. Higginbottom (1996) believes this piece to be in the private collection of Landon or Flaskerd. A sixth specimen, known as the "Washington Avenue Bridge Clovis" (site 21HEy), was reportedly discovered in 1941 along a high bank of the Mississippi River just south of the Washington Avenue Bridge in Minneapolis (Steinbring 1974). Steinbring (1974:64) reported it to be in the collections of the Koochiching County Historical Society and it has since been examined and photodocumented by DAC archeologists (see below). The final specimen was collected in 1994 from the surface of site 21HE310 near Old Lake

Medina (Birk 1994:5). The area was subsequently subjected to Phase II testing; however, no additional intact deposits were observed in association with the find (Carter 1997). The area has since been developed and the site area is now likely destroyed.

Region 5: Central Lakes Coniferous

The Central Lakes Coniferous Archaeological Region is located in north-central and northeastern Minnesota. It contains portions of Aitkin, Beltrami, Carlton, Cass, Clearwater, Crow Wing, Hubbard, Itasca, Kanabec, Koochiching, Lake, Pine, and St. Louis counties (see Figure 1). This region is bounded to the south by Region 4, to the west by Regions 4 and 6, to the north by Regions 7 and 8, and to the east by Regions 8 and 9.

Region 5 is similar in many respects to Region 4 and includes a substantial number of lakes, many of which are very deep. Topography in the central part of the region is rugged because of the many terminal moraines present; however, relief lessens in the remaining areas that are characterized by a combination of outwash plains, ground moraines, and glacial lake plains. The large plain of Glacial Lake Aitken-Upham is present in the northeastern part of the region, and lake development is consequently poor there. Though outcropping bedrock is rare, some Precambrian deposits are present in the northeastern part of the region, as are a variety of cherts and jasper taconite (Anfinson and Peterson 1988:298). Models (Dyke et al. 2003) indicate that, although virtually surrounded by glaciers, the majority of Region 5 remained free of glacial ice as early as 12,500 RCYBP (ca. 14,200-15,050 cal B.P.). By 12,000 RCYBP (ca. 13,750-14,000 cal B.P.), the entire region was ice free.

Region 5 also contains a number of reported artifact finds attributed to early Paleoindian cultural groups. Approximately 14 specimens have been identified from seven different localities in Cass, Crow Wing, Itasca, Pine, and St. Louis.

As in Region 4, no early Paleoindian finds have been reported from the Central Lakes Coniferous *West* sub-region. The only reported find from the southern sub-region, as briefly discussed above, was discovered at the Timberline Campground near Sturgeon Lake in northern Pine County (Kammerer 1982). Kammerer erroneously identifies the find as being from Carlton County; however, Anfinson (n.d.) notes that the campground in question is actually on Sturgeon Lake in northern Pine County. Regardless, its provenience is uncertain because the piece was apparently discovered in fill from a horseshoe pit (Kammerer 1982). Two specimens have been identified in the northern sub-region, including one complete fluted piece found at an unknown location on Round Lake in Itasca County (Higginbottom 1996) and the base of a Folsom piece discovered at the Jim Reagan site (21SL875) north of Virginia (Mulholland et al. 2001; Mulholland and Mulholland 2002). The whereabouts of the Round Lake specimen are presently unknown (Higginbottom 1996) while the specimen from site 21SL875 is currently curated at the Superior National Forest offices in Duluth (see below). In the central sub-region, four specimens have been reported. One fluted point is reported from the vicinity of site 21CA17 near Lake Harry in Cass County (Anfinson n.d.; Higginbottom 1996); however, it appears as though the specimen has not been observed or further documented by a professional archeologist since it was reported. In Crow Wing County, the distal tip of a fluted point was discovered at the Thompson site (21CW109) by staff of the Great Lakes Archaeological Research Center (GLARC), Milwaukee, Wisconsin (Richards 1993). The specimen was discovered in Lake Bertha immediately adjacent to the shoreline. Site files indicate that, at the time, the artifact was curated at GLARC's facility under accession no. 93-053-001 (21CW109 site file). Two additional points from Itasca County have been documented in a private collection obtained from an area near the Williams Narrows site (21IC23) between Cut Foot Sioux Lake and Little Cut Foot Sioux Lake (Johnson et al. 1977). Florin (1996:61) notes a Plainview-like specimen in the collection while Higginbottom (1996) discusses the fluted specimen and notes that the collection is presently in the possession of the owners of Williams Narrows Resort. At least seven early Paleoindian projectile point specimens have been documented in four private collections and one public collection from the Reservoir Lakes vicinity north of Duluth. One point, identified as the "Island Lake Clovis," was discovered near Island Lake in 1967 and is presently in the collection of Anthony Romano (Romano and Johnson 1990). The six additional specimens, three of which are tentatively identified as Gainey and one as Holcombe, have been examined and photodocumented by DAC archeologists (Mulholland et al. 2009; Mulholland and Mulholland 2008) and are described in further detail below. Two additional specimens from these collections remain to be fully examined (Susan Mulholland, personal communication 2011).

Region 6: Red River Valley

The Red River Valley Archaeological Region occupies a substantial portion of northwestern Minnesota. All of Clay, Kittson, Norman, and Wilkin counties are located within this region, as are portions of Marshall, Pennington, Polk, Red Lake, Roseau, and Traverse counties (see Figure 1). The region is located within the low, flat plain of Glacial Lake Agassiz. Its eastern boundaries are defined by the Campbell beach ridge in the north, and the Herman beach ridge elsewhere. The Red River of the north forms the region's western boundary, and it extends into eastern North Dakota and southeastern Manitoba to the north.

Topographically, the only relief of note is along the multitude of beach ridges in the eastern portion of the region. There are no bedrock outcrops in the region, although lithic cobbles pervade the beach ridge deposits in the east. Consequently, soils in this area are coarser and only grade to a finer composition as they extend further onto the Agassiz plain. The region is devoid of lakes; however, numerous small marshes were present at the time of Euroamerican settlement and many were likely lakes into prehistoric times (Anfinson and Peterson 1988:301). Deglaciation models (Dyke et al. 2003) suggest that the entirety of this region was glaciated through 12,500 RCYBP (ca. 14,200-15,050 cal B.P.) and that all but the southern and easternmost portions were beneath Glacial Lake Agassiz through 11,000 RCYBP (ca. 12,700-13,000 cal B.P.). Between 10,500 and 10,250 RCYBP (ca. 12,550-11,950 cal B.P.), Lake Agassiz had retreated to the northwestern corner of the region; however, by 10,000 RCYBP (ca. 11,300-11,600 cal B.P.), it had again advanced to cover all but the southern and easternmost portions of the region. Only after this time did it fully abandon the region.

Archeologically, only one site of possible early Paleoindian age has been documented in the Red River Valley region, and six additional artifacts are reported to have come from within its confines. Five of the specimens, one from Marshall County and four from Roseau County, are identified as Plainview-like (Florin 1996:193). The sixth specimen, presently curated at the Lake of the Woods County Historical Society, has been photodocumented and is tentatively classified as Gainey (see below). The documented site, Donarski (21MA33), is located along the Campbell beach ridge and was professionally excavated in 2004 by archeologists from Foth & Van Dyke (Kluth and Hudak 2004). Mitigative excavations at the Donarski site produced two specimens with early Paleoindian technological characteristics, including a bifacial projectile point preform suggested to most closely exhibit characteristics of the Clovis complex, and the distal tip and midsection of what was identified as a Holcombe style projectile point (Figure 24; Kluth and Hudak 2004:36-39). Unfortunately, the broken projectile point was recovered from a feature dating to the Middle Archaic period, the preform was not associated with a dated feature, and none of the radiocarbon samples recovered from the site pre-date this Middle Archaic age (Kluth and Hudak 2004:105).

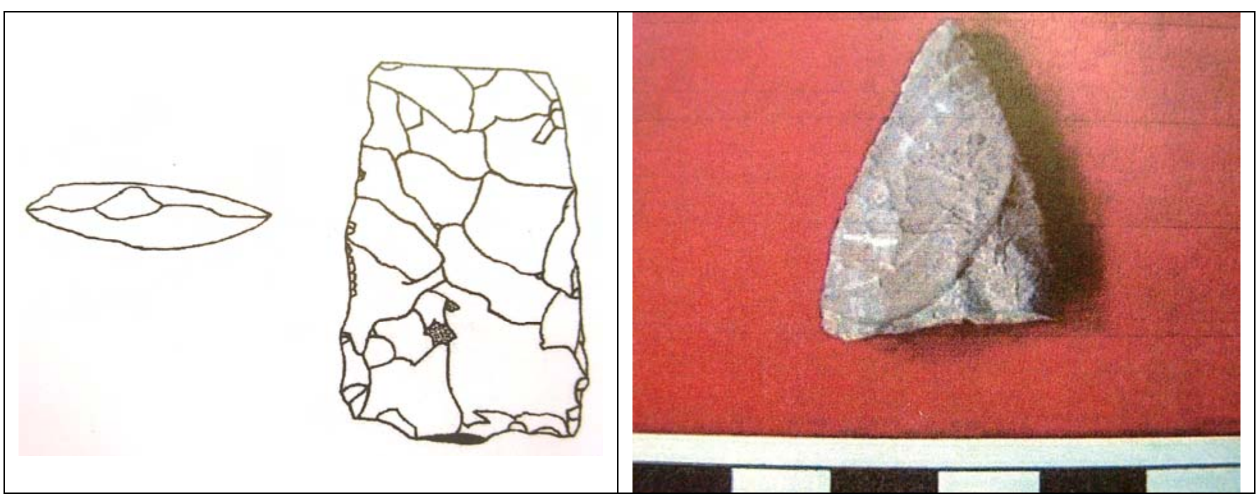


Figure 24. Scale line drawing of preform (left) and distal tip/midsection of projectile point (right) from site 21MA33 (from Kluth and Hudak 2004: Figures 15 [left] and 18 [right]).

Region 7: Northern Bog

The Northern Bog Archaeological Region is located in north-central Minnesota. It contains all of Koochiching and Lake of the Woods counties, and portions of Beltrami, Clearwater, Marshall, Pennington, Polk, Red Lake, and Roseau counties (see Figure 1). The region comprises what, at one time, was the long, eastern arm of Glacial Lake Agassiz known as the Beltrami arm. It is bounded to the west by Region 6, to the south by Region 5, and to the east by Region 8; it extends north to the Canadian border.

Because the region is almost entirely an old lake plain, the topography is predominantly level, although a series of poorly defined beach ridges are present in certain areas. There is very little lake development in the region, and the central area is wholly devoid of these. The exception is further west, where a few large, shallow remnants of Lake Agassiz (Lake of the Woods, Mud Lake, Red Lake, and Thief Lake) remain. The eastern two-thirds of the region consists of peatland, and the less peaty prairie soils are only present further to the west. Outcropping bedrock is present near the Rainy River, Lake of the Woods, and in eastern Koochiching County but the remainder of the region is covered by thick deposits of glacial drift and lake sediments (Anfinson and Peterson 1988:304). Deglaciation models (Dyke et al. 2003) indicate that the vast majority of this region was beneath either the ice sheets or Lake Agassiz through 11,500 RCYBP (ca.13,250-13,450 cal B.P.) and that the northernmost portion of the region was beneath the lake through 11,000 RCYBP (ca. 12,700-13,000 cal B.P.).

No archeological sites of early Paleoindian age have been documented in the Northern Bog region. Florin (1996:193, 205) does report three Plainview-like specimens and five Holcombe-like points from collections in Koochiching County, and Magner (1994:42-43) identifies a Plainview point in a collection obtained from the shores of Thief Lake in northeastern Marshall County. One additional specimen, tentatively identified as either Clovis or Gainey, is presently in the collection of the Koochiching County Historical Society in International Falls (Susan C. Mulholland, personal communication 2011). This specimen has been photodocumented by archeologists from DAC; however, it is likely that the piece is actually the one identified by both Higginbottom (1996) and Steinbring (1974:64) as the "Washington Avenue Bridge Clovis," which, in 1996, was confirmed to be curated by the Koochiching County Historical Society. The "Washington Avenue Bridge Clovis" was purportedly first discovered along a high bank of the Mississippi River in 1941 just south of the Washington Avenue Bridge in Minneapolis, and so its provenience is not, therefore, linked to the Northern Bog region. However, questions remain since it appears that its reported provenience south of the Washington Avenue Bridge was also called into question (see Higginbottom 1996).

Region 8: Border Lakes

The Border Lakes Archaeological Region is in northeastern Minnesota and includes the northern portions of Cook, Lake, and St. Louis counties, as well as a small portion of eastern Koochiching County. Region 9 forms its easternmost boundary and Region 5 its southernmost. It is bounded to the west by Region 7, and to the north it extends into Canada's Quetico Park (see Figure 1).

The region is covered by numerous glacial lakes of varying sizes and contains abundant outcrops of Precambrian bedrock. The Gunflint and Vermillion iron formations, extending into the region from the southwest, include outcropping sources of high quality cherts. Because of the extent of outcropping bedrock, terrain throughout the region is rugged and soil development is typically poor. The Pigeon River drains the eastern part of the region and the Rainy River drains the central and western parts (Anfinson and Peterson 1988:306). Deglaciation models (Dyke et al. 2003) suggest that much of the region remained glaciated through 12,000 RCYBP (ca. 13,750-14,000 cal B.P.) and that the northernmost portion was covered by the eastern arm of Lake Agassiz through 11,000 RCYBP (ca. 12,700-13,000 cal B.P.).

One Holcombe-like specimen was observed in a private collection from near the Fowl Lakes site (21CK1) in Cook County (Florin 1996:49; Platcek 1965). Additionally, one fluted point was recovered by Forest Service archeologists during testing at the Bearskin Point site (21CK18) in 1989 (Peters 1990). The point, presently in the collections of the Superior National Forest, Duluth, was originally termed Holcombe-like, but has since been reevaluated as being of the Gainey style (Mulholland et al. 2007).

Region 9: Lake Superior Shore

The Lake Superior Shore Archaeological Region occupies extreme northeastern Minnesota and includes the eastern edges of Carlton, Cook, Lake, and St. Louis counties. The region extends northeast along the shores of Lake Superior to Thunder Bay, Ontario (see Figure 1).

The region is characterized by numerous small bays and points located along the rocky cliffs of Lake Superior's northwestern shoreline. The southernmost portion of the region is located in what once was the low lakebed of Glacial Lake Duluth. Precambrian bedrock exposures are abundant and excepting Superior itself, the region is devoid of lakes (Anfinson and Peterson 1988:309). Deglaciation models (Dyke et al. 2003) suggest that all but the southernmost extent of this region remained either glaciated or beneath Glacial Lake Duluth through 11,000 RCYBP (ca. 12,700-13,000 cal B.P.) and that Lake Duluth continued to cover large areas of the northern portion of the region as late as 10,000 RCYBP (ca. 11,300-11,600 cal B.P.).

To date, no sites with early Paleoindian components have been identified in Region 9, and no such specimens have been observed in private collections. Even recent survey efforts of the region have failed to identify anything older than late Paleoindian pieces, and the late-period pieces identified are associated with private collections (Stephen Mulholland, personal communication 2011).

INSTITUTIONAL AND PRIVATE ARTIFACT COLLECTIONS

In total, 20 public institutions and 13 private collectors were consulted in researching artifact collections of early Paleoindian antiquity during this study. Some collectors provided information on multiple collections. Early Paleoindian artifacts from 10 of the institutional collections and 15 private collections are addressed below. The following institutions/individuals were consulted but were found to have no early Paleoindian specimens in their respective collections: Ms. Paula Nelson, Ms. Leota Silver, and Mrs. Molly Van Winkle, Tracy, Minnesota; the Rock County Historical Society, Luverne, Minnesota; the Pipestone National Monument and the Pipestone County Museum, Pipestone, Minnesota; the Siouxland Heritage Museums, ALAC, and CWS, Sioux Falls, South Dakota; Minnesota State University, Moorhead, Minnesota (MSUM); and St. Cloud State University, St. Cloud, Minnesota.

All of the collections consulted are held in Minnesota, and although it is impossible to unequivocally verify where the pieces originated, the vast majority are believed to have come from within the state. Many of these collections have, at least to some extent, been previously documented (see Florin 1996; Higginbottom 1996; Magner 1994; Mulholland 2008; S. C. Mulholland and S. L. Mulholland 2002, 2008, 2010, 2011; S. L. Mulholland and S. C. Mulholland 2011; Mulholland et al. 2007; Mulholland et al. 2001; Mulholland et al. 2009; Shane 1978, 1989, n.d.). Therefore, the intent here is directed more towards collating as much of this data as possible into one current reference report.[3] In light of this, and equally in the interest of time management, much of the technical detail pertaining to individually documented specimens is not included here. Instead, a brief overview of the collections is presented in order to alert researchers to the presence and general composition of these resources, while concurrently affording them the information requisite for pursuing future study. Scale photographs and/or line drawings *are* provided when possible, and color, material type, metric measurements, and other data for those specimens *not* previously documented have been tabulated and appended to this report when possible.

Institutional Collections

Carver County Historical Society Collection

Present Owner: Carver County Historical Society	**Present Location:** Carver County Historical Society, Waconia
Composition: 1 Fluted biface/preform?	**Provenience:** Carver County
Accessibility: By appointment	**Previously Documented?:** No
Documentation Methods: Photographed	**References:** N/A

[3] Although every attempt was made to be comprehensive in this regard, it is conceded that a number of collections with early Paleoindian specimens could have been overlooked.

Very little is known about this specimen at present. What is known is that it was donated to the Carver County Historical Society in Waconia, Minnesota, it is currently in the collections there, and it was likely, albeit not definitely, collected from Carver County (Larry Hutchings, Curator, Carver County Historical Society, personal communication 2011). Unfortunately, it was not possible to examine the specimen in-person during the course of this project. A black-and-white photograph of the specimen was provided by the Carver County Historical Society (Figure 25); however, the image depicts only one face of the piece and does not include a scale, thereby making it impossible to obtain measurement data or material type color from the piece. What appears to be a faintly visible flute seemingly extends distally from the base for approximately one-third the length of the specimen. As a whole, the specimen is asymmetrical, exhibits several step fractures, and appears very grainy in a number of areas – suggestive of a generally poor material quality. Although there may be some minor retouch, if the piece was intended as a projectile point, it does not appear to be a finished product. The asymmetrical beveling, evident distally (and possibly near the proximal end as well) along the right lateral margin, coupled with the general form of the specimen, appears more indicative of a bifacial tool utilized in the capacity of a hafted knife than as a projectile point. This can neither be confirmed nor refuted without a more detailed examination of the piece.

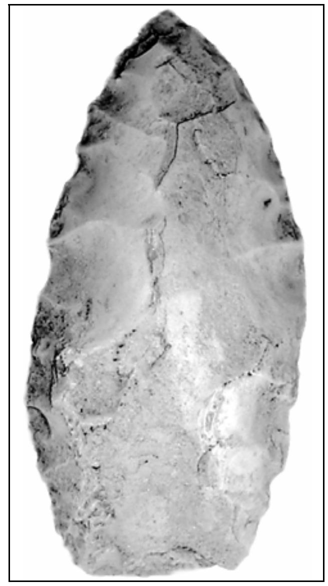


Figure 25. Carver County Historical Society Specimen 1, not to scale (courtesy of Carver County Historical Society).

Koochiching County Historical Society Collection

Present Owner: Koochiching County Historical Society	**Present Location:** Koochiching County Historical Society, International Falls
Composition: 1 Fluted (Clovis/Gainey?)	**Provenience:** Minneapolis, Hennepin County?
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographed	**References:** Higginbottom 1996; Steinbring 1974:64?

One fluted projectile point, tentatively identified as either Clovis or Gainey (based on descriptions provided in Morrow and Morrow 2002), is presently in the collection of the Koochiching County Historical Society in International Falls (Susan C. Mulholland, personal communication 2011). This specimen has been photodocumented by archeologists from DAC; however, it is likely that this specimen is actually the one identified by both Higginbottom (1996) and Steinbring (1974:64) as the "Washington Avenue Bridge Clovis," which, in 1996, was confirmed to be curated by the Koochiching County Historical Society. Images for this specimen are available at DAC; however, time constraints precluded their inclusion in this report.

Lake of the Woods County Historical Society Collection

Present Owner: Lake of the Woods County Historical Society	**Present Location:** Lake of the Woods County Historical Society
Composition: 1 Fluted (Gainey?)	**Provenience:** Lake of the Woods County
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographed	**References**: N/A

One fluted projectile point, tentatively identified as Gainey (based on descriptions provided in Morrow and Morrow 2002), is presently in the collection of the Lake of the Woods County Historical Society (Susan C. Mulholland, personal communication 2011). This specimen has been photodocumented by archeologists at DAC; however, time constraints precluded inclusion of the photographs in this report.

MHS, OSA, and U-of-M, Twin Cities Collections

Present Owner: State of Minnesota	**Present Location:** Ft. Snelling History Center, St. Paul
Composition: 1 Clovis; 1 unfluted Folsom (Midland)	**Provenience:** Yellow Medicine County; Fillmore County
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographs; line drawings	**References:** Anfinson n.d.; Higginbottom 1996; Vernon et al. 1979

Two projectile point specimens in the MHS collections now housed at the Ft. Snelling History Center in St. Paul were examined by the current investigators on January 26, 2011. The first, MHS Specimen 1 (Accession No. 49.1 [Catalog No. 68.182]), is a complete point from site 21YM104 (see Figures 26 and 27). The site file indicates that the piece was donated to MHS in 1968 by a Kathleen Jordan of Granite Falls, who discovered it near a rock quarry in the Minnesota River valley. The location of the find, since destroyed by quarrying, had been scoured to bedrock by Glacial River Warren (21YM104 site file). As a result, the piece was almost certainly redeposited there from some point further upstream. Originally designated as Folsom, the piece has since been reclassified by Higginbottom (1996) as Clovis. Detailed measurements, together with a scale drawing and a description of this specimen are provided in Higginbottom (1996); however, he designates its site/locality as simply *Yellow Medicine County*, so it must not have been assigned a formal site number until after his examination of the piece.

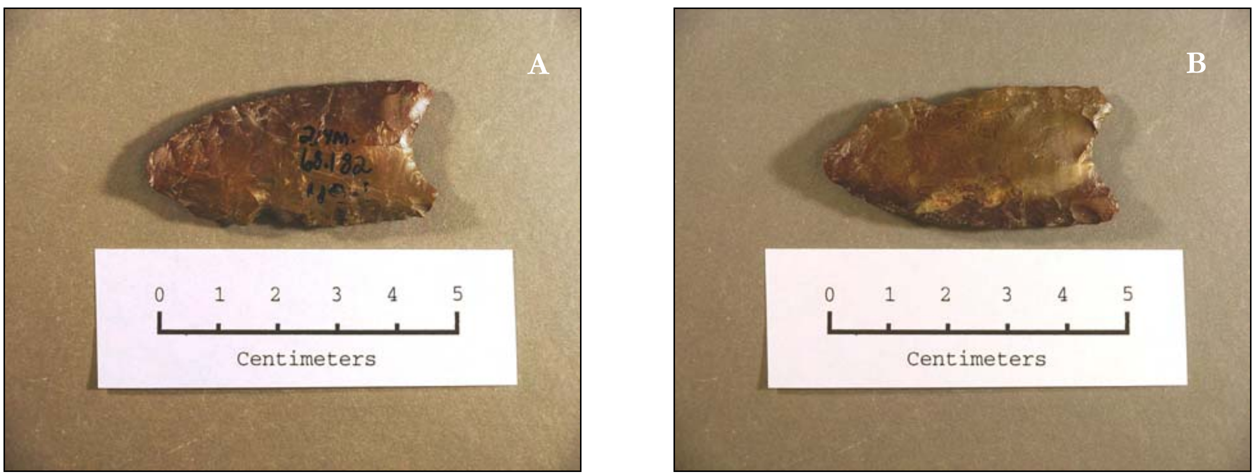


Figure 26. Specimen 1, obverse (A) and reverse (B).

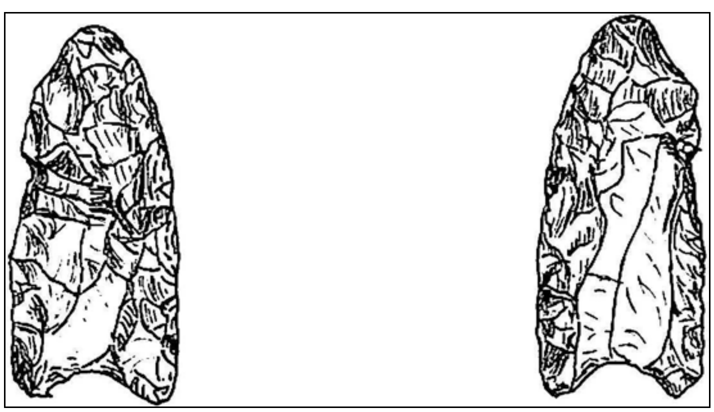


Figure 27. Scale line drawing of MHS Specimen 1 (Catalog No. 68.182) (from 21YM104 site file).

MHS Specimen 2 (MHS Catalog No. 172.2.1.1) is the base of an unfluted Folsom projectile point from site 21FL107 (Figures 28 and 29). The site file indicates that the piece was discovered during a survey of Forestville State Park near the Root River in Fillmore County (Vernon et al. 1979). Vernon et al. (1979:56), citing Queripel and Coppini (1976:21), report the location of the site as being on the floodplain of the South Branch of the Root River approximately 800 feet from its banks and "approximately half way between the Meighen store and the first intermittent stream bed." The context of the find led them to suggest that it had been redeposited from further upstream during a previous high-energy flood (Vernon et al. 1979). Detailed measurements, together with a scale drawing and a description of this specimen are provided in Higginbottom (1996); however, he designates it as being from site *21FL – Field site No. 1*, so it must not have been assigned a formal site number until after his examination of the piece.

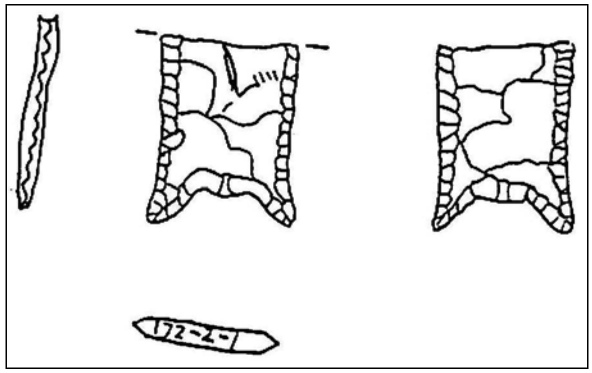


Figure 28. Scale drawing of MHS Specimen 2 (Catalog No. 172.2.1.1) (from Higginbottom 1996: Figure 19).

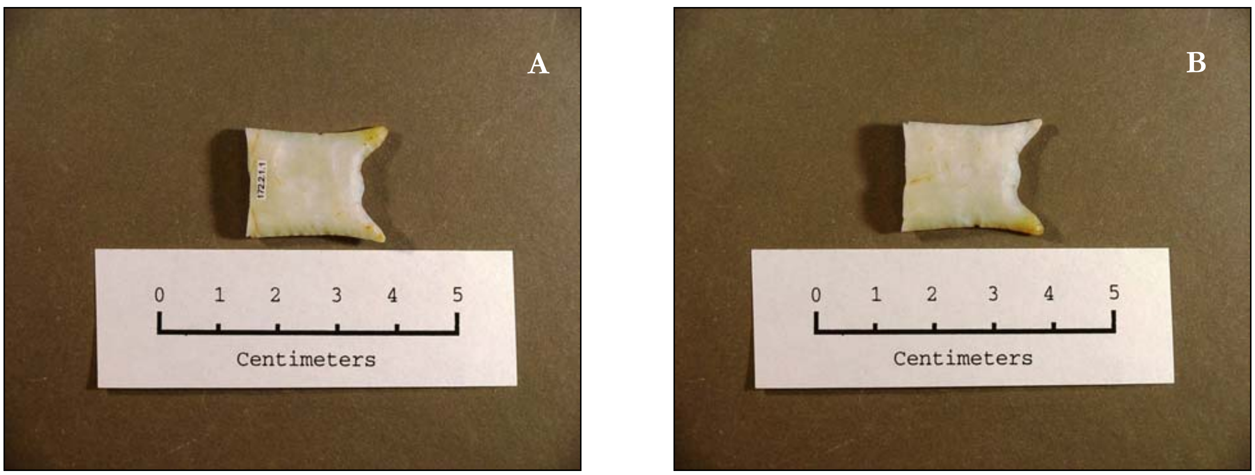


Figure 29. Specimen 2 obverse (A) and reverse (B).

Owen Johnson Collection

Present Owner: State of Minnesota	**Present Location:** Myre-Big Island State Park, Albert Lea
Composition: 6 Folsom	**Provenience:** Freeborn County
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographs; line drawings; measurements	**References:** Clouse 1992; Florin 1996; Higginbottom 1996; Shane 1989, n.d.

Six fluted projectile points from the Owen Johnson artifact collection were examined by the current investigators on January 27, 2011 at Myre-Big Island State Park, Albert Lea, Minnesota. All of these pieces (Specimens 1-6) have been designated as Folsom and have been previously documented (Clouse 1992; Higginbottom 1996). One Midland point from Walnut Lake in Faribault County is cited as being in the collection, as are two Plainview-like, four Holcombe-like, and one Midland-like point from the lakes in the Albert Lea vicinity (Clouse 1992; Florin 1996:52, 55). However, these additional specimens were not available for examination during the most recent visit. Also not available for examination during the current study was a seventh fluted point in the collection reported by Shane (n.d.) as a complete Clovis piece

(Figure 30). Higginbottom (1996) briefly mentions the latter piece, identifying it as *MFP.FE.6*, but notes that he also was unable to locate it when he examined the collection. The piece is listed in Higginbottom (1996) and Shane (n.d.) under Accession No. 07207; however, this number is stricken from Shane's notes on the piece and beside it, handwritten, is the number 64267. If the piece was initially listed under the wrong accession number, this would explain why it appeared unaccounted for. Unfortunately, the number discrepancy was not observed until after our examination of the collection.

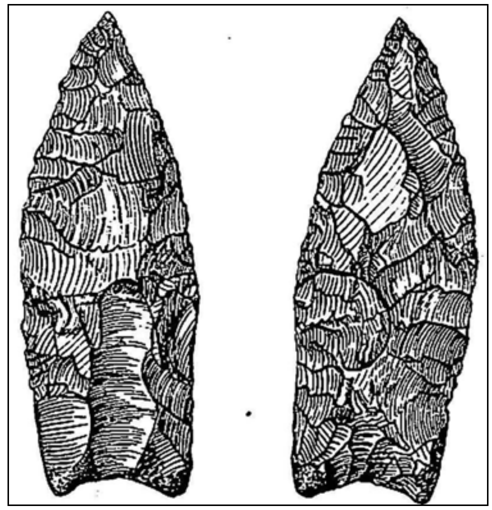


Figure 30. Scale drawing of Owen Johnson Accession No. ~~07207.0~~ (64267.0) (from Shane n.d.).

Specimen 1 (Accession No. 02479.0) is a basal fragment of an unfinished point collected from near Albert Lea Lake (see Figures 31 and 32). A broad channel flake removed from the obverse face of the specimen resulted in a transverse fracture. The reverse face is unfluted. Edge and basal grinding are absent. The material type is described by Higginbottom (1996) as Maynes Creek Cream chert. Higginbottom (1996) provides detailed measurements, together with a scale drawing and description of this specimen, which he numbers MFP.FE.8.

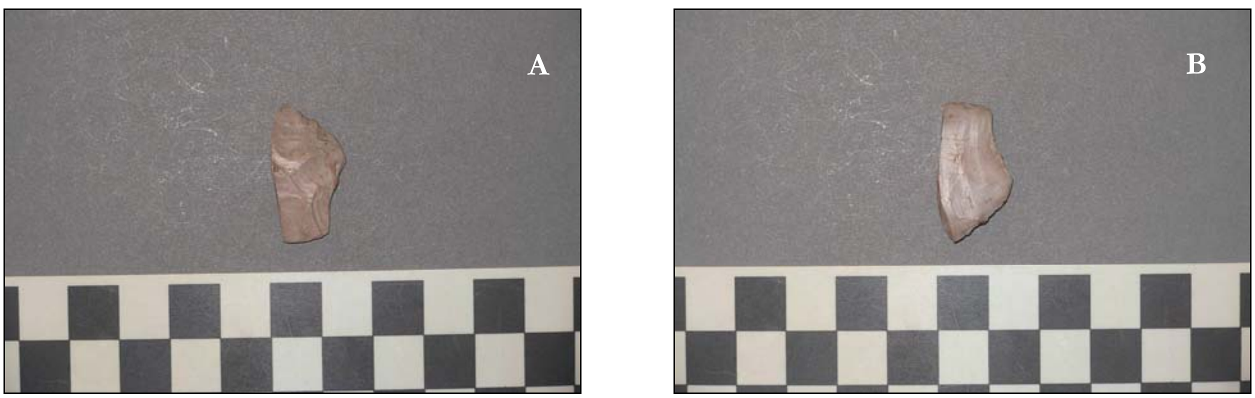


Figure 31. Owen Johnson Specimen 1, obverse (A) and reverse (B).

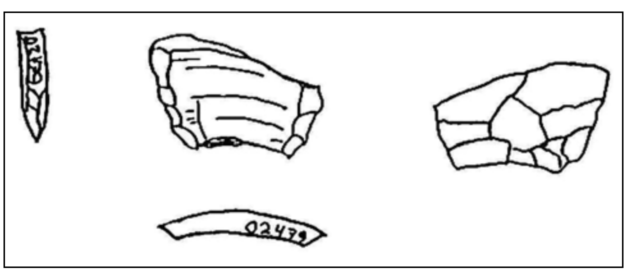


Figure 32. Scale drawing of Owen Johnson Specimen 1 (Accession No. 02479.0) (from Higginbottom 1996: Figure 17).

Specimen 2 (Accession No. 02484.0) is a basal fragment of an unfinished point collected from near Albert Lea Lake (Figures 33 and 34). A broad channel flake was removed from the obverse face of the specimen. The reverse face is unfluted. Edge grinding appears to be present along both lateral margins; however, it is noted that this specimen may have been utilized as a graver after the initial failed fluting attempt, and the perceived "grinding" may actually be, at least in part, from usewear (Higginbottom 1996). The specimen is produced on Cedar Valley chert. Higginbottom (1996) provides detailed measurements, together with a scale drawing and description of this specimen, which he numbers MFP.FE.7.

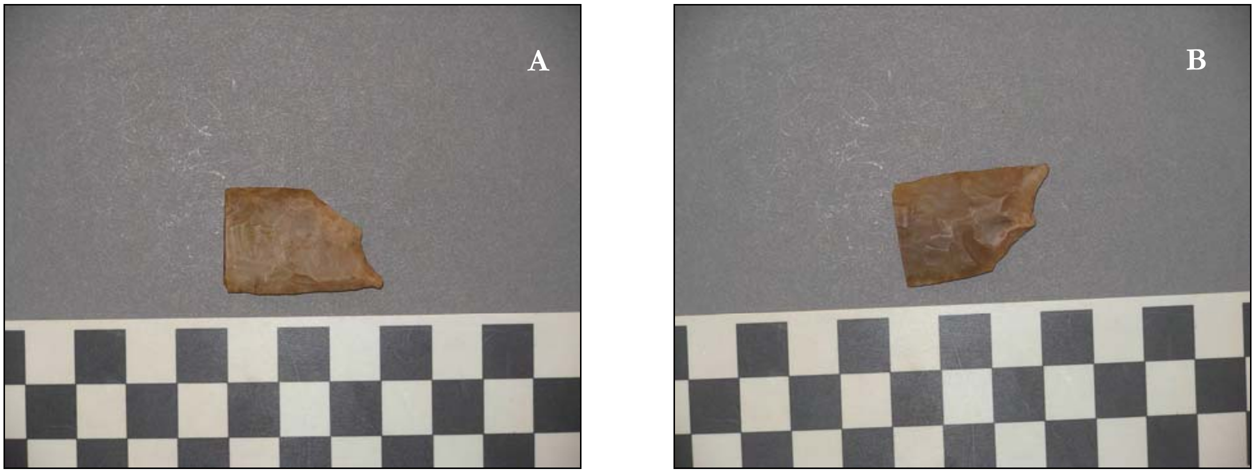


Figure 33. Owen Johnson Specimen 2, obverse (A) and reverse (B).

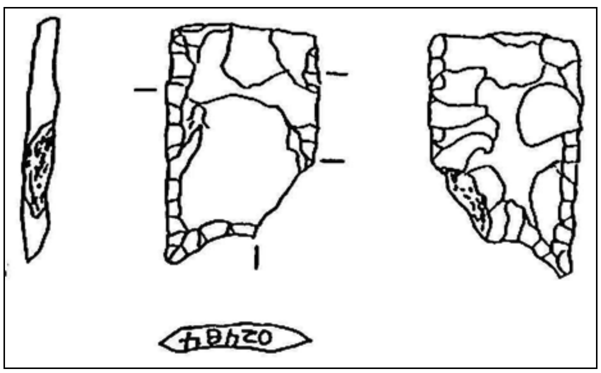


Figure 34. Scale drawing of Owen Johnson Specimen 2 (Accession No. 02484.0) (from Higginbottom 1996: Figure 16).

Specimen 3 (Accession No. 02492.0) is a basal fragment of an unfinished point collected from near Albert Lea (Figures 35 and 36). Some discrepancy exists as to a more precise provenience for the piece, as Shane (n.d.) indicates that it was discovered on the shores of Albert Lea Lake, while Higginbottom (1996) indicates that it was found near Pickerel Lake. The collection's 2004 inventory catalog notes Albert Lea Lake as the location of the find, so the possibility exists that Higginbottom mistakenly listed the wrong lake. A single channel flake removed from the obverse face of the specimen resulted in a transverse fracture. The reverse face is unfluted; however, a nipple platform characteristic of Folsom fluting technology is visible along the base. Edge and basal grinding are absent. The specimen is produced on Burlington chert. Higginbottom (1996) provides detailed measurements, together with a scale drawing and a description of this specimen, which he numbers MFP.FE.4.

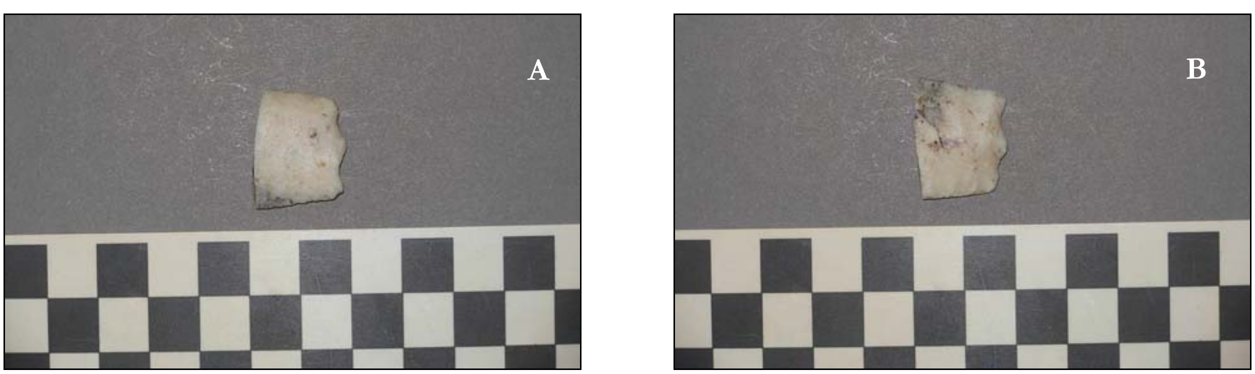


Figure 35. Owen Johnson Specimen 3, obverse (A) and reverse (B).

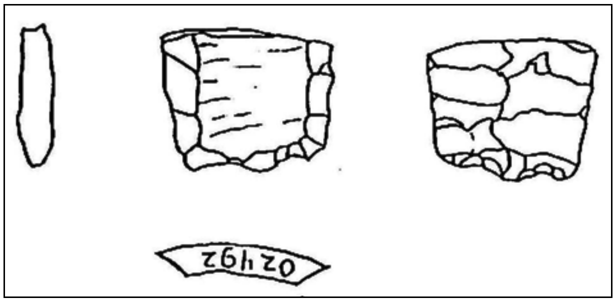


Figure 36. Scale drawing of Owen Johnson Specimen 3 (Accession No. 02492.0) (from Higginbottom 1996: Figure 14).

Specimen 4 (Accession No. 07201.0) is a basal fragment of a bi-fluted point collected from near Pickerel Lake (Figures 37 and 38). Broad channel flakes have been removed from both faces of the specimen and the base exhibits precise retouching. Edge and basal grinding are present. This specimen exhibits all the characteristics of a successfully manufactured projectile point, and it, therefore, must have broken at some subsequent point in time. The material type is described by Shane (n.d.) as resembling both Gunflint silica and a fine-grained version of Hixton silicified sandstone. Higginbottom (1996) simply refers to it as an unidentified chalcedony or chert. The collection's 2004 inventory catalog identifies the material as Cedar Valley chert, which lends credence to Shane's observation of a fine-grained version of Hixton since Cedar Valley chert is known to resemble Hixton superficially (Bakken 1995). Higginbottom (1996) provides detailed measurements, together with a scale drawing and a description of this specimen, which he numbers MFP.FE.3.

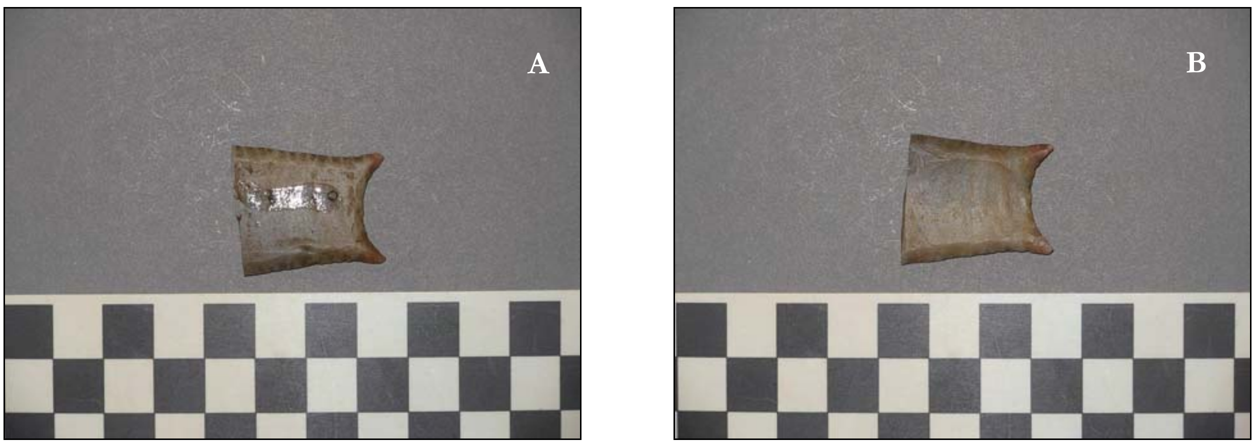


Figure 37. Owen Johnson Specimen 4, obverse (A) and reverse (B).

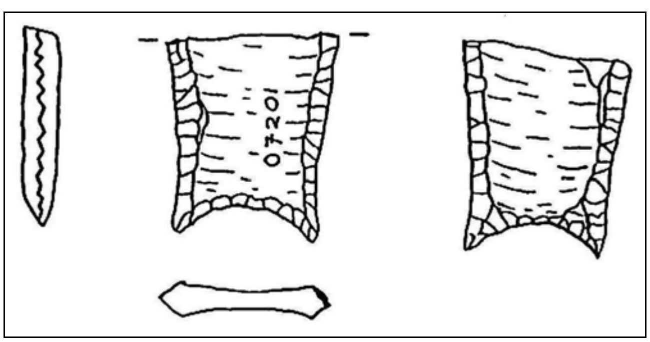


Figure 38. Scale drawing of Owen Johnson Specimen 4 (Accession No. 07201.0) (from Higginbottom 1996: Figure 13).

Specimen 5 (Accession No. 12398.0) is a bi-fluted point collected from near Pickerel Lake (Figures 39 and 40). Broad channel flakes have been removed from both faces of the specimen and an impact fracture has removed the tip. Edge grinding is present laterally near the top of the specimen only, and Higginbottom (1996) interestingly notes that the fluting ripple marks indicate that the channel flakes were removed from what appears to be the *distal* end. This suggests that the piece was originally manufactured with the point where the base is currently, and that it was presumably reworked subsequent to this. The material type is described by Higginbottom (1996) as Winterset chert and by Shane (n.d.) as a gray oolitic chert; however, the "ooliths" observed by Shane are not circular but rice-shaped, and are thus actually fusulinids. Higginbottom (1996) provides detailed measurements, together with a scale drawing and a description of this specimen, which he numbers MFP.FE.5.

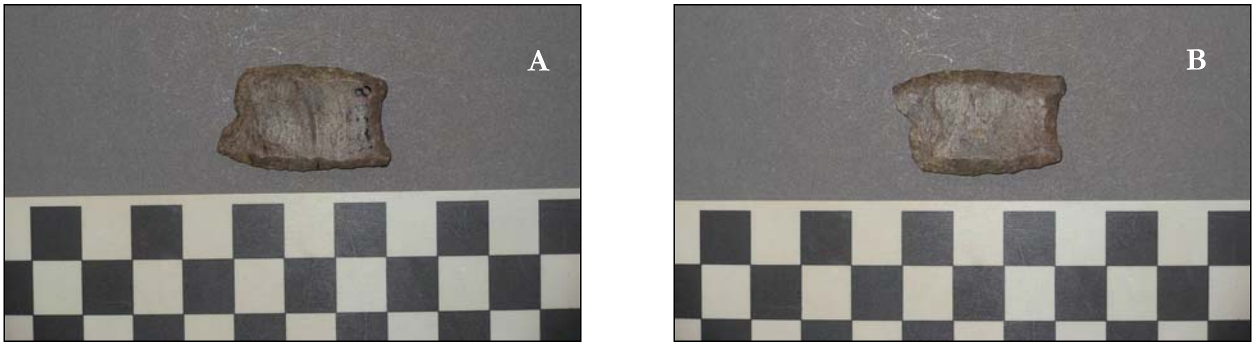


Figure 39. Owen Johnson Specimen 5, obverse (A) and reverse (B).

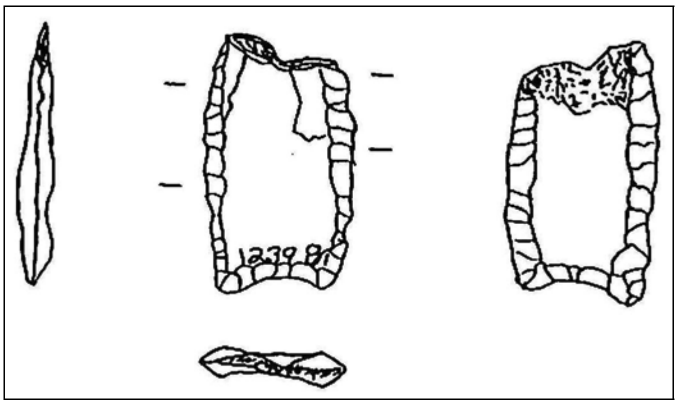


Figure 40. Scale drawing of Owen Johnson Specimen 5 (Accession No. 12398.0) (from Higginbottom 1996: Figure 15).

Specimen 6 (Accession No. 12428.0) is a basal fragment of an unfinished point collected from near Pickerel Lake (Figures 41 and 42). Broad channel flakes have been removed from both faces of the specimen, the second of which resulted in the distal fracture. Edge and basal grinding are absent. The material type is Burlington chert. Higginbottom (1996) provides detailed measurements, together with a scale drawing and a description of this specimen, which he numbers MFP.FE.2.

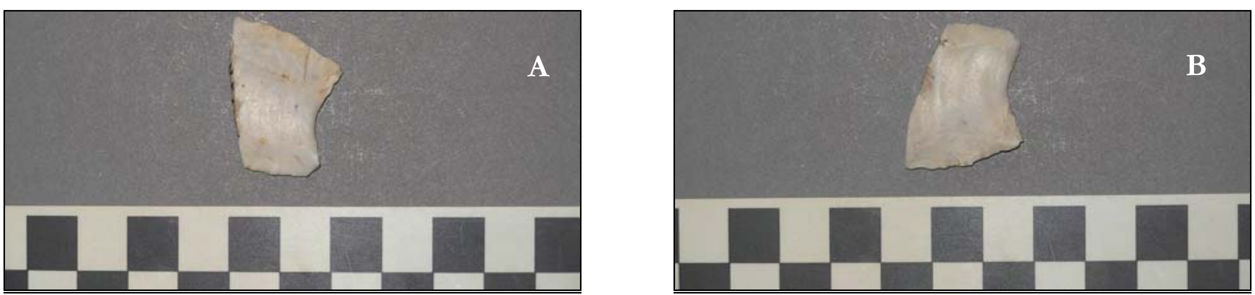


Figure 41. Owen Johnson Specimen 6, obverse (A) and reverse (B).

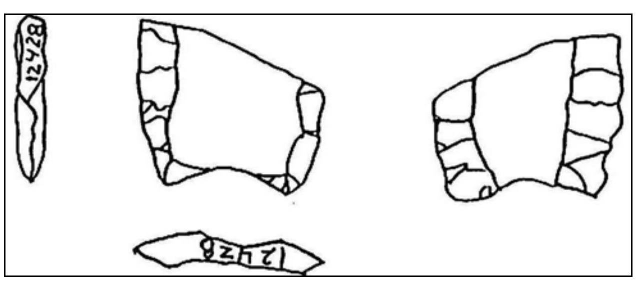


Figure 42. Scale drawing of Owen Johnson Specimen 6 (Accession No. 12428.0) (from Higginbottom 1996: Figure 12).

Science Museum of Minnesota Collection

Present Owner: Science Museum of Minnesota	**Present Location:** Science Museum of Minnesota, St. Paul
Composition: 1 Folsom; 1 Clovis	**Provenience:** Washington County; Murray County?
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographs; line drawings	**References:** Flaskerd 1943; Higginbottom 1996; Shane n.d.

Two fluted projectile point specimens were examined by the current investigators in the collections of the SMM on January 25, 2011. The first, Specimen 1, is a broken Folsom base and midsection produced from Hixton silicified sandstone (Figures 43 and 44). This specimen is technically part of the Monroe Killy collection that is on loan to the SMM, so it has not been assigned a catalog or accession number by the museum. The piece was originally collected by B. W. Thayer in western Washington County very close to the Anderson site (21AN8). It was subsequently given to Killy, who in turn, loaned it to the SMM. Measurements, a scale drawing, and a description of this specimen are provided in both Higginbottom (1996) and Shane (n.d.), and it is also reported by Flaskerd (1943). However, Higginbottom (1996) could not locate the actual specimen during his inventory, and his measurements and descriptive data were thus obtained from line drawings reproduced to scale from photographs and from Shane's (n.d.) measurements.

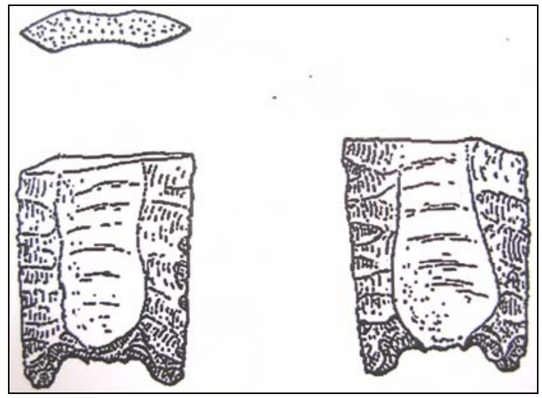


Figure 43. Scale drawing of SMM Specimen 1 (Monroe Killy collection) (courtesy of Science Museum of Minnesota).

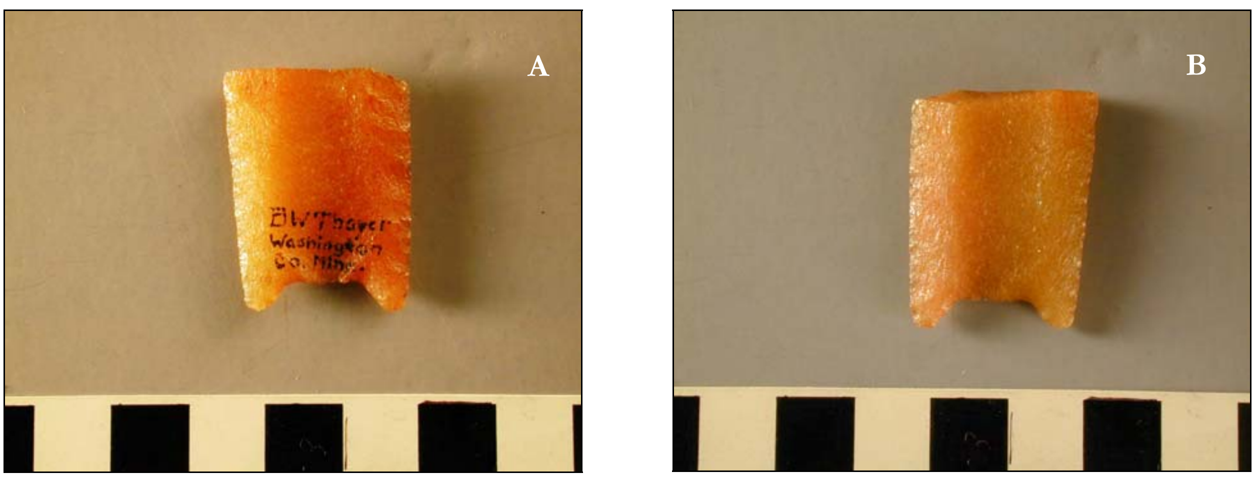


Figure 44. Science Museum of Minnesota Specimen 1, obverse (A) and reverse (B).

The second specimen examined in the SMM collections, Specimen 2 (Accession No. A94:4), is a complete, bi-fluted projectile point (Figure 45) that was part of an extensive artifact collection confiscated by the Bureau of Criminal Apprehension (BCA). This specimen, produced on Grand Meadow chert, was part of a collection obtained from somewhere in southwestern Minnesota, possibly in Murray County (Edward Fleming, Curator of Archaeology, Science Museum of Minnesota, personal communication 2011). Unfortunately, little else is known about the history or provenience of the piece. There are neither line drawings nor a formal description of the specimen; however, it measures approximately 6.5 cm in total length and 2.4 cm in maximum width. The depth of the basal concavity measures approximately 0.5 cm, the obverse flute length measures 1.5 cm, while the reverse flute length measures 2.4 cm.

Figure 45. Science Museum of Minnesota Specimen 2, obverse (A) and reverse (B).

Superior National Forest Collection

Present Owner: U.S. Department of Agriculture, Forest Service, Superior National Forest	**Present Location:** Superior National Forest Office, Duluth
Composition: 2 Fluted (1 Folsom, 1 Gainey?)	**Provenience:** Site 21SL875; Site 21CK18
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographed	**References:** Florin 1996; Higginbottom 1996; Mulholland and Mulholland 2002; Mulholland et al. 2007; Okstad et al. 2000; Peters 1990

Two fluted projectile point bases are presently in the collection of the U.S. Department of Agriculture, Forest Service, Superior National Forest in Duluth (Susan C. Mulholland, personal communication 2011). The first specimen is a Folsom base discovered in 2000 at the Jim Reagan site (21SL875) north of Duluth (Mulholland and Mulholland 2002). The second specimen is a fluted projectile point base recovered from the Bearskin Point site (21CK18) on East Bearskin Lake in Cook County (Peters 1990). It was originally identified as Holcombe-like (Florin 1996; Higginbottom 1996; Mulholland et al. 1997; Okstad et al. 2000), but has since been reevaluated and tentatively identified as Gainey (Mulholland et al. 2007). Both specimens have been photodocumented by archeologists from DAC; however, time constraints precluded inclusion of the photographs in this report. The Folsom specimen is depicted in Mulholland and Mulholland (2002:68), while the Gainey/Holcombe-like piece is depicted in Mulholland et al. (2007:122).

Minnesota Power Collection

Present Owner: University of Minnesota, Duluth	**Present Location:** University of Minnesota, Duluth
Composition: 1 Fluted (1 Holcombe?)	**Provenience:** Site 21SL314
Accessibility: By appointment	**Previously Documented?:** Yes
Documentation Methods: Photographed	**References:** Mulholland and Mulholland 2008

One fluted projectile point, identified as a probable Holcombe type (Mulholland and Mulholland 2008), is presently in the collection of the University of Minnesota, Duluth (Susan C. Mulholland, personal communication 2011). This specimen, recovered from the Balls Beach site (21SL314) adjacent to Island Lake Reservoir and the Otter River north of Duluth (see Mulholland and Rapp 1991, 1993; Mulholland et al. 1995, 1996), has been photodocumented by archeologists from DAC; however, time constraints precluded inclusion of the photographs in this report. The specimen is, however, depicted in Mulholland and Mulholland (2008:123).

Private Collections

Thomas Amble Collection

Present Owner: Thomas Amble	**Present Location:** St. Paul, Minnesota
Composition: 1 Clovis	**Provenience:** Mississippi River valley, southeastern Minnesota/southwestern Wisconsin
Accessibility: By appointment with Tom Amble	**Previously Documented?:** No
Documentation Methods: Photodocumented	**References:** N/A

This specimen, from the private collection of Thomas Amble, is a complete, bi-fluted projectile point produced on Cochrane chert (Figure 46). It measures 7.8 cm in total length, 3.4 cm in total width, and 0.8 cm in thickness. The depth of the basal concavity measures 0.6 cm and the obverse and reverse flutes extend distally from the base 4.6 cm and 5.9 cm, respectively. The specimen was discovered circa 1920 by a farmer who owned land on both the southeastern Minnesota and southwestern Wisconsin sides of the Mississippi River. Mr. Amble purchased the specimen from a relative of the farmer who was uncertain which side of the river it had been discovered on (Thomas Amble, personal communication 2011). It was also not clear which counties the farms were in.

Figure 46. Thomas Amble Specimen 1. Specimen is depicted to scale (courtesy of Thomas Amble).

William H. Jensen Collection

Present Owner: Thomas Amble	**Present Location:** St. Paul, Minnesota
Composition: 4 Folsom; 1 Barnes; 1 Clovis	**Provenience:** Brown's Valley Minnesota vicinity
Accessibility: By appointment with Tom Amble	**Previously Documented?:** No, but see below
Documentation Methods: Photodocumented	**References:** Amble (in preparation)

These fluted specimens from the William H. Jensen collection are currently owned by Thomas Amble (Figure 47). Specimens A-C and E are produced on Knife River flint, Specimen D is produced on Burlington chert, and Specimen F is produced on an unidentified material (Thomas Amble, personal communication 2011). Although William Jensen grew up on Jensen's Island in Lake Traverse near Browns Valley, Minnesota and the South Dakota border, the provenience of the pieces he collected is unknown. However, the majority of his artifact collecting excursions consisted of day-trips from Browns Valley, and was known to include areas in northeastern South Dakota and southeastern

North Dakota. Anecdotal information suggests that the Folsom pieces were collected during the 1930s from blowouts located along the southwestern beach ridges of Glacial Lake Agassiz (Thomas Amble, personal communication 2011). Detailed technical data for these specimens are not yet available; however, a publication is in preparation which will provide a detailed history and analysis of these and other artifacts from the William H. Jensen collection (Thomas Amble, personal communication 2011).

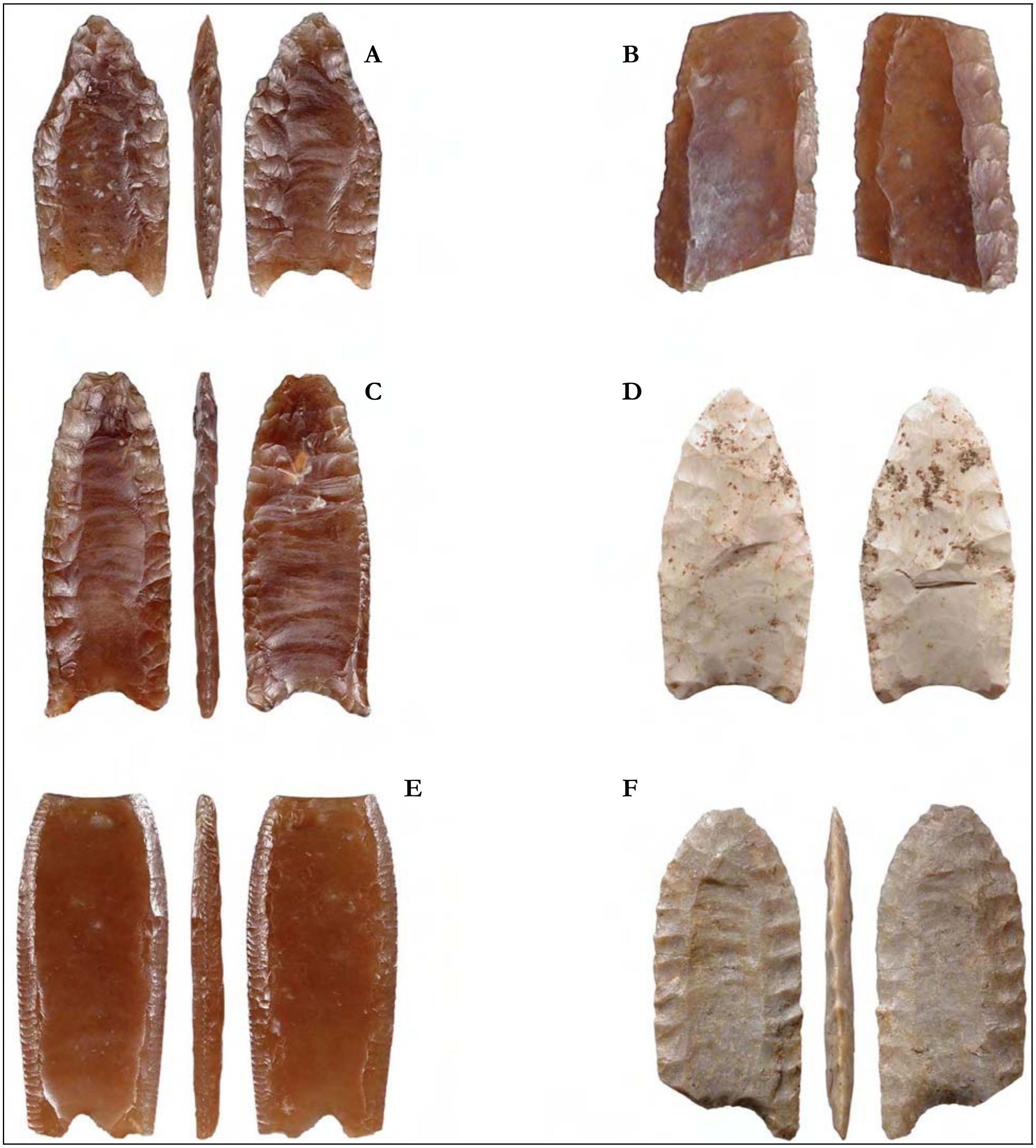


Figure 47. Fluted specimens from the William H. Jensen collection. Specimens depicted to scale (courtesy of Thomas Amble).

Ambrose Briscoe Collection

Present Owner: Davis Bonk	**Present Location:** Appleton, Minnesota
Composition: 1 Folsom	**Provenience:** Big Stone, Chippewa, and Swift counties
Accessibility: See below	**Previously Documented?:** Yes
Documentation Methods: Photographs	**References:** Holley et al. 2011:118-120

The Ambrose Briscoe collection contains one fluted specimen; a Folsom point (Figure 48) purportedly collected from Swift or one of the surrounding counties (Holley et al. 2011:118). It was recently recorded as part of a larger effort to document the archeology of Swift County, and is presently in the Minnesota State University Moorhead Archeology Laboratory, on loan from the owner (Michael G. Michlovic, personal communication 2011). Holley et al. (2011:118) report the specimen as basally ground and produced on Knife River Flint; however, no additional metric data was available in the report.

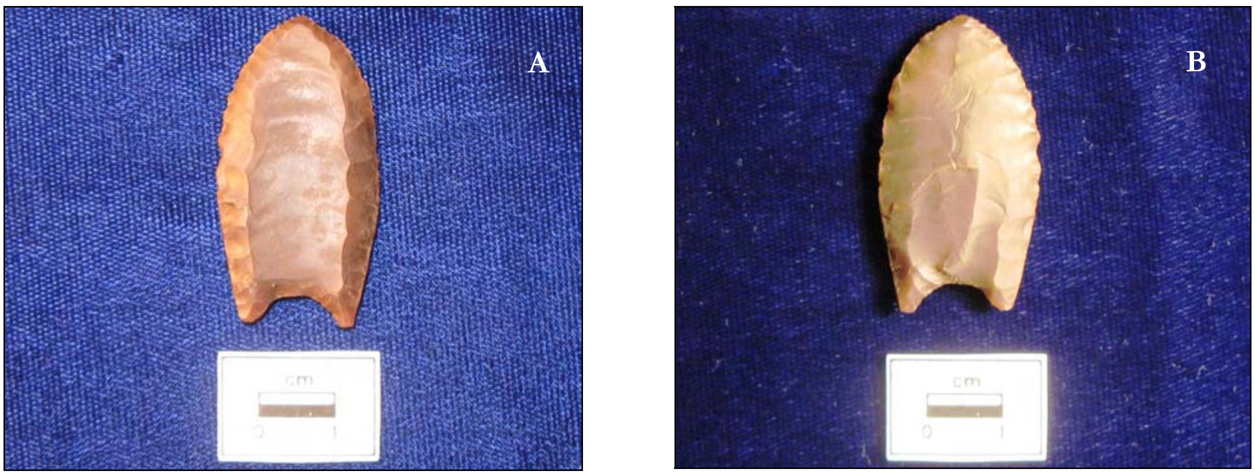


Figure 48. Ambrose Briscoe Specimen 1, obverse (A) and reverse (B) (courtesy of Michael G. Michlovic).

Harris Darling Collection

Present Owner: Harris Darling	**Present Location:** Worthington, Minnesota
Composition: 1 Fluted	**Provenience:** Big Slough, Murray County; Worthington
Accessibility: by Appointment with Harris Darling	**Previously Documented?:** Yes
Documentation Methods: Photographs; line drawings; fluted point data sheet completed	**References:** Shane n.d.

The Harris Darling collection was examined by ALAC on April 8, 2011. The collection is extensive and contains material from several areas in southern and southwestern Minnesota dating from the Paleoindian age through late prehistoric/protohistoric times. One fluted specimen in Darling's collection (Specimen 1) was previously documented by Orrin Shane (n.d.), then of the SMM (Figures 49 and 50) as Clovis. This specimen, which was collected by Darling from an island at Big Slough in Murray County, was examined in detail. Upon reexamination, it was determined that the specimen does not exhibit characteristics attributable to Clovis technology. It was also noted that Mr. Darling possesses a number of additional end scrapers and unifacial tools reminiscent of the Paleoindian style in his collection (Figures 51 and 52). Although the majority of the collection was obtained from Big Slough and the Worthington area, the exact provenience of the end scrapers and unifacial tools is uncertain.

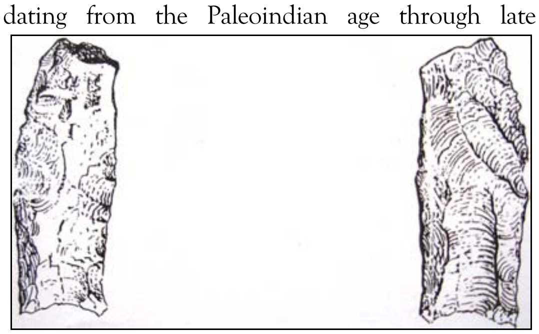


Figure 49. Scale line drawing of Harris Darling Specimen 1 (courtesy of the Science Museum of Minnesota).

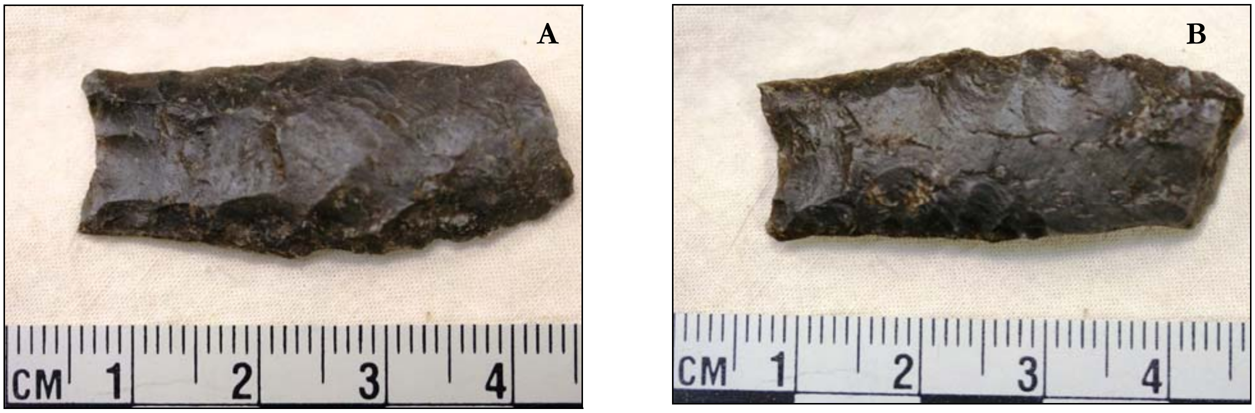


Figure 50. Harris Darling Specimen 1, obverse (A) and reverse (B).

Figure 51. Example of spurred end scrapers from the Darling Collection.

Figure 52. Example of Paleoindian-like unifacial tools from the Darling Collection.

Dennis Emerson Collection

Present Owner: Molly and Gary Van Winkle	**Present Location:** Tracy, Minnesota
Composition: No early Paleoindian specimens identified	**Provenience:** Lake Shetek, Murray County
Accessibility: By appointment with Molly Van Winkle	**Previously Documented?:** No
Documentation Methods: Visual inspection	**References:** N/A

The collection of the late Dennis Emerson was examined on April 1, 2011 following a report that it might contain a possible fluted point (LeRoy Gonsior, personal communication 2011). The daughter of Emerson and the present owner, Molly Van Winkle, brought the collection into ALAC's office for examination. Unfortunately, no Paleoindian artifacts were observed. Mrs. Van Winkle indicated that another framed arrowhead remained at her home with other rocks from her dad's collection, but that nothing there resembled a fluted lanceolate point.

Leota Silver Collection

Present Owner: Leota Silver	**Present Location:** Tracy, Minnesota
Composition: No fluted specimens identified	**Provenience:** Lake Shetek, Murray County
Accessibility: By appointment with Leota Silver	**Previously Documented?:** No
Documentation Methods: Photographs; sketches; specimen data sheet completed	**References:** N/A

The collection of Ms. Leota Silver was examined by ALAC on April 7, 2011 in Tracy, Minnesota. The Silver collection is small, containing only a handful of pieces obtained from lands located along the northern shores of Lake Shetek. Unfortunately, no fluted projectile points were observed; however, Ms. Silver's collection did include multiple artifacts with technological characteristics attributable to late Paleoindian groups.

Paula Nelson Collection

Present Owner: Paula Nelson	**Present Location:** Tracy, Minnesota
Composition: See below	**Provenience:** Lake Shetek, Murray County
Accessibility: By appointment with Paula Nelson	**Previously Documented?:** No
Documentation Methods: Photographs; sketches; specimen data sheet completed	**References:** N/A

The collection of Ms. Paula Nelson was examined by ALAC on April 7, 2011 in Tracy, Minnesota. The Nelson collection is extensive and includes hundreds of prehistoric artifacts of all varieties dating from Paleoindian times through the late pre-contact period. Nelson has been actively collecting artifacts from the Lake Shetek and Lake Sarah areas for about three decades. The majority of her collection comes from lands located along the northern and southeastern shores of Lake Shetek, and many of the specimens, albeit, not all of them, were visually inspected. No projectile points or tools clearly exhibiting early Paleoindian technological characteristics were observed; however, five different specimens were documented in greater detail. Specimens 1-3 exhibit late Paleoindian technological characteristics and are discussed in greater detail in Appendix B. Specimen 4, collected from the north shores of Lake Shetek in 2004, is a projectile point base produced on a yellowish-white colored chalcedony (Figure 53). It exhibits evidence of basal thinning on the obverse face, as well as edge grinding. It also possesses a possible faint flute on the reverse side, although the particular material type made it impossible to confirm macroscopically. Specimen 5 is a broken lanceolate preform base produced on a mottled gray colored, fusulinid chert (Figure 54). The specimen is straight-based and exhibits some edge grinding, although at this stage in the manufacturing process, it certainly is not indicative of any form of hafting preparatory work. Multiple flaws are evident in this piece, and these likely played a role in the final breaking. It exhibits some characteristics noted among other specimens associated with the Chesrow complex of the Great Lakes area (Overstreet 1993); however, far too little in the way of additional evidence exists to corroborate a definitive link at this time.

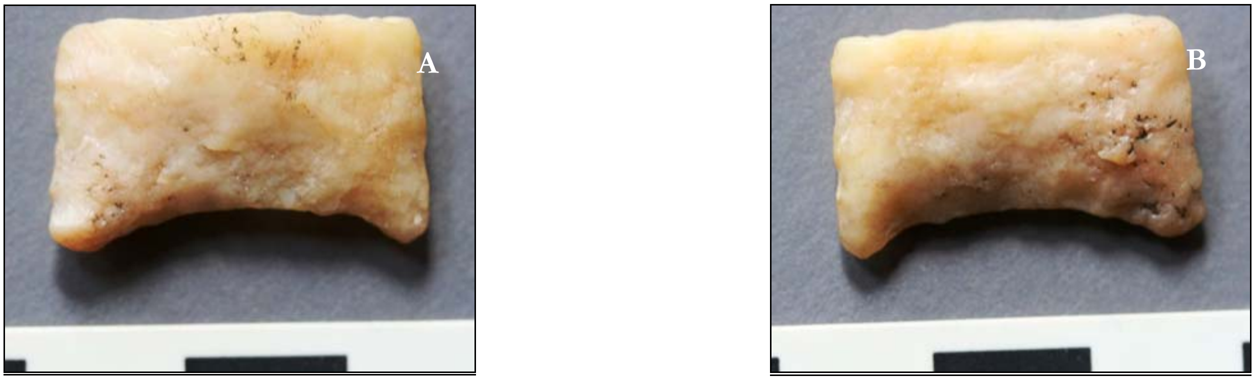


Figure 53. Paula Nelson Specimen 4, obverse (A) and reverse (B).

Figure 54. Paula Nelson Specimen 5, obverse (A) and reverse (B).

Gregg Nelson Collection

Present Owner: Gregg S. Nelson	**Present Location:** Owatonna, Minnesota
Composition: 3 Fluted	**Provenience:** Cobb River, Blue Earth County (Specimens 1 & 2); southeastern Minnesota (Specimen 3)
Accessibility: By appointment with Gregg Nelson	**Previously Documented?:** Yes (Specimen 1)
Documentation Methods: Photographs; line drawing	**References:** Higginbottom 1996; Kammerer 1963:155

The Gregg Nelson collection includes three complete fluted projectile point specimens. These specimens were very briefly examined by ALAC on February 19, 2011 at the Council for Minnesota Archaeology symposium, Inver Hills Community College, Inver Grove Heights, Minnesota. Consequently, no measurement data was obtained at the time. Specimens 1 and 2 (Figures 55-57) were reportedly discovered on a knoll overlooking the Cobb River in Blue Earth County, Minnesota. Specimen 1 was previously reported by both Higginbottom (1996) and Kammerer (1963:155); however, Higginbottom never actually examined the piece in person, and his account is based solely on Kammerer's brief announcement and illustration (see Figure 56) (Higginbottom 1996). Kammerer (1963:155) identifies the piece as an eastern fluted variety but does not offer any further specifics. The specimen is produced on Tongue River silica and exhibits basal grinding and grinding along the lateral margins from the ears distally to a point at which the flutes terminate.

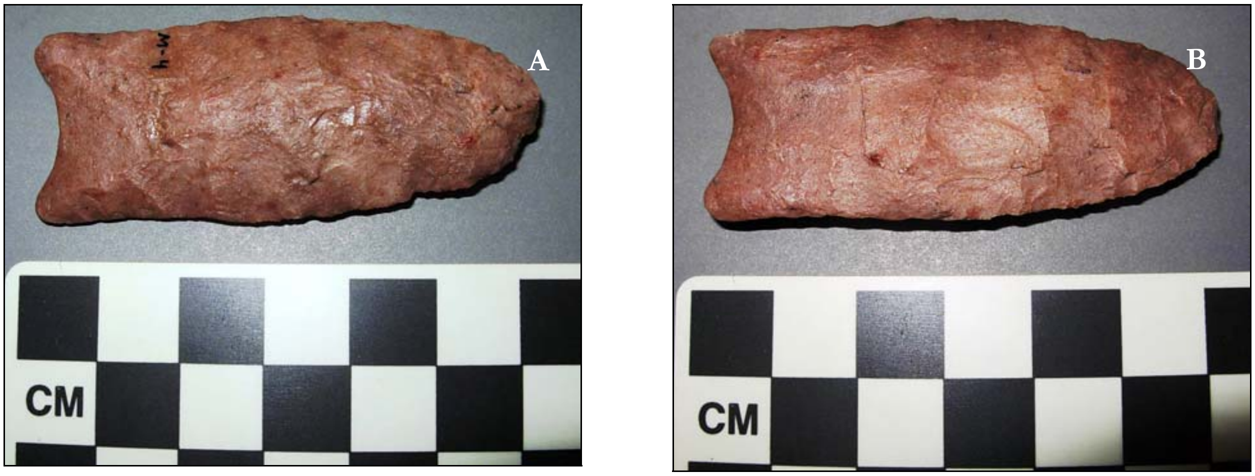


Figure 55. Gregg Nelson Specimen 1, obverse (A) and reverse (B).

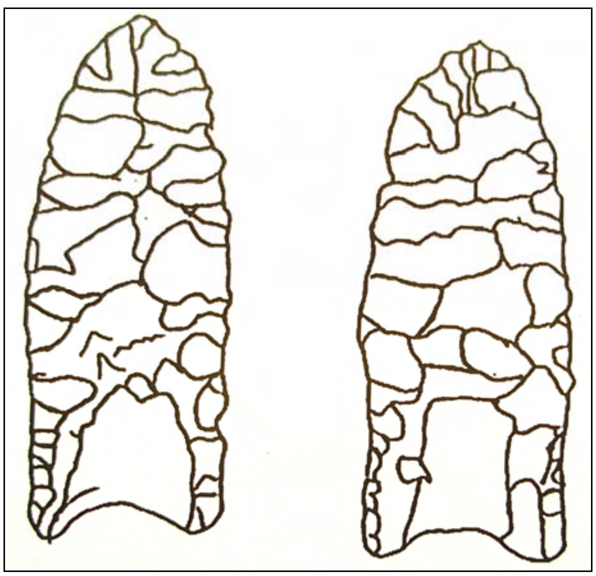


Figure 56. Scale line drawing of Gregg Nelson Specimen 1 (from Higginbottom 1996: Figure 4).

Specimen 2 is a bi-fluted projectile point produced on a butterscotch-colored chert or jasper. It was collected from the same general location as Specimen 1 (Gregg Nelson, personal communication 2011). It bears the designation M-47 on its obverse face.

Specimen 3 of Nelson's collection is a bi-fluted, heavily reworked complete projectile point produced on Hixton silicified sandstone (Figure 58). The specimen was collected from the southeastern corner of Minnesota; however, more precise provenience data is lacking (Gregg Nelson, personal communication 2011).

Figure 57. Gregg Nelson Specimen 2, obverse (A) and reverse (B).

Figure 58. Gregg Nelson Specimen 3, obverse (A) and reverse (B).

Arthur Gnadt Collection

Present Owner: Arthur Gnadt	**Present Location:** Gnadt Farm, Lake Wilson, Minnesota
Composition: 2 Folsom preform bases; 1 Folsom tip; 2 Clovis bases; 1 possible Clovis base	**Provenience:** Gnadt Farm and Lake Shetek/Current Lake, Murray County
Accessibility: By appointment with Arlen Gnadt (son)	**Previously Documented?:** No
Documentation Methods: Photographs; sketches; fluted point data sheet completed (see Appendix B)	**References:** N/A

The Arthur Gnadt collection was examined by ALAC on April 7, 2011 at the Gnadt farm approximately 1.5 miles west of Lake Wilson in Murray County. The farm is located on the Bemis Moraine just east of the high point of the Buffalo Ridge and immediately west of a low basin that was a kettle lake prior to its draining in 1920 (Arthur Gnadt, landowner, personal communication 2011). Gnadt's collection includes three incomplete Folsom projectile points and two likely Clovis bases, one possible Clovis base, and a lanceolate-shaped base of uncertain (though likely late Paleoindian) affiliation. Three of the pieces, Specimens 1-3, were collected from the surface of plowed hilltops on Gnadt's farm (Specimens 1 and 2) or from within a few miles of the farm (Specimen 3) (Arthur Gnadt, landowner, personal communication 2011). The remaining pieces, Specimens 4-7, were surface finds collected from the vicinity of Lake Shetek (near the Lutheran Bible Camp) and Current Lake further north and east of the farm in Murray County (Arthur Gnadt, landowner, personal communication 2011). An eighth fluted specimen, now unaccounted for, was purportedly also collected from the surface of one of the fields near the Gnadt farmhouse (Arthur Gnadt, landowner, personal communication 2011).

Gnadt Specimen 1 is the basal fragment of a bi-fluted Folsom preform collected from the surface of a small plowed hilltop just north of the farmhouse (Figure 59). Channel flakes have been removed from both faces of the specimen, the second of which resulted in the distal fracture. Edge and basal grinding are absent and the nipple platform is clearly visible on the proximal margin. Wide parallel-collateral flake scars are visible along the lateral margins. The material type is an unidentified gray mottled chert. It exhibits evidence of substantial surface abrasion due to prolonged exposure.

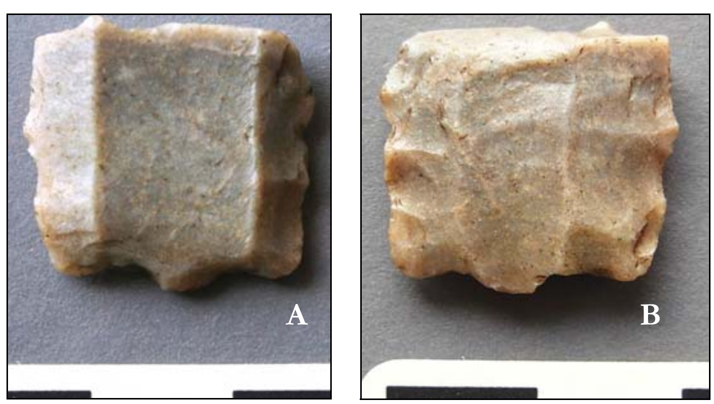


Figure 59. Arthur Gnadt Specimen 1, obverse (A) and reverse (B).

Gnadt Specimen 2 is the distal portion of a Folsom projectile point collected from the surface of a plowed hilltop just southwest of the Gnadt farmhouse (Figure 60). The specimen was produced from a flake blank and the very distal tip has been removed as a result of an impact fracture. The transverse fracture along the proximal end of the specimen is the result of a hinge fracture. Lateral grinding is present on both margins, but only near the very proximal end. The specimen was produced from an unidentified mottled, yellowish-gray colored, slightly translucent chert. Parallel-collateral flaking is present along both margins of the reverse face, while wide parallel flakes, some collateral and some slightly oblique, are present across the obverse surface.

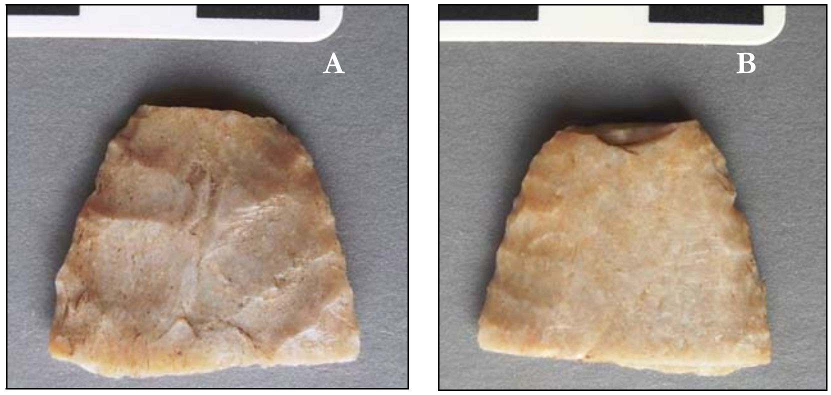


Figure 60. Arthur Gnadt Specimen 2, obverse (A) and reverse (B).

Gnadt Specimen 3 is the basal fragment of a bi-fluted projectile point collected from the surface of an unknown locality within a few miles of the Gnadt farm (Figure 61). Though difficult to discern, the flaking pattern on the margins appears to be primarily parallel, transitioning to slightly oblique on the ears. One of the ears has largely been removed, and it is also difficult to determine whether the specimen has been ground either basally or laterally. The material type of this specimen is a glossy, light pink-colored quartzite with small red speck inclusions.

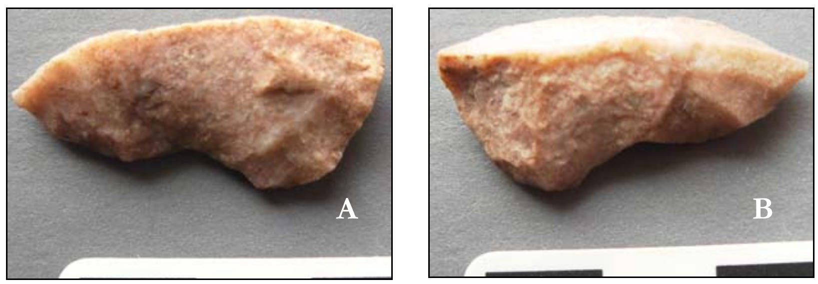


Figure 61. Arthur Gnadt Specimen 3, obverse (A) and reverse (B).

Gnadt Specimen 4 is an unfinished basal fragment of a bi-fluted projectile point collected from the surface of an unknown locality near either Current Lake or the Lutheran Bible Camp at Lake Shetek (Figure 62). The flaking pattern is largely parallel-collateral and grinding along the basal and lateral margins was not noted. The specimen is produced from a below-average quality piece of thermally altered Tongue River silicified sediment, as evidenced by multiple inclusions/ imperfections. One of these, partially visible along the distal margin of the obverse face, was probably responsible for the transverse break there.

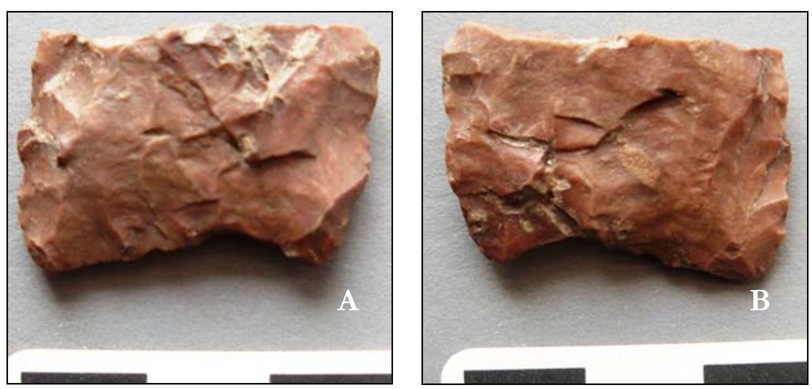


Figure 62. Arthur Gnadt Specimen 4, obverse (A) and reverse (B).

Gnadt Specimen 5 is the basal fragment of a projectile point preform/possible knife collected from the surface of an unknown locality near either Current Lake or the Lutheran Bible Camp at Lake Shetek (Figure 63). The flaking pattern is largely parallel-collateral and grinding along one lateral margin was not noted. However, slight grinding appears present along the base, as well as along the more distal portion of the opposite, slightly beveled, lateral margin. A small, shallow flute, terminating in a hinge fracture, is present on the obverse face of the specimen; however, the reverse face is unfluted. Like Specimen 4, this specimen is also produced from a below-average quality piece of thermally altered Tongue River silicified sediment, as evidenced by multiple inclusions/imperfections. The distal tip has been removed by way of a transverse fracture, the ultimate cause of which may be a small inclusion visible along this break on the reverse face. One of the ears has also been broken. This specimen is rather perplexing, and although it would require a more detailed analysis to confirm, it almost seems as though it was initially intended to be a projectile point but ultimately became a knife. Perhaps the material had too many imperfections to allow its manufacturer to produce a viable projectile point and it ended up serving a different purpose. If this is, in fact, the case, then the perceived "grinding" observed on the base and one lateral margin may actually be the result of usewear and/or hafting wear.

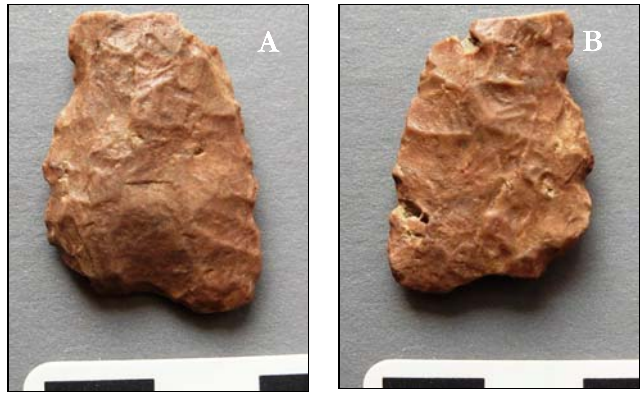


Figure 63. Arthur Gnadt Specimen 5, obverse (A) and reverse (B).

Gnadt Specimen 6 is the basal fragment of a lanceolate projectile point collected from the surface of an unknown locality near either Current Lake or the Lutheran Bible Camp at Lake Shetek (Figure 64). The flaking pattern is largely parallel collateral and light grinding is present along the basal and lateral margins. The specimen is produced on an unidentified mottled, light-grayish-colored opaque chert. A series of small thinning flakes have been removed from the base and the distal margin is characterized by a transverse fracture.

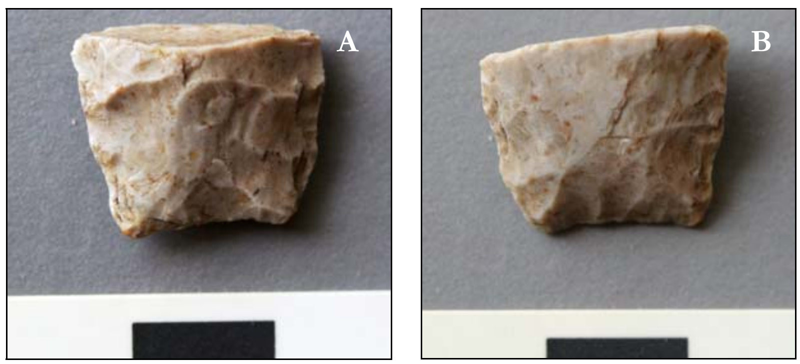


Figure 64. Arthur Gnadt Specimen 6, obverse (A) and reverse (B).

Gnadt Specimen 7 is the basal fragment of a Folsom preform collected from the surface of an unknown locality near either Current Lake or the Lutheran Bible Camp at Lake Shetek (Figure 65). The specimen is produced on a lustrous, white and gray-colored banded opaque chert. The texture is similar to that of Burlington chert. A single channel flake removed from the obverse face of the specimen resulted in the distal fracture and the collapsing of one of the ears. Edge and basal grinding are absent and the nipple platform is clearly visible medially along the proximal margin.

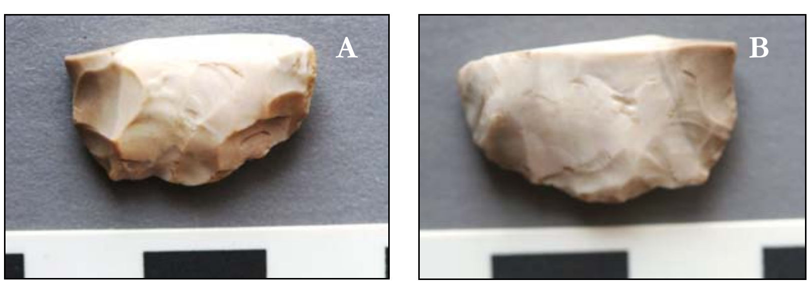


Figure 65. Arthur Gnadt Specimen 7, obverse (A) and reverse (B).

Bruce and Christy Hess Collection

Present Owner: Bruce & Christy Hess	**Present Location:** Luverne, Minnesota
Composition: 3 retouched Knife River flint overshot flakes; 1 unfluted projectile point base	**Provenience:** Site 21RK14 and 1.5 miles northeast of site
Accessibility: By appointment with Bruce Hess	**Previously Documented?:** No
Documentation Methods: Photographs; sketches; projectile point data sheet completed	**References:** N/A

The collection of Bruce and Christy Hess was examined by ALAC on May 18, 2011 in Luverne, Minnesota. The collection includes numerous artifacts ranging temporally from Paleoindian times through the post-contact period. The Hess family has been actively collecting artifacts from the Rock River valley near Blue Mounds State Park for the better part of 10 years. The majority of the collection comes from upland bluffs and hilltops located along the eastern valley margins across from the state park, many of which are associated with site 21RK14 (see below). No projectile points or tools clearly exhibiting early Paleoindian technological characteristics were observed; however, three retouched overshot flake tools and one obsidian tertiary flake were observed in the collection (Figure 66), and one unfluted projectile point base (Specimen 1) was documented in greater detail. Each of the three overshot flakes is produced from a chocolate brown-colored chalcedony resembling Knife River flint and exhibits unifacial retouch on at least one lateral margin. These flakes, together with the obsidian flake, were collected by Mr. Hess from site 21RK14. Specimen 1 (Figure 67) was collected by Mr. Hess from an upland site area located approximately 1.5 miles northeast of site 21RK14. The point base exhibits evidence of basal thinning on both faces, as well as heavy basal and lateral grinding. Grinding is present on the entirety of both remaining lateral margins. The material type is an unidentified light grayish pink-colored, thermally altered chert. Flaking patterns were generally difficult to discern, although a short series of parallel-oblique flakes were noted on the left side of the obverse face. The oblique angle of these flakes may, however, simply relate to their location along the basal margin and they are not necessarily reflective of the flaking pattern used on the more distal portions of the piece. This specimen is further detailed in Appendix B.

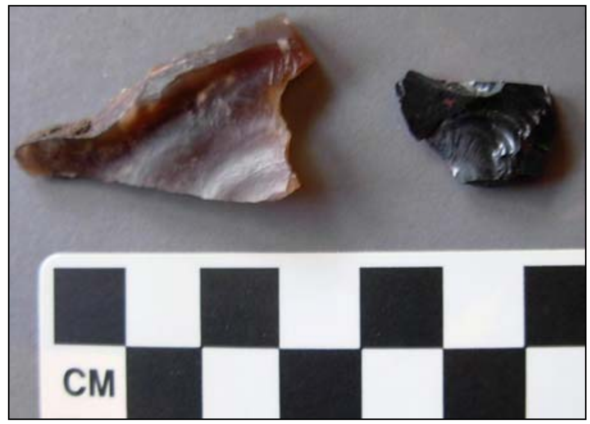


Figure 66. Retooled Knife River flint overshot flake (left) and obsidian tertiary flake (right) from site 21RK14, Bruce Hess collection.

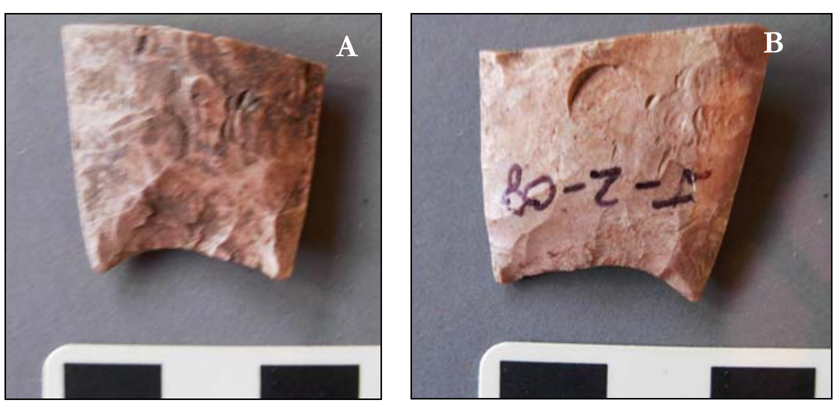


Figure 67. Bruce Hess Specimen 1, obverse (A) and reverse (B).

Joseph Neubauer, Senior Collection

Present Owner: Joseph Neubauer, Sr.	**Present Location:** Pine City, Minnesota
Composition: 5 Clovis; 5 Folsom; 3 Holcombe; 3 Gainey	**Provenience:** Along Snake River and its tributaries in the Pine City area
Accessibility: By permission from Joe Neubauer	**Previously Documented?:** Yes (10 specimens)
Documentation Methods: Photographs (Mulhollands); line drawings (Shane); metric data obtained (Mulhollands)	**References:** Higginbottom 1996; S. C. Mulholland and S. L. Mulholland 2011; S. L. Mulholland and S. C. Mulholland 2011; Shane n.d.

The following information concerning the projectile point specimens from the Joseph Neubauer, Sr. Collection and the Bernard Langdahl Collection has been provided by Susan C. and Stephen L. Mulholland, DAC, Duluth and is based on their recent reevaluation of the Neubauer specimens (see S. C. Mulholland and S. L. Mulholland 2011; S. L. Mulholland and S. C. Mulholland 2011) and previous data obtained from an examination of Langdahl's piece. The Neubauer Collection contains at least 16 fluted points (Holcombe are here considered a fluted variant) from the general Pine City, Minnesota area. Many of the points were collected from farm fields on the banks of the Snake River and its tributaries, primarily west of Pine City but including localities to the south and north. The collection is currently owned by Joseph Neubauer, Sr. and is located in Pine City, Minnesota. The points have been photodocumented and measured by Susan C. and Stephen L. Mulholland for future publication. Material types include Hixton Silicified sandstone, Fat Rock quartz (metamorphosed), bull/vein quartz, Prairie du Chien chert, brecciated Kakabeka Falls chert, and Cedar Valley chert (provisional).

Specimen 1 (Figure 68; see Higginbottom 1996: Figure 34) is a complete Clovis point made from Hixton silicified sandstone. Its measurements are: length 9.501 cm; width 3.145 cm; thickness (just above the flutes) 0.756 cm; weight 24.92 g; basal width 2.606 cm; basal concavity 0.316 cm.

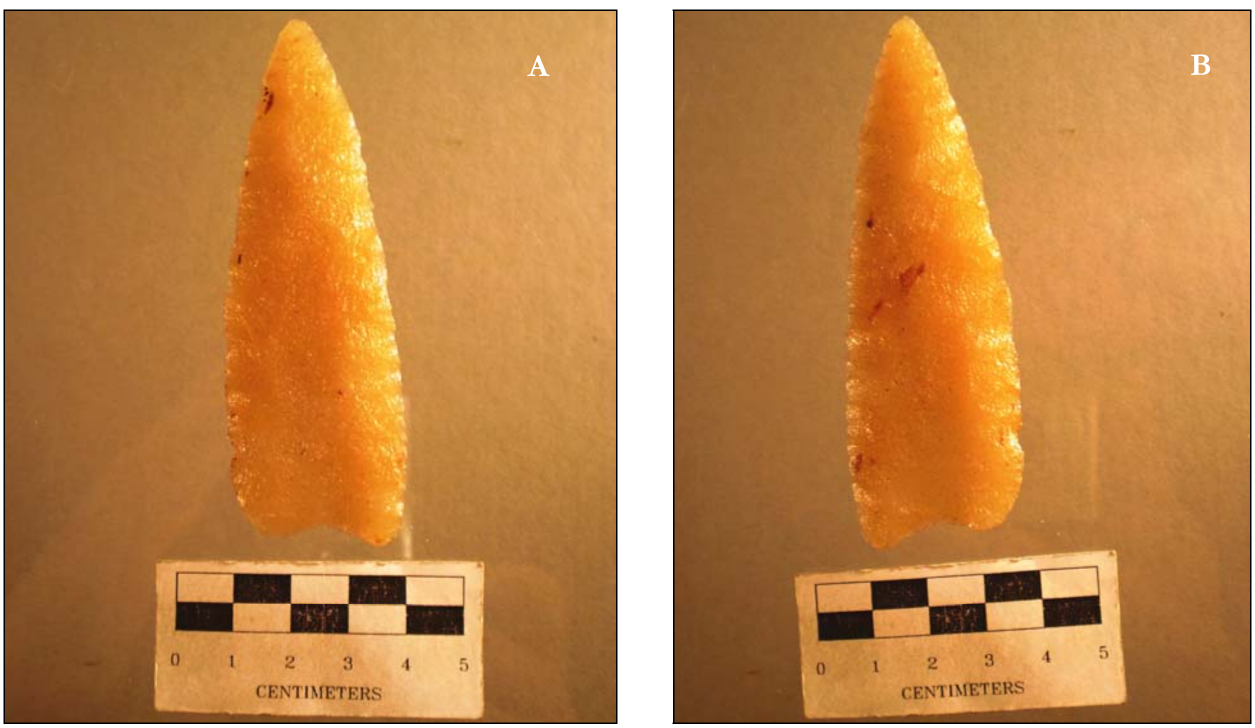


Figure 68. Neubauer Specimen 1, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 2 (Figure 69; see Higginbottom 1996: Figure 32) is a complete Gainey point made from Hixton silicified sandstone. Its measurements are: length 4.330 cm; width 2.364 cm; thickness 0.704 cm; weight 7.44 g; basal width 2.111 cm; basal concavity 0.760 cm.

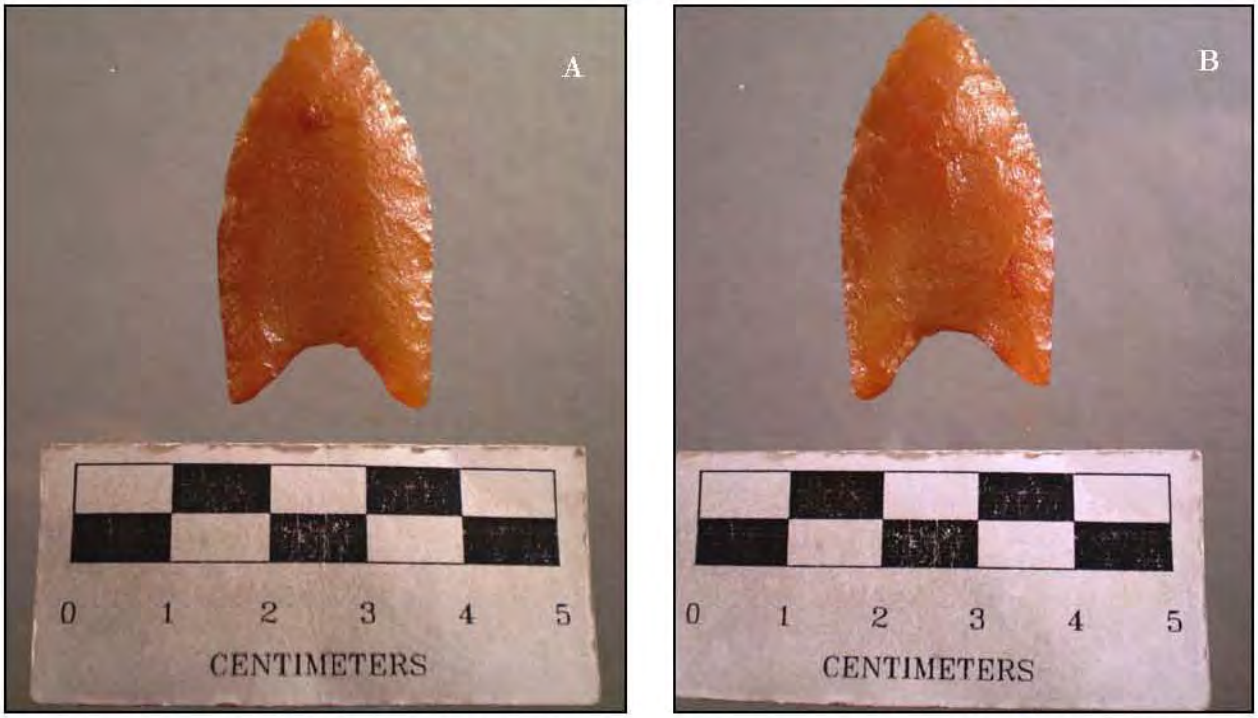


Figure 69. Neubauer Specimen 2, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 3 (Figure 70) is a complete Folsom point made from Cedar Valley chert (provisional). Its measurements are: length 2.896 cm; width 1.958 cm; thickness 0.395 cm; weight 2.86 g; basal width 1.750 cm; basal concavity 0.344 cm.

Figure 70. Neubauer Specimen 3, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 4 (Figure 71; see Higginbottom 1996: Figure 33) is a complete Folsom point made from Prairie du Chien chert. Its measurements are: length 2.700 cm; width 1.667 cm; thickness 0.466 cm; weight 2.25 g; basal width 1.627 cm; basal concavity 0.366 cm.

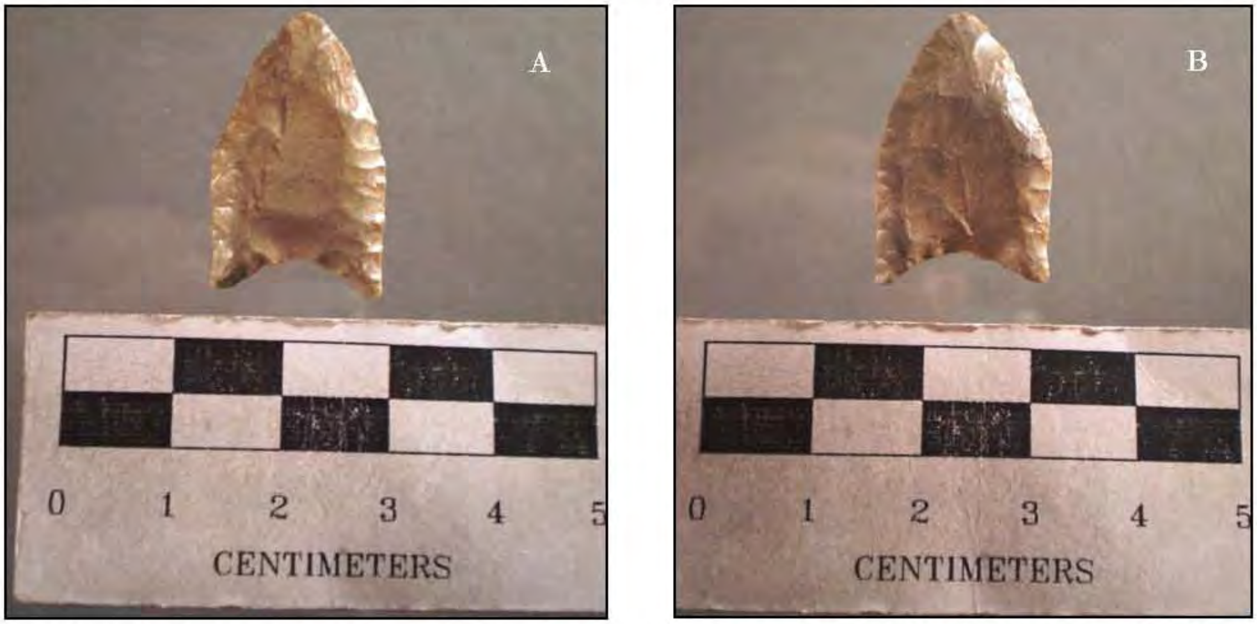


Figure 71. Neubauer Specimen 4, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 5 (Figure 72; see Higginbottom 1996: Figure 36) is the basal portion of a bi-fluted Folsom point made from Prairie du Chien chert. Its measurements are: length (broken) 2.178 cm; width (at break) 2.196 cm; thickness (at break) 0.517 cm; weight 2.78 g; basal width 1.799 cm; basal concavity 0.369 cm.

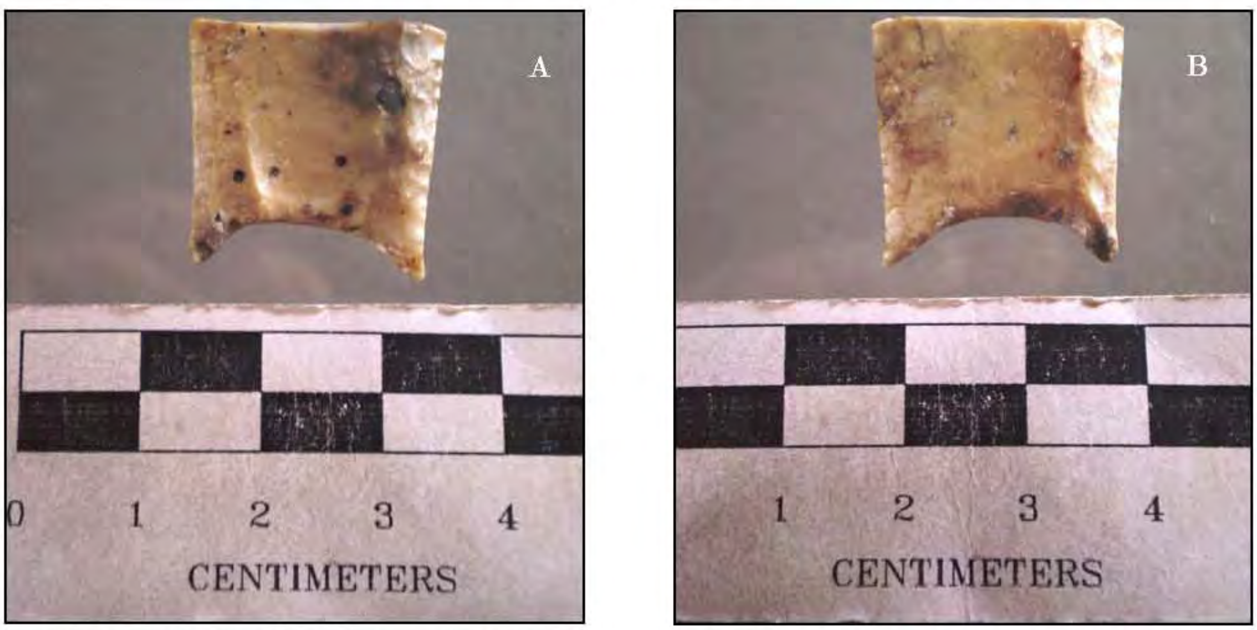


Figure 72. Neubauer Specimen 5, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 6 (Figure 73) is the basal portion of a Folsom point made from a medium to dark gray colored chert (possibly Grand Meadow). Its measurements are: length (broken) 2.274 cm; width (just below break) 1.732 cm; thickness (near base) 0.341 cm; weight 1.64 g; basal width 1.708 cm; basal concavity 0.422 cm.

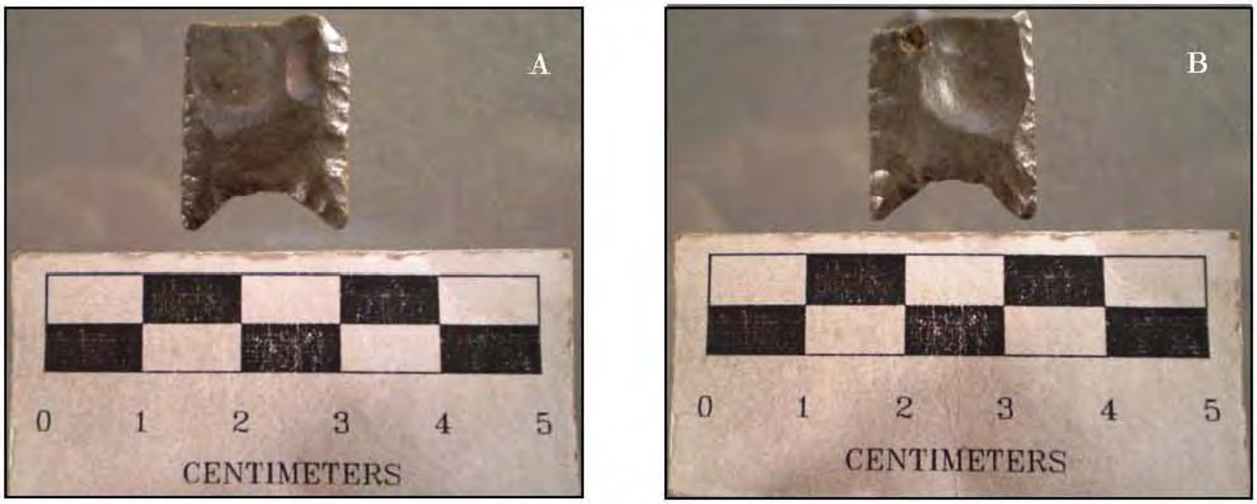


Figure 73. Neubauer Specimen 6, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 7 (Figures 74 and 75) is a Clovis point made from Fat Rock quartz, possibly from the Little Falls, MN area. The oblique angle shows the layering of the quartz from its metamorphosis. Its measurements are: length 5.600 cm; width 2.968 cm; thickness 0.816 cm; weight 15.93 g; basal width 1.859 cm; basal concavity 0.070 cm.

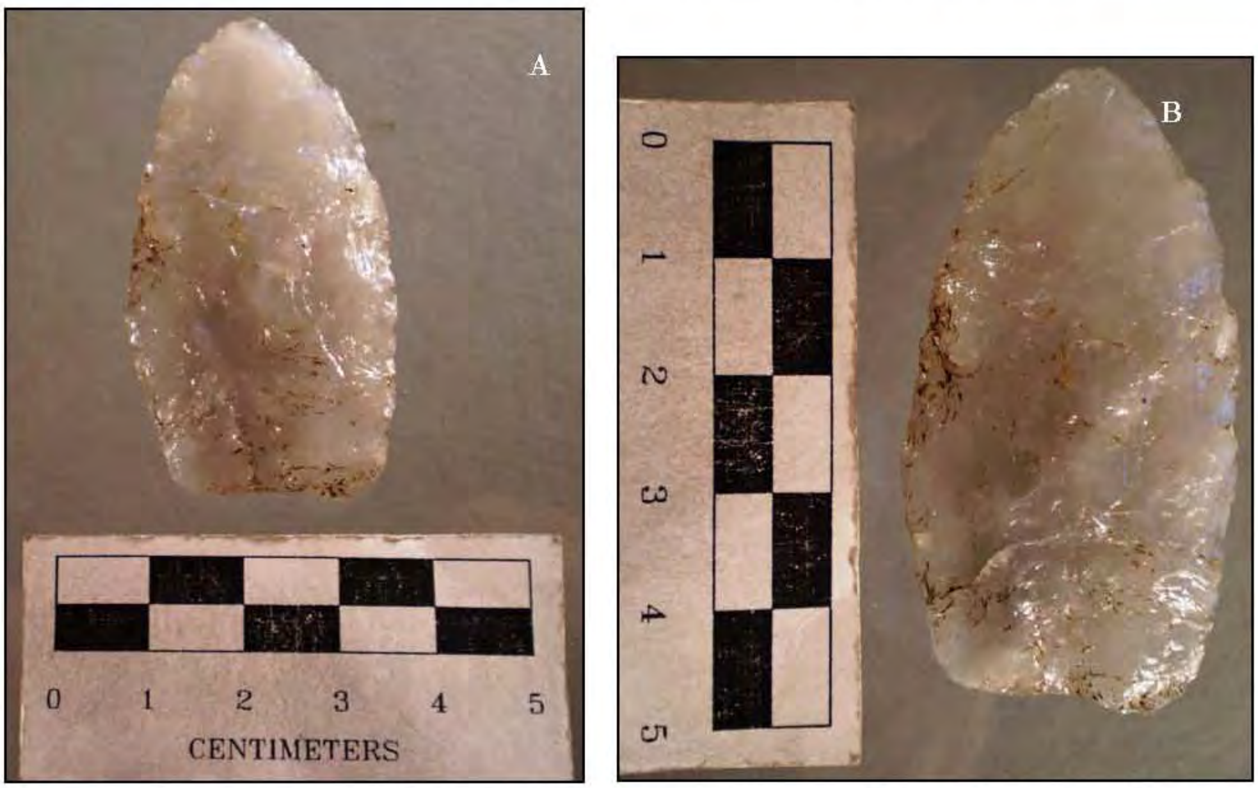


Figure 74. Neubauer Specimen 7, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Figure 75. Neubauer Specimen 7, oblique view highlighting layering of quartz and flute (courtesy of Duluth Archaeology Center).

Specimen 8 (Figure 76) is a complete Holcombe point made from Biwabik silica. Its measurements are: length 3.997 cm; width 2.438 cm; thickness 0.638 cm; weight 6.40 g; basal width 2.106 cm; basal concavity 0.229 cm.

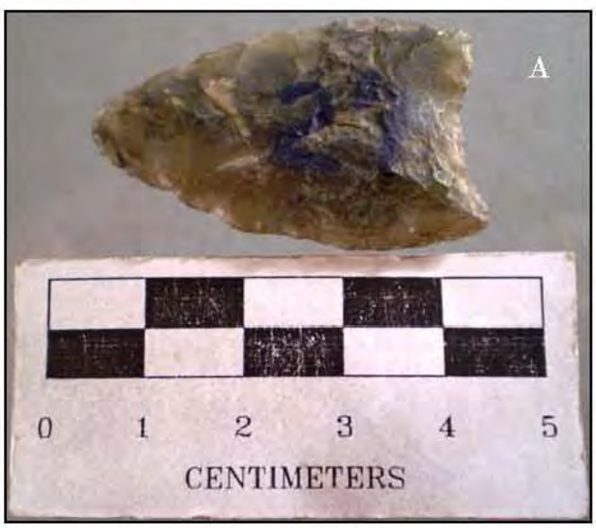


Figure 76. Neubauer Specimen 8, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 9 (Figure 77; see Higginbottom 1996: Figure 35) is a complete Holcombe point made from brecciated Kakabeka Falls chert. Its measurements are: length 3.226 cm; width 2.094 cm; thickness 0.495 cm; weight 3.23 g; basal width 1.745 cm; basal concavity 0.247 cm.

Figure 77. Neubauer Specimen 9, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 10 (Figure 78) is a Clovis point made from what appears to be thermally altered Prairie du Chien chert. Its measurements are: length 5.025 cm; width 2.643 cm; thickness 0.798 cm; weight 11.64 g; basal width 1.913 cm; basal concavity 0.272 cm.

Figure 78. Neubauer Specimen 10, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 11 (Figure 79; see Higginbottom 1996: Figure 37) is a Clovis point made from Hixton silicified sandstone. It is broken and is fluted on the obverse side only. Its measurements are: length (broken) 3.217 cm; width (at break) 2.326 cm; thickness (at break) 0.522 cm; weight 4.97 g; basal width 1.218 cm; basal concavity 0.063 cm.

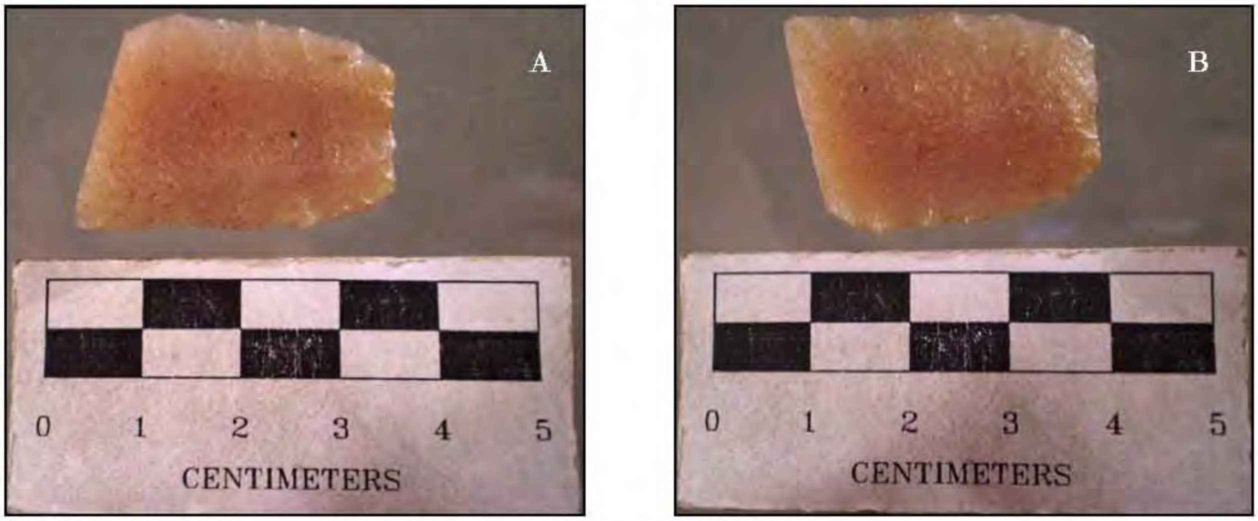


Figure 79. Neubauer Specimen 11, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 12 (Figure 80; see Higginbottom 1996: Figure 38) is a Holcombe point made from an undetermined chert. It exhibits multiple flutes and the distal tip has been removed. Its measurements are: length 3.301 cm; width (at midpoint) 2.289 cm; thickness (at midpoint) 0.642 cm; weight 5.69 g; basal width 2.046 cm; basal concavity 0.237 cm.

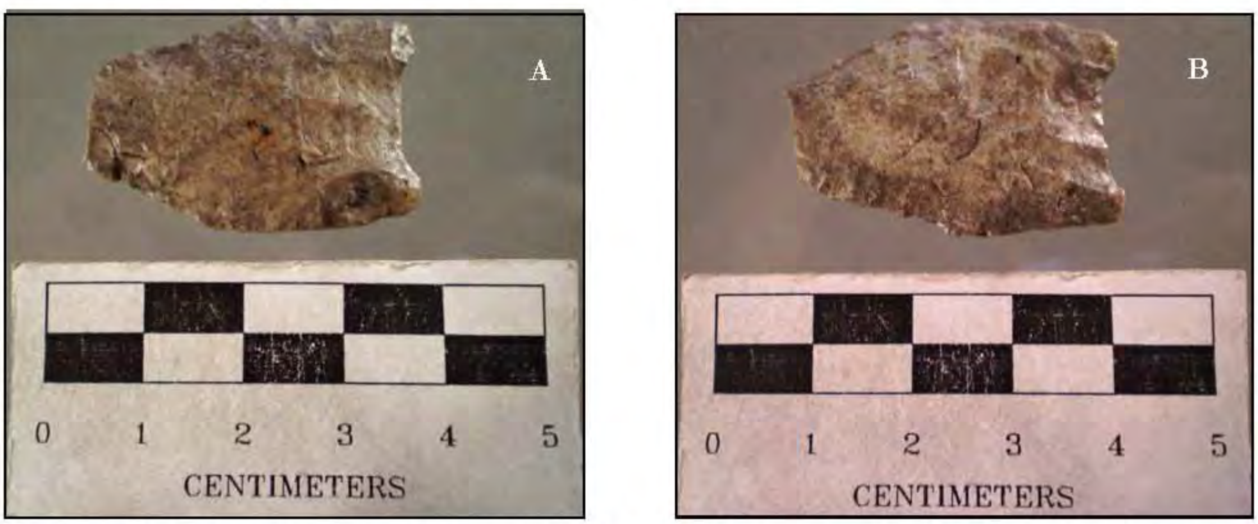


Figure 80. Neubauer Specimen 12, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 13 (Figure 81) is a possible Clovis point made from Knife Lake siltstone. Its measurements are: length 3.805 cm; width 1.988 cm; thickness (at midpoint) 0.600 cm; weight 5.55 g; basal width 1.964 cm; basal concavity 0.072 cm.

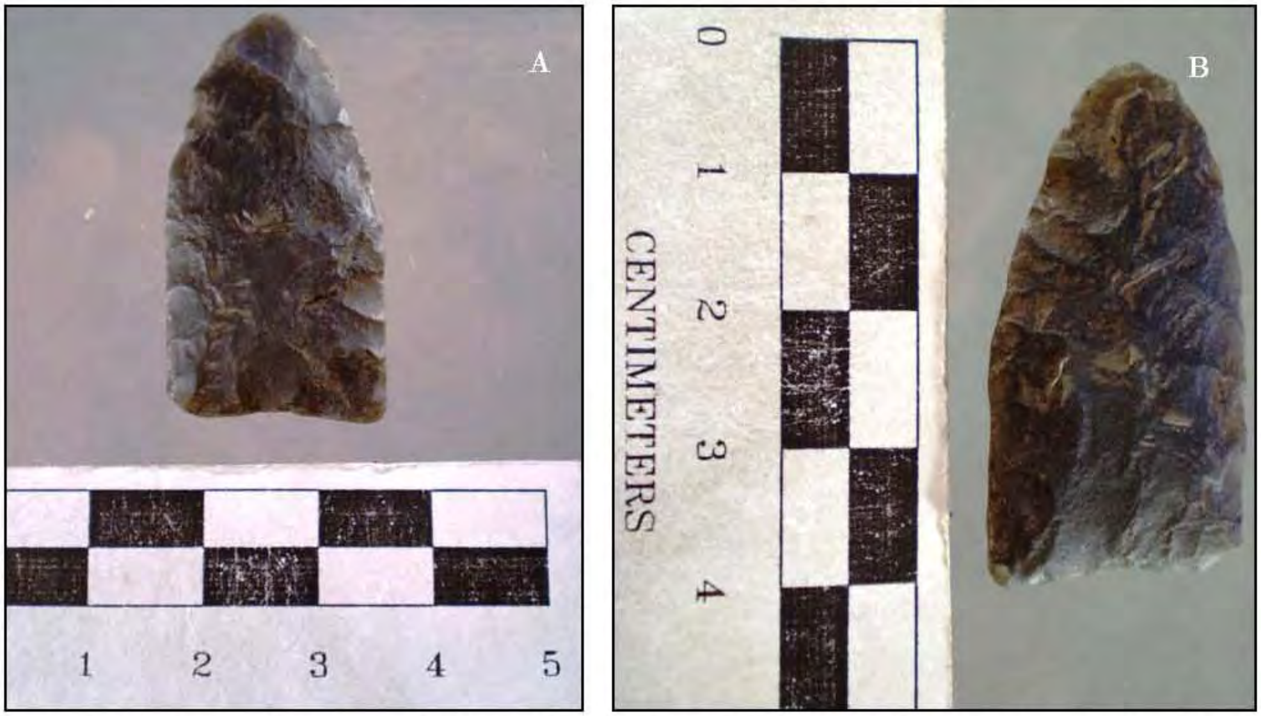


Figure 81. Neubauer Specimen 13, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 14 (Figure 82) is a Gainey point that has been reworked into an asymmetrical knife made from Swan River chert. Its measurements are: length 4.776 cm; width 2.311 cm; thickness 0.645 cm; weight 7.40 g; basal width 2.233 cm; basal concavity 0.315 cm.

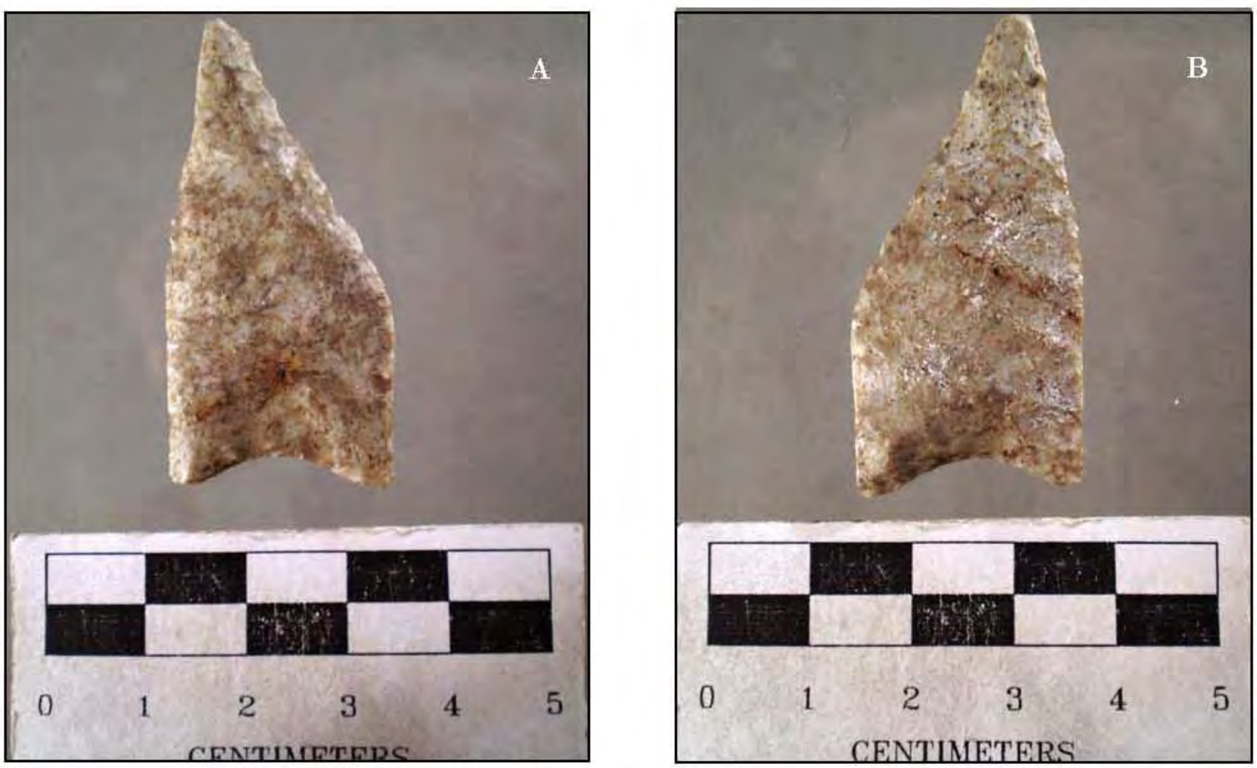


Figure 82. Neubauer Specimen 14, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 15 (Figure 83) is a basal portion of a Folsom point made from Hixton silicified sandstone. Its measurements are: length 2.911 cm; width 1.749 cm; thickness 0.470 cm; weight 1.61 g; basal concavity 0.272 cm. A measurement was not obtained for the basal width because one of the ears was broken off.

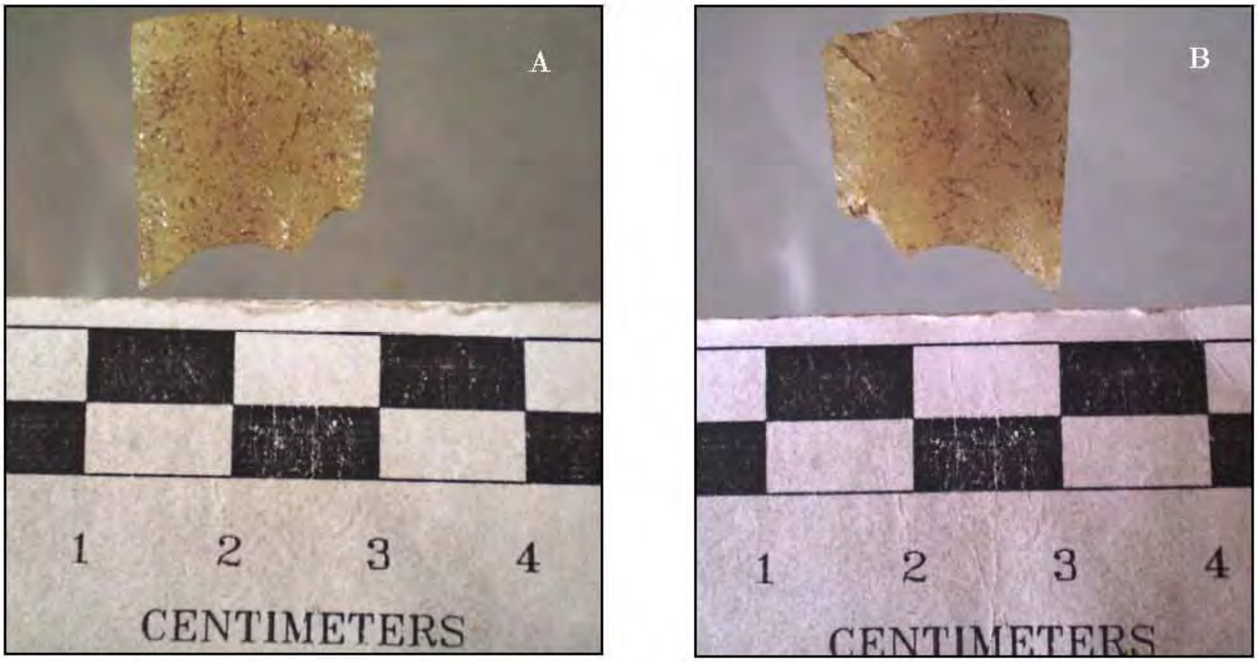


Figure 83. Neubauer Specimen 15, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Specimen 16 (Figures 84 and 85) is a Gainey point made from vein quartz. The distal tip has been removed. Its measurements are: length (broken) 3.044 cm; width 2.208 cm; thickness 0.699 cm; weight 5.10 g; basal width 1.884 cm; basal concavity 0.346 cm.

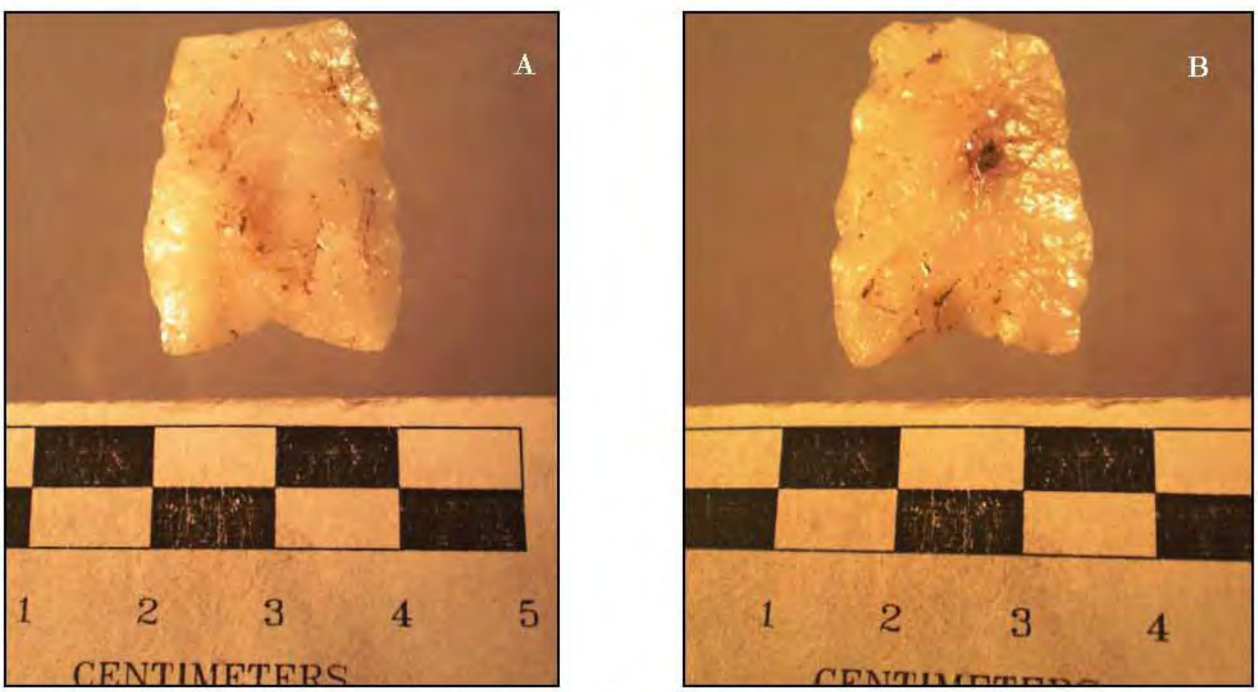


Figure 84. Neubauer Specimen 16, obverse (A) and reverse (B) (courtesy of Duluth Archaeology Center).

Figure 85. Neubauer Specimen 16, oblique view highlighting flute (courtesy of Duluth Archaeology Center).

Bernard Langdahl Collection

Present Owner: Duluth Archaeology Center	**Present Location:** Duluth, Minnesota
Composition: 1 Gainey	**Provenience:** Fish Lake Reservoir
Accessibility: By appointment with DAC	**Previously Documented?:** No
Documentation Methods: Photographs; metric data obtained	**References:** N/A

The Bernard Langdahl specimen (Figure 86) is a Gainey point that is currently in the DAC curation facility in Duluth, Minnesota. The specimen was donated to DAC a number of years ago by Mr. Bernard Langdahl (now deceased). It was found by Mr. Langdahl in the Fish Lake Reservoir area north of Duluth, most likely in the Cloquet/Beaver River drainage. It is fluted on both sides, extensively resharpened, and is made from Prairie du Chien chert.

Figure 86. Langdahl Specimen 1, obverse face (courtesy of Duluth Archaeology Center).

Belle Plaine Collection

Present Owner: Unspecified	**Present Location:** Belle Plaine, Minnesota
Composition: 1 Fluted	**Provenience:** Scott County
Accessibility: Uncertain (inquire with Steve Mulholland)	**Previously Documented?:** No
Documentation Methods: Photographs	**References:** N/A

This specimen was recently observed and photographed by Stephen Mulholland, DAC (Figure 87). It is currently part of a private collection in Belle Plaine, Minnesota, although the owner did not wish to be mentioned. It was reportedly discovered from an unknown location in Scott County (Stephen Mulholland, personal communication 2011). Little else is know at this time.

Figure 87. Fluted point from private collection in Belle Plaine, Scott County, Minnesota (courtesy of Stephen L. Mulholland).

Site 21RC6 Collection

Present Owner: Unspecified	**Present Location:** Lonsdale, Minnesota
Composition: 2 Fluted	**Provenience:** Rice County, near Lonsdale
Accessibility: Uncertain (inquire with Gregg Nelson)	**Previously Documented?:** No
Documentation Methods: Photographs	**References:** N/A

These specimens, photographed by Gregg Nelson, are currently part of a private collection in Lonsdale, Minnesota, although the owner's name is unknown to the author. Both pieces are reportedly part of a much more extensive surface collection from site 21RC6 in Rice County (Gregg Nelson, personal communication 2011). Little else is know at this time. Though difficult to discern, both specimens are fluted.

Figure 88. Two fluted points in a private collection from site 21RC6 near Lonsdale, Rice County, Minnesota (courtesy of Gregg Nelson).

Lloyd Dugstad Collection

Present Owner: Unknown	**Present Location:** Unknown
Composition: at least 10 Fluted	**Provenience:** Freeborn County; Root River valley in Fillmore and Mower counties; unknown
Accessibility: Uncertain	**Previously Documented?:** No
Documentation Methods: Photographs	**References:** N/A

These specimens are from the collection of the late Lloyd Dugstad of Freeborn County. Unfortunately, the entire collection was sold subsequent to his death and their whereabouts are no longer accounted for. The majority of Dugstad's collection was reportedly obtained from Freeborn County and other nearby counties, including several areas along the Root River drainage in Fillmore and Mower counties (Mike Bradley, personal communication 2011). Two pieces were reportedly collected from near Rushford in Fillmore County (Figure 89); however, the remaining specimens (Figure 90) are from areas of uncertain provenience (Mike Bradley, personal communication 2011). Mike Bradley of Freeborn County photographed these specimens prior to their being sold. Little else is known about this collection.

Figure 89. Fluted specimens from the Lloyd Dugstad Collection reportedly recovered from near Rushford, Fillmore County, Minnesota (courtesy of Mike Bradley).

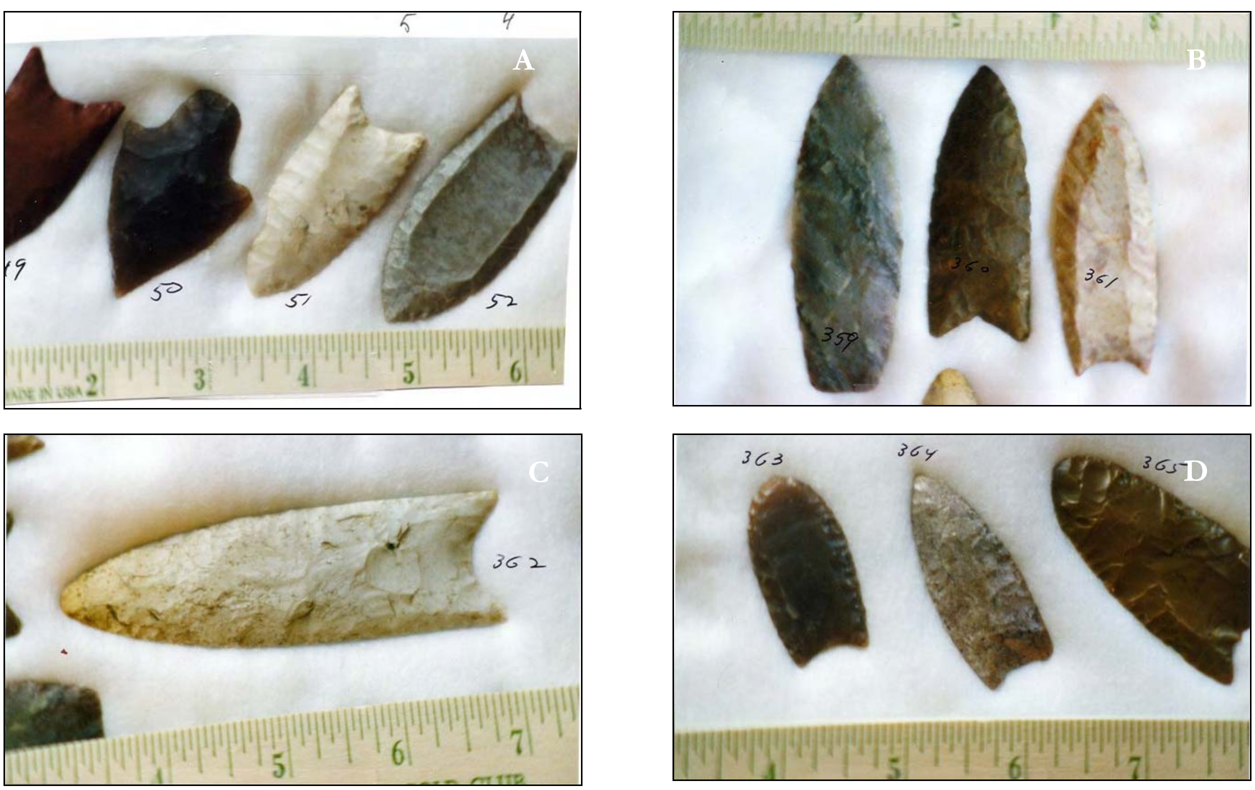


Figure 90. Fluted and other specimens from the Lloyd Dugstad Collection, provenience unknown (courtesy of Mike Bradley).

THE SEARCH FOR EARLY PALEOINDIAN SITES IN MINNESOTA: A GEOARCHEOLOGICAL PERSPECTIVE

INTRODUCTION

The emergence of archeological geology, or geoarcheology, in North America is strongly linked to Paleoindian studies (Holliday 2000; Mandel 2000). These studies began in the mid- to late 1920s with the discoveries at the Folsom site in New Mexico, but it was work at the Clovis site (New Mexico) during the 1930s that established a tradition of integrating geoscientific investigations with Paleoindian research (Holliday 1997:1). This tradition has persisted into the twenty-first century, and geoarcheology continues to play a significant role in analysis of early sites. Geoscientific methods also have been used to develop predictive models for locating stratified late Wisconsin and early Holocene cultural deposits that may contain Paleoindian cultural deposits (e.g., Mandel 2008).

The open grasslands of the midcontinent have yielded some of the most important Paleoindian sites in the Western Hemisphere (Holliday 1997:1; Holliday and Mandel 2006; Hofman and Graham 1998; Stanford 1999). Although material evidence of Paleoindians has been discovered throughout the Great Plains and Central Lowlands, many of the sites with buried, *in situ*, and, in many cases, stratified occupations, such as Clovis, Plainview, Lubbock Lake, Lindenmeier, Hell Gap, Scottsbluff, Olsen-Chubbuck, Lime Creek, Dutton, Lange-Ferguson, and Agate Basin, are found on the High Plains (Holliday and Mandel 2006). The Southern High Plains of Texas and New Mexico and the Western High Plains of Colorado and Wyoming have especially high concentrations of recorded Early Paleoindian sites (Albanese 2000; Holliday 2000). This pattern, however, does not hold in the western Great Lakes region. Despite finds of Early Paleoindian projectile points on uplands and in streambed contexts, few *in situ* camp and kill sites predating 10,300 RCYBP have been documented in the region. The dearth of recorded, stratified Early Paleoindian sites is especially apparent in Minnesota, an area that should have been attractive to the early human inhabitants of North America (Phillips and Hill 2004).

The paucity of recorded Early Paleoindian sites in Minnesota may be partially attributed to insufficient archeological investigations in the region. Although archeological surveys have been conducted in Minnesota, especially in association with highway construction projects, most involved only shallow shovel testing and/or surface survey. Deep testing was not common in the state until after 1980, and it was not until relatively recently that a clearly defined protocol for deep testing became available (Monaghan et al. 2006). Also, few systematic archeological surveys have been conducted in sparsely populated northern and northwestern Minnesota and only a few of those involved deep testing.

The low number of recorded Early Paleoindian sites in Minnesota probably is not just a result of insufficient surveying, but is a product of the filtering effects of geomorphic processes on the regional archeological record. Specifically, the geomorphic settings and associated micro-environments that would have been most attractive to the early residents of the region—stream valleys, proglacial lakes, and kettle ponds/wetlands—also were zones of episodic sedimentation during the terminal Pleistocene. Consequently, Paleoindian-age landscapes that may harbor *in situ* cultural deposits tend to be buried and are rarely detected unless deep archeological testing is employed. Also, during the Holocene, entrenchment and lateral migration of stream channels most certainly removed some of the late-Wisconsinan alluvial deposits that contained Early Paleoindian cultural deposits.

The primary goal of this study was to determine where Early Paleoindian cultural deposits are likely to occur in buried contexts in Minnesota. The following question was specifically addressed: Have buried Paleoindian-age landscapes been identified in Minnesota, and if so, where do they occur in the landscape? The geoarcheological investigation originally focused on the Rock River valley in southwestern Minnesota, though LsSA's in a small area near Lake Benton were also mapped during the MN/Model project (see pages 105-106, below). Initially, the results of Curt Hudak and Ed Hajic's geomorphological investigations in the Rock River basin (Hudak and Hajic 2002) were reviewed. Subsequent to this, a reconnaissance was conducted in the main stem of the Rock River valley. This was followed by a review of the entire MN/Model, a GIS-based modeling tool that includes maps that depict the potential for pre-1837 surface archeological sites throughout Minnesota. Although the MN/Model does not provide specific information on buried Paleoindian-age landscapes, the soil stratigraphic and radiocarbon data were used to identify areas where Early Paleoindian cultural deposits may occur in buried contexts.

THE ROCK RIVER VALLEY

Physiography and Surface Geology

The Rock River originates at the crest of the Coteau des Prairies along the Bemis Moraine. From this point, it flows south before joining the Big Sioux River in northwestern Iowa. The Coteau des Prairies is a wedge-shaped plateau about 320 kilometers long and 160 kilometers wide that stands above the surrounding plains of southwestern Minnesota. The area is covered with loess that thickens to the southwest and probably has a source from the outwash deposits of the Sioux River (Hudak and Hajic 2002). The loess overlies pre-Wisconsin and Wisconsin-age glacial tills. Two lobes of ice appear to have parted around the pre-existing plateau and further deepened the lowlands that flank it. A small ridge of resistant Cretaceous shale underlies the glacial deposits.

Glacial end moraines are situated at the crest of the Coteau des Prairies and are responsible for the outwash that initially carved the Rock Valley. The Rock River valley carried large volumes of meltwater and sediment from the margin of the late-Wisconsinan Des Moines lobe, especially from an outwash channel emanating from the Bemis moraine (Patterson 1997); however, today it is an underfit stream.

Landscape Sediment Assemblages

According to Hudak and Hajic (2002), seven landscape sediment assemblages (LsSA's) comprise the Rock River valley: the Upland; Pediment; Glaciofluvial; Paleo-Valley; Valley Terrace; Floodplain; and Valley Margin LsSA's (Figure 91). In the following discussion, each LsSA is described and its potential for containing buried Early Paleoindian cultural deposits is assessed. This information was derived from the MN/Model.

The *Upland* LsSA is undifferentiated glacial drift and bedrock, the latter of which is predominantly Sioux Quartzite (see Figure 91, below). Although Early Paleoindian cultural deposits may occur on and/or near the surface of the Upland LsSA, they are not likely to have good vertical or horizontal integrity. There is low potential for *in situ* Early Paleoindian cultural deposits below the plowzone, except in areas where the uplands are mantled by loess.

The *Glaciofluvial* landscape has two different geomorphic surfaces that are traceable throughout the Rock River valley (see Figure 91, below). The higher of these two surfaces includes both plains and terraces, and the lower surface includes both terraces and paleochannels. The higher and older glaciofluvial surface grades upslope to an end moraine on the Coteau des Prairies. The younger outwash surface is inset beneath the higher and older plain at the end moraine's front. Glaciofluvial channels occupied by underfit tributary streams similar to the Rock River enter the Rock River valley mostly from the higher elevations to the east. The glaciofluvial surfaces are mantled by loess or fine-grained vertical accretion deposits (alluvium). The alluvium is derived from tributaries of the Rock River. Veneers of loess and alluvium are usually less than one meter thick, and either bedrock or glacial drift occurs immediately beneath the loess or alluvium. According to the MN/Model, the glaciofluvial depositional environments are high-energy settings unfavorable for the preservation of cultural resources. Furthermore, the age of the outwash is too old for cultural resources. However, buried cultural resources may occur within the strata mantling the glaciofluvial deposits. Loess, in particular, and any overbank deposits may be young enough for Paleoindian and possibly younger cultures.

The *Paleo-Valley* LsSA could have been lumped with the Glaciofluvial LsSA, but Hudak and Hajic (2002) separated it in case of different origins (see Figure 91, below). The main Paleo-Valley mapped in the MN/Model is related to the glaciofluvial events derived from the end moraine on the Coteau des Prairies, and this Paleo-Valley is correlated to the youngest outwash surface. The Paleo-Valley has an equal or greater chance than the main valley of the Rock River to contain suitable landscapes for preserving cultural resources because alluvial deposits associated with tributaries are inset into the Paleo-Valley LsSA. The Paleo-Valley is further distinguished by having one of the following sets of traits: less than one-meter-thick loess over coarse outwash; greater than two-meter-thick loess over coarse outwash; or, meandering channel patterns related to post-glacial tributaries to the Rock River, and greater than two-meter-thick fine-grained alluvium over interstratified fine- and coarse-grained strata. The 2+ meter-thick overbank deposits may pre-

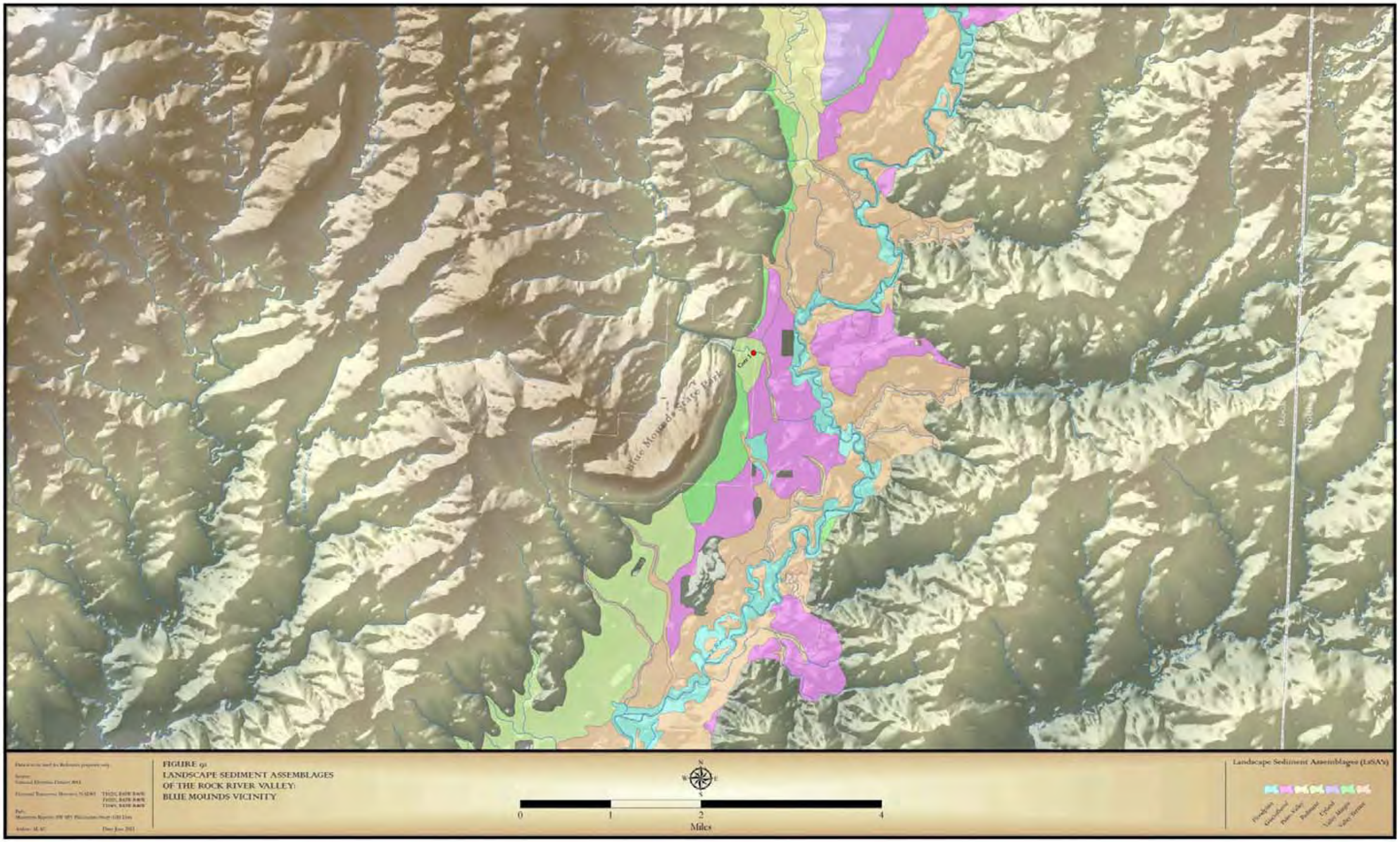


FIGURE 91
LANDSCAPE SEDIMENT ASSEMBLAGES
OF THE ROCK RIVER VALLEY:
BLUE MOUNDS VICINITY

date Euroamerican settlement in the region, but they are too young to contain Paleoindian cultural deposits. However, *in situ* Early Paleoindian cultural materials may be buried in the loess mantle on the Paleo-Valley landscape.

The *Pediment* LsSA is inset beneath the uplands on the west side of the Rock River valley (see Figure 91, above). A Pediment LsSA is a long slope shaped like an alluvial fan or colluvial apron. A thin veneer (< 2 meters) of fine-grained pedisediment occurs above an erosional surface from which the pedisediment was derived. Typically, the pediments are cut into the tills and possibly bedrock at the proximal ends of the pediments. The pediments also cut into the higher outwash terrace near the Iowa border, and grade to the youngest outwash terrace. Hence, the deepest underlying strata are probably too old to contain cultural resources since the younger outwash surface is roughly equal in time to the Bemis or Altamont moraines (Hudak and Hajic 2002). The age of the pedisediment itself, however, may be young enough to contain *in situ* cultural resources, including Early Paleoindian cultural deposits.

The *Valley Terrace* LsSA is primarily inset beneath the youngest outwash terrace, and is overlying part of the Glaciofluvial landscape (see Figure 91, above). The Valley Terrace LsSA may have either a steep escarpment between the lowest outwash terrace and itself, or a very gentle slope. There is a relatively thin mantle (typically 1-2 meters) of fine-grained alluvium over interstratified fine and coarse alluvium below the Valley Terrace surface. Buried soils were rarely recorded in the Valley Terrace fill, and when they were recognized they were typically within 1.5 meters of the surface (Hudak and Hajic 2002). Two radiocarbon ages are reported in the MN/Model for the Terrace fill: 7940 ± 100 RCYBP determined on a seed recovered at a depth of 312-320 cmbs in stratified alluvium, and 5430 ± 60 RCYBP determined on wood collected at a depth of 162-169 cmbs in stratified alluvium. Although the ages of the terrace fills are suitable for containing prehistoric cultural material, the potential for *in situ* cultural deposits is low because most of the alluvium aggraded under high-energy conditions. There is even less potential for stratified Early Paleoindian cultural deposits, as no buried Paleoindian-age landscapes occur in the Valley Terrace fill.

The *Floodplain* landscape is either inset against or overlying the Valley Terrace landscape (see Figure 91, above). Overbank deposits are common on the Floodplain landscape and are mostly of post-Euroamerican settlement age (Hudak and Hajic 2002). Fine-grained alluvium (i.e., loam or finer) mantles interstratified fine- and coarse-grained alluvium, which overlies coarse glacial outwash. The depositional environment is of mixed energies; hence there are mixed potentials for buried cultural resources within the Floodplain landscape. However, there is no potential for *in situ* Early Paleoindian cultural deposits because the alluvium above the glacial outwash is late Holocene in age.

The *Valley Margin* LsSA consists of alluvial fans and colluvial slopes (see Figure 91, above). In the Rock River valley, colluvial slopes are more common than alluvial fans. Both of these landforms overlie the Glaciofluvial LsSA and consist of fine-grained sediment. The fans and slopes are generally more than two meters thick and often contain buried soils. The fine textures result from the downslope movement of reworked loess. The Valley Margin LsSA can be easily confused with the Pediment landscape if not examined in outcrop or by coring. According to the MN/Model, the alluvial fans and colluvial slopes are of the right age and depositional energy to contain buried cultural resources. The alluvial fans tend to be ranked high and the colluvial slopes tend to be ranked moderate to depths greater than five meters. Although the potential for buried Early Paleoindian cultural deposits in alluvial fans and colluvial slopes has not been assessed in the Rock River valley, buried Clovis cultural deposits were found in an alluvial fan at the Chalk Rock Site (39BK100) in the Big Sioux River valley of northeastern South Dakota (Fosha and Donohue 2005a, 2005b; Fosha et al. 2004; Fosha and Woodside 2003; Mandel 2004).

In sum, there is geologic potential for buried Early Paleoindian cultural deposits in late-Wisconsinan loess on the Upland, Pediment, Glaciofluvial, and Paleo-Valley LsSA's. Also, reworked loess (pedisediment) on the Pediment LsSA and comprising the Valley Margin LsSA (alluvial fans and colluvial slopes) may contain Early Paleoindian cultural deposits. The potential for buried Early Paleoindian cultural deposits remains to be tested in all of these landscapes of the Rock River valley.

OTHER POTENTIAL CONTEXTS FOR EARLY PALEOINDIAN CULTURAL DEPOSITS IN MINNESOTA

Although this investigation focused on the Rock River valley, the MN/Model was reviewed to see if other stream valleys and/or landscapes in Minnesota have geologic potential for buried Early Paleoindian cultural deposits. To this end, Dr. Edwin Hajic, who has conducted geoarcheological research in many areas of the state, was consulted. Based on the results of this inventory, five targets for future investigation were identified. They are as follows:

1. Specific Upper Mississippi River valley and Minnesota River valley terrace remnants, and correlative terrace remnants in their tributary valleys, where they are buried by æolian dunes, colluvial slopes or alluvial fans of tributaries of low or intermediate order that date to, or post-date, the Early Paleoindian period. Remnants are those that pre-date the St. Croix Valley catastrophic flood(s), and include terrace remnants formed by, or in response to, the Glacial River Warren flood(s) emanating out of the Lake Agassiz basin.

2. Wetland basins and basin margins, formed primarily in response to one form or another of ice collapse or melting, on the Des Moines Lobe, drift plains of the Superior Lobe and other late Wisconsin glacial ice lobes that pre-date the Early Paleoindian period, outwash terraces on outwash plains related to the Des Moines lobe, and other lobes of appropriate age, and on the Anoka Sand Plain.

3. Within and beneath colluvial slopes that date to, or post-date, the Early Paleoindian period in obscure pre-Wisconsin glacial terrain in southwest and southeast Minnesota, and dissected bedrock terrain in southeast Minnesota, particularly where loess contributes to colluvial deposits.

4. Beach ridges (with or without dunes), lagoons, relict shorelines, and relict lake beds of appropriate age in the Lake Agassiz basin in west-central, northwest, and north-central Minnesota, including the Red Lake Bog basin, and other glacial lake and wetland basins that would have had margins of appropriate age. This can include entire, as yet undetected, lake margin landscapes developed on or into older glacial or bedrock terrain, now buried by glaciolacustrine, lacustrine or wetland deposits that post-date the Early Paleoindian period. Though results from previous surveys have indicated that glacial lake beach ridges are not accurate indicators of prehistoric site distribution (Dobbs et al. 1994:16; Michlovic 1987:55; Minnesota Historical Society 1981:29-32), evidence obtained through an examination of private artifact collections (Magner 1994:61) and a more recent examination of mapped site distribution (Kluth and Hudak 2004:10-11) suggest a clear connection between Paleoindian groups and the Agassiz beach ridges in the northwestern part of the state.

5. Æolian dune fields that date to, or post-date, the Early Paleoindian period, such as those on the Anoka Sand Plain.

VEGETATION & CLIMATE OF SOUTHWESTERN MINNESOTA DURING THE PALEOINDIAN PERIOD

INTRODUCTION

The modern era of pollen analysis in Minnesota was initiated with a series of publications in 1962 emanating from the Limnological Research Center (LRC) at the University of Minnesota. One of these publications was of the Madelia site (Jelgersma 1962), in southwest Minnesota near Mankato. In November 1958, University of Minnesota geologist Herbert E. Wright, Jr. and Swedish palynologist Magnus Fries sampled buried lake sediments discovered in excavation at this site. Radiocarbon dates bracketing the sediments indicated a late-glacial age for the deposit (Rubin and Alexander 1960). Wright had established the pollen laboratory at the University of Minnesota in 1956, and in 1959 he established the LRC. To teach American students palynology and paleoecology, Wright invited several European palynologists to Minnesota for year-long visits. Magnus Fries was the first of these visitors. Saskia Jelgersma from the Netherlands, who eventually analyzed the pollen from Madelia, was the second visitor. Thus, one of the very first pollen diagrams from Minnesota was from a late-glacial deposit in the southwestern part of the State and involved the first two visiting palynologists from Europe. Since that time, a large number of paleoecological studies have been conducted in Minnesota with many publications emanating from these studies. However, no other late-glacial palynological sites have been published from southwestern Minnesota since Jelgersma's 1962 paper.

A number of palynological investigations from the Paleoindian period have been carried out at sites surrounding the southwest Minnesota study area. Although these existing palynological studies reveal the progression of vegetation and climate change during the Paleoindian period, the details and timing are generally poorly resolved. The problems are poor dating control and often low temporal resolution (few pollen counts) (Grimm and Jacobson 2004; Grimm et al. 2009). Most of the existing studies have few radiocarbon dates, and most of these dates are on bulk sediments, which typically yield ages that are too old because a significant proportion of the bulk-sediment carbon is derived from ancient carbonate or carbonaceous rocks. Aquatic organisms incorporate carbon from dissolved carbonate rocks, limestones and dolomites (the "hardwater effect") and carbonaceous rocks, such as shales, often contribute a significant amount of carbon. The magnitude of this error is typically hundreds of years, and often thousands. Moreover, the error changes through time at individual sites (Grimm et al. 2009). In addition to the problems of bulk-sediment dates, most sites have few dates. For sites from which a large number of radiocarbon dates have been obtained (e.g., Curry et al. 2007; Gonzales and Grimm 2009), the sedimentation rate often shows considerable variation through the Paleoindian period, as lake productivity, marl precipitation, and loess deposition have varied through time. Technical coring problems are an additional source of uncertainty in late-glacial chronologies. Late-glacial sediments are typically silty or clayey, and these compact sediments are difficult to penetrate compared to overlying Holocene organic sediments. Thus, core recovery is often less than core-drive length. Whether the shorter recovery lengths are due to compaction or missing material is usually not known; and age models, which must assume a deposition time (yr/cm) between dated horizons, are compromised.

Nowadays, most investigators take multiple cores, thus enabling stratigraphic correlation and ensuring complete recovery. In addition, the new radiocarbon technique of accelerator mass spectrometry (AMS) permits the dating of much smaller amounts of material than conventional decay-count dating (Bronk Ramsey 2008; Hellborg and Skog 2008). Thus, modern studies utilize AMS dates from terrestrial plant macrofossils such as needles and seeds, which can provide reliable chronologies.

The principal reason for the lack of palynological studies from southwestern Minnesota is the general lack of suitable sites. Several attempts at coring lakes have been made (E. J. Cushing and B. C. S. Hansen, personal communication); however, these efforts recovered only late Holocene sediments, as the sites dried-out during the mid-Holocene. Although late-glacial sediments may underlie the mid-Holocene sections of these lakes, the dried out sediments are difficult to penetrate and, of course, the mid-Holocene pollen record is compromised. Because of the mid-Holocene desiccation of shallow lakes in the region, Fish Lake near Windom was targeted for study because it was the deepest lake in the region. It proves to have a complete record although sandy layers common throughout much of the mid-Holocene section may indicate very shallow water levels.

PREVIOUS PALYNOLOGICAL STUDIES

Palynological studies from the Paleoindian period have been carried out at a number of sites encircling southwest Minnesota (Figure 92; Table 2). Sites selected for this study are from the prairie or prairie-forest border region south of where pine (*Pinus*) expanded during the early Holocene, as there is no evidence that *Pinus* ever occurred in the southwestern part of the State. The data from most of these sites have been deposited in the North American Pollen Database (NAPD), now part of the Neotoma Paleoecological Database (www.neotomadb.org). However, Jelgersma's data from Madelia was never incorporated into this database. Only the pollen data older than 8000 RCYBP are considered. Although most studies today report findings in calibrated radiocarbon years, which is the real time scale and which is necessary for comparison with other proxies in calendar years, such as the Greenland ice cores, this chapter will use RCYBP. The primary reason is that most of the radiocarbon dates from sites reviewed in this report are from lake sediments with an ancient carbon reservoir. To calibrate dates, the reservoir must first be subtracted and must be known. Unfortunately, the reservoir is not known with any accuracy, and since slight differences in the estimation of the reservoir during the late-glacial period can place a date on or off a radiocarbon plateau, calibration is problematic.

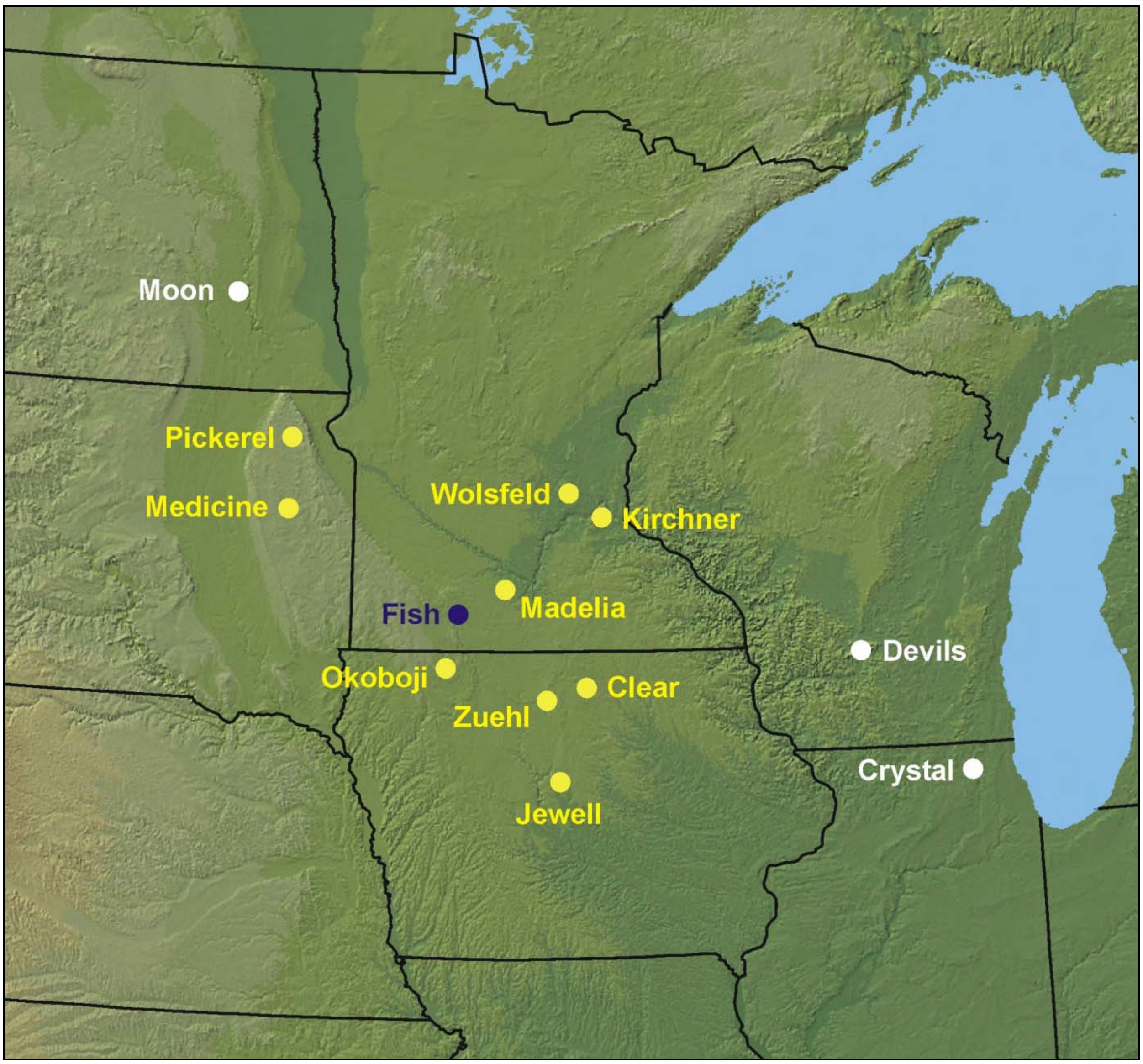


Figure 92. Sites surrounding southwest Minnesota reviewed in this study. Sites in white have chronologies based on AMS radiocarbon dates; whereas yellow sites have chronologies based on conventional decay-count dates. Fish Lake, a new site analyzed in this study, is in blue.

Table 2. Palynological Sites Encircling Southwest Minnesota.

Abbrev	Site Name	State	Latitude	Longitude	Reference
MOO	Moon Lake	ND	46.8575	-98.1583	Laird et al. 1996, Laird et al. 1998
PIC	Pickerel Lake	SD	45.5000	-97.3300	Watts and Bright 1968
MED	Medicine Lake	SD	44.8167	-97.3500	Radle et al. 1989
MAD	Madelia site	MN	44.0833	-94.4167	Jelgersma 1962
OKO	West Okoboji Lake*	IA	43.3333	-95.2000	Van Zant 1979
ZUE	Zuehl Farm site	IA	43.0300	-93.8700	Kim 1982, 1986
CLE	Clear Lake	IA	43.1500	-93.3500	Baker et al. 1992
JEW	Jewell site	IA	42.2600	-93.7000	Kim 1986
WOL	Wolsfeld Lake	MN	45.0000	-93.5667	Grimm 1983
KIR	Kirchner Marsh	MN	44.7724	-93.1202	Wright et al. 1963
DEV	Devils Lake	WI	43.4273	-89.7256	Baker et al. 1992, Grimm et al. 2009
CRY	Crystal Lake	IL	42.2349	-88.3556	Gonzales and Grimm 2009

*Called Lake West Okoboji in Van Zant (1979).

The original counts from Madelia have probably been lost; however, the published foldout pollen diagram includes all types identified, and the published paper indicates how the percentages were calculated. Thus, for this project we digitized the data from the published pollen diagram. After the data were digitized, the percentages were added, and then based on this sum, which was generally within 1-2 percent of 100 percent, the percentages were adjusted to add to 100 percent. The total pollen sums were not indicated in the paper, so sums of 500 were assumed. The percentages were multiplied times 500 to produce digitized pollen counts. These were rounded to the nearest integer. Although the exact sums are not known, the digitized counts allow faithful recalculation of percentages based on a different pollen sum from which Jelgersma used.

Of the sites in review, only three have age models based on AMS radiocarbon dates from terrestrial plant macrofossils – Moon Lake, Devils Lake, and Crystal Lake – and these three are the most distant from the study area (see Figure 92). An initial comparison of age models based on the bulk-sediment radiocarbon ages (Table 3) indicates some discrepancies (Figure 93). Most notably, the spruce (*Picea*) decline at West Okoboji Lake is older than all other sites. Inasmuch as Okoboji is one of the nearest sites to the southwestern Minnesota study area, this site is particularly important for reconstruction of Paleoindian environments.

Table 3. Radiocarbon Dates from Sites Surrounding Southwest Minnesota. Only Dates >8000 RCYBP Plus the Oldest Date Younger than 8000 RCYBP are Shown.

Depth	Thick	Lab Nr	Type	^{14}C Age	SD	Material Dated
Pickerel Lake, SD						
940	5	Y-1361	Conventional	10,670	140	Spruce (*Picea*) wood
Medicine Lake, SD						
1648	8	WIS-1245	Conventional	5050	80	gyttja
1954	4	WIS-1246	Conventional	8750	100	gyttja
2213.5	7	WIS-1227	Conventional	10,940	135	wood
2213.5	7	WIS-1225	Conventional	12,610	120	gyttja
Madelia site, MN						
215.5	5	W-825	Conventional	9300	350	peat
278.5	5	W-824	Conventional	12,650	350	gyttja

Table 3 (continued).

Depth	Thick	Lab Nr	Type	^{14}C Age	SD	Material Dated
West Okoboji Lake, IA						
745		WIS-830	Conventional	7730	80	bulk sediment
935		WIS-832	Conventional	9075	90	bulk sediment
1045		WIS-836	Conventional	11,800	110	bulk sediment
1115		WIS-835	Conventional	13,990	135	bulk sediment
Zuehl Farm site, IA						
97.5		Beta-14243	Conventional	4790	80	bulk sediment
157		Beta-14244	Conventional	10,250	150	bulk sediment
199.5	33	Beta-3049	Conventional	12,430	160	gray silty mud
Clear Lake, IA						
695	10	Beta-30372	Conventional	7430	110	bulk sediment
787	10	Beta-30373	Conventional	8310	140	bulk sediment
884	8	Beta-30374	Conventional	10,370	140	bulk sediment
983.5	15	Beta-30375	Conventional	15,180	540	bulk sediment
1077.5	15	Beta-30376	Conventional	22,600	1100	bulk sediment
Jewell site, IA						
183	6	Beta-14237	Conventional	5860	90	calcareous silty muck
324.5	7	Beta-14239	Conventional	7690	100	calcareous organic silt
491	8	Beta-14240	Conventional	8290	90	calcareous organic silt
617	6	Beta-14238	Conventional	8720	140	calcareous organic silt
635.5	11	Beta-15072	Conventional	10,450	110	calcareous organic silt
713	14	Beta-15073	Conventional	11,350	110	calcareous silt
860	20	Beta-14241	Conventional	14,450	120	sandy silt
Wolsfeld Lake, MN						
1520	10	WIS-1624	Conventional	7990	110	silty gyttja
1640	10	WIS-1625	Conventional	10,600	110	silty gyttja
1774	8	WIS-1034	Conventional	12,060	125	wood
Kirchner Marsh, MN						
780	6	Y-1140	Conventional	7120	110	bulk sediment
985	6	Y-1141	Conventional	10,230	110	bulk sediment
1195	10	Y-1358	Conventional	11,760	150	Spruce (*Picea*) wood
1180	7	Y-1326	Conventional	13,270	200	gyttja
Moon Lake, ND						
2224.5	8.9	CAMS-9156	AMS	7300	80	charcoal flakes
2308.4	4.5	CAMS-6826	AMS	9530	130	charcoal flakes
2356.5	5	CAMS-6827	AMS	10,780	100	Spruce (*Picea*) needle
2418	4	CAMS-6828	AMS	11,770	80	woody twig
2442.5	5	CAMS-6829	AMS	11,830	80	woody twigs

Table 3 (continued).

Depth	Thick	Lab Nr	Type	^{14}C Age	SD	Material Dated
Devils Lake, WI						
397	4	WIS-998	Conventional	6920	75	bulk sediment
457	4	WIS-999	Conventional	8640	85	bulk sediment
474	2	CAMS-78446	AMS	8590	50	needles, wood, seeds, leaves
535	1	CAMS-78445	AMS	9740	50	needles, wood, seeds, leaves
550	2	CAMS-78444	AMS	10,110	140	needles, wood, seeds, leaves
583.75	2.5	CAMS-78443	AMS	10,730	50	needles, wood, seeds, leaves
633	12	CAMS-78442	AMS	12,580	130	needles, wood, seeds, leaves
Crystal Lake, IL						
1750	4	CAMS-99038	AMS	7860	60	charcoal
1788.5	3	CAMS-99039	AMS	8520	50	charcoal
1834.5	9	CAMS-99040	AMS	9490	45	charcoal
1866.5	3	UCIAMS-30989	AMS	9995	35	Larch (*Larix*) needles
1915	4	UCIAMS-30990	AMS	10,360	25	Spruce (*Picea*) seed wing
1948	2	UCIAMS-38362	AMS	10,320	110	Spruce (*Picea*) needles
1970.5	1	UCIAMS-30991	AMS	10,375	25	Fir (*Abies*) seed
2004.5	1	UCIAMS-38363	AMS	10,930	45	Spruce (*Picea*) needle fragments
2022.5	1	UCIAMS-38364	AMS	11,330	30	2 charcoalized Spruce (*Picea*) needle tips
2026	2	UCIAMS-30992	AMS	11,375	50	Spruce (*Picea*) needle
2038	2	UCIAMS-38365	AMS	11,520	120	Spruce (*Picea*) and larch (*Larix*) needle fragments
2051.5	1	UCIAMS-30993	AMS	11,020	35	Spruce (*Picea*) needle
2064.5	1	UCIAMS-38366	AMS	12,025	40	Spruce (*Picea*) needle fragments
2070.5	1	UCIAMS-30994	AMS	12,180	30	Spruce (*Picea*) needle fragments
2080	2	UCIAMS-38367	AMS	12,295	35	Spruce (*Picea*) and larch (*Larix*) needle fragments
2082.5	3	UCIAMS-38368	AMS	12,255	25	Spruce (*Picea*) and larch (*Larix*) needle fragments
2110.5	1	UCIAMS-30995	AMS	12,320	35	Larch (*Larix*) seed
2116.5	3	UCIAMS-38369	AMS	12,310	120	Spruce (*Picea*) and larch (*Larix*) needle fragments
2142.5	3	UCIAMS-38370	AMS	12,620	220	Larch (*Larix*) needle fragments
2163	4	UCIAMS-38371	AMS	13,175	30	Larch (*Larix*) and spruce (*Picea*) needle fragments
2172.5	1	OxAW864.13	AMS	13,427	126	Spruce (*Picea*) needles
2172.5	7	ISGS-4367	Conventional	13,560	90	wood
2222.5	1	OxAW864.14	AMS	13,377	123	wood
2239	1	OxAW864.16	AMS	13,533	126	wood
2258.5	1	OxAW864.15	AMS	17,143	173	bryophytes

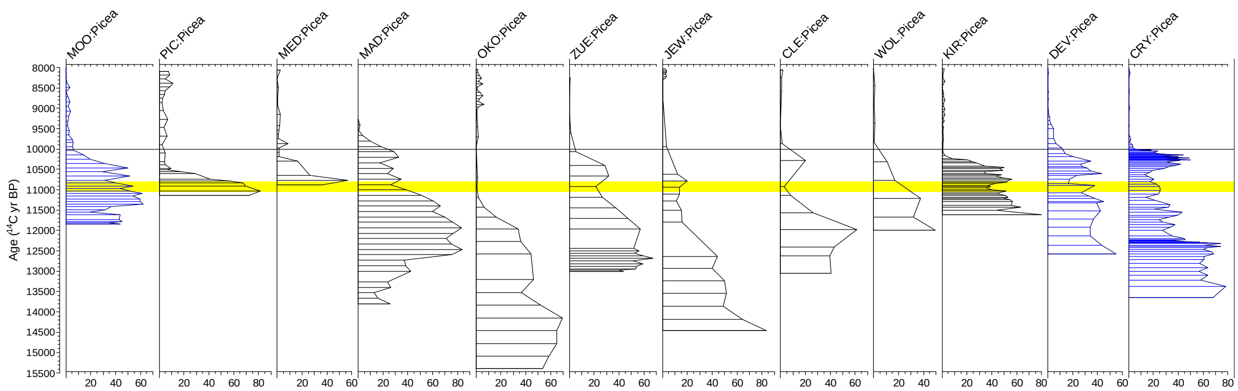


Figure 93. *Picea* curves from study sites surrounding southwest Minnesota with original age models. Site abbreviations from Table 2. Blue curves are from sites with chronologies based on AMS radiocarbon dates. Yellow bar indicates the Clovis period (Waters and Stafford 2007). Line is drawn across the diagram at 10,000 RCYBP to aid visual correlation.

This older age of Okoboji is unlikely due to a time-transgressive decline in spruce (*Picea*), as the spruce (*Picea*) decline at sites both north and south of Okoboji is younger. Although most of the radiocarbon dates are on bulk sediment, several sites have basal dates on wood, which are more reliable and which fix a maximum age. Wood is commonly found in the basal sediments of glacial lakes and was probably derived from trees growing on superglacial sediments above buried, stagnant ice (Wright and Stefanova 2004). Although wood may be derived from long-lived trees and dead wood may persist on the landscape for some time (Gavin 2001; Grimm et al. 2009), these wood dates are typically younger than bulk-sediment dates from overlying or encasing lacustrine sediments. For example, Medicine Lake and Kirchner Marsh have basal wood dates 1500-1700 years younger than overlying or encasing lake sediment (see Table 3). This age difference is similar to that between the Okoboji spruce (*Picea*) profile and other nearby sites (see Figure 93). In addition to basal wood dates at Medicine Lake (12,610 ± 120 RCYBP) and Kirchner Marsh (11,760 ± 150 RCYBP), Pickerel Lake (10,670 ± 140 RCYBP) and Wolsfeld Lake (12,060 ± 125 RCYBP) also have chronologies fixed by basal wood dates. The basal ages of these sites are all much younger than Okoboji (bottommost ^{14}C date is 13,990 ± 135 RCYBP). These sites are north of Okoboji, and therefore conceivably younger; however, the basal date of Fish Lake (12,210 ± 60 RCYBP), which is much closer to Okoboji, has a basal age similar to the other Minnesota sites. The spruce (*Picea*) profile at Okoboji is very similar in shape to Zuehl Farm, the nearest site to Okoboji with the exception of Madelia. Consequently, the ages of the Okoboji samples were adjusted to correlate with Zuehl Farm (Figure 94). With this adjustment, the spruce (*Picea*) decline at all sites, including those with AMS based age models, is at or slightly before 10,000 RCYBP. However, given the uncertainties in the age models based on conventional bulk-sediment dates and on the low temporal resolution of several of the sites, we must be circumspect in our interpretations.

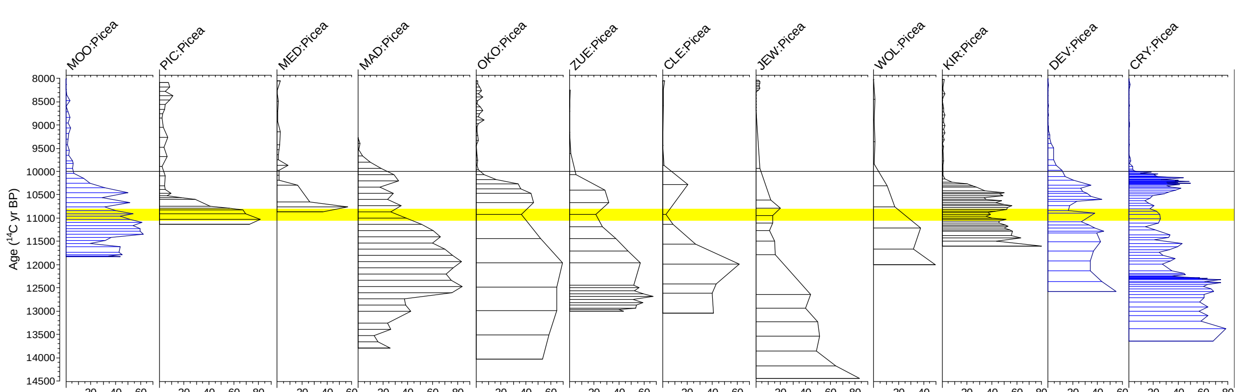


Figure 94. *Picea* curves from study sites surrounding southwest Minnesota with the chronology of West Lake Okoboji adjusted to match the Zuehl Farm site.

FISH LAKE

Fish Lake (43° 50.83' N, 95° 2.66' W, 424 m altitude, ~120 ha in area) straddles the Cottonwood County-Jackson County line ~5 km southeast of Windom, Minnesota. The lake is a glacial-kettle lake formed in deposits of the late Wisconsin Des Moines lobe. It is located on ground moraine of the Altamont Moraine Association just inside the outer belt of stagnation moraine of this association (Hobbs and Goebel 1982). The Altamont Moraine lies inside the Bemis Moraine, the outermost moraine of the Des Moines lobe. The Algona Moraine in Iowa, a correlative of the Altamont Moraine in Minnesota (Hobbs and Goebel 1982), is dated to ~14,000 RCYBP (~17,000 cal B.P.). Ice retreated rapidly from this position, and southwestern Minnesota was deglaciated by ~13,000 RCYBP (Dyke et al. 2003; Wright et al. 1973). The basal radiocarbon date from Fish Lake is 12,210 ± 60 RCYBP (Table 4).

Table 4. Radiocarbon Dates from Fish Lake.

Depth (cm)	Thickness (cm)	Lab No.	^{14}C Age	SD	Calibrated Range	Calibrated Median	Material Dated
1046	1	CAMS-57138	200	40	-2 – 308	181	charcoal
1047	2	CAMS-46204	250	60	-2 – 482	297	charcoal
1194	1	CAMS-57136	2470	40	2363 – 2713	2557	charcoal
1284.5	1	CAMS-46205	3560	50	3704 – 3977	3855	wood
1328	1	CAMS-57137	4650	40	5305 – 5571	5404	charcoal
1362.5	1	CAMS-46206	4880	50	5482 – 5725	5622	wood
1665	2	CAMS-46207	7300	50	8000 – 8199	8105	charcoal
1714	1	CAMS-57139	8190	50	9014 – 9287	9144	charcoal, wood
1844	4	CAMS-152236	10,435	50	12,112 – 12,536	12,325	S*choenoplectus* seeds, *Picea* needle frag, *Picea* seed wing
1852	4	CAMS-152237	10,520	110	12,082 – 12,638	12,422	*Betula* seeds and bract, *Picea* needle, *Schoenoplectus* seed
1864	4	CAMS-152238	11,270	70	12,956 – 13,317	13,173	*Larix* and *Picea* needle frags, *Picea* seed wing
1911.5	1	CAMS-25278	12,210	60	13,837 – 14,508	14,065	wood

Fish Lake was cored from a raft anchored in the deepest portion of the lake on July 18-20, 1995. Water depth was 8.68 m. The top of the casing was 38 cm above the water surface, so datum for the core depths was 9.06 m from the sediment surface. The core bottomed in sand at 19.27 m; thus total core length was 10.21 m. The basal 22 cm of the core was a "trash" layer of sand, gravel, and wood that presumably rapidly fell into the basin as the ice block forming the kettle melted.

Initial work on the core soon after it was collected included the acquisition of nine AMS radiocarbon dates (see Table 4) and the creation of a skeleton pollen diagram. Fish Lake was selected as the eastern site located in tall-grass prairie on a transect of sites across the northern Great Plains. The preliminary work on this transect was the basis of a grant proposal to the National Science Foundation. The proposal was funded, however, at a level less than initially requested. As a consequence, Fish Lake, the easternmost site on the transect, was eliminated in favor of sites in the Great Plains proper. Because the focus of this proposal was the Holocene, only a few counts were made from the late-glacial section, although a basal date and the occurrence of spruce (*Picea*) pollen indicated that the core had penetrated late-glacial sediments. For this project, additional counts were obtained for the Paleoindian period, through the Pleistocene-Holocene transition (Figure 95).

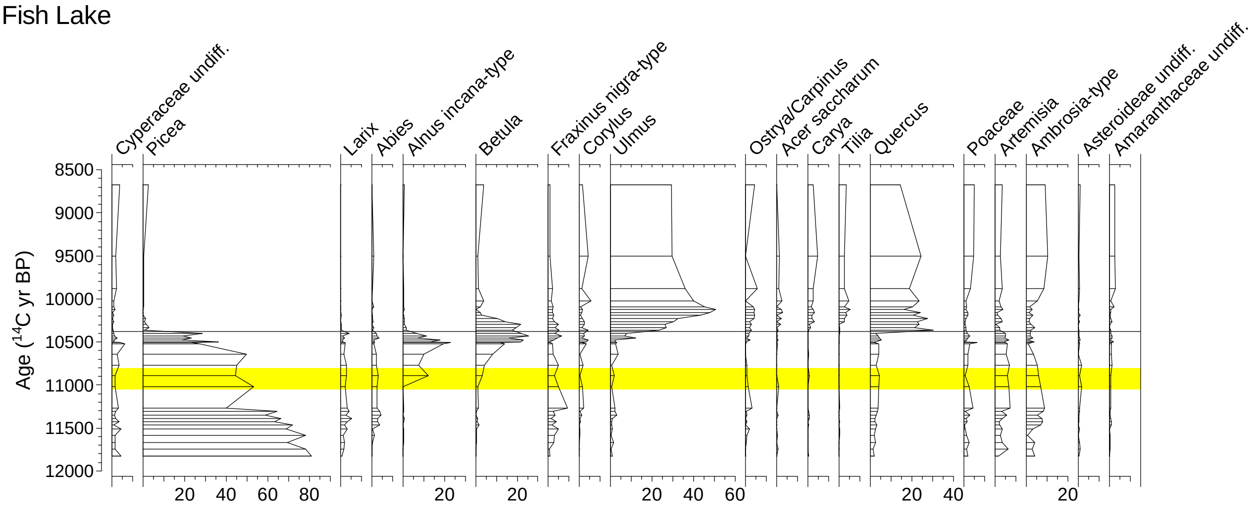


Figure 95. Pollen diagram from Fish Lake, southwestern Minnesota.

VEGETATION AND CLIMATE FOR THE PALEOINDIAN PERIOD IN SOUTHWESTERN MINNESOTA

The Paleoindian period, which transects the Pleistocene-Holocene transition, was a dynamic time in terms of vegetation and climate change. The Des Moines lobe ice stagnated and melted sometime after ~14,000 RCYBP (Dyke et al. 2003; Wright et al. 1973). Madelia is the only site to record this earliest period. A basal pollen zone at Madelia is dominated by sedges (*Cyperaceae*) (Figure 96) and scattered grains of tundra plants, such as purple saxifrage (*Saxifraga oppositifolia*), also occur (Jelgersma 1962). This zone represents a tundra-like vegetation in the region, much of which may have covered superglacial deposits such as those described by Curry et al. (2010) in northeastern Illinois. The estimated age of ~14,000 RCYBP for the base of this zone on Figure 96 is extrapolated from the lowermost ^{14}C age of 12,650 ± 350 and is probably too old. Nevertheless, Madelia is the only site from the region that records this early tundra zone, and the base of Madelia must be older than any other site.

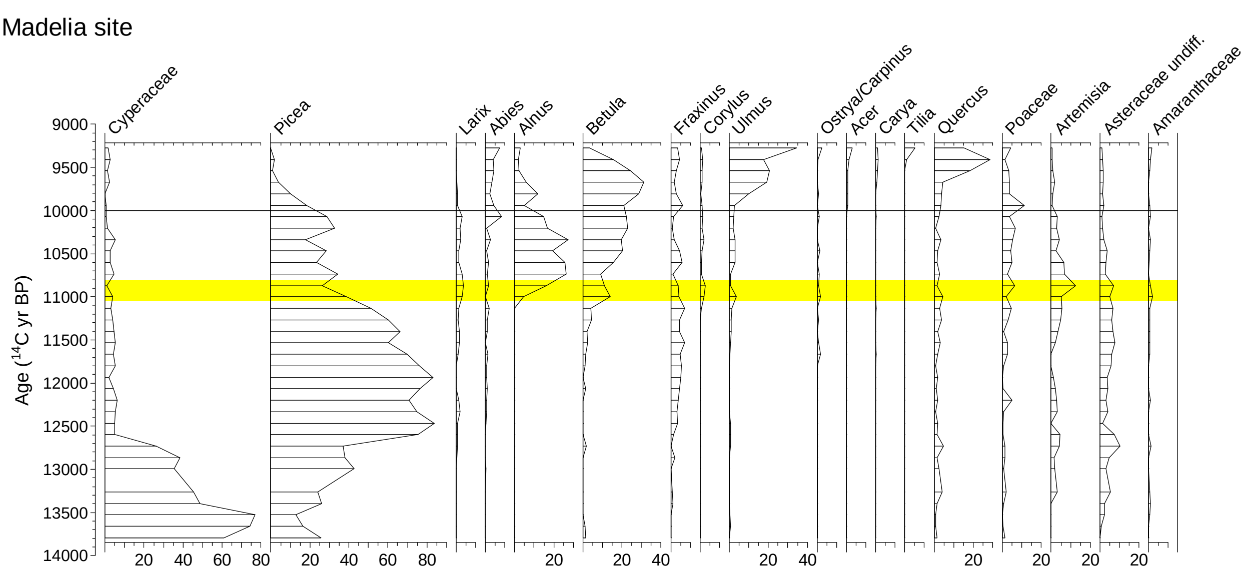


Figure 96. Pollen diagram from the Madelia site, southwestern Minnesota.

By 12,000 RCYBP, spruce (*Picea*) forest covered the landscape. This age is secured by the basal AMS date at Fish Lake of 12,210 ± 60 and by the basal wood dates at Wolsfeld Lake of 12,060 ± 125 and Kirchner Marsh of 11,760 ± 150. This spruce (*Picea*) forest differed from the modern boreal forest in the absence of pine (*Pinus*) and the absence or very minor presence of birch (*Betula*). These are typically postfire secondary successional taxa, and their absence from the late-glacial forest suggests a low incidence of fire. A number of deciduous taxa occurred in the spruce forest, most notably black ash (*Fraxinus nigra*) (Figures 97 and 98; see also Figures 95 and 96, above).

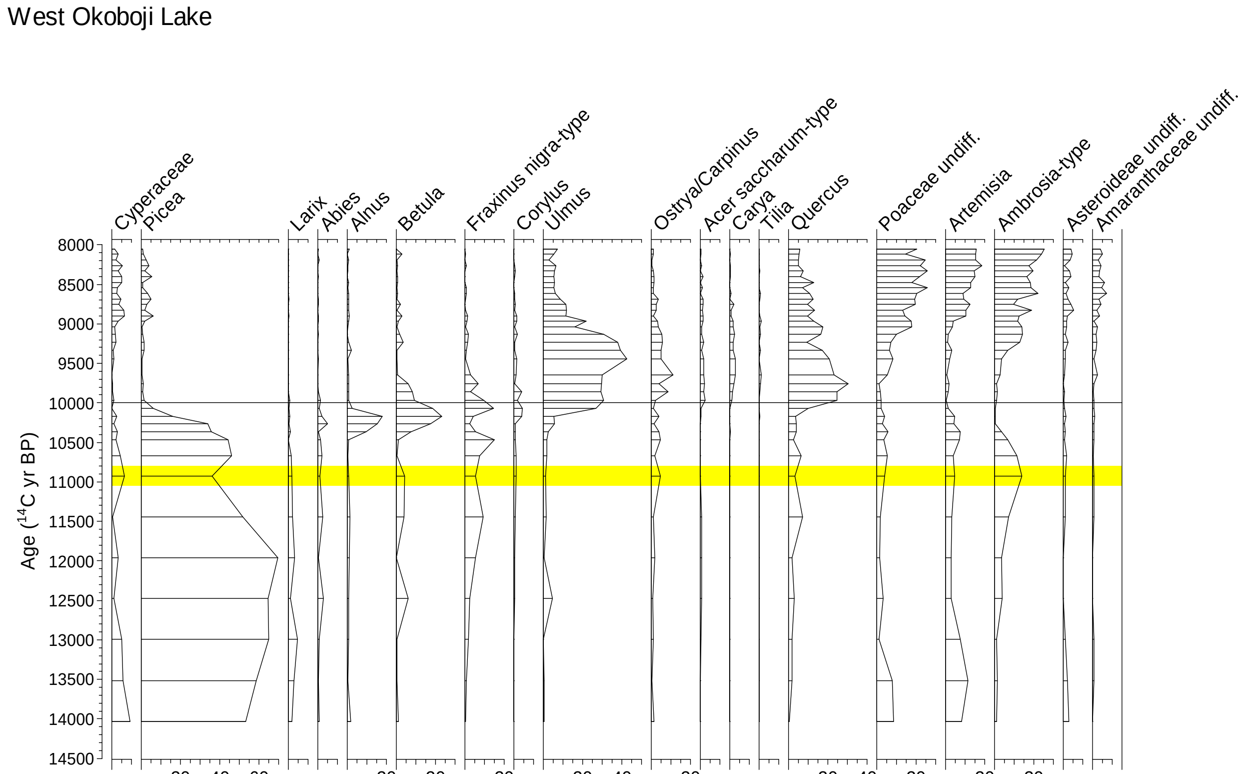


Figure 97. Pollen diagram from West Okoboji Lake, northwestern Iowa.

The mixture of deciduous trees and spruce (*Picea*) has long been recognized as a vegetation type having no modern analog (e.g., Cushing 1965; Wright et al. 1963). The vegetation was widespread in the upper Midwest during late-glacial time (Overpeck et al. 1992; Williams et al. 2001). Climatic interpretations for this no-analog vegetation have included both less seasonality of temperature and greater seasonality of temperature relative to today. However, a new modeling study based on the pollen data from Crystal Lake in northeastern Illinois indicates that temperature seasonality was similar to today but that precipitation, especially winter precipitation, was greatly enhanced (Gonzales et al. 2009). This interpretation of extremely wet conditions is consistent with the autecology of black ash (*Fraxinus nigra*), which favors swamps and poorly drained soils. Madelia and Fish Lake have lower ash (*Fraxinus*) values than sites farther south in Iowa and sites farther east in Wisconsin and Illinois (see Figure 98). This pattern might suggest cooler temperatures in southern Minnesota relative to Iowa and sites to the east; however, Kirchner Marsh, which is northeast of the study area, also has higher ash (*Fraxinus*) values. Ash (*Fraxinus*) values are considerably lower at the sites in the eastern Dakotas, so the climate signal may rather be one of somewhat drier conditions in southwestern Minnesota.

A recent evaluation of radiocarbon dates for the Clovis cultural period narrows the Clovis time range to ~10,800–11,050 RCYBP (Waters and Stafford 2007). The calibrated ages for this time span bracket the Allerød-Younger Dryas (GI-1a – GS-1) transition (Lowe et al. 2008). In Greenland, this transition marked a sudden shift to cooler climate. Many sites in the upper Midwest show an increase in spruce (*Picea*) during the Younger Dryas. This increase was first noted in the eastern Midwest, especially Ohio and Indiana (Shane 1987; Shane and Anderson 1993). More recently, the highly resolved pollen chronology from Crystal Lake, Illinois also shows an increase in spruce (*Picea*) during the Younger Dryas interval. However, the detailed chronology indicates that this increase began 300-400 years *after* the beginning of the Younger Dryas in Greenland (Gonzales and Grimm 2009). The climate reconstruction indicates that the late Allerød and early Younger Dryas are the warmest conditions of the late-glacial period (Gonzales et al. 2009).

Thus, based on this Illinois record, the Clovis cultural period corresponded with relatively warm conditions and ended before the onset of cooler conditions.

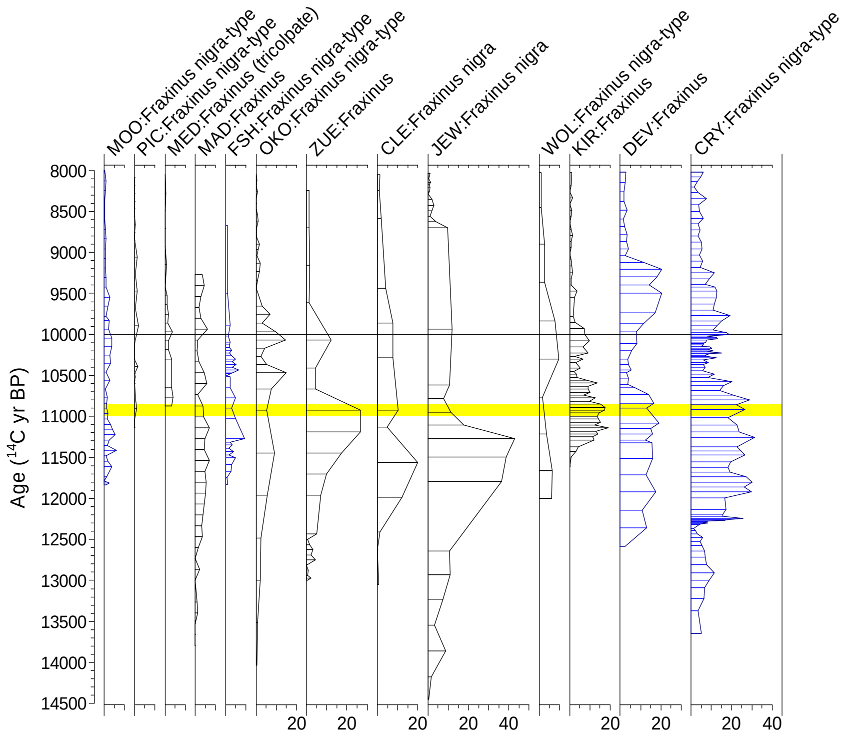


Figure 98. *Fraxinus nigra* profiles from the sites in Figure 92. Not all analysts have split the *Fraxinus* species; however, where the species have been split, the late-glacial Fraxinus is virtually all *F. nigra*. *F. nigra* is generally tricolpate; whereas *F. pennsylvanica*-type (green ash) is tetracolpate.

Several sites show an increase in ragweed (*Ambrosia*) pollen during the Clovis interval (e.g., Fish Lake, West Okoboji Lake, Kirchner Marsh), although beginning before and ending after this interval (Figure 99). However, other prairie grasses (*Poaceae*) and herb/shrub (*Artemisia*) types do not increase at most sites, and ragweed (*Ambrosia*) does not increase at the Moon Lake and Pickerel Lake sites. Thus, the rise in ragweed (*Ambrosia*) does not seem to be an expansion of prairie, nor is it due to long-distance transport from more western prairies. It may represent landscape disturbance, possibly due to climate perturbations, and the activities of Proboscidians cannot be ruled out.

Whether this pattern evident in Illinois also applies to southwestern Minnesota awaits better dated chronologies. Several sites in the region show an increase in spruce (*Picea*) generally corresponding with the Younger Dryas, particularly Madelia, Okoboji, Zuehl Farm, and Clear Lake (see Figure 94, above), but the dating is too poor to evaluate the exact timing and whether the lag observed in Illinois is also evident farther west in Minnesota. It should be noted that based on the conventional radiocarbon dates from Devils Lake, Shuman et al. (2002) interpreted climatic warming during the Younger Dryas due to the apparent decline in spruce (*Picea*) at the beginning of the interval. However, new AMS dates from Devils Lake show that the conventional dates were ~1000 years too old, and that the spruce (*Picea*) decline occurred at the *end* of the Younger Dryas period, not the beginning. This, therefore, suggests a cooler climate regime during the Younger Dryas, not a warmer one (Grimm et al. 2009).

The new AMS radiocarbon dates from Fish Lake place the spruce decline at 10,375 RCYBP (Figure 95), which is in good agreement with AMS-dated Moon Lake and the less certain chronologies from Pickerel Lake and Kirchner Marsh (Figure 94). This date is a few centuries earlier than at securely dated sites farther east: Devils Lake and Crystal Lake. Thus, it appears that the decline of spruce began somewhat earlier in the west. Spruce at Fish Lake declined before the beginning of the Younger Dryas and does not show the distinct rise shown at the eastern sites. The Clovis interval at Fish Lake is marked by an increase in alder (*Alnus*) pollen. Site-specific differences exist in the Younger Dryas increases in alder and birch (Betula) within the southwestern Minnesota/northwestern Iowa area. Whereas at Fish Lake birch rises after alder, birch rises somewhat before alder at Madelia (Figure 96) and they rise simultaneously at West Okoboji Lake (Figure 97).

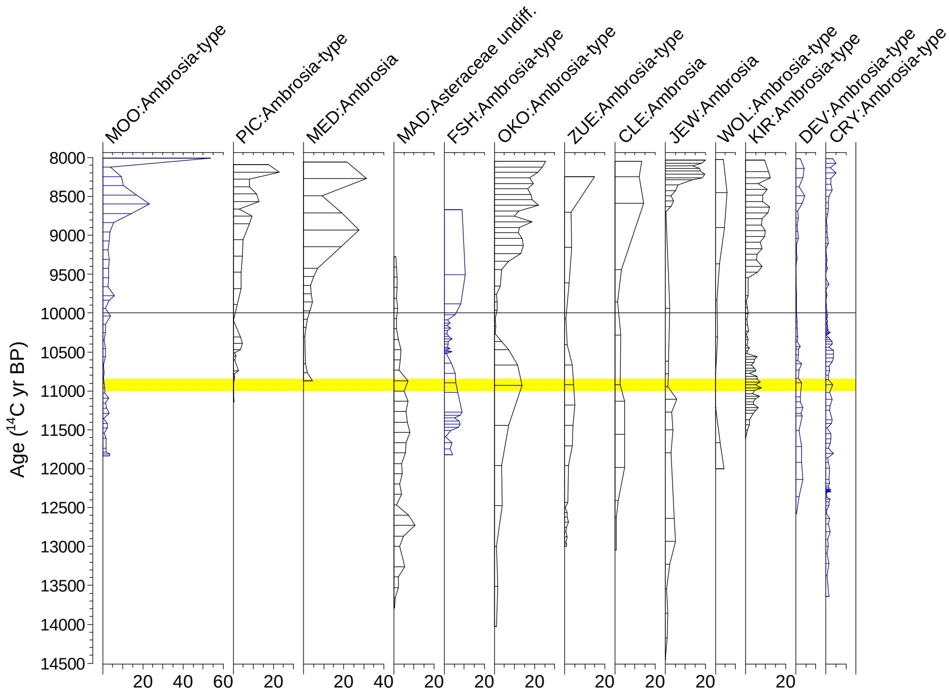


Figure 99. *Ambrosia* profiles from the sites in Figure 92. *Iva axillaris* (povertyweed) is morphologically similar to *Ambrosia*, hence the *Ambrosia*-type designation used by many palynologists. *Ambrosia* was not identified at Madelia; however, as percentages of non-Ambrosiinae types are low at other sites, Asteraceae undiff. (sunflower family) at Madelia is probably mostly *Ambrosia*-type.

At sites across the Midwest, the Younger Dryas is particularly marked by peaks of alder (*Alnus*) and birch (*Betula*) (Figures 100 and 101). The peak in alder (*Alnus*) generally slightly precedes the peak in birch (*Betula*), but not at all sites (see Figures 95-97, above). These ecological and climatic peaks are difficult to interpret. The birch (*Betula*) pollen grains indicate tree *Betula* rather than shrub *Betula*, and macrofossils indicate the species to be paper birch (*B. papyrifera*) (Watts and Bright 1968; Watts and Winter 1966; Van Zant 1979). *B. papyrifera* is generally a postfire successional species. However, a charcoal study at Sharkey Lake, which is near Kirchner Marsh, indicates little fire during this period (Camill et al. 2003). Thus, the proliferation of birch may have been the result of climate-induced disturbance rather than fire.

Alder (*Alnus*) is perhaps even more puzzling. The pollen type is speckled alder (*Alnus incana*), a species that typically grows in wetlands. Today, in northern Minnesota, *A. incana* is most abundant in the Northern Alder Swamp, Northern Rich Spruce Swamp, and Northern Rich Tamarack Swamp communities (Minnesota Department of Natural Resources 2003). In the Northern Rich Spruce Swamp, it is associated with black spruce (*Picea mariana*). Thus, the peak in *Alnus* during the Younger Dryas would seem to indicate wet, swamp-like conditions. *Alnus* may have replaced black ash (*Fraxinus nigra*) in these wetland communities during the Younger Dryas, while birch (*Betula*) expanded on the uplands. In northeastern North America, a Younger Dryas increase in alder (*Alnus*) is interpreted to indicate cooler climate, but the evidence is somewhat circular as alder (*Alnus*) expands during the Younger Dryas, which, from other evidence, is interpreted to be cooler. Moreover, the alder (*Alnus*) species that expanded at many northeastern sites is green alder (*A. viridis*) rather than speckled alder (*A. incana*) (Mayle et al. 1993). However, alder (*Alnus*) is generally more northern in its modern distribution than black ash (*Fraxinus nigra*), and if it did replace *F. nigra* in wetland swamp communities, the signal may indeed be one of cooling.

At ~10,000 RCYBP, spruce (*Picea*), alder (*Alnus*), and birch (*Betula*) (Figures 100 and 101; see Figure 94) decline while the deciduous trees elm (*Ulmus*) and oak (*Quercus*) increase (Figures 102 and 103). The exact timing seems to vary, but it is difficult to assess how much of this variation is due to age model inaccuracies versus regional variation. However, the alder (*Alnus*) peaks at AMS-dated Moon Lake and Fish Lake are before 10,000 RCYBP; whereas alder peaks at about 10,000 RCYBP at Crystal Lake, another AMS-dated site. Therefore, a west to east trend does seem to exist. At Fish Lake, birch (*Betula*) peaks and declines well before 10,000 RCYBP, whereas it peaks after 10,000 RCYBP at the eastern sites. Elm (*Ulmus*) and oak (*Quercus*) rise virtually simultaneously at individual southwest Minnesota sites, whereas at sites farther east, such as Devils Lake and Crystal Lake, elm (*Ulmus*) rises distinctly before oak (*Quercus*). The pollen data show the development of a rich deciduous forest across the region by about 10,000 RCYBP. This forest persists for about 500 years. However, by about 9500 RCYBP, prairie begins to develop, as indicated by increases in ragweed (*Ambrosia*), prairie herbs and shrubs (*Artemisia*), and grasses (*Poaceae*) (see Figures 97 and 99, above).

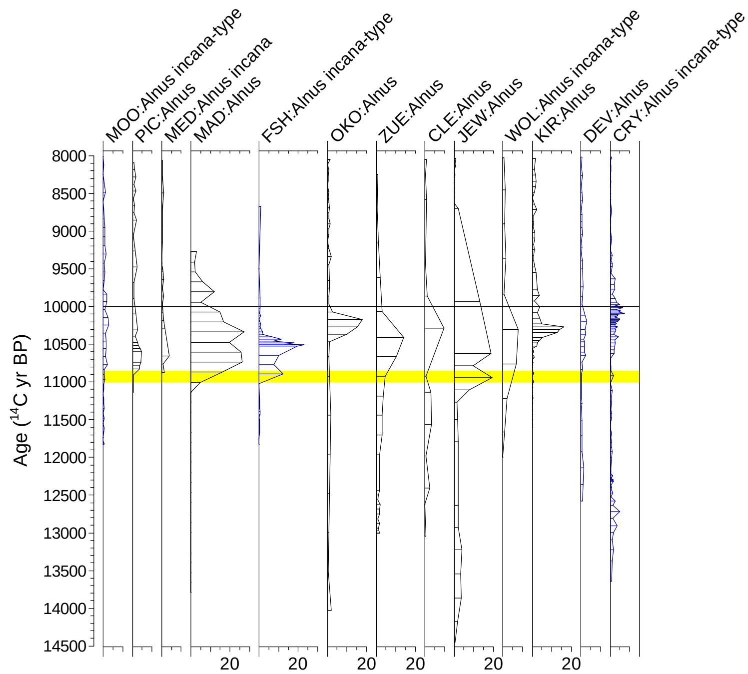


Figure 100. *Alnus* profiles from the sites in Figure 92. Not all palynologists have separated the generally tetraporate *Alnus incana*-type from the generally pentaporate *A. viridis*-type; however, where the types have been separated the late-glacial *Alnus* is predominantly *A. incana*-type.

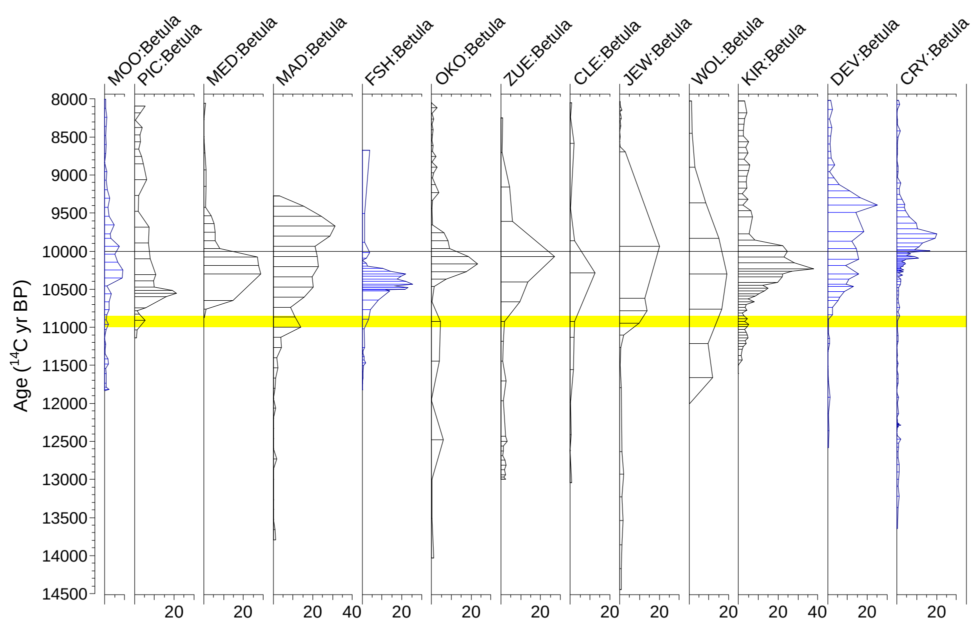


Figure 101. *Betula* profiles from the sites in Figure 92.

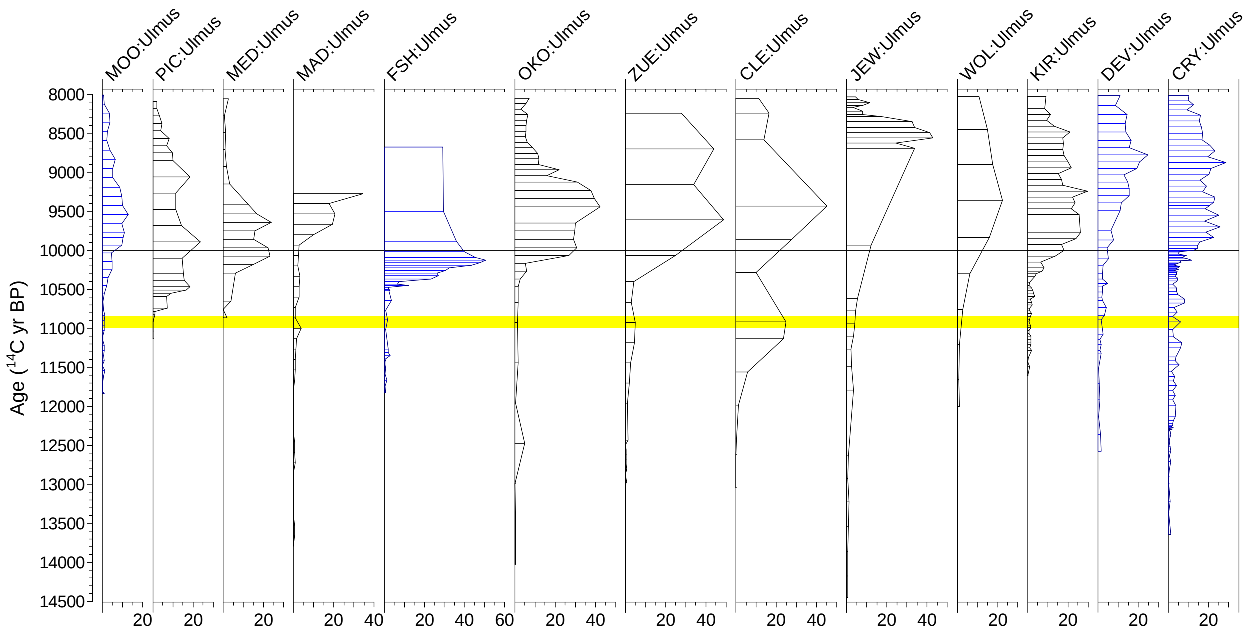


Figure 102. ***Ulmus*** **profiles from the sites in Figure 92.**

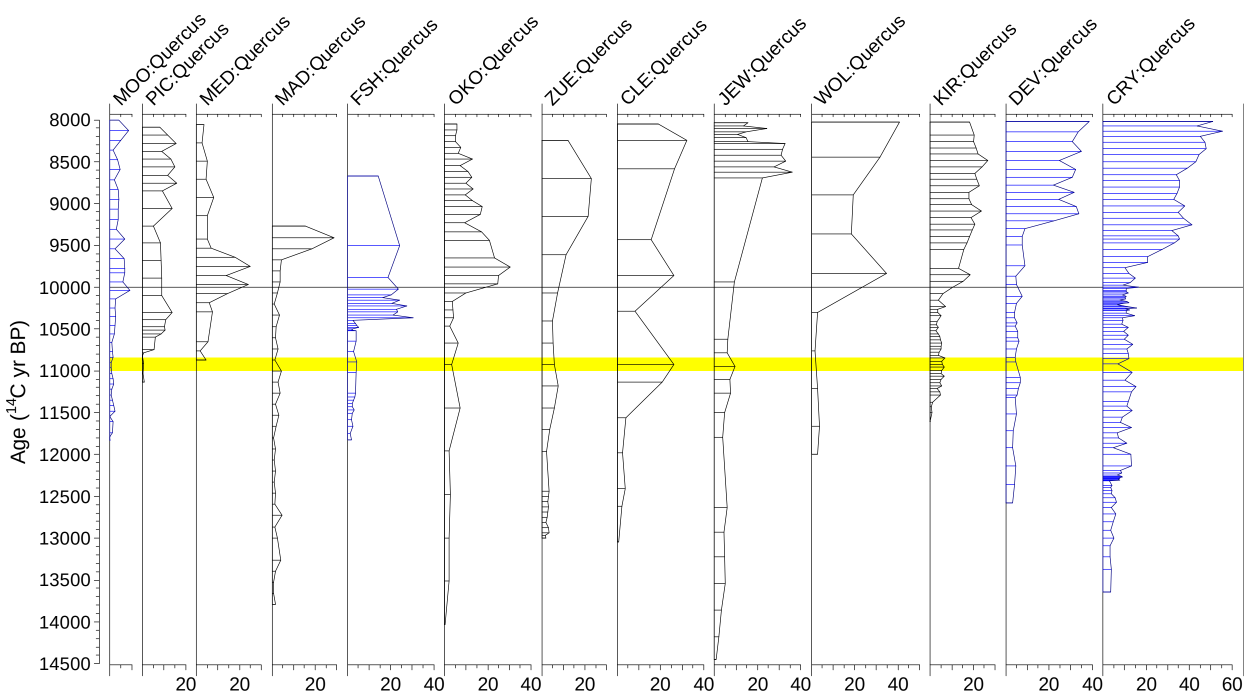


Figure 103. ***Quercus*** **profiles from the sites in Figure 92.**

SUMMARY

The climatic and vegetation history can be summarized as follows (dates are approximate):

- *Before 12,500 RCYBP*: Lake basins are forming as stagnating ice melts. A tundra-like vegetation, with probably some spruce (*Picea*), grew on superglacial deposits. This vegetation type is represented only at Madelia.
- *12,000–11,300 RCYBP*: Gradually warming conditions during the Bølling-Allerød interval. Spruce (*Picea*) gradually declines, and black ash (*Fraxinus nigra*) increases, indicating wet conditions.

- *11,300–10,400 RCYBP*: During the Younger Dryas interval, spruce (*Picea*) increases at some sites, black ash (*Fraxinus nigra*) decreases, and peaks of birch (*Betula*) and alder (*Alnus*) occur. Conditions were probably somewhat cooler than previously, although climate may still have remained quite wet, as indicated by the expansion of alder (*Alnus*), which may have replaced black ash (*Fraxinus nigra*) in wetlands and on poorly drained soils.
- *11,050–10,800 RCYBP, the Clovis cultural period*: This iconic period occurs right at the transition from the Allerød to the Younger Dryas. Determination of whether a major vegetation-climate change occurred during the Clovis interval, or perhaps after this interval, depends on the accuracy of the age models for palynological profiles. The high-resolution age model and pollen data from Crystal Lake, Illinois indicate that the Clovis period occurred during a warm late-glacial interval, and that cooling, which lagged the beginning of the Younger Dryas interval in Greenland, postdated the Clovis period. This site is far to the east of southwest Minnesota, though. However, the Clovis period also corresponds with spruce (*Picea*) at West Lake Okoboji, Zuehl Farm, and Clear Lake – assuming the age models for these sites are accurate. In fact, the error in age models is almost certainly greater than the length of the Clovis interval, so definitive reconstruction of vegetation and climate during this interval will require more data with much more accurate dating control. The now well-dated Fish Lake record indicates that alder (*Alnus*) increased during the Clovis interval, probably indicating cool, wet conditions, and at some sites birch (*Betula*) increased, indicating vegetational instability. Spruce shows evidence of a decline in the late Allerød before the Clovis interval, then rises during the Younger Dryas, but the decline is represented by only one sample.
- *10,400–9500 RCYBP*: Rapidly warming conditions as spruce (*Picea*), alder (*Alnus*), and birch (*Betula*) decline and elm (*Ulmus*) and oak (*Quercus*) increase, indicating the development of a rich deciduous forest and continuing wet conditions, especially indicated by the high values of elm (*Ulmus*).
- *After 9500 RCYBP*: A trend toward drier climate as prairie expands in the region.

Recommendations for Further Study

Although the general vegetation and climate history of southwest Minnesota can be interpreted from existing data, including the new data from Fish Lake, the precise timing of events and reliable reconstruction of paleoenvironments, especially the timing of climate shifts relative to cultural periods will require additional data with much more accurate age control. The following is therefore recommended:

1. The core from Fish Lake was a single 5-cm-diameter core originally collected for reconnaissance purposes. Additional work at this lake could prove very promising. Acquisition of overlapping 7.5-cm-diameter cores, which would (1) ensure complete recovery and (2) provide much more material for AMS radiocarbon dating, is recommended. The sediment is not rich in terrestrial macrofossils (which is typical of a larger lake), but multiple cores would provide more material. These cores should be split and imaged to facilitate stratigraphic correlation. For an accurate age model and for detection of outlier dates, 10-20 AMS radiocarbon dates should be acquired for the late glacial-early Holocene period. This number is similar to that obtained for Crystal Lake, Illinois. New methods are now becoming available for determining the confidence intervals of ages interpolated between radiocarbon-dated horizons. However, these methods require a fairly large number of dates to provide reliable results. In particular, if the probability density functions of calibrated ages overlap, they constrain each other and provide a much more accurate chronology.
2. Although not in Minnesota, West Lake Okoboji is very near, and the existing pollen data indicate a thick stratigraphic sequence through Paleoindian time that could be resolved with higher resolution pollen counting and AMS radiocarbon dates. Coring methods should be the same as recommended for Fish Lake.
3. The Minnesota DNR online lake data (http://www.dnr.state.mn.us/lakefind/ index.html) from southwest Minnesota was examined, and the only other lake that appears potentially deep enough to have not dried out during the mid-Holocene is Sleepy Eye Lake, adjacent to the town of Sleepy Eye. This lake has a small deep hole with a maximum depth of 6 m (20 ft). A reconnaissance core from this lake would be advisable before attempting larger-diameter cores.
4. The Madelia site could potentially be relocated and a core obtained for developing an accurate age model. Reconnaissance work with a Giddings rig might relocate the site.

5. In addition to pollen, charcoal studies could be revealing. Charcoal data from the upper Midwest from the Paleoindian period is sparse, and the role of fire in controlling vegetation is not well-understood, nor is the role of people as sources of ignition. In general, charcoal appears to be sparse in late-glacial sediments, as we do not find large amounts when sieving for macrofossils, including charcoal, for AMS radiocarbon dating. While we do find some charcoal, we do not have a good feeling for its stratigraphic variation.

PROBABILITY MODELING & FIELD TESTING

PROBABILITY AND PREDICTIVE MODELING IN ARCHEOLOGY

Scientific model building was first employed in the study of the earliest Americans in the early 1960s through the *Clovis-first* model (Stanford et al. 2005:318). In the United States, the use of archeological predictive modeling occurred with some frequency during the 1970s and became increasingly widespread throughout the 1980s and 1990s (Judge and Sebastian 1988; Kvamme 1995:3; Wheatley and Gillings 2002:165; Whitley 2003:1). The subsequent introduction of GIS allowed a greater degree of flexibility and utility in applying these models across much larger areas (Dalla Bona 1994). In theory, well-constructed models can be effective planning tools for managing cultural resources and understanding prehistoric land utilization (Kvamme 1990:289). Land use could potentially encompass topics such as settlement practices, travel and trade routes, hunting and foraging areas, and locales for lithic and other resource procurement.

Predictive models can be designed using a myriad of approaches; however, they all essentially assume one of two forms: *inductive* or *deductive*. Inductive models are derived from a database of existing observations, such as known site locations, whereas deductive models are based upon theories that predict some form of human behavior (Dalla Bona 1994; Wheatley and Gillings 2002:166). Although there is typically some degree of interdependence between data and theory in archeology, it is still useful to maintain this distinction for the purpose of model building.

In its most basic form, an archeological predictive model is characterized by one or more outputs generated from a set of inputs that conform to a specific rule. Although the data generated as outputs from a given model are always archeological in nature (e.g., presence/absence of a site, site density, site probability), those utilized as inputs rarely are. Instead, input data are often associated with landscape and environmental parameters, such as slope, elevation, aspect, proximity to water and other resources, geomorphology, and other factors. Models can vary greatly in scope and complexity. Very basic models may simply predict the presence or absence of a site based on previously documented site boundaries and negative survey data for a particular area. Others may provide the probability of site occurrence in a particular location based on a variety of factors that have been assigned different weighted values in accordance with their significance. For example, if it was determined that proximity to water was more integral to the process of selecting a site than whether or not the site area had a predominantly south-facing aspect, the proximity to water variable would be assigned a greater value than the aspect variable.

Although these models can serve as excellent tools for provoking thought and testing hypotheses, they are not without drawbacks. The overwhelming majority are developed for use in large scale cultural resource management (CRM) projects with the underlying objectives solely economic in nature (Wheatley and Gillings 2002:165; Whitley 2003:2). These models are commonly utilized for the purpose of limiting or reducing the extent of on-the-ground archeological investigations required in a given study area. Unfortunately, they are all-too-often regarded (whether intentionally or unintentionally) as a definitive authority on where sites will and will not be found, and consequently, significant sites located in *low potential* areas can oftentimes be overlooked. Whitley (2003:2) succinctly addresses the danger of such an approach in arguing that "…any site which would have been found in low potential zones should, theoretically, be more significant merely by the fact that it was not expected. Therefore, the counter-intuitive argument could be made that low potential zones are the areas which should be more intensively scrutinized…"

In terms of the current study, there are two recently established archeological models of consequence. Within the last decade, both Minnesota and Iowa have developed comprehensive, statewide site locational probability models that are integrated with GIS capabilities. These models, Minnesota's *MN/Model* (Hudak et al. 2002) and Iowa's *Landscape Model for Archaeological Site Suitability*, or *LANDMASS™* (University of Iowa, Office of the State Archaeologist 2005), are further addressed below.

MN/Model and LANDMASS™

MN/Model and LANDMASS™ are similar in the sense that they each identify the probability of archeological site occurrence for a given land parcel using logistic regression analysis. LANDMASS™ uses a 10-point scale between 0 (ill-suited) and 1 (well-suited) to establish the probability of a site occurring in a given locality. MN/Model also assigns site probability on a scale of 0 to 1; however, instead of a 10-point suitability ranking, it segregates land parcels into areas of Low, Medium, and High probability for containing archeological sites. In the GIS of both models, land parcels are assigned different color values based on their probability ranking and this is combined to generate a map overlay. They are useful tools for conducting general desktop assessments at modest scales; however, the analytical reliability of these models typically decreases with an increase in map scale. In fact, the MN/Model includes a cautionary statement indicating that it is "…at best, suitable for analysis at 1:24,000 scale" (Hudak et al. 2002). Although MN/Model and LANDMASS™ both address, to some extent, geomorphology and buried site potential, input data for each are also heavily reliant on previously recorded site data – the majority of which were derived through traditional surface survey methodology. Because of this, and because many of the earliest Paleoindian sites are deeply buried with no surface expression, the utility of these models may be quite limited for this project.

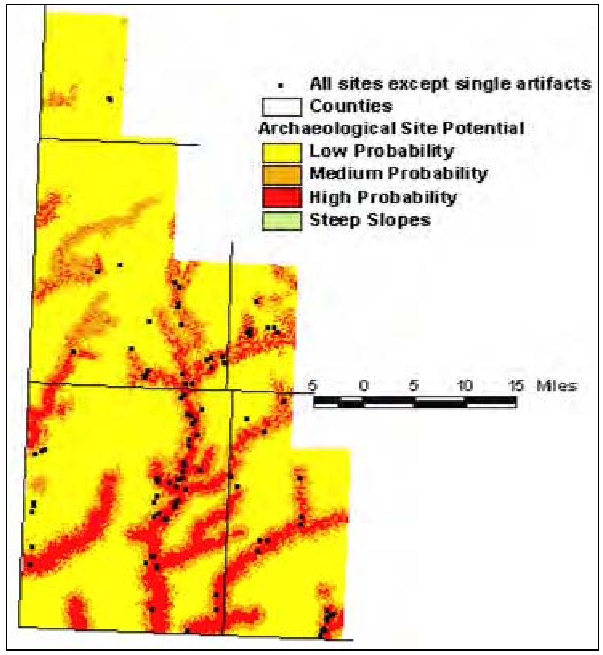


Figure 104. MN/Model basic site probability model (excluding isolated finds) for the Southwest Riverine Archaeological Region (from Hobbs 1997).

The example from MN/Model (Figure 104) predicts that the vast majority of prehistoric sites in Region 1 will occur in close proximity to its major river and stream valleys and that very few will be discovered in the uplands. Interestingly, the three previously unrecorded sites documented during this study (sites 21MU130, 21MU131, and 21RK69) are in areas classified as low probability on the model shown if Figure 104, and the two sites in Murray County are projectile point fragments diagnostic of the Folsom complex (see below). Of course, these three sites are all located in areas that are adjacent to artificially drained, upland glacial lakebeds that are now farmland. The lakebed adjacent to the two sites in Murray County is probably not large enough to be visible at the above model's scale, but it still serves to illustrate the level of complexity involved in utilizing non-archeological inputs to generate prehistoric site location potential, particularly as it relates to the oldest of sites. That proximity to freshwater was one of the most significant variables in prehistoric site selection is widely recognized, and evidence indicates that this was no less the case during early Paleoindian times in Minnesota (Anfinson n.d.). The challenge in model development for these early sites, however, is not in determining where these water sources *are*, but rather where they *were* some 10,000-14,000 years ago.

THE EARLY PALEOINDIAN REGIONAL MODEL

The *Clovis-first* model, as originally proposed, put forth four testable assertions: 1) the Clovis culture was the first human group to populate the Americas, and did so by migrating from Siberia via Beringia sometime around 11,500 RCYBP; 2) they moved east and south across the Americas, arriving in southern South America by about 10,600 RCYBP; 3) they possessed a distinctive and efficient technology; and 4) they were responsible, at least in part, for the extinctions of several species of Pleistocene megafauna (Stanford et al. 2005:318 paraphrasing Bonnichsen and Schneider 1999). Since the Clovis-first model was proposed, new data have challenged the model's foundations and revealed that, not only were humans in the Americas earlier than 11,500 RCYBP (see Fosha and Donohue 2005a, 2005b; Holen 2006, 2008; Overstreet 2004, 2005), but that their collective *entrada* and dispersal across the continents was most certainly more varied than initially proposed (see Brace et al. 2001; Bradley and Stanford 2004; Erlandson 2002; Fladmark 1979; Merriwether et al. 1995; Neves et al. 1993; Schurr and Wallace 1999; Stanford and Bradley 2002; Stanford 2008).

As noted in the introduction, it is considered highly unlikely that a single, all-encompassing model for Paleoindian land use, settlement, economy, and organization can be established for all or even a portion of Minnesota. The primary reasons are that the economies were most likely diverse, not culturally specific, and were linked to a rapidly changing environment. Technological elements preserved in the durable portion of the archeological record provide us limited means to address the problems of cultural relationships, land use patterns, group movements, and cultural changes during the late Pleistocene and early Holocene.

Modeling early Paleoindian behaviors in Minnesota can be successfully approached by partitioning the problem into specific kinds of questions and parameters appropriate to different prey species or species combinations, the availability of different resources across the landscape, and to different climate regimes. In exploring these parameters (*i.e.*, the factors that led a given group to choose one particular site over another), there are certain characteristics of the early Minnesotan's lifeways that are presupposed. First among these is that the human groups populating the landscape during late-glacial/early Holocene times were small, mobile units. Secondly, the mobility of these groups was highly organized, leading to the selection of specific camp localities, oftentimes repeatedly utilized, that contained predictable, readily available suites of resources, such as fresh water, knappable stone, timber, and edible/medicinal/utilitarian plants (Binford 1980; LaBelle 2010).

Multiple scales of time and space are considered. In so doing, the overall climatic and vegetational history of southwestern Minnesota is segregated into five time periods based on substantial noted changes in the palynological data: pre-12,500 RCYBP; 12,000-11,000 RCYBP; 11,000-10,000 RCYBP; 10,000-9500 RCYBP; and post-9500 RCYBP (see pages 87-88). Four general models are developed based on these temporal divisions; the post-9500 RCYBP division is not discussed because it falls outside of the *early* Paleoindian designation. Paleoclimatic and vegetational reconstructions for each period establish the basis for resource availability across the landscape. From this data and other information from previously documented early Paleoindian sites and artifact assemblages, potential subsistence and site locational strategies can be extrapolated for each time period.

Although documented and theorized subsistence strategies of various early Paleoindian cultural complexes are accounted for, it must be stressed that the absence of chronological controls for these groups in both the study area and, in many instances, beyond, complicates the modeling process. We know, for instance, that Clovis and Folsom groups were in southwestern Minnesota because we have found evidence of their stone tools; what we do not know is *when*, exactly they were here. Therefore, we are forced to rely on evidence from other sites in the modeling of these group's subsistence strategies – sites that oftentimes are located in parts of the country that are geographically dissimilar to southwestern Minnesota. Available evidence from other North American sites suggests that the Folsom complex employed a specialized subsistence strategy developed around the hunting of extinct forms of bison (Frison 1974; Frison et al. 1976), while other sites have demonstrated a correlation between Clovis groups and the hunting of mammoth and other megafauna (Figgins 1933; Frison and Todd 1986; Hannus 1985). This may ultimately prove to be the case in Minnesota as well; however, the issue requires further exploration.

Seasonal, yearly, and long-term adaptations with varied combinations of resources are all assumed subsistence strategies. Such strategies would have included generalized foraging; specialized big game hunting of mammoth, caribou, bison, deer, elk, or moose – each of which requires different technologies and knowledge-bases; fishing; and the procurement of waterfowl and other small game. Proximity to other resources, such as potable water (from streams or glacial lakes), knappable lithics (outcrops of Sioux quartzite are present in the region, but the vast majority of this would have been derived from till cobbles), forage (berries, fruits, nuts, mussels, and plants), and timber (for use in manufacturing tools, shelter, and watercraft, as well as for fuel), must also be considered for each timeframe. Almost certainly, the strategies employed would have entailed economic flexibility to such an extent that even the most specialized of strategies would have been supplemented regularly by other means. For example, generalized foraging could represent a distinct economic and cultural adaptation or simply a seasonal variant on a more technologically focused hunting economy. In tundra and spruce forest habitats, generalized foraging would likely *not* be successful on a year-round basis.

Also significant is the consideration of general landscape position, which is divided into *upland*, *riverine*, and *lacustrine* zones, and resource *abundance* versus resource *predictability*. Some areas may harbor only limited supplies of certain resources or may be rich in a particular resource for only a very brief period of time annually. Such areas would be considered as having a low degree of abundance, but a relatively high degree of predictability (see LaBelle 2010:45-46). It should be noted that the lacustrine zone, while of the utmost importance throughout the majority of Minnesota, is almost entirely absent from the Southwest Riverine Region because the landscape is very old and has a highly developed drainage network. It is included, however, for future use in other regions of the state, and because a small number of paleolakes were present in Region 1.

Before 12,500 RCYBP (ca. > 14,625 cal B.P.)

In Minnesota, the late and terminal Pleistocene environment would have supported, perhaps in relatively rapid succession, glacial, tundra, and spruce forest environments. Prior to 12,500 RCYBP, evidence suggests that the stagnated Des Moines lobe had melted (Dyke et al. 2003; Wright et al. 1973) and lake basins were forming amidst a tundra-like environment dominated by sedges, other tundra plants such as purple saxifrage, and some spruce (Table 5; see page 82). Archeological and radiocarbon data from other sites in North America suggest that only pre-Clovis groups would have occupied southwestern Minnesota during this time.

Table 5. Estimated Resource Predictability and Abundance by Landscape Area, ca. > 12,500 RCYBP.

		Potable Water	Lithics	Timber	Forage	Small Game	Large Game
Uplands (> 1,000 m from Water)	**Hilltop/Ridge**	N/A	Medium	Low	Low	Low/Medium	Low/Medium
	General	N/A	Low/Medium	Low	Low	Low/Medium	Low/Medium
Riverine	**Valley Margin**	Medium	Low/Medium	Low/Medium	Low/Medium	Medium	Low/Medium
	Confluence	High	Low/Medium	Medium	Medium	High	Medium
	Floodplain	High	Low	Low/Medium	Low/Medium	Medium	Medium
	Terrace	Medium	Low	Low	Low/Medium	Medium	Low/Medium
	Bluff	Medium	Medium	Low	Low	Low/Medium	Low
Lacustrine (Marsh/Slough/Kettle Lake)	**Inlet/Outlet**	High	Low/Medium	Low/Medium	Medium	High	Medium
	Shoreline	High	Low	Low/Medium	Medium	Medium/High	Low/Medium
	Beach/Upland Ridge	Medium	Medium	Low	Low	Low/Medium	Low
	Island/Peninsula	High	Low	Low/Medium	Medium	Medium/High	Low

As the Wisconsin ice retreated, caribou would likely have inhabited the region (Cleland 1965; Hibbard 1951). A tundra environment would have supported only modest edible plant food on a seasonal basis. Because sedges retain higher protein content later into the fall than other plants, they are favored by caribou late into the season and herds will travel to areas with concentrations of these plants during this time. This phenomenon of annual caribou herd migration to specific sedge-rich areas in the fall was documented in Labrador in the 1950s (Hare 1959). Taking this one step further, an interesting correlation is apparent between the prehistoric archeological and palynological records of this area of Labrador. Pollen cores from four separate locations in the vicinity document a sharp rise in sedge pollen around 1250 RCYBP (McAndrews 1976). Archeological records indicate a modest human occupation of the area from between ca. 5000-1000 RCYBP, but a distinct increase in population by 1000 RCYBP (Samson 1976). Strengthening this apparent correlation, ethnographic accounts document the barren-ground band of Naskapi basing their entire winter subsistence on an annual fall caribou hunt in this same area of Labrador (Spiess 1979:50). This heavy dependence on hunted resources supplemented by seasonal fishing is typical among the economies of hunter/gatherer groups in such environments (Binford 2001; Kelly 1995).

Intercept hunting strategies for caribou (Binford 1980; Brink 2005; Spiess 1979), which may involve river crossings or drive lines, are well known and provide a framework for what may have occurred briefly and on a generally south-to-north time-transgressive pattern during the period of caribou occurrence in the Minnesota area. Despite the widespread assumption that caribou were a key economic resource for Paleoindians in the Great Lakes region and northeastern North America (Gramley 1984; Jackson 1988; Spiess 1979; Spiess et al. 1985), very little substantive evidence has been forthcoming. In spite of investigations at many sites, only a few have yielded definitive caribou remains that are clearly associated with the archeological assemblages. These include Udora (Ontario), Whipple (Maine), and Bull Brook (Massachusetts), with possible caribou of uncertain association also documented for Michaud (Maine), Dutchess Quarry Caves (New York), and Holcombe (Michigan) (Spiess et al. 1985; Storck 2004:208-226). Effective adaptation to, and use of, tundra environments in eastern North America at the close of the Pleistocene may have necessitated some effective and focused use of caribou for food and technological needs. A variety of site types associated with intercept hunting of caribou during seasonal herd movements are likely to be represented (Deller and Ellis 1988, 1992; Ellis and Deller 2000; Fitting et al. 1966; Gramley 1982, 1984; Jackson 1988; Lepper 1999; MacDonald 1968; Storck 2004). Lepper (1999:375) and others have suggested that the importance of caribou to Paleoindian peoples in the region has been exaggerated. However, it is important to also consider the fact that caribou may have represented the most productive (in terms of return on costs and time), important (for technological as well as economic needs), abundant, and reliable single resource for a period of time in the region along the Wisconsin ice front during the latest Pleistocene. Focused seasonal use of caribou among recent groups such as the Nunamiut in central Alaska (Gubser 1965) was done hand-in-hand with the use of a wide variety of other resources. Such was likely the case in Paleoindian times as well.

Mammoth and mastodon were also present in the area during this period, and multiple arguments have been offered suggesting their utilization by Paleoindians in the western Great Lakes and northeastern Plains region (Dixon 1993; Fisher 1987, 2004; Fisher et al. 1991; Graham et al. 1981; Lepper 1999; Overstreet 2005; Palmer and Stoltman 1976). Especially important, regionally, is work at the Schaefer and Hebior sites in southeastern Wisconsin (Overstreet 2004, 2005) and the Chalk Rock site just west of the study area in Brookings County, South Dakota (Fosha and Donohue 2005a, 2005b; Fosha et al. 2004; Fosha and Woodside 2003). At Schaefer/Hebior, mammoth remains are associated with stone tools in contexts that pre-date Clovis. Overstreet (2005:191) argues that the Schaefer and Hebior sites were used at a time when the region was a tundra environment with likely key economic species being woolly mammoth, mastodon, muskoxen, and caribou. He has defined the Chesrow complex based on distributional and technological data which he argues to be associated with this pre-Clovis age mammoth utilization. Chesrow projectile points are unfluted and have yet to be found and dated in a stratified context. It will be difficult to attribute isolated or surface-recovered points to this type with confidence because the morphology is so generalized and similar artifacts representing preforms and knives occur in much later prehistoric contexts. The Chalk Rock site has received far less extensive study in comparison to Schaefer and Hebior; however, its location in the Inner Coteau, in what is essentially an extension of the Southwest Riverine archaeological region, makes it particularly intriguing. Mammoth remains at this site were tenuously associated with lithic debitage and two possible feature-like stains dating to pre-Clovis times. Additional investigations appear warranted to confirm these findings, but should they prove meritous, this site's implications for a human presence on the landscape during this early time would be immensely significant.

12,000-11,300 RCYBP (ca. 13,875-13,200 cal B.P.)

By 12,000 RCYBP, the southwestern Minnesota landscape was predominantly covered by spruce forest. Unlike modern-day boreal forests, however, this forest supported no pine communities and little to no birch. Instead, several species of deciduous trees were interspersed throughout (Table 6; see pages 82-83). Gradual warming conditions began during the Bølling-Allerød interval, and this resulted in an equally gradual decline in spruce until the onset of the Younger Dryas. Temperature seasonality has been interpreted as analogous to that of today, albeit with much higher levels of precipitation (Gonzales et al. 2009). Although these higher levels of precipitation characterized the climate further east and south, it seems as though a somewhat drier regime persisted in southwestern Minnesota (see page 83). Available evidence indicates that both pre-Clovis and Clovis groups would likely have occupied the landscape during this timeframe. Though Gainey lacks chronological control, its similarities with Clovis suggest that it, too, may have a presence on the landscape during this time. Other eastern groups, such as Barnes, may also be present during the very end of this period.

In the northern Plains, extinct bison, as well as small amounts of pronghorn, camel, and horse have been documented from Clovis sites (Frison 2004:39). Although barren ground caribou would no longer have occupied southwestern Minnesota by this time, it is entirely possible that communities of woodland caribou were present. Further south, in the Mississippi valley of eastern Missouri, the Kimmswick site provides good evidence for the association of Clovis people and mastodon, ground sloth, and other species (Graham et al. 1981; Graham and Kay 1988). Additional resources in this environment that would likely have been exploited include migratory waterfowl (Fiedel 2007) and fish ([e.g., Shawnee Minisink site, Pennsylvania] Dent 2007; McNett 1985).

Kuehn (2007) provides direct evidence for early Holocene or latest Pleistocene-period Paleoindian utilization of birds, turtles, and fish from sites in northern Wisconsin. He also documents the occurrence of a variety of mammals, including deer, large cervids (possibly elk or moose), bear, porcupine, beaver, and muskrat from these sites and argues that late Paleoindian groups employed a generalized foraging strategy (Kuehn 2007:97). Kuehn suggests that Paleoindian groups would have utilized a wide variety of resources including large mammals, but that we need not characterize them as *big game* hunters. His "generalized foraging" model merits further evaluation and development. It is also important to acknowledge that several different economic strategies could have been employed in the region of the glacial margin in fairly rapid succession, or even contemporaneously, as conditions frequently changed during the Pleistocene-Holocene transition.

Table 6. Estimated Resource Predictability and Abundance by Landscape Area, ca. 12,000-11,300 RCYBP.

		Potable Water	Lithics	Timber	Forage	Small Game	Large Game
Uplands (> 1,000 m from Water)	**Hilltop/Ridge**	N/A	Medium	Low/Medium	Low	Low/Medium	Low/Medium
	General	N/A	Low/Medium	Medium	Low/Medium	Low/Medium	Low/Medium
Riverine	**Valley Margin**	Medium	Low/Medium	High	Medium/High	Medium	Medium
	Confluence	High	Low/Medium	High	Medium/High	High	Medium/High
	Floodplain	High	Low	Medium/High	Medium	Medium	Medium
	Terrace	Medium	Low	Medium/High	Medium	Medium	Medium
	Bluff	Medium	Medium	Medium/High	Low/Medium	Low/Medium	Low/Medium
Lacustrine (Marsh/Slough/Kettle Lake)	**Inlet/ Outlet**	High	Low/Medium	High	Medium/High	High	Medium/High
	Shoreline	High	Low	Medium/High	Medium	Medium/High	Medium
	Beach/Upland Ridge	Medium	Medium	Medium	Low	Low/Medium	Low/Medium
	Island/Peninsula	High	Low	High	Medium/High	Medium/High	Low/Medium

11,300-10,400 RCYBP (ca. 13,200-12,300 cal B.P.)

With the onset of the Younger Dryas came cooler temperatures, and an expansion of the spruce forests is noted at some sites. This coincides with a decrease in the prevalence of black ash and peaks in both the birch and alder communities. Though cooler than before, precipitation probably remained high as evidenced by the expanse of alder during this time (Table 7; see page 88). An ephemeral Clovis/Gainey presence may be detected at the beginning of this period; however, groups such as Folsom, Holcombe, and Barnes fit more closely within the timeframe.

Bison became a particularly important prehistoric resource in the Minnesota area at the close of the Pleistocene or soon after. Prior to 11,000 RCYBP, there are comparatively few paleontological records of bison in the region south of the ice margin, and most of these represent individual death sites rather than mass death events (Graham and Lundelius 1994; Graham et al. 1987). As other species became extinct (mammoth, mastodon, horse, camel, sloth) or extirpated (caribou, muskoxen) during the late Pleistocene, bison populations increased dramatically, filling the changing and expanding herbivore niche. Bison became more gregarious with increasing herd sizes evident (Graham et al. 1987; Guthrie 1990a, 1990b). Bison kill sites with as many as a dozen animals are known from the Southern Plains by Clovis time (Bement and Carter 2010; Haynes and Huckell 2007; Hester 1971). Intensive bison hunting throughout the Plains and adjacent areas is well-documented during the early Holocene (Hofman and Graham 1998; Kornfeld et al. 2010). Regionally, bison hunting during the terminal Pleistocene/early Holocene probably included intercept strategies with the aid of arroyo traps (e.g., Frison 1991; Frison et al. 1976; Frison and Stanford 1982; Wheat 1972) and possibly corrals (Stanford 1999). Bison jump sites are well-documented by Middle Holocene time, but are rare earlier (Brink 2008; Dibble and Lorraine 1968; Hofman 2010).

Table 7. Estimated Resource Predictability and Abundance by Landscape Area, ca. 11,300-10,400 RCYBP.

		Potable Water	Lithics	Timber	Forage	Small Game	Large Game
Uplands (> 1,000 m from Water)	**Hilltop/Ridge**	N/A	Medium	Low/Medium	Low	Low/Medium	Low/Medium
	General	N/A	Low/Medium	Medium	Low/Medium	Low/Medium	Low/Medium
Riverine	**Valley Margin**	Medium	Low/Medium	High	Medium/High	Medium	Medium
	Confluence	High	Low/Medium	High	Medium/High	High	Medium/High
	Floodplain	High	Low	Medium/High	Medium	Medium	Medium
	Terrace	Medium	Low	Medium/High	Medium	Medium	Medium
	Bluff	Medium	Medium	Medium/High	Low/Medium	Low/Medium	Low/Medium
Lacustrine (Marsh/Slough/Kettle Lake)	**Inlet/ Outlet**	High	Low/Medium	High	Medium/High	High	Medium/High
	Shoreline	High	Low	Medium/High	Medium	Medium/High	Medium
	Beach/Upland Ridge	Medium	Medium	Medium	Low	Low/Medium	Low/Medium
	Island/Peninsula	High	Low	High	Medium/High	Medium/High	Low/Medium

10,400-9500 RCYBP (ca. 12,300-10,750 cal B.P.)

Consistent with the transition to the Preboreal interval, southwestern Minnesota experienced rapidly warming conditions during this time. This is traced, palynologically, through a noted decline in spruce, alder, and birch communities concomitant with an increase in deciduous species dominated by elm and oak. The extensive elm populations during this time suggest that high precipitation levels continued in concert with the increase in temperatures (Table 8; see page 88). It would not be until after approximately 9500 RCYBP that a decidedly drier climate regime prevailed across the region as evidenced by a marked increase in ragweed, sage, and prairie grass pollen (see page 86). Folsom and Barnes groups may have had a presence on the landscape, at least during the earlier part of this period, whereas the presence of Holcombe groups is questionable given the absence of good dates associated with the complex.

During this time, it is likely that the tempo of bison hunting in the region continued to accelerate while other large game, such as deer, elk, and moose, also continued to be exploited. A broader spectrum of small game and plant resources brought about as a result of the warming would likely have characterized this period. In response, an increased reliance upon foraging and small game procurement could, therefore, also be postulated during this time. By the Middle Holocene (7000-4000 RCYBP), bison kills are well-documented in the eastern Prairie region including Minnesota, Iowa, and eastern Nebraska (Anderson and Semken 1980; Frison 1998; Shay 1971; Widga 2006). The Cherokee Sewer site in Iowa and the Itasca site in Minnesota are relatively early bison bone beds in the region that employed unknown methods, although Cherokee Sewer may represent an arroyo trap.

Table 8. Estimated Resource Predictability and Abundance by Landscape Area, ca. 10,400-9500 RCYBP.

		Potable Water	Lithics	Timber	Forage	Small Game	Large Game
Uplands (> 1,000 m from Water)	**Hilltop/Ridge**	N/A	Medium	Low/Medium	Low	Low/Medium	Low/Medium
	General	N/A	Low/Medium	Medium	Low/Medium	Low/Medium	Low/Medium
Riverine	**Valley Margin**	Medium	Low/Medium	High	Medium/High	Medium	Medium
	Confluence	High	Low/Medium	High	Medium/High	High	Medium/High
	Floodplain	High	Low	Medium/High	Medium	Medium	Medium
	Terrace	Medium	Low	Medium/High	Medium	Medium	Medium
	Bluff	Medium	Medium	Medium/High	Low/Medium	Low/Medium	Low/Medium
Lacustrine (Marsh/Slough/Kettle Lake)	**Inlet/ Outlet**	High	Low/Medium	High	Medium/High	High	Medium/High
	Shoreline	High	Low	Medium/High	Medium	Medium/High	Medium
	Beach/Upland Ridge	Medium	Medium	Medium	Low	Low/Medium	Low/Medium
	Island/Peninsula	High	Low	High	Medium/High	Medium/High	Low/Medium

Site Types, Utilization, and Landscape

Approximately seven primary functional site-types could reasonably be expect to occur in association with early Paleoindian occupation of the landscape. Based on its function, we can also expect to recognize certain trends associated with the selection of a site's location, the frequency with which it was occupied, the number of similar sites present on the landscape, and the way in which it manifests archeologically. These site-types, including a short description, are listed below.

- **Base Camps** represent large camp sites located in areas with both abundant and predictable resources; areas such as large valley terraces or fans at or near the confluence of major waterways and their tributaries. It could also be expected that these areas would have access to known herd migration corridors and/or high elevation observation localities. These camps were likely occupied multiple times for extended periods. Very few are likely to have been present on the landscape.

- **Small Sites/Isolated Finds** are far more ephemeral in nature and are expected to exist in far greater numbers on the landscape. Though such site areas are more abundant, they are not necessarily more predictable in that they could represent any number of different activities. These sites may represent small, single-use camps, specialized function areas that may have been reused at various times throughout the year (e.g., fishing or foraging areas, overlooks/animal herd observation areas), a brief rest area where a tool was resharpened or discarded, or an unintended, chance occurrence (e.g., a lost tool). This site type is likely to occur with the greatest frequency in the region and is also most likely to occur in a wide variety of landscape positions. The landscape position of certain sites in this category will be far easier to predict than others. Herd observation/overlook sites, for instance, will always be found in some elevated position that affords an ample viewshed of the surrounding landscape or particular landscape feature (e.g., a high hilltop above a surrounding plain or a river bluff overlooking a shallow crossing frequented by herd animals).

- **Tool Caches** are extremely rare, and it is anticipated that very few exist in Region 1. Part of the problem with such sites is that they appear to have served a very particular function; what that exact function was, however, oftentimes remains elusive. Some have been interpreted as simply a store of tools that could be readily recovered at a later time, while others have been viewed as ceremonial offerings. It is not clear that these sites appear with any greater frequency in certain landscape positions than others and any affiliation with resource abundance and/or predictability is unclear. This category does not include meat caches, which are discussed in concert with kill/processing localities below.

- **Quarries** are sites utilized for the very specific function of obtaining workable lithics for tool manufacture. These sites provide a highly predictable resource and would likely be returned to fairly regularly, albeit, for very brief periods of time. In Region 1, only Sioux quartzite and catlinite outcrops are present in this area. Sioux quartzite is known to be very difficult to knap and although the later use of catlinite among prehistoric and historic-period groups has been extensively documented, its use among the earliest groups in the region has not been confirmed. Because the entirety of the region was glaciated in the past, the vast majority of knappable lithics was most likely obtained from till cobbles. Other, higher quality exotic lithics were imported into the area by early Paleoindian groups. It is anticipated that very few quarries will be discovered in Region 1.

- **Mortuary/Burial** sites also serve a very specific function, both ceremonially and practically. However, no burials have yet been documented in Minnesota from such an early time period and the frequency of their occurrence in Region 1 – particularly considering preservation – would, at best, be extremely low. The likely landscape position of these sites is also extremely difficult to ascertain given the absence of contemporary sites for comparison. The interment associated with the Browns Valley site (21TR5) north of Region 1 was radiocarbon dated to approximately 9000 RCYBP (Shane 1991) and might provide some clues; however, this represents a gap of several thousand years from the earliest Paleoindian groups and probably also represents a different cultural foundation. A much larger sample set is necessary before even the broadest of generalizations can be made about mortuary customs of the earliest Paleoindian groups. Because we lack this evidence, it is also impossible to draw any meaningful correlations between the proximity of these sites and abundant/predictable natural resources.

- **Kill/Processing** areas are, for the most part, medium- to large-sized sites representative of a single hunting event. However, certain sites that include herding and trapping components like drive lines, arroyo traps, and jumps, may have been utilized multiple times. These sites can represent the taking, butchering, and/or caching of one or more animals and will typically be found in a variety of areas across the landscape. Some of these areas include the heads of steep-sided tributaries adjacent to major waterways, the base of cliffs or gullies, the edge of lakes or watering holes, shallow river crossings, and open upland environments. Such sites typically represent events of high resource abundance; however, unless the circumstances of a particular kill site allowed for its repeated reuse, predictability tends to be lower.

- **Cave/Rockshelter** sites represent either single-use or extended-period habitations located in very specific areas on the landscape (*i.e.*, areas with exposed rock overhangs or natural caves). The frequency with which these sites occur is largely related to the presence of the natural features necessary to define them. Because these sites are tied to very specific settings, their association with areas of abundant and/or predictable resources can be difficult to project. In Region 1, there are very few areas conducive to such sites and few, if any, are likely to occur.

FIELD METHODOLOGY AND EQUIPMENT EMPLOYED

Typical investigation of the study localities began by consulting the appropriate county plat books and obtaining access permission from landowners and/or tenants. This was followed by an initial reconnaissance of each area's landscape that combined elements of an on-the-ground survey with those of a *windshield* inspection. Also during this time, landowners were consulted about the history of their property and any previous archeological finds. Most landowners were quite interested in the project, shared information, and granted permission to access their land. In general, pedestrian survey of portions of each area was conducted. The amount of subsurface testing conducted was minimal – limited by seasonal constraints (e.g., heavy winter snowfall followed by heavy spring rainfall and flooding) and landowner constraints, as well as by landform composition. Landowners of Locality C, The Nature Conservancy, denied permission for *any* subsurface testing, while a combination of landform issues precluded the effective use of a deep soil core rig in Locality D. A small number of shallow shovel tests were hand-excavated in Locality B. Only one deep soil core was obtained, from Locality A, with the assistance of a Giddings hydraulic soil probe (Figure 105). The probe was fitted with a 2.5-inch-diameter continuous core.

Figure 105. The Giddings soil probe used during a portion of the geomorphological study.

SELECTED SURVEY LOCALITIES

Due to constraints imposed by both Father Time and Mother Nature, it was decided from the outset that field investigations would necessarily be limited in scope. A preliminary examination of the topographic and geologic history of Region 1 (City of Pipestone Staff and Planning Commission 2008; Diers 1988; Gries 1998; Hokanson et al. 1970, 1976; Minnesota Geological Survey 1995; Nelson 1990; Patterson 1997; SDGS 2008; Southwick 2007; Southwick et al. 1993), previous archeological and geomorphological data obtained as part of the MN/Model study (Hudak and Hajic 2002; Hudak et al. 2002) and other projects in the region (Boraas 1968; Gibbon and Hruby 1983; Hudak 1971; Minnesota Historical Society 1981; Scott et al. 2006), and information obtained from the examination of artifact collections, culminated in the selection of four areas for further field study (Figure 106). These areas, designated Study Localities A-D, include a river valley setting near Blue Mounds State Park, an expansive perched lakebed/marsh of probable glacial origin, the Hole-in-the-Mountain glacial outwash channel near Lake Benton, and an upland kettle lake landscape just below the Buffalo Ridge. Each locality is briefly addressed below.

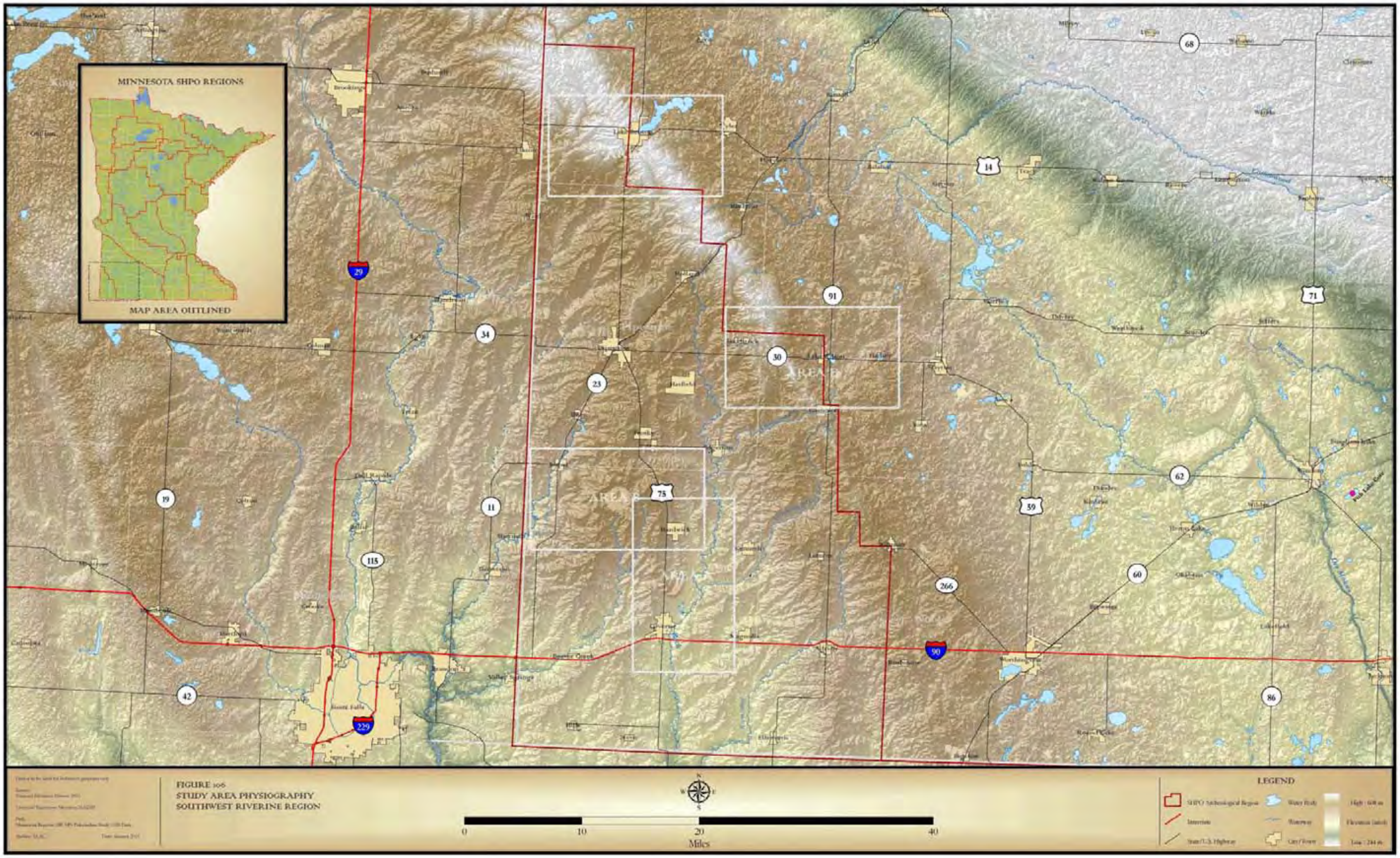


FIGURE 106
STUDY AREA PHYSIOGRAPHY
SOUTHWEST RIVERINE REGION

Locality A: Blue Mounds State Park/Rock River Valley

Study Locality A is a segment of the Rock River valley located approximately four miles northeast of the town of Luverne at the site of Blue Mounds State Park (Figure 107). The landscape comprising this area represents a distinctive combination of topographic and riverine confluence features, which would have made it well-suited to the observation of caribou herd movements and to intercepting animals as they crossed the Rock River in this locality or as they passed along Mound Creek from the Rock River bottom onto the upland area to the west. Overlook or hunting stands for observing game movements and repairing or preparing tools, camp sites, and kill and processing sites should all occur in this vicinity or others where caribou were likely to have been hunted (Figures 108 and 109). Issues of site preservation, geomorphology, recognition (depth of burial), and subsequent activities of other groups are all important considerations in locating and investigating these elements of the archeological record and their formational history. Combinations of terrain features such as are found in the Blue Mounds area should serve as targets for modeling and investigating possible caribou hunting in other parts of Minnesota. Site locations in this and other portions of the state may be modeled based on documented Gainey, Parkhill phase (Barnes), and Holcombe sites in southern Ontario, Michigan, and elsewhere (e.g., Deller and Ellis 1988, 1992; Ellis and Deller 2000; Fitting et al. 1966; Storck 2004).

Figure 107. Overview of site 21RK14. The Mound at Blue Mounds State Park is visible in the background across the Rock River valley, west-southwestern orientation.

The landscape of this study area would also have been well-suited to the observation and hunting of bison, and it reportedly had an extensive bison bone bed in early historic times that was mined for its bone, which was supposedly shipped out by rail. The dramatic bluff feature known as *the Mound* would have worked well as a bison jump; with the herd "collecting area" on the prairie to the west (see Figures 108 and 109). Though the possibility of a bison jump at Blue Mounds has been explored (Boraas 1968; Hudak 1971), it has neither been substantiated nor fully evaluated to date. Evaluation and documentation of bison kills at Blue Mounds, of any age, is an important archeological concern. It is certainly possible that this feature was used to aid in bison hunting as early as bison herds would have populated the area.

One area that would have been particularly well-suited for herd observation, be it bison or caribou, is the area of previously recorded site 21RK14. This site is located on a hilltop along the eastern valley bluff line across from the Mound and Mound Creek, and just above the confluence of Champepadan Creek with the Rock River. A surface survey of the area was conducted on April 9, and a substantial lithic scatter was observed. Of particular interest was a small, chalcedony end scraper observed near the field edge. This specimen (Figure 110), measuring 2.35 cm long, 1.87 cm wide, and 0.73 cm wide, exhibits a small spur distally on the right lateral margin. Although not a definitive temporal marker, spurred end scrapers are commonly documented in Paleoindian artifact assemblages and are rarely seen in assemblages of more recent groups (e.g., Frison 1991:128; Rogers 1986). The private artifact collection of Bruce Hess also contains several specimens from this site. Among these are multiple Knife River flint overshot flakes with lateral retouch. Again, nothing definitive, but the circumstantial evidence suggestive of a Paleoindian presence is compelling.

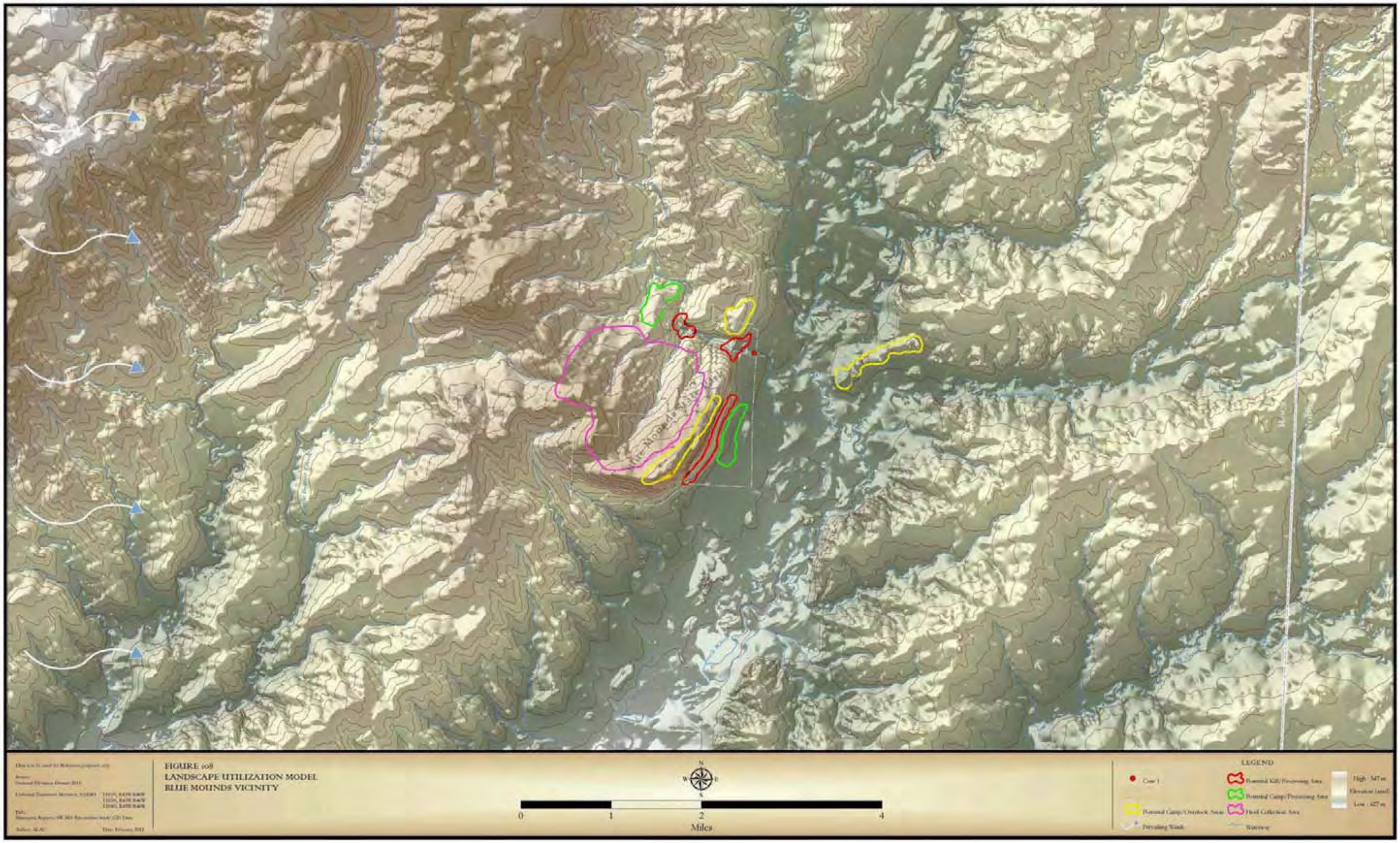


FIGURE 108
LANDSCAPE UTILIZATION MODEL
BLUE MOUNDS VICINITY

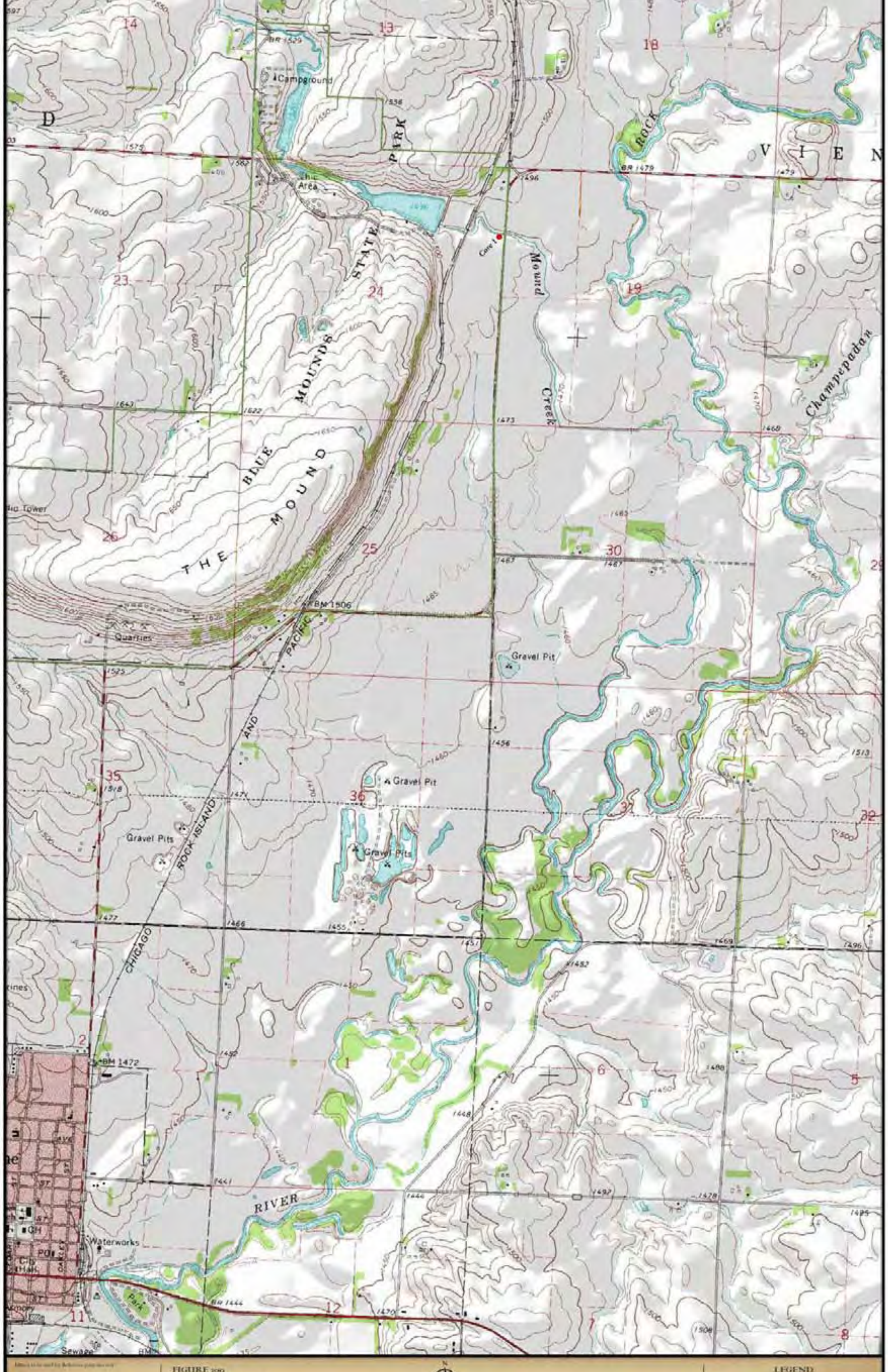


FIGURE 109
STUDY LOCALITY A

Figure 110. Spurred end scraper from site 21RK14.

One soil core, identified as Core 1, was obtained from a pasture along the south bank of Mound Creek in Locality A (Table 9; Figure 111, see also Figures 108 and 109, above). Despite the designation of *Pediment* on the MN/Model LsSA map (see Figure 91, page 72), the core was actually extracted from an alluvial terrace landform. The core extended to a depth of 250+ cmbs, at which point it was no longer possible to push the probe further. High water tables (encountered at a depth of approximately 150 cmbs), caused by spring snow melt and heavy rains, were primarily to blame for the inability of the probe to obtain greater depths. No buried soil horizons or cultural material were recovered from the core.

It was hoped that an additional core could be extracted from an area of the park further south below the Mound designated as a *Valley Margin* LsSA (see Figure 91, page 72); however, recent heavy rains prevented vehicle travel to this area at the time of the investigation.

Table 9. Description of Core 1, Blue Mounds State Park, South Bank of Mound Creek.

Landform: Alluvial terrace
Slope: 1 percent
Described by: Rolfe D. Mandel
Remarks: The water table was intercepted at a depth of ~150 cmbs.

Depth (cmbs)	Soil Horizon	Description
0-20	Ap	Very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; friable; many fine and very fine roots; clear boundary.
20-45	A1	Very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; friable; many fine and very fine roots; common worm casts and open worm burrows; gradual boundary.
45-75	A2	Very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and fine granular structure; friable; common fine and very fine roots; few worm casts and open worm burrows; gradual boundary.
75-100	AB	Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; common very fine and fine roots; few worm casts and open worm burrows; gradual boundary.
100-145	Bw1	Brown (10YR 5/3) to yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) to dark yellowish brown (10YR 4/4) moist; common fine faint dark yellowish brown (10YR 4/6) and brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few very fine and fine roots; gradual boundary.
145-170	Bw2	Brown (10YR 5/3) to yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) to dark yellowish brown (10YR 4/4) moist; common fine distinct brown (7.5YR 4/4) and greenish gray (5GY 5/1 and 5GY 6/1) mottles; weak fine subangular blocky structure; friable; gradual boundary.
170-200	C	Strongly mottled yellowish brown (10YR 5/8), pale olive (5Y 6/3), strong brown (7.5YR 5/6 and 5/8), and light olive brown (2.5Y 5/4) silt loam and loam interbedded with fine, medium and coarse sand; massive; firm; coarsens downward; abrupt boundary.
200-250+	2C	Stratified sand and gravel; single grain; loose.

Figure 111. Core 1, Study Locality A, Blue Mounds State Park, eastern orientation.

Locality B: Rock County Glacial Lake

This topographic feature, as conspicuous as it is anomalous, is located approximately three miles southeast of the town of Jasper and about eight miles northwest of Blue Mounds State Park in northern Rock County (see Figure 106, above). *The Marsh*, as it is affectionately known by locals, is a circular depression and former lakebed measuring approximately two miles in diameter and covering more than 1,052 hectares (2,600 acres) (Figures 112-114). Southwick et al. (1993:15) describe the former lake plain as being situated topographically about 33 feet below its outer rim. Lake sediment within the basin, measuring approximately six feet in depth, is Quaternary-aged and ranges in composition from clays to sands (Alan Knaeble, Minnesota Geological Survey, personal communication 2011). This is underlain by about 50 feet of glacial sediment in which two different tills separated by earlier lacustrine sediments have been identified (Patterson 1997:23). The rim enclosing the feature is composed of a variety of Quaternary glacial deposits that shallowly overlie Sioux quartzite bedrock. Immediately west and southwest of the feature, Sioux quartzite outcrops are abundant (Patterson 1997:23; Southwick 2007:1).

The Marsh was first artificially drained in 1913, and was again drained as recently as 10 years ago (Jesse Ellefson Wenzel, landowner, personal communication 2011). The land comprising the old lakebed is now cultivated farmland (Figure 115). Historical accounts relate how, during certain times of the year, tens of thousands of migratory waterfowl, including a variety of ducks, geese, and other birds, would gather there. Residents from across the county would visit the Marsh during these times to view the spectacle (Jesse Ellefson Wenzel, landowner, personal communication 2011). It has probably served as a nesting and resting location for migratory waterfowl since the Pleistocene, and Fiedel (2007) and others have suggested that we have underestimated the importance of waterfowl in the economies of early Paleoindian peoples. During wetter periods, the lake also likely provided fish and other aquatic species. The Marsh is perched on a topographic high area and multiple drainages have their headwaters around the perimeter of the lake. The eroded headcuts of these drainages would have provided traps for bison hunting, and presumably bison and other herd animals would have used the lake/marsh and vicinity as a watering and grazing area. Likely camp site and overlook locations occur along the sand ridges on the eastern margin of this lake area, and at least one archeological site, 21RK69, has been documented along one of these ridgelines (Figures 116 and 117).

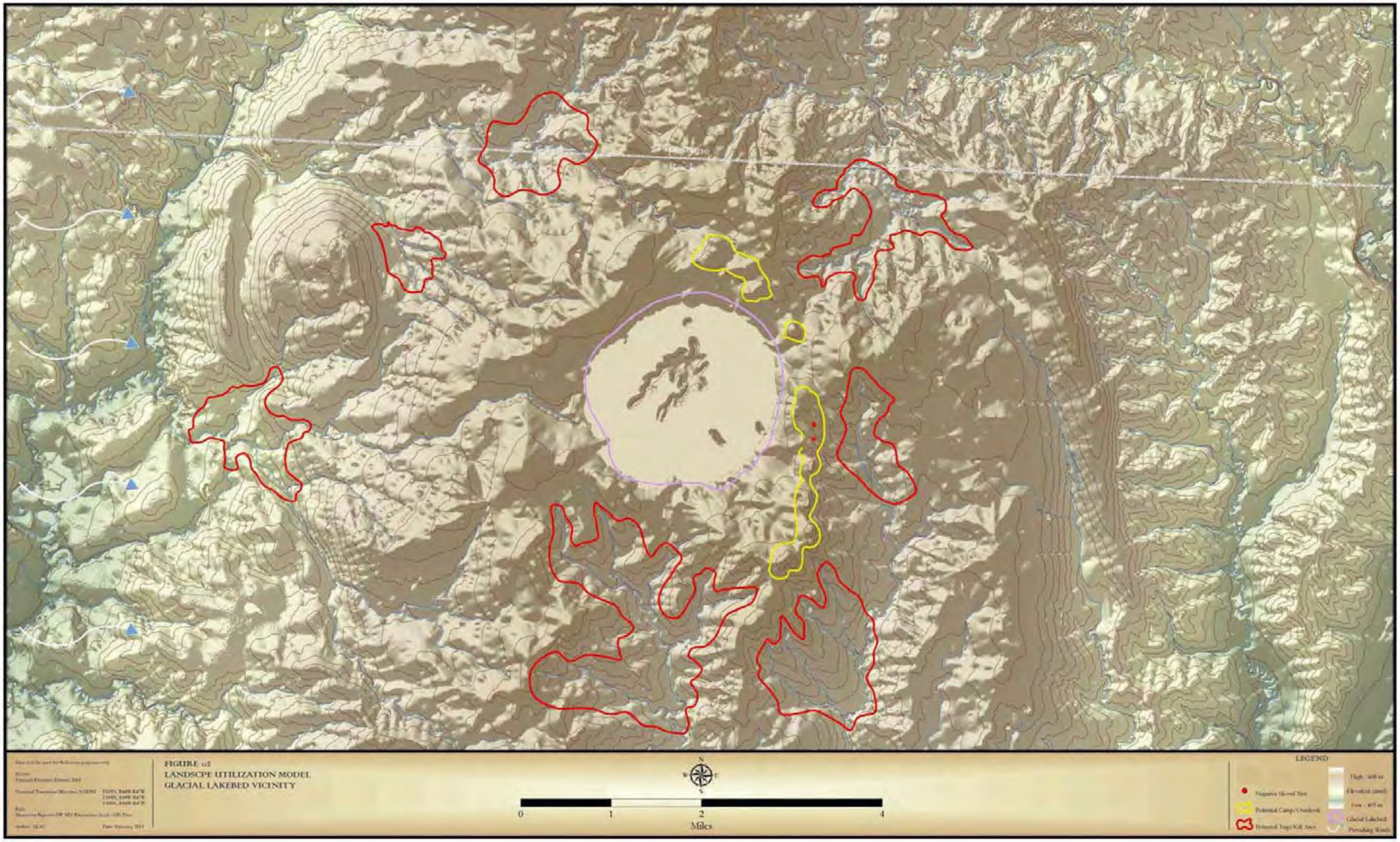


FIGURE 12
LANDSCPE UTILIZATION MODEL
GLACIAL LAKEBED VICINITY

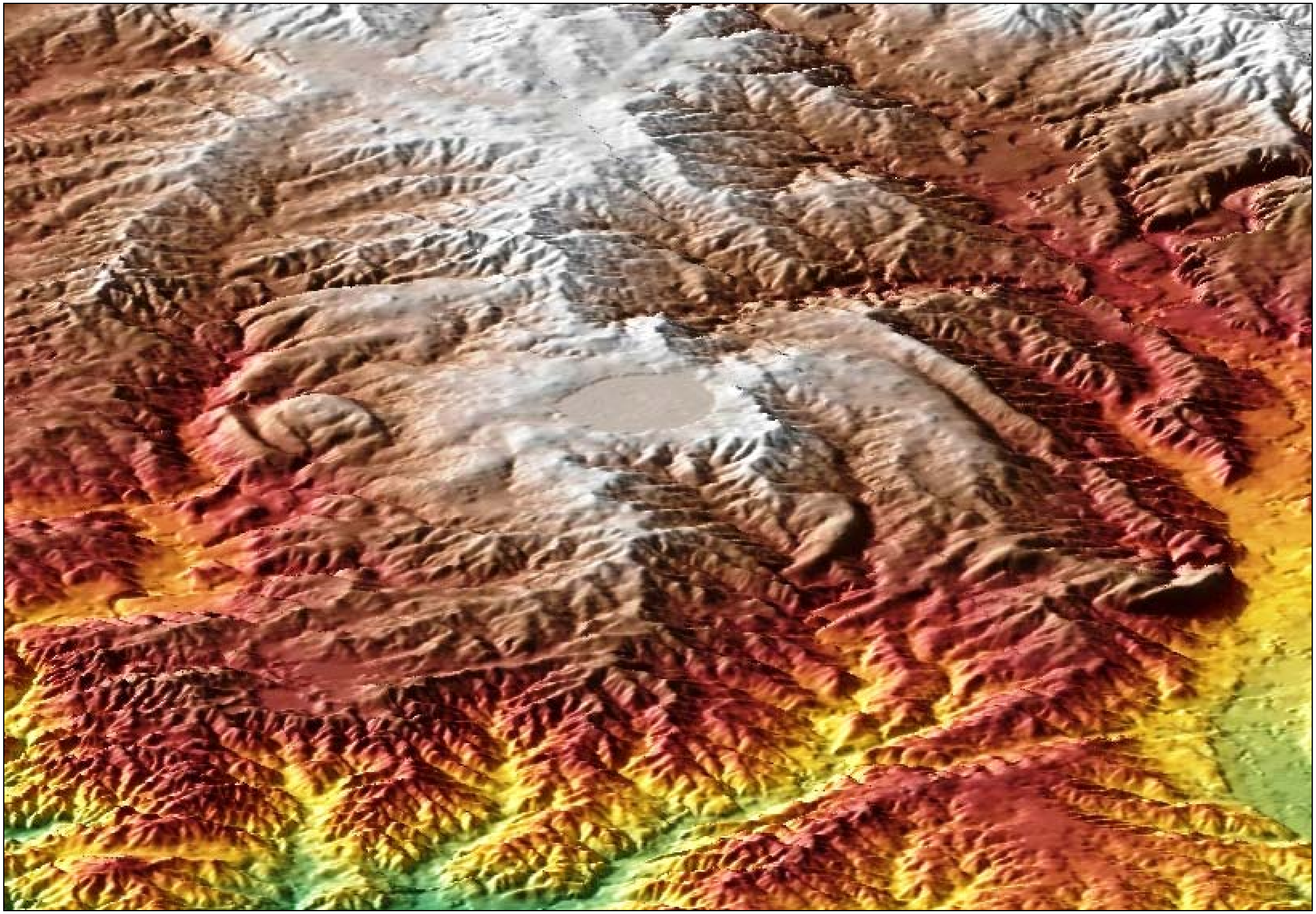


Figure 113. Oblique digital elevation model of the glacial lakebed in relation to its surrounding topography (courtesy of U.S. Geological Survey, Earth Resources Observation and Science data center, Sioux Falls, South Dakota).

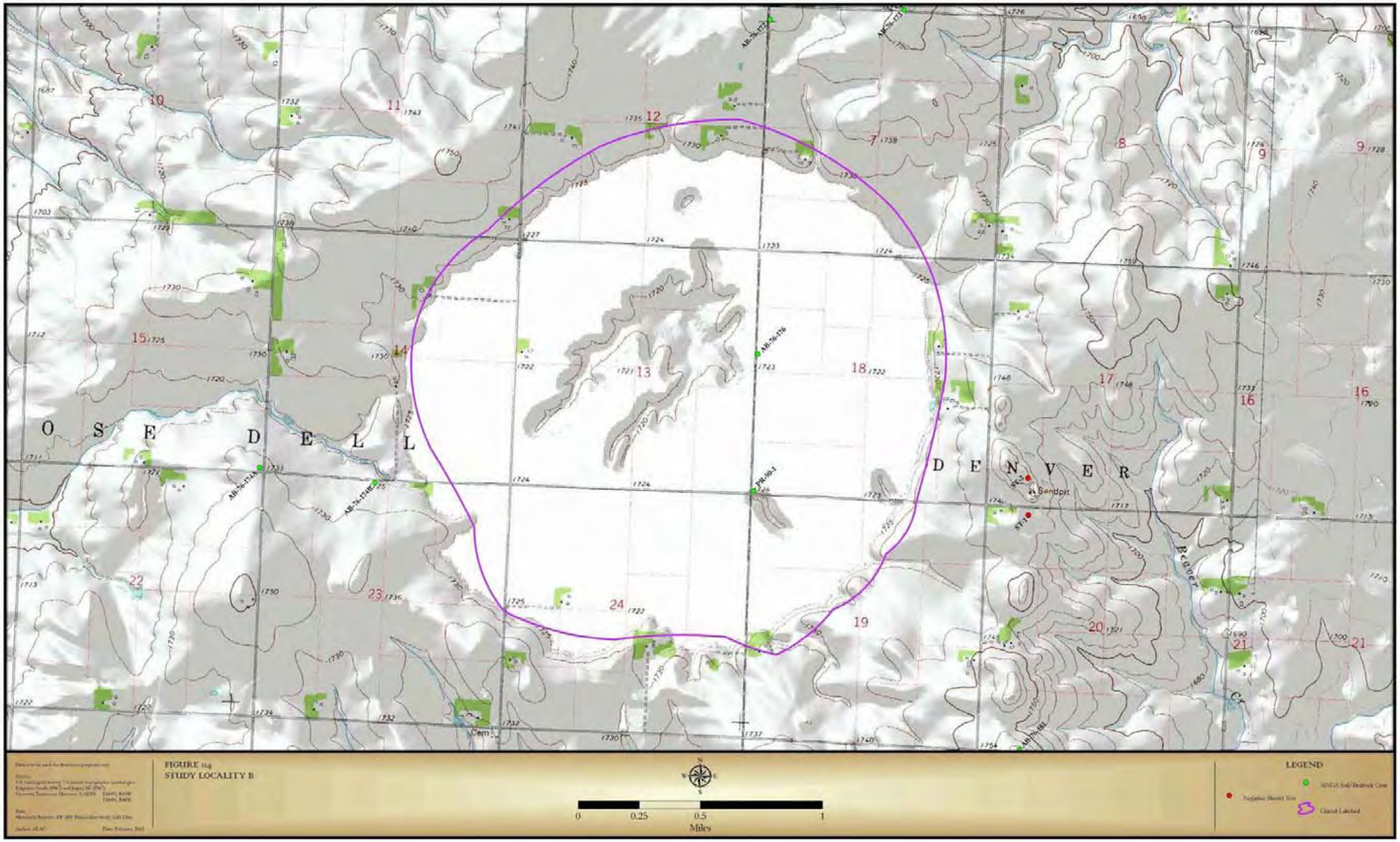


FIGURE 114
STUDY LOCALITY B

Figure 115. View across the former lake plain from site 21RK69, Study Locality B, western orientation.

Figure 116. View of site 21RK69 atop the ridgeline on the eastern margin of the glacial lake, Study Locality B, east-southeastern orientation.

Figure 117. View of the elevated ground atop the eastern ridges, site 21RK69, Study Locality B, south-southeastern orientation.

Site 21RK69 was documented on June 16, 2011 along a prominent ridgeline overlooking the eastern edge of the Marsh. The area containing the site is now cultivated, although a portion of it was previously mined for sand and gravel. A pedestrian survey of the ridgeline was conducted and two subsurface tests were excavated in an attempt to establish a vertical extent to the site (Figures 118 and 119). Thirteen artifacts were documented in an ephemeral scatter across the ridgeline, including four fragments of FCR, one piece of shatter, two cores, and six flakes. Primary, secondary, and tertiary reduction flakes were observed, many of which exhibited evidence of heat-treating. Material types observed were predominantly quartzites and chalcedonies; however, Swan River chert and Hixton orthoquartzite were also documented. The subsurface tests produced no additional cultural material and revealed no indication of a buried soil horizon. In each instance, sterile subsoil was encountered at a depth of approximately 50 cmbs. No artifacts diagnostic of Paleoindian cultures were documented in this area; however, this does not preclude the possibility that the area was utilized by very early peoples.

Figure 118. Overview of Subsurface Test 1, site 21RK69, Study Locality B, southwestern orientation.

Figure 119. Overview of Subsurface Test 2, site 21RK69, Study Locality B, southwestern orientation.

Locality C: Hole-in-the-Mountain Prairie

Study Locality C is a unique, picturesque valley landscape located immediately southwest of the town of Lake Benton in Lincoln County (Figure 120). Translated from the Dakota language as *Hole-in-the-Mountain*, this feature is a large, deeply incised valley that formed through the Bemis moraine as a glacial outwash channel during the Wisconsinan glaciation (Patterson 1997:11; Upham 2001:333). Meltwater from the receding glaciers flowed from northeast to southwest, carving the valley as it went. Flandreau Creek now occupies this valley. Till from the Bemis Moraine is extremely thick in this area, measuring between 150 and 200 feet from the valley bottom to the adjacent bluff tops. The valley, however, is not particularly expansive, ranging between ⅛-mile and ¼-mile in width (Upham 2001:333). The result of this is dramatic topographic relief and steep valley walls. Elevations are greater here than anywhere else in southwest Minnesota. Lake Benton sits just northeast of the Hole-in-the-Mountain and approximately 10 feet in elevation below the Bemis Moraine, or Buffalo Ridge. The lake, which also formed as a result of the receding glaciers, outlets into the Redwood River further east.

Figure 120. Overview of a portion of the Hole-in-the-Mountain study locality south of Lake Benton, west-northwestern orientation.

Similar to the Blue Mounds vicinity, the landscape comprising Study Area C represents a distinctive combination of topographic features that would have made it well-suited to the observation of migratory animal herds and their subsequent interception. Overlook/hunting stands for observing game movements and repairing or preparing tools should be present in this area, as should camp sites (albeit perhaps nearer the lake) and kill/processing sites (most likely near the headcuts of one or more of the several steep-walled tributary draws that feed into the main valley) (Figures 121 and 122). Again, the primary archeological concerns in this locality include site preservation, geomorphology, recognition (depth of burial), and subsequent activities of other groups. As is evident in Figure 121, LsSA's were mapped in only a portion of the area near Lake Benton during the MN/Model geomorphology study. Only four of the sediment assemblages identified along the Rock River valley, the *Floodplain*, *Valley Margin*, *Valley Terrace*, and *Glaciofluvial* LsSA's, are present in this area. As a result of the topography, the majority of these consist of narrow Floodplains and Valley Margins formed in colluvium adjacent to the steep valley walls. In geomorphological terms, the extremely high-energy forces responsible for carving the main valley are also likely to have virtually eliminated the possibility for buried archeological deposits of Paleoindian age there. However, some of the narrow tributary draws, particularly those mapped as Valley Margin landscapes, do possess the potential to contain early deposits.

The majority of the land in Locality C is either in the town of Lake Benton or within the Hole-in-the-Mountain Prairie, a privately owned nature preserve under the stewardship of the Nature Conservancy. Although the Hole-in-the-Mountain Prairie is open to public access, the Nature Conservancy denied permission for all forms of subsurface testing within the preserve. As a result, no subsurface testing was conducted here during the study. Portions of the preserve were examined via pedestrian survey and windshield inspection; however, it has all been returned to native prairie and visibility was consequently extremely poor. A more thorough examination of Locality C is needed.

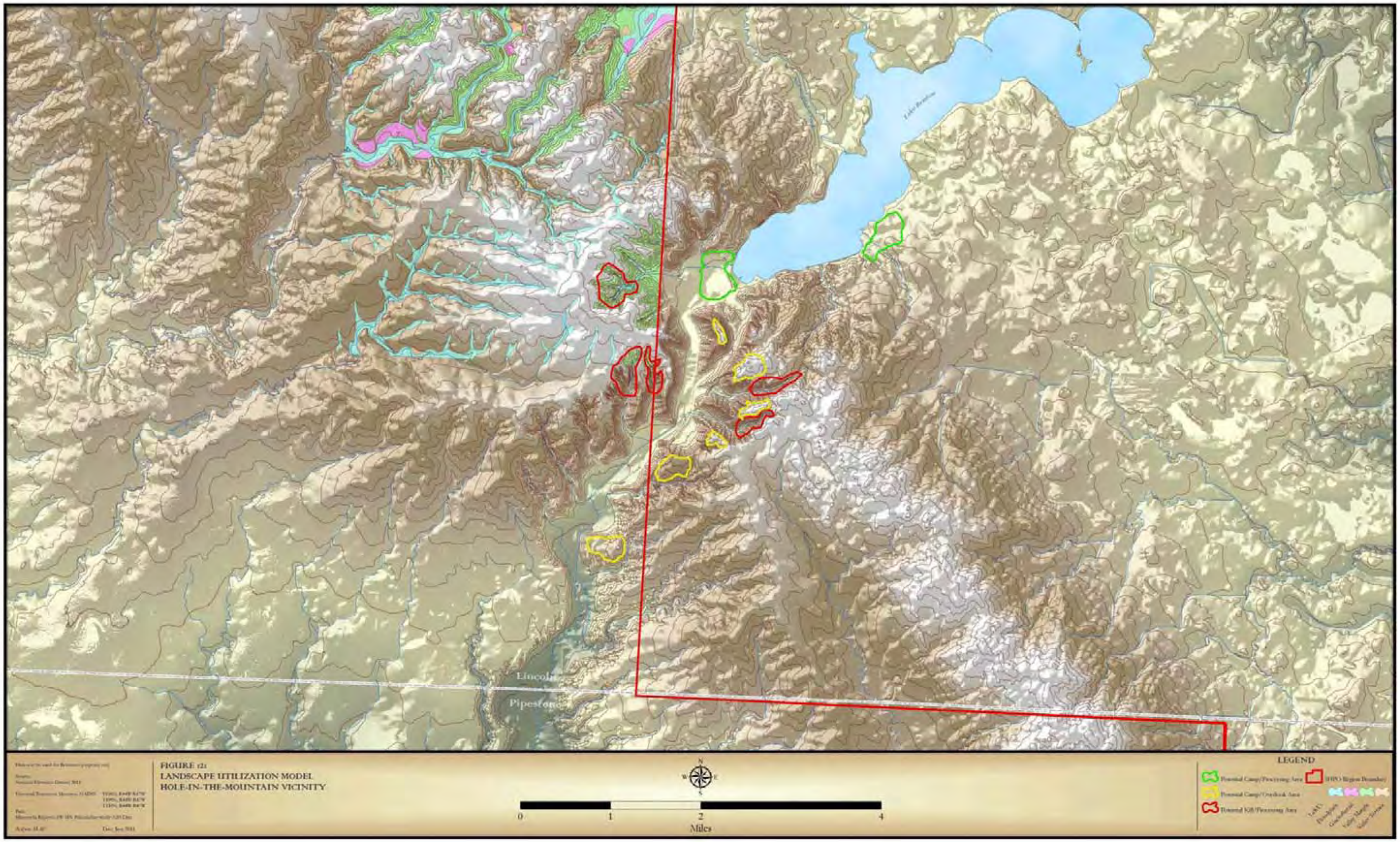


FIGURE 12:
LANDSCAPE UTILIZATION MODEL
HOLE-IN-THE-MOUNTAIN VICINITY

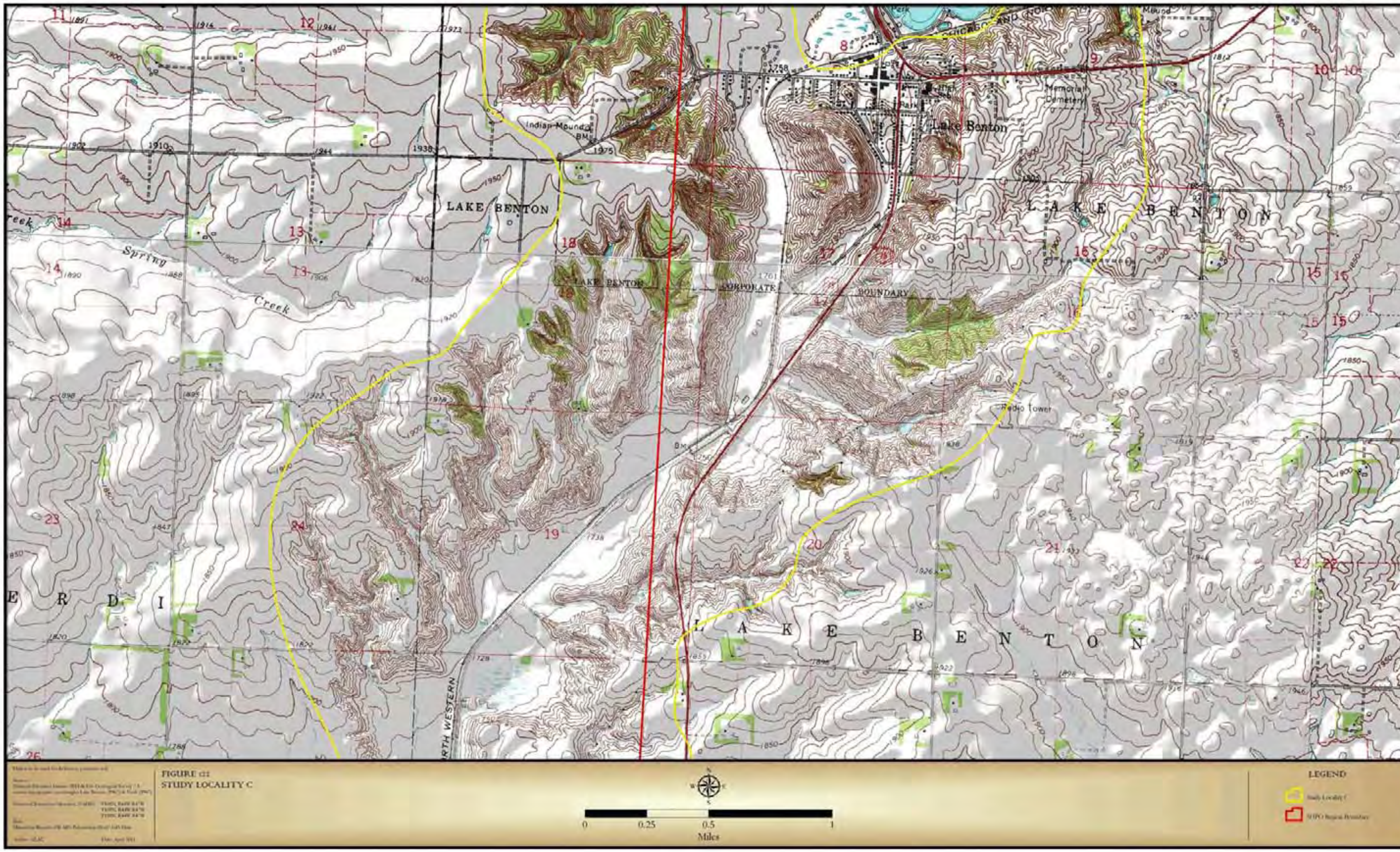


FIGURE 122
STUDY LOCALITY C

Locality D: Arthur Gnadt Farm

Study Locality D includes the property of Mr. Arthur Gnadt and its immediate surroundings. The Gnadt farm is located about 1.5 miles west of Lake Wilson in Murray County, Minnesota. The Buffalo Ridge is located immediately to the west of the farm and represents a topographic high point for the area, boasting the second highest elevation in southwestern Minnesota (Figures 123-125). The farm was first visited on April 7, 2011 when Mr. Gnadt's artifact collection was documented (see pages 54-56, above). The investigators returned on May 3, 2011 for additional evaluation. During the first visit, it was learned that a bison bone bed measuring at least four-feet-thick was discovered on the property by the landowner and his son several years ago (Arthur Gnadt, landowner, personal communication 2011). Originally, the bone bed was discovered in an intermittent drainageway located west of the house. This drainageway, which descends east from the Buffalo Ridge into Mr. Gnadt's field, was characterized by a steep, erosional cutbank measuring several feet in height. The bone bed was uncovered while moving earth in this area to level the field. Likely a small jump or arroyo trap, the bone bed is of unknown age and, unfortunately, Mr. Gnadt was unable to accompany the investigators into the field to identify its precise location. He did indicate its general area on a map and also pointed it out from the highway (Figure 126). Mr. Gnadt's son, Arlen, offered to identify the precise location but was unable to meet during the second visit. A left M_3 molar from the bone bed area was examined during the investigation of the Gnadt property. The specimen exhibited very little wear and was most likely from a juvenile *Bison bison*. No evidence of earlier, extinct bison species was observed. The ridge of the Bemis Moraine would have provided an important pathway for herd animals such as bison or caribou and for humans moving through the area. There is little doubt that bison played a significant role in the economies of early Holocene hunter/gatherers in the Minnesota region, but substantive evidence for this is essentially lacking. Further investigations are needed in the Gnadt Farm locality and other such sites in the region.

Figure 123. Overview of a portion of the Arthur Gnadt farm west of Lake Wilson. The crest of the Buffalo Ridge is clearly defined in the background by the line of wind turbines, west-southwestern orientation.

Surface finds of projectile points in the immediate vicinity of the farm include two Folsom specimens (sites 21MU130 and 21MU131), an unidentified fluted specimen (which was presumably either lost or stolen some years prior), and later Holocene types. Mr. Gnadt identified the precise location from which he collected the two Folsom specimens (Figures 127 and 128; see Figures 124 and 125). An additional Clovis base in Gnadt's collection was discovered somewhere within ten miles of the farm. Both Folsom pieces were collected from the surface of cultivated fields atop low hills near the farmhouse. From a geomorphological perspective, the surfaces of these low hilltops both exhibit copious quantities of Wisconsin-age glacial till. This not only bespeaks the great age of these landforms, but also their inability to contain any form of buried archeological deposits.

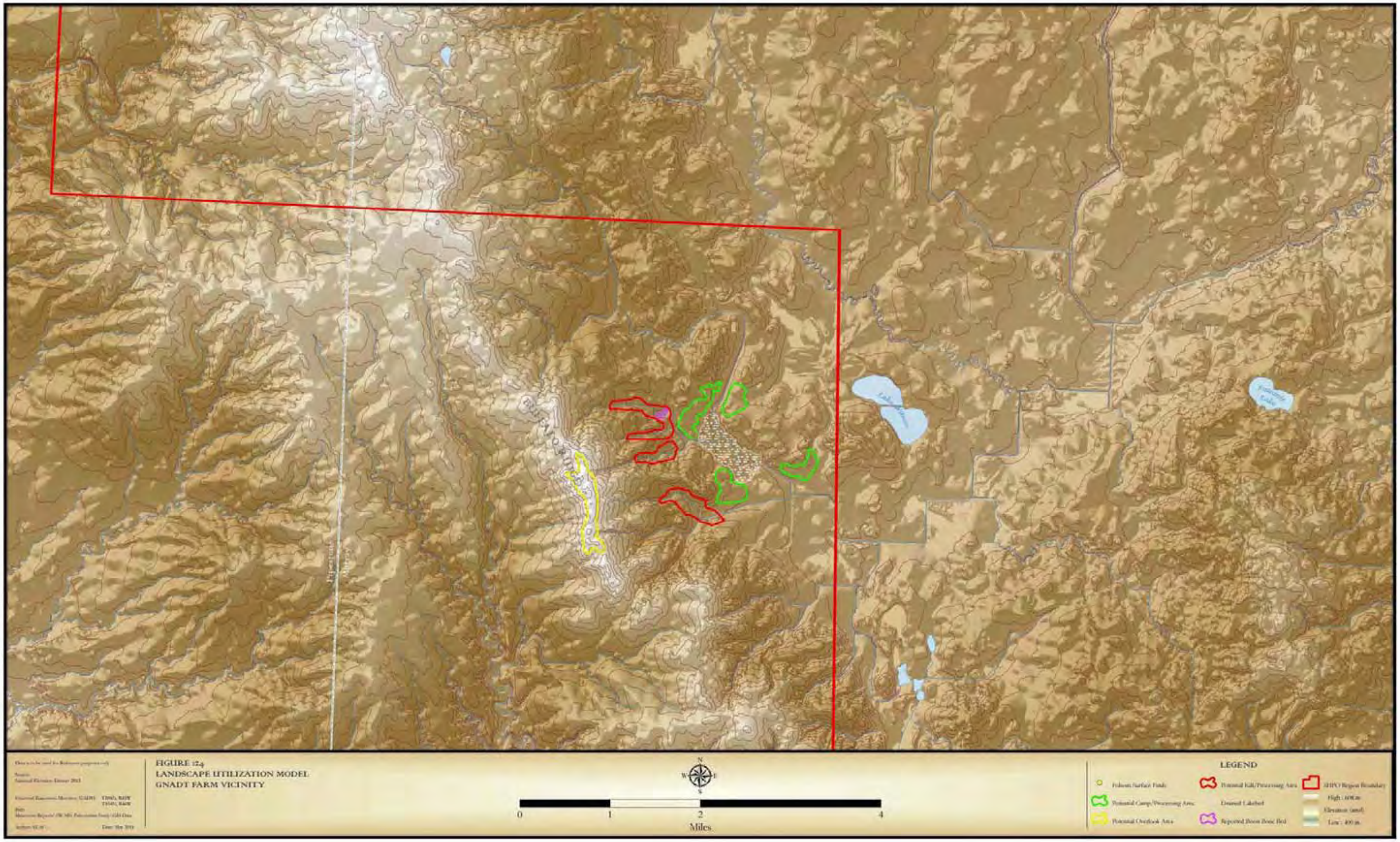


FIGURE 124
LANDSCAPE UTILIZATION MODEL
GNADT FARM VICINITY

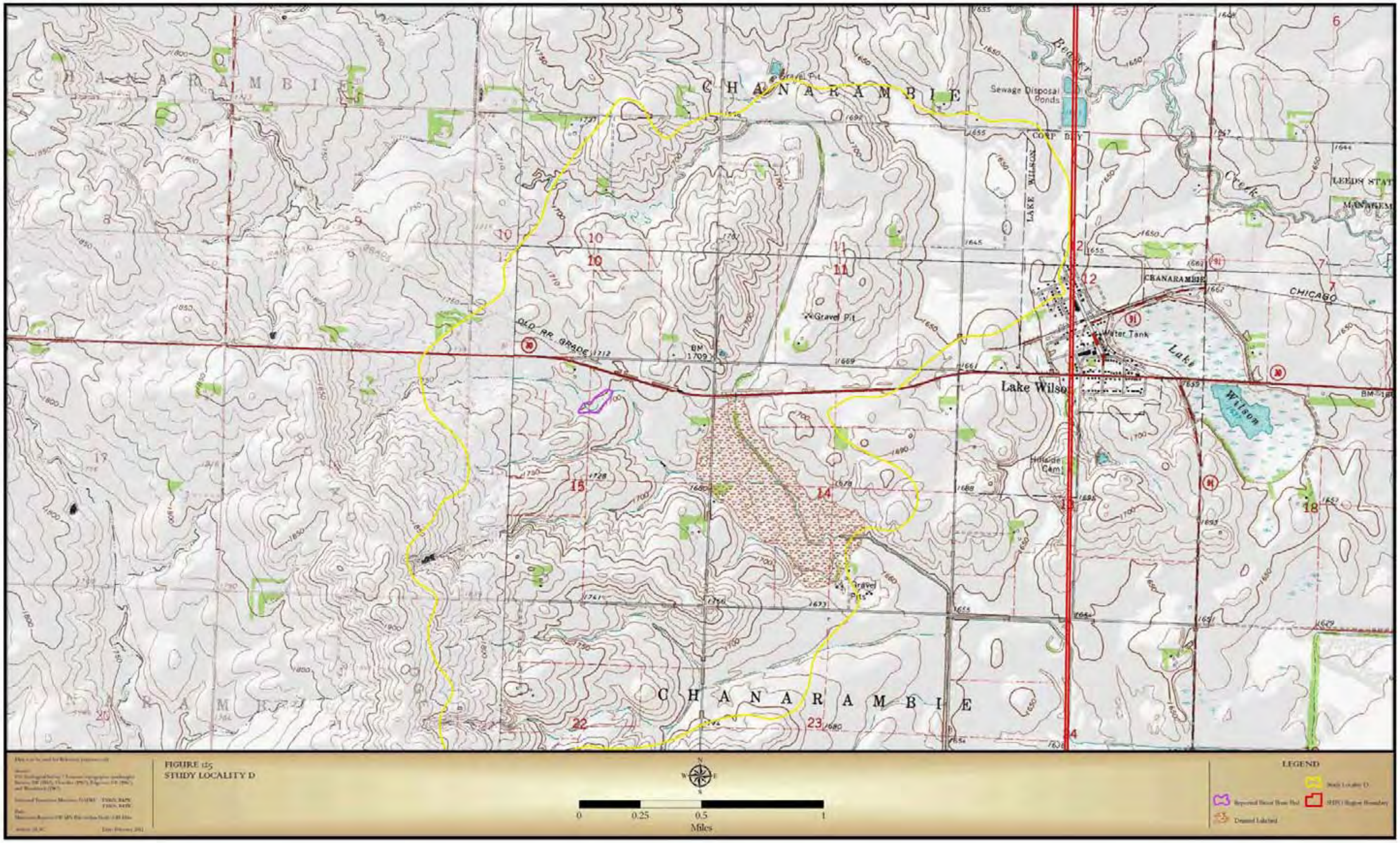


FIGURE 125
STUDY LOCALITY D

Figure 126. Overview of reported bison jump and bone bed from Highway 30, Study Locality D, south-southwestern orientation.

Figure 127. Overview of site 21MU130, Study Locality D, southwestern orientation.

Figure 128. Overview of site 21MU131, Study Locality D, southwestern orientation.

It was also learned during discussions with Mr. Gnadt that the area located immediately east of the farm was originally a shallow lake basin; almost certainly a kettle lake of glacial origin. Shortly after Mr. Gnadt moved to the farm in 1919, this lake was artificially drained, and is now cultivated farmland (Arthur Gnadt, landowner, personal communication 2011). The area defined as the drained lakebed on Figures 124 and 125 is an approximation based on Gnadt's description and an examination of the topography. It is unclear whether the lake basin actually extended north across the highway along the route of the drainage ditch, whether it extended further south and east, whether it was actually part of a larger lake that included present-day Lake Wilson, or whether all or none of the above was the case. Regardless of the lake's full extent, both sites 21MU130 and 21MU131 would have been in ideal topographic positions overlooking the lake to the southeast and east and the Buffalo Ridge to the west. The specimen from site 21MU130 is the base of a projectile point preform that broke prior to its completion (see Figure 59, above). This item, coupled with the second nearby specimen, indicates that Folsom people engaged in full-out tool manufacture at this locality and were not simply passing through the area. The setting, being adjacent to the lake resources and immediately east of a prominent topographic high suitable for herd observation and trapping, would likely have been ideal for small camps.

SYNTHESIS & RECOMMENDATIONS

RESEARCH OBJECTIVES AND INVESTIGATION RESULTS

The objective of the current study, as defined in the project RFP, was "…to determine if fluted point-age sites or even pre-fluted sites can be found in Minnesota through a comprehensive analysis of environmental and archaeological records followed by intensive field survey…" (see Appendix A). Four primary tasks were identified as requisite for the successful completion of the project:

1) Assess what is known about the early human occupation of Minnesota by reviewing site records and reports, examining institutional artifact collections, and interviewing local artifact collectors.
2) Develop a regional statewide model of early prehistoric site locations based on known locations in Minnesota, early prehistoric research in other states, and environmental reconstruction.
3) Conduct a limited field survey of one region that is already suggested to have high potential to contain early sites [the Southwest Riverine Region], utilizing methods that are efficient, safe, and cost effective.
4) Complete an analytical and descriptive report that summarizes the findings of the literature search, collections research, collector interviews, site locational model construction, fieldwork, and artifactual and geomorphological analysis.

In addressing Task 1, site records and reports were reviewed at the Minnesota OSA and SHPO, and prehistoric artifacts were examined from 20 different public institutions and 15 different private collections throughout the state. Limited interviews were conducted with the owners of a number of these collections. While time constraints did not allow for an examination of all of the collections brought to our attention, information and leads obtained about these collections were still included in the report in the hope of facilitating future documentation.

The second task addressed was the development of a regional site locational probability model for early Paleoindian resources. As previously noted, development of a single reliable site locational probability model that encompasses the whole of the early Paleoindian timeframe was not considered feasible due to both the substantial ecological transformations occurring during this time, and the varying ways in which different cultural groups adapted to these changes. Rather, multiple models were developed based on the climatic and ecological variance perceived between different temporal periods during the Pleistocene/Holocene transition. Although these models were developed specifically for the Southwest Riverine Region, the overall framework should be applicable to the development of future models for the state's eight other regions. Data utilized in the regional paleoclimatic reconstruction were derived from a lakebed sediment core from Fish Lake, near Windom, and from several other sites surrounding southwestern Minnesota. The paleoclimatic data afforded a clearer picture of the general climatic regimes present during different time periods of consequence (ca. > 12,500-9500 RCYBP); these included vegetational communities, relative temperatures, and general levels of precipitation. In turn, this afforded a better understanding of the faunal communities present during these times. Other site location variables were then considered during the development process, and these factors were compared with existing data from early Paleoindian sites in Minnesota and beyond. A geomorphological overview of landscape sediment assemblages in the Rock River valley was then used to determine the likelihood of deeply buried site potential for these areas. Four localities were subsequently selected for closer examination in Region 1 based on perceived trends in the existing data, and models for these areas were produced in a GIS.

With regard to Task 3, the four targeted localities were investigated in the field between March 21 and June 16, 2011. The ultimate extent of these investigations was predicated on available time, landowner permission, and weather conditions. Investigations consisted of complementary archeological and geomorphological components. The archeological component involved an examination of local artifact collections, both private and institutional, and a combination windshield reconnaissance/pedestrian surface survey conducted in conjunction with limited, shallow subsurface testing of various upland lake margin, stream divide, and river bluff landforms. The geomorphic component involved the mapping of surfaces and landforms and the describing and sampling of sections of alluvial fill in a stream valley setting. In Study Locality A, a small, spurred end scraper was discovered across the Rock Valley from

Blue Mounds State Park at previously recorded site 21RK14. Multiple retouched overshot flake tools were also documented from this site in the private collection of Bruce Hess. A previously undocumented prehistoric site, 21RK69, was recorded along a ridge overlooking a massive glacial lakebed at Study Locality B; the site is of uncertain cultural affiliation. No sites were documented at Locality C; however, visibility was limited and permission to conduct subsurface testing in this locality was denied by the landowner. In Study Locality D, two Folsom find spots, sites 21MU130 and 21MU131, were documented above a drained lakebed, and the landowner also reported a substantial bison bone bed immediately west of these sites. No definitive association between the Folsom sites and the bone bed has been established.

This document represents the results of Task 4. What follows is a brief discussion of model refinement and recommendations for future research.

DATA COLLATION AND MODEL REFINEMENT

At least 133 early Paleoindian sites have been identified across the state through either professional documentation or avocational reports. Sites have been identified in surface contexts in the field, as well as in both public institution and private artifact collections (Table 10). The vast majority of these sites has been identified through the examination of private artifact collections and reports from avocationals; most lack accurate or field-confirmed site provenience data and none has been recovered from intact, datable subsurface deposits during controlled, professional excavations.[1]

Table 10. Summary of Documented and Reported Minnesota Early Paleoindian Sites (after Anfinson n.d.).

Site No.	Site Name	Specimen Type (No.)	Material Type	Level of Investigation	Site Type	Site Setting	SHPO Region	Reference/ Collection
21AK58	Cedar Creek	Pv	?	Exc†	Habitation?	Creek	5c	F
21AN8	Anderson	Fo (2)	Hx (1); ? (1)	Am	Habitation?	Lake	4e	H; Flaskerd 1943
21AN49	Dupre	Pv	?	Am	?	Lake	4e	F; site file
21AN_	(Cain)	Pv	?	Am	?	?	4e	F; Cain 1969
21AN_		Pv	?	Am	?	?	4e	F
21BE_	(Cobb River)	EF	?	Am	?	River	2e	H; Kammerer 1963
21BW10	Fischer	Fo	?	Am	?	?	2s	H; Trow 1979
21BW21	Gilman Lake	Fo	?	Am	?	Lake	2s	H; Trow 1979
21BW29	Treml	Pv	?	Am	?	Lake	2s	F; SAS
21CR_	(Waconia)	Fo	Hx	Am	?	?	4s	H; Klammer 1941
21CR_	(Historical Society)	fl	?	Am	?	?	2n/4s	None
21CA17	Lake Harry	fl	?	Am	?	Lake	5c	H; site file
21CP35	Ostlie	fl	?	Am	?	River	2n	H; site file
21CK1	Fowl Lake	Hol	?	Am	?	Lake	8	F
21CK18	Bearskin Point	Gn	ss	Exc†	Habitation?	Lake	8	H; Peters 1990
21CO_		fl	chal	Am	?	?	2s	H; Shane 1989
21CO_		fl	chal	Am	?	?	2s	H; Shane 1989
21CW109	Thompson	fl	quartz	P1	?	Lake	5c	Richards 1993; site file
21FA_	(Walnut Lake)	Md	?	Am	?	Lake	2e	OJC; F
21FL58		Cl?	?	Am	?	?	3w	Site file
21FL107		Fo	?	P1	?	River	3w	H; Vernon et al. 1979
21FL_	(FS 1)	Md	?	P1	?	Upland	3w	F; site file
21FL_	(Magelsson)	Pv	?	Am	?	?	3w	F
21FL_	(Lloyd Dugstad Collection)	Cl?, fl	?	Am	?	River	3w	None
21FE1	Albert Lea Lake	Pv	?	Am	?	Lake	2e	F; site file
21FE_	(Albert Lea Lake)	fl	CVC	Am	?	Lake	2e	H
21FE_	(Albert Lea Lake)	Fo	BuC	Am	?	Lake	2e	H; OJC
21FE_	(Albert Lea Lake)	Fo	BuC	Am	?	Lake	2e	H; OJC
21FE_	(Albert Lea Lake)	Fo	chert	Am	?	Lake	2e	H; OJC
21FE_	(Albert Lea Lake)	Pv (2)	?	Am	?	Lake	2e	F; OJC
21FE_	(Pickerel Lake)	Fo	BuC	Am	?	Lake	2e	H; OJC
21FE_	(Pickerel Lake)	Fo	chert	Am	?	Lake	2e	H; OJC
21FE_	(Pickerel Lake)	Fo	WnC	Am	?	Lake	2e	H; OJC
21FE_	(Pickerel Lake)	fl	chert	Am	?	Lake	2e	H; OJC
21FE_	(Twin Lake)	fl	GS	Am	?	Lake	2e	H

[1] One specimen recovered via controlled professional excavations at the Donarski site (21MA33), reportedly associated with the Holcombe cultural complex, was discovered in a pit feature dating to the middle Archaic period (Kluth and Hudak 2004:105). Because of this obvious complication, it is omitted from this particular consideration for the time being.

Table 10 (continued).

Site No.	Site Name	Specimen Type (No.)	Material Type	Level of Investigation	Site Type	Site Setting	SHPO Region	Reference/ Collection
21FE_	(Geneva Lake)	Hol (2)	?	Am	?	Lake	2e	H; OJC
21FE_	(Geneva Lake)	Md	?	Am	?	Lake	2e	F; OJC
21FE_	(Lloyd Dugstad Collection)	fl	?	Am	?	?	2e	None
21GRf?		fl	?	Am	?	?	2n	Gonsior et al. 1999
21HE100	Long Lake	fl	?	Am	?	Lake	4s	H; Landon & Flaskerd 1945b
21HE310	Fluted Pt. Ridge	Cl	KRF	P1	?	Lake	4s	H; Birk 1994
21HEy	Washington Ave. Bridge	Cl?	?	Am	?	River	4s	H; Steinbring 1974
21HE_	Orono	fl	white chert	Am	?	Lake	4s	H; Landon & Flaskerd 1945a
21HE_		fl, Pv (2)	?	Am	?	?	4s	H; F; Flaskerd 1945
21HE_		fl	?	Am	?	?	4s	H; Kammerer 1942
21HE_		fl	?	Am	?	?	4s	H; Flaskerd 1945
21HU40	Kulas II	Hol; Pv	?	Am	?	River	3w	F
21HU123	Mindrum	Pv	?	P1	?	River	3w	F; site file
21HU_		fl	?	Am	?	River?	3_	H; Jensen & Birch 1963
21HU_		fl	?	Am	?	River?	3_	H; Jensen & Birch 1963
21HU_		Cl?	?	Am	?	River?	3_	H
21HU*	(multiple sites)	Pv (2)	?	Am	?	?	3_	F; Jensen & Birch 1963
21IC23	Williams Narrows	EF; Pv	chert	Am	Habitation?	Lake	5c	H; Johnson et al. 1977
21IC_	Round Lake	Fo?	GS	Am	?	Lake	5c	H
21KC27	Plummer	Hol; Pv	?	Am	?	River	7e	F
21KC*_	Brenning	Hol (4)	?	Am	?	River	7e	F
21KC_		Pv	?	Am	?	?	7e	F
21KC_		Pv	?	Am	?	?	7e	F
21LW_	(Historical Society)	Gn?	?	Am	?	?	7e	None
21LY61	Garvin Park 12	fl	quartz	P1	?	Upland/ River	2s	Pedersen and Hudak 1982; site file
21MA33	Donarski	Cl?, Hol	ss, chert	Exc†	Habitation?	Lake	6n	Kluth & Hudak 2004
21MA42	Pearson	Pv; fl	?	Am	?	Lake	7w	M; F; site file
21ME1	Lake Koronis	Pv	?	Am	Habitation	Lake	4s	F; BRW 1994
21ME*	(Cain) – 2 sites	Pv (2)	?	Am	?	?	4s	F
21MU130	Gnadt Farm 1	Fo	gray chert	Am	?	Lake	1	AGC
21MU131	Gnadt Farm 2	Fo	chert	Am	?	Lake	1	AGC
21MUu	Lake Shetek S.	Fo?	?	Am	?	Lake	2s	AGC
21MU_	(Shetek Lutheran Bible Camp)	Fo	wt. chert	Am	?	Lake	2s	AGC
21MU_	(Shetek Lutheran Bible Camp)	Cl?	TRSS	Am	?	Lake	2s	AGC
21MU_	(Shetek Lutheran Bible Camp)	Cl	TRSS	Am	?	Lake	2s	AGC
21MU_	(west of Lake Wilson Area)	Cl	pink quartzite	Am	?	?	1	AGC
21MU_		fl	?	Am	?	?	2s	H
21MU_	(Harris Darling Collection)	fl	black chert	Am	Habitation?	Lake	2s	Shane n.d.
21MU_?	SMM #A94:4	Cl	GM	Am	?	?	2s?	None
21MW_	(Lloyd Dugstad Collection)	fl	?	Am	?	River	3w	None
21NO_	(Harris Darling Collection)	Tools	KRF; cherts	Am	?	Lake?	2s	None
21OL39	Hruska	Cl?	JT	Am	?	Upland	3w	Vermeer 2005
21OL44	Schumann Cache	Cl? (cache)	Hx	Am	?	Upland	3w	Carr et al. 2008a, 2008b
21OL_	(Lewis)	Md	?	Am	?	?	3w	F
21PN_	(Neubauer 1)	Cl	Hx	Am	?	?	4e	JNC
21PN_	(Neubauer 2)	Gn	Hx	Am	?	?	4e	JNC
21PN_	(Neubauer 3)	Fo	CVC	Am	?	?	4e	JNC
21PN_	(Neubauer 4)	Fo	PduC	Am	?	?	4e	JNC
21PN_	(Neubauer 5)	Fo	PduC	Am	?	?	4e	JNC
21PN_	(Neubauer 6)	Fo	GM?	Am	?	?	4e	JNC
21PN_	(Neubauer 7)	Cl	FRq	Am	?	?	4e	JNC
21PN_	(Neubauer 8)	Hol	BS	Am	?	?	4e	JNC
21PN_	(Neubauer 9)	Hol	bKF	Am	?	?	4e	JNC

Table 10 (continued).

Site No.	Site Name	Specimen Type (No.)	Material Type	Level of Investigation	Site Type	Site Setting	SHPO Region	Reference/ Collection
21PN_	(Neubauer 10)	Cl	PduC?	Am	?	?	4e	JNC
21PN_	(Neubauer 11)	Cl?	Hx	Am	?	?	4e	JNC
21PN_	(Neubauer 12)	Hol	chert	Am	?	?	4e	JNC
21PN_	(Neubauer 13)	Cl?	KLS	Am	?	?	4e	JNC
21PN_	(Neubauer 14)	Gn	SR	Am	?	?	4e	JNC
21PN_	(Neubauer 15)	Fo	Hx	Am	?	?	4e	JNC
21PN_	(Neubauer 16)	Gn	quartz	Am	?	?	4e	JNC
21PNb	Timberline Campground	EF?	CVC	Am	?	Lake	5s	H; Kammerer 1982
21PN4	Stumne Village	Md	?	Am	Habitation?	River	4e	F
21PN11	Northwest Co. Fur Post	Fo?	Animake silicate?	Exc?	?	River	4e	None
21PP/RK_		Cum/Bar	GM	Am	?	?	1	H; Wilford 1960
21RA_	(St. Paul)	Pv	?	Am	?	Upland	4e	F
21RC6	(Gregg Nelson)	fl (2)	?	Am	?	?	2e	None
21RC_	(Lewis)	Pv	?	Am	?	?	2e	F
21RK14		Tools	KRF; chal	P1; Am	Habitation?	River	1	None
21RO2	Johnson	Pv (3)	?	Am	?	River	6n	F; M; site file
21RO_	Bergland	Hol	?	Am	?	?	6n	F
21RO_	(Magnuson)	Pv	?	Am	?	Creek	6n	F
21SC_	(Belle Plaine Coll)	fl	chert	Am	?	?	2e	None
21SL314	Balls Beach	Hol	?	P1	?	Lake	5e	Harrison et al. 1995; site file
21SL875	Jim Regan	Fo	JT	P1	?	Upland	5n	Mulholland & Mulholland 2002
21SL_	Island Lake	Cl?	GS	Am	?	Lake	5e	H; Romano & Johnson 1990
21SL_	Fish Lake Res.	Gn	PduC	Am	?	Lake	5e	None
21SL*	(Reservoir Lakes)	Pv**	?	Am/P1	?	Lake	5e	F; Harrison et al. 1995
21SH_		fl	CVC	Am	?	?	4e	H; BRW 1994
21SHbg	Wold	Fo	red chert	Am	?	Lake	4e	Site file
21SHaw		Fo	?	Am	?	Upland	4e	Site file
21SN10(g)	Wenner	fl	Hx	Am	?	Lake	4s	H
21SW_	(Briscoe Collection)	Fo	KRF	Am	?	?	2n?	Holley et al. 2011
21WB_		fl	chert	Am	?	?	3_	H
21WA_	(near 21AN8)	fl	Hx	Am	?	?	4s	H; Flaskerd 1943
21WE78	Winegar Farm	Fo	?	P1	?	Upland	2e	Mulholland 2008
21WR_	Reifler	fl	?	Am	?	?	4s	H; BRW 1994
21WR_		fl	CVC?	Am	?	?	4s	H; Flaskerd 1945
21WR_	(Flaskerd)	Pv	?	Am	?	?	4s	F
21YM104		Cl	CVC	Am	?	River	2s	H
21??_	(Gregg Nelson)	Cl?	Hx	Am	?	?	3_	None
21??_	(W. Jensen Collection)	Cl, Fo (4), Cum/Bar	KRF, BuC	Am	?	Lake?	2n?/6s?	None
21??_	(Tom Amble)	Cl	CH	Am	?	River	3e	None

Abbreviations:

Number: * = multiple site locations reported, ** = point type present in unknown totals

Specimen Types: Clovis (Cl), Folsom (Fo), Eastern Fluted (EF), Holcombe (Hol), Cumberland/Barnes (Cum/Bar), Gainey (Gn), Plainview (Pv), Midland (Md), fluted (fl), Tools (non-projectile point tools – spurred end scrapers, retouched overshot flake tools, etc.)

Material: Hixton quartzite (Hx), Cedar Valley chert (CVC), Burlington chert (BuC), Winterset chert (WnC), Gunflint silica (GS), Grand Meadow chert (GM), Knife River flint (KRF), Prairie du Chien chert (PduC), jasper-taconite (JT), Swan River chert (SR), Knife Lake siltstone (KLS), brecciated Kakabeka Falls chert (bKF), Biwabik silica (BS), Fat Rock quartz (FRq), Tongue River silicified sediment (TRSS), Cochrane chert (CH), siltstone (ss), chalcedony (chal)

Level of Investigation (Inv): Amateur/Private Collector (Am), Phase I CRM Survey (P1), Professional Excavation (Exc)

Reference/Collection: Higginbottom 1996 (H), Owen Johnson Collection (OJC), Joe Neubauer Collection (JNC), Florin 1996 (F), Magner 1994 (M), Art Gnadt Collection (AGC), *Minnesota Archaeologist* (MnArch), Statewide Archaeological Survey Report (SAS)

† the material from 21MA33 was recovered from features dating to the Archaic period. The point from 21CK18 was not associated with any dates, nor were the specimens excavated from site 21AK58.

The number and percentage of early Paleoindian sites that have been reported and/or documented from each of the nine SHPO Archaeological Regions are illustrated in Figure 129 (n=133 total). Figure 130 depicts the segregation of site component finds by general cultural complex (Clovis, Folsom/Midland, Eastern Fluted, and Plainview varieties) identified within each region. A certain degree of caution must be taken in interpreting these graphs. At first glance, a significant disparity is apparent between the total number of documented sites in Regions 2 and 4 (over 60 percent of the total) and everywhere else (see Figure 129). It is difficult to ascertain the reasons behind this. Regions 2 and 4 do cover a relatively large area, particularly in comparison to Regions 1 and 9. They are not, however, very different in size from Region 5, yet they still have substantially more reported sites. Both Regions 2 and 4 have been intensively collected by well-known artifact collectors for many years, whereas others, such as Regions 6 and 7 have received comparatively less attention – both from avocational collectors and professional researchers. This, then, may also account for some of the perceived disparity. Alternatively, some aspect(s) of these particular regions may simply have been more appealing to Minnesota's earliest occupants. Each of these factors may have contributed in some form or another, and although we are limited in our ability to draw substantial inferences from the graphs at present, the more the database of early Paleoindian sites expands, the more viable patterns are likely to emerge.

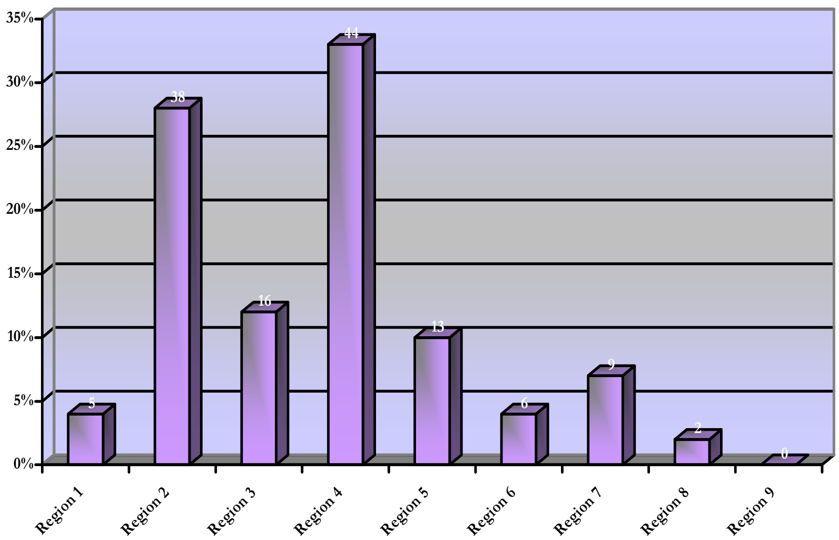


Figure 129. Early Paleoindian sites identified by Archaeological Region (by count and percentage of total).

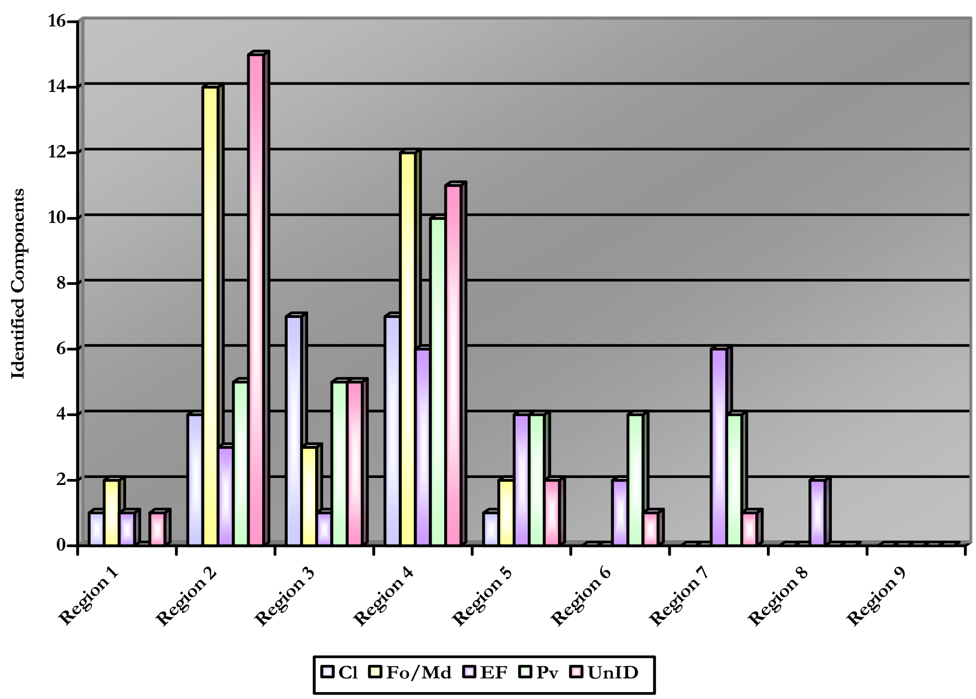


Figure 130. Early Paleoindian cultural complexes identified as site components by Archaeological Region (by count).

Based on the limited timeframe and small sample size available during the current study, the matter of model testing and refinement is largely relegated to future endeavors. Most significant in this respect, particularly at such an early juncture, is expansion of the known site database. This is especially true with respect to sites that have good provenience data. The more site locational data that are made available, the more reliably we will be able to identify distributional patters of particular sites across given landscapes. The models are malleable to the extent that their utility should remain viable when applied to the eight additional archaeological regions in the state. Minor adjustments are, however, likely to be required in accounting for the varying nuances present between different regions and/or sub-regions. As with the graphs above, the utility of the models should only increase as the limited database of early Paleoindian sites expands.

RECOMMENDATIONS FOR FUTURE STUDY

Being a pilot study, it was felt that the culmination of this investigation ought, necessarily, to present a series of avenues suitable for the further exploration of Minnesota's earliest inhabitants. To this end, a series of cogent issues and future research targets are presented from the perspectives of geomorphology, paleoecology, and archeology. Although the majority of the issues associated with future geoarcheological and paleoecological research were presented earlier in this report, they are reiterated here.

Geomorphology Outlook

Similar to the need to expand the database of known early Paleoindian site locations, is the need to further understand the basic make-up of paleolandscapes throughout the state. In essence, this means more testing of areas with the potential to contain buried sites of late glacial age. A valuable guide in this respect, albeit only in the specific areas where they were mapped, is the LsSA data obtained during the MN/Model geomorphology study (Hudak and Hajic 2002). Another valuable resource is the Minnesota Deep Test Protocol Project (Monaghan et al. 2006). The five areas viewed as particularly valuable future research targets, as previously outlined, are:

1. Specific Upper Mississippi River valley and Minnesota River valley terrace remnants, and correlative terrace remnants in their tributary valleys, where they are buried by æolian dunes, colluvial slopes or alluvial fans of tributaries of low or intermediate order that date to, or post-date, the early Paleoindian period. Remnants are those that pre-date the St. Croix Valley catastrophic flood(s), and include terrace remnants formed by, or in response to, the Glacial River Warren flood(s) emanating out of the Lake Agassiz basin.

2. Wetland basins and basin margins, formed primarily in response to one form or another of ice collapse or melting, on the Des Moines lobe, drift plains of the Superior lobe, and other late Wisconsin glacial ice lobes that pre-date the early Paleoindian period, outwash terraces on outwash plains related to the Des Moines lobe, and other lobes of appropriate age, and on the Anoka Sand Plain.

3. Within and beneath colluvial slopes that date to, or post-date, the early Paleoindian period in obscure pre-Wisconsin glacial terrain in southwest and southeast Minnesota, and dissected bedrock terrain in southeast Minnesota, particularly where loess contributes to colluvial deposits.

4. Beach ridges (with or without dunes), lagoons, relict shorelines, and relict lake beds of appropriate age in the Lake Agassiz basin in west-central, northwest, and north-central Minnesota, including the Red Lake Bog basin, and other glacial lake and wetland basins that would have had margins of appropriate age. This can include entire, as yet undetected, lake margin landscapes developed on or into older glacial or bedrock terrain, now buried by glaciolacustrine, lacustrine or wetland deposits that post-date the early Paleoindian period. Though results from previous surveys have indicated that glacial lake beach ridges are not accurate indicators of prehistoric site distribution (Dobbs et al. 1994:16; Michlovic 1987:55; Minnesota Historical Society 1981:29-32), evidence obtained through an examination of private artifact collections (Magner 1994:61) and a more recent examination of mapped site distribution (Kluth and Hudak 2004:10-11) suggest a clear connection between Paleoindian groups and the Agassiz beach ridges in the northwestern part of the state.

5. Æolian dune fields that date to, or post-date, the Early Paleoindian period, such as those on the Anoka Sand Plain [see page 74].

Paleoecology Outlook

The most pertinent issues confronting future paleoenvironmental researchers are the overall paucity of sites in the region from which data have been obtained and the extremely poor chronological control that exists for those sites that have produced otherwise usable records. In southwestern Minnesota, this noted paucity is even more pronounced because of the shallow depth of the lakes in Region 2 and the near absence of lakes in Region 1. Almost all of the lakes in Region 2 dried-up during the mid-Holocene, and so complete, uninterrupted sediment cores are truly rare. If, however, the time period of interest happens to pre-date this drying period (as it conveniently does with this project), even the lakes that dried-up at one time or another may contain viable datasets from late glacial/early Holocene times. Were one capable of drilling through the hardened middle Holocene dry zone, even an area such as Great Oasis lakebed could conceivably yield a datable pollen record spanning the breadth of early Paleoindian times. Though difficult, penetrating the middle Holocene zone in a previously desiccated lakebed has been accomplished successfully in the past (Eric Grimm, personal communication 2011). In addition to this possibility, the five areas of primary consideration for future paleoecological research are:

1. The core from Fish Lake was a single 5-cm-diameter core originally collected for reconnaissance purposes. Additional work at this lake could prove very promising. Acquisition of overlapping 7.5-cm-diameter cores, which would (1) ensure complete recovery and (2) provide much more material for AMS radiocarbon dating, is recommended. The sediment is not rich in terrestrial macrofossils (which is typical of a larger lake), but multiple cores would provide more material. These cores should be split and imaged to facilitate stratigraphic correlation. For an accurate age model and for detection of outlier dates, 10-20 AMS radiocarbon dates should be acquired for the late glacial-early Holocene period. This number is similar to that obtained for Crystal Lake, Illinois. New methods are now becoming available for determining the confidence intervals of ages interpolated between radiocarbon-dated horizons. However, these methods require a fairly large number of dates to provide reliable results. In particular, if the probability density functions of calibrated ages overlap, they constrain each other and provide a much more accurate chronology.

2. Although not in Minnesota, West Lake Okoboji is very near, and the existing pollen data indicate a thick stratigraphic sequence through Paleoindian time that could be resolved with higher resolution pollen counting and AMS radiocarbon dates. Coring methods should be the same as recommended for Fish Lake.

3. The Minnesota DNR online lake data (http://www.dnr.state.mn.us/lakefind/ index.html) from southwest Minnesota was examined, and the only other lake that appears potentially deep enough to have not dried out during the mid-Holocene is Sleepy Eye Lake, adjacent to the town of Sleepy Eye. This lake has a small deep hole with a maximum depth of 6 m (20 ft). A reconnaissance core from this lake would be advisable before attempting larger-diameter cores.

4. The Madelia site could potentially be relocated and a core obtained for developing an accurate age model. Reconnaissance work with a Giddings rig might relocate the site.

5. In addition to pollen, charcoal studies could be revealing. Charcoal data from the upper Midwest from the Paleoindian period is sparse, and the role of fire in controlling vegetation is not well understood, nor is the role of people as sources of ignition. In general, charcoal appears to be sparse in late-glacial sediments, as we do not find large amounts when sieving for macrofossils, including charcoal, for AMS radiocarbon dating. While we do find some charcoal, we do not have a good feeling for its stratigraphic variation [see page 88].

Archeology Outlook

The ultimate objective of the models is full incorporation into a broadly available, user-friendly GIS. However, the early stage of this project and the necessity for substantial testing and refinement will likely preclude accomplishing such an objective for at least the immediate future. In terms of future objectives/target research areas for the project as a whole, three areas seem to stand out:

1. Archaeological Region 2. SHPO Region 2 reflects the second highest recorded incidence of early Paleoindian sites in the state (38) – approximately 28 percent of the total documented. The region contains multiple areas from which significant concentrations of early Paleoindian artifacts have been collected, including the Lake Shetek and Albert Lea lakes vicinities, a vast stretch of the Minnesota River valley and its primary tributaries, and an area located near the southernmost outlet of Glacial Lake Agassiz. The generally

shallow nature of the lakes in the region makes prospects more troublesome for obtaining complete pollen records; however, Sleepy Eye Lake, mentioned above, is in this region, and the ability to drill through the dry middle Holocene zones of lakebed sediment has been successfully demonstrated in the past.

2. Archaeological Region 3. Region 3, despite having only 16 documented early Paleoindian sites (roughly 12 percent of the state total), is geologically one of the oldest landscapes in Minnesota and remained ice-free during the Wisconsinan glaciation that covered the majority of the state. It is close in proximity to the well-documented lithic quarries of Hixton orthoquartzite in southwestern Wisconsin, and the Mississippi and Root River valleys have each produced multiple early Paleoindian artifacts. Significant paleofaunal sites have also been documented in this region.

3. Archaeological Region 4. Region 4 contains the highest frequency of recorded early Paleoindian sites in the state (44) – some 33 percent of the total documented. Key features that make this region of particular research interest include the Mississippi/Minnesota River confluence, the St. Croix and Snake River valleys, the Anoka Sand Plain, and a variety of deeper lakes that should be suitable for obtaining continuous sediment cores. The impressive assemblage of early Paleoindian artifacts from the collection of Joseph Neubauer was obtained from the Snake River valley and its tributaries in the region.

As noted in the prior section, one of the most pressing issues going forward is the accumulation of basic locational data for previously undocumented early Paleoindian sites. This is true not only with respect to early Paleoindian sites in Minnesota, but also with regard to sites across the northern Plains, Great Lakes, and Upper Midwest. Equally pressing is the need to establish some form of chronological control. There are literally no dates for these early sites and we cannot hope to truly understand *how*, *where*, and *why* these people occupied the landscape and interacted with its environs if we cannot understand *when* they were there. Despite the advantages realized in professionally recorded, *in situ* early Paleoindian sites, the value inherent in the continued documentation of early Paleoindian artifacts from private collections should not be dismissed. Most of the information that has been compiled to date on the early Paleoindian presence in Minnesota has come from such collections, and even our modest degree of present understanding would not have been reached without it. Additionally, the possibility exists that some of these collectors may recall the precise location from which their artifacts were recovered. This could lead, in turn, to the discovery of associated, *in situ* deposits.

The research yet required to adequately address the topic of the earliest Minnesotans is substantial and the investigations necessary are far from complete. The models generated are only the most coarse-grained in nature and are in need of a significant degree of additional testing and refinement. In spite of this, it is clear that early Paleoindian presence in Minnesota was considerable, and new discoveries from both here and surrounding states continue to expand our database. Nearby sites such as Schaefer and Hebior in Wisconsin intimate the likelihood of an even earlier human presence on the landscape than was previously believed. Minnesota's unique central position on the continental landscape and the mounting number of early projectile point finds stylistically attributable to both eastern and western North American technocomplexes indicate a commingling of the earliest cultural groups that is unseen elsewhere on the continent. Implicit in this is the notion that Minnesota may, indeed, play a significant role in the future of Paleoamerican studies and the understanding of the New World's earliest inhabitants.

REFERENCES CITED

Albanese, J.
2000 Resumé of Geoarchaeological Research on the Northwestern Plains. In *Geoarchaeology in the Great Plains*, edited by R. D. Mandel, pp. 199-249. University of Oklahoma Press, Norman.

Allan, S.
1993 *Final Report on the Data Recovery Investigation of the Cedar Creek Site, 21AK58, A Multicomponent Habitation Site*. Minnesota Historical Society, St. Paul, Minnesota. Submitted to the Minnesota Department of Transportation, St. Paul.

Anderson, D. C., and H. A. Semken, Jr. (editors)
1980 *The Cherokee Excavations: Holocene Ecology and Human Adaptations in Northwestern Iowa*. Academic Press, New York.

Anderson, D. G, D. S. Miller, S. J. Yerka, and M. K. Faught
2005 Paleoindian Database of the Americas: 2005 Status Report. *Current Research in the Pleistocene* 22:91-92.

Anfinson, S. F.
1990 Chapter 10: Archaeological Regions in Minnesota and the Woodland Period. In *The Woodland Tradition in the Western Great Lakes: Papers Presented to Elden Johnson*, edited by G. E. Gibbon, pp. 138-166. University of Minnesota Publications in Anthropology Number 4. University of Minnesota, Minneapolis.

1997 *Southwestern Minnesota Archaeology: 12,000 Years in the Prairie Lake Region*. Minnesota Prehistoric Archaeology Series No. 14. Minnesota Historical Society, St. Paul.

2005 *SHPO Manual for Archaeological Projects in Minnesota*. Minnesota State Historic Preservation Office, St. Paul.

2007 *The Walker Hill Site (21CA668): Comments on the Possibility of a Late Glacial Human Presence in Minnesota*. Electronic document, http://www.osa.admin.state.mn.us/documents/The%20Walker%20Hill%20Site.pdf, accessed March 14, 2011.

n.d. Unpublished personal notes concerning Paleoindian archeology in Minnesota. On file, Office of the State Archaeologist, Ft. Snelling History Center, St. Paul.

Anfinson, S. F., and R. J. Peterson
1988 *1988 Annual Report: Minnesota Municipal and County Highway Archaeological Reconnaissance Study*. Minnesota Historical Society, St. Paul, Minnesota.

Baker, R. G., L. J. Maher, Jr., C. A. Chumbley, and K. L. Van Zant
1992 Patterns of Holocene Environmental Change in the Midwestern United States. *Quaternary Research* 37:379-389.

Bakken, K. E.
1995 Lithic Raw Material Resources in Minnesota. Paper presented at the annual meeting of the Society for American Archaeology, Minneapolis, May 3-7, 1995. Electronic document, http://www.tc.umn.edu/~bakk0029/MinnLith/, accessed April 2, 2011.

2011 Lithic Raw Material Use Patterns in Minnesota. Unpublished Ph.D. dissertation, Department of Anthropology, University of Minnesota, Twin Cities. Electronic document, http://www.tc.umn.edu/~bakk0029//, accessed March 11, 2011.

Bamforth, D. B.
2009 Projectile Points, People, and Plains Paleoindian Perambulations. *Journal of Anthropological Archaeology* 28:142-157.

Bement, L. C., and B. J. Carter
2010 Jake Bluff: Clovis Bison Hunting on the Southern Plains of North America. *American Antiquity* 75(4):907-934.

Binford, L. R.
1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4-20.

2001 *Constructing Frames of Reference*. University of California Press, Berkeley.

Birk, D. A.
1994 *A Phase I Archaeological Survey of the Proposed Second Phase Foxberry Farm Development Area, Medina Township, Hennepin County, Minnesota*. Reports of Investigations No. 300. Institute for Minnesota Archaeology, Minneapolis, Minnesota. Submitted to Lundgren Brothers Construction, Inc., Woodbury, Minnesota.

Bonnichsen, R., B. T. Lepper, D. Stanford, and M. R. Waters (editors)
2005 *Paleoamerican Origins: Beyond Clovis*. Center for the Study of the First Americans, Texas A&M University Press, College Station.

Bonnichsen, R., and A. L. Schneider
1999 Breaking the Impasse on the Peopling of the Americas. In *Ice Age People of North America: Environments, Origins, and Adaptations*, edited by R. Bonnichsen and K. L. Turnmire, pp. 1-26. Oregon State University Press, Center for the Study of the First Americans, Corvallis.

Boraas, A.
1968 *Site Survey – Blue Mounds State Park, Rock County, Minnesota*. Report on file, Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, Minnesota.

Brace, C. L., A. R. Nelson, N. Seguchi, H. Oe, L. Sering, P. Qifeng, L. Yongyi, and D. Tumen
2001 Old World Sources of the First New World Human Inhabitants: A Comparative Craniofacial View. *PNAS* 98:10017-10022.

Bradley, B. A., and D. Stanford
2004 The North Atlantic Ice-edge Corridor: A Possible Paleolithic Route to the New World. *World Archaeology* 36:459-478.

Brink, J. W.
2005 Inukshuk: Caribou Drive Lanes on Southern Victoria Island, Nunavut, Canada. *Arctic Anthropology* 42(1):1-28.

2008 *Imagining Head-Smashed-In: Aboriginal Buffalo Hunting on the Northern Plains*. Athabasca University Press, Edmonton.

Bronk Ramsey, C.
2008 Radiocarbon Dating: Revolutions in Understanding. *Archaeometry* 50:249-275.

BRW, Inc.
1994 *Geoarchaeological Data Recovery, East Terrace Site (21BN6) and Gardner Site (21SN14), Benton and Stearns Counties, Minnesota*. SHPO File No. 91-1570. BRW, Inc., Minneapolis, Minnesota. Submitted to Minnesota Department of Transportation, St. Paul, Minnesota.

Cain, L. K.
1969 Some Probable Late Paleo-Indian Early Archaic Projectile Points from East Central Minnesota. *The Minnesota Archaeologist* 30(2):45-48.

Caine, C. A. H.
1969 The Archaeology of the Snake River Valley. Unpublished Master's thesis, Department of Anthropology, University of Minnesota.

Camill, P., C. E. Umbanhowar, Jr., R. Teed, C. E. Geiss, J. Aldinger, L. Dvorak, J. Kenning, J. Limmer, and K. Walkup
2003 Late-Glacial and Holocene Climatic Effects on Fire and Vegetation Dynamics at the Prairie–Forest Ecotone in South-central Minnesota. *Journal of Ecology* 91:822-836.

Carr, D., R. Boszhardt, A. Bloedorn, D. Winkler, and S. Wagner
2008a A Preliminary Report on the Schumann Cache: An Early-Paleoindian Find in Southeastern Minnesota. *Current Research in the Pleistocene* 25:66-67.

Carr, D., D. Winkler, A. Bloedorn, and R. Boszhardt
2008b The Schumann Cache: A Silicified Sandstone Clovis Cache from Southeastern Minnesota. Paper presented at the Midwest Archaeological Conference, Milwaukee, Wisconsin, October 15-19, 2008.

Cater, J. D.
1997 *Phase II Archaeological Investigation of Foxberry Farm Development Area, Medina Township, Hennepin County, Minnesota*. Reports of Investigations No. 438. Institute for Minnesota Archaeology Consulting, Inc., Minneapolis. Submitted to Lundgren Brothers Construction, Inc., Woodbury, Minnesota.

City of Pipestone Staff and Planning Commission
2008 Physical Features. In *City of Pipestone Minnesota Comprehensive Plan*. Prepared by City of Pipestone Staff and Planning Commission. Electronic document, http://www.swrdc.org/PipestonePlan.htm, accessed February 16, 2011.

Cleland, C. E.
1965 Barren Ground Caribou (*Rangifer arcticus*) from an Early Man Site in Southeastern Michigan. *American Antiquity* 30(3):350-351.

Clouse, R. A.
1992 *Summary Report of the Owen Johnson Artifact Collection at Myre-Big Island State Park*. Minnesota Historical Society, St. Paul. Submitted to Division of Parks and Recreation, Minnesota Department of Natural Resources.

Curry, B. B., E. C. Grimm, J. E. Slate, B. C. S. Hansen, and M. E. Konen
2007 *The Late-Glacial and Early Holocene Geology, Paleoecology, and Paleohydrology of the Brewster Creek Site, a Proposed Wetland Restoration Site, Pratt's Wayne Woods Forest Preserve, and James "Pate" Philip State Park, Bartlett, Illinois*. Circular 571. Illinois State Geological Survey, Champaign.

Curry, B. B., M. E. Konen, T. H. Larson, C. H. Yansa, K. C. Hackley, H. Alexanderson, and T. V. Lowell
2010 The DeKalb Mounds of Northeastern Illinois as Archives of Deglacial History and Postglacial Environments. *Quaternary Research* 74:82-90.

Cushing, E. J.
1965 Problems in the Quaternary Phytogeography of the Great Lakes Region. In *The Quaternary of the United States*, edited by H. E. Wright, Jr. and D. G. Frey, pp. 403-416. Princeton University Press, Princeton.

Dalla Bona, L.
1994 *Volume 3: Methodological Considerations*. Center for Archaeological Resource Prediction, Lakehead University, Thunder Bay, Ontario. Submitted to the Ontario Ministry of Natural Resources, Thunder Bay, Ontario. Electronic document, http://modelling.pictographs.com/method.htm, accessed March 10, 2011.

Davis, L. B., S. T. Greiser, and T. W. Greiser
1987 Spring Cleanup at a Folsom Camp in the Northern Rockies. *Current Research in the Pleistocene* 4:5-6.

Deller, D. B., and C. Ellis
1984 Crowfield: A Preliminary Report on a Probable Paleo-Indian Cremation in Southwestern Ontario. *Archaeology of Eastern North America* 12:41-71.

1988 Early Paleoindian Complexes in Southwestern Ontario. In *Late Pleistocene and Early Holocene Paleoecology and Archeology of the Eastern Great Lakes Region*, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 251-263. Bulletin of the Buffalo Society of Natural Sciences No. 33, New York.

1992 *Thedford II: A Paleo-Indian Site in the Ausable River Watershed of Southwestern Ontario*. Memoir of the Museum of Anthropology No. 24. University of Michigan, Ann Arbor.

Dent, R. J.
2007 Seed Collecting and Fishing at the Shawnee Minisink Paleoindian Site, Everyday Life in the Late Pleistocene. In *Foragers of the Terminal Pleistocene in North America*, edited by R. B. Walker and B. N. Driskell, pp. 116-131. University of Nebraska Press, Lincoln.

Dibble, D. S., and D. Lorraine
1968 *Bonfire Shelter: A Stratified Bison Kill Site, Val Verde County, Texas*. Miscellaneous Paper 1. Texas Memorial Museum, University of Texas, Austin.

Diers, M. P.
1988 *Soil Survey of Rock County, Minnesota*. U.S. Department of Agriculture, Soil Conservation Service in cooperation with the University of Minnesota Agricultural Experiment Station. U.S. Government Printing Office, Washington, D.C.

Dixon, E. J.
1993 *Quest for the Origins of the First Americans*. University of New Mexico Press, Albuquerque.

Dobbs, C. A.
1989 Outline of Historic Contexts for the Prehistoric Period (ca. 12,000 B.P. – A.D. 1700). *Minnesota History in Sites and Structures: A Comprehensive Planning Series*. Reports of Investigations No. 37. Institute for Minnesota Archaeology, Minneapolis. On file, Minnesota Historical Society, State Historic Preservation Office, St. Paul.

Dobbs, C. A., and S. F. Anfinson
1993 Pre-Contact Period Historic Contexts (9500 B.C. – A.D. 1650). *Minnesota History in Sites and Structures: A Comprehensive Planning Series*. On file, Minnesota Historical Society, State Historic Preservation Office, St. Paul, Minnesota.

Dobbs, C. A., K. Breakey, and H. Mooers
1994 *A Model of Archaeological Sensitivity for Landforms Along the Lakehead Pipe Line Company Corridor from Neche, North Dakota to Clearbrook, Minnesota*. Reports of Investigations No. 282. Institute for Minnesota Archaeology, Minneapolis, Minnesota.

Dyke, A. S., A. Moore, and L. Robertson
2003 *Deglaciation of North America*. Open File Number 1574. Geological Survey of Canada, Ottawa, Ontario. Electronic Document, http://geopub.nrcan.gc.ca/link_e.php, accessed February 15, 2011.

Ellis, C., and D. B. Deller
2000 *An Early Paleo-Indian Site near Parkhill, Ontario*. Mercury Series, Archaeological Survey of Canada. Canadian Museum of Civilization, Gatineau, Quebec.

Erlandson, J. M.
2002 Anatomically Modern Humans, Maritime Voyaging, and the Pleistocene Colonization of the Americas. In *The First Americans: The Pleistocene Colonization of the New World*, edited by N. G. Jablonski, pp. 59-92. California Academy of Sciences, San Francisco.

Fiedel, S. J.
2007 Quacks in the Ice: Waterfowl, Paleoindians and the Discovery of America. In *Foragers of the Terminal Pleistocene in North America*, edited by R. B. Walker and B. N. Driskell, pp. 1-14. University of Nebraska Press, Lincoln.

Figgins, J. D.
1933 A Further Contribution to the Antiquity of Man in America. *Proceedings of the Colorado Museum of Natural History* 12(2):4-8.

Fisher, D.
1987 Mastodont Procurement by Paleoindians of the Great Lakes Region: Hunting or Scavenging? In *The Evolution of Human Hunting*, edited by M. H. Nitecki and D. V. Nitecki, pp. 309-421. Plenum Press, New York.

2004 Mastodons, Mammoths, and Humans in the North American Mid-Continent. In *New Perspectives on the First Americans*, edited by B. T. Lepper and R. Bonnichsen, pp. 81-86. Center for the Study of the First Americans. Texas A&M Press, College Station.

Fisher, D. C., B. T. Lepper, and P. E. Hooge
1991 Evidence for Butchery of the Burning Tree Mastodon. In *The First Discovery of America: Archaeological Evidence of the Early Inhabitants of the Ohio Area*, edited by W. S. Dancey, pp. 43-57. Ohio Archaeological Council, Columbus.

Fisher, T. G.
2003 Chronology of Glacial Lake Agassiz Meltwater Routed to the Gulf of Mexico. *Quaternary Research* 59:271-276.

Fitting, J. E., J. Devisscher, and E. J. Wahla
1966 *The Paleo-Indian Occupation of the Holcombe Beach*. Anthropological Papers No. 27. Museum of Anthropology, University of Michigan, Ann Arbor.

Fladmark, K. R.
1979 Routes: Alternate Migration Corridors for Early Man in North America. *American Antiquity* 44(1):55-69.

Flaskerd, G. A.
1943 The A. H. Anderson Site. *The Minnesota Archaeologist* 9(1):4-15.

1945 Folsom and Yuma Type Points from Minnesota. *The Minnesota Archaeologist* 11(2):32-33.

Flint, R. F.
1955 *Glacial and Pleistocene Geology*. John Wiley and Sons, New York.

Florin, F.
1996 Late Paleo-Indians of Minnesota and Vegetation Change from 10,500-8000 BP. Unpublished Master's thesis, Department of Anthropology, University of Minnesota, Twin Cities. On file at the Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, Minnesota.

Fosha, M., and J. A. Donohue
2005a Updates on the Chalk Rock Site and its Geologic Relationship to Holocene/Pleistocene Transition Soils in South Dakota. *Newsletter of the South Dakota Archaeological Society* 35(1):1-3.

2005b Preliminary Assessment of 39BK100, a Multi-component Paleoindian Site and Possible Mammoth Kill. Paper presented at the 2nd International World of Elephants Congress, Hot Springs, South Dakota.

Fosha, M., J. A. Donohue, C. Widga, and R. D. Mandel
2004 Preliminary Assessment of 39BK100, a Multi-component Site and Possible Mammoth Kill. Paper presented at the 62nd Annual Plains Anthropological Conference, Billings, Montana.

Fosha, M., and A. Woodside
2003 A Preliminary Report on Excavations at the Brookings County Mammoth Locality, South Dakota. *Newsletter of the South Dakota Archaeological Society* 33(2 and 3):1-3.

Frison, G. C.
1974 *The Casper Site: A Hell Gap Bison Kill on the High Plains*. Academic Press, New York.

1991 *Prehistoric Hunters of the High Plains*. 2nd ed. Academic Press, New York.

1996 *The Mill Iron Site*. University of New Mexico Press, Albuquerque.

1998 Paleoindian Large Mammal Hunters on the Plains of North America. *Proceedings of the National Academy of Sciences* 95:14,576-14,583.

2004 *Survival by Hunting: Prehistoric Human Hunters and Animal Prey*. University of California Press, Berkeley.

Frison, G. C., and D. J. Stanford
1982 *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains*. Academic Press, New York.

Frison, G. C., and L. C. Todd
1986 *The Colby Mammoth Site: Taphonomy and Archaeology of a Clovis Kill in Northern Wyoming*. University of New Mexico Press, Albuquerque.

Frison, G. C., M. J. Wilson, and D. J. Wilson
1976 Fossil Bison and Artifacts from an Early Altithermal Period Arroyo Trap in Wyoming. *American Antiquity* 41:28-57.

Gavin, D. G.
2001 Estimation of Inbuilt Age in Radiocarbon Ages of Soil Charcoal for Fire History Studies. *Radiocarbon* 43:27-44.

Gibbon, G. E., and H. Hruby
1983 "First-Step" Settlement Subsistence Models for the Rock River Drainage in Southwestern Minnesota. In *Prairie Archaeology*, edited by G. E. Gibbon, pp. 131-149. Publications in Anthropology No. 3, University of Minnesota, Minneapolis.

Gonsior, L., D. C. George, and S. Allan
1999 *Archaeological Investigation of the Lake Carlos State Park Beach Site (21DL2), Lake Carlos State Park, Douglas County, Minnesota*. Department of Archaeology, Minnesota Historical Society, St. Paul, Minnesota. Submitted to Minnesota Department of Natural Resources, St. Paul, Minnesota.

Gonzales, L. M., and E. C. Grimm
2009 Synchronization of Late-Glacial Vegetation Changes at Crystal Lake, Illinois, USA with the North Atlantic Event Stratigraphy. *Quaternary Research* 72:234-245.

Gonzales, L. M., J. W. Williams, and E. C. Grimm
2009 Expanded Response Surfaces: A New Method to Reconstruct Paleoclimates from Fossil Pollen Assemblages that Lack Modern Analogues. *Quaternary Science Reviews* 28:3,315-3,332.

Graham, R. W., C. V. Haynes, D. L. Johnson, and M. Kay
1981 Kimmswick: A Clovis-Mastodon Association in Eastern Missouri. *Science* 213:1115-1117.

Graham, R. W., and M. Kay
1988 Taphonomic Comparison of Cultural and Noncultural Faunal Deposits at the Kimmswick and Barnhart Sites, Jefferson County, Missouri. In *Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region*, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 227-240. Bulletin of the Buffalo Society of Natural Sciences 33. Buffalo, New York.

Graham, R. W., and E. L. Lundelius, Jr.
1994 *FAUNMAP: A Database Documenting Late Quaternary Distributions of Mammal Species in the United States*. Illinois State Museum, Scientific Papers 25(1-2). Springfield.

Graham, R. W., H. A. Semken, and M. A. Graham (editors)
1987 *Late Quaternary Mammalian Biogeography and Environments of the Great Plains and Prairies*. Illinois State Museum Scientific Papers 22. Springfield.

Gramley, R. M.
1982 *The Vail Site: A Paleo-Indian Encampment in Maine*. Bulletin of the Buffalo Society of Natural Sciences 30. Buffalo, New York.

1984 Kill Sites, Killing Ground and Fluted Points at the Vail Site. *Archaeology of Eastern North America* 12:110-121.

Gries, J. P.
1998 *Roadside Geology of South Dakota*. 2nd ed. Mountain Press Publishing Co., Missoula.

Grimm, E. C.
1983 Chronology and Dynamics of Vegetation Change in the Prairie-Woodland Region of Southern Minnesota, U.S.A. *New Phytologist* 93:311-350.

Grimm, E. C., and G. L. Jacobson, Jr.
2004 Late Quaternary Vegetation History of the Eastern United States. In *Development in Quaternary Science vol. 1. The Quaternary Period in the United States*, edited by A. R. Gillespie, S. C. Porter, and B. F. Atwater, pp. 381-402. Elsevier, Amsterdam.

Grimm, E. C., L. J. Maher, and D. M. Nelson
2009 The Magnitude of Error in Conventional Bulk-Sediment Radiocarbon Dates from Central North America. *Quaternary Research* 72:301-308.

Gubser, N.
1965 *The Nunamiut Eskimos – Hunters of Caribou*. Yale University Press, New Haven.

Guthrie, R. D.
1990a *Frozen Fauna of the Mammoth Steppe: The Story of Blue Babe*. University of Chicago Press, Chicago.

1990b Late Pleistocene Faunal Revolution: A New Perspective on the Extinction Debate. In *Megafauna and Man: Discovery of America's Heartland*, edited by L. D. Agenbroad, J. I. Mead, and L. W. Nelson, pp. 42-53. The Mammoth Site of Hot Springs, South Dakota, Inc., Hot Springs and Northern Arizona University, Flagstaff.

Hannus, L. A.
1985 The Lange/Ferguson Site – An Event of Clovis Mammoth Butchery with the Associated Bone Tool Technology: The Mammoth and Its Track. Unpublished Ph.D. dissertation, University of Utah, Salt Lake City.

Hare, F. K.
1959 A Photo-reconnaissance Survey of Labrador-Ungava. *Canada Department of Mines and Technical Resources, Geographic Branch Memoir* No. 6.

Harrison, C., E. Redepenning, C. L. Hill, G. Rapp Jr., S. E. Aschenbrenner, J. K. Huber, and S. C. Mulholland
1995 *The Paleo-Indian of Southern St. Louis County, Minnesota: The Reservoir Lakes Complex*. Kendall/Hunt Publishing Company, Dubuque.

Haynes, C. V., Jr., and B. Huckell (editors)
2007 *Murray Springs: A Clovis Site with Multiple Activity Areas in the San Pedro Valley, Arizona*. The University of Arizona Press, Tucson.

Hellborg, R., and G. Skog
2008 Accelerator Mass Spectrometry. *Mass Spectrometry Reviews* 27:398-427.

Hester, J. J.
1971 *Blackwater Locality 1: A Stratified Early Man Site in Eastern New Mexico*. Fort Burgwin Research Center Publication 8. Southern Methodist University, Dallas.

Hibbard, C. W.
1951 Remains of the Barren Ground Caribou in Pleistocene Deposits of Michigan. *Papers of the Michigan Academy of Science, Arts, and Letters* 37:235-237. Ann Arbor.

Higginbottom, D. K.
1996 *An Inventory of Fluted Projectile Points from Minnesota*. Draft Copy. For Distribution at the 54th Annual Plains Anthropological Conference, Iowa City, Iowa.

Hobbs, E.
1997 *MN/Model: An Archaeological Predictive Model for Minnesota*. Electronic document, http://proceedings.esri.com/library/userconf/proc97/proc97/to200/pap151/p151.htm, accessed June 13, 2011.

Hobbs, H. C., and J. E. Goebel
1982 Geologic Map of Minnesota: Quaternary Geology, State Map Series S-1. Minnesota Geological Survey, Minneapolis. Scale 1:500,000, 1 sheet.

Hofman, J. L.
2010 Allen Complex Behavior and Chronology in the Central Plains. In *Exploring Variability in Early Holocene Hunter-Gatherer Lifeways*, edited by S. Hurst and J. L. Hofman, pp. 135-152. University of Kansas Publications in Anthropology No. 25. Lawrence.

Hofman, J. L., and R. W. Graham
1998 The Paleo-Indian Cultures of the Great Plains. In *Archaeology on the Great Plains*, edited by W. R. Wood, pp. 87-139. University Press of Kansas, Lawrence.

Hofman, J. L., S. R. Holen, and L. A. Hannus
1999 *Clovis on the Great Plains*. Poster presented at the Clovis and Beyond Conference, Santa Fe, New Mexico.

Hokanson, H. L., W. W. Anderson, D. W. Calkins, K. W. Hein, F. D. Lorenzen, J. J. Murray, R. O. Paulson, and R. F. Peterson
1970 *Soil Survey of Lincoln County, Minnesota*. U.S. Department of Agriculture, Soil Conservation Service in cooperation with the University of Minnesota Agricultural Experiment Station. U.S. Government Printing Office, Washington, D.C.

Hokanson, H. L., F. D. Lorenzen, J. J. Murray, and R. O. Paulson
1976 *Soil Survey of Pipestone County, Minnesota*. U.S. Department of Agriculture, Soil Conservation Service in cooperation with the University of Minnesota Agricultural Experiment Station. U.S. Government Printing Office, Washington, D.C.

Holen, S. R.
2003 Clovis Projectile Points and Preforms in Nebraska: Distribution and Lithic Sources. *Current Research in the Pleistocene* 20:31-33.

2006 Taphonomy of Two Last Glacial Maximum Mammoth Sites in the Central Great Plains of North America: A Preliminary Report on La Sena and Lovewell. *Quaternary International* 142-143:30-43.

2008 Geological and Technological Considerations in the Search for Early Paleoindian Archaeological Sites in the Great Plains. Paper presented at the 66th Annual Plains Anthropological Conference, Laramie, Wyoming.

Holen, S. R., and D. W. May
2002 The La Sena and Shaffert Mammoth Sites: History of Investigations. In *Medicine Creek: Seventy Years of Archaeological Investigations*, edited by Donna C. Roper, pp. 20-36. University of Alabama Press, Tuscaloosa.

Holley, G. R., M. G. Michlovic, and R. A. Dalan
2011 *Archaeological Survey of Swift County, Minnesota*. Archaeology Laboratory, Minnesota State University, Moorhead, Minnesota. Submitted to Minnesota Historical Society, St. Paul.

Holliday, V. T.
1997 *Paleoindian Geoarchaeology of the Southern High Plains.* University of Texas Press, Austin.

2000 Historical Perspective on the Geoarchaeology of the Southern High Plains. In *Geoarchaeology in the Great Plains*, edited by R. D. Mandel, pp. 10-43. University of Oklahoma Press, Norman.

Holliday, V. T., and R. D. Mandel
2006 Paleoindian Geoarchaeology of the Southwest, Great Plains and Central Lowlands. In *Handbook of North American Indians: Origins of Native Americans*, edited by D. Stanford, pp. 23-46. Smithsonian Institution Press, Washington, D.C.

Hudak, C. M., and E. R. Hajic
2002 Landscape Suitability Models for Geologically Buried Precontact Cultural Resources. In *Mn/Model: A Predictive Model of Precontact Archaeological Site Location for the State of Minnesota*, edited by G. J. Hudak, E. Hobbs, A. Brooks, C. Sersland, and C. Phillips, Chapter 12. Minnesota Department of Transportation, St. Paul. Electronic document, http://www.mnmodel.dot.state.mn.us/chapters/chapter12.htm, accessed December 21, 2010.

Hudak, G. J.
1971 *Notes on the Archaeology, Blue Mounds State Park*. Report on file, Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, Minnesota.

Hudak, G. J., E. Hobbs, A. Brooks, C. Sersland, and C. Phillips (editors)
2002 *Mn/Model: A Predictive Model of Precontact Archaeological Site Location for the State of Minnesota*. Minnesota Department of Transportation, St. Paul. Electronic document, http://www.mnmodel.dot.state.mn.us/pages/final_report.html, accessed December 21, 2010.

Jackson, L.
1988 Fossil Cervids and Fluted Point Hunters: A Review for Southern Ontario. *Ontario Archaeology* 48:27-41.

Jelgersma, S.
1962 A Late-Glacial Pollen Diagram from Madelia, South-central Minnesota. *American Journal of Science* 260:522-529.

Jenks, A. E.
1937 *Minnesota's Browns Valley Man and Associated Burial Artifacts*. Memoirs of the American Anthropological Association No. 49. Menasha.

Jensen, P. S., and B. Birch
1963 Archaeological Survey of Southeastern Minnesota. *The Minnesota Archaeologist* 25(2):46-85.

Johnson, E.
1988 *The Prehistoric Peoples of Minnesota*. 3rd ed. Minnesota Prehistoric Archaeology Series No. 3. Minnesota Historical Society, St. Paul.

Johnson, E., C. Harrison, and J. Schaaf
1977 *Cultural Resources Inventory of Lands Adjacent to Lake Winnibigoshish*. Contract No. DACW 37-76-C-0181. Archaeology Laboratory, University of Minnesota, Minneapolis. Submitted to U.S. Army Corps of Engineers, St. Paul District.

Judge, J., and L. Sebastian (editors)
1988 *Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archaeological Predictive Modeling*. U.S. Department of the Interior, Bureau of Land Management, Denver, Colorado.

Justice, N. D.
1995 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference*. Indiana University Press, Bloomington.

Kammerer, J. J.
1942 Survey of a Little-Known Hennepin County Site and a Classification of 903 Artifacts. *The Minnesota Archaeologist* 8(4):142-168.

1963 Eastern Multiple Fluted Projectile Point…A Recent Find by Bradley Durling. *The Minnesota Archaeologist* 25(4):155.

1982 Fluted Point Found in Carlton County. *Minnesota Archaeological Newsletter* 29:1.

Kelly, R. L.
1995 *The Foraging Spectrum*. Smithsonian Institution Press, Washington, D.C.

Kim, H. K.
1982 Late-Glacial and Postglacial Pollen Studies from the Zuehl Farm Site, North-central Iowa and the Cattail Channel Bog, Northwestern Illinois. Unpublished Master's thesis, University of Iowa, Iowa City.

1986 Late-Glacial and Holocene Environment in Central Iowa: A Comparative Study of Pollen Data from Four Sites. Unpublished Ph.D. dissertation, University of Iowa, Iowa City.

Klammer, P.
1941 Another Sugar Quartz Folsom from Minnesota. *The Minnesota Archaeologist* 7(2):97.

Kluth, D. W., and C. M. Hudak
2004 *Phase III Archaeological Mitigation and Geoarchaeological Investigation of the Donarski Site (21MA33), Marshall County, Minnesota (S.P. 45-598-11)*. Forth & Van Dyke and Associates, Inc., Eagan, Minnesota. Submitted to Marshall County Highway Department, Warren, Minnesota.

Kornfeld, M., G. C. Frison, and M. L. Larson
2010 *Prehistoric Hunters and Gatherers of the High Plains and Rocky Mountains* 3rd ed. Left Coast Press, Walnut Creek.

Kuehn, S. R.
2007 Late Paleoindian Subsistence Strategies in the Western Great Lakes Region: Evidence for Generalized Foraging from Northern Wisconsin. In *Foragers of the Terminal Pleistocene in North America*, edited by R. B. Walker and B. N. Driskell, pp. 88-115. University of Nebraska Press, Lincoln.

Kvamme, K. L.
1990 The Fundamental Principles and Practice of Predictive Archaeological Modeling. In *Mathematics and Information Science in Archaeology: A Flexible Framework*, edited by A. Voorips, pp. 257-295. Studies in Modern Archaeology, Holos-Verlag, Bonn.

1995 A View from Across the Water: The North American Experience in Archaeological GIS. In *Archaeology and Geographic Information Systems: A European Perspective*, edited by G. Lock and Z. Stančič, pp. 1-14. Taylor and Francis, London.

LaBelle, J. M.
2010 *Re*Occupation of Place: Late Paleoindian Land Use Strategies in the Central Plains. In *Exploring Variability in Early Holocene Hunter-Gatherer Lifeways*, edited by S. Hurst and J. L. Hofman, pp. 37-72. Publications in Anthropology No. 25. University of Kansas, Lawrence.

Laird, K. R., S. C. Fritz, B. F. Cumming, and E. C. Grimm
1998 Early-Holocene Limnological and Climatic Variability in the Northern Great Plains. *The Holocene* 8:275-285.

Laird, K. R., S. C. Fritz, E. C. Grimm, and P. G. Mueller
1996 Century-scale Paleoclimatic Reconstruction from Moon Lake, a Closed-basin Lake in the Northern Great Plains. *Limnology and Oceanography* 41:890-902.

Landon, R. H., and G. A. Flaskerd
1945a The Long Lake Site. *The Minnesota Archaeologist* 11(2):31-46.

1945b A Minnesota Point with Folsom and Yuma Characteristics. *The Minnesota Archaeologist* 11(2):47.

Larson, M. L., M. Kornfeld, and G. C. Frison (editors)
2009 *The Hell Gap Site*. University of Utah Press, Salt Lake City.

Lepper, B. T.
1999 Pleistocene Peoples of Midcontinental North America. In *Ice Age Peoples of North America*, edited by R. Bonnichsen and K. Turnmire, pp. 362-394. Center for the Study of the First Americans, Oregon State University Press, Corvallis.

Lepper, B. T., and R. Bonnichsen (editors)
2004 *New Perspectives on the First Americans*. Center for the Study of the First Americans, Texas A&M University Press, College Station.

Lopinot, N. H., J. H. Ray, and M. D. Conner (editors)
2000 *The 1999 Excavations at the Big Eddy Site (23CE426)*. Special Publication 3. Center for Archaeological Research, Southwest Missouri State University, Springfield.

Lopinot, N. H., and J. H. Ray
2010 Late Paleoindian Interaction and Exchange at the Big Eddy Site in Southwest Missouri. In *Exploring Variability in Early Holocene Hunter-Gatherer Lifeways*, edited by S. Hurst and J. L. Hofman, pp. 119-134. University of Kansas Publications in Anthropology 25. Lawrence.

Lowe, J. J., S. O. Rasmussen, S. Björck, W. Z. Hoek, J. P. Steffensen, M. J. C. Walker, Z. C. Yu, and INTIMATE Group
2008 Synchronisation of Palaeoenvironmental Events in the North Atlantic Region During the Last Termination: A Revised Protocol Recommended by the INTIMATE Group. *Quaternary Science Reviews* 27:6-17.

MacDonald, G. F.
1968 *Debert: A Paleo-Indian Site in Central Nova Scotia*. Anthropology Papers 16. National Museum of Canada, Ottawa.

McAndrews, J. H.
1976 Holocene Pollen Analysis from Northern Quebec. *American Quaternary Association Abstracts III*. 4th Biennial Meeting, Tempe.

McNett, C. W. (editor)
1985 *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*. Academic Press, New York.

Magner, M. A.
1994 Lanceolate Points from the Lake Agassiz Region of Northwestern Minnesota. Unpublished paper submitted in lieu of Master's thesis, University of Illinois, Urbana-Champaign. On file, Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, Minnesota.

Malo, D. D.
1997 *South Dakota's Physiographic Regions*. Electronic document, http://www.northern.edu/natsource/EARTH/Physiol.htm, accessed December 26, 2006. Northern State University, Aberdeen.

Mandel, R. D.
2008 Buried Paleoindian-age Landscapes in Stream Valleys of the Central Plains, USA. *Geomorphology* 101:342-361.

Mandel, R. D. (editor)
2000 *Geoarchaeology in the Great Plains.* University of Oklahoma Press, Norman.

2004 Odyssey Archaeological Research Fund Report of Investigations, Summer and Fall, 2004. Kansas Geological Survey, Lawrence.

Mandel, R. D., S. R. Holen, and J. L. Hofman
2005 Geoarchaeology of Clovis and Potential Pre-Clovis Cultural Deposits at the Kanorado Locality, Northwestern Kansas. *Current Research in the Pleistocene* 22:56-57.

Mayle, F. E., A. J. Levesque, and L. C. Cwynar
1993 *Alnus* as an Indicator Taxon of the Younger Dryas Cooling in Eastern North America. *Quaternary Science Reviews* 12:295-305.

Merriwether, D. A., F. Rothhammer, and R. E. Ferrell
1995 Distribution of the Four Founding Lineage Haplotypes in Native Americans Suggests a Single Wave of Migration for the New World. *American Journal of Physical Anthropology* 98:411-430.

Michlovic, M. G.
1987 *Archaeological Survey and Test Excavations in Clay County, N.D.* Ms. on file, State Historical Society of North Dakota, Bismarck.

Minnesota Department of Natural Resources
2003 Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. Minnesota Department of Natural Resources, St. Paul.

Minnesota Geological Survey
1995 *Regional Hydrogeologic Assessment: Quaternary Geology – Southwestern Minnesota*. RHA–2, Part A, Plate 1 – Surficial Geologic Map and RHA–2, Part A, Plate 2 – Quaternary Stratigraphy. Minnesota Geological Survey, Minneapolis, Minnesota.

Minnesota Historical Society
1981 *Minnesota Statewide Archaeological Survey Summary: 1977-1980*. Minnesota Historical Society, St. Paul, Minnesota. Submitted to the Minnesota Legislature.

Minnesota River Basin Data Center
2004 *Valley Formation*. Electronic document, http://mrbdc.wrc.mnsu.edu/mnbasin/fact_sheets/valley_formation.html, accessed April 19, 2011. Minnesota River Basin Data Center, Minnesota State University, Mankato.

Monaghan, G. W., K. C. Egan-Bruhy, M. J. Hambacher, D. R. Hayes, M. F. Kolb, S. R. Kuehn, S. Peterson, J. A. Robertson, and N. R. Schaffer

2006 *Minnesota Deep Test Protocol Project*. Commonwealth Cultural Resources Group, Inc., Jackson, Michigan. Submitted to Minnesota Department of Transportation, St. Paul, Minnesota.

Morrow, J. E.

1996 The Organization of Paleoindian Lithic Technology in the Confluence Area of the Mississippi, Illinois, and Missouri Rivers. Unpublished Ph.D. dissertation, Washington University, St. Louis.

Morrow, J. E., and B. Koldehoff

2002a Exploring the Clovis-Gainey-Folsom Continuum: Technological and Morphological Variation in Midwestern Fluted Points. In *Folsom Technology and Lifeways*, edited by J. E. Clark and M. B. Collins, pp. 141-157. Special Publication of Lithic Technology No. 4. University of Tulsa, Oklahoma.

2002b Rummells-Maske Revisited: A Fluted Point Cache from East Central Iowa. *Plains Anthropologist* 47:307-322.

2005 Evidence for Early-Paleoindian (Gainey) Occupation of the Taylor No. 2 Site (11EF129), Effingham County, Illinois. *Current Research in the Pleistocene* 22:57-60.

Mulholland, S. C., G. E. Larimer, and G. Rapp

1995 *Archaeological Survey and Site Evaluation of Submerged Portions of the Island Lake Reservoir, St. Louis County, Minnesota: 1994 Field Season*. Archaeometry Laboratory Report No. 95-4. Archaeometry Laboratory, University of Minnesota, Duluth.

1996 *Archaeological Survey and Site Evaluation of Submerged Portions of the Island Lake Reservoir, St. Louis County, Minnesota: 1995 Field Season*. Archaeometry Laboratory Report No. 96-4. Archaeometry Laboratory, University of Minnesota, Duluth.

Mulholland, S. C., and S. L. Mulholland

2002 A Folsom Site in Northeastern Minnesota. *Current Research in the Pleistocene* 19:68-70.

2008 A Probable Holcombe Point from Northeastern Minnesota. *Current Research in the Pleistocene* 25:123-125.

2010 Two Fluted Quartz Points from Pine County, Minnesota. *Current Research in the Pleistocene* 27:125-127.

2011 The Fluted Points of Pine City: Reexamination of the Neubauer Collection. Paper presented at the 2011 Council for Minnesota Archaeology Conference, Inver Grove Heights, Minnesota.

Mulholland, S. C., S. L. Mulholland, and R. C. Donahue

2008 *The Archaeology of the Fish Lake Dam Site: Pre-contact Occupations on the East Bank*. Occasional Publication Number 12. Minnesota Archaeological Society, St. Paul, Minnesota.

Mulholland, S. C., S. L. Mulholland, G. R. Peters, J. K. Huber, and H. D. Mooers

1997 Paleo-Indian Occupations in Northeastern Minnesota: How Early? *North American Archaeologist* 18(4):371-400.

Mulholland, S. C., S. L. Mulholland, and G. Rapp

2001 *Phase I and II Archaeological Investigations on T.H. 53 North of Virginia (S.P. 6920-44), St. Louis County, Minnesota*. Archaeometry Laboratory Report No. 01-12. Archaeometry Laboratory, University of Minnesota, Duluth. Submitted to Minnesota Department of Transportation, St. Paul, Minnesota.

Mulholland, S. C., and G. Rapp

1991 *Archaeological Survey of Submerged Portions of the Island Lake Reservoir, St. Louis County, Minnesota*. Archaeometry Laboratory, University of Minnesota, Duluth. Submitted to Minnesota Power Company, Duluth, Minnesota.

1993 *Archaeological Survey of Aerial Portions of Island Lake Reservoir, St. Louis County, Minnesota*. Archaeometry Laboratory, University of Minnesota, Duluth. Submitted to Minnesota Power Company, Duluth, Minnesota.

Mulholland, S. C., A. D. Romano, and S. L. Mulholland

2007 A Fluted Point from East Bearskin Lake, Minnesota. *Current Research in the Pleistocene* 24:121-124.

Mulholland, S. L.

2008 *Phase I Archaeological Investigations of T.H. 13 and Phase II Evaluation of Site 21WE0078, Waseca County, Minnesota*. Duluth Archaeology Center Report No. 09-012. Duluth Archaeology Center, Duluth, Minnesota. Submitted to Minnesota Department of Transportation, St. Paul, Minnesota.

Mulholland, S. L., and S. C. Mulholland

2011 Fluted Points from Pine County, Minnesota: The Neubauer Collection. Submitted to *Current Research in the Pleistocene*.

Mulholland, S. L., S. C. Mulholland, and L. Furo

2009 A Newly Discovered Fluted Point from Northeastern Minnesota. *Current Research in the Pleistocene* 26:95-97.

Munson, P. J.

1990 Folsom Fluted Projectile Points East of the Great Plains and Their Bio-geographical Correlates. *North American Archaeologist* 11:255-272.

Nelson, G. D.

1990 *Soil Survey of Murray County, Minnesota*. U.S. Department of Agriculture, Soil Conservation Service in cooperation with the University of Minnesota Agricultural Experiment Station. U.S. Government Printing Office, Washington, D.C.

Neves, W. A., H. M. Puccarelli, and D. Meyer

1993 The Contribution of the Morphology of the Early South and North American Skeletal Remains to the Understanding of the Peopling of the Americas. *American Journal of Physical Anthropology* 16:150-151.

Okstad, W., D. Woodward, and S. Crump

2000 Overview of the Superior National Forest Heritage Program 1979-1999. *The Minnesota Archaeologist* 59:22-28.

Olmanson, T.

2007 *Summary of Ongoing Phase III Treatment of Site 21CA668, SHPO Number: 2004-2253, State License #06-048*. Leech Lake Heritage Sites Program, Cass Lake, Minnesota. Submitted to Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, Minnesota.

2008 *Summary Report of All Investigations Conducted by the Leech Lake Heritage Sites Program in the 2007 Field Season*. Leech Lake Heritage Sites Program, Cass Lake, Minnesota. Submitted to Leech Lake Band of Ojibwe, Cass Lake, Minnesota.

Olmanson, T., and C. Wells

2005 *Archaeological Reconnaissance Survey of the Walker Area Community Center Site in Cass County, Minnesota* Contract Completion Report. Leech Lake Heritage Sites Program, Cass Lake, Minnesota.

Olmanson, T., and C. Wells (continued)
2006 *Phase II Archaeological Testing of Site 21CA668 on the Proposed Walker Area Community Center Site in Cass County, Minnesota*. Contract Completion Report. Leech Lake Heritage Sites Program, Cass Lake, Minnesota.

Overpeck, J. T., R. S. Webb, and T. Webb, III
1992 Mapping Eastern North American Vegetation Change of the Past 18 ka: No-Analogs and the Future. *Geology* 20:1,071-1,074.

Overstreet, D. F.
1993 *Chesrow, A Paleoindian Complex in the Southern Lake Michigan Basin*. Case Studies in Great Lakes Archaeology No. 2. Great Lakes Archaeological Press, Milwaukee.

1998 Late Pleistocene Geochronology and the Paleoindian Penetration of the Southwestern Lake Michigan Basin. *The Wisconsin Archaeologist* 79(1):28-52.

2004 Pre-Clovis Occupation in Southeastern Wisconsin. In *New Perspectives on the First Americans*, edited by B. T. Lepper and R. Bonnichsen, pp. 41-48. Center for the Study of the First Americans. Texas A&M Press, College Station.

2005 Late-Glacial Ice-Marginal Adaptation in Southeastern Wisconsin. In *Paleoamerican Origins: Beyond Clovis*, edited by R. Bonnichsen, B. T. Lepper, D. Stanford, and M. R. Waters, pp. 183-195. Center for the Study of the First Americans. Texas A&M University Press, College Station.

Overstreet, D. F., and M. F. Kolb
2003 Geoarchaeological Contexts for Late Pleistocene Archaeological Sites with Human-Modified Woolly Mammoth Remains in Southeastern Wisconsin. *Geoarchaeology* 18:91-114.

Owsley, D. W., and R. L. Jantz
2005 Nearsightedness in Paleoamerican Research: Historical Perspective and Contemporary Analysis. In *Paleoamerican Origins: Beyond Clovis*, edited by R. Bonnichsen, B. T. Lepper, D. Stanford, and M. R. Waters, pp. 289-294. Center for the Study of the First Americans, Texas A&M University Press, College Station.

Palmer, H. A., and J. B. Stoltman
1976 The Boaz Mastodon: A Possible Association of Man and Mastodon in Wisconsin. *Midcontinental Journal of Archeology* 1(2):163-177.

Patterson, C. J.
1997 Surficial Geology of Southwestern Minnesota. In *Contributions to the Quaternary Geology of Southwestern Minnesota*, edited by C. J. Patterson, pp. 1-45. Report of Investigations No. 47. Minnesota Geological Survey, Minneapolis, Minnesota.

Pedersen, H. C., and G. J. Hudak
1982 *An Archaeological Reconnaissance Survey of the 588 Remaining Acres in Garvin Park, Lyon County, Minnesota*.

Peters, G. R.
1990 *Cultural Resource Management of the Superior National Forest – 1989 Annual Report*. Cultural Resource Report No. 7. U.S. Department of Agriculture, Forest Service, Superior National Forest, Duluth, Minnesota.

Phillips, B. A. M., and C. L. Hill
2004 Deglaciation History and Geomorphological Character of the Region Between the Agassiz and Superior Basins, Associated with the 'Interlakes Composite' of Minnesota and Ontario. In *The Late Paleo-Indian Great Lakes: Geological and Archaeological Investigations of Late Pleistocene and Early Holocene Environments*, edited by L. J. Jackson and A. Hinshelwood, pp. 275-301. Mercury Series, Archaeology Paper 165. Canadian Museum of Civilization, Gatineau, Quebec.

Pitblado, B. L.
2003 *Late Paleoindian Occupation of the Southern Rocky Mountains*. University Press of Colorado, Niwot.

Platcek, E. P.
1965 A Preliminary Survey of a Fowl Lakes Site. *The Minnesota Archaeologist* 27:51-92.

Queripel, S. R., and C. Coppini
1976 *Forestville State Park (A Preliminary Report)*. Minnesota Historical Society.

Radle, N. J., C. M. Keister, and R. W. Batterbee
1989 Diatom, Pollen, and Geochemical Evidence for the Paleosalinity of Medicine Lake, South Dakota, During the Late Wisconsin and Early Holocene. *Journal of Paleolimnology* 2:159-172.

Reimer, P. J., M. G. L. Baillie, E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwell, C. Bronk Ramsey, C. E. Buck, G. S. Burr, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, I. Hajdas, T. J. Heaton, A. G. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, F. G. McCormac, S. W. Manning, R. W. Reimer, D. A. Richards, J. R. Southon, S. Talamo, C. S. M. Turney, J. van der Plicht, and C. E. Weyhenmeyer
2009 INTCAL09 and MARINE09 Radiocarbon Age Calibration Curves, 0-50,000 Years CAL BP. *Radiocarbon* 51(4):1111-1150.

Richards, J. D.
1993 *Archaeological Reconnaissance of Five Lake Shores, Pine River Reservoir, Crow Wing County, Minnesota*. GLARC Reports of Investigation No. 342. Great Lakes Archaeological Research Center, Milwaukee, Wisconsin. Submitted to U.S. Army Corps of Engineers, St. Paul District. DACW 37-93-A-0019.

Rogers, R. A.
1986 Spurred End Scrapers as Diagnostic Paleoindian Artifacts: A Distributional Analysis on Stream Terraces. *American Antiquity* 51(2):338-341.

Romano, A. D., and E. Johnson
1990 A Northern Minnesota Gunflint Silica Clovis Point. *The Wisconsin Archeologist* 71(3-4):204-215.

Rubin, M., and C. Alexander
1960 U. S. Geological Survey Radiocarbon Dates V. *Radiocarbon* 2:129-185.

Samson, G.
1976 Paper presented at the Labrador prehistory symposium, American Anthropological Association annual meetings, November 16, 1976, Washington, D.C.

Sandstrom, C. B., and J. H. Ray
2004 *A Point Identification Guide for Southwest Missouri*. Ozarks Chapter, Missouri Archaeological Society, Springfield.

Schurr, T. G., and D. C. Wallace
1999 mtDNA Variation in Native Americans and Siberians and Its Implications for the Peopling of the New World. In *Who Were the First Americans?*, edited by R. Bonnichsen, pp. 41-77. Oregon State University, Center for the Study of the First Americans, Corvallis.

Scott, D. D., T. D. Thiessen, J. J. Richner, and S. Stadler
2006 *An Archeological Inventory and Overview of Pipestone National Monument, Minnesota*. Midwest Archeological Center Occasional Studies in Anthropology No. 34. U.S. Department of the Interior, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Shane, L. C. K.
1987 Late-Glacial Vegetational and Climatic History of the Allegheny Plateau and the Till Plains of Ohio and Indiana, *U.S.A. Boreas* 16:1-20.

Shane, L. C. K., and K. H. Anderson
1993 Intensity, Gradients and Reversals in Late Glacial Environmental Change in East-central North America. *Quaternary Science Reviews* 12:307-320.

Shane, O. C., III
1978 A Survey of Fluted Points from Minnesota. *The Minnesota Archaeologist* 37(4):150.

1989 Ice Age Hunters in Minnesota. *The Institute for Minnesota Archaeology Quarterly Newsletter* 4(3).

1991 *Final Report to the Minnesota Historical Society for Contract 90-C2443: Radiocarbon Assays of Bone from the Browns Valley Skeleton*. Science Museum of Minnesota, St. Paul. Submitted to the Minnesota Historical Society, St. Paul.

n.d. Unpublished personal notes concerning fluted projectile points from Minnesota. On file, Science Museum of Minnesota, St. Paul.

Shay, C. T.
1971 *The Itasca Bison Kill Site: An Ecological Analysis*. Minnesota Prehistoric Archaeology Series No. 6. Minnesota Historical Society, St. Paul.

Shuman, B., T. Webb, III, P. Bartlein, and J. W. Williams
2002 The Anatomy of a Climatic Oscillation: Vegetation Change in Eastern North America During the Younger Dryas Chronozone. *Quaternary Science Reviews* 21:1,777-1,791.

Simmons, D. B., M. J. Schott, and H. T. Wright
1984 The Gainey Site: Variability in a Great Lakes Paleo-Indian Assemblage. *Archaeology of Eastern North America* 12:266-279.

Smith, D. G., R. S. Malhi, J. A. Eshleman, F. A. Kaestle, and B. M. Kemp
2005 Mitochondrial DNA Haplogroups of Paleoamericans in North America. In *Paleoamerican Origins: Beyond Clovis*, edited by R. Bonnichsen, B. T. Lepper, D. Stanford, and M. R. Waters, pp. 243-254. Center for the Study of the First Americans, Texas A&M University Press, College Station.

South Dakota Geological Survey (SDGS)
2008 *Glacial History of the Coteau des Prairies*. Electronic document, http://www.sdgs.usd.edu/collstudies/Coteau/index.html, accessed September 16, 2008.

Southwick, D. L.
2007 Further Thoughts on the Circular Depression Near Jasper, Minnesota with Specific Reference to the Problem of the Deformation Lamellae in Quartz of the Sioux Quartzite. Unpublished manuscript on file, Minnesota Geological Survey, University of Minnesota, St. Paul.

Southwick, D. L., D. R. Setterholm, A. J. Runkel, C. J. Patterson, and V. W. Chandler
1993 *Scientific Test Drilling, 1989-1992: Descriptions and Interpretations Pertinent to the Bedrock Geology and Quaternary Hydrogeology of Southwestern Minnesota*. Information Circular 39. Minnesota Geological Survey, University of Minnesota, St. Paul.

Spiess, A. E.
1979 *Reindeer and Caribou Hunters: An Archaeological Study*. Academic Press, New York.

Spiess, A. E., M. L. Curran, and J. R. Grimes
1985 Caribou (*Rangifer tarandus L.*) Bones from New England Paleoindian Sites. *North American Archaeologist* 6(2):145-159.

Stafford, T., Jr., P. E. Hare, L. Currie, A. J. T. Jull, and D. J. Donahue
1990 Accuracy of North American Human Skeleton Ages. *Quaternary Research* 34:11-21.

Stanford, D. J.
1999 Paleoindian Archaeology and Late Pleistocene Environments in the Plains and Southwestern United States. In *Ice Age People of North America: Environments, Origins, and Adaptations*, edited by R. Bonnichsen and K. L. Turnmire, pp. 281-339. Center for the Study of the First Americans, Oregon State University Press, Corvallis.

2008 A View of the Short Clovis Chronology from the Far Eastern Plains Periphery. Paper presented at the 66th Annual Plains Anthropological Conference, Laramie, Wyoming.

Stanford, D. J., R. Bonnichsen, B. Meggers, and D. G. Steele
2005 Paleoamerican Origins: Models, Evidence, and Future Directions. In *Paleoamerican Origins: Beyond Clovis*, edited by R. Bonnichsen, B. T. Lepper, D. Stanford, and M. R. Waters, pp. 313-353. Center for the Study of the First Americans. Texas A&M University Press, College Station.

Stanford, D. J., and B. A. Bradley
2002 Ocean Trails and Prairie Paths? Thoughts about Clovis Origins. In *The First Americans: The Pleistocene Colonization of the New World*, edited by N. G. Jablonski, pp. 255-271. California Academy of Sciences, San Francisco.

Stanford, D. J., and R. W. Graham
1985 Archaeological Investigations of the Selby and Dutton Mammoth Kill Sites, Yuma, Colorado. *National Geographic Society Research Reports* 19:519-541.

Steele, D. G., and J. F. Powell
1994 Paleobiological Evidence of the Peopling of the Americas: A Morphometric View. In *Method and Theory for Investigating the Peopling of the Americas*, edited by R. Bonnichsen and D. G. Steele, pp. 141-164. Center for the Study of the First Americans, Oregon State University, Corvallis.

Steinbring, J.
1974 Preceramic Archaeology of Northern Minnesota. In *Aspects of Upper Great Lakes Anthropology*, edited by E. Johnson, pp. 64-73. Prehistoric Archaeology Series No. 11. Minnesota Historical Society, St. Paul.

Storck, P. L.
2004 *Journey to the Ice Age: Discovering an Ancient World*. Royal Ontario Museum and the University of British Columbia Press, Vancouver.

Trow, T.
1978 Field Notes: Cottonwood River Survey, Brown and Redwood Counties, Minnesota. On file, Minnesota Historical Society, State Historic Preservation Office, St. Paul, Minnesota.

Trow, T. (continued)
1979 *The Prehistory of Brown and Redwood Counties: An Archaeological Survey of the Cottonwood River*. Minnesota Historical Society, State Historic Preservation Office, St. Paul, Minnesota.

University of Iowa, Office of the State Archaeologist
2005 *LANDMASS (Landscape Model for Archaeological Site Suitability)*. Office of the State Archaeologist, University of Iowa, Iowa City. Electronic document, http://www2.uiowa.edu/landmass/index.htm, accessed December 16, 2010.

Upham, W.
2001 *Minnesota Place Names: A Geographical Encyclopedia*. 3rd ed. Minnesota Historical Society Press, St. Paul.

Van Zant, K. L.
1979 Late Glacial and Postglacial Pollen and Plant Macrofossils from Lake West Okoboji, Northwestern Iowa. *Quaternary Research* 12:358-380.

Vermeer, A.
2005 *Phase I Archaeological Survey for the Silver Creek Sanitary Sewer Sub-Trunkline Project, Rochester, Olmsted County, Minnesota*. Project No. 04-36. The 106 Group, LTD., St. Paul, Minnesota. Submitted to the City of Rochester, Minnesota.

Vernon, R., S. Queripel, and M. Budak
1979 *A Cultural Resource Survey for the Minnesota Department of Natural Resources*. Archaeology Department, Minnesota Historical Society, St. Paul.

Waters, M. R., and T. W. Stafford, Jr.
2007 Redefining the Age of Clovis: Implications for the Peopling of the Americas. *Science* 315:1,122-1,126.

Watts, W. A., and R. C. Bright
1968 Pollen, Seed, and Mollusk Analysis of a Sediment Core from Pickerel Lake, Northeastern South Dakota. *Geological Society of America Bulletin* 79:855-876.

Watts, W. A., and T. C. Winter
1966 Plant Macrofossils from Kirchner Marsh, Minnesota – A Paleoecological Study. *Geological Society of America Bulletin* 77:1,339-1,360.

Wheat, J. B.
1972 *The Olsen-Chubbuck Site: A Paleo-Indian Bison Kill*. Society for American Archaeology Memoir 26.

Wheatley, D. W., and M. Gillings
2002 *Spatial Technology and Archaeology: The Archaeological Applications of GIS*. Taylor Francis, London.

Whitley, T. G.
2003 Causality and Cross-Purposes in Archaeological Predictive Modeling. Paper presented at the Computer Applications in Archaeology Conference, Vienna, Austria, April 8-12, 2003. Electronic document, http://www.brockington.org/research/papers/Whitley-2003-Causality.pdf, accessed March 2, 2011.

Widga, C.
2006 Bison, Bogs and Big Bluestem: The Subsistence Ecology of Middle Holocene Hunter-Gatherers in the Eastern Great Plains. Unpublished Ph.D. dissertation, University of Kansas, Lawrence.

Wilford, L. A.
1960 The First Minnesotans. In *Minnesota Heritage*, edited by L. M. Brings, pp. 40-79. T. S. Denison, Minneapolis.

Williams, E. G., and J. L. Hofman
2010 Folsom Evidence in Nebraska. *Current Research in the Pleistocene* 27:145-147.

Williams, J. W., B. N. Shuman, and T. Webb, III
2001 Dissimilarity Analyses of Late-Quaternary Vegetation and Climate in Eastern North America. *Ecology* 82:3,346-3,362.

Wilmsen, E. N., and F. H. H. Roberts, Jr.
1978 *Lindenmeier, 1934-1974: Concluding Report on Investigations*. Smithsonian Contributions to Anthropology 24. Washington, D.C.

Withrow, R. W., and R. L. Rodell
1984 *Archaeological Investigations in Southeastern Minnesota: The 1984 Root River Survey*. Reports of Investigations No. 29. Mississippi Valley Archaeology Center, University of Wisconsin, La Crosse.

Wormington, H. M.
1957 *Ancient Man in North America*. Denver Museum of Natural History Popular Series No. 4.

Wright, H. E., Jr., C. L. Matsch, and E. J. Cushing
1973 Superior and Des Moines Lobes. *Geological Society of America Memoir* 136:153-185.

Wright, H. E., Jr., and I. Stefanova
2004 Plant Trash in the Basal Sediments of Glacial Lakes. *Acta Palaeobotanica* 44:141-146.

Wright, H. E., Jr., T. C. Winter, and H. L. Patten
1963 Two Pollen Diagrams from Southeastern Minnesota: Problems in the Regional Late-Glacial and Postglacial Vegetational History. *Geological Society of America Bulletin* 74:1,371-1,396.