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A COMPARISON OF PLANO COMPLEXES

BY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Comparison of Plano Complexes", submitted by Thomas G. Arnold in partial fulfillment of the requirements for the degree of Master of Arts.

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ABSTRACT

Three Early Prehistoric (Plano) period complexes located on the the northeastern edge of the Plains are compared. The three complexes are the Lakehead, in northwestern Ontario; the Caribou Lake, in southeastern Manitoba; and the Beverly Unit of the Agate Basin complex, in Keewatin District, N.W.T.. These complexes have been considered relate to each other as well as to earlier Plains Plano complexes.

These relationships were based principally on projectile point morphology. Based on the postulate that the entire lithic tool assemblages shall better reflect degrees of cultural relatedness I compared five tool groups from these three complexes using Cluster and Discriminant Function analyses on both metric and non-metric variable data. In order to get a glimpse of wider geographical and temporal relationships I also compared the projectile points from the Agate Basin site in Wyoming, and the Wasden site in Idaho with the points from Lakehead, Caribou Lake, and the Beverly Unit.

The results indicate that there is little similarity in the tool types between Lakehead, Caribou Lake and Grant Lake, suggesting that these complexes are not related. In the wider geographical and temporal sense the Beverly Unit

and Wasden site materials are considered to be the derive from the earlier Agate Basin complex; however, Caribou Lake and Lakehead are not related to this earlier complex.

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This thesis is dedicated to my parents and family in return for all the financial and moral support they have given me in the last three years.

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CHAPTER ONE

INTRODUCTION

The prelimanary nature of this study has nothing to do with the newness of the data, since some of them have been around for at least 30 years. Instead it has to do with the fact that as of this study no detailed comparison of the material has been undertaken. Researchers have tended to make wide ranging synchronic and diachronic cultural affilations based on projectile point morphology. It now seemed possible to test these cultural relationships statistically by using a wide range of tool types in the comparison.

The assemblages in question are from three Plano complexes located in Canada along the northeastern and eastern edge of the Plains (Figure 1). They are the Beverly Unit of the Agate Basin complex, represented by the Grant Lake site, the Caribou Lake complex in southeastern Manitoba, and the Lakehead complex in northwestern Ontario (Figure 1). References in the literature suggest that cultural similarities exist among these three complexes as well as with complexes from the Plains of similar or older age (Wright 1976:78; Steinbring and Buchner 1980:25,27,29;

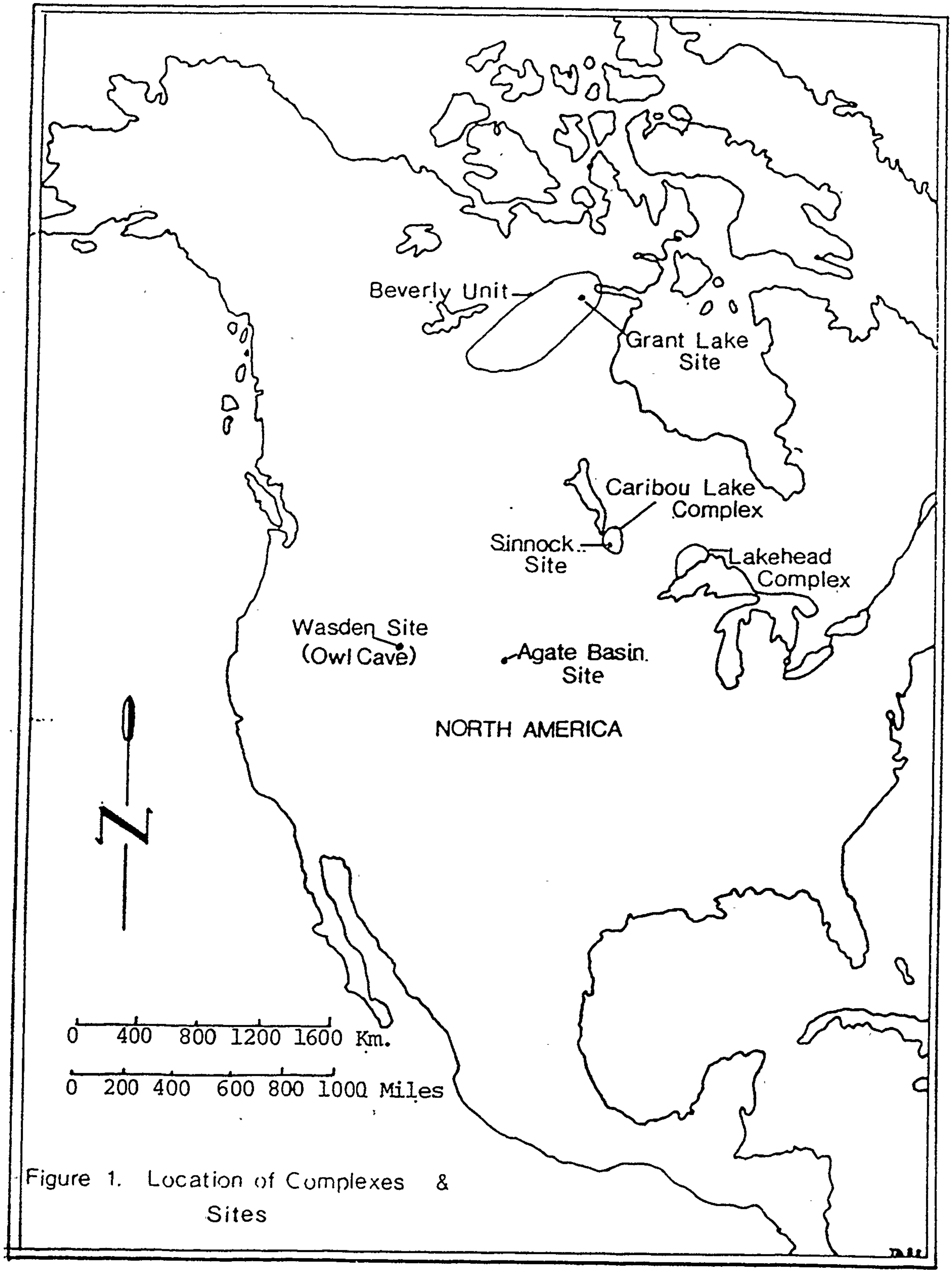


Figure 1. Location of Complexes & Sites

Buchner 1981:81-99; MacNeish 1952:28-29; Fox 1975:44; Reid 1980:34; Buchner 1978:3-4; Dawson 1983:25-26; Pettipas and Buchner 1983:439,443; Buchner 1984:89-100). These similarities have been based on projectile point morphology alone.

The term complex is here defined as a group of traits (tools) that are associated with each other through time and that show stylistic differences from other such groups (Fagan 1981:526; Winick 1977:127; Bray and Trump 1975:62-63). It is this temporal association of a group of tools over space that would seem to define different archaeological cultures from one another. In this study I have accepted previous researchers statements that the data in question does belong to complexes.

The term Plano has generally come to refer to any complex with lanceolate projectile points, usually with parrallel flaking, starting with Agate Basin and lasting into post-Altithermal times that are associated with big game hunting. These types have included San Jon, Meserve, Milnsand, Browns Valley, Portales, Angostura, Agate Basin, Hanna, Duncan, Midland, Hell Gap, Cascade, Plainview, Scottsbluff and Eden points (Jennings 1974:109). Not all researchers, however, have included this many types under Plano (Willey 1966:44). Originally defined for the Plains area the term Plano has taken on broader geographical and temporal dimensions as the point list above and the discovery of Plano-like points were found outside the Plains (Mason 1962:227-278; MacNeish 1959a:11-12; 1959b:47). (For a developmental review of the usage of the term Plano see Pettipas 1982:46-51.) The complexes being compared here would all seem to fit into the general description of Plano except that they are not all on the Plains. In each case they post date the Folsom complex and they were big game hunters (Wright 1976:94-95; Buchner 1984:1Ø1-1Ø6; Fox 1975:32). The only missing trait trait is the "occasional appearance of the flat milling stones" (Jennings 1974:112) that differentiated Plano from the preceding fluted point complexes.

Based on the assumption that cultural similarities will be reflected in the lithic artifacts, the purpose of the study is to compare statistically the lithic artifact assemblages to see if close similarities do exist among these three Plano complexes. If such similarities do exist then it can be inferred that a close cultural association exists that may reflect a common ancestor. Likewise, a comparison using projectile points from two sites, one on the Plains and one in the Intermontane region, (Agate Basin site in Wyoming and the Wasden (Owl Cave) site in Idaho) will provide useful constrasts. The Agate Basin site points provide the temporal comparison of complexes and the

Wasden site a spatial synchronic comparison with a complex described as generalized Late Plano (Butler 1978:67).

The methodology of this study involves the comparison of metric and non-metric variables on the different tool groups in the assemblages of the three complexes. The comparisons were done using the Discriminant Function analysis in the Statistical Package for the Social Sciences (SPSS), level 9 (Nie et al 1975; Hull and Nie 1981) and the Clustan Cluster analysis (Wishart 1978) on the Honeywell Multics DPS 8 computer system at the University of Calgary.

RESEARCH

The gathering of the data involved acquiring, on a six month loan, the Grant Lake site lithic artifacts from the Archaeological Survey of Canada. From this collection 415 separate artifacts in 21 different tool groups were identified, measured, and recorded on file cards. Of these only five types, totalling 317 artifacts , had enough artifacts to allow for comparison with tool groups from the other complexes.

The data obtained on the Lakehead and Caribou Lake complexes were gathered by travelling to where these collections were stored. The Caribou Lake material is housed in Winnipeg, Manitoba, at the Department of

Anthropology, University of Winnipeg and at the offices of the Ministry of Culture and Historical Resources at Fort Osborne. During the visits I recorded data on the five specific tool groups that offered the greatest possibility of comparison with materials from the other complexes. This concentration on certain tool groups was possible since by this second trip I had finished my analysis of the Grant Lake site material and had also made one trip to study the Lakehead artifacts in Thunder Bay. This gave me some idea of which tool categories offered the greatest potential for comparison among the three complexes. In all 225 artifacts were recored on file cards, of which 167 were used in the comparison.

As with the Caribou Lake complex material I made two trips to Thunder Bay, Ontario to gather data on the Lakehead complex. Almost the entire time during both visits was spent at the office of the Ministry of Citizenship and Culture. Small amounts of time were also spent at Lakehead University doing analysis on material stored there. During these visits I recorded data on artifacts in the five specific tool groups used in this comparison. This was possible for the same reasons mentioned above in my recording of Caribou Lake complex material. Four of the artifacts, three of which were used in the final analysis, were not measured directly by me but were taken from an article published by Reid (1980) because they were in a private collection and were not readily available. Any difference between my measurements and those published by Reid (1980:36) are due to the effects of converting my measurements from Reid`s illustrations to full size. In total 176 artifacts were recorded on file cards from the Lakehead complex; 150 of these artifacts were used in the analysis.

Because of the intensive study with each of thesee two collections and the size of the data set available I feel that the samples are diagnostic to these two complexes. In the case of the Caribou Lake complex all of the non-diagnostics, those artifacts that show little or no stylistic variation through time and space, were taken from the Sinnock site and except for the endscrapers all complete artifacts of a particular tool group were recorded. Also, all diagnostic artifacts, those types of artifacts that do show stylistic variation through time and space, from the Sinnock site were recorded. Additional material was obtained from the collections at the Department of Anthropology, University of Winnipeg that had been previously identified as belonging to the Caribou Lake complex.

In Thunder Bay the non-diagnostics were obtained only from sites designated as having Lakehead complex material and thought by reseachers as probably belonging to it. This does not rule out the possibility of a mixture from later complexes in the area, but for this study I shall accept them as being Lakehead complex material. As a matter of fact most of these artifacts come from the Catherine site (DjJh-11). Most of the diagnostic artifacts of the Lakehead complex that were available in the area around Thunder Bay were brought to the Ministry`s office by the staff for study. Thus, I feel confident that the samples obtained are quite characteristic of these two complexes, at least as they are presently defined.

The need to provide at least a glimpse of a wider cultural relationship provided the impetus to travel to Laramie, Wyoming and Pocatello, Idaho. At Laramie I recorded data on 39 projectile points (20 complete and 19 fragmentary) from the Agate Basin level of the Agate Basin type site. This was important since some of the material from the three Plano complexes under study, especially the material from the Grant Lake site, have been identified as Agate Basin. In Pocatello I recorded a total of 20 fragmentary or complete projectile points from the Wasden site (Owl Cave), a late Plano period kill site in southern Idaho. These points have also been variously described as Agate Basin (Miller and Dort 1978:137) or generalized Late Plano (Butler 1878:78).

This study has provided a necessary detailed regional assemblage comparison of several Plano period complexes and with complexes farther afield. The results, as noted above should be considered preliminary since this is the first detailed study comparing these complexes, and future field work will no doubt provide more information for such comparisons. Although I gathered no raw data on the environment and the human adaptation to it, a summary and comparison based on the extant literature is provided for each complex. Such a review will provide the background information on the environment.

CHAPTER TWO

THE PLANO COMPLEXES AND THEIR ENVIRONMENT

This chapter provides a summarized account of the extant knowledge of the regional environment and the sites in each of the complexes. It includes: physical location and environs of the site, excavation data, and the dates of the sites and the complexes. It will locate the complexes in terms of time, space and environs and review the present knowledge and definitions of the complexes.

THE BEVERLY UNIT

The Beverly Unit of the Agate Basin complex is the term given by Dr. J. V. Wright to describe the regional variant of the Agate Basin material he found in the Keewatin District of the Northwest Territories. It was based principally on his excavation of the Grant Lake site (KkLn-2) and other material collected in the region (Figure 2)(Wright 1976:94). In comparing the Grant Lake site assemblage with that of the Agate Basin site Wright noted that "The only artifact category present at Agate Basin but absent from the Grant Lake site are blades struck from prepared blade cores, whereas chithos, adzes, wedges, saws,

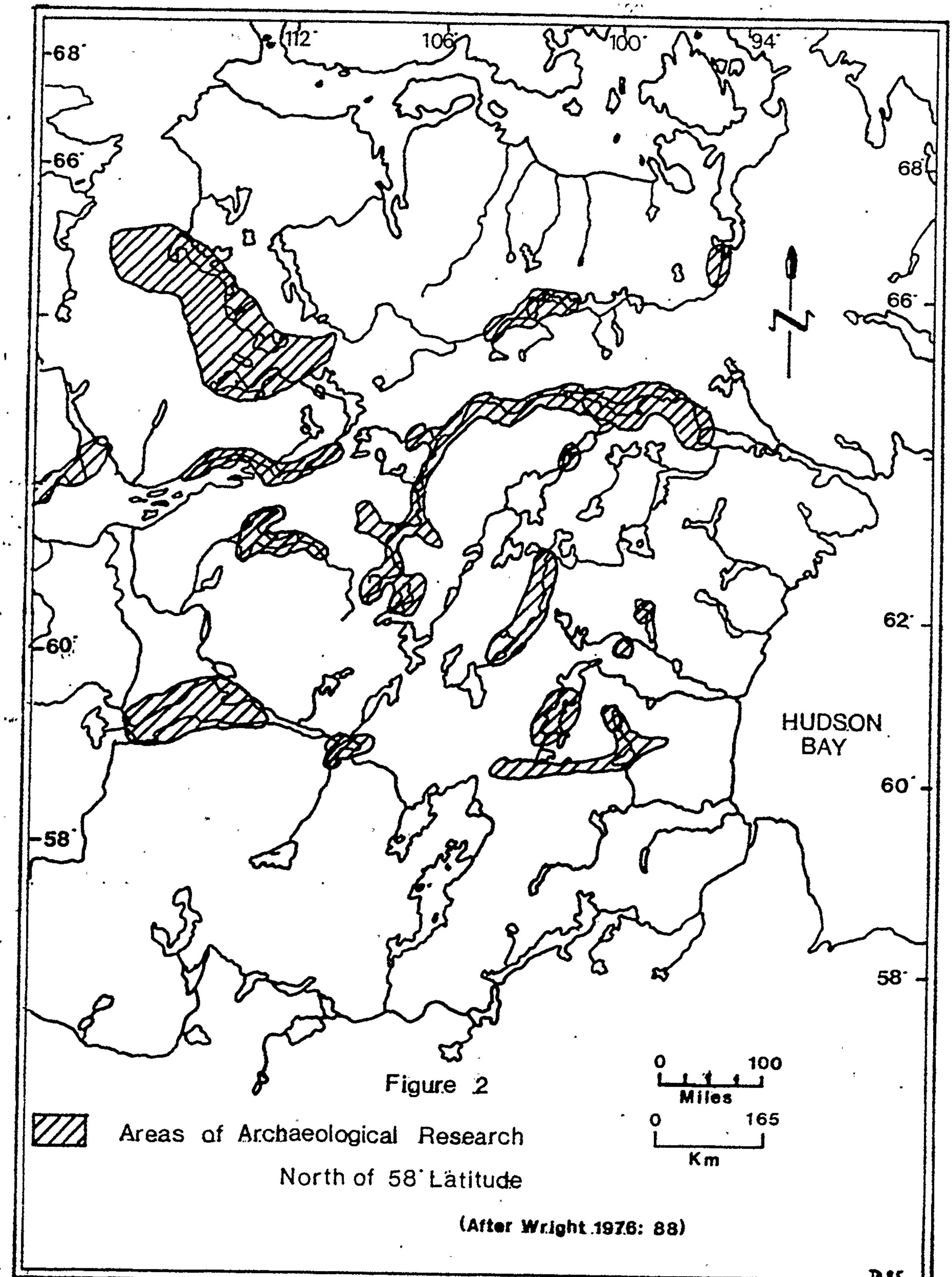


Figure 2

Areas of Archaeological Research

North of 58° Latitude

(After Wright 1976: 88)

linear flakes, gravers-on-a-point and a scraper knife are restricted to the Grant Lake site." (Wright 1976:79). Wright also noted, when comparing projectile points from Agate Basin and and Grant Lake that they were close "in terms of both form and metrical attributes. Major differences are the absence of bi-pointed forms from Grant Lake...."(Wright 1976:80).

The people of this complex, according to Wright, moved into the barrenlands area between 7000 B.C. and 6000 B.C. to exploit the caribou herds (Wright 1976:91). Wright feels that the Agate Basin people "moved to the northwest between mid-July to mid-August to exploit the caribou resources around the calving grounds and then drifted to the southwest as the herds shifted into the wintering grounds in southeastern Mackenzie District and adjacent northern Saskatchewan" (Wright 1976:85)(Figure 3). Thus, establishing a pattern of exploitation that apparently survived into the historic period (Gordon 1975:70-72,90-92,94-95; Jenness 1982:386).

The only detailed excavation of a site belonging to the Beverly Unit is the Grant Lake site (I shall use these names interchangeably) excavated by Wright (1976). It site is situated at the northeast end of Grant Lake where the latter narrows to become the Dubawnt River again (Figure 3). The site is partially surrounded by

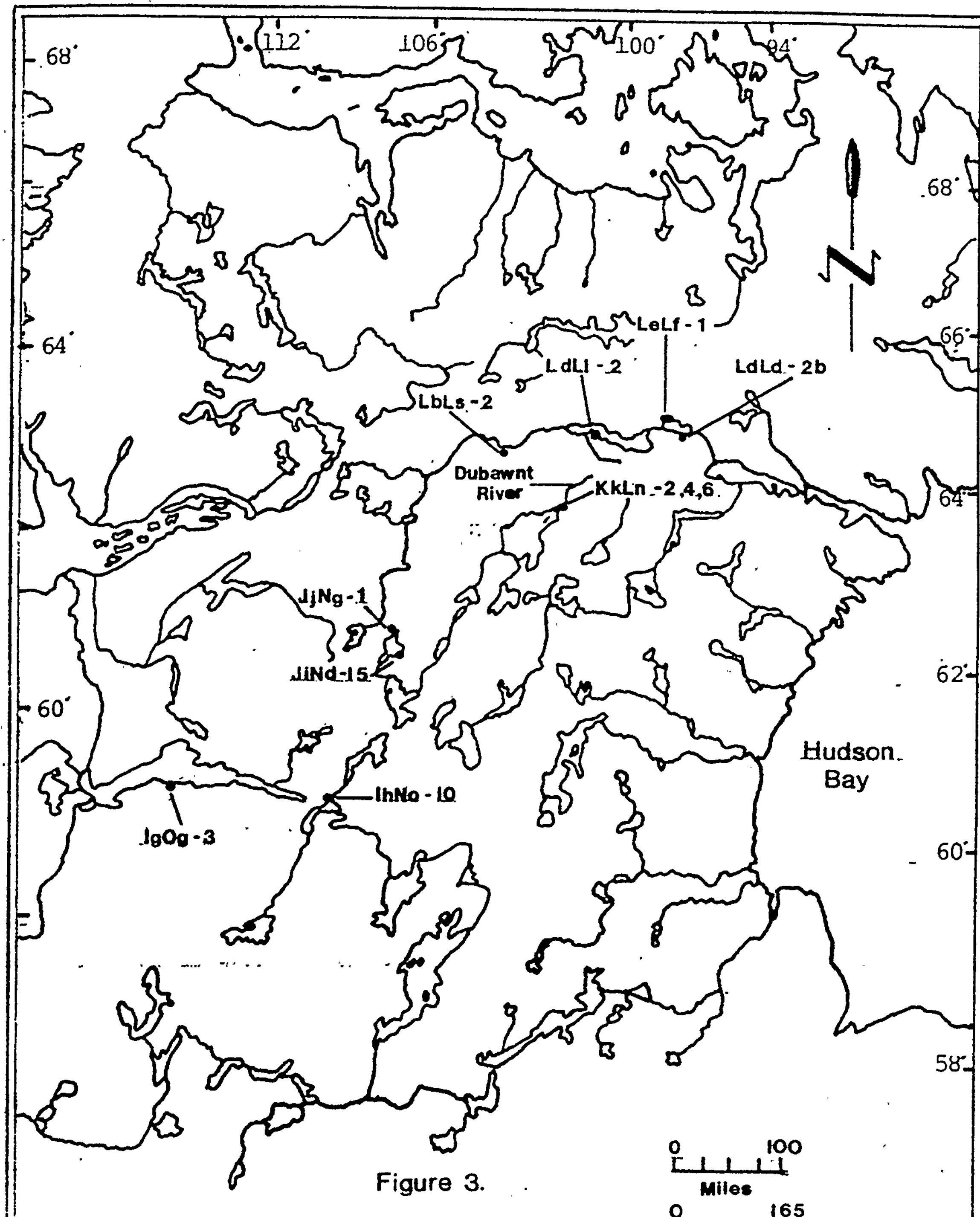


Figure 3.

Sites Producing Beverly Unit

Projectile Points North of 58° Latitude

(After Wright 1976: 87)

eskers that provide protection from the wind and possibly provide cover for the stalking of game (Wright 1976:1).

This site was originally discovered by the Moffat canoe party in 1955 with subsequent visits by Dr. Elmer Harp (1961), Dr W. N. Irving (1968), and Dr. J. V Wright who excavated the site in 1973. The latter of the three descibed the site in the following mannner: "Sporadic concentrations of cultural debris occur in a band approximately 30 feet wide and 400 feet long hugging the foot of a relatively flat plateau that rises from 5 to 6 feet above the occupation area" (Wright 1976:1).

Wright's excavation consisted of digging six, 20 foot squares and 2 trenches. Trench I was 60 feet by 5 feet while Trench II was 20 feet by 10 feet. From these excavations Wright identified five features consisting of a scatter of weight stones. In four of these scatters hearth features were indentified. He interpreted this combination of weight stones and hearths as evidence of tent floors (Wright 1976:8-25). Throughout the site Wright found that "Cultural material occurred from the surface down to varying depths but generally no more than 3 inches in loose sand and rested on sterile sand or a black organic layer" (Wright 1976:1). The latter, which consisted of as many as four separate layers were interpreted as a number of "plant floors that were periodically capped by thin lenses of sand" (Wright 1976:6), and according to Wright were only partially covered with sand when humans first occupied the site.

Wright interpreted the Grant Lake site as a habitation site situated at a intercept migrating herds of caribou as they crossed the river during their fall migration (Wright 1976:82,85). This was based on pollen profiles taken from the Grant Lake site that indicated an environment similar to present conditions prevailed during the occupation of the site. Wright felt that based on these conditions that "the most reasonable time of occupation was mid-July to mid-August"(Wright 1976:82).

Many other sites in the Keewatin and neighbouring regions have been identified as having Beverly Unit components (Figure 3). These finds, although consisting of single projectile points from each site, all fall in either the calving territory or migration routes of the present day Beverly Caribou herd. The lone exception is the IgOg-3 which is located on the south shore of Lake Athabasca (Wright 1976:85,87).

Wright (1976:75) rejected as belonging to the Beverly Unit of the Agate Basin complex the lanceolate projectile points described by Forbis (1961:112-113) and Noble (1971:104-105) from northcentral Mackenzie District because they lacked controlled collateral flaking. He also rejected projectile points reported by Nash (1975:165) from Manitoba as Agate Basin because they lacked basal and/or lateral grinding, attributes that are common on the Grant Lake site points.

Dating

The radiocarbon dating of the Beverly Unit from the Grant Lake site produced mixed results. These are 75 B.C. ±100 (S-809) on charcoal, 1670 B.C. +105 (S-810) on charcoal, A.D. 435± (S-811) on preoccupation peat from Trench I, and 5,270 B.C. + 850 (S-1056) on a combined sample of carbonized bone from three different squares. This last date is the only one that Wright accepted as pertaining to the occupation of the Grant Lake site by the Agate Basin people (Wright 1976:86).

Further confusing the matter are two radiocarbon dates from the lowest levels of the nearby Migod (KkLn-4) site taken from a test trench dug by Wright in 1973. The lowest sample (stratigraphically) gave an age of 3595 B.C. +120 (S813) while a sample from the layer above this gave an age of 5,980 B.C. ±500 (S-834). A third sample submitted from this trench, to test for a possible label exchange, produced a date of 4,055 B.C. +130 and did not clarify the situation.

The more extensive excavations undertaken by Gordon in 1974 at the Migod site revealed that the lowest level that Wright had encountered the previous year in his test trench was discontinous over the site. Gordon could not, therefore, help resolve the conflicting radiocarbon dates from both Migod and Grant Lake (Gordon 1976:48; Wright 1976:86-89).

Despite these problems with the dating most researchers have accepted the antiquity and Dr. Wright's interpretation that the Grant Lake site and other material from the area represent a regional variation of the Agate Basin complex, and that these people migrated into the area after deglaciation sometime between 7000 B.C. and 5000 B.C. to exploit the caribou herds.

CARIBOU LAKE COMPLEX

The first evidence of the Caribou Lake complex came from the 10,000 piece collection of artifacts of amateur archaeologist, Mr. H. Iwatcha of Winnipeg. Iwatcha had recorded finds from 22 different sites, and later surveys by the University of Winnipeg located 52 sites pertaining to th Caribou Lake complex (Steinbring and Buchner 1980:25). Most of these sites were located during the

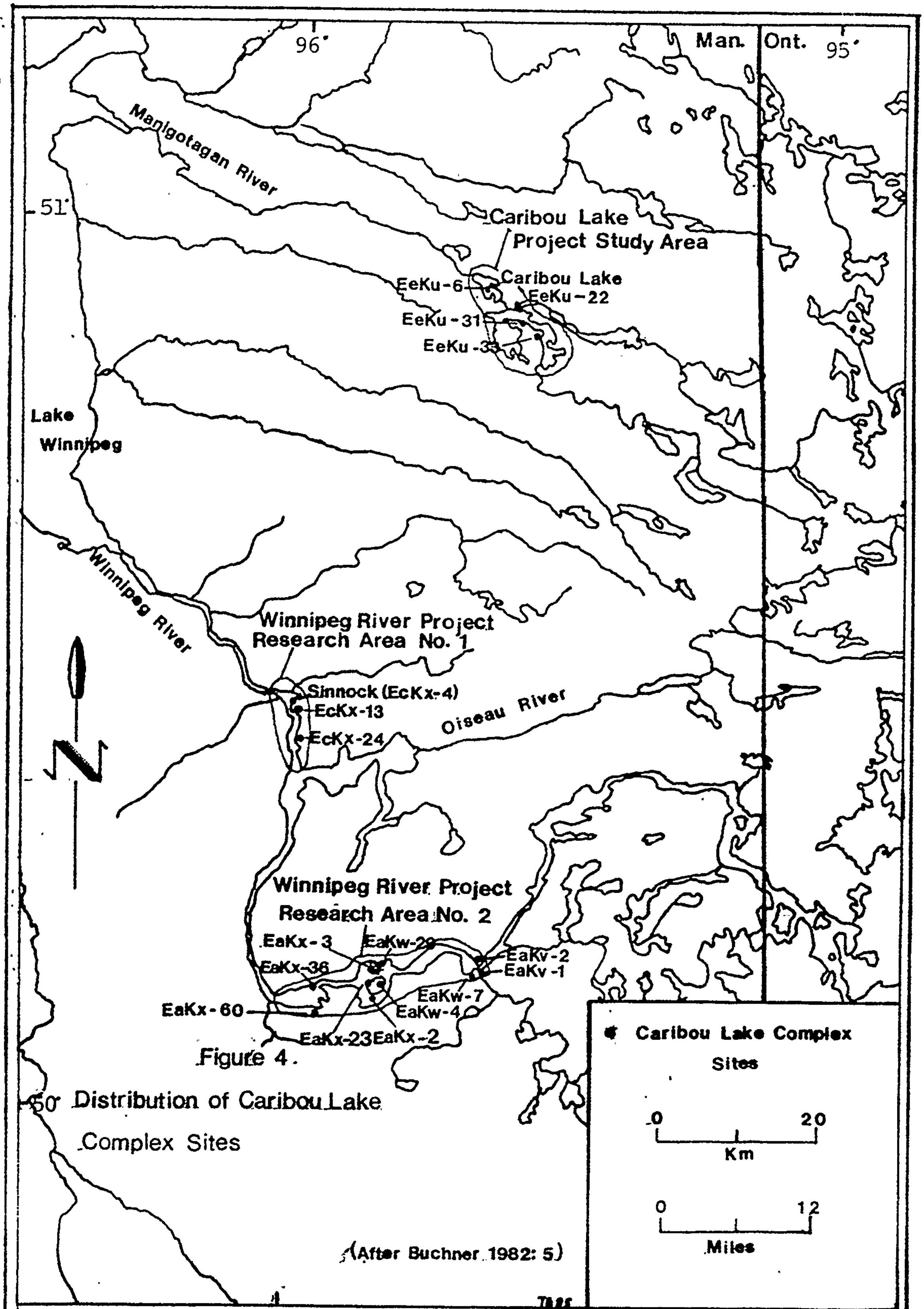


Figure 4. Distribution of Caribou Lake Complex Sites

Caribou Lake Project and were described by Wheeler (1978) and Buchner (1979) (Figure 4). Another 13 sites attributed to the Caribou Lake complex were also found during the Winnipeg River Survey (Buchner 1982:12-13,16,59-60).

In the summer of 1977 Mr. C. J. Wheeler did an assessment of the Caribou-Manigotagen area and increased Iwatcha's site list from 22 to 52, collected nearly 50,000 artifacts, and tested three sites. The following summer the University of Winnipeg continued the survey under the directions of Dr. A. P. Buchner. One site (EeKu-33) had a total of 58, 1x1 metre, 1x2 metre, and 2x2 metre units excavated as well as a 22 foot trench and two, 5 foot units excavated by Iwatcha. These units were excavated in arbitrary levels of 5 to 2.5 centimetres, depending on the depth of deposition and degree of vertical artifactual compaction, and were later correlated with observed natural strata (Buchner 1979:5-9).

The Winnipeg River Archaeological Project consisted of two field seasons (1980 and 1981) in two different locales (Fiqure 4). The first field season dealt with Research Area 1 above the Great Falls Dam and included: a survey for new sites, an assessment of existing sites, and excavation of the Sinnock site.

The excavation of the Sinnock site totalled 102, 1x1 metre units dug in 5 centimetre arbitrary levels with the depth of each artifact measured to the nearest centimetre. A distributional analysis indicated that three areas existed. These were two hide processing areas, indicated by an abundance of scrapers and hide rubbing stones, and a living area, that contained cores, pieces esquilles, chopping tools, flake kives, and denticulates as well as a hearth feature. The existence of the latter was supported by a chemical analysis of the soil that revealed ph levels as being high and phosphate levels as low in the squares with The hearth. The immediately surrounding squares had neutral ph levels and high phosphate levels (Buchner 1981:4,23,58-65; 1984:7Ø).

The second field season consisted of a survey and test or controlled excavation of the area behind the Seven Sisters dam. The second field season resulted in an increase in the number of Borden designated sites from 24 to 13Ø with 7 sites having been controlled excavated and 49 others test excavated. Almost all the sites located during this season had been affected by erosion due to the flooding and confirmed observations made in the first field season (Buchner 1982:11-18).

Site Location

The Caribou Lake complex, as presently defined, is situated in southeastern Manitoba. So far sites or find spots belonging to it (with one exception) have only been found south or east of Lake Winnipeg (with one exception), and tend to be located along the shores and rivers and lakes. In the Caribou-Manigotagen Lake area these tend to occur "on the shores of large bodies of water, or at narrows connecting such bodies....Particularly favoured locations....are the tips of peninsulae which extend to the southeast, south, and southwest" (Steinbring and Buchner 1980:31). These areas, it is assumed, could have provided year round protection from the wind, from insects during the summer, and allow the maximum use of the sun during the winter (Steinbring and Buchner 1980:25).

Steinbring and Buchner (1980:26) have suggested that such site locations indicated a use "of various micro-environments within the Boreal Forest throughout the year" by the Caribou Lake complex people, as opposed to a seasonal round. From the larger lake and riverbank camps, moose hunting and fishing took place in the summer. During the winter, however, moose hunting, the trapping of small animals, and caribou hunting are thought to have occurred. and caribou hunting occurred during the winter.

With the discovery of the Caribou Lake complex sites along the Winnipeg River, Buchner and Pettipas (Buchner 1980:104; Pettitpas and Buchner 1983:447) have suggested that the Sinnock site, and other Winnipeg River sites, represented an intermediate stage in terms of both age and adaptation from a purely Plains habitat to a Boreal Forest environment in the Caribou-Manigotagan Lakes area. In other words, the Caribou Lake complex sites from the latter area were the temporal descendents of the people who intercepted bison at the Sinnock, and related sites, on the Winnipeg River, but who had by now totally adapted to the Boreal Forest.

I would suggest, however, that the data shows that the Caribou Lake complex people did in fact have a seasonal round. The raw material from which most of The Sinnock site lithics were made are obtainable from the area around the Winepigon and Orsua river system, that includes the Caribou and Manigotagen lakes. These resources were probably most accessible during the spring or summer months. During the autumn the Caribou Lake people intercepted bison herds as the animals crossed the Winnipeg River to find shelter along the edge of the Boreal Forest for the winter (Buchner 1984:96,102,104).

Buchner has interpreted the sites in Research Area 2 as being the earliest evidence of Plano period peoples entering the area from the grasslands to the south and west. This is based on the lack of trihedral adzes (to be discussed further below) at any of the sites or in any of the collections from this area. The absence of this a key element of the Caribou Lake complex seems to be most logically explained by the hypothesis that the people were new to the surroundings and had not as yet adapted to them (Buchner 1984:87-88). This is presuming that there were trees or activities that needed adzes.

This temporal differentiation between these various groupings of Caribou Lake complex sites is, however, demonstrated since only the Sinnock site has been radiocarbon dated (discussed below). Thus, it seems to me that the different areas could still be interpreted as parts of a seasonal round with the Caribou-Manigotagen river sites being winter/spring and the Winnipeg River sites being autumn camps. It is also possible that these people spent part of the year, maybe the spring and summer, on the Plains to the west, as indicated by Ebell's find of a Caribou Lake projectile point near St. Norbert, Manitoba (Ebell 1982a:1Ø3; Buchner 1984:1Ø2).

Diagnostic Artifacts

Of the many types of lithic tools found on Caribou Lake sites three tool types are considered diagnostic of the complex. The main diagnostic artifact is a generally percussion flaked lanceolate projectile point that is identified as an Agate Basin variant (Buchner 1979 :3-4). Dr. Robson Bonnischon (Buchner 1979:49 noted that theis emphasis on percussion flaking of projectile points is rare in North America; it has only been found so far in the Akmak Culture in Alaska (Anderson 1968) and from the Sheguiandah site in Ontario (Lee 1957). At the Sinnock site however, the points were initially percussion flaked and then pressured flaked in an irregular pattern over both surfaces. Other characteristics of the points are a greatest width above the mid-point, a basal edge ranging from slightly concave to slightly convex, and in some instances basal and lateral grinding (Buchner 1979:22; 1982:83).

The second tool type that is diagnostic of the Caribou Lake complex are the refined bifaces. These bifaces come in a variety of forms including quadralateral, bipointed , lunate, semi-lunate, ovoid, and lanceolate. Although such forms are found in later cultures in the area, the Caribou Lake complex materials are at least three times the size of the later forms and are thus distinctive (Steinbring and Buchner 1980:27-29). These bifaces are generally assumed to be knives used in the butchering of animals. Experimentation using such forms for butchering has supported this interpretation (Frison 1978:166).

The final diagnostic tool type of this complex is the trihedral adze. The trihedral adze was originally defined by Fox (1977) and assigned to the Early Shield Archaic

Tradition in the Thunder Bay area (Fox 1977:5). Good archaeological context from the Sinnock site, however, shows that the trihedral adze was part of the Caribou Lake complex (Buchner 1984:35,67). Also, one complete and several fragmentary specimens were found at the Grant Lake site and are considered by Wright to be part of the Beverly Unit assemblages.

The resolution of this debate about the age of the trihedral adze must await further research. It should be noted that researchers in the Thunder Bay area still maintain an Early Shield Archaic association for the adzes in that area. No adzes have been found, as yet, on single component Palaeo-Indian sites (Ross personal communications 1983). If this fact remains unchanged then it seems that the Palaeo-Indian inhabitants of the Thunder Bay area had a tool kit that did not include the trihedral adze, and that the latter was either adopted later or developed in situ during the Early Shield Archaic period.

The trihedral adze, as the name suggests, has a triangular transverse cross section that was produced by percussion flaking on the ventral and dorsal surfaces. The bit end usually shows evidence of use, either in the form of striations or polish. Buchner noted that differences in size, bit end shape, and wear pattern suggest slightly different but overlapping functions for the adzes of the

Caribou Lake complex. He suggested that the functions ranged from quarrying activities, to wood working, to use as a mattock for digging in frozen earth (Buchner 1981: 49; 1984:35-41).

Dating

Due to the poor preservation of carbon samples for radiometric dating the age of the Caribou Lake complex was originally based on the geological positioning of the material. This positioning indicated that the complex was younger than the 7000 B.C. lacustrine clay upon which the artifacts sat, and older than the 3000 B.C. Oxbow Phase material that overlay them in the stratified sites. Based on these data and on the typological data, which described the projectile points as an Agate Basin variety, an estimated age of between 6000 B.C. and 4400 B.C. was proposed (Buchner 1979:28; 1981:67-68). A recent radiocarbon date on bone from the Sinnock site gave an uncalibrated date of 6080 B.C. + (OXA 116). Two other samples produced unacceptable dates of modern (OXA 150) on humus and 2345 B.C. +90 (Beta 4868) on a mixed sample (Buchner personal communication 1984; Buchner 1984:46). The first date supports the estimated age from the geological and typological data.

THE LAKEHEAD COMPLEX

Although not defined the Lakehead complex until 1975 (Fox 1975), material now considered part of this complex was first unearthed by MacNeish (1952) from the Brohm site (DdJe-1) in 1950. The Lakehead complex is located in and around the city of Thunder Bay, in northwestern Ontario (Figure 5), in an area that lay between glacial lakes Agassiz to the west, and Minong to the east, and the receding Wisconsin Glacier, to the north.

The original definition of the Lakehead complex came from sites located on the Lake Minong beach ridges (such as Brohm and Cummins), and thus emphasized the littoral aspects of the economy of these Plano people. Many of these sites are located near outcrops of jasper taconite an important lithic resource used by the inhabitants; thus, indicating that this is one reason why they located their sites where they did.

The Cummins site (DcJi-1) is the largest of these quarry/habitation sites and has been estimated to be as large as 200 acres (80.9 hectares). It is located west of Thunder Bay and is approximately 50.3 metres above, and 9.6 kilometres west of the present lake shore in the Kaministikwia River Valley (Figure 5). Test excavations were done in 1963 under a joint survey and excavation

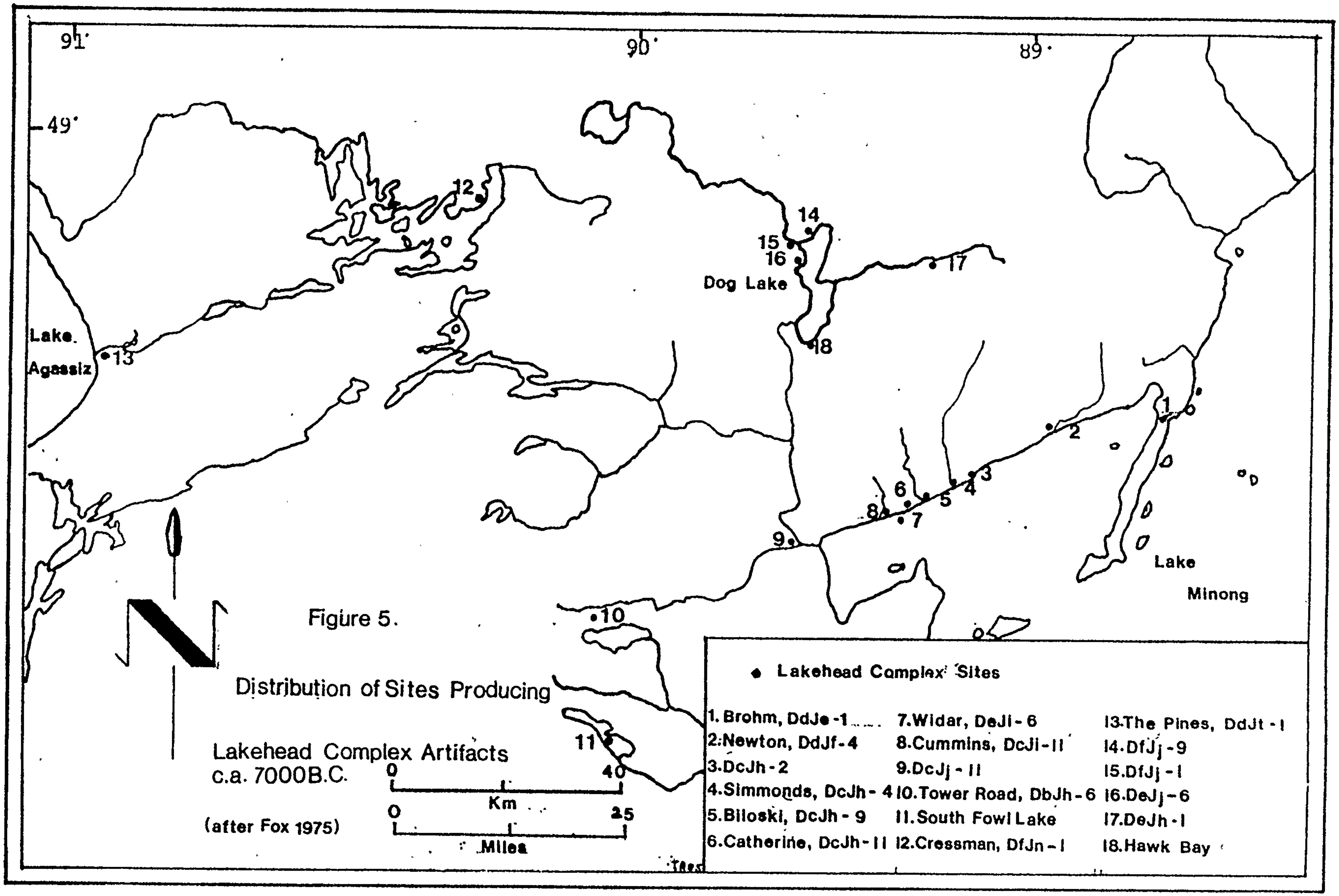


Figure 5.

Distribution of Sites Producing Lakehead Complex Artifacts c.a. 7000B.C.

(after Fox 1975)

program between Lakehead University and the Archaeological Survey of Canada. The excavations consisted of five test trenches. Trenches I and V each contained features interpreted as hearths; the latter also revealed two other features interpreted as caches or storage pits (Dawson 1983:8). All five trenches produced lithic tools and debitage.

The remains of a disturbed cremation burial were discovered in a sandblowout on the eastern side of a nearby jasper taconite outcrop, and was radio carbon date to 6530 B.C. ±390 (Dawson 1983:8). The material culture recovered from the site, its location near both a small swamp, and a jasper taconite outcrop all lead researchers to construe the site as a combined quarry and habitation site (Dawson 1983:23).

The only other site that has had controlled excavations is the Simmonds site (DcJh-4). The site is an estimated 1600 square metres, of which Dawson dug nine, 2 metre squares in 5 centimetre arbitrary levels. He uncovered, what has been described elsewhere (Fox 1975:34), as four circular or oval activity areas in Level II that were evident by a dense lithic debitage distribution (Dawson 1973:12-14).

The site is situated in the Kaministikwia River Valley on the west bank of Current River near the Cummins site.

This site is considered by Dawson to be an outcamp of the latter, and that its postioning, at what was then the mouth of the river, suggested it was used to intercept caribou crossing the river (Dawson 1973:9).

The other major site belonging to the Lakehead complex that has been excavated is the Brohm site (DdJe-1) dug by MacNeish (1952). The site is located on what once was the isthmus at the northern end of a pennisula (presently the Sibly Pennisula). MacNeish excavated 22 five foot squares, the stratigraphy of which, generally consisted of "a 6 inch humus layer overlaying a layer of beach pebbles and sand which contained artifacts or chips in the uppermost 9 inches" (MacNeish 1952:25).

The Brohm site yielded 82 artifacts or fragments along with hundreds of flakes. The most distinctive class or artifacts were the projectile points described by MacNeish as Plainview. Most of the material was made from jasper taconite, an outcrop of which, is located about 1/2 mile (1 kilometre) from the site (MacNeish 1952:35).

Later researchers have described the location of the Brohm site as being "strategically located with regards to the interception of migrating caribou herds" (Fox 1975:33). Unfortunately, no faunal remains have been recovered from a Lakehead complex context to confirm this hypothissis.

Interior Sites

Very little is known about the interior sites, since few have had any controlled excavations done on them. These interior sites (so called because they lie inland from the sites located on the beaches on the large glacial lakes) tend to be situated along the shores of smaller interior lakes and rivers and display some of the same locational characteristics as the sites along the Minong beach ridges.

For example the Rocky Point (DeJj-6) and Narrows (DaJn-7) sites, in the Dog Lake/Arrow River vicinity are both located adjacent to areas of good fishing, attested to by the multi-component natures of the sites, and also would have been warm season game crossings (Fox 1977:33-44) similar to the Brohm and Simmonds sties. The Tower Road site (DdJm-6) and Vieux Point site (DaJt-15) on Knife Lake were quarry or quarry/habitation site similar to Cummins. The Tower Road site, more specifically, is located near an interior outcrop of the same taconite bearing Gunflint formation that the Cummins and other Minong beach ridge sites are near. The Vieux Point site on the other hand is located near an outcrop of Knife Lake siltstone. Tools manufactured from this latter material have been found on the Brohm, Cummins, Rocky Point, South Fowel Lake II, DaJn-7, Cressman (DfJn-1), the Pines (DdJt-1), and the

Sturgeon Sand Spit (DcJv-1) sites. This distribution, ranging from the shores of Lake Minong in the east to the shores of Lake Agassiz in the west, was interpreted by Fox (1977:6,11) as more likely due to social interactions between Palaeo-Indian bands than to the seasonal round of one band.

Settlement Pattern

Fox notes that the settlement pattern of the Lakehead complex paralleled that of later cultures in the area except that it was influenced by important outcrops of lithic raw material(Fox 1977:34). Probably, the declining glacial lake water levels forced later cultures farther and farther away from these outcrops in order to continue their littoral based economy, thus, causing a split in the Lakehead complex's dual site function of quarry/habitation sites, such as at Cummins. These later peoples may have compensated by including their quarrying into outcamp activities from the base camp that involved comparatively short term stays at these quarrying areas or by using other lithic sources, such as cobbles or nodules(Dawson 1985:Table 1).

Dating

Except for the C14 date on the cremation burial from the Cummins site that was dated to 6530 B.C. +390 (Dawson 1983:8), and which is assumed to be associated with the Lakehead complex, even though no artifactual material was found with it, no radiocarbon dates are available from any Lakehead complex site. Because of this, attempts at dating have been based on typological and geological data.

The geological data has suggested a date of between 7500 B.C. to 5000 B.C. (Phillips 1982) which are dates given in association with the Lake Minong beach ridges. As noted above, many of the eastern sites of the Lakehead complex (Cummins, Brohm, Catherine, Simmonds, Boulevard Lake, Newton etc) are all located on Minong strandlines which suggested a close correlation beteen the two (Dawson 1983:23; Fox 1975:28-30; 1977:4). Typologically, a similar broad range of ages is indicated. Based completely on projectile point types and their appearance in neighbouring areas, a date of from 8000 B.C. to 4000 B.C. is suggested. Fox (1975:44) notes possible relationships with the Reservoir Lake phase in Minnisota and the Flambeau and Minoqua phases in Wisconsin (also see Steinbring 1974:67; Salzer:1974:43-45). The range of projectile point types discovered and assigned to the Lakehead complex is greater than that noted for either the Beverly Unit or the Caribou

Lake complex. The types noted are Plainview, Agate Basin, Minoqua, Scottsbluff Type I as well as large Triangular and general Lanceolate forms (MacNeish 1952:28-30; Fox 1975:41,44; Ross 1979:21-32; Reid 1980:35; Dawson 1983:8-9). So on both geological and typological data the Lakehead complex is rather broadly bracketed between 7500 B.C. and 4000 B.C..

THE WASDEN SITE: OWL CAVE

The Wasden site consists of three adjacent large lava overhangs designated Coyote, Dry Cat, and Owl caves that were formed by the collapse of the lava tube roofs. They are located on the Eastern Snake River Plain in Bonneville County, Idaho. Of the three caves only Owl Cave has had extensive excavations done on it (Butler 1978:65-67; Miller and Dort 1978:131; Miller 1983:39).

Owl Cave is a multicomponent site that was first used by Folsom big game hunters. This occupation has been radiocarbon dated to between 10,850 and 7785 B.C.. (Miller 1983:41; 1978:131; Butler 1978:59-61). Above this Folsom layer is a level dated to about 6000 B.C. that is of primary interest to this study. Between these two major levels there was only a scatter of material "such as isolated projectile points, lithic debris, broken and burned animal bones, and fine divided charcoal" (Miller 1978:131) that indicated only occasional use of the cave.

The 6000 B.C. level consisted of an extensive layer of bison bone, that has been interpreted as a bison pound and/or fall (Butler 1978:67; Miller 1979:137). The quantity of bone recovered suggested that a total of 150 bison had been killed and butchered on at least two separate occasions. The presence of many animals from all age groups, including fetal bones, suggested a late winter/early spring kill (Butler 1978:66; Miller 1978:137). The lithic material recovered from this bone layer consisted of complete and fragmentary projectile points that have been variously described as Agate Basin (Miller 1978:137) or reworked Birch Creek points and generalized Late Plano (Butler 1978:67).

THE AGATE BASIN/BREWSTER SITE

The Agate Basin site is situated in extreme eastern Wyoming (Figure 1) in Moss Agate Arroyo, a small usually dry tributary of the Cheyenne River. It was originally found in 1916 by William H. Spencer when he noticed a number of artifacts eroding out of the banks of the arroyo. In 1942 Dr. Frank Roberts test excavated a portion of the site discovering 32 points, several scrapers, and knife fragments. Since this area was loacally called Agate Basin, Roberts christened the points Agate Basin (Roberts 1962:125-1269.

Agate Basin points are described as: medium to large unstemmed lanceolate points with slightly convex sides, flat lenticular in longitudinal cross-section and lenticular to diamond shape in trasverse cross section. Basal edges range from concave to straight to convex with lateral edge grinding running 1/4 to 1/2 the length of the point. The points usually have horizontal parallel flaking with the lateral edges minutely retouched. The basal edges are thinned by removal of longitudinal flakes and are ground. Occasionally oblique parallel scars occur in association with horizontal parallel scars (Frison 1978:159; Agogino, Rovner, and Irwin-Williams 1964:141; Irwin 1967:228-229).

Since the initial excavations by Roberts, several different researchers have dug at the site (Agogino 1958, Roberts 1961, Frison 1975-1976), and have confirmed the existence of two or more components, one Folsom and at least one Agate Basin (Frison 1978:5Ø; Roberts 1962:9Ø-91).

The Agate Basin site and complex have been dated by Frison (1978:25,32) and Irwin (1967:99) to greater than 8ØØØ B.C.; however, some radiocarbon dates for Agate Basin levels at other sites on the Plains do date later than 8ØØØ

B.C. (Frison 1978 24-26); whether or not later complexes with similarly shaped projectile points are temporal variants of the earlier Agate Basin complex is unclear, though Irwin (1967:1Ø5-1Ø8) has suggested not, based on technological considerations.

As with the Wasden site, the Agate Basin site was a pound into which the bison were driven, killed, and butchered. In this case however, the bison were corraled into a box-canyon-like feature or knickpoint. Frison (1978:15Ø) feels that about 1Ø-2Ø bison were driven into the arroyo at any one time and killed. From estimates of the age of the bison at their time of death, Frison has suggested that the bison were killed in the late winter/early spring.

SUMMARY

The data presented above have suggested that both broad interregional similarites as well as specific regional differences existed among the complexes under study. Apart from the common attribute of lanceolate projectile points, four of the collections in question all date to roughly the same time period (bracketed between 75ØØ B.C. and 5ØØØ B.C.). The only exceptions are the Agate Basin dates dicussed above. Some researchers, however, have suggested that the Agate Basin complex people moved north following the retreating glacier, eventually adapting to a Boreal Forest environment. In this way they spread their lithic tool kit over a large area, which may account for the temporal lag between the Agate Basin complex site dates on the Plains and those of the more northerly and later complexes (Ebell 1982:96-103; Buchner 1981:98,104; Pettipas and Buchner 1983:446-447).

Economy

The economy of these complexes suggests a hunting and gathering seasonal round based on the interception of large ungulate herds. In the case of the Beverly Unit and Lakehead complex this is assumed to be herds of caribou. For the Caribou Lake complex, the Wasden site, and the Agate Basin site bison were for at least part of the year. In three of the areas evidence has suggested that the people intercepted these herd animals in the late summer/early autumn as the herds forded major river systems on their migration to the protection of the Boreal Forest for the winter. The Grant Lake site, the Sinnock site, and the Brohm site are all considered to be ideal locations for intercepting these migrating herds. The two other sites (Agate Basin and Owl Cave) were both bison pounds used during the late winter/early spring. In each of these complexes the actual details of the seasonal round are still very speculative.

The difference in herd animal exploited by these different complexes is explained as a result of Boreal Forest adaption of former Plains bison hunters (Buchner 1981:98; Ebell 1982:96-103). Wright counters this hypothesis with the following:

> ...that the northern unit or units of the Agate Basin complex may have developed out of an earlier complex that also concentrated their predation on the caribou herds and that groups such as the Beverly Unit were not simply bison hunters that decided caribou were both tastier and less dangerous than bison. At 10,000 B.C. for example, when the continental glacier covered all of the prairie provinces except for the southern portions, what were the calving, migration and wintering ranges of the caribou herds, and who was preying upon this presumably rich source.
> (Wright 1976:95)

A similar arguement has been put forward by McLeod (1982:112-113). The resolution of this debate is beyond the scope of this study and can only be resolved through future research in these areas.

Other economic activities are derived principally on the bases of site location, and have suggested a strong littoral aspect to the Lakehead and probably the Caribou Lake complex. There is little such data available for the Beverly Unit, although, Wright does note one site on the southern shore of Lake Athabasca that may correspond to a lacustrine aspect of the complexes to the southeast. The lack of such evidence for the Beverly Unit may be simply due to a visiblity problem resulting from a concentration on surveys in the calving grounds.

Site Location

The one major difference in site location between these complexes involves the combined quarry/habitation aspect of the Lakehead complex sites. The sites were usually located both to take advantage of local important lithic material outcrops (of the Gunflint Formation and Knife Lake Siltstone) as well as to exploit lacustrine and caribou resources. This was in part due to regional geologic and environmental factors since later cultures followed similar economic activities, however, the later sites were progressively farther away from these lithic outcrops as the water level fell in the post-glacial lakes. No comparable data exists indicating a similar pattern from either the Beverly Unit, or Caribou Lake complex.

Artifacts

Finally, the wide variety of seemingly contemporaneous projectile points noted above in the Lakehead complex is not found in the other areas. The reasons for this variation are only speculative: whether this variation is a reflection of successive waves of migration into the area over time, a possiblity considering the temporal positioning of point types from the Plains (Irwin 1967:86-113,221-237; Frison 1978:27-40), or whether it reflects several generally contemporaneous migrations from different cultural areas into a newly accessible frontier area, a possiblity considering the range of variation from any one site (Dawson 1983:8-11; MacNeish 1952:28-30; Ross 1979:21-32; McLeod 1982:113), must again wait further research. Similar multi-cultural influences have been proposed for neighbouring complexes in Minnesota (Steinbring 1974:65-67) and Wisconsin (Mason 1974:204-205; Salzer:43-45).

Conclusions

As the data summarized above should indicate any conclusions must remain either very speculative or generalized and not very profound. In keeping with the latter it would seem that around 6000 B.C. there is a series of late Plano period cultures inhabiting the recently deglaciated areas. These cultures hunted herds of large ungulates, either caribou or bison, with lanceolate projectile points that are identified as Agate Basin or other Plains late Palaeo-Indian point types; hunting was by pounding or at interceptions points in the animals migration routes. These cultures may be transitional Plains cultures developing into a Boreal Forest adapted culture.

THE ENVIRONMENT

During the time period under study the environment was changing as the final remnants of the Wisconsin glaciation disappeared. This deglaciation opened up previously uninhabitatd portions of the continent that were quickly (relatively speaking) populated by plants, animals, and humans. This section will review and compare the data on post-glacial environments in the three main study areas: Keewatin District in the Northwest Territories, southeastern Manitoba, and northwestern Ontario.

Keewatin District

Prest (1970:Figures xii-15) estimated that the final remanent of the Keewatin ice sheet disappeared from the Keewatin District about 5000 B.C.. Wright however, feels that this date is too late since he brackets the occupation of this area by Agate Basin people to between 6000 B.C. and 7000 B.C.. Deglaciation must have then occurred earlier to allow for this occupation (Wright 1976:89-91).

Using a pollen profile taken from a soil sample from the Grant Lake site, Wright postulates a relatively warm dry period during the site's occupation. This is evidenced by the increase in arboreal pollen species of spruce and pine (Picea and Pinus), and by grasses and herbs such as Gramineae and Caryopyllinceae. A radiocarbon date from the preoccupation level gave a reading of A.D. 435 +85 (S-811) which Wright rejected (Wright 1976:84).

Southeastern Manitoba

The data from southeastern Manitoba has also suggested a warmer and drier climate during Caribou Lake complex times. This climatic warm period is known by several names such as the Atlantic Climatic Episode or the Altithermal and is dated to between 6500 B.C. to 1050 B.C. (Ritchie 1983:167-168). This warming trend raised the mean summer temperature to about 17 C between 6000 B.C. and 4500 B.C. causing an expansion of prairie type environment into southeastern Manitoba. At around 6500 B.C. pollen diagrams have suggested an open pine savannah that consisted of pine (Pinus), grasses (Gramineae), and goosefoot (Chenopodinae); this was followed by a mixed deciduous woodland and praire environment that consisted of poplar (Populus), oak (Quercus), birch (Betula), and ash (Fraxinus) (Ritchie 1983:168; Buchner 1982:110; Pettipas and Buchner

1983:438-439; Buchner 1981:69,72-75) as well as grasses (Gramineae), ragweed (Ambrosia), and wormwood (Artemisia). Such an environment would have provided both food and shelter for the bison that were hunted by the Caribou Lake complex peoples at sites such as Sinnock (Buchner 1984:78-80).

Northwestern Ontario

The area occupied by the Lakehead complex first became deglaciated during the Early Moorhead Phase of Lake Agassiz (about 8750 B.C.) and Early Lake Minong in the Superior Basin. This area was greatly reduced in size by about 7850 B.C. because of the readvance of the Superior and Rainy Lobes that raised Lake Agassiz water levels to the Campbell level again (this caused the Emerson Phase in Lake Agassiz and the Marquette Phase in the Superior Basin were Early Lake Minong was reduced in size). This effectively eliminated human occupation in the immediate Thunder Bay area since it was probably underneath the Superior Lobe (Clayton 1983:301).

By at least 7000 B.C., and probably as early as 7500 B.C., this area was again free of ice and habitable (Clayton 1983:300-303; Drexler et al 1983:317; Prest 1970:721). A lone C14 date on wood from a convergence of the Lowest Lake Minong and highest Post-Minong beach ridges has given a date of 7430 +150 B.C. (GSC-287) (Zoltai 1965:268).

The vegetation cover during this time period is hypothesized by Fox as "spruce dominant cover with lesser amounts of jack pine, white birch, larch and balsam fir" (1977:5). This seems to be supported by pollen profiles done on lakes to the east of Thunder Bay along the north shore of Lake Superior (Saarnisto 1974:323-328) which showed a spruce dominated forest cover till about 7000 B.C. . This forest was replaced by birch in northwestern Ontario, thus indicating a possibly cooler and wetter climate (Buchner 1980:85; Saarnisto 1974:336). Other authors, such as McLeod (1982:107-108), have suggested a more variable hodgepodge forest was typical for what would later become the Boreal Forest of northwestern Ontario. In any event, the area occupied by the Lakehead complex was habitable at least by 7000 B.C. and maybe as early as 7500 B.C..

Summary

These brief environmental summaries indicate that the occupation of the Keewatin District and southeastern Manitoba occurred during the warm dry Altighermal that marked the beginning of the Holocene. By about 6500 B.C. climatic conditions were milder than present, probably producing a pine savannah type environment in both areas (if we accept Wright's assertion of an earlier date for deglaciation in Keewatin). In southeastern Manitoba this was followed, by about 6000 B.C., by an expansion of the grassland and a replacing of pine trees by deciduous species (Buchner 1981:72-75; Pettipas and Buchner 1983:437-440). This enlarged grassland area provided ample food for herds of ungulates to feed upon in both areas.

Northwestern Ontario, however, during the early period of human occupation around 7500 B.C., was dominated by a spruce forest and was probably cooler and wetter than at present. Starting at about 7000 B.C. and lasting to between 6000 B.C. to 5500 B.C. a birch/pine forest predominated, after which the modern pine forest appeared (Saarnisto 1974:328; 1975:303). Data from Hayes Lake to the west of Thunder Bay has indicated a slightly earlier sequence for these events with the spruce forest being replaced by the pine/birch forest sometime around 8800 B.C.; this may be due to the earlier deglaciation of the area (McAndrews 1982:44).

The evidence has suggested that while the areas to the west and north, involving the Beverly Unit and Caribou Lake complexes, were becoming warmer and drier during the Altithermal, the environment of the Lakehead complex in northwestern Ontario remained cool and wet until the end of this period (Buchner 1980:85).

CHAPTER THREE

TOOL TYPES

This chapter describes the variables, both metric (measured) and non-metric (non measured), noted for each artifact in the five tool types that were used in the final analysis. More tool types did appear in the complexes but they were not numerous enough to allow for comparison. The attributes used in this study are based in part on B. O. K. Reeves's lithic analysis system (1970) as well as the work of other researchers (Irwin 1967; Irwin and Wormington 1979; Bonnichson 1974; Crabtree 1972; Wilmsen and Roberts 1978). One variable that was noted for each artifact but not reported on the lists below or used in the analysis was the lithic mareria1 type: I felt that this attribute would distort the analysis in that the complexes would in all likelihood use the lithic resources that were regionally available, and considering the distances between the complexes these resources could be quite distinct (i.e. the jasper taconite outcrops in the Lakehead complex area). This would have the effect of differentiating between the complexes. All measurements were determined to the nearest one-twentieth of a millimetre using sliding calipers and all weights were weighed to the closest tenth of a gram.

Also, a binocular microscope with 4 to 16 times magnification was used to help identify the flake scar attributes used in some of the tool groups.

CORES

This category includes both cores and core fragments; the difference between the two being the presence of complete flake scars that could be measured. It should also be noted that the term Blade Core, that appears below, is defined by the presence of a scar that was twice as long as it was wide, and although these were present in the collections they may not represent true blade technology but blade like cores, such as those suggested by Knudson (1983:20-23,84) for other Palaeo-Indian complexes. There were 72 cores or core fragments identified in the collections; 48 of which were complete.

<u>Metric variables</u>(Figure 6)

1. Maximum Length
2. Maximum Width
3. Maximum Thickness
4. Weight
5. Average Flake Scar Width

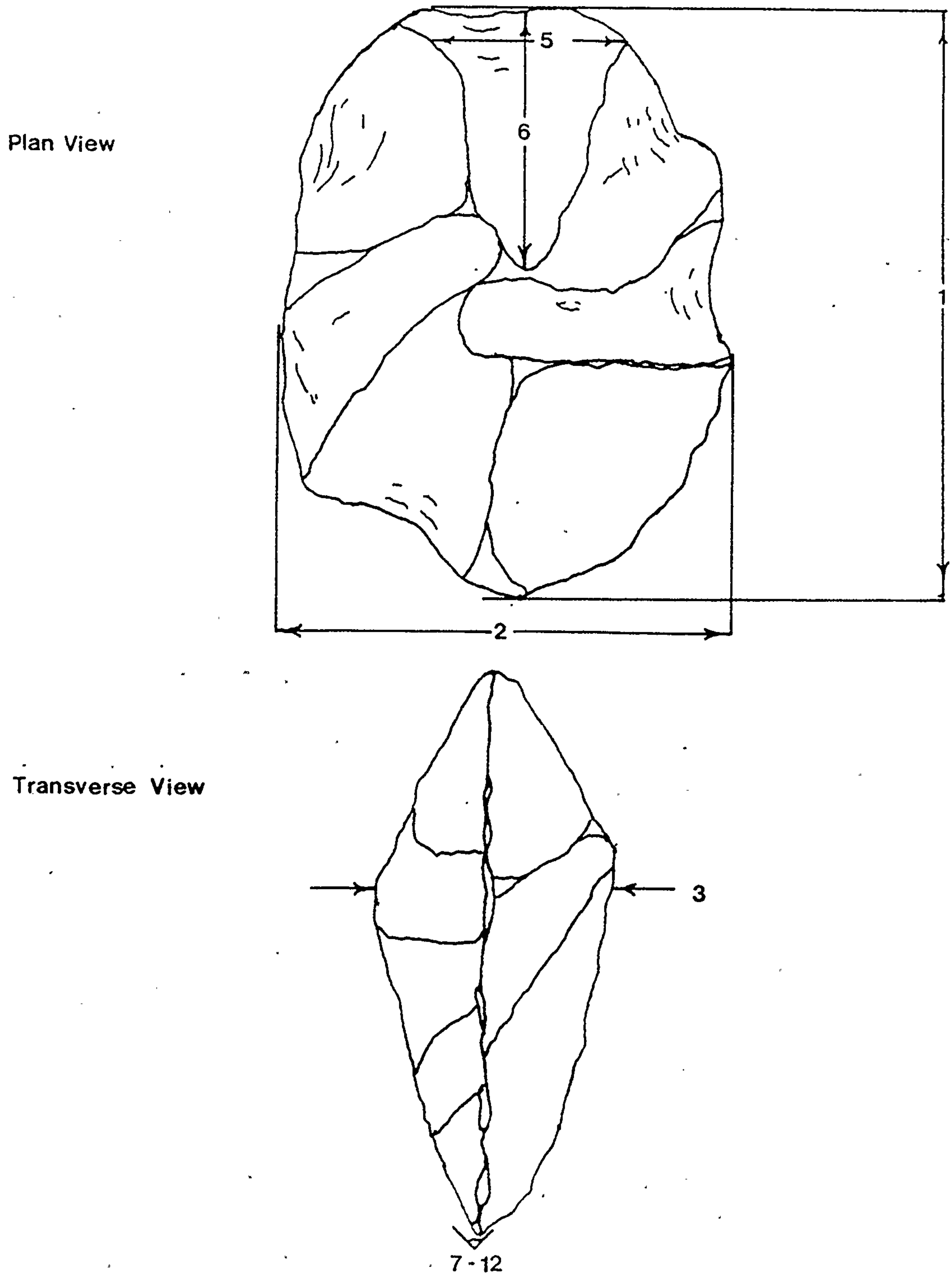


Figure 6. Cores

6. Average Flake Scar Length

7. - 12. Platform Angles (Depends on the number present)

<u>Non Metric variables</u>

Core Type I

1. Prepared Core
2. Unprepared Core

Core Type II

1. Polymorphic Core
2. Double Ended Core
3. Single Ended
4. Split Cobble Core
5. Flake Core
6. Block Core
7. Angular Core
8. Blade Core

EDGE RETOUCHED FLAKES

This tool group is a amalgamation of three small tool groups; side scrapers, denticualtes, and retouched flakes. Artifacts belonging to the category are described as any flake that shows enough extensive lateral edge retouching to be considered a tool. There were 86 such tools identified in the collections; 59 of which were complete.

<u>Metric</u> <u>variables</u>(Figure 7)

spb 2 1. Maximum Length

2. Maximum Width

3. Maximum Thickness

4. Weight

<u>Non</u> <u>Metric</u> <u>variables</u>

Flaking I

1. Edge Retouched Flake Scars
2. Parallel Sided Flake Scars
3. Expanding Flake Scars
4. Mixed Flake Scars (this indicates that a combination of the above three types of flaking.)

Flaking II

1. Broad Flake Scars
2. Thin Flake Scars
3. Moderate Width of Flake Scars
4. Mixed Widths

Flaking III

1. Shallow Flake Scars
2. Moderatly Deep Flake Scars
3. Deep Flake Scars
4. Regular Retouch
5. Irregular Retouch

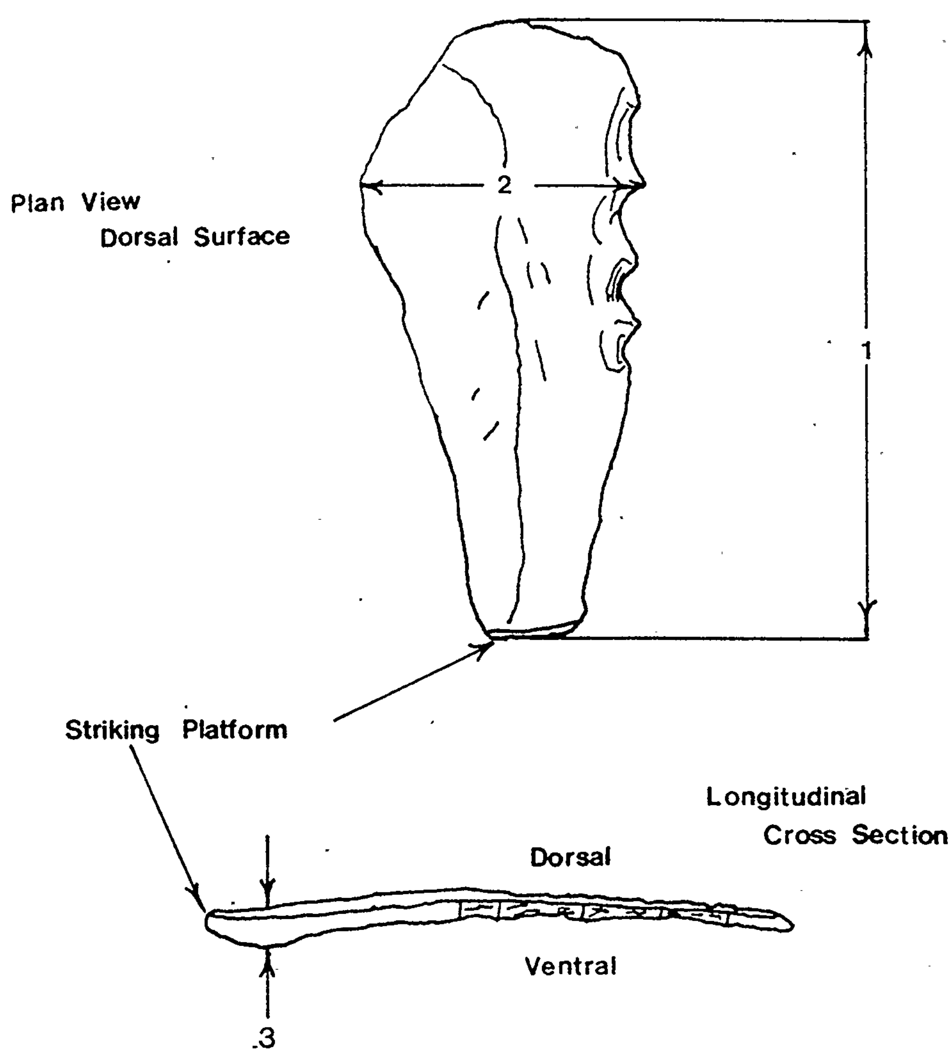


Figure 7. Edge Retouched Flake Tools

6. Mixed Flake Scars

In Flaking III numbers 4 and 5 were only used if edge retouch was present in Flaking I and number 6 was used to indicate a mixture of numbers 1 to 5 were present in Flaking III.

BIFACES

The biface category, like the edge retouched flakes, is a combination of two smaller tool groups that had originally been identified as knives and preforms. The joining of the two groups not only increased the size of the tool category for analysis, but reduced the chance of misidentification of artifacts and some of the functional bias inherent in the tool group names. There were 150 bifaces; 53 of them were complete. In those instances where proximal/distal end determination was difficult (including fragmentary cases) I arbitrarily choose one end as proximal and the other as distal. I generally distinguished between proximal and distal ends by the shape of the end, with the proximal end being blunt and the distal end sharp or pointed. In the attributes below describing the flake scars (Flaking I, Flaking II, Flaking III) the ventral and dorsal surfaces were considered separately for each variable. The term Mixed Flake Scars has the same meaning as in the Edge Retouched Tools; that is, a mixture of the flake scar types of that particular attribute (i.e. Flaking II) are present on the artifact.

Metric variables (Figure 8)

1. Maximum Length
2. Maximum Width
3. Maximum Thickness
4. Weight
5. Distance to Maximum Width from the Proximal End
6. Distance to Maximum Thickness from the Proximal End
7. Proximal End Width

Non Metric variables

Transverse Cross Section

1. Plano Convex Cross Section
2. Flat Lenticular Cross Section
3. Asymmetrical Triangular Cross Section
4. Lenticular Cross Section
5. Bi-Plano Cross Section
6. Asymmetrical Lenticular Cross Section
7. Plano Triangular Cross Section
8. Concave Plano Cross Section
9. Convex Triangular Cross Section
10. Concave Convex Cross Section

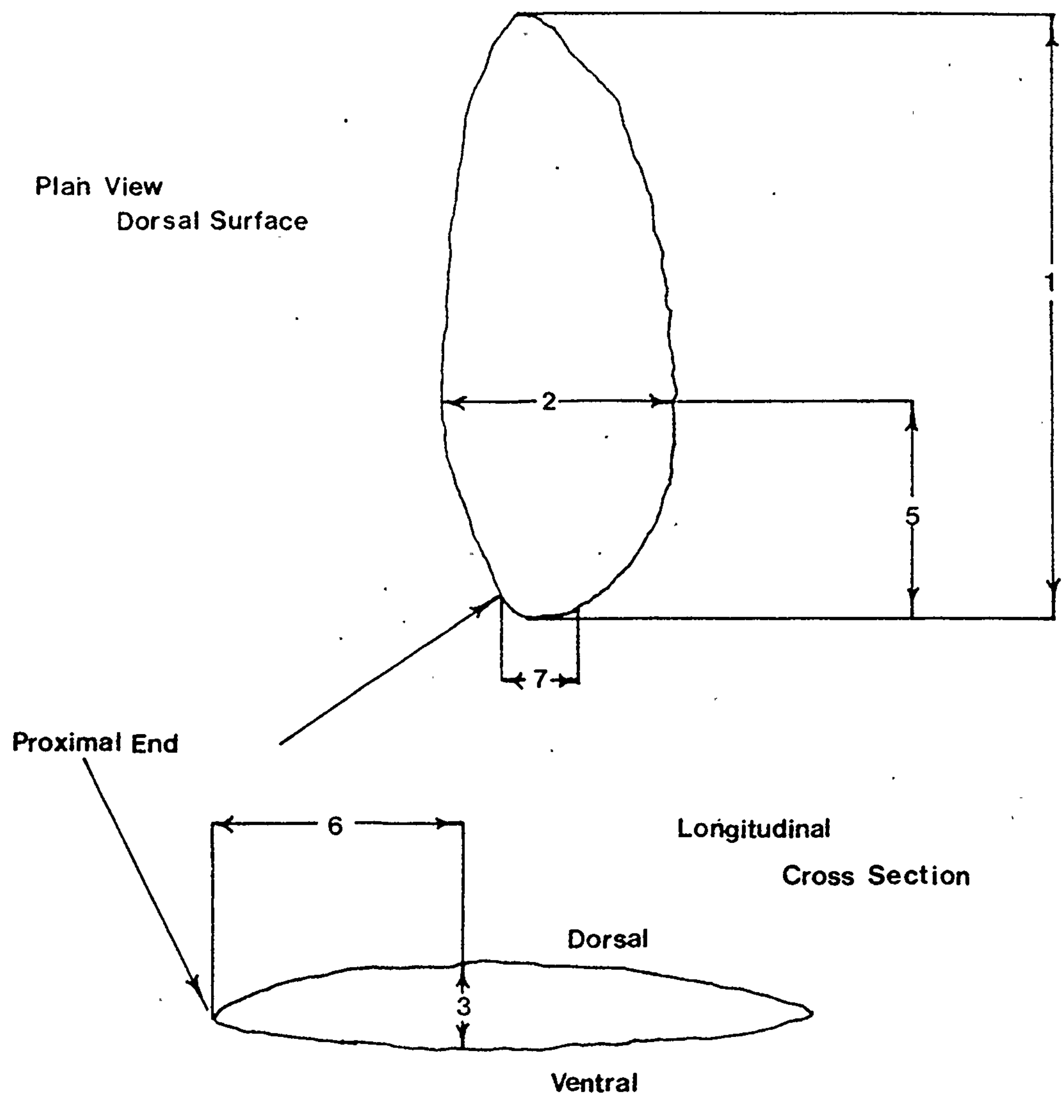


Figure 8. Bifaces

11. Bi-Concave Cross Section
12. Diamond Cross Section
13. Irregular Cross Section

Shape

1. Rectangular
2. Semi-Lunate
3. Ovate
4. Lanceolate
5. Triangular
6. Asymmetrical Lanceolate
7. Bipolar
8. Stemmed Lanceolate

Flaking I (Ventral and Dorsal Surfaces)

1. Edge Retouch Flake Scars
2. Mixed Flake Scars
3. Expanding Flake Scars
4. Parallel Sided Flake Scars
5. No Flake Scars

Flaking II (Ventral and Dorsal Surfaces)

1. Broad Flake Scars
2. Thin Flake Scars
3. Moderate Flake Scars
4. Mixed Flake Scars

Flaking III (Ventral and Dorsal Surfaces)

1. Shallow Flake Scars

2. Deep Flake Scars
3. Moderate Flake Scars
4. Mixed Flake Scar Depths

ENDSCRAPERS

Endscrapers are scraping tools with the scraping edge opposite the bulb of percussion or striking platform of the flake on which it is made or at one end of the longitudinal axis of the flake. They were presumably used for scraping animal hides. There were 1Ø5 artifacts identified as endscrapers in the collections; 8Ø of them were complete. The variables describing the flake scars (Flaking I, Flaking II, and Flaking III) were noted separately for the ventral and dorsal surfaces. The mixed categories of the flake scar attributes (Flaking I, Flaking II, and Flaking III) indicate a mixture of the other categories of these variables.

<u>Metric</u> <u>variables</u>(Figure 9)

1. Maximum Length
2. Maximum Width
3. Maximum Thickness
4. Weight
5. Width of Distal End

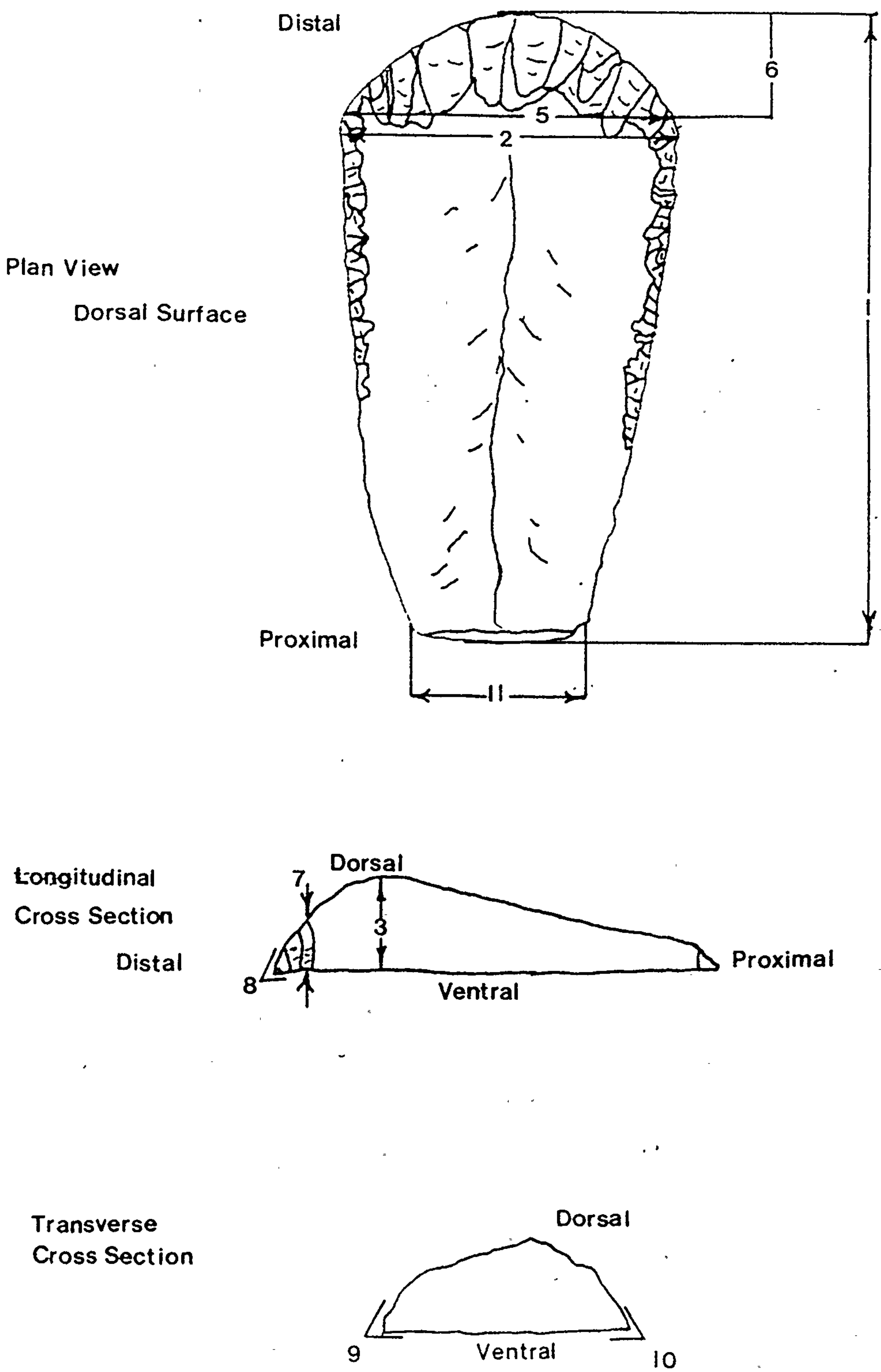


Figure 9. Endscrapers

6. Length of Distal End

7. Thickness of the Distal End

8. Angle of the Distal End (taken in the middle of the edge)

9. Angle of the Left Lateral Edge (taken in the middle of the edge)

1Ø. Angle of the Right Lateral Edge (taken in the middle of the edge)

11. Proximal Width

<u>Non Metric variables</u>

Striking Platform

1. present
2. absent

Flaking I (Ventral and Dorsal Surfaces)

1. Edge Retouch Flake Scars
2. Mixed Flake Scars
3. Expanding Flake Scars
4. Parallel Sided Flake Scars
5. No Flake Scars (This refers to flake scars on either surface excluding those that appear on the scraping edge.)

Flaking II (Ventral and Dorsal Surfaces)

1. Broad Flake Scars
2. Thin Flake Scars

3. Moderate Width Flake Scars

4. Mixed Flake Scars

Flaking III (Ventral and Dorsal Surfaces)

1. Shallow Flake Scars

2. Deep Flake Scars

3. Moderate Depth of Flake Scars

4. Mixed Depth Flake Scars

PROJECTILE POINTS

This category includes all artifacts identified as the tips of either throwing or thrusting spears used for hunting or similar activities. Although these artifacts may have been purposefully made for, and used in hunting they also may have been used for other functions, such as a knife if the sitution required it. Since no use wear analysis was done in this study I have assumed that the basic function of these tools was as projectile points. As in the previous tool types, the term Mixed Flake Scars in the nominal level variables, indicates a mixture of the other kinds of flake scars, noted in that attribute, are present on the artifact.

<u>Metric variables</u>(Figure 10)

1. Maximum Length

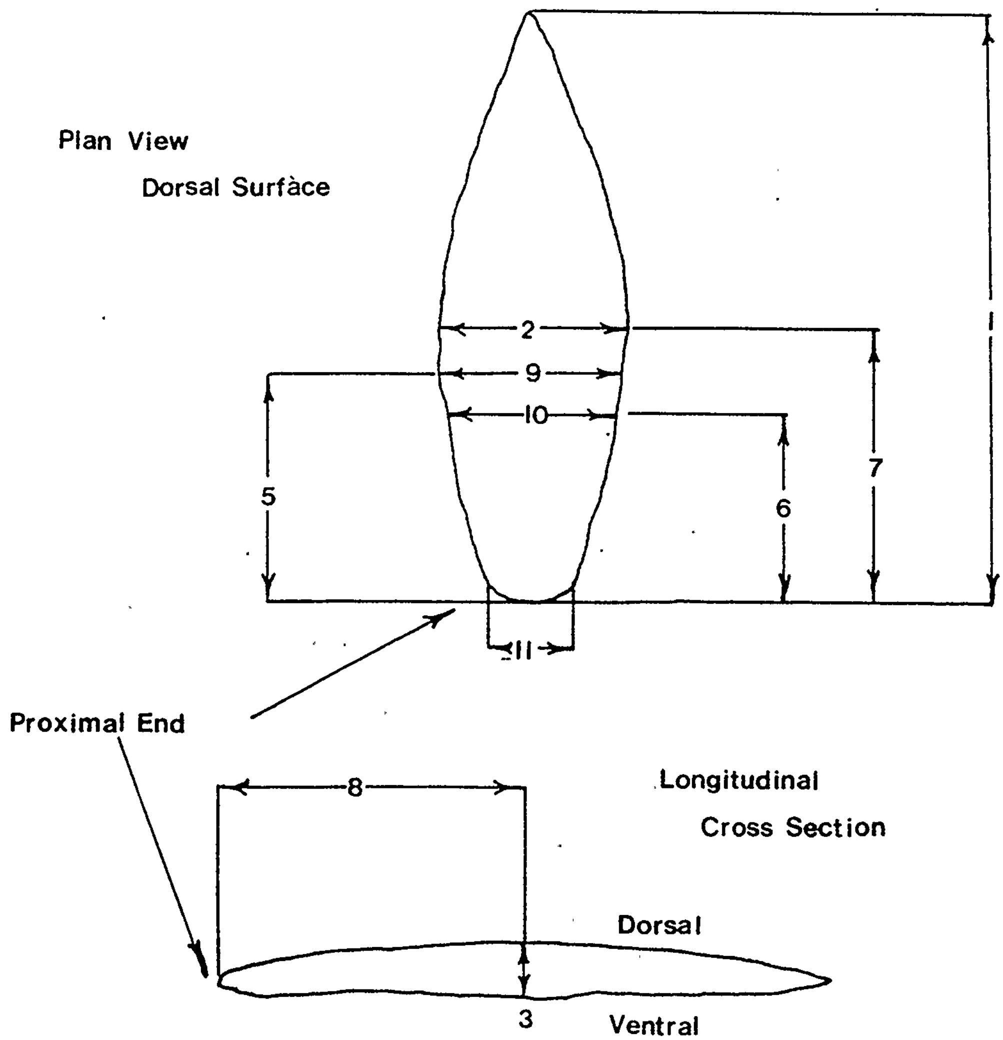


Figure 10. Projectile Points

2. Maximum Width
3. Maximum Thickness
4. Weight
5. Left Haft Element (Defined as the extent of lateral edge grinding)
6. Right Haft Element (Defined as the extent of lateral edge grinding)
7. Distance to Maximum Width from Proximal End
8. Distance to Maximum Thickness from Proximal End
9. Maximum Width of Left Haft Element
10. Maximum Width of Right Haft Element
11. Proximal End Width
12. Number of Basal Thinning Flake Scars (Ventral)
13. Number of Basal Thinning Flake Scars (Dorsal)

<u>Non Metric variables</u>

Basal Edge Shape

1. Straight Edge Shape
2. Concave Edge Shape
3. Convex Edge Shape
4. Irregular Edge Shape

Transverse Cross Section

1. Plano Convex Cross Section
2. Flat Lenticular Cross Section
3. Asymmetrical Triangular Cross Section

4. Lenticular Cross Section
5. Bi-Plano Cross Section
6. Asymmetrical Lenticular Cross Section
7. Plano Triangular Cross Section
8. Concave Plano Cross Section
9. Convex Triangular Cross Section
10. Concave Convex Cross Section
11. Asymmetrical Convex Cross Section
12. Irregular Cross Section
13. Diamond Cross Sectin

Longitudinal Cross Section

1. Plano Convex
2. Flat Lenticular
3. Lenticular
4. Bi-Plano
5. Asymmetrical Lenticular
6. Concave Convex

Edge Retouch (Ventral Surface)

1. Present
2. Absent

Edge Retouch (Dorsal Surface)

1. Present
2. Absent

Flaking I (Ventral and Dorsal Surfaces)

1. Mixed Flake Scars

2. Expanding Flake Scars

3. Parallal Sided Flake Scars

4. No Flake Scars

Flaking II (Ventral and Dorsal Surfaces)

1. Broad Flake Scars

2. Thin Flake Scars

3. Moderate Flake Scar Widths

4. Mixed Flake Scar Widths

Flaking III (Ventral and Dorsal Surfaces)

1. Shallow Flake Scars

2. Deep Flake Scars

3. Moderate Flake Scar Depths

4. Mixed Flake Scar Depths

Flake Scar Patterning (Ventral and Dorsal Surfaces)

In multiple patterning types the patterning should be read from the proximal to the distal ends; thus, Horizontal-Chevron indicates that horizontal flake scar patterning was present on the proximal end to the artifact and a chevron pattern was present towards the distal end.

1. Horizontal

2. Oblique

3. Chevron

4. Irregular

5. Horizontal-Chevron

6. Chevron-Horizontal-Chevron

7. Chevron-Oblique
8. Chevron-Horizontal
9. Horizontal-Oblique
10. Chevron-Chevron (In this type, the chevron patterns come from different directions; one from the distal end and one from the proximal end.)
11. Chevron-Oblique-Chevron
12. Oblique-Horizontal
13. Oblique-Chevron

Basal Edge Grinding

1. Present
2. Absent

Portion

1. Complete
2. Base
3. Mid-Section
4. Distal End
5. Base and Mid-Section
6. Distal Mid-Section
7. Edge Fragment
8. Right Half
9. Left Half
10. Indeterminate Fragment
11. Surface Fragment

CHAPTER FOUR

THE ANALYSIS AND INTERPRETATION

The two multivariate statistical procedures used in the analysis were discriminant function analysis and cluster analysis. Both techniques were used on all metric variables of all complete artifacts of the five tool groups just discussed. The non-metric, or nominal level, variables were compared in the discriminant analysis, but not in the cluster analysis because of the time needed to transform the raw data to a form that would allow the cluster program to run.

The use of these two techniques forms a sort of cross-check: in many respects their purposes are antithetical (Greaves 1982:90-91). The purpose of discriminant analysis is to separate and distinguish between a set of objects of known groupings using a set of variables; while, cluster analysis creates groupings of similar objects based on the variables.

In this analysis however, cluster analysis is not used to create groupings, since these are already known (the complexes), but to check how well these known groupings actually do combine. If an artifact of a complex forms clusters with other artifacts from the same complex we can assume that there is a difference in the tools between the complexes; if however, the artifacts cluster into mixed complex groups we can presume that there is little difference in the tool types between the complexes.

THE CLUSTER ANALYSIS

Cluster analysis: A general overview

As stated above, cluster analysis produces a series of homogeneous groups based on the variables provided in the study through the use of a series of statistical procedures. In this study I used the Ward's Method of error sum of squares in the Hierarchy procedure with Procedure Correl in the Clustan Manual on the Honeywell computer at the University of Calgary Computing Services. This is generally considered one of the best methods when using a hierarchical form of clustering (Wishart 1978:33), as in this analysis; however, the peculiarities of certain data sets or research objectives may require other methods. The Ward's method uses distance coefficients between artifacts: if the distance between two artifacts is small then the objects are similar, and if it is large then they are dissimilar. A generalized procedure would take the following steps:

1. Standardization of the n x m data matrix

(n=artifacts and m=variables) so that each variable is weighted equally, occasionally the variables may be orthogonalized.

2. The computing of the distance coefficient (for the formula see Davis 1973:457).
3. A similarity measurement (using the distance coefficient) is then computed for all possible pairs of artifacts; this results in an n x n symmetrical matrix. This step must be preceded by a transposing of the n x m matrix to an m x n matrix to allow the formation of a matrix of similarity of artifacts and not a matrix of similarity of variables (Davis 1973:457).
4. The artifacts are then arranged hierarchically by using Ward's error sum of squares where the latter is defined as the sum of the distances from each individual to the centroid of its parent cluster. The Ward's method combines those two clusters, P and Q, whose fusion yields the least increase in the error sum of squares (Wishart 1978:33).
5. Finally, a dendrogram and its associated line graph, comparing the number of clusters present at equal interval coefficient levels, is produced. The latter is produced in order to determine where distortion, due to the averaging process inherent in

the clustering procedure, becomes too great. This distortion is best represented by converting the cluster diagram to a line graph and noting where a major break in the shape of this graph occurs. Where this break occurs, the distortion has become too great. The line graph is needed because the statistical procedures that have been developed to test for the significance of the clusters produced by cluster are not widely used.

In the running of the program the Procedure Correl card was left blank indicating that the appropriate distance coefficients would be used. In each run option 1, a dissimilarity coefficient (step 2 above) was chosen. Also, clustering parameters of 2 minimum and 8 maximum clusters of interest were used in the Hierarchy Procedure. This allows the formation of as few as 2, since the formation of 1 cluster would be analytically useless in this study, and as many as 8 clusters, since the formation of more than 10 would again be useless since the study is analyzing the relationships between either 3 or 5 complexes. Eight would allow for the formation of more than the expected number while not losing the analytical purpose of this research by creating too many clusters.

The results of the cluster analysis

Cores

Forty eight cores with seven metric variables were used in this comparison. Only the first seven variables in the list printed above were used, since not all artifacts had more than one striking platform angle, thus the use of the first seven variables maximized both the number of variables and the number of artifacts that could be used in the analysis.

Figures 11 and 12 show the results obtained from the cluster analysis. It would seem that the best clustering, with the least amount of distortion, occurred at 14% loss of information (Figure 12) where four clusters are formed. The cluster dendrogram (Figure 11) showed that the four clusters correspond to some degree to the complexes. Cluster 1 is almost totally dominated by Lakehead complex cores; while, cluster 2 though mixed with cores from the Grant Lake site is still dominated by Lakehead artifacts. A third cluster had a majority of Caribou Lake complex cores with an even mixture from the other two complexes. Cluster 4 is a small mixed cluster with very little distinction. At 38% loss of information the last cluster joins with the Caribou Lake cluster to form three clusters. Two clusters are then formed at 45% loss of information as the two Lakehead dominated combinations join.

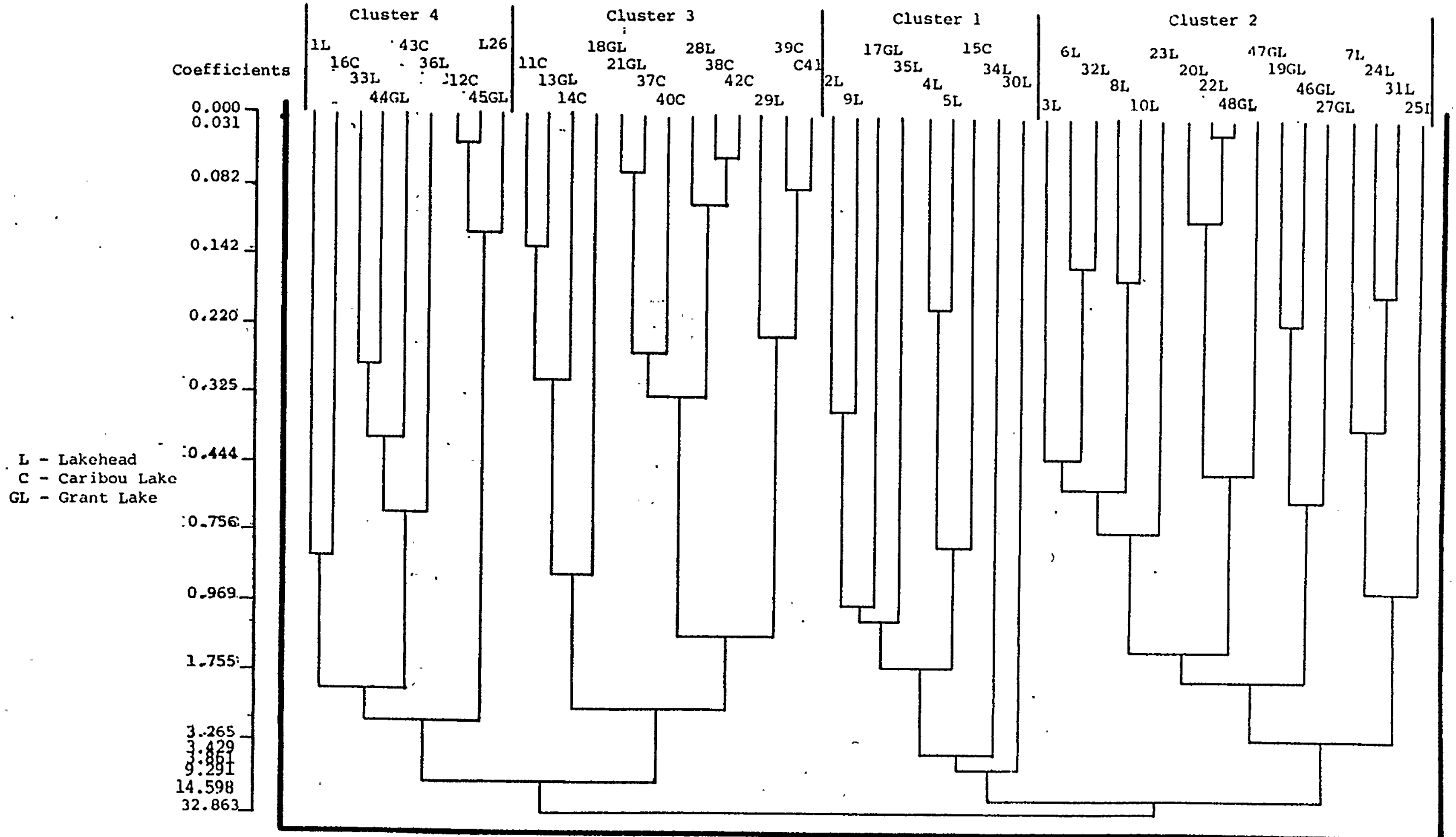


Figure 11. Dendrogram of Cores

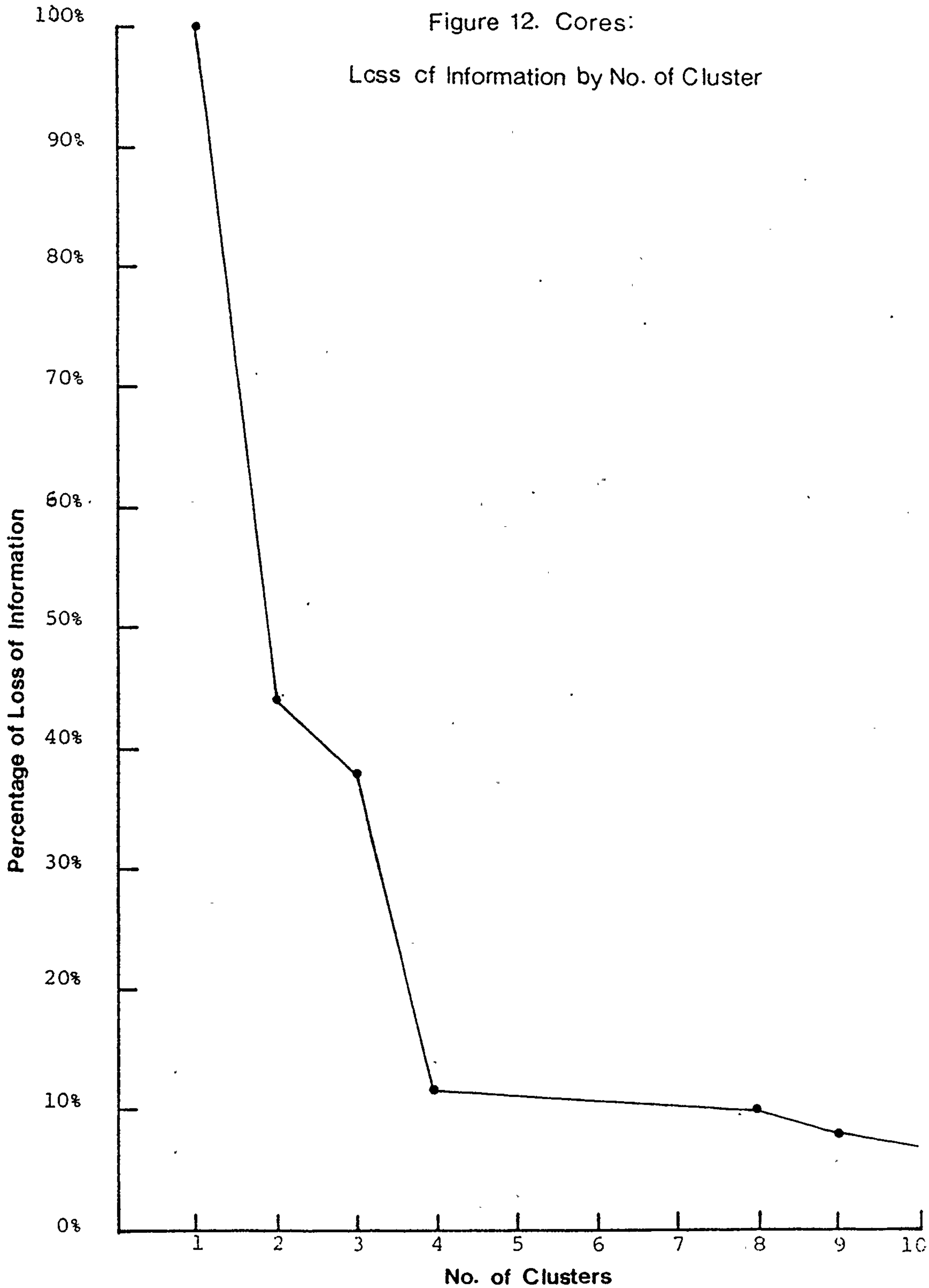


Figure 12. Cores:

Loss of Information by No. of Cluster

The inferences drawn from this clustering were that Lakehead complex cores were quite distinct; Caribou Lake complex cores were also unique while Grant Lake site cores were quite indistinct and cluster in with the other two complexes. On why this should occur we can only speculate, but I surmise that since this analysis used only metric variables that what is being reflected is the quarry site differences of the complexes. Recalling that many of the Lakehead complex sites were combined habitation and quarry sites, one might expect to find larger and less exhausted cores and core fragments. The Caribou Lake complex sites however, probably reflect the transportation of lithic material from its source to the site, at least sites like the Sinnock site, as well as supplementing it with any local nodules that may have been available (Buchner 1984:75-76,99-100). Such a system as the latter may have facilitated a greater need for conservation of lithic materials and therefore smaller cores would be recoverable.

The generalized nature of the Grant Lake site artifacts is hard to interpret; since, no local source is known for the material. From the clustering one might infer that some lithic acquistion pattern that was intermediate between the two just discussed existed for the inhabitants of the Grant Lake site. Possibly, the Grant Lake site people used local river cobbles or outcrops rather than a number of regional sources due to their longer seasonal round. The Grant Lake inhabitants may have carried small amounts of high grade lithic materials with them in their migrations and supplemented this with the local sources mentioned above. The latter type of acquistion would probably leave larger core and fragments similar to the Lakehead complex and the former would leave smaller and more exhausted cores that would compare with the Caribou Lake complex material. This explanation must remain highly speculative, at this point, since it is not based on any hard facts.

Edge Retouched Flake Tools

The combined edge retouched flake tools group, which combined side scrapers, retouched flakes and denticulates, provides a slightly different analysis: in that I could compare both how the tools from the three complexes clustered and how the three initial tool types clustered. The latter comparison could reveal either that a certain size of flake was being selected for certain tool groups or it could also reflect my own judgemental classification of these generally non-descript tools into functional categories.

Four metric variables, length, width, thickness, and weight, were used on the 59 artifacts compared. Figures 13 and 14 showed that two large clusters can be formed with the loss of 26% of the information. Cluster 1, the larger of the two, can be sub-divided into two smaller clusters that join at the 26% level (1a,1b). The second large cluster (Cluster 2) forms at the 16% loss of information level.

As the cluster diagram (Figure 13) revealed, Cluster 1a and 1b and Cluster 2 correspond quite well with the three complexes. There is one very distinct Grant Lake site cluster (1b) that connected with slightly more mixed cluster (1a) of Caribou Lake complex tools to form the large Cluster 1. Cluster 2, though mixed as Figure 13 shows, does predominatly contain Lakehead complex tools.

Viewing the clustering in terms of the three original tool types revealed that, with the exception of a grouping of retouched flakes associated with the Grant Lake site, the clustering is not quite as well defined. The Caribou Lake cluster, although containing a majority of side scrapers (N=12), also has a large number (N=9) of retouched flakes. Likewise, the Lakehead complex combination (Cluster 2) is dominated by retouched flakes (N=10), but when the number of side scrapers and denticulates are added together (N=10) they equal the number of retouched flakes. Even the Grant Lake site cluster (Cluster 1b) has three side scrapers included with its retouched flakes; while,

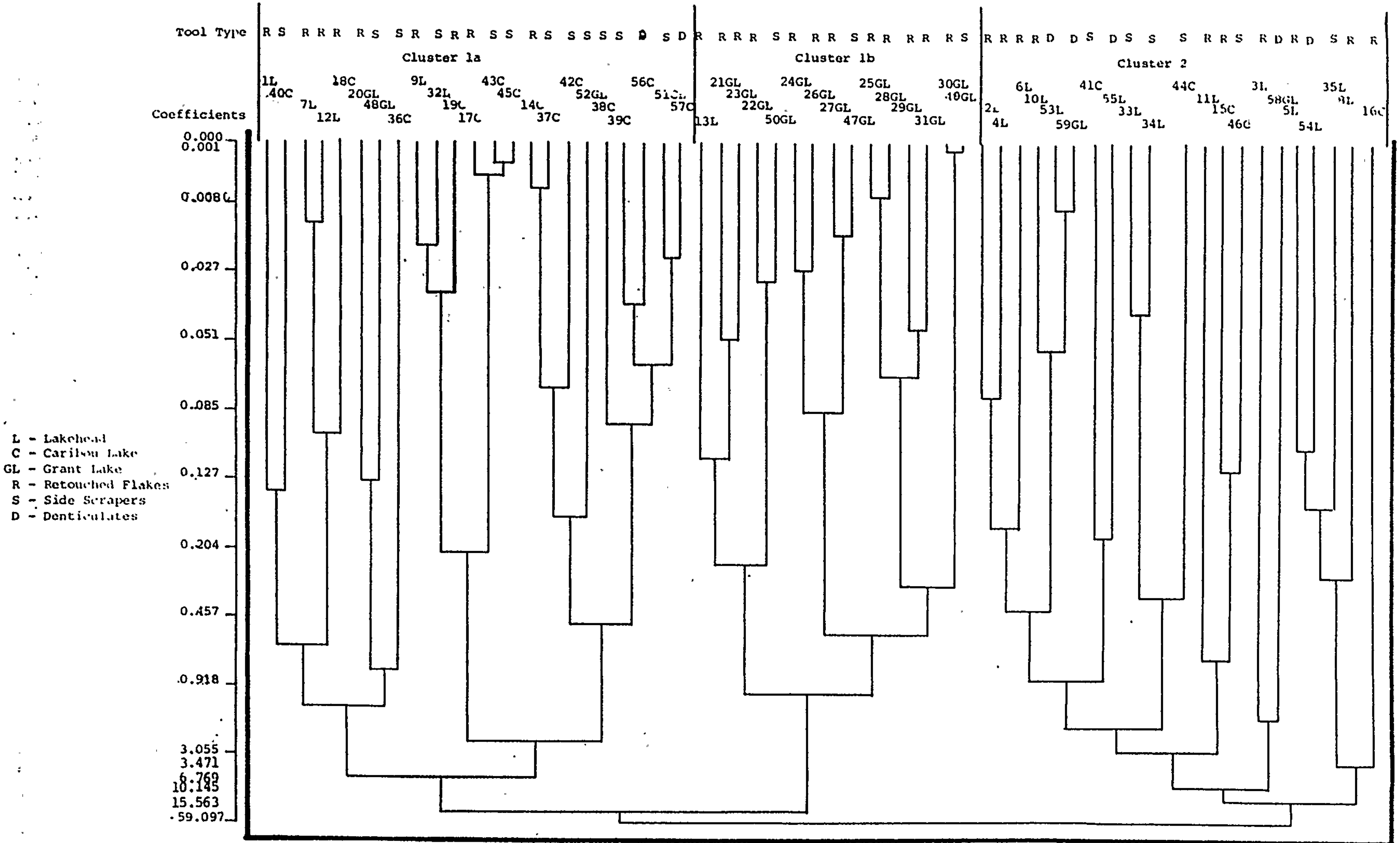


Figure 13. Dendrogram of Edge Retouched Flakes

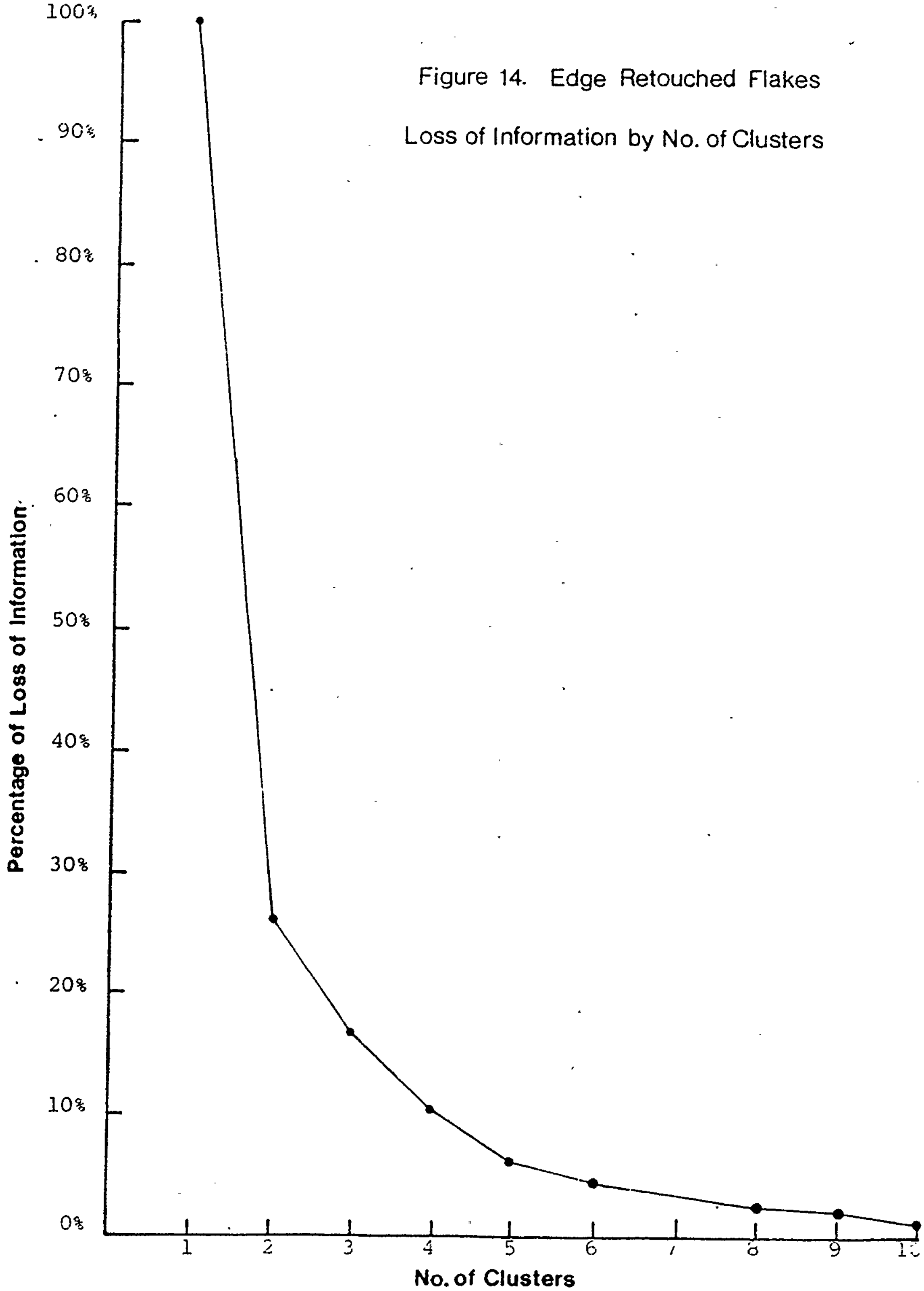


Figure 14. Edge Retouched Flakes
Loss of Information by No. of Clusters
Percentage of Loss of Information
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
8
9
No. of Clusters

only one of the artifacts in this cluster in fact belongs to a different complex.

The results of the cluster analysis on the edge retouched tools suggested that the complexes tended to produce different size flakes for these types of tool. To some extent there was also a selection based on the type of tool needed. This is most evident in the correspondence between the Grant Lake cluster (1b) and the retouched flakes. Since I presume that the people of these three complexes used these edge retouched flake tools, whether side scrapers, retouched flakes or denticulates, for similar if not identical functions within these three sub-groups, then I must assume that the clustering is due to cultural differences. These differences however, may be directly related to the different size cores and quarrying activites discussed above and may not have been part of a conscious decision making process, since larger cores are more capable of producing larger flakes. The fact that the size of flakes had some functional importance would support the cultural explanation. It is obvious from the clustering that the size of the flakes was being purposefully selected for the different types of tools within the edge retouched flakes despite the difference in core sizes.

<u>Bifaces</u>

Fifty three complete bifaces were used in this comparison. This tool category combines artifacts originally identified as preforms and knives into one type to allow for a larger sample size. It also allows a comparison of the tools both by complex and by the original tool group.

The graph in Figure 15 showed that there were two definite breaks in the slope of the graph; one at the formation of seven cluster and one at five. The five clusters formed at about 35% loss of information and relate weakly to the three complexes. As the dendrogram in Figure 16 revealed these five groupings were not very distinct. Two of the combinations, Clusters 2 and 4, had equal numbers of Lakehead and Caribou Lake complex artifacts. The other two large clusters had either a slight majority of Lakehead (Cluster 1) or Caribou Lake (Cluster 3) complex artifacts. The Grant Lake site bifaces, like the cores, do not seem to be distinguishable from either of the other two complexes. From these results it would seem likely to conclude that there is little variation in the bifaces between the three complexes.

At the formation of seven clusters at 20% loss of information the dendrogram revealed groupings by tool types. Although these clusters are mixed they are much

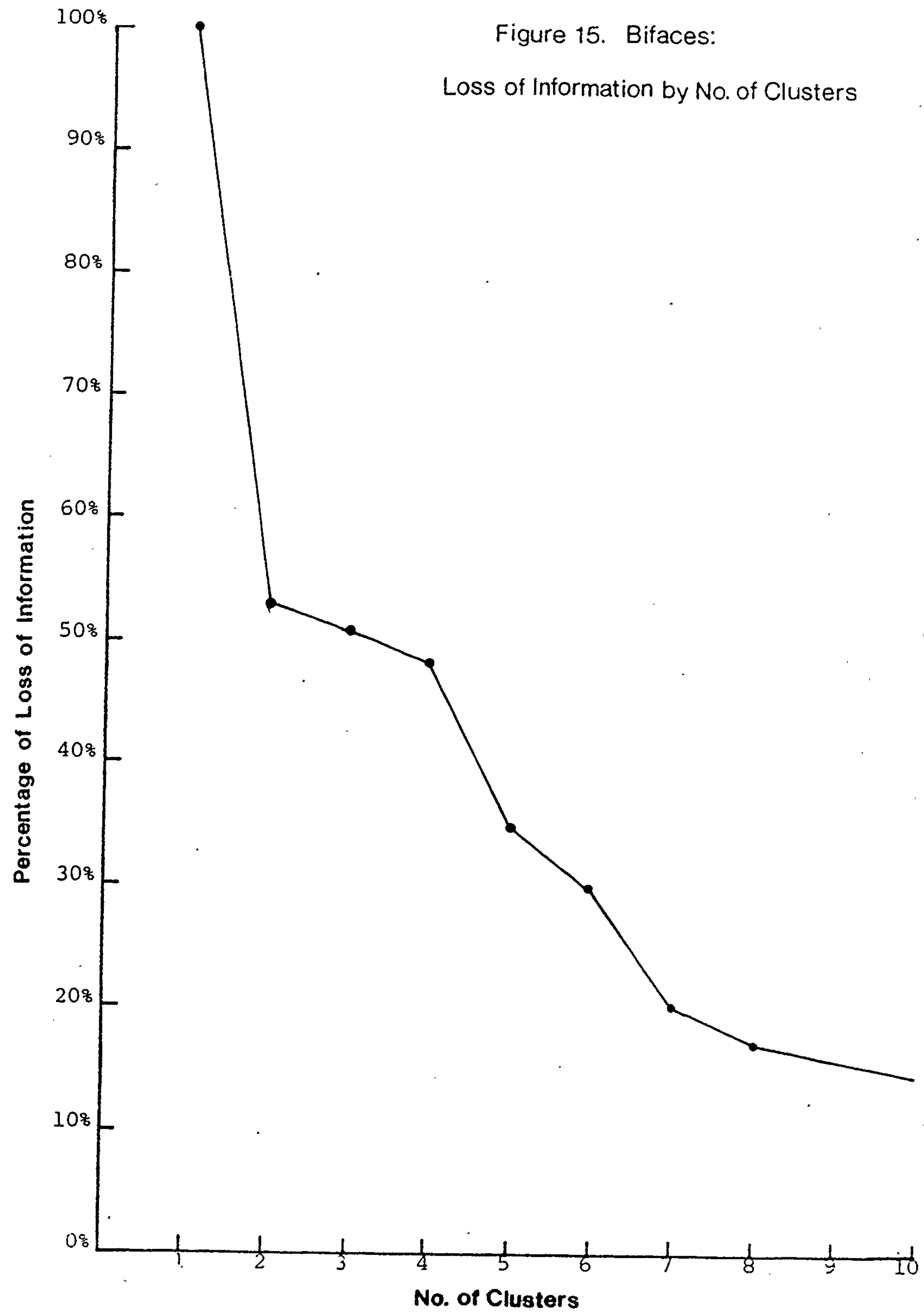


Figure 15. Bifaces:
Loss of Information by No. of Clusters
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of Loss of Information
1
2
3
4
5
6
7
8
9
10
No. of Clusters

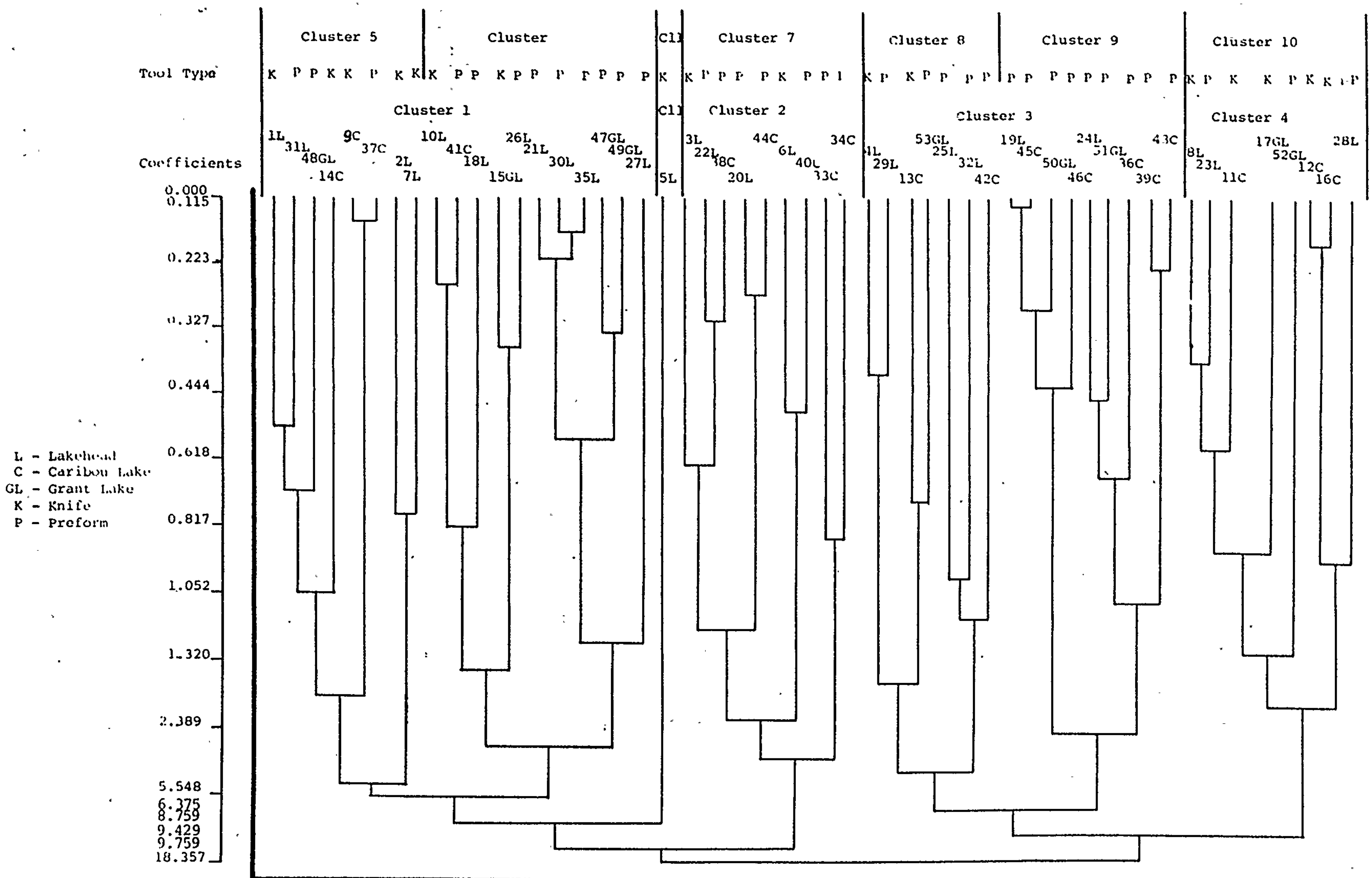


Figure 16. Dendrogram of Bifaces

more distinct than the complex combinations. Clusters 5 and 1Ø are clusters of knives and groupings 6,7,8, and 9 are preforms. The last cluster is the lone Lakehead complex knife that joins Cluster 1 at 48% loss of information. The separation of the two knife cluster suggested two different sizes of knives are present; however, why these two different sizes should occur is at present unexplainable, perhaps it has to do with the differences between flake knives and the more well formed knives. The intervening clusters of preforms probably reflects different stages in the biface reduction sequences or different stages for different types of tools (points vs knives).

In summary then the cluster analysis showed that there is little or no difference between the complexes in their bifaces, but among the two sub-types of tools that make up the biface category the cluster analysis is able to distinguish between the knives and preforms and possibly between stages in their reduction sequence.

Endscrapers

Eleven metric variables were taken on the 8Ø endscrapers used in this analysis. The loss of information graph (Figure 17) revealed that either 3 or 4 significant groups, that correspond to the complexes, formed. The three clusters appear at about 33% loss of information; at which point one extremely large cluster (Cluster 3) (Figure 18) consisting almost exclusively of Caribou Lake complex endscrapers is formed; also, one mixed cluster dominated by Grant Lake (Cluster 1) and one small cluster of Lakehead complex artifacts (Cluster 2) with one artifact from each of the other complexes.

The one large Caribou Lake cluster (Cluster 3) can be broken into two smaller groups when viewed below the 33% loss of information level, and in fact, when viewed from below the 23% loss of information level four distinct Caribou Lake clusters appeared. It was at this 23% level that the four large clusters formed. These included one Grant Lake cluster (1), one small Lakehead cluster (2), and two Caribou Lake clusters (3a,3b). As Figure 17 shows, it is at this level that a major break in the line graph occurs (although it only rises to the 33% level discussed above); whether, this internal differentiation of endscrapers in the Caribou Lake complex are due to different craftsmen or to the manufacturing of different types of endscrapers for slighlty different purposes is hard to determine at this time.

In summary then it can be said that there are definite differences between the complexes in their styles of endscrapers, at least as far as size is concerned. Assuming, that the people of these complexes used these

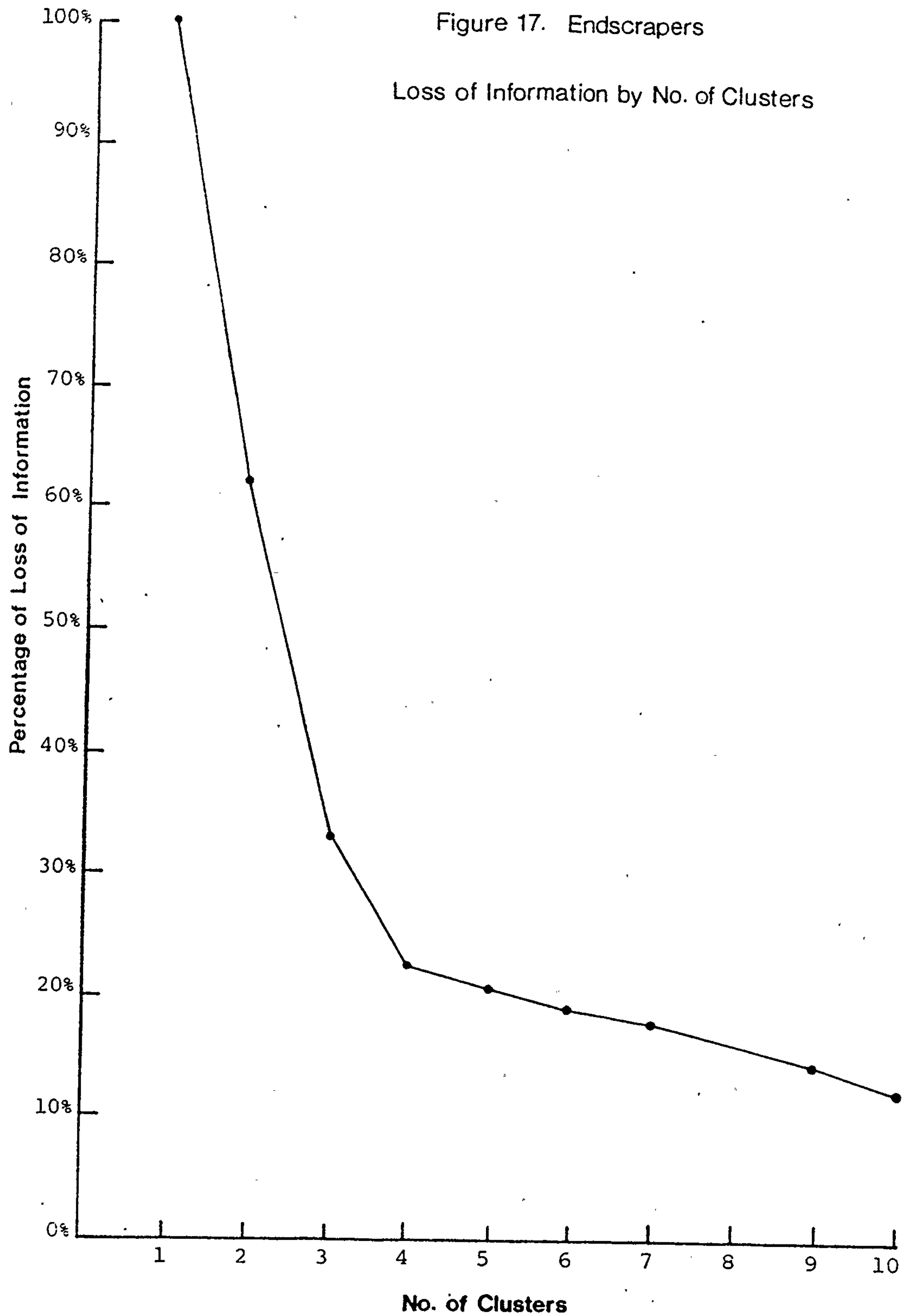


Figure 17. Endscrapers
Loss of Information by No. of Clusters
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of Loss of Information
1
2
3
4
5
6
7
8
9
10
No. of Clusters

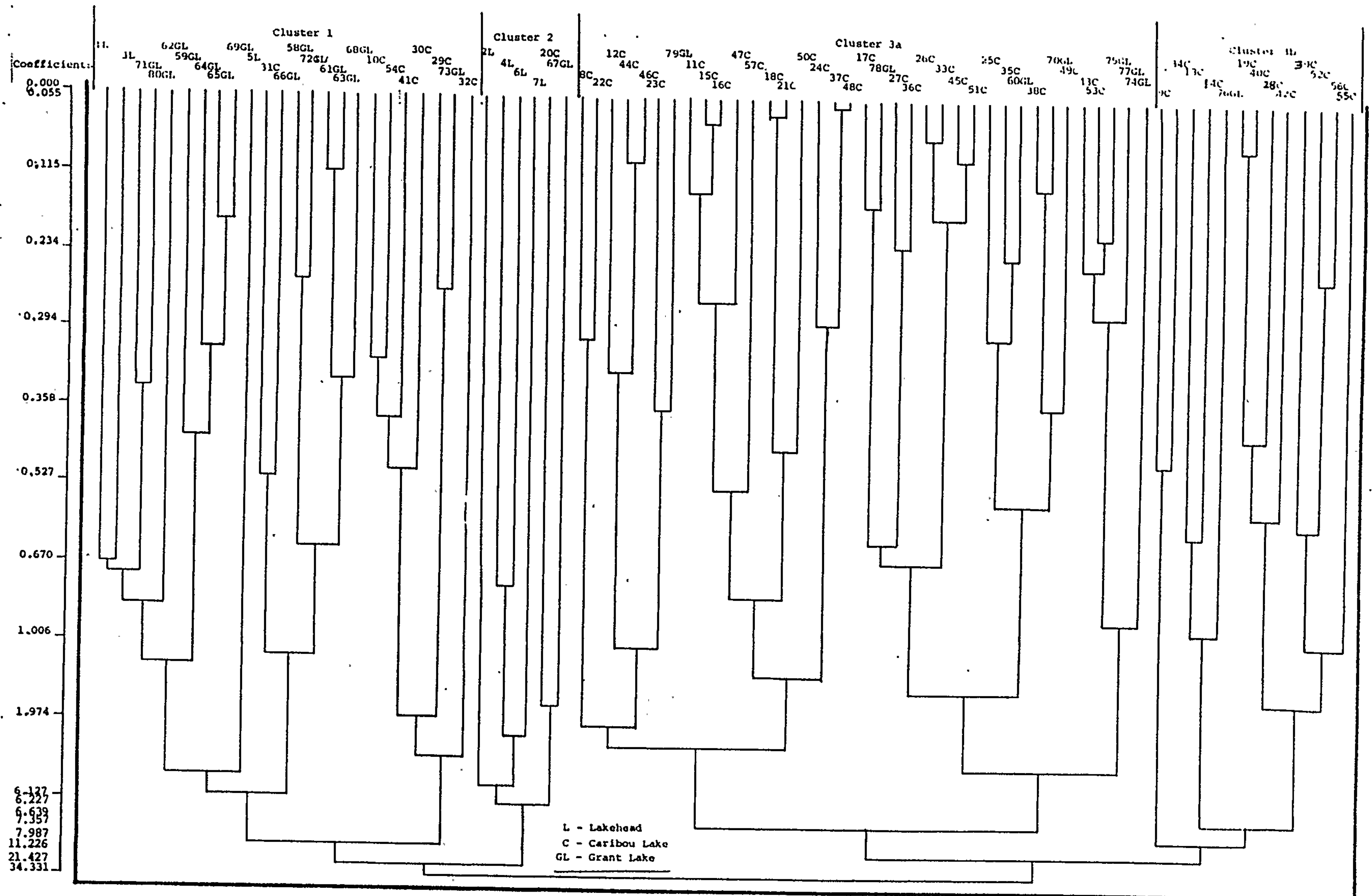


Figure 18. Dendrogram of Endscrapers

tools for quite similar purposes, then it follows that the differences observed are due to culturally induced stylistic patternings.

Projectile Points

Eleven metric variables were used in the analysis on the 84 points from the five complexes. As the loss of information graph (Figure 19) indicated there are three significant clusters that existed at about the 26% level. A second earlier break in the graph occurred after the formation of eight clusters at the 8% level.

When the dendrogram (Figure 2Ø) is observed at this latter level the eight groupings correspond roughly with the five complexes. There is one small Lakehead cluster (Cluster 1a), a distinct Agate Basin cluster (1c), two mixed clusters one dominated by Grant Lake (1d) and one by Wasden (1e). Next there is a mixed cluster dominated by Caribou Lake artifacts (2a), a small mixed cluster of Lakehead and Caribou Lake complex points (2b) and several lone artifacts that make up their own clusters (1b,2c).

Studied from the viewpoint of three cluster it can be seen that there is one grouping of Agate Basin points (consisting of clusters 1a,b,c), one very large mixed Grant Lake site grouping of (clusters 1d,e), and one large

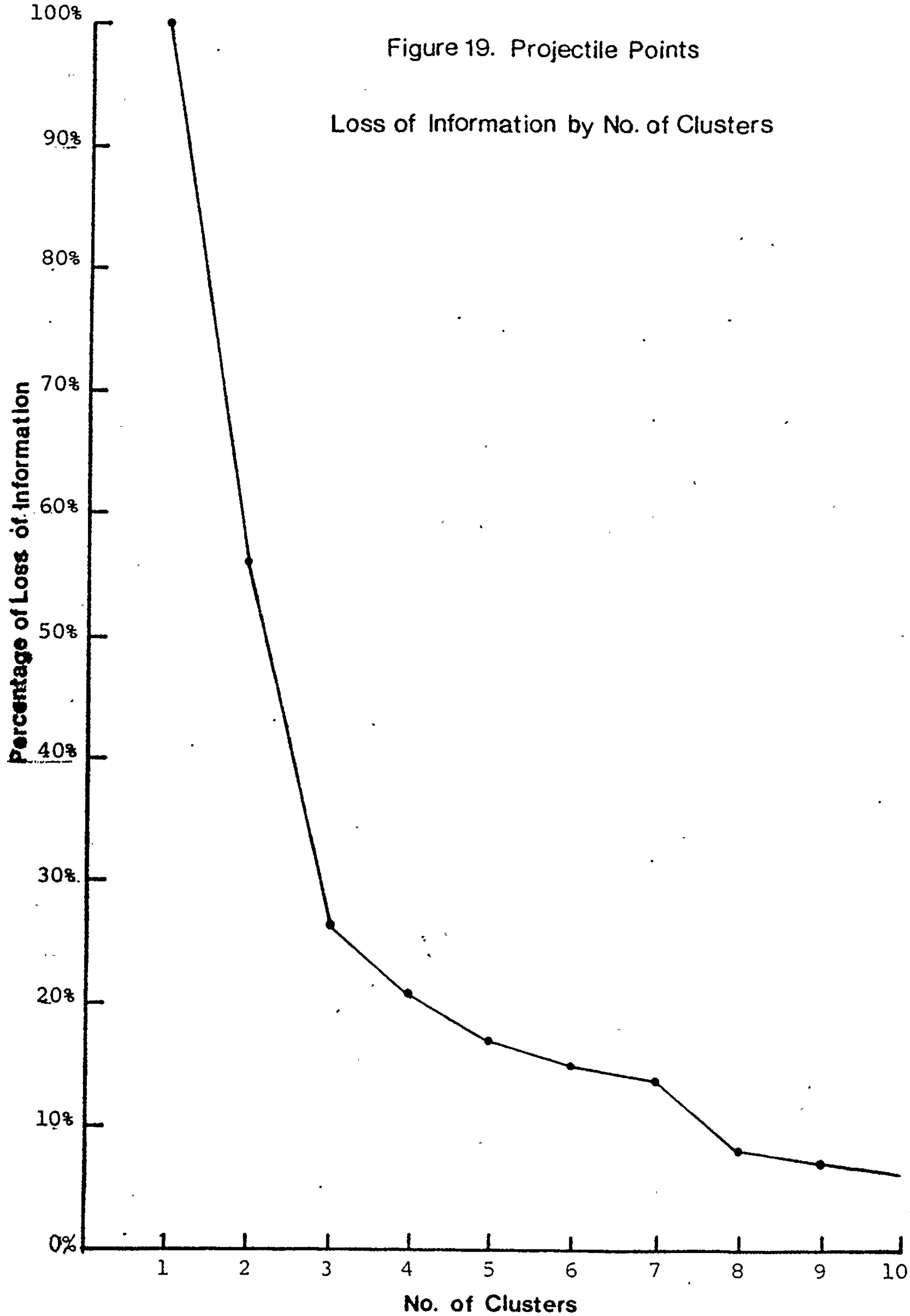


Figure 19. Projectile Points
Loss of Information by No. of Clusters
Percentage of Loss of Information
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
10
No. of Clusters

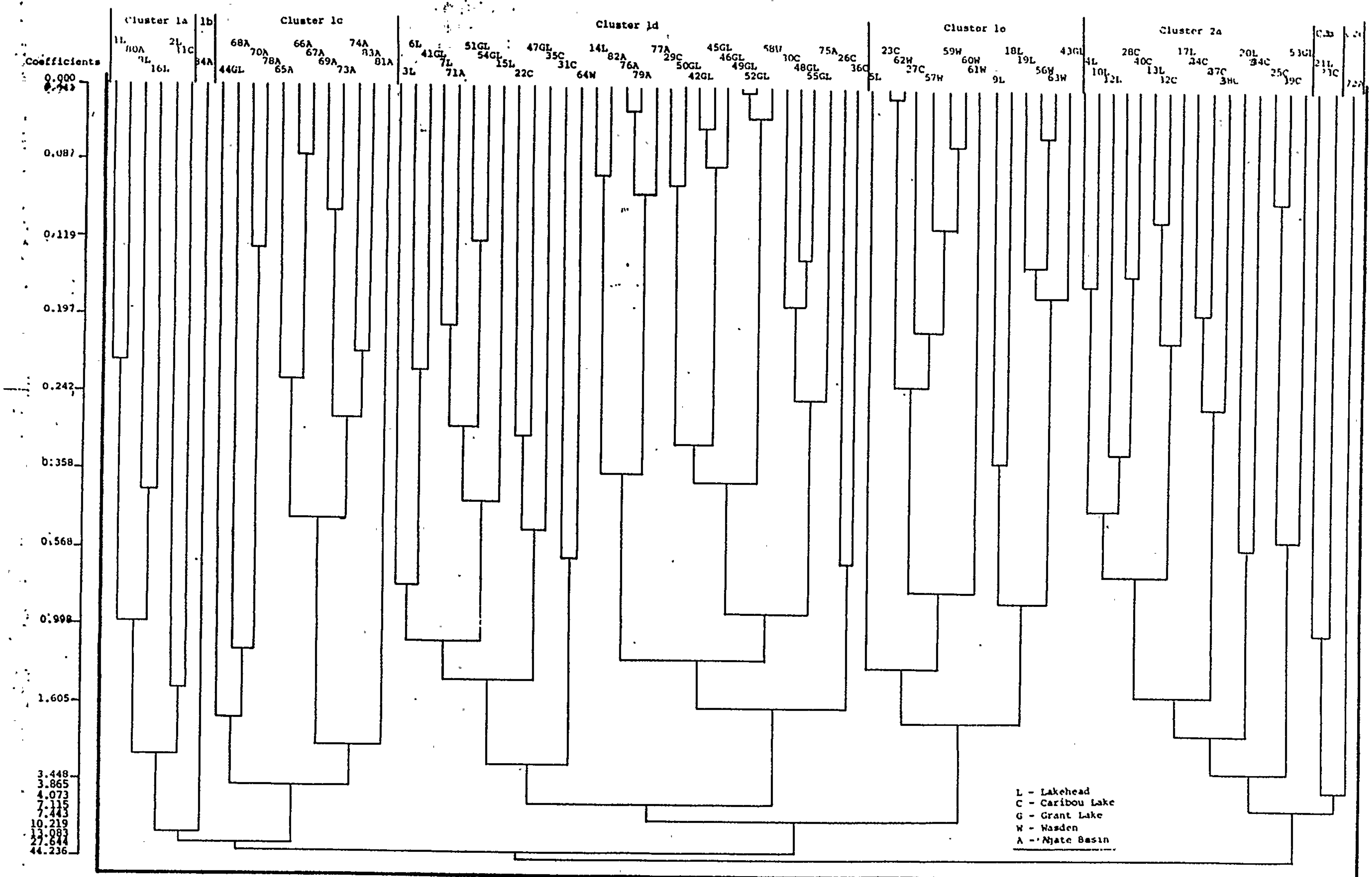


Figure 20. Dendrogram of Projectile Points

Lakehead/Caribou Lake group that is dominated by the latter (clusters 2a,b,c).

The production of these clusters suggested that the Agate Basin, Grant Lake, Wasden, and possibly part of Lakehead are similar to each other; while, the Caribou Lake and a second grouping of Lakehead complex artifacts were not. The implications are that the Grant Lake, Wasden and part of the Lakehead complex were descendent of the Agate Basin complex; while the Caribou Lake Another possiblity are technological constraints imposed on the manufacturers by the medium in which they worked. and another part of the Lakehead complex were not, or not as directly. The joining of the Grant Lake and Wasden clusters (1d,e) with the Agate Basin groupings at the 56% loss of information level would be expected considering the nearly 2000 years difference between the three complexes.

Buchner (1984:84) has stated that the difference he noted between the Caribou Lake points and those of the Agate Basin points is due to the adaption of a Plains people to the Boreal Forest causing a certain amount of regionalism to occur that had not been present on the Plains. This may also explain why there are two groupings of Lakehead complex points, although this can be explained by the effects of many different cultures influencing the development of the Lakehead complex. These influences were evident in the variety of projectile points assigned to the Lakehead complex that included Plainview, Agate Basin, Scottsbluff, and Minoque. If, however, adaptation to a Boreal Forest environment is the key, why did not a similar result occur in the Grant Lake site material, which was likewise, partly adapted to the Boreal Forest at the same time as the Caribou Lake complex was. At present based solely on the projectile point clustering I believe that the best explanation must be that the differences observed are due to different cultural historical influences, that are presently unknown, and do not include, to any great extent, the effects of the adapatation of a Plains people to a forest habitat.

Summary and Conclusions

The results of the cluster analysis are difficult to interpret. The cores, bifaces and maybe the edge retouched flake tools suggest that the Lakehead complex is quite different from either of the other two complexes. Also, the Grant Lake site, at least as far as the cores and bifaces are concerned, is very generalized in nature. Yet, this uniqueness of the Lakehead complex can be explained in part by factors relating to the distinctive quarry/habitation site of this complex; thus, the cores and bifaces of the three complexes are considered similar to each other. The different clusters of edge retouched flakes may relate to the different size cores: in that different size cores will generally produce different size flakes.

The comparisons on the other three tool groups (including the edge retouched flakes) reveal that the combinations generally correspond with the complexes. In the study of edge retouched flakes all three complexes separated out indicating that cultural differences in the selection of certain sized flakes for these tools existed between the complexes, or as noted above this clustering may relate to the difference in core sizes and lithic resource acquisition. Although not as strongly clustered, when this tool group is viewed using the three original tool types (side scrapers, retouched flakes and denticulates) there is a definite clustering suggesting that certain sizes of flakes were being selected for certain tasks. This lends support to the cultural explanation, since size had some functional importance that crosscuts all three areas despite the different core sizes. In this study the Caribou Lake and Grant Lake cluster join a 27% level before joining with the Lakehead cluster.

In the endscraper analysis the Lakehead and Grant Lake material join first at the 60% level before joining with the Caribou Lake cluster. This suggests that there is a fair amount of differentiation between the complexes, and assuming similar functions on similar types of material for these artifacts, it also suggests that a cultural difference exists here.

Finally, the clustering of the projectile points shows that the Agate Basin, Grant Lake, Wasden, and a small portion of the Lakehead are all much more similar to each other than they are to the Caribou Lake and another part of the Lakehead. The implications are that the Agate Basin, Grant Lake, Wasden, and part of the Lakehead complex are culturally related as are the Caribou Lake and another portion of the Lakehead complex.

From the examination of edge retouched flake tools, endscrapers, and projectile points, and the fact that the latter two are formed tools involving a good deal more work to create, I would state that there is little proof that the Grant Lake site, Caribou Lake complex, and the Lakehead complex material belong to a common culture (Buchner 1981:81-99; 1984:89-100; Dawson 1983:25-26; Pettipas and Buchner 1983: 439,443 Steinbring and Buchner 1980:25). Also, based solely on the projectile points that the Grant Lake, Wasden, and a portion of the Lakehead complex all stem from a common Plains antecedent, namely the Agate Basin culture, while the Caribou Lake complex and another portion of the Lakehead complex derive from a different cultural source. The cluster analysis revealed that the Grant Lake and Wasden points were similar in size and shape and that these two complexes were closest to the Agate Basin and a portion of the Lakehead points, while the Caribou Lake and another part of the Lakehead complex were of different size and shape.

DISCRIMINANT ANALYSIS

Discriminant analysis: A general overview

As stated earlier the purpose of Discriminant Function Analysis is to predict group membership on the basis of a set of variables. The procedure involves the creation of a column matrix of scores on the variables in each group (complex) for each case (artifact), and then subtracting the appropriate variable mean from each case variable score producing a matrix of difference scores. Finally, these are squared by multiplying the latter matrix by its transpose matrix and then these squared difference scores are summed for each case. The transpose of a matrix is simply the original matrix turned on its side so that the rows become the columns and the columns become the rows.

This statistical method can be used to investigate three types of problems: first, in a decision ruling for classifying new cases (artifacts), second, interpreting the discriminant space in terms of the variables contributing most heavily to separation of the groups, and third, to provide a test for the adequacy of classification. Discriminant analysis does not answer questions of causality. This must be left to the researcher to determine.

There are several assumptions about the data that must be considered when using discriminant analysis:

1. The sample is random.
2. The probablity of an unknown observation is equal for all groups.
3. The variables are normally distributed within each group.
4. The range of variance and the number of variables is equal for all groups.
5. No observations are mis-classified

In the analysis below assumptions 1, 2, and 5 are taken as given without any discussion; while numbers 3 and 4 will likewise be assumed to be true it should be noted that some of the data may not be strictly conform to these assumptions.

Finally, the relationship between sample size and the number of variables is such that in unequal group sample sizes the sample size of the smallest group should exceed the number of variables. If the number of cases does not notably exceed the number of variables than an overfitting can occur. This problem of sample size and number of variables occurs in several runs in the discriminant analysis of the data. I decided to run the procedure anyways taking care to note the possiblity of overfitting in the smaller samples and by providing a partial test. This test involves the use of an option (to be discussed in detail below) in the SPSS Discriminant program that uses only complete artifacts or artifacts with a complete set of variables in the analysis stage of the procedure and artifacts with missing variables (usually incomplete artifacts) in the final classification stage of the process. During the latter stage, the artifacts with the missing variables have the total between group variable mean susbstituted as values for those variables that are missing.

The Specifics of the Discriminant Function Analysis

The discriminant analysis program in the SPSS level 9 manual was used on the Honeywell Multics DPS computer in the Department of Academic Computing Services at the University of Calgary. The analysis of each of the five tool groups involved the use of three separate runs on the data. The first involved metric data, the second the non-metric data, and the third used a combination of the best discriminating variables from the previous two runs. All non-metric variables were first transformed by IF and RECODE statements into binary (present or absent) format so that they could be treated as interval level measures (Nie 1975:5-6).

In each analysis the program was told to note those artifacts with missing variables and to eliminate them in the analytical stage, but to include them in the classification stage (OPTION 2), as discussed earlier. Prior probabilities for group membership were set at equal for each complex (PRIORS=EQUAL), only if the difference in size between the complexes was such that the largest complex had ten times the number of artifacts of the smallest would this be changed. In several instances the maximum number of steps was set (MAXSTEPS=1Ø) to help the program run and to save time. A stepwise procedure was asked for with the default options on the tolerence levels of .ØØ1 and a minimum F to enter and and maximum F to remove of 1.ØØØ (see Nie et al. 1975:452-457). The method used in the stepwise selection process was Malalanobis distance (MAHAL) between two groups which compares the two groups with the closest values of a particular variable. Any deviance from this general pattern will be noted in those specific runs.

During each run a certain number of options and statistics were printed for output. For reasons of space and explanatory clarity and interpretation only those aspects of the printout preceived as being the most useful will be discussed. These include the variable means for each group and the standard deviations of only the metric variables, since in the nominal level variables this statistic does not seem to have any real tangible meaning. The classification tables provide the percentage of correctly classified artifacts of each complex. The classification function coefficients, which are useful in the classification of artifacts, and the significance test for Mahalonobis statistic, which is an F statistic of significance of the group centroids and has an arbitrarily set significance or alpha level of 1%. In some cases the Pooled-Within Group Correlation matrix is also discussed to determine the interrelationships among the variables.

The results of the Discriminant Analysis

Cores

The metric variables

Of the original 72 cores and core fragments 48 were complete enough to be included in the analytical stage of the study. Seven metric variables were used on 25 Lakehead, 13 Caribou Lake, and 10 Grant Lake cores. After five steps in the analysis three variables; length, width and weight remained in the analysis and were considered important in discriminating between the complexes. The four variables not included were the average flake scar width and length, striking platform angle or the maximum thickness. The exclusion of these variables suggested that the flakes being removed were similar in size among the three complexes. The discriminating variables however, suggested that there is a definite difference in size of the cores among the complexes.

The classification coefficients (Table 1) allow the construction of equations that will permit the prediction of group membership of an artifact of unknown affiliation. The following example shows how such an equation is constucted:

$$\begin{aligned}\text{Lakehead} = {} & 0.2002448(\text{length}) + 0.2647237(\text{width}) \\ & -0.04914213(\text{weight}) - 12.75659\end{aligned}$$

Determining which complex an artifact would belong to involves solving each such equation for each complex, plugging in the length, width and weight variables, and the equation that gives the highest value is the complex to which the artifact has the greatest probablity of belonging. Table 2 gives the results of this classification procedure for the data of this study and Figure 21 the distribution. It showed that 70.83% of the

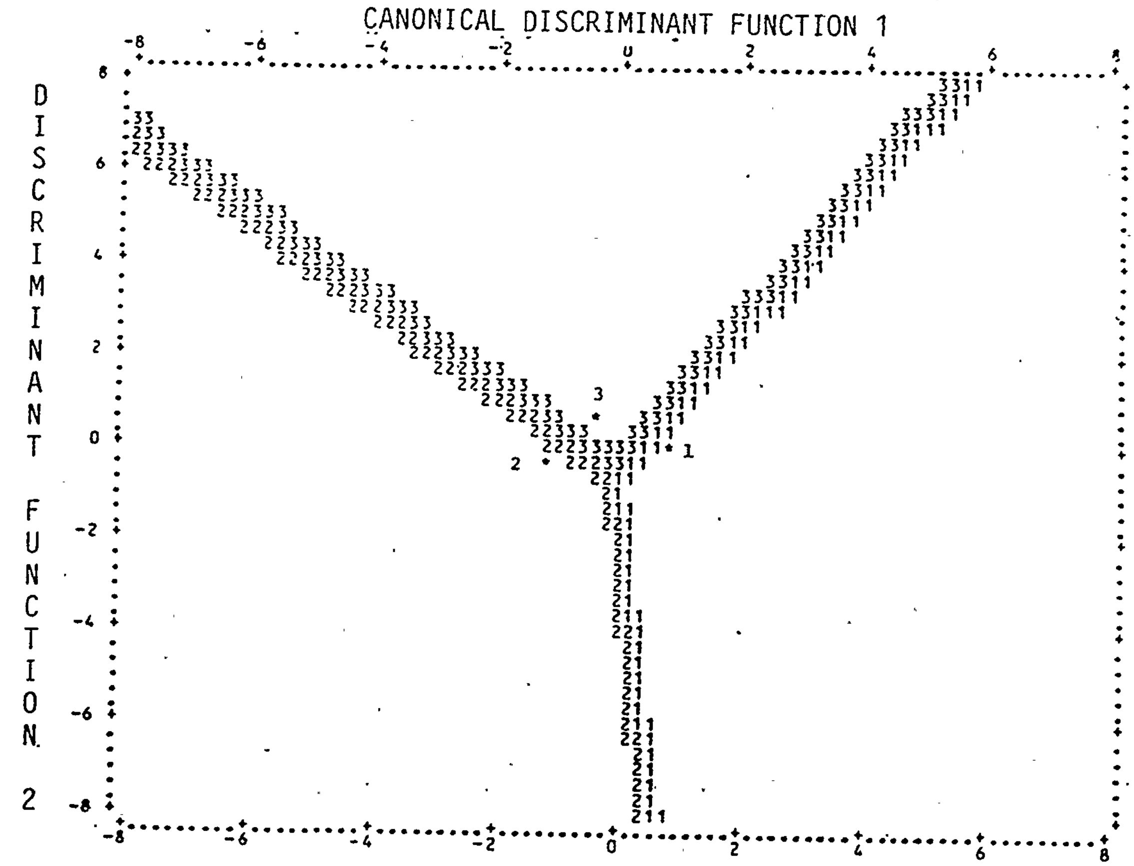
Table 1. Classification Function Coefficients for Cores (Metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	.2002448	.1054412	.1200132
Width	.2647237	.2107027	.3159155
Weight	-.04914213	-.03610432	-.04861035
Constant	-12.75695	-5.830336	-9.932277

Table 2. Classification Results for Cores (Metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	29	19 65.5%	4 13.8%	6 20.7%
Complex 2 Caribou Lake	26	2 7.7%	23 88.5%	1 3.8%
Complex 3 Grant Lake	17	2 11.8%	6 35.3%	9 52.9%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 70.83%



1 – Lakehead
2 – Caribou Lake
3 – Grant Lake
* – Group Centroids

Figure 21. Territorial Distribution of Cores
(Metric Variables)

cores and core fragments were classified correctly using the three discriminating variables.

The F statistic of significance (Table 3) of between pairs of group centroids at the 1% level of significance with 3 and 43 degrees of freedom and a critical value of 4.28 showed that there is no statistically significant difference between the Beverly Unit (Grant Lake) and that of either of the other two complexes. (All critical values are determined from Davis 1975:1Ø4.) So that although the classification table showed that there is a good probablity of correctly classifying Beverly Unit cores this classification is not statistically significant and so there is little difference between Grant Lake cores and either Lakehead or Caribou Lake cores.

Tables 2 and 3 confirmed the results of the cluster analysis. They showed that both Lakehead and Caribou Lake cores were distinct and that Grant Lake cores were not. The only difference was that Caribou Lake is more distinct, 88.5% correctly classified, instead of Lakehead, 65.5% classified correctly.

The above results confirmed my interpretation of the cluster analysis that what is being refected is the difference in quarrying activities among the complexes and not so much the differences or similarities of the cultural technologies. This is further confirmed when the

Table 3. F Statistics and Significances between Complexes of Cores (Metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 3, EACH F STATISTIC HAS 3 AND 43 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	9.6533 Ø.ØØØØ	
Grant Lake	3.7986 Ø.Ø167	2.4932 Ø.Ø727

Table 4. Means and Standard Deviations of Cores (Metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	81.6Ø	24.Ø1	43.82	21.89	56.72	16.4Ø*
Width	54.82	14.56	33.93	2Ø.95	49.Ø4	16.23*
Thickness	27.3Ø	12.71	21.59	1Ø.53	26.38	9.75*
Weight	153.34	113.48	63.85	1Ø2.72	92.25	1Ø6.41
Flake Scar Width (Average)	21.14	8.64	12.Ø5	6.61	15.63	4.78
Flake Scar Length(Average)	35.74	12.58	27.25	12.Ø4	25.88	1Ø.77
Angle	93.96	23.25	82.54	13.81	95.3Ø	23.15

All measurements are in millimetres except Weight which is in grams.
* Denotes descriminating variable.

discriminant analysis found that little difference existed in the average flake scar width and length and the platform angle. This indicated that similar sized flakes were being removed from the cores. The classification table also suggested that the Grant Lake cores were more similar to Caribou Lake complex than to the Lakehead cores. Now whether this means Grant Lake quarrying activities were more like those of Caribou Lake than to Lakehead complex activites is speculative. I do feel that the classification percentages supported my proposal that Grant Lake quarrying activities were intermediate in nature to those of the other two complexes. The misclassification of 35.3% of Grant Lake and 3.8% of Caribou Lake cores for each other reflected the obtaining, transportation and conservation of material from site to site during the seasonal round; while, the misallocation of 11.8% of Grant Lake and 20.7% of Lakehead cores is suggestive of supplementing lithic resources from locally occuring material.

My reasoning for such an interpretation stemmed from the means and standard deviations (Table 4), which showed that based on the three discriminating variables there is a decrease in the size of the cores from Lakehead, to Grant Lake, to Caribou Lake. The overlap, observed in the standard deviations, between Grant Lake and Lakehead is due to supplementing lithic supplies from local resources which created relatively large cores and core fragments, and the overlap between Grant Lake and Caribou Lake is because of transportation and conservation of some cores from camp to camp. The standard deviations also showed that weight was very widely scattered about the mean indicating that central clustering is weak. The other two variables tended to show a modest trend to central clustering of more or less comparable size.

Non-metric variables

Of the 72 original cores only 48 could be used in this stage of the analysis. The three nominal level variables, dealing with typing, were used on 25 Lakehead, 11 Caribou Lake, and 12 Grant Lake cores. After four steps in the stepwise procedure four variables were left in the analysis. These were the presence or absence of unprepared cores, double ended cores, single ended cores, and blade-like cores. The core types whose presence did not distinguish between the complexes are prepared, polymorphic, split cobble, flake, block, angular unprepared, and block cores. As the classification table (Table 5) and significance table (Table 6) suggested, the discrimination between these complexes based on the presence of certain kinds of cores is not very good (43.06% overall). The classification table showed that in all

Table 5. Classification Results on Cores

(Non-metric Variables)

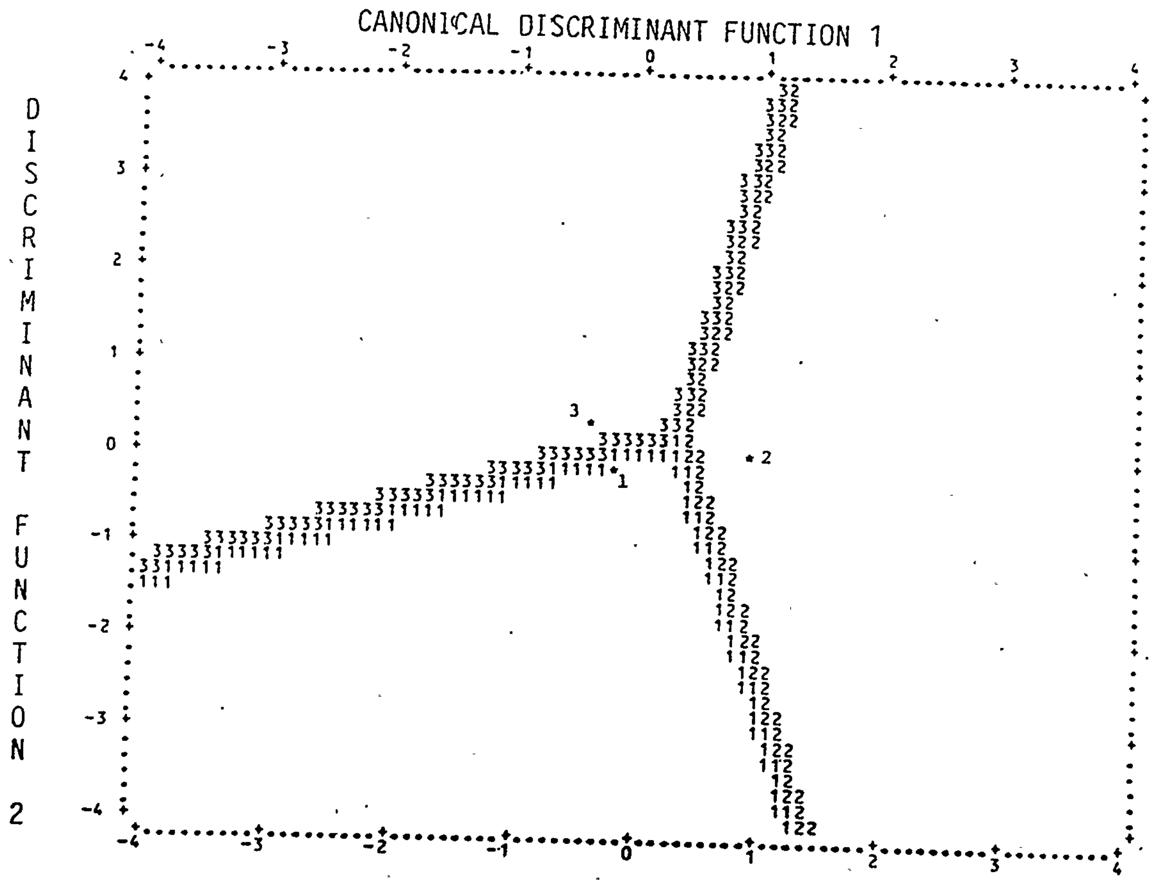
Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	29	21 72.4%	7 24.1%	1 3.4%
Complex 2 Caribou Lake	26	18 69.2%	8 3Ø.8%	Ø Ø.Ø%
Complex 3 Grant Lake	17	12 7Ø.6%	3 17.6%	2 11.8%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 43.Ø6%

Table 6. F Statistics and Significances between Complexes on Cores (Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 4, EACH F STATISTIC HAS 4 AND 42 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	2.4128 Ø.Ø639	
Grant Lake	Ø.71467 Ø.5866	2.5161 Ø.Ø556



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 22. Territorial Distribution of Cores
(Non-Metric Variables)

Table 7. Classification Function Coefficients for Cores (Non-metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Unprepared Cores	.8634241	3.818Ø88	1.525927
Double Ended Cores	1.295Ø96	3.817196	.47466Ø3
Single Ended Cores	1.Ø57955	.976Ø7Ø5	3.2871Ø5
Blade-like Cores	1.412687	2.978442	1.582697
Constant	-1.3Ø1819	-2.545939	-1.568ØØ9

three instances more cores are classified as Lakehead than any of the other two complexes. Figure 22 shows the distribution of this classification. The significance table (Table 6) of F statistics between pairs of group centroids also indicated that at the 1% alpha level, with 4 and 42 degrees of freedom and a critical value of 3.81 that none of the centroids are statistically significantly different and so the discrimination is not strong.

A discussion of the classification coefficients (Table 7) would be misleading and essentially useless, considering the results of the classification. What these results do, is support my interpretation of the metric run and cluster analysis, in that there is essentially little difference, except in in terms of size, between the complexes. This latter difference has already between explained as not necessarily being caused by culturally different technologies, but by culturally different quarrying activites.

Combined metric and non-metric variables

Of the 72 cores and core fragments in the three complexes only 25 Lakehead, 10 Caribou Lake, and 11 Grant Lake cores were complete enough to be used in the combined analysis. Seven variables, three metric that included length, width, and weight; and four non-metric which consisted of the presence of unprepared cores, double ended cores single ended cores and blade-like cores were used.

After five steps the five variables that remained in the analysis were length, width, weight, the presence of double ended and single ended cores. The two variables eliminated were the presence of unprepared cores and blade-like cores.

The classification equation can be constructed from Table 8 as described above. The only difference was the presence of the nominal level variables; for these variables a 1 is to indicate the presence of this attribute and a Ø is used to indicate the absence of the attribute. Then the equation is solved in the manner discussed earlier.

As the classification table (Table 9) revealed these functions do not increase the overall predictability of the three groups over that of the metric run. Figure 23 shows the distribution of this classification. Within this table changes were apparent. The most notable being a reduction in the correct predictablity of the Caribou Lake cores from 88.5% to 84.6%, and an increase in the predictability in the Grant Lake cores. There was also an improvement in the significance (Table 1Ø) of between group centroids at the 1% level of significance, at least between Grant Lake and Lakehead. At this alpha level and with 5 and 39 degrees of

Table 8. Classification Function Coefficients for Cores

(Combined Metric and Non-metric Variables)

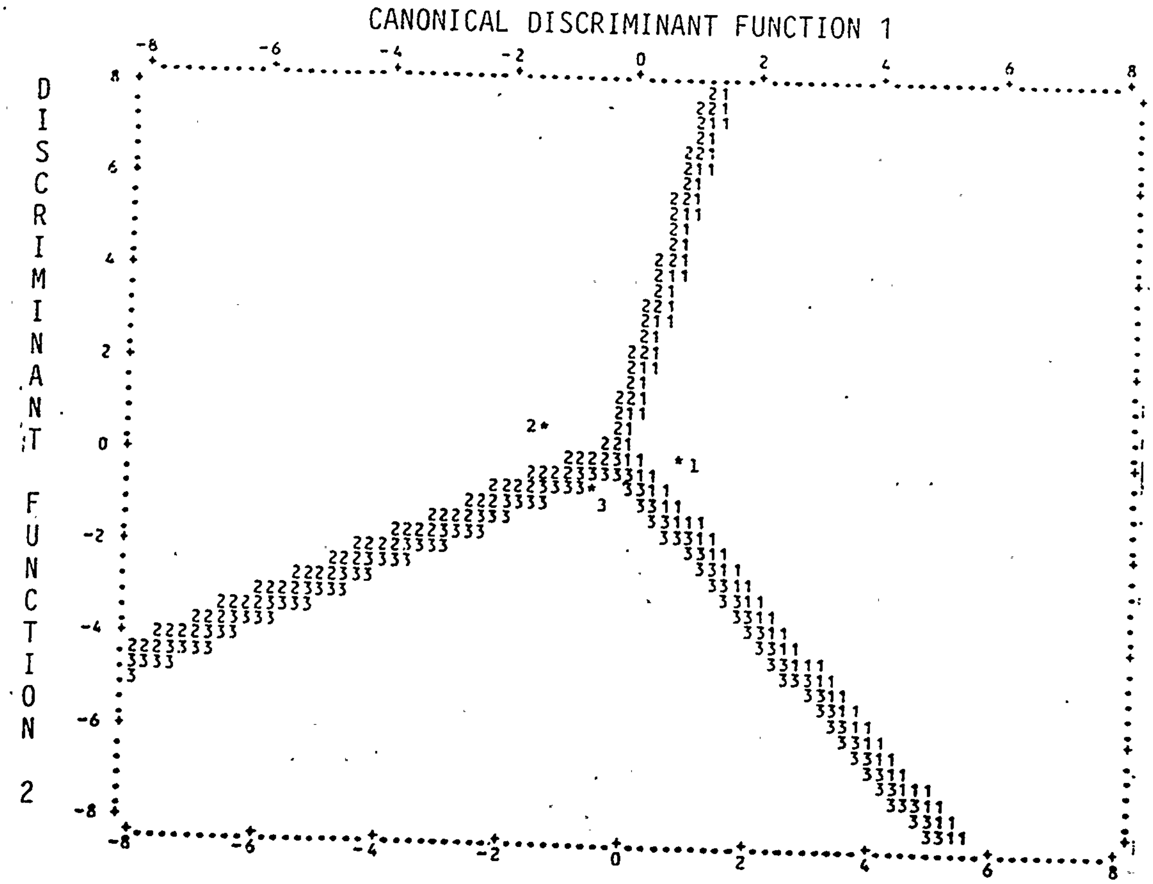
Variable	Lakehead	Caribou Lake	Grant Lake
Length	.2184542	.1106436	.1203567
Width	.3001220	.2300616	.3146363
Weight	-.05271279	-.03638334	-.04438824
Double Ended Cores	.1511565	2.812608	-.5508488
Single Ended Cores	-4.097879	-2.990397	-1.094760
Constant	-14.54089	-6.762641	-9.828153

Table 9. Classification Results for Cores

(Metric and Non-metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	29	19 65.5%	3 10.3%	7 24.1%
Complex 2 Caribou Lake	26	2 7.7%	22 84.6%	2 7.7%
Complex 3 Grant Lake	17	3 17.6%	4 23.5%	10 58.8%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 70.83%



1 – Lakehead
2 – Caribou Lake
3 – Grant Lake
* – Group Centroids

Figure 23. Territorial Distribution of Cores
(Combined Variables)

Table 10. F Statistics and Significances between Complexes of Cores (Metric and Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 5, EACH F STATISTIC HAS 5 AND 39 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	6.3279 0.0002	
Grant Lake	3.7264 0.0075	2.2930 0.0641

Table 11. Means and Standard Deviations of Cores (Metric and Non-metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	85.34	20.45	45.11	23.01	58.50	27.10*
Width	57.76	13.08	35.96	23.68	51.90	20.20*
Weight	169.64	107.18	76.39	115.17	128.69	157.77*
Unprepared Cores	0.0400		0.3000		0.0909	
Double Ended Cores	0.0800		0.3000		0.0000	
Single Ended Cores	0.0400		0.0000		0.1818	
Blade-like Cores	0.1600		0.2000		0.1818	

All measurements are in millimetres except Weight which is in grams.
* Denotes a discriminating variable.

freedom and a critical value of 3.52 only the discrimination of the Grant Lake and Caribou Lake were not significant.

The means and standard deviations table (Table 11) revealed that Lakehead cores were the largest and Caribou Lake cores were the smallest; while, the Caribou Lake cores were most likely to be double ended and Grant Lake the least likely. Finally, single ended cores were more common at the Grant Lake site. Again weight showed a lack of central clustering around the mean while length and width had modest tendencies of comparable size. (Any differences between the means and standard deviations of any variables between the three runs is due to slightly different subsets of the data being used; this in turn is caused by which variables are being used and how many artifacts are missing one of these variables.)

The results of this combined variable analysis mirrored the results of the first two runs and the cluster analysis, in that there is little or no difference between the three complexes in terms of the type of cores present, and that the differences in size was explainable in terms of how the inhabitants of these complexes obtained their lithic resources.

Edge Retouched Flake Tools

Metric variables

The combined edge retouched flake tools allowed six different comparisons, three comparing the complexes and three comparing the original tool types. Only the analyses on the complexes will be discussed in detail since it is the primary focus of this study. The results of the other three runs will be discussed briefly.

Of the 86 edge retouched flake tools 59 were complete enough to be used in the analysis with the four metric variables. These 59 artifacts were broken down by complex into 20 Lakehead, 19 Caribou Lake, and 20 Grant Lake tools. After three steps length, width, and weight remained in the analysis and thickness had been eliminated as an important discriminating variable. Such results indicated that the thickness of the flake was equal in all three complexes and was important in the selection of flakes for these types of tools while the length, width, and weight varied. This suggested that different sizes of flakes were being used for the same sort of tools. To some extent these three discriminating variables, especially weight, may reflect the different material types common in each area.

Table 12 reports the classification functions for the three complexes. Using these coefficients the classification procedure was able to classify correctly

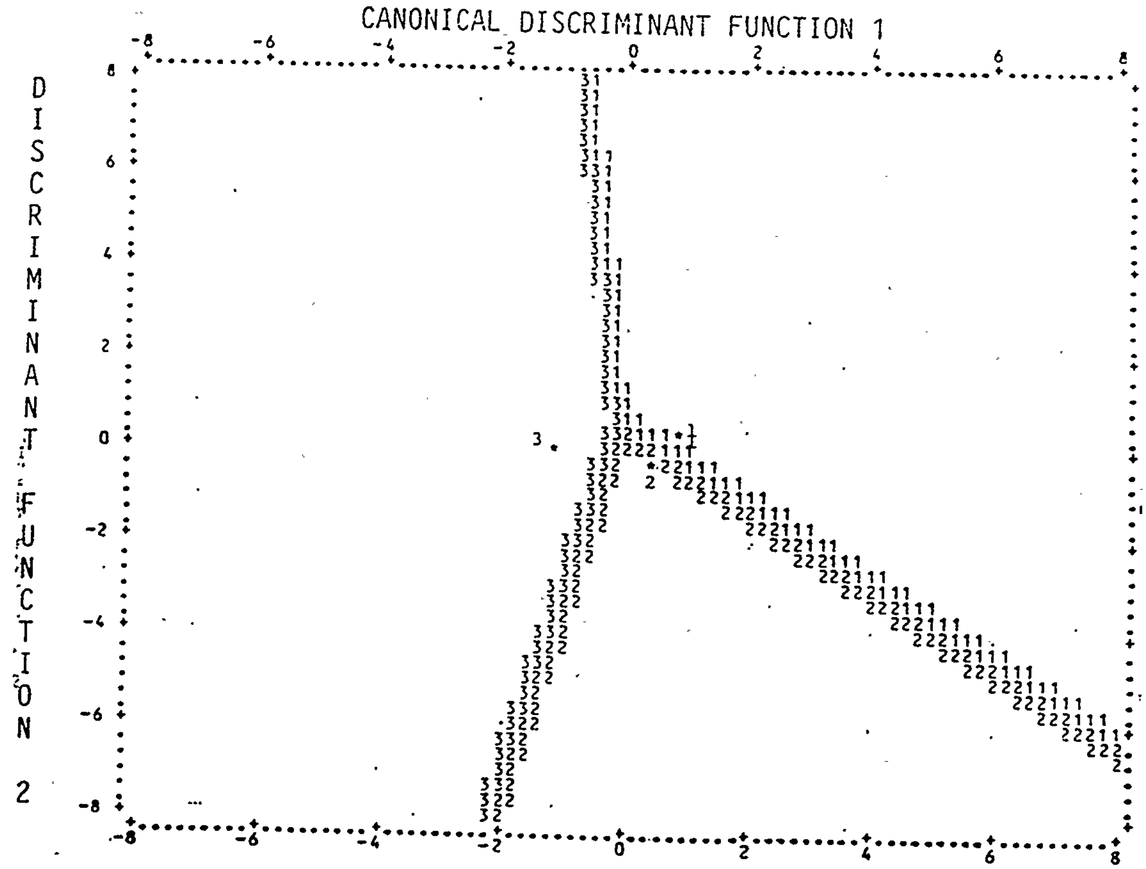
Table 12. Classification Function Coefficients for Edge Retouched Flake Tools (Metric Variables by Complex)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	.4326492	.4295175	.3218858
Width	.6635624	.6696707	.5327440
Weight	-2.198424	-2.408463	-1.991939
Constant	-25.93169	-24.73548	-14.88638

Table 13. Classification Results for Edge Retouched Flake Tools (Metric Variables by Complex)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	24	13 54.2%	9 37.5%	2 8.3%
Complex 2 Caribou Lake	21	5 23.8%	14 66.7%	2 9.5%
Complex 3 Grant Lake	41	2 4.9%	14 34.1%	25 61.0%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 60.47%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 24. Territorial Distribution of Edge Retouched Flakes (Metric Variables)

6Ø.47% of the artifacts into their correct complexes. Specifically, the classification table (Table 13) showed that all three complexes can be separated with better than 5Ø% probablity. Figure 24 visually shows this separation. Only the Grant Lake site centroid however, was statistically significantly (Table 14) different from the other two with 3 and 54 degrees of freedom and a critical value of 4.Ø9 at the 1% alpha level. This contrasted with the cluster analysis which showed that the Grant Lake and Caribou Lake clusters were more similar to each other than to the Lakehead cluster.

The means and standard deviations (Table 15) of the discriminating variables showed that the Lakehead complex had the longest, widest and heaviest flakes and the Grant Lake had the shortest, thinnest, and lightest. As with the cores this may reflect the difference in the size of the cores and quarrying activites, discussed above. The standard deviations revealed that there is a strong tendency to central clustering around the means of the discriminating variables and that the ranges are all of the same magnitude, with weight having the greatest difference in range between the complexes.

The analysis of the data comparing the tools by the original flake tool types found only a 56.98% correct classification rate with the denticulates and retouched

Table 14. F Statistics and Significances for Edge Retouched Flake Tools (Metric Variables by Complex)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 3, EACH F STATISTIC HAS 3 AND 54 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	1.6786 0.1824	
Grant Lake	14.882 0.0000	9.2861 0.0000

Table 15. Means and Standard Deviations of Edge Retouched Flake Tools (Metric Variables by Complex)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	74.97	19.80	65.84	13.41	43.53	17.09*
Width	50.20	10.18	45.49	12.52	33.11	10.05*
Thickness	18.06	7.65	14.40	4.62	10.88	8.66
Weight	7.31	4.83	4.76	2.80	2.05	2.33*

All measurements are in millimetres except Weight which is in grams.
* Denotes a discriminating variable.

flakes being statistically significantly different (Table 16 and Table 17). The only important discriminating variable was the thickness of the flake which was not important when comparing by complexes. This supported the cluster analysis which showed that the artifacts were grouped better by complex than by tool types. It also indicated that there are both differences in these tools between complexes and similarities within the tool types across complexes.

Overall, this analysis showed that only the Grant Lake edge retouched flake tools were significantly different from either the Caribou Lake or Lakehead complex tools. This supported, to some extent, both the cluster analysis and the metric run of the cores which displayed that there was little difference in flake scar lengths and widths between the complexes. The latter obsevation is however, contradicted when comparing these flake tools by complex which showed the length and width were discriminating variables. Obviously some complicated decisions went into the selection of the proper size flakes for these tools involving both functional consideration (thickness) and local cultural preferrences (length, width and weight).

Table 16. Classification Results for Edge Retouched Flake Tools (Metric Variables by Original Tool Type)

Actual Group	No. of Cases	Predicted Group Membership Retouched Flakes	Side Scrapers	Denticulates
Group 1 Retouched Flakes	42	3Ø 71.4%	5 11.9%	7 16.7%
Group 2 Side Scrapers	29	1Ø 34.5%	14 48.3%	5 17.2%
Group 3 Denticulates	15	5 33.3%	5 33.3%	5 33.3%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 56.98%

Table 17. F Statistics and Significances for Edge Retouched Flake Tools (Metric Variables by Original Tool Type)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 1, EACH F STATISTIC HAS 1 AND 56 DEGREES OF FREEDOM.

	Retouched Flakes	Side Scrapers
Side Scrapers	Ø.7Ø186 Ø.4Ø57	
Denticulates	8.16Ø4 Ø.ØØ6Ø	4.8246 Ø.Ø322

Non-metric variables

All 86 artifacts were complete enough to be used in this part of the analysis. The three original nominal level variables were recoded into binomial variables reflecting the types of flaking observed on the edge retouched flake tools. After seven steps seven variables were considered to be useful in discrimanting between the complexes. The following variables were left in the analysis after step seven: the presence or absence of edge retouch scars, expanding flake scars, mixed flake scars, broad flake scars, mixed widths of flake scars, regular edge retouched and mixed depths of flake scars. Those variables not in the analysis, which suggested that their occurrence in the three complexes is similar, were the presence or absence of parallel sided scars, thin flake scars, moderately wide scars, shallow scars, medium deep flake scars, deep scars, and irregular edge retouch.

Table 18 presents the classification functions obtained from the analysis. Although, these equations look long and complicated they are not since only a 1 or Ø will be used to fill in the variables, with 1 indicating the presence and Ø the absence of a particular trait.

These classification functions produced the results of the classification table (Table 19) which revealed that there is an overall 56.98% classification rate, with

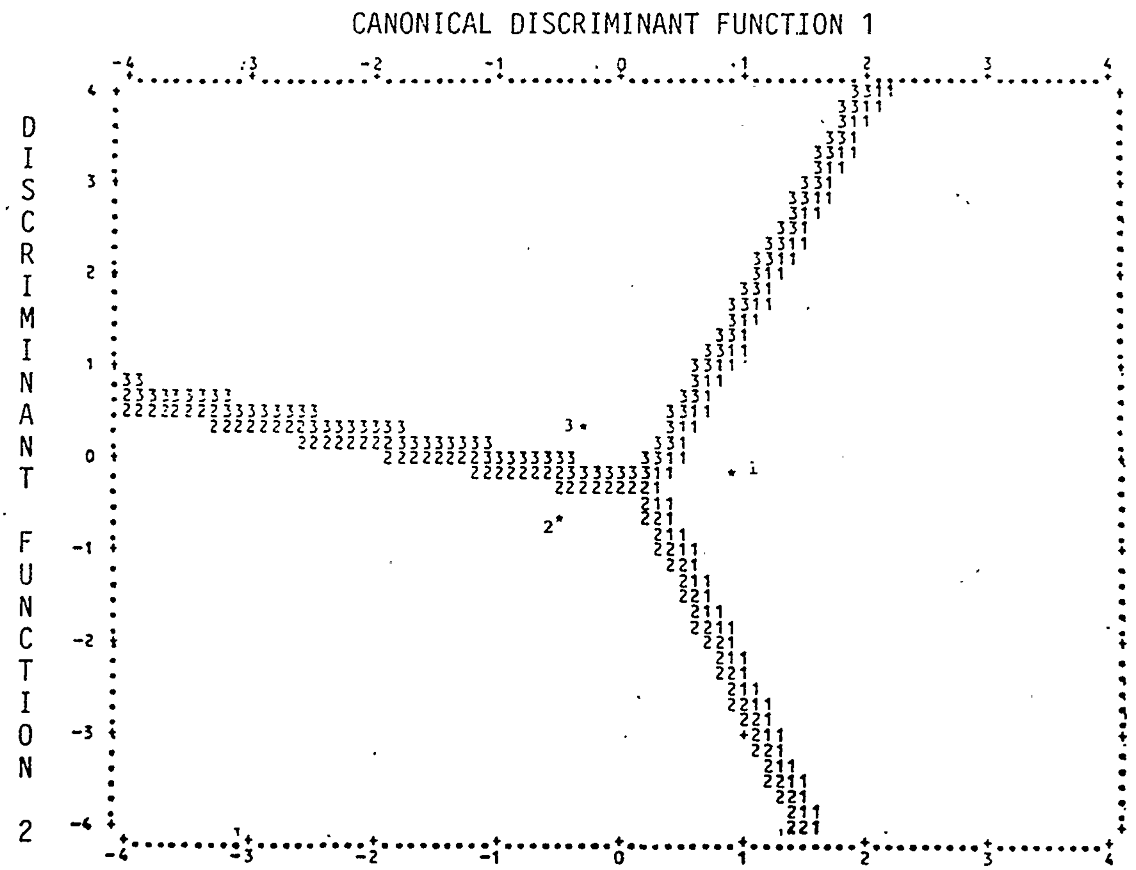
Table 18. Classification Function Coefficients for Edge Retouched Flake Tools (Non-metric Variables by Complex)

Variable	Lakehead	Caribou Lake	Grant Lake
Edge Retouch	6.831817	5.082112	5.163791
Expanding Flake Scars	5.041969	6.134391	4.068633
Mixed Scar Types	7.672694	3.960198	3.611699
Broad Flake Scars	-.00216971	.1617551	1.959304
Mixed Widths	.7472651	2.486389	1.793626
Regular Edge Retouch	-1.465296	-.5114855	.6410605
Mixed Depths	-1.333314	-1.019248	.1506614
Constant	-4.015291	-3.681073	-3.330377

Table 19. Classification Results on Edge Retouched Flake Tools (Non-metric Variables by Complex)

		Predicted Group Membership		
Actual Complex	No. of Cases	Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	24	15 62.5%	3 12.5%	6 25.0%
Complex 2 Caribou Lake	21	3 14.3%	9 42.9%	9 42.9%
Complex 3 Grant Lake	41	10 24.4%	6 14.6%	25 61.0%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 56.98%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centoids

Figure 25. Territorial Distribution of Edge Retouched Flakes (Non-Metric Variables)

Lakehead having the best success at classification at 62.5% and Caribou Lake the worst at 42.9%. Figure 25 shows the distribution of this classification. In the latter case Caribou Lake is also misclassified with Grant Lake 42.9% of the time. From the significance table (Table 20) at 7 and 77 degrees of freedom and with a critical value of 2.91 and the 1% alpha level the difference between Grant Lake and Caribou Lake centroids are not statistically significant; while the difference between Lakehead and the other two groups is.

Again, as an aside, a run was made using the original tool groups. In this analysis seven variables were also picked as discriminating variables. Three of these variables were indentical to those used on the comparison of the complexes and four were not. These discriminating variables had an overall correct classification rate of 73.21% (Table 21), much better than the complex results, and all group centroids were statistically significant (Table 22). Besides showing the usefulness of discriminating tool types this exploratory analysis revealed that there were certain flake scar types associated with each complex and flake scar types associated with the tool types that crosscut to some degree that of the complexes.

Table 2Ø. F Statistics and Significances for Edge Retouched Flake Tools (Non-metric Variables by Complex)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 7, EACH F STATISTIC HAS 7 AND 77 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	3.3229 Ø.ØØ38	
Grant Lake	3.227Ø Ø.ØØ47	1.964Ø Ø.Ø7Ø9

Table 21. Classification Results for Edge Retouched Flake Tools (Non-metric Variables by Original Tool Type)

Actual Groups	No. of Cases	Predicted Group Membership Retouched Flakes	Scrapers	Side Denticulates
Group 1 Retouched Flakes	42	29 69.Ø%	11 26.2%	2 4.8%
Group 2 Side Scrapers	29	3 1Ø.3%	21 72.4%	5 17.2%
Group 3 Denticulates	15	Ø Ø.Ø%	2 13.3%	13 86.7%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 73.26%

Table 22. F Statistics and Significances for Edge Retouched Flake Tools (Non-metric Variables by Original Tool Type)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 11, EACH F STATISTICE HAS 7 AND 77 DEGREES OF FREEDOM.

	Retouched Flakes	Side Scrapers
Side Scrapers	5.9809 0.0000	
Denticulates	13.532 0.0000	7.8290 0.0000

Table 23. Means of Edge Retouched Flake Tools (Non-metric Variables by Complex)

	Lakehead M	Caribou Lake M	Grant Lake M
Edge Retouch	0.41667	0.14286	0.34146*
Parrallel Sided	0.12500	0.19048	0.21951
Expanding	0.12500	0.61905	0.34146*
Mixed Types	0.33333	0.04762	0.09756*
Broad Scars	0.08333	0.19048	0.29268*
Thin Scars	0.37500	0.42857	0.24390
Moderate Width	0.00000	0.00000	0.00000
Mixed Widths	0.12500	0.23810	0.12195*
Shallow Scars	0.50000	0.61905	0.34146
Medium Deep Scars	0.00000	0.04762	0.02439
Deep Scars	0.00000	0.04762	0.09756
Regualar Edge Retouch	0.12500	0.04762	0.21951*
Irregular Edge Retouch	0.29167	0.09524	0.14634
Mixed Depths	0.08333	0.14286	0.17073*

* Denotes a discriminating variable.

The means of the discriminating variables (Table 23) disclosed that the Lakehead complex was more likely to have edge retouch or mixed type scars, and least likely to have expanding or broad flake scars. The Caribou Lake complex was more likely to have expanding and mixed width flake scars and least likely to have edge retouch, mixed types, broad, and regular edge retouch flake scars. The Grant Lake site tools tended to have broad flake scars, regular edge retouch and mixed depths of scars and tended not to have mixed width scars, and fall between the other complexes in the appearance of the other traits.

These results suggested that the Grant Lake site and Caribou Lake complexes had similar kinds of flaking scars indicating that both had similar manufacturing methods and functional uses of these tools. Like the metric run, this partly supports the results of the cluster analysis that showed a distinction between the complexes in the edge retouched flake tools. In the metric run, however, Grant Lake was significantly distinct from the other complexes while in this non-metric analysis the Lakehead complex is unique. This contradiction may reflect different functional uses of these tools in the Lakehead complex. The results of the comparison by tool type, however, would suggest there is some consistency between tool types in the type of flaking present that runs across the complexes.

Combined metric and non-metric variables

Of the 86 edge retouched flake tools 59 were complete enough to allow for analysis using the three metric and seven non-metric variables produced from the two previous analyses. This included 20 Lakehead, 19 Caribou Lake and 20 Grant Lake artifacts. After 11 steps 10 variables remained in the study. These included the three metric variables length, width, and weight as well as the presence or absence of six of the nominal variables: edge retouch, expanding, mixed types, broad, regular edge retouch and mixed depth flake scars. The only variable eliminated from the study was the presence of mixed widths of flake scars.

Table 24 provides the classification function coefficients for the mixed variable analysis, and although they look long and involved they really are not, for reasons already discussed. The classification table (Table 25) and the significance table (Table 26) both indicated that a substantial improvement in the discrimination of these flake tools between the complexes over either of the previous two runs. Figure 26 helps to visualize the classification. The classification table showed that 73.26% of the artifacts were correctly classified with Lakehead having the best percentage at 79.2%, then Caribou Lake at 71.4%, and finally Grant Lake at 70.7%. According to the significance table the separation of these three

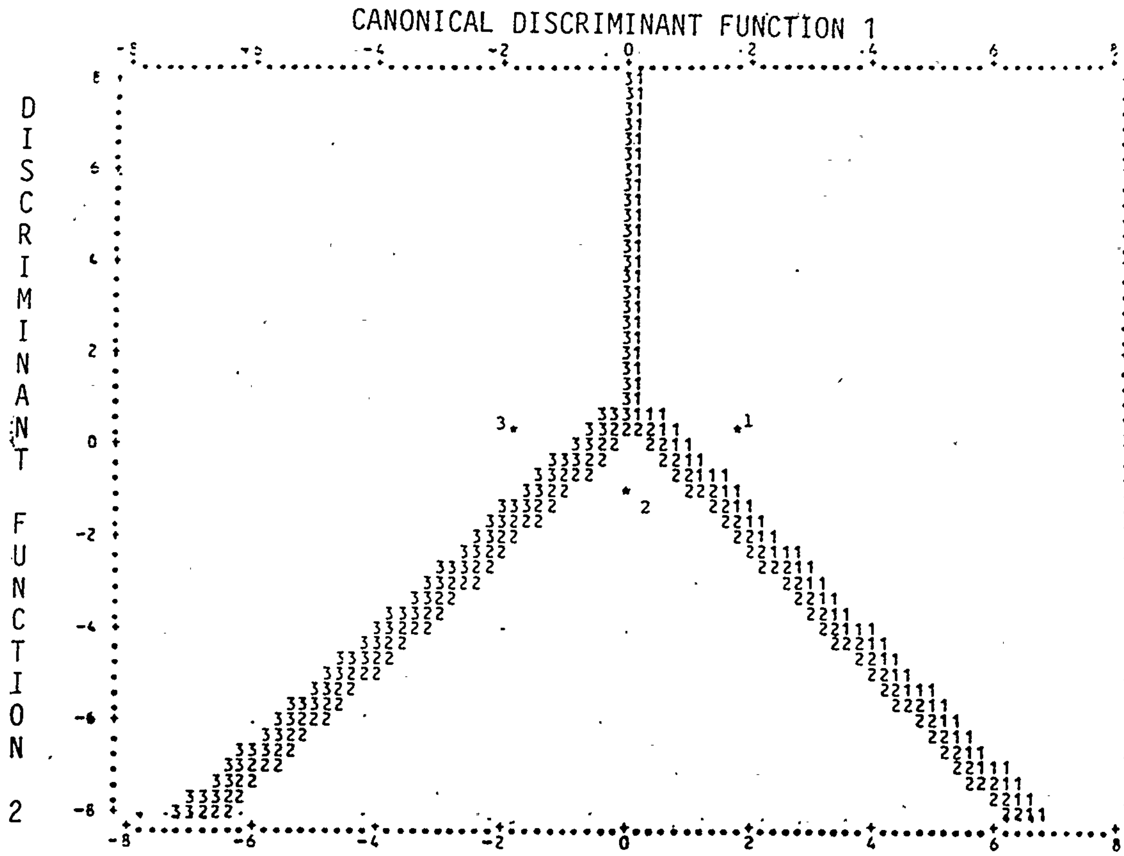
Table 24. Classification Function Coefficients for Edge Retouched Flake Tools (Metric and Non-metric Variables by Complex)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	.5246160	.4926798	.3485476
Width	.7043578	.6799326	.5221998
Weight	-1.939672	-2.414193	-1.954393
Edge Retouch	10.31637	7.264563	7.810707
Expanding	3.929783	6.699715	6.728459
Mixed Types	11.99449	9.053605	8.625350
Broad Scars	-7.259443	-5.160251	-2.253639
Regular Edge Retouch	-3.849749	-2.233851	-.3171343
Mixed Depths	-5.838634	-4.915720	-2.308399
Constant	-35.20361	-28.97185	-18.08910

Table 25. Classification Results for Edge Retouched Flake Tools (Metric and Non-metric Variables by Complex)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	24	19 79.2%	3 12.5%	2 8.3%
Complex 2 Caribou Lake	21	3 14.3%	15 71.4%	3 14.3%
Complex 3 Grant Lake	41	7 17.1%	5 12.2%	29 70.7%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 73.26%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 26. Territorial Distribution of Edge Retouched Flakes (Combined Variables)

Table 26. F Statistics and Significances for Edge Retouched Flake Tools (Metric and Non-metric Variables by Complex)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 11, EACH F STATISTIC HAS 9 AND 48 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	4.7227 Ø.ØØØ1	
Grant Lake	11.867 Ø.ØØØØ	4.4282 Ø.ØØØ3

Table 27. Classification Results of Edge Retouched Flake Tools (Metric and Non-metric Variables by Tool Type)

Actual Group	No. of Cases	Predicted Group Membership Retouched Flakes	Side Scrapers	Denticulates
Group 1 Retouched Flakes	42	29 69.Ø%	11 26.2%	2 4.8%
Group 2 Side Scrapers	29	4 13.8%	2Ø 69.Ø%	5 17.2%
Group 3 Denticulates	15	Ø Ø.Ø%	2 13.3%	13 86.7%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 72.Ø9%

groups are all statistically significant with 9 and 48 degrees of freedom and a critical value of 2.82.

In the analysis comparing the data by tool type 72.09% of the artifacts were classified correctly (Table 27) and all centroids were statistically significant (Table 28). Of the ten original variables obtained from the first two runs only six nominal levels variables were considered important in discriminating between the tool types. The occurrence of these six flake scar types and the level of significance and classification rate indicated that there were unique flake scar types that differentiated the tool types, and that these flake scars crosscut the complex boundaries. It should be noted that these results may also be due to my own subjective categories for differentiating these tools which relied in part on the type of flaking observed on the artifacts. If nothing else it would seem that my catgorization of these tools was fairly constant.

The means and standard deviations (Table 29) of the discriminating variables described the edge retouched flakes in the following manner:

1. The Lakehead complex flake tools were the largest in terms of length, width, and weight and were more likely to have a mixture of flake types and were equally as likely, along with the Grant Lake site tools, to have edge retouch. They are least likely

Table 28. F Statistic and Significance for Edge Retouched Flake Tools (Metric and Non-metric Variables by Original Tool Type)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 5, EACH F STATISTIC HAS 5 AND 71 DEGREES OF FREEDOM.

	Retouched Flakes	Side Scrapers
Side Scrapers	6.2529 Ø.ØØØ1	
Denticulates	18.Ø3Ø Ø.ØØØØ	7.9674 Ø.ØØØØ

Table 29. Means and Standard Deviations for Edge Retouched Flake Tools (Metric and Non-metric Variables by Complex)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	74.97	19.8Ø	65.84	13.41	43.53	17.Ø9*
Width	5Ø.2Ø	1Ø.18	45.49	12.52	33.11	1Ø.Ø5*
Weight	7.31	4.83	4.76	2.8Ø	2.Ø5	2.33*
Edge Retouch	Ø.45ØØØ		Ø.15789		Ø.45ØØØ*	
Expanding Scars	Ø.1ØØØØ		Ø.63158		Ø.4ØØØØ*	
Mixed Types	Ø.35ØØØ		Ø.Ø5263		Ø.Ø5ØØØ*	
Broad Scars	Ø.Ø5ØØØ		Ø.21Ø53		Ø.25ØØØ*	
Mixed Widths	Ø.15ØØØ		Ø.26316		Ø.1ØØØØ	
Regular Edge Retouch	Ø.15ØØØ		Ø.Ø5263		Ø.3ØØØØ*	
Mixed Depths	Ø.1ØØØØ		Ø.15789		Ø.2ØØØØ*	

All measurement are in millimeters except Weight which is in grams.
* Denotes a discriminating variable.

to have expanding, broad, or mixed depth flake scars. The complex fell in between the other complexes in terms of the presence of regular retouch.

2. Caribou Lake tools were moderate in size in comparison to the other complexes and were most likely to have expanding flake scars. They were least likely to have edge retouch and if it was present it was least likely to be regular edge retouch. In all other variables it lies between Lakehead and Grant Lake in their presence.

3. Grant Lake site tools were the smallest in terms of size and were just as likely as the Lakehead complex to have edge retouch. They were more probable to have broad, regular retouch or mixed depth flake scars and it fell between the two other complexes in the occurrence of expanding or mixed type of flake scars.

The standard deviations were identical to those obtained in the metric analysis of the edge retouched flake tools.

Discussion

From all of the above results I speculate that there are definite differences in terms of the both the size of the flakes produced and in the types of flakes removed from the flake for use between the three complexes. Now whether differences are due to different functional uses between the complexes, to the different sizes of cores, or to cultural differences that are strictly related to the function of the tool is difficult to determine without use wear analysis. The analyses comparing the data by tool types have suggested support for the latter interpretation. This seemed even more apparent when in the non-metric run the comparison of tool types gave the better classification rate (73.26% to 56.98%) which indicated that flake scar were much more generalized between the complexes.

Bifaces

Metric variables

Of the 150 artifacts recorded as bifaces 53 were complete enough to be used in this analysis stage using the seven metric variables. This included 24 Lakehead, 20 Caribou Lake, and 9 Grant Lake site artifacts. After three steps three variables were found to be significant in differentiating between these complexes. These discriminating variables were length, thickness, and basal width. Those variables not included in the analysis, and can thus be considered as more or less constant across the three complexes, were width, weight, distance to the maximum width and distance to the maximum thickness.

The classification and significance tables (Table 30 and Table 31) revealed that, although the separation of the groups is statistically significant with 3 and 48 degrees of freedom and a critical value of 4.30 at the 1% significant level, it is not a very strong separation. Figure 27 shows the distribution of this classification. The only complex that showed a strong discreteness is the Caribou Lake complex with 73.7% classified correctly bifaces. There was an overall classification rate of 44.67% with both of the other two complexes being misclassified as Caribou Lake at least as much as they were correcly classified. In the case of the Grant Lake site, where only nine artifacts were available for the analysis stage, the results may be attributable to the small sample size. The fact, however, that the Lakehead complex bifaces also showed a lack of distinction between it and the Caribou Lake complex, and that in both instances the Lakehead and Grant Lake material was misidentified more with Caribou Lake than with each other, might suggest that the results involving the Grant Lake site were correct.

Table 32 provides the classification coefficients, although I would caution the use of these due to the poor classification results discused above. The means and standard deviations (Table 33) indicated that the artifacts from the Lakehead complex were the longest, thickest and

Table 3Ø. Classification Results for Bifaces

(Metric Variables)

Actual Complexes	No. of Cases	Predicted Group Membership: Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	35	15 42.9%	15 42.9%	5 14.3%
Complex 2 Caribou Lake	38	2 5.3%	28 73.7%	8 21.1%
Complex 3 Grant Lake	77	1 1.3%	52 67.5%	24 31.2%

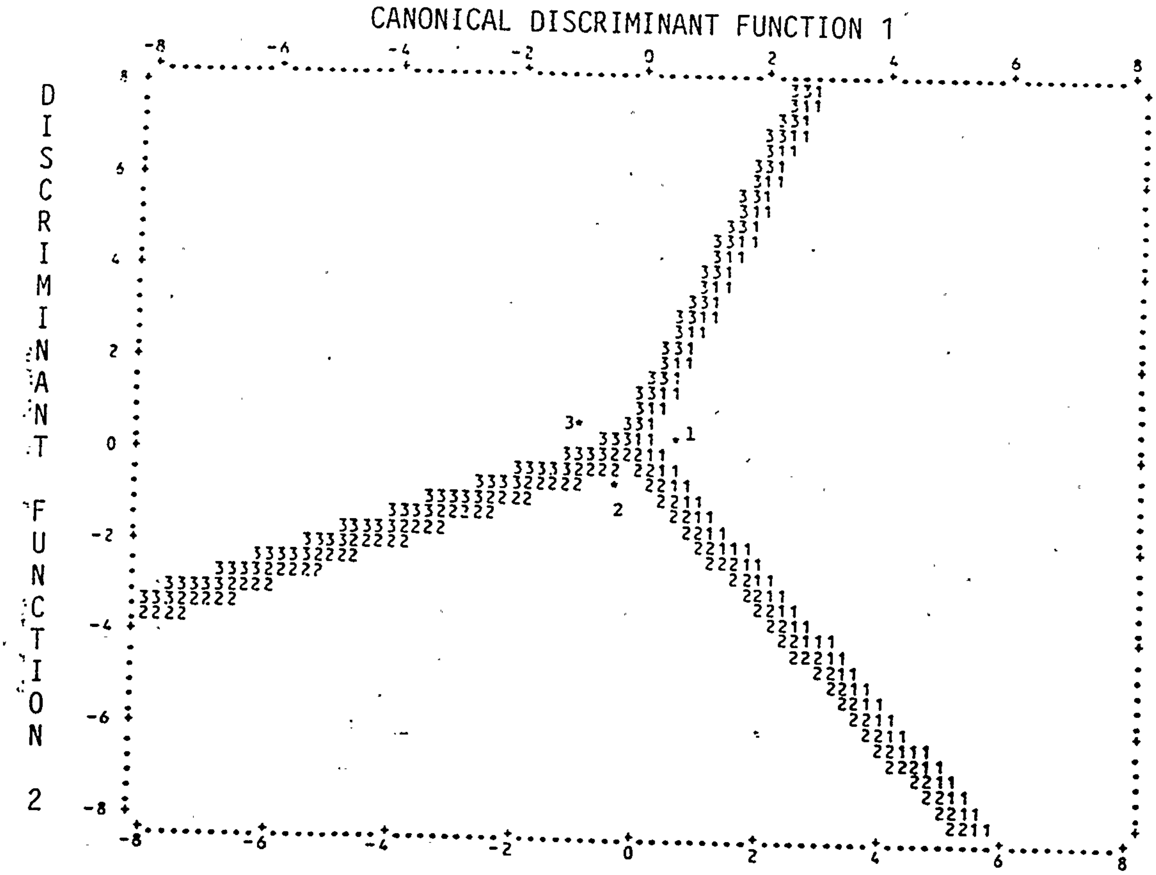
PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 44.67%

Table 31. F Statistics and Significances for Bifaces

(Metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 3, EACH F STATISTIC HAS 3 AND 48 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	5.9715 Ø.ØØ15	
Grant Lake	6.9759 Ø.ØØØ5	4.4687 Ø.ØØ76



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 27. Territorial Distribution of Bifaces
(Metric Variables)

Table 32. Classification Function Coefficients for Bifaces

(Metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	.2519857	.2254969	.1618307
Thickness	.5018055	.5051723	.3173547
Basal Width	.006507235	-.09165014	.04736607
Constant	-16.90020	-12.28842	-8.546649

Table 33. Means and Standard Deviations of Bifaces

(Metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	90.88	22.25	75.23	11.33	61.49	15.66*
Width	53.01	17.96	39.58	8.51	35.87	8.89
Thickness	16.93	5.71	14.07	3.72	11.81	3.82*
Weight	111.43	100.73	46.08	22.04	26.38	18.04
Distance to Maximum Width	40.16	14.05	35.30	7.88	27.26	13.39
Distance to Max. Thickness	37.69	18.35	33.08	14.26	24.07	9.29
Basal Width	31.75	13.02	18.45	7.60	25.29	10.06*

All measurements are in millimeters except Weight which is in grams.
* Denotes a discriminant variable.

had the widest basal widths. The Caribou Lake complex bifaces were the smallest in terms of their basal widths and moderate in terms of length and thickness. Finally, the Grant Lake site is smallest in length and thickness but moderate in terms of basal width. The standard deviations tended to show that in all three variables some clustering about the means did occur. In each case the Lakehead complex had the largest range and Caribou Lake the smallest, and with the possible exception of length the magnitude of the ranges were approximatly the same. Again, as a reminder although these differences are statistically significant they are not very strong in actually distinguishing between the complexes.

In conclusion it would seem that despite the significance of these groups of bifaces that there is really very little difference between the complexes in the size of the bifaces being manufactured.

<u>Non-metric variables</u>

Of the 150 bifaces 101 were complete enough to be used in the non-metric variable analysis. This included 34 Lakehead, 36 Caribou Lake, and 31 Grant Lake site artifacts. The eight original nominal level variables were recoded into 47 binomial variables, 15 of which remained in the analysis as discriminating variables after the maximum number of 15 steps in the stepwise procedure. The discriminating variables were the presence or absence of lenticular, asymmetrical lenticular, plano triangular, bi-concave or diamond transverse cross section, a rectangular or ovate shape, expanding ventral flake scars, deep or moderately deep ventral flake scars, expanding, thin or moderately wide dorsal flake scars, and moderately deep dorsal flake scars. The presence of all the other variables is more or less constant across the three complexes.

Table 34 gives the classification coefficients for the complexes which resulted in the classification table (Table 35) and a 71.33% classification rate using the nominal level variables. Figure 28 helps to visualize this separation. These results showed that the Lakehead complex is most distinct at 82.9% with Caribou Lake next at 78.9% and Grant Lake last at 62.3%. The significance table (Table 36) revealed that at 15 and 84 degrees of freedom, with a critical value of 2.29 that the classification results were statistically significant.

Using the means (Table 37) of the discriminanting variables, the bifaces of the three complexes can be described in the following manner:

1. Lakehead complex bifaces were more likely to have a lenticular cross section and were more likely than either of the other complexes to have a diamond

Table 34. Classification Function Coefficients for Bifaces (Non-metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Cross Section			
Lenticular	2.105141	2.877973	.5024883
Asymmetrical Lenticular	-.5732233	3.294258	1.638801
Plano Tri.	-8.673372	6.615674	-3.344252
Bi-Concave	-1.784443	-2.827886	3.468299
Diamond	8.769782	1.607163	2.174800
Shape			
Rectangular	5.806820	-1.314853	2.401698
Oval	2.723513	.02561728	1.299643
Flaking I (Ventral)			
Expanding	2.092025	2.612553	.5776242
Flaking III (Ventral)			
Deep	2.585318	-.1166303	3.814325
Moderate Deep	2.758530	-1.289716	3.076141
Flaking I (Dorsal)			
Expanding	1.828342	1.446362	-.2595214
Flaking II (Dorsal)			
Thin	5.165698	.8115871	2.421725
Moderate Wide	-2.237298	-.1397011	.3277165
Flaking III (Dorsal)			
Moderate Deep	4.008824	4.900734	.07646568
Mixed Depth	4.231993	4.612351	1.634507
Constant	-6.158323	-4.823163	-2.394281

Table 35. Classification Results for Bifaces

(Non-metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	35	29 82.9%	4 11.4%	2 5.7%
Complex 2 Caribou Lake	38	2 5.3%	3Ø 78.9%	6 15.8%
Complex 3 Grant Lake	77	15 19.5%	14 18.2%	48 62.3%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 71.33%

Table 36. F Statistics and Significances for Bifaces

(Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 15, EACH F STATISTIC HAS 15 AND 84 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	5.1253 Ø.ØØØØ	
Grant Lake	4.7183 Ø.ØØØØ	6.2353 Ø.ØØØØ

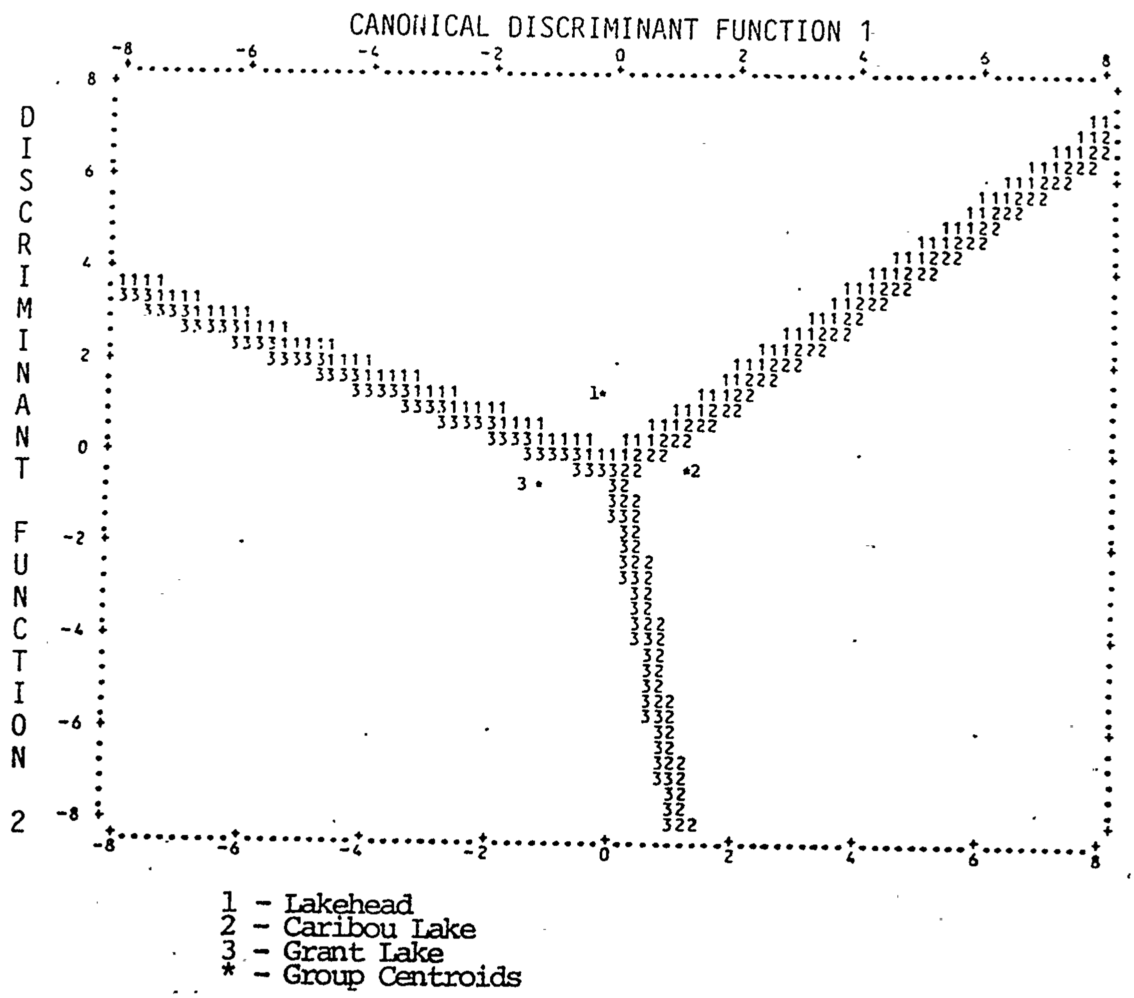


Figure 28. Territorial Distribution of Bifaces
(Non-Metric Variables)

Table 37. Means of Bifaces (Non-metric Variables)

	Lakehead M	Caribou Lake M	Grant Lake M
Cross Section			
Plano Convex	0.08824	0.05556	0.06452
Flat Lenticular	0.32353	0.27778	0.41935
Asy. Triangular	0.02941	0.00000	0.00000
Lenticular	0.35294	0.47222	0.12903*
Bi-Plano	0.05882	0.02778	0.19355
Asy. Lenticular	0.00000	0.05556	0.03226*
Plano Triangular	0.00000	0.02778	0.00000*
Concave Plano	0.00000	0.00000	0.00000
Convex Tri.	0.02941	0.05556	0.03226
Concave Convex	0.02941	0.02778	0.06452
Bi-Concave	0.00000	0.00000	0.06452*
Diamond	0.02941	0.00000	0.00000*
Irregular	0.05882	0.00000	0.00000
Shape			
Rectangular	0.20588	0.02778	0.03226*
Semi-Lunate	0.14706	0.33333	0.25806
Oval	0.32353	0.02778	0.22581*
Lanceolate	0.26471	0.44444	0.45161
Triangular	0.00000	0.00000	0.00000
Asy. Lanceolate	0.05882	0.11111	0.00000
Bipolar	0.00000	0.02778	0.03226
Stemmed	0.00000	0.02778	0.00000
Flaking I (Ventral)			
Edge Retouch	0.00000	0.02778	0.12903
Mixed Type	0.35294	0.25000	0.58065
Expanding	0.55882	0.66667	0.22581*
Parrallel Sided	0.08824	0.05556	0.06452
No Flake Scars	0.00000	0.00000	0.00000
Flaking II (Ventral)			
Broad	0.55882	0.52778	0.51613
Thin	0.11765	0.02778	0.06452
Moderate	0.00000	0.11111	0.00000
Mixed	0.32353	0.30556	0.29032
Flaking III (Ventral)			
Shallow	0.14706	0.30556	0.25806
Deep	0.14706	0.00000	0.22581*
Moderate	0.20588	0.02778	0.16129*
Mixed Depths	0.50000	0.63889	0.22581

Table 37 (continued).

	Lakehead	Caribou Lake	Grant Lake
Flaking I (Dorsal)			
Edge Retouch	Ø.ØØØØØ	Ø.ØØØØØ	Ø.Ø9677
Mixed Type	Ø.26471	Ø.5ØØØØ	Ø.58Ø65
Expanding	Ø.647Ø6	Ø.47222	Ø.16129*
Parrallel Sided	Ø.Ø8824	Ø.ØØØØØ	Ø.16129
No Flake Scars	Ø.ØØØØØ	Ø.Ø2778	Ø.ØØØØØ
Flaking II (Dorsal)			
Broad	Ø.647Ø6	Ø.41667	Ø.3871Ø
Thin	Ø.17647	Ø.Ø2778	Ø.Ø6452*
Moderate	Ø.ØØØØØ	Ø.11111	Ø.Ø3226*
Mixed Widths	Ø.17647	Ø.41667	Ø.41935
Flaking III (Dorsal)			
Shallow	Ø.147Ø6	Ø.22222	Ø.45161
Deep	Ø.17647	Ø.ØØØØØ	Ø.258Ø6
Moderate	Ø.147Ø6	Ø.11111	Ø.Ø3226*
Mixed Depths	Ø.52941	Ø.61111	Ø.16129*

* Denotes discriminating variable.

shaped cross section. The overall shape of the biface was equally likely to be rectangular or ovate and in both cases Lakehead was more likely to have bifaces of these shapes than either Caribou Lake or Grant Lake. Ventral flaking tended to be expanding, though less so than Caribou Lake, with mixed depths predominating over deep scars. The former were more common in Lakehead than in the other complexes. They were less likely than Grant Lake bifaces to have deep scars on the ventral surface. Dorsally, the scars were expanding, more so than in the other complexes, and were more likely to be thin but least likely to be of moderate widths. They also tended to be moderate in depth when compared to the other complexes but more likely to be of mixed depths within the complex.

2. Caribou Lake bifaces were more likely to be lenticular, asymmetrical lenticular, or plano-triangular than the other complexes, but within the complex lenticular predominates. They are least likely of any of the complexes to be either ovate or rectangular in shape and showed no preferrence for either form within the complex. The ventral flaking tended to have expanding flake scars, more so than the other complexes, but it was

least likely to have been either deep or moderately deep; there is a slightly better chance of the latter appearing over the former. On the dorsal surface, scars are expanding, though not as often as in Lakehead bifaces, they were more likely to be of mixed widths than to be thin and mixed depths predominate both within and between complexes.

3. Grant Lake site bifaces were least likely of the three complexes to have a lenticular cross section, but were most likely to have a bi-concave cross section. The former did, however, predominate over the latter within the complex. They tended to be ovate as opposed to rectangular but in both variables their appearance was second to the Lakehead complex. On the ventral surface Grant Lake site bifaces were least likely to have expanding scars. The depth of the scars was more likely to be deep than to be moderately deep both within and outside the complex. Dorsally, the scars tended not to be expanding and were least likely to be of moderate width than thin within the complex. Between the complexes Grant Lake bifaces were least likely to have either moderately deep or mixed depth dorsal flake scars, while internally mixed depths were more dominant.

In general the descriptions of the flake scars is consistent with what would be expected in the reduction sequence of bifaces. The differences in the occurrence of the discriminating variables is interpretd as technological differences in the technique of reducing the biface through the removal of thinning flakes. The variation in overall shape may reflect different stages in the reduction sequence, but the similarity in size indicated in the metric analysis of the bifaces suggested that this is not the case and that the difference in shape has another, possibly cultural explanation. This explanation being, that the variation in nominal level variables was due to different manufacturing techniques used by the Plano complexes. From the classification table it would seem that the Lakehead complex and the Caribou Lake complex were the most distinct while the Grant Lake site in the most general.

Combined metric and non-metric variables

Of the 150 bifaces only 52 (23 Lakehead, 20 Caribou Lake and 9 Grant Lake) were complete enough to be used in this stage of the analysis using the three metric and the 15 non-metric variables from the previous two runs on the bifaces. The maximum number of steps was set at six after which there were six variables remaining in the discriminant analysis. The six remaining variables were length, basal width, the presence of a lenticular or bi-concave trasverse cross section, the presence of rectangular or ovate shape. The variables excluded were thickness, the presence of an asymmetrical lenticular cross section, plano-triangular cross section or diamond cross section, ventral flake scars that are expanding, deep, or moderately deep, and dorsal flake scars that are expanding, thin or of moderate width and scars that are moderately deep or of mixed depths. These non-discriminatory variables were considered to be constant across the complexes.

Table 38 provides the classification coefficients that were used to obtain the classification (Table 39) which showed a poor separation, with only 42.67% of bifaces being classified correctly Figure 29 visualizes this separation. In fact, the separation of the Grant Lake site artifacts was extremely poor at only 20.8%. This may be due to the low sample size of artifacts for Grant Lake at the analysis stage of the comparison (N=9). The results did however, agree with the non-metric run which showed that the Grant Lake site bifaces were the least distinct of the three.

Despite the poor classification rate the significance table (Table 40) showed that at the 1% alpha level with 6 and 44 degrees of freedom and a critical level of 3.25 all the group centroids were statistically significantly

Table 38. Classification Function Coefficients for Bifaces

(Metric and Non-metric Variables)

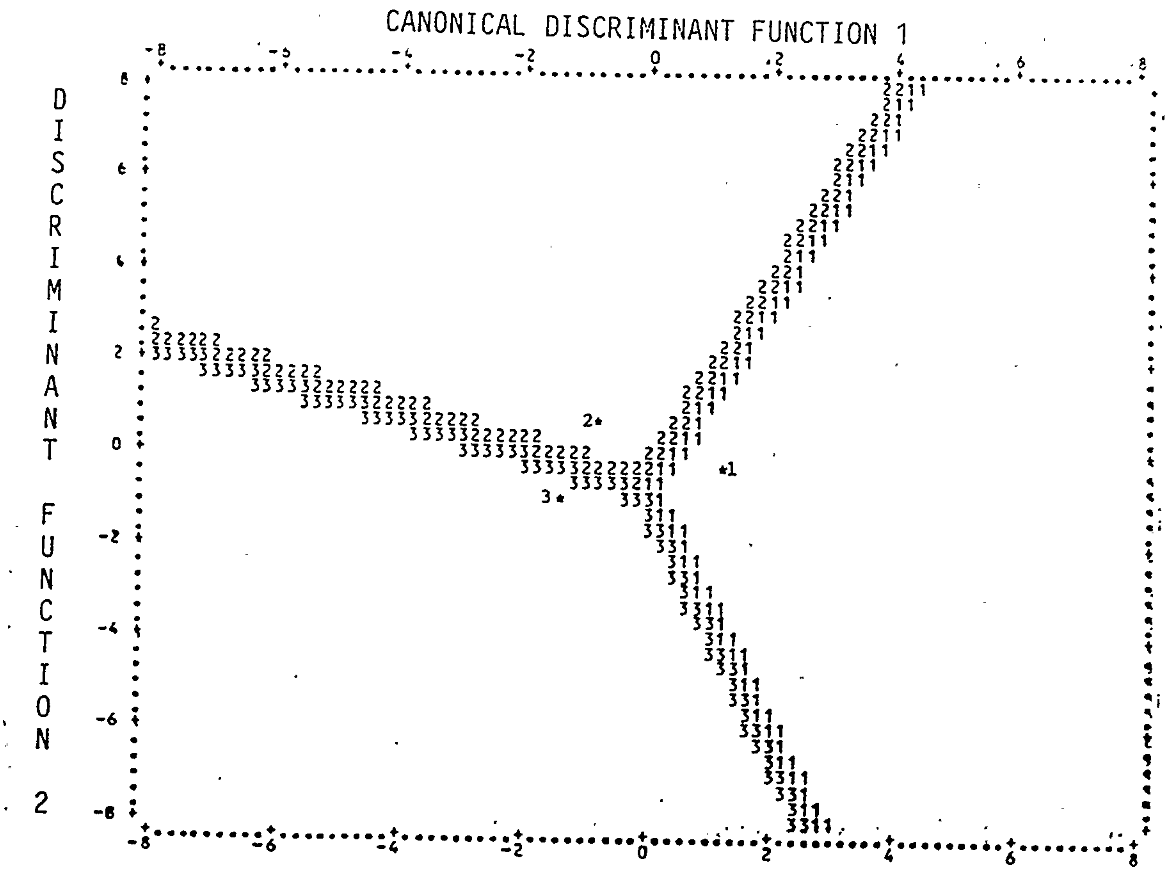
Variable	Lakehead	Caribou Lake	Grant Lake
Length	.3089006	.2739256	.1795573
Basal Width	-.01211208	-.08582796	.0782224
Cross Section			
Lenticular	2.920291	3.659636	.7774684
Bi-Concave	-3.770523	.7428084	5.909258
Shape			
Rectangular	6.900326	3.791862	1.078977
Oval	6.787219	2.081626	1.102926
Constant	-17.78139	-11.58002	-8.058087

Table 39. Classification Results for Bifaces

(Metric and Non-metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	35	20 57.1%	12 34.3%	3 8.6%
Complex 2 Caribou Lake	38	2 5.3%	28 73.7%	8 21.1%
Complex 3 Grant Lake	77	26 33.8%	35 45.5	16 20.8%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 42.67%



1 – Lakehead
2 – Caribou Lake
3 – Grant Lake
* – Group Centroids

Figure 29. Territorial Distribution of Bifaces
(Combined Variables)

Table 40. F Statistics and Significances for Bifaces

(Metric and Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 6, EACH F STATISTIC HAS 6 AND 44 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	6.8912 0.0000	
Grant Lake	7.4564 0.0000	3.7739 0.0041

Table 41. Means and Standard Deviations for Bifaces

(Metric and Non-metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	90.47	22.66	75.23	11.33	61.49	15.55*
Thickness	17.02	5.82	14.07	3.72	11.81	3.82
Basal Width	32.43	12.88	18.45	7.60	25.29	10.06*
Cross Section						
Lenticular	0.26087		0.45000		0.00000*	
Asymmetrical Lenticular	0.00000		0.10000		0.11111	
Plano-Tri.	0.00000		0.05000		0.00000	
Bi-Concave	0.00000		0.00000		0.11111*	
Diamond	0.04348		0.00000		0.00000	
Shape						
Rectangular	0.30435		0.05000		0.11111*	
Oval	0.43478		0.05000		0.11111*	
Flaking I (Ventral)						
Expanding	0.56522		0.65000		0.22222	
Flaking III (Ventral)						
Deep Scars	0.08696		0.00000		0.11111	
Moderate Deep	0.17391		0.05000		0.11111	

Table 41 (continued).

Flaking I (Dorsal)			
Expanding	Ø.65217	Ø.55ØØØ	Ø.ØØØØØ
Flaking II (Dorsal)			
Thin	Ø.Ø8696	Ø.Ø5ØØØ	Ø.ØØØØØ
Moderate Width	Ø.ØØØØØ	Ø.1ØØØØ	Ø.ØØØØØ
Flaking III (Dorsal)			
Moderate Deep	Ø.13Ø43	Ø.15ØØØ	Ø.ØØØØØ
Mixed Depths	Ø.65217	Ø.65ØØØ	Ø.33333

All measurements are in millimeters.
* Denotes a discriminating variable.

So that although the complexes are significantly different the difference was not very strong and that the nominal level variables were the best for differentiating the complexes.

Table 41 provides the means and standard deviations for describing the complexes using the discriminating variables. The means showed that for the metric variables Lakehead bifaces were the largest and Caribou Lake the smallest with the standard deviations showing the same pattern. As for the four nominal level variables lenticular cross sections occurred most often in Caribou Lake artifacts and then in Lakehead and finally in Grant Lake, while bi-concave occurred only in the Grant Lake site bifaces. As for shape Lakehead was the most likely complex to have either rectangular or ovate shaped bifaces, Grant Lake was next in both cases, and Caribou Lake was last. For Lakehead ovate was slightly more common that rectangular and for the other two complexes both shapes had equal occurrence within each complex.

Discussion of the Biface analysis

The analysis of the bifaces revealed that of the three runs the non-metric run provided the best discrimination between the complexes. These differences in the transverse cross section, shape and types of flake scars their widths and depths were interpretd as the results of different techniques or ways of manufacture in the reduction of the bifaces. The results showed that the Lakehead complex and Caribou Lake were the most unique while the Grant Lake site material was the most generalized.

In the metric analysis only the Caribou Lake complex was unique percentage wise with Lakehead and Grant Lake being indistinguishable from it. This is similar to the cluster analysis on metric traits which showed very weak clustering between Lakehead and Caribou Lake and with Grant Lake showing no distinction at all. The results of the Grant Lake site, it should be noted, may be due to the small sample size used during the analysis stage of the comparison.

In conclusion, it is apparent that these three Plano complexes were producing similar sized bifaces using different production techniques. I interpret these differences as the product of different cultural responses to working in stone, which may be related to the different lithic material used. Whether or not the original technology that produced these distinct Plano technologies was one common source (i.e. Agate Basin) or three is difficult to determine, since I had no Agate Basin bifaces to compare them with. In any event, by 6ØØØ B.C. at least three distinct cultural technologies were apparent in the Plano complex.

Endscrapers

Metric variables

Of the 105 endscrapers 80 were complete enough to be used in the metric analysis. This included 7 Lakehead, 50 Caribou Lake, and 23 Grant Lake scrapers. The 11 metric variables noted above were used. After seven steps, seven variables were considered important in distinguishing between the three complexes. These were the length, width, thickness, weight, width of the distal end, distal end thickness, and distal end angle. The variables not included in the analysis were length of the distal end, left lateral edge angle, right lateral edge angle and the proximal width. It would seem from these non-discriminating variables that these traits were constant among the complexes which may mean they were either important in the function of the tool, or more likely, that they were not important to the tool makers in either a cultural or functional manner.

Table 42 provides the classification functions and Table 43 the classification results. Figure 30 shows the distribution of this classification. As the latter indicated there is a 83.81% overall correct classification

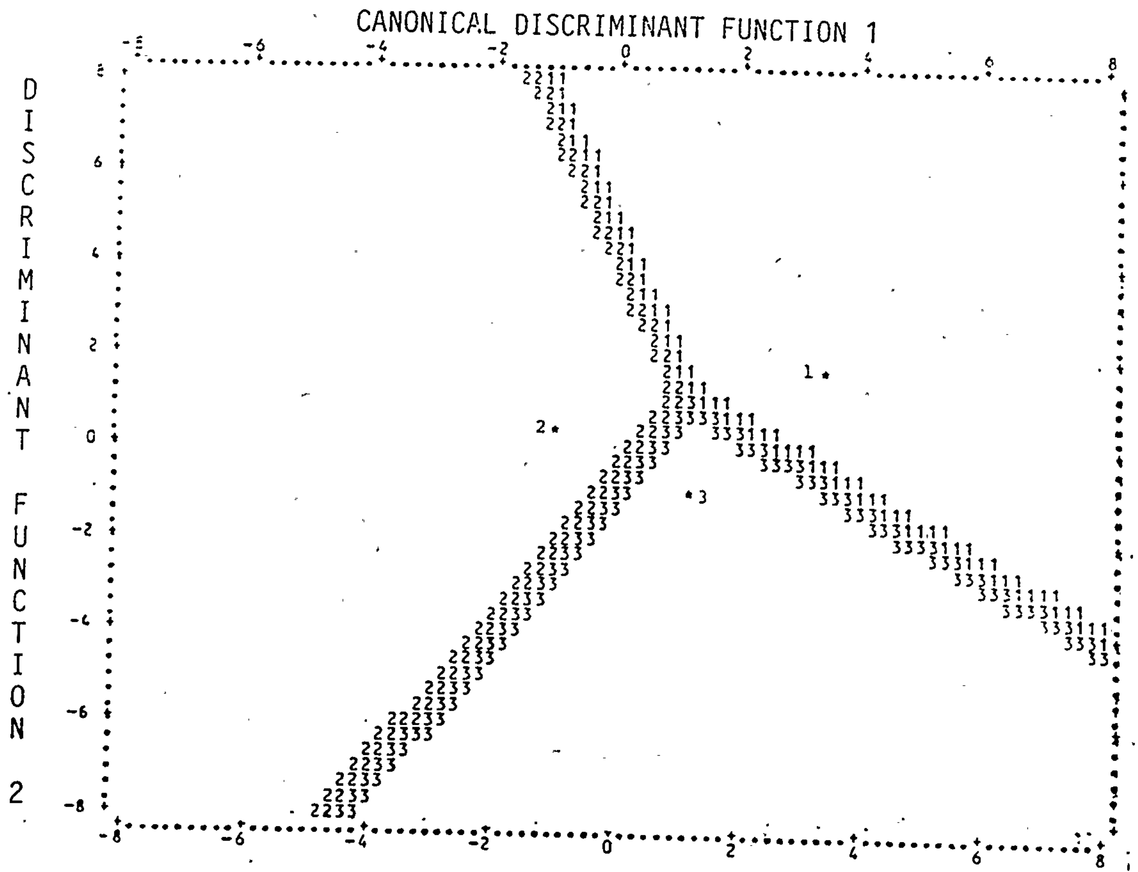
Table 42. Classification Function Coefficients for Endscrapers (Metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	1.081369	.7142234	.9627621
Width	1.203193	1.680372	1.549273
Thickness	1.344761	2.297294	1.792415
Weight	-1.127284	-1.425547	-1.481272
Distal End Width	-.2864836	-.5502232	-.2844519
Distal End Thickness	.6655676	-.1817309	-.1353369
Distal End Angle	.5503480	.7316484	.6828954
Constant	-60.36340	-59.38124	-63.45959

Table 43. Classification Results for Endscrapers (Metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership: Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	9	6 66.7%	1 11.1%	2 22.2%
Complex 2 Caribou Lake	53	1 1.9%	48 90.6%	4 7.5%
Complex 3 Grant Lake	43	0 0.0%	9 20.9%	34 79.1%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 83.81%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 30. Territorial Distribution of Endscrapers (Metric Variables)

rate. The Caribou Lake complex showed the best separation at 90.6% followed by Grant Lake at 79.1% and Lakehead at 66.7%. At present there is no evidence to suggest that different scraping functions were taking place between the complexes, so the differences in size are considered to be culturally induced.

The sigificance table (Table 44) showed that at 7 and 71 degrees of freedom and with a critical value of 2.92 the differences between the three complexes in terms of size is statistically significant.

The means and standard deviations (Table 45) of the discriminating variables gives the following descriptions of the endscrapers for each complex:

1. Lakehead endscrapers were the largest of the three complexes in all variables except the distal end angle in which it had the lowest angle.
2. Caribou Lake complex endscrapers had the greatest distal end angle, were second behind Lakehead in terms of thickness and distal end thickness, and were the smallest in length, width, weight and distal end width.
3. Grant Lake site endscrapers were second to Lakehead endscrapers in terms of length, width, weight, distal end width, and distal end angle, and were smallest in thickness and distal end thickness.

Table 44. F Statistics and Significances for Endscrapers (Metric Variables)

F STATISTIC AND SIGNIFICANCES BETWEEN PAIRS OF GROUPS AFTER STEP 7, EACH F STATISTIC HAS 7 AND 71 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	16.881 0.0000	
Grant Lake	9.1139 0.0000	13.297 0.0000

Table 45. Means and Standard Deviations of Endscrapers (Metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	62.82	17.73	28.72	7.04	42.76	9.45*
Width	43.84	9.67	26.13	8.62	36.20	8.93*
Thickness	14.39	4.18	10.45	3.08	8.01	2.92
Weight	45.89	28.31	9.64	7.06	15.60	12.11*
Distal End Width	39.34	5.50	23.88	9.14	35.29	8.44*
Distal End Length	6.34	2.61	6.87	5.46	8.35	3.29
Distal End Thickness	11.80	3.04	8.58	3.02	6.49	1.71*
Distal End Angle	61.1	24.5	77.3	9.04	69.0	10.3*
Left Lateral Edge Angle	63.7	19.9	77.7	16.4	63.4	16.1
Right Lateral Edge Angle	58.1	23.5	76.5	14.6	63.2	14.6
Proximal Width	21.61	8.59	17.40	6.63	14.96	7.05

All measurements are in millimeters except Weight which is in grams and Angles which are in degrees.
* Denotes a discriminating variable.

The standard deviations of the discriminating variables all showed clustering about the means but only width, thickness, distal end width showed similar magnitudes in the ranges. In each instance Lakehead complex artifacts had the largest deviations, Grant Lake was second, except in thickness and distal end width, and Caribou Lake was the smallest.

From this metric analysis of endscrapers it seemed evident that there were distinct differences in the size of the endscrapers produced in each of the cultural areas. The similarities in the types of sites from which these artifacts were recovered, all were habitation sites, suggest that the differences were not due to different scraping functions, a use wear analysis would be needed to prove this, but were due to culturally specific styles. These results agreed with the results from the cluster analysis that showed distinct separations of endscrapers into their respective complexes.

Non-metric variables

Of the 105 endscrapers 91 were complete enough to be used in this stage of the analysis. This included 9 Lakehead, 52 Caribou Lake and 30 Grant Lake site endscrapers. The seven non-metric variables were transformed into 27 binomial variables. After nine steps seven variables remained in the analysis. These seven discriminating variables were the presence or absence of a striking platform, of expanding flake scars, of parallel sided flake scars, the absence of ventral flaking, moderately wide flake scars, mixed flake scar widths and moderately deep flake scars.

Table 46 provides the classification functions and Table 47 the classification results obtained from these functions. The overall correct classification rate was 55.29% with Caribou Lake having 58.5%, Grant Lake 53.5% and Lakehead with 33.3% of endscrapers correctly classified. According to the significance table (Table 48) only the difference between the Lakehead and Caribou Lake complexes was statistically significant at 7 and 82 degrees of freedom and with a Although Grant Lake had a better than 50% classification rate it was not significantly different from Lakehead and that only Caribou Lake's classification rate was significantly different from that of either Lakhead and Grant Lake.

The means (Table 49) of the nine discriminating binomial variables revealed the following descriptions of the endscrapers of each of the complexes:

1. Lakehead complex endscrapers were most likely, of the three complexes, to have expanding ventral flake scars, ventral flaking, and moderately wide or mixed

Table 46. Classification Function Coefficients for Endscrapers

(Non-metric Variables)

Variables	Lakehead	Caribou Lake	Grant Lake
Striking Platform	5.129021	3.402954	4.957535
Flaking I (Ventral)			
Expanding	34.10066	25.02266	22.15367
Parrallel Sided	24.57348	22.32011	20.23586
No Flake Scars	22.10502	22.44094	18.87281
Flaking II (Ventral)			
Moderate	-8.038332	-2.108667	-3.880379
Mixed Widths	23.60552	22.24402	19.43777
Flaking III (Ventral)			
Moderate Depth	-15.43382	-5.252838	-5.330956
Constant	-15.56955	-12.92376	-10.91071

Table 47. Classification Results for Endscrapers

(Non-metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	9	3 33.3%	2 22.2%	4 44.4%
Complex 2 Caribou Lake	53	3 5.7%	31 58.5%	19 35.8%
Complex 3 Grant Lake	43	0 0.0%	20 46.5%	23 53.5%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 54.29%

Table 48. F Statistics and Significances for Endscrapers (Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 9, EACH F STATISTIC HAS 7 AND 82 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	2.9278 Ø.ØØ87	
Grant Lake	2.8643 Ø.Ø1ØØ	3.2126 Ø.ØØ46

Table 49. Means of Endscrapers (Non-metric Variables)

	Lakehead M	Caribou Lake M	Grant Lake M
Striking Platform	Ø.55556	Ø.38462	Ø.73333*
Flaking I (Ventral)			
Edge Retouch	Ø.ØØØØØ	Ø.ØØØØØ	Ø.Ø6667
Mixed Types	Ø.22222	Ø.15385	Ø.26667
Expanding	Ø.33333	Ø.Ø7692	Ø.Ø3333*
Parrallel Sided	Ø.22222	Ø.Ø9615	Ø.16667*
No Flake Scars	Ø.22222	Ø.673Ø8	Ø.46667*
Flaking II (Ventral)			
Broad	Ø.11111	Ø.Ø1923	Ø.Ø3333
Thin	Ø.33333	Ø.11538	Ø.26667
Moderate Width	Ø.11111	Ø.Ø3846	Ø.ØØØØØ*
Mixed	Ø.22222	Ø.15385	Ø.16667*
Flaking III(Ventral)			
Shallow	Ø.33333	Ø.19231	Ø.26667
Deep	Ø.11111	Ø.Ø1923	Ø.ØØØØØ
Moderate	Ø.ØØØØØ	Ø.Ø1923	Ø.Ø3333*
Mixed Depths	Ø.33333	Ø.Ø9615	Ø.16667

Table 49 (continued).

	M	M	M
Flaking I (Dorsal)			
Edge Retouch	Ø.ØØØØØ	Ø.Ø7692	Ø.Ø6667
Mixed Types	Ø.22222	Ø.44231	Ø.4ØØØØ
Expanding	Ø.22222	Ø.13462	Ø.Ø6667
Parrallel Sided	Ø.11111	Ø.21154	Ø.3ØØØØ
No Flake Scars	Ø.44444	Ø.13462	Ø.16667
Flaking II (Dorsal)			
Broad	Ø.11111	Ø.Ø7692	Ø.ØØØØØ
Thin	Ø.11111	Ø.25ØØØ	Ø.26667
Moderate Width	Ø.11111	Ø.Ø3846	Ø.Ø3333
Mixed Width	Ø.22222	Ø.423Ø8	Ø.46667
Flaking III (Dorsal)			
Shallow	Ø.33333	Ø.423Ø8	Ø.46667
Deep	Ø.ØØØØØ	Ø.ØØØØØ	Ø.ØØØØØ
Moderate	Ø.ØØØØØ	Ø.Ø9615	Ø.Ø6667
Mixed Depths	Ø.22222	Ø.26923	Ø.23333

* Denotes a discriminating variable.

widths of ventral flake scars. This is probably related to the greater probablity of having ventral flaking. Lakehead endscrapers were also least likely to have moderately deep ventral flake scars. The presence of the striking platform on these endscrapers was second behind that of endscrapers from the Grant Lake site.

2. Caribou Lake endscrapers were most likely to have mixed ventral flake scar widths. It was second behind Grant Lake in having moderately deep ventral flake scars and Lakehead in having expanding and moderately wide ventral flake scars. Internally, parallel sided ventral flake scars predominate over expanding scars, and mixed widths scars were more prevalent than moderately wide ventral flake scars. Caribou Lake was last in the occurrence of parallel sided ventral flake scars, ventral flaking, the striking platform or mixed width flake scars.

3. Grant Lake endscrapers were most likely to have the striking platform and moderately deep ventral flake scars. They were second in the prevalence of mixed widths and parallel sided ventral flake scars as well as having ventral flaking. Within the complex parallel ventral flake scars occurred more often than expanding scars, and mixed width scars were

more likely to be present over moderately wide scars.

The results on the non-metric variables contradicted those of the metric and cluster analysis which showed three distinct styles of endscrapers. If these nominal level variables are viewed as evidence of technique or method of manufacture then the results indicated that there is very little difference among the three complexes in the manufacturing of endscrapers. Caribou Lake would seem to have the greatest difference in technique, but even this only produced a 58.5% correct classification rate. The lack of a significant difference between Grant Lake and Lakehead may be due to the small sample size from the latter.

Combined metric and non-metric variables

Of the 105 endscrapers available for this stage in the investigation 82 were complete enough to be used in the analysis stage using the seven metric and seven non-metric discriminating variables. This included 9 Lakehead, 50 Caribou Lake and 23 Grant Lake site endscrapers. After a maximum of eight steps there were eight variables remaining in the stepwise procedure. These eight were the length, thickness, weight, distal end width, distal end thickness, distal end angle, the presence or absence of expanding and moderately deep ventral flake scars. Those variables eliminated were the width, the presence of the striking platform, of parallel sided ventral flake scars, ventral flaking, and moderate and mixed width ventral flake scars.

Table 50 provides the classification function coefficients for each complex that resulted in the classification rate in Table 51. Figure 31 shows the distribution of the classification. The overall classification rate was 78.1% classified correctly artifacts with Lakehead at 66.7%, Caribou Lake at 88.7% and Grant Lake at 67.4%. The significance table (Table 52) revealed that at 8 and 72 degrees of freedom with a critical value of 2.82 all complexes were statistically siginificantly different. Overall the classification and significance tables showed a better discrimination than the nominal variable analysis but not as good as the metric variable run. The results also showed that the Grant Lake site and Caribou Lake complex endscrapers tended to be misclassified with each other more than either did with the Lakehead complex.

Using the means and standard deviations (Table 53) of the discriminating variables, the following endscraper descriptions can be formulated:

1. Lakehead artifacts, except for the distal end angle, were the largest, in terms of the six remaining

Table 50. Classification Function Coefficients for Endscrapers

(Metric and Non-metric Variables)

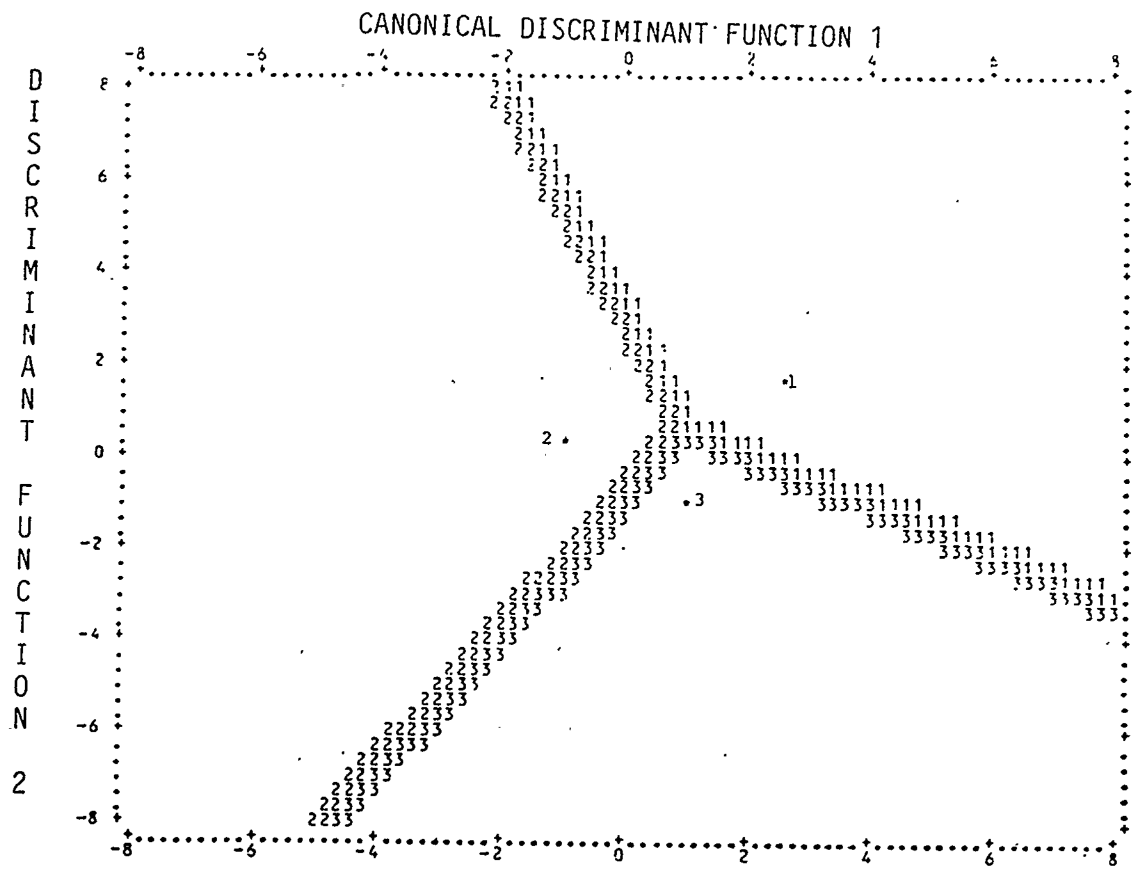
Variable	Lakehead	Caribou Lake	Grant Lake
Length	1.152976	.8114341	1.073570
Thickness	.1079743	-.1424120	-.2440084
Weight	-.8115501	-.8221982	-.9669316
Distal End Width	.6307890	.6200195	.8152993
Distal End Thickness	1.281060	1.582191	1.308579
Distal End Angle	.5587481	.6592268	.6273715
Flaking I (Ventral)			
Expanding	6.099889	1.395976	.5040704
Flaking III (Ventral)			
Moderate Depth	-23.09509	-11.12811	-12.29339
Constant	-57.70081	-47.66746	-55.56347

Table 51. Classification Results for Endscrapers

(Metric and Non-metric Variables)

		Predicted Group Membership		
Actual Complex	No. of Cases	Lakehead	Caribou Lake	Grant Lake
Complex 1 Lakehead	9	6 66.7%	0 0.0%	3 33.3%
Complex 2 Caribou Lake	53	0 0.0%	47 88.7%	6 11.3%
Complex 3 Grant Lake	43	1 2.3%	13 30.2%	29 67.4%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 78.10%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
* - Group Centroids

Figure 31. Territorial Distribution of Endscrapers
(Combined Variables)

Table 52. F Statistic and Significance for Endscrapers

(Metric and Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 8, EACH F STATISTIC HAS 8 AND 72 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake
Caribou Lake	12.970 0.0000	
Grant Lake	7.5957 0.0000	11.006 0.0000

Table 53. Means and Standard Deviations for Endscrapers

(Metric and Non-metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	57.83	18.68	28.72	7.04	42.76	9.45*
Width	42.22	9.78	26.23	8.62	36.20	8.93
Thickness	19.23	17.48	10.45	3.08	8.01	2.92*
Weight	37.53	29.63	9.64	7.06	15.60	12.11*
Distal End Width	38.41	6.07	23.88	9.14	35.29	8.44*
Distal End Thickness	9.96	4.50	8.58	3.02	6.49	1.71*
Distal End Angle	64.2	22.3	77.3	9.0	69.04	10.29*

Table 53 (continued).

	M	SD	M	SD	M	SD
Striking Platform	Ø.55556		Ø.38ØØØ		Ø.826Ø9	
Flaking I (Ventral)						
Expanding	Ø.33333		Ø.Ø8ØØØ		Ø.Ø4348*	
Parrallel	Ø.22222		Ø.Ø8ØØØ		Ø.13Ø43	
No Flake	Ø.22222		Ø.68ØØØ		Ø.47826	
Flaking II (Ventral)						
Moderate	Ø.11111		Ø.Ø4ØØØ		Ø.ØØØØØ	
Mixed Widths	Ø.22222		Ø.16ØØØ		Ø.17391	
Flaking III (Ventral)						
Moderate	Ø.ØØØØØ		Ø.Ø2ØØØ		Ø.Ø4348*	

All measurements are in millimeters except Weight which is in grams and Angle which is in degrees.
* Denotes a discrimininating variable.

The nominal variables showed that Lakehead complex endscrapers were most likely to have expanding ventral flake scars, and least likely to have moderately deep ventral flake scars.

2. Caribou Lake endscrapers were the smallest in terms of length, weight, and width of distal end; were second behind Lakehead in terms of thickness, distal end thickness, and had the steepest distal end angle. They were second in the probablity of having expanding and moderately deep ventral flake scars behind Lakehead and Grant Lake respectively.

3. Grant Lake endscrapers were second in terms of length, weight, distal end thickness and distal end angle. They were the thinnest both in terms of maximum and distal end thickness. Grant Lake artifacts were the most probable of any in having moderately deep ventral flake scars and was least likely to have expanding ventral flake scars. They were least likely to have expanding ventral flake scars and were second to Lakehead in the occurrence of thin ventral flake scars.

The standard deviations of the metric variables showed the same patterning of clustering about the means as in the metric analysis, and except for thickness, the deviations have the same magnitude as the results from the metric comparison.

From this combined metric and non-metric variable analysis there would seem to be three distinct endscraper styles associated with the three complexes. Also, the metric variables were more important in discriminating between the complexes than the nominal level variables. This has been interpretd as evidence of similar techniques in the manufacturing of these tools.

Discussion of the Endscraper analysis

Although there is some concern about the results and any interpretations surrounding the Lakehead complex endscrapers due to the small sample size, it would seem that from the results involving the other two complexes that there are three distinct endscraper styles associated with each of the complexes. These types were most distinguishable by size but some technological difference, especially concerning the Caribou Lake complex, was also apparent. On their own the latter do not serve as the most accurate measure of discrimination between complexes. Whether this is due to a common cultural heritage or is due to the constraints imposed on the manufacturers by the functional needs of the tool is difficult to surmize. Since there is at present no evidence for different scraping fuctions (wood working versus hide scraping) being done by endscrapers in the different complexes, I must assume the tools were used for similar purposes on similar materials. The difference noted then, are cultural styles and the common technological features are interpretd as being due to the functional nature of the artifacts.

Projectile points

Metric variables

Unlike the previous tool types in this study there were projectile points from five different complexes. As mentioned earlier this would provide a wider cultural comparisons for the three Canadian Plano complexes. There were 84 points out of 280 that were complete enough to be used in this study. This included 21 Lakehead, 20 Caribou Lake, 14 Grant Lake, 9 Wasden site, and 20 Agate Basin points. After an maximum of 10 steps 10 variables remained in the analysis. These included length, width, thickness, weight, left haft element, right haft element, distance to the widest point, distance to the thickest point, width at the distal end of the right haft element, and basal width. The variables excluded from the analysis were the width at the distal end of the left haft element and the number of basal thinning flake removed from both the ventral and dorsal surfaces, this indicated that the number of basal flakes removed to facilitate hafting were more or less the same in all five complexes. Why the width at the distal end of the left haft element should be more constant than the width taken at the end of the right haft element is inexplicable.

Table 54 provides the classification functions that produced the classification rate in Table 55. Figure 32 helps to visualize this classification. The overall classification rate was 62.5% but only two complexes had rates over 50%, namely Agate Basin at 53.8% and Grant Lake at 82.7%. The other classification rates were 44.8% for Caribou Lake and 34.6% for Lakehead. Also of note was the fact that 43.6% of Agate Basin and 57.1% of Wasden site points were misclassified as Grant Lake, and finally, approximately equal portions (around 20% to 35%) of both Lakehead and Caribou Lake points were misclassified into the remaining two Plano complexes. Table 56 showed that with 10 and 70 degrees of freedom and a critical value of 2.60 at the 1% alpha level all separations were statistically significant, except for the one between the Grant Lake and Wasden sites.

The means and standard deviations (Table 57) of the 10 discriminating variables gave the following descriptions:

1. Lakehead points in general can be described as fairly long, wide, thick, heavy points with the widest point falling towards the proximal end and

Table 54. Classification Function Coefficients for Projectile Points (Metric Variables)

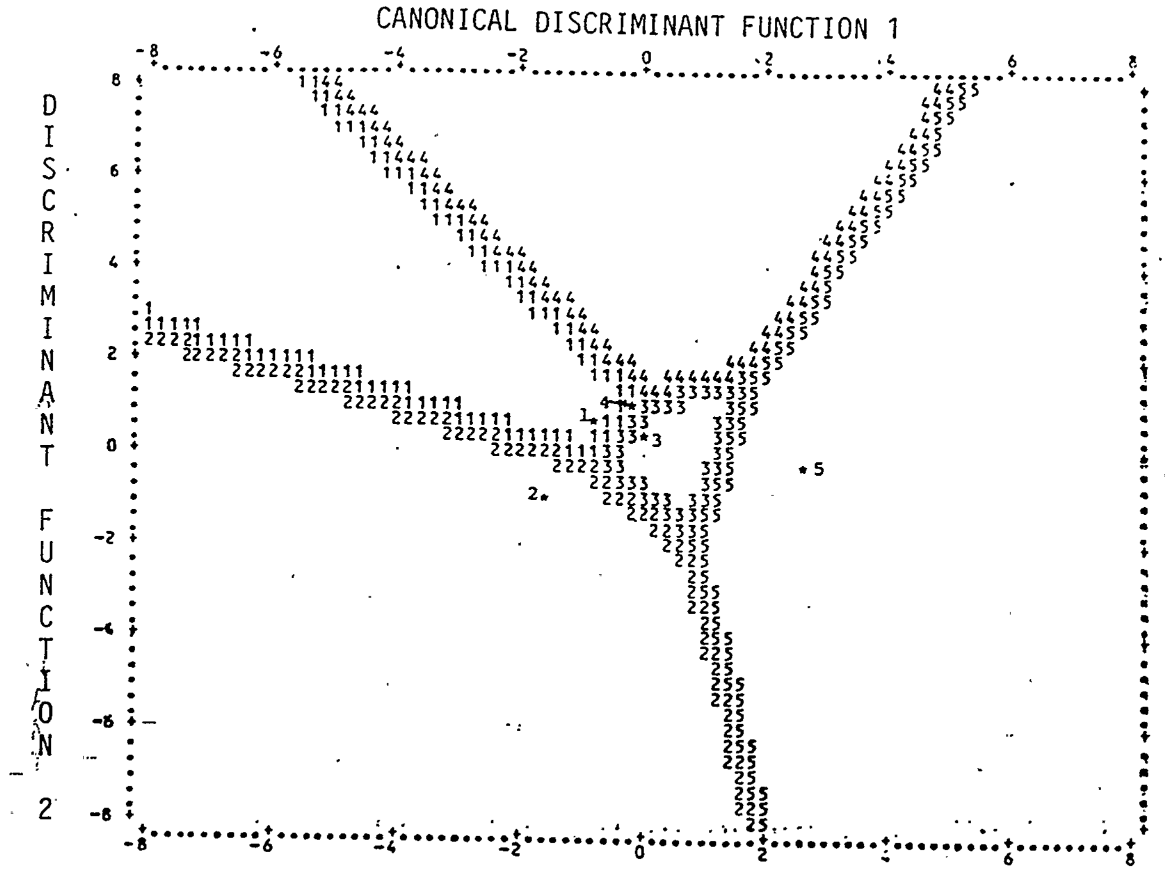
Variable	Lakehead	Caribou Lake	Grant Lake
Length	.06219366	.1077438	.03001889
Width	1.015616	1.350849	.8909213
Thickness	.8741838	1.075641	.7909807
Weight	-.0999538	-.1310569	-.1007765
Left Haft	-.05856946	-.1956131	.008121652
Right Haft	-.001666117	-.0125369	-.05692296
Distance to Maximum Width	.1196330	.1348302	.1509994
Distance to Max. Thick.	-.0002147489	-.04679642	.01758127
Width of Right Haft	-.0448910	-.08063525	.01155696
Basal Width	.5917998	-.07712948	.2795124
Constant	-16.39029	-24.5968	-18.19216

Variable	Wasden	Agate Basin
Length	-.03261829	-.03777002
Width	.8215581	.5881922
Thickness	.7097916	.6307184
Weight	-.08778583	-.04999386
Left Haft	.07752299	.08062012
Right Haft	-.1387230	.2357652
Distance to Maximum Width	.1762118	.3172105
Distance to Max. Thick.	-.04653672	.1235785
Width of Right Haft	.1037719	-.3375132
Basal Width	.4742022	.5410905
Constant	-16.24392	-22.49838

Table 55. Classification Results for Projectile Points (Metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership: Lakehead	Caribou Lake	Grant Lake	Wasden	Agate Basin
Complex 1 Lakehead	52	18 34.6%	13 25.0%	12 23.1%	7 13.5%	2 3.8%
Complex 2 Caribou Lake	29	8 27.6%	13 44.8%	6 20.7%	2 6.9%	0 0.0%
Complex 3 Grant Lake	139	3 2.2%	15 10.8%	115 82.7%	3 2.2%	3 2.2%
Complex 4 Wasden	21	0 0.0%	1 4.8%	12 57.1%	8 38.1%	0 0.0%
Complex 5 Agate Basin	39	0 0.0%	0 0.0%	17 43.6%	1 2.6%	21 53.8%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 62.50%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
4 - Wasden
5 - Agate Basin
* - Group Centroids

Figure 32. Territorial Distribution of Projectile Points (Metric Variables)

Table 56. F Statistic and Significances for Projectile Points (Metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 1Ø, EACH F STATISTIC HAS 1Ø AND 7Ø DEGREES OF FREEDOM.

	Lakehead	Caribou Lake	Grant Lake	Wasden
Caribou Lake	4.7187 Ø.ØØØØ			
Grant Lake	2.7225 Ø.ØØ69	3.5225 Ø.ØØØ8		
Wasden	3.Ø786 Ø.ØØ27	4.5335 Ø.ØØØØ	.77855 Ø.6489	
Agate Basin	11.9Ø7 Ø.ØØØØ	15.463 Ø.ØØØØ	5.8586 Ø.ØØØØ	6.9Ø59 Ø.ØØØØ

Table 57. Means and Standard Deviations for Projectile Points (Metric Variables)

	Lakehead M	Lakehead SD	Caribou Lake M	Caribou Lake SD	Grant Lake M	Grant Lake SD
Length	70.76	22.25	61.35	16.88	59.74	12.20*
Width	26.07	5.97	24.40	3.47	21.63	2.78*
Thickness	8.67	2.30	9.00	2.57	7.65	2.38*
Weight	18.76	13.39	13.37	6.33	11.55	4.03*
Left Haft	16.33	14.95	8.97	10.96	22.89	7.75*
Right Haft	16.77	14.04	9.91	10.12	21.02	6.87*
Distance to Maximum Width	24.44	13.51	26.13	8.47	26.08	6.02*
Distance to Maximum Thick.	31.88	15.12	26.26	9.98	29.50	9.10*
Width of Left Haft	16.39	14.07	9.68	10.25	20.10	6.07
Width of Right Haft	17.35	13.71	11.16	10.68	20.21	6.06*
Basal Width	19.98	5.04	13.46	5.46	12.66	2.01*
Ventral Thinning Flakes	3.1	1.6	2.1	1.4	2.6	0.9
Dorsal Thinning Flakes	2.9	1.7	1.5	1.0	2.5	0.8

	Wasden M	Wasden SD	Agate Basin M	Agate Basin SD
Length	45.75	13.82	73.00	15.53*
Width	20.06	1.44	20.53	5.85*
Thickness	6.83	4.07	7.90	3.24*
Weight	6.30	2.47	21.29	36.72*
Left Haft	20.43	5.53	34.54	12.94*
Right Haft	18.27	3.18	33.43	13.10*
Distance to Maximum Width	19.98	2.16	41.05	8.12*
Distance to Max. Thick.	19.27	6.95	42.34	10.68*
Width of Left Haft	19.56	1.58	20.16	5.88
Width of Right Haft	19.69	1.18	20.14	5.88*

	Wasden M	Wasden SD	Agate Basin M	Agate Basin SD
Basal Width	13.23	1.66	11.86	2.93*
Ventral Thinning Flakes	2.6	1.4	1.6	1.5
Dorsal Thinning Flakes	2.6	1.7	1.6	1.6

All measurement are in millimeters except Weight which is in grams, and Thinning Flakes which are counted.
* Denotes a discriminating variable.

the thickest point towards the distal end, a wide base with some lateral edge grinding.

2. Caribou Lake points by comparison with the other complexes were moderately long and heavy points but were relatively thick and wide with a moderately wide base. The thickest and widest points both occurred towards the proximal end of the point but the latter was not as proximally located as on the Lakehead points. The haft elements tended to be very small as was the width at the distal end of the right haft element.

3. Grant Lake site points were comparatively short, thin, light, narrow points with a narrow basal width. There was a great deal of lateral edge grinding with a wide associated right haft element width. The maximum width fell towards the proximal end of the points but the thickest spot lies almost dead centre. These points tended to fall in the middle of all the variables and were neither the smallest nor largest in any measurement.

4. Wasden site projectile points were very small, thin, narrow and light points. Compared to their size they had a large amount of lateral edge grinding and a wide base, this may be due to the reworked nature of some of the points. The widest and thickest

spots on the artifacts tended to occur towards the proximal end.

5. Agate Basin points were long heavy points with the widest and thickest spots falling towards the distal end. They were relatively narrow and thin with a very narrow basal width. Probably due to their great length, they have a great deal of lateral grinding with an associated wide right lateral haft element width.

The standard deviations all showed a relatively strong clustering about the means. The size of the ranges were similar for the length, widht, thickness, and basal width variables but were of relatively different sizes for the other variables between the complexes.

These results agreed quite well with the cluster analysis which showed a close similarity between the Wasden and Grant Lake site and these two with the Agate Basin points. It also showed that the Lakehead complex points were not as distinct as the other complexes and that Caribou Lake was also different to some degree. The discriminant analysis revealed that Wasden points were very similar to Grant Lake and that Agate Basin points were likewise. Lakehead complex points were split almost equally among itself and the Caribou Lake and Grant Lake complexes; while Caribou lake, though more distinct than

Lakehead, was not as distinct as Grant Lake and Agate Basin, and was misclassified with Lakehead and Grant Lake.

Due to the time difference and the similarity revealed in this analysis of metric variables I infer that Wasden and Grant Lake site inhabitants were the cultural descendents of the Agate Basin culture. The Lakehead classification is in accordance with the interpretation that many different cultures from different times and places make up the Lakehead complex. The Caribou Lake complex, although with only 44.8% classified correctly projectile points, seems quite distinct from anything else with its closest similarities being to Lakehead and Grant Lake. If Caribou Lake was related to the Agate Basin complex, as postulated by some researchers (Buchner 1984; Pettipas and Buchner 1983; Pettipas 1982, 1985), it may be a very distant cultural relationship, possibly dating back before the actual emergence of Agate Basin from a common cultural ancestor.

Non-metric variables

This analysis was the only one that came close to the prior probabilities limit, noted above, of the largest group (Grant Lake N=93) being ten times the size of the smallest (Wasden N=11). Because of this the analysis was also run with prior probabilities equal to the size of the group as well as it being equal for all groups. This only affected the classification rate and classification functions so both sets of results will be given. In general the results were the same. Also, since this comparison involved the variables that described the flaking patterns of each artifact a correlation matrix was produced to see if there were any relationships between the presence of a particular pattern and the completeness of the points since many of the points used in this stage were not complete. As the correlation table (Table 58) showed there were no strong correlations between flaking pattern and the portion of the point present. The strongest correlation (Ø.4Ø626) was between the distal end (Portion 4) and the occurrence of the chevron flaking pattern. Such an occurrence, although not very strong, may reflect the need to hold the fabricator at a particular angle to the artifact in order to shape the distal end correctly.

Of the 28Ø projectile points 179 were complete enough to be used in this analysis. This included 29 Lakehead, 21 Caribou Lake, 93 Grant Lake, 11 Wasden, and 25 Agate Basin points. The original 14 nominal level variables were transformed into 75 binomial level variables. After a maximum of 1Ø steps 1Ø variables remained in the analysis. These included the presence of a concave basal edge, a concave-convex longitudinal cross section, of expanding ventral flake scars, of oblique, irregualr, and

Table 58. Pooled Within-Groups Correlation Matrix for Projectile Points (Portion vs. Pattern)

Pattern \ Portion	1	2	3	4	5
Ventral					
1	-0.21857	99.99999	0.05437	-0.13729	0.15636
2	-0.04914	99.99999	0.03638	-0.07757	0.11340
3	-0.06807	99.99999	-0.00982	0.40626	-0.11826
4	0.08969	99.99999	0.02970	-0.02255	-0.06816
5	0.14514	99.99999	-0.00008	0.02052	-0.12112
6	99.99999	99.99999	99.99999	99.99999	99.99999
7	0.06905	99.99999	0.00000	0.00000	-0.00909
8	0.24191	99.99999	-0.08640	0.03363	-0.11760
9	-0.02450	99.99999	-0.03671	-0.01844	0.05272
10	0.13033	99.99999	-0.01947	-0.01841	-0.03116
11	0.13033	99.99999	-0.01947	-0.01841	-0.03116
12	-0.08055	99.99999	0.00000	0.00000	-0.00909
13	0.04537	99.99999	-0.08180	-0.03038	-0.05922

Pattern \ Portion	6	7	8	9	10
Ventral					
1	0.00205	99.99999	99.99999	-0.08932	0.05686
2	-0.07805	99.99999	99.99999	-0.01572	-0.04449
3	-0.03187	99.99999	99.99999	-0.03086	0.00000
4	0.01304	99.99999	99.99999	-0.00314	-0.02401
5	0.02451	99.99999	99.99999	-0.01044	-0.00886
6	99.99999	99.99999	99.99999	99.99999	99.99999
7	-0.07544	99.99999	99.99999	0.00000	0.00000
8	0.06025	99.99999	99.99999	0.25252	-0.02217
9	-0.02403	99.99999	99.99999	-0.00473	-0.01203
10	-0.00840	99.99999	99.99999	-0.00813	0.00000
11	-0.00840	99.99999	99.99999	-0.00814	0.00000
12	-0.07544	99.99999	99.99999	-0.00000	0.00000
13	0.11724	99.99999	99.99999	0.00000	-0.00834

Table 58 (continued).

Pattern \ Portion	11
Ventral	
1	99.99999
2	99.99999
3	99.99999
4	99.99999
5	99.99999
6	99.99999
7	99.99999
8	99.99999
9	99.99999
10	99.99999
11	99.99999
12	99.99999
13	99.99999

Pattern \ Portion	1	2	3	4	5
Dorsal					
1	-0.14339	99.99999	0.13985	-0.04323	0.05437
2	-0.13679	99.99999	-0.08029	-0.03501	0.15964
3	-0.01963	99.99999	-0.04365	0.23246	-0.07504
4	0.09948	99.99999	0.03919	-0.02707	-0.06190
5	0.04467	99.99999	-0.02505	-0.04831	-0.04565
6	0.08221	99.99999	-0.03606	-0.01340	-0.02885
7	0.13860	99.99999	0.04784	-0.03933	-0.06933
8	0.14364	99.99999	-0.09731	0.11053	-0.08471
9	-0.08055	99.99999	0.00000	0.00000	-0.00909
10	0.13033	99.99999	-0.01947	-0.01841	-0.03116
11	99.99999	99.99999	99.99999	99.99999	99.99999
12	99.99999	99.99999	99.99999	99.99999	99.99999
13	0.16481	99.99999	-0.08180	-0.03038	-0.05922

Table 58 (continued).

Pattern \ Portion	6	7	8	9	10
Dorsal					
1	-Ø.Ø5633	99.99999	99.99999	-Ø.Ø8256	-Ø.Ø7451
2	Ø.Ø388Ø	99.99999	99.99999	-Ø.Ø2657	Ø.15522
3	-Ø.Ø2Ø51	99.99999	99.99999	-Ø.Ø1687	Ø.ØØØØØ
4	-Ø.Ø6767	99.99999	99.99999	-Ø.ØØ67Ø	-Ø.ØØ853
5	Ø.Ø34Ø5	99.99999	99.99999	-Ø.Ø1567	-Ø.ØØ443
6	-Ø.Ø2566	99.99999	99.99999	Ø.ØØØØØ	-Ø.Ø2Ø83
7	Ø.Ø6746	99.99999	99.99999	-Ø.Ø1471	-Ø.ØØ936
8	Ø.Ø9364	99.99999	99.99999	Ø.237Ø1	-Ø.Ø3Ø95
9	-Ø.Ø7544	99.99999	99.99999	Ø.ØØØØØ	Ø.ØØØØØ
1Ø	-Ø.ØØ84Ø	99.99999	99.99999	-Ø.ØØ813	Ø.ØØØØØ
11	99.99999	99.99999	99.99999	99.99999	99.99999
12	99.99999	99.99999	99.99999	99.99999	99.99999
13	-Ø.Ø5Ø52	99.99999	99.99999	Ø.ØØØØØ	-Ø.ØØ834

Pattern \ Portion	11
Dorsal	
1	99.99999
2	99.99999
3	99.99999
4	99.99999
5	99.99999
6	99.99999
7	99.99999
8	99.99999
9	99.99999
1Ø	99.99999
11	99.99999
12	99.99999
13	99.99999

CORRELATIONS WHICH CANNOT BE COMPUTED ARE PRINTED AS 99.99999 irregular, and horizontal-chevron ventral flaking patterns, of thin dorsal flakes, of chevron-horizontal-chevron and oblique-chevron dorsal flaking patterns and finally of the presence of basal edge grinding. All other variables had a more or less constant appearance among the complexes.

The only difference between the two sets of classification functions (Table 59) produced by the two different prior probabilities is in the constant values. This produced the two different classification tables (Table 60 and Table 61). As these two tables revealed, when prior probabilities were set at the percentage of complex contribution to the overall data set, a better classification resulted than when the probabilities for each group were equal (62.5% to 58.21% respectively). Figure 33 shows the distribution of the better classification in Table 60. Thus, a size range difference between the smallest and largest groups of 9 times or less, as opposed to 10 times, would probably be a better limit for setting prior probabilities for group membership. In any event the same general results appeared in both classification rates with Grant Lake, Caribou Lake and Agate Basin being the most distinct, in that order. Lakehead was split between itself, Caribou Lake and Grant Lake, and the Wasden site points were divided between

Table 59. Classification Function Coefficients for Projectile Points (Non-Metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Trans. X-Section			
Concave	1.601567	2.932534	.2297202
Long. X-Section			
Concave-Convex	-1.089791	3.746403	3.001742
Flaking I (Ventral)			
Expanding	4.238357	6.627400	1.886337
Pattern (Ventral)			
2	3.652857	1.472419	.7768159
4	1.886503	6.988124	.8929686
5	2.815151	1.097822	1.633344
Flaking II (Dorsal)			
Thin	2.382206	1.406724	2.051729
Pattern (Dorsal)			
6	8.542457	3.094116	-1.588520
13	2.686326	.8267261	1.349031
Basal Grinding	2.460929	.8794981	5.708744
Constant 1	-4.321783	-5.254448	-3.833253
Constant 2	-4.111131	-4.721023	-4.787905

Variable	Wasden	Agate Basin
Trans. X-Section		
Concave	2.683105	.8023523
Long. X-Section		
Concave-Convex	.2474836	-.2938886
Flaking I (Ventral)		
Expanding	2.779672	2.224803
Pattern (Ventral)		
2	3.065935	.9614536
4	2.040414	4.063000
5	8.727053	9.074124
Flaking II (Dorsal)		
Thin	2.771342	4.006019
Pattern (Dorsal)		
6	1.924599	2.572751
13	13.28225	6.648193

Table 59 (continued).

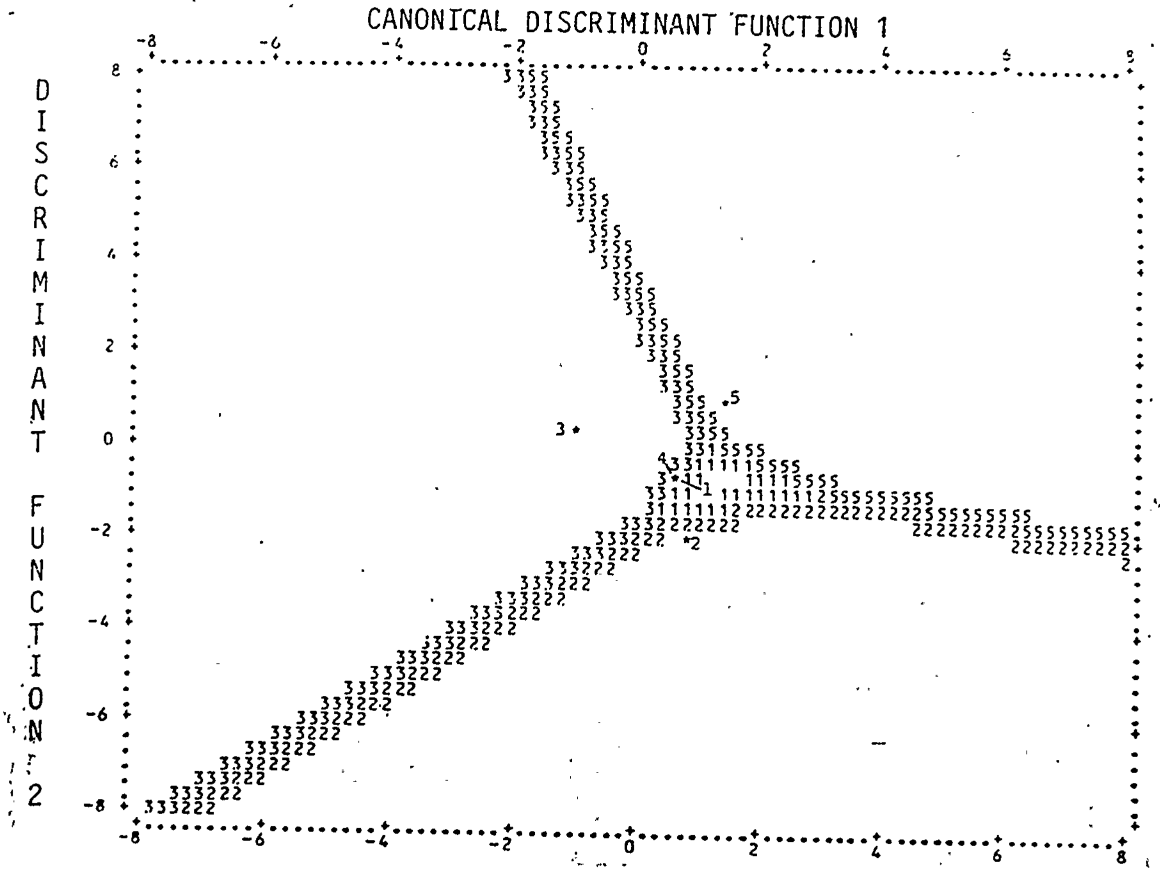
Variable	Wasden	Agate Basin
Basal Grinding	3.959689	1.811438
Constant 1	-8.794127	-6.256626
Constant 2	-7.614075	-5.897554

Constant 1 = Prior Probablities equal to size.
Constant 2 = Prior Probablities equal for each complex.

Table 60. Classification Results for Projectile Points (Non-metric Variables, Prior Probablities equal Size)

Actual Comlex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake	Wasden	Agate Basin
Complex 1 Lakehead	52	10 19.2%	16 30.8%	23 44.2%	1 1.9%	2 3.8%
Complex 2 Caribou Lake	29	1 3.4%	18 62.1%	10 34.5%	0 0.0%	0 0.0%
Complex 3 Grant Lake	139	4 2.9%	5 3.6%	123 88.5%	0 0.0%	7 5.0%
Complex 4 Wasden	21	3 14.3%	0 0.0%	8 38.1%	5 23.8%	5 23.8%
Complex 5 Agate Basin	39	1 2.6%	1 2.6%	16 41.0%	2 5.1%	19 48.7%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 62.50%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
4 - Wasden
5 - Agate Basin
* - Group Centroids
(Centroids for Wasden and Lakehead are in approximately the same location)

Figure 33. Territorial Distribution of Projectile Points (Non-Metric Variables)

Table 61. Classification Results for Projectile Points (Non-metric Variables, Prior Probablities are Equal)

Actual Complex	No. of Cases	Predicted Group Membership Lakehead	Caribou Lake	Grant Lake	Wasden	Agate Basin
Complex 1 Lakehead	52	19 36.5%	17 32.7%	13 25.Ø%	1 1.9%	2 3.8%
Complex 2 Caribou Lake	29	6 2Ø.7%	19 65.5%	4 13.8%	Ø Ø.Ø%	Ø Ø.Ø%
Complex 3 Grant Lake	139	22 15.8%	8 5.8%	1Ø2 73.4%	Ø Ø.Ø%	7 5.Ø%
Complex 4 Wasden	21	4 19.Ø%	Ø Ø.Ø%	7 33.3%	5 23.8%	5 23.8%
Complex 5 Agate Basin	39	6 15.4%	1 2.6%	11 28.2%	3 7.7%	18 46.2%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 58.21%

itself, Grant Lake and Agate Basin. These results will be discussed in more detail below.

The significance table (Table 62) showed that at 10 and 165 degrees of freedom all groups, except Agate Basin and Wasden, are statistically significantly different at the 1% alpha level. This would explain the misclassification of Wasden with Agate Basin but not with Grant Lake. The latter can be interpretd as indicating a statistically significant separation between the complexes but not a very strong one, this may be due to the small sample size of the Wasden site points.

Based on the means (Table 63) of the 10 discriminating variables the following descriptions can be stated for each of the complexes:

1. Lakehead projectile points had oblique ventral flaking or chevron-horizontal-chevron dorsal flaking. The points may have expanding ventral or thin dorsal flake scars with a moderate probablity of there being basal edge grinding.
2. Caribou Lake complex projectile points tended to have a concave basal edge with expanding ventral flake scars and an irregular ventral flaking pattern. On the dorsal surface they were least likely to have thin flake scars or to have either of the two dorsal flaking patterns that discriminate

Table 62. F Statistic and Significances for Projectile Points (Non-metric Variables)

F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 1Ø, EACH F STATISTIC HAS 1Ø AND 165 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake	Grant Lake	Wasden
Caribou Lake	3.7876 Ø.ØØØ1			
Grant Lake	6.54Ø2 Ø.ØØØØ	12.345 Ø.ØØØØ		
Wasden	3.9658 Ø.ØØØ1	7.6319 Ø.ØØØØ	6.74ØØ Ø.ØØØØ	
Agate Basin	6.1254 Ø.ØØØØ	1Ø.514 Ø.ØØØØ	12.722 Ø.ØØØØ	2.Ø44Ø Ø.Ø319

Table 63. Means of the Projectile Points (Non-metric Variables)

	Lakehead M	Caribou Lake M	Grant Lake M
Basal Edge Shape			
Straight	Ø.48276	Ø.52381	Ø.63441
Concave	Ø.13793	Ø.2381Ø	Ø.Ø1Ø75*
Convex	Ø.37931	Ø.19Ø48	Ø.344Ø9
Irregular	Ø.ØØØØØ	Ø.Ø4762	Ø.Ø1Ø75
Transverse Cross Section			
Plano Convex	Ø.ØØØØØ	Ø.ØØØØØ	Ø.Ø6452
Flat Lenticular	Ø.24138	Ø.2381Ø	Ø.ØØØØØ
Asymmetrical Tri.	Ø.ØØØØØ	Ø.ØØØØØ	Ø.ØØØØØ
Lenticular	Ø.62Ø69	Ø.52381	Ø.83871

Table 63 (continued).

	Lakehead M	Caribou Lake M	Grant Lake M
Bi-PLano	0.00000	0.00000	0.02151
Asy. Lenticular	0.13793	0.19048	0.03226
Plano Triangular	0.00000	0.00000	0.02151
Concave Plano	0.00000	0.00000	0.00000
Convex Triangular	0.00000	0.00000	0.01075
Concave Convex	0.00000	0.00000	0.00000
Asy. Convex	0.00000	0.00000	0.00000
Irregular	0.00000	0.00000	0.00000
Diamond	0.00000	0.04762	0.01075
Longitudinal Cross Section			
Plano Convex	0.06897	0.00000	0.12903
Flat Lenticular	0.68966	0.52381	0.72043
Lenticular	0.00000	0.00000	0.02151
Bi-Plano	0.03448	0.00000	0.02151
Asy. Lenticular	0.20690	0.42857	0.09677
Concave Convex	0.00000	0.04762	0.01075*
Flaking I (Ventral)			
Mixed	0.20690	0.23810	0.18280
Expanding	0.31034	0.66667	0.11828*
Parallal Sided	0.48276	0.09524	0.69892
No Flake Scars	0.00000	0.00000	0.00000
Flaking II (Ventral)			
Broad	0.31034	0.80952	0.15054
Thin	0.44828	0.00000	0.58065
Moderate Width	0.00000	0.00000	0.00000
Mixed	0.24138	0.19048	0.26882
Flaking III (Ventral)			
Shallow	0.65517	0.33333	0.77419
Deep	0.00000	0.04762	0.00000
Moderate Depth	0.17241	0.38095	0.06452
Mixed	0.17241	0.23810	0.16129
Pattern (Ventral)			
1	0.55172	0.66667	0.74194
2	0.24138	0.04762	0.06452*
3	0.00000	0.00000	0.05376
4	0.00000	0.09524	0.01075*
5	0.06897	0.00000	0.02151*
6	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000
8	0.06897	0.14286	0.07527
9	0.03448	0.04762	0.01075
10	0.00000	0.00000	0.01075
11	0.00000	0.00000	0.01075

Table 63 (continued).

	Lakehead M	Caribou Lake M	Grant Lake M
Pattern (Ventral)			
12	0.00000	0.00000	0.00000
13	0.03448	0.00000	0.00000
Flaking I (Dorsal)			
Mixed	0.17241	0.38095	0.19355
Expanding	0.31034	0.47619	0.17204
Parallal Sided	0.51724	0.14286	0.63441
No Flake Scars	0.00000	0.00000	0.00000
Flaking II (Dorsal)			
Broad	0.34483	0.61905	0.21505
Thin	0.41379	0.04762	0.47312*
Moderate Widths	0.00000	0.00000	0.00000
Mixed	0.24138	0.33333	0.31183
Flaking III (Dorsal)			
Shallow	0.62069	0.28571	0.69892
Deep	0.00000	0.00000	0.00000
Moderate Depth	0.17241	0.33333	0.10753
Mixed	0.20690	0.38095	0.19355
Pattern (Dorsal)			
1	0.51724	0.71429	0.65591
2	0.24138	0.00000	0.15054
3	0.00000	0.04762	0.02151
4	0.00000	0.04762	0.02151
5	0.03448	0.00000	0.06452
6	0.03448	0.00000	0.00000*
7	0.00000	0.00000	0.02151
8	0.13793	0.19048	0.05376
9	0.00000	0.00000	0.00000
10	0.00000	0.00000	0.01075
11	0.00000	0.00000	0.00000
12	0.00000	0.00000	0.00000
13	0.03448	0.00000	0.00000*
Dorsal			
Edge Retouch	0.31034	0.42857	0.12903
Ventral			
Edge Retouch	0.31034	0.28571	0.08602
Basal Grinding	0.41379	0.14286	0.88172*

Tables 63 (continued).

	Wasden M	Agate Basin M
Basal Edge Shape		
Straight	Ø.54545	Ø.6ØØØØ
Concave	Ø.27273	Ø.12ØØØ*
Convex	Ø.18182	Ø.24ØØØ
Irregular	Ø.ØØØØØ	Ø.Ø4ØØØ
Transverse X-Section		
Plano Convex	Ø.ØØØØØ	Ø.ØØØØØ
Flat Lenticular	Ø.ØØØØØ	Ø.ØØØØØ
Asymmetrical Tri.	Ø.ØØØØØ	Ø.ØØØØØ
Lenticular	1.ØØØØØ	1.ØØØØØ
Bi-Plano	Ø.ØØØØØ	Ø.ØØØØØ
Asy. Lenticular	Ø.ØØØØØ	Ø.ØØØØØ
Plano Triangular	Ø.ØØØØØ	Ø.ØØØØØ
Concave Plano	Ø.ØØØØØ	Ø.ØØØØØ
Convex Triangular	Ø.ØØØØØ	Ø.ØØØØØ
Concave Convex	Ø.ØØØØØ	Ø.ØØØØØ
Asy. Convex	Ø.ØØØØØ	Ø.ØØØØØ
Irregular	Ø.ØØØØØ	Ø.ØØØØØ
Diamond	Ø.ØØØØØ	Ø.ØØØØØ
Longitudinal X-Section		
Plano Convex	Ø.ØØØØØ	Ø.ØØØØØ
Flat Lenticular	1.ØØØØØ	Ø.68ØØØ
Lenticular	Ø.ØØØØØ	Ø.16ØØØ
Bi-Plano	Ø.ØØØØØ	Ø.Ø4ØØØ
Asy. Lenticular	Ø.ØØØØØ	Ø.12ØØØ
Concave Convex	Ø.ØØØØØ	Ø.ØØØØØ
Flaking I (Ventral)		
Mixed	Ø.27273	Ø.16ØØØ
Expanding	Ø.Ø9Ø91	Ø.ØØØØØ*
Parallal Sided	Ø.63636	Ø.84ØØØ
No Flake Scars	Ø.ØØØØØ	Ø.ØØØØØ
Flaking II (Ventral)		
Broad	Ø.Ø9Ø91	Ø.ØØØØØ
Thin	Ø.54545	Ø.68ØØØ
Moderate Width	Ø.ØØØØØ	Ø.ØØØØØ
Mixed	Ø.36364	Ø.32ØØØ
Flaking III (Ventral)		
Shallow	Ø.81818	Ø.76ØØØ
Deep	Ø.ØØØØØ	Ø.ØØØØØ
Moderate Depth	Ø.ØØØØØ	Ø.ØØØØØ
Mixed	Ø.18182	Ø.24ØØØ

Table 63 (continued).

	Wasden M	Agate Basin M
Pattern (Ventral)		
1	Ø.27273	Ø.32ØØØ
2	Ø.18182	Ø.Ø4ØØØ*
3	Ø.ØØØØØ	Ø.ØØØØØ
4	Ø.ØØØØØ	Ø.Ø4ØØØ*
5	Ø.36364	Ø.48ØØØ*
6	Ø.ØØØØØ	Ø.ØØØØØ
7	Ø.ØØØØØ	Ø.Ø4ØØØ
8	Ø.ØØØØØ	Ø.ØØØØØ
9	Ø.ØØØØØ	Ø.ØØØØØ
1Ø	Ø.ØØØØØ	Ø.ØØØØØ
11	Ø.ØØØØØ	Ø.ØØØØØ
12	Ø.ØØØØØ	Ø.Ø4ØØØ
13	Ø.18182	Ø.Ø4ØØØ
Flaking I (Dorsal)		
Mixed	Ø.18182	Ø.16ØØØ
Expanding	Ø.ØØØØØ	Ø.ØØØØØ
Parallal Sided	Ø.81818	Ø.84ØØØ
No Flake Scars	Ø.ØØØØØ	Ø.ØØØØØ
Flaking II (Dorsal)		
Broad	Ø.ØØØØØ	Ø.ØØØØØ
Thin	Ø.54545	Ø.72ØØØ*
Moderate Width	Ø.ØØØØØ	Ø.ØØØØØ
Mixed	Ø.45455	Ø.28ØØØ
Flaking III (Dorsal)		
Shallow	Ø.72727	Ø.76ØØØ
Deep	Ø.Ø9Ø91	Ø.ØØØØØ
Moderate Depth	Ø.ØØØØØ	Ø.ØØØØØ
Mixed	Ø.18182	Ø.24ØØØ

Table 63 (continued).

	Wasden M	Agate Basin M
Pattern (Dorsal)		
1	Ø.27273	Ø.36ØØØ
2	Ø.Ø9Ø91	Ø.Ø4ØØØ
3	Ø.ØØØØØ	Ø.ØØØØØ
4	Ø.Ø9Ø91	Ø.Ø4ØØØ
5	Ø.27273	Ø.44ØØØ
6	Ø.ØØØØØ	Ø.ØØØØØ*
7	Ø.ØØØØØ	Ø.ØØØØØ
8	Ø.ØØØØØ	Ø.ØØØØØ
9	Ø.ØØØØØ	Ø.Ø4ØØØ
1Ø	Ø.ØØØØØ	Ø.ØØØØØ
11	Ø.ØØØØØ	Ø.ØØØØØ
12	Ø.ØØØØØ	Ø.ØØØØØ
13	Ø.27273	Ø.Ø8ØØØ*
Dorsal Edge Retouch	Ø.54545	Ø.56ØØØ
Ventral Edge Retouch	Ø.45455	Ø.48ØØØ
Basal Grinding	Ø.54545	Ø.28ØØØ*

* Denotes a discriminating variable.

complexes and did not have basal edge grinding.

3. Grant Lake site projectile points tended not to have or had a modest probablity of having a concave base, concave-convex longitudinal cross section, expanding ventral flake scars, thin dorsal flake scars or any of the ventral or dorsal discriminating flaking patterns. These points did have the greatest occurrence of basal edge grinding among the complexes.

4. Wasden site points were likely to have a concave base either horizontal-chevron or oblique ventral flaking patterns or oblique-chevron dorsal flaking pattern. They tended not to have expanding ventral flake scars but did have thin dorsal scars and basal edge grinding. They did not have a concave-convex longitudinal cross section.

5. Agate Basin points tended not to have a concave base, expanding ventral flake scars, basal edge grinding, oblique or irregular ventral flaking patterns or chevron-horizontal-chevron or oblique-chevron dorsal flaking patterns. They did tend to have horizontal-chevron and ventral flaking patterns and thin dorsal flake scars.

These results supported the results of the metric and cluster analyses which showed that Grant Lake, Caribou Lake and Agate Basin points were the most distinct. Both the Lakehead complex points and the points from the Wasden site were split more or less equally between themselves and two other complexes. In the case of the former it was between Lakehead, Caribou Lake and Grant Lake, and for the latter it was between Wasden, Grant Lake and Agate Basin.

Using the inference that these nominal level variables were evidence of different techniques for the finishing of projectile points, then these results again suggest that the Agate Basin complex is more closely related to both Wasden and Grant Lake and due to temporal differences was probably ancestral to them. Due to the similar temporal positioning and the widely spaced geographical distances between the Wasden site and Grant Lake site the common denominator between them was the Agate Basin complex. Caribou Lake suggested a rather unique culture that stemmed from something totally different from that of the Agate Basin complex or possibly from a culture that separated from the ancestors of what would become Agate Basin (i.e. Folsom)(Irwin 1967). Finally, Lakehead showed evidence of the influence of several different cultrual areas and also the possible effects of the large time bracket for what is called the Lakehead complex (7500 B. C. to 5000 B. C.).

<u>Combined metric and non-metric variables</u>

Of the 280 projectile points only 78 were complete enough to be used in this stage of the analysis. This included 19 Lakehead, 14 Grant Lake, 9 Wasden, and 20 Agate Basin. The analysis was done using the 10 metric and 10 transformed nominal level variables from the two previous runs, just dicussed. After a maximum of 10 steps in the stepwise procedure 10 variables remained in the comparison. These were the length, width, right haft element, left haft element, right haft element width, the presence of expanding ventral flake scars, of oblique and horizontal-chevron ventral flaking patterns, of oblique-chevron dorsal flaking pattern and of basal edge grinding.

The significance and classification tables (Table 64 and Table 65) showed that there is 65.36% correct classification rate based on the classification functions in Table 66, and that all complexes were statistically siginificantly different at 10 and 63 degrees of freedom with a critical value of 2.62 at an alhpa level of 1%. Figure 34 helps to visualize the distribution and classification. As the internal classification showed not all the complexes had a strong discrimination. As in the

Table 64. F Statistic and Signifiances for Projectile Points (Metric and Non-metric Variables)

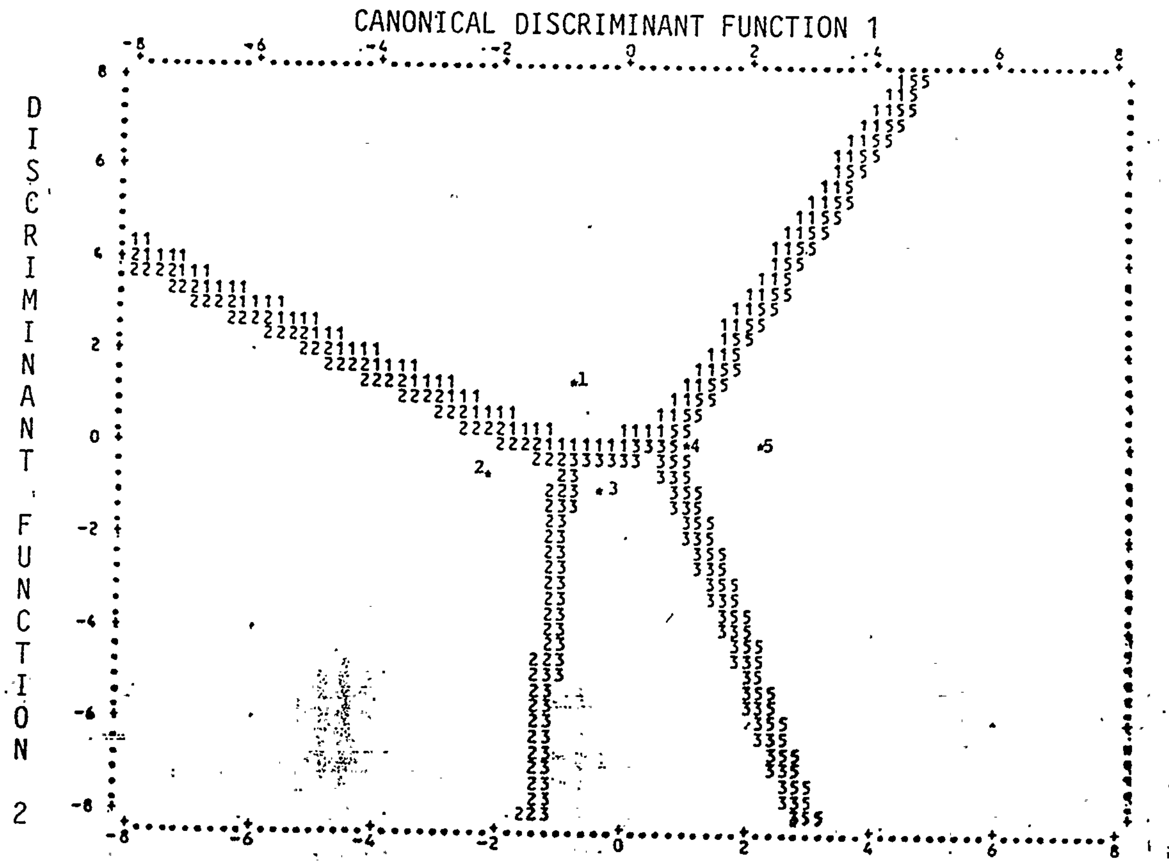
F STATISTIC AND SIGNIFICANCE BETWEEN PAIRS OF GROUPS AFTER STEP 1Ø, EACH F STATISTIC HAS 1Ø AND 63 DEGREES OF FREEDOM.

	Lakehead	Caribou Lake	Grant Lake	Wasden
Caribou Lake	4.9345 Ø.ØØØØ			
Grant Lake	4.1856 Ø.ØØØ2	3.8987 Ø.ØØØ4		
Wasden	5.Ø97Ø Ø.ØØØØ	7.6179 Ø.ØØØØ	3.4682 Ø.ØØ11	
Agate Basin	1Ø.Ø22 Ø.ØØØØ	14.284 Ø.ØØØØ	6.5324 Ø.ØØØØ	3.9431 Ø.ØØØ3

Table 65. Classification Results for Projectile Points (Metric and Non-metric Variables)

Actual Complex	No. of Cases	Predicted Group Membership: Lakehead	Caribou Lake	Grant Lake	Wasden	Agate Basin
Complex 1 Lakehead	52	24 46.2%	19 36.5%	6 11.5%	2 3.8%	1 1.9%
Complex 2 Caribou Lake	29	3 10.3%	21 72.4%	5 17.2%	0 0.0%	0 0.0%
Complex 3 Grant Lake	139	12 8.6%	10 7.2%	109 78.4%	4 2.9%	4 2.9%
Complex 4 Wasden	21	2 9.5%	1 4.8%	8 38.1%	7 33.3%	3 14.3%
Complex 5 Agate Basin	39	0 0.0%	0 0.0%	11 28.2%	6 15.4%	22 56.4%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 65.36%



1 - Lakehead
2 - Caribou Lake
3 - Grant Lake
4 - Wasden
5 - Agate Basin
* - Group Centroids

Figure 34. Territorial Distribution of Projectile Points (Combined Variables)

Table 66. Classification Function Coefficients for Projectile Points (Metric and Non-metric Variables)

Variable	Lakehead	Caribou Lake	Grant Lake
Length	.05678151	.0781500	.05687636
Width	.7644204	1.143080	.7482260
Left Haft	-.07135188	-.1590109	-.01618240
Right Haft	.1177290	.007213871	.04798747
Basal Width	.784479	.03995095	.3245220
Flaking (Ventral)			
Expanding	.9540241	1.766763	.09370524
Pattern (Ventral)			
2	5.983420	1.340277	1.667344
5	1.279411	-1.935135	.3182882
Pattern (Dorsal)			
13	5.082739	3.510463	4.441496
Basal Grinding	1.395206	.5125630	3.610306
Constant	-23.09705	-18.04623	-15.34273

Variable	Wasden	Agate Basin
Length	-.05701601	.09670489
Width	.6991648	.3396976
Left Haft	.1847098	.03970516
Right Haft	.004145709	.2269780
Basal Width	.5920266	.5583184
Flaking I (Ventral)		
Expanding	1.039233	-.8514605
Pattern (Ventral)		
2	6.551933	4.697124
5	6.297733	5.945128
Pattern (Dorsal)		
13	12.69083	8.454948
Basal Grinding	2.416683	.09798343
Constant	-17.76400	-18.60695

two previous analyses Grant Lake, Caribou Lake, and Agate Basin were the most distinct, based on the classification rates, and Lakehead and Wasden were the least.

Based on the means and standard deviations (Table 67) of the discriminating variables the projectile points of the complexes differentiated in the following manner:

1. Lakehead complex projectile points were relatively long, wide points with relatively moderate to light amounts of lateral edge grinding and a moderately wide right haft element and a wide base. They may have expanding ventral flake scars and are more likely to have oblique than horizontal-cheveron ventral flaking patterns and a moderate chance of basal edge grinding.
2. Caribou Lake points tended to be of medium length and width but to have had small haft elements and consequently small right haft element widths but a moderate basal width. Expanding ventral flake scars predominate but none of the ventral or dorsal flaking patterns were present. There tended to be very little basal edge grinding.
3. Grant Lake points were of moderate length and width with a rather large haft element and right haft element width as well as a moderate to narrow basal width. It had a moderate chance of having expanding

Table 67. Means and Standard Deviations for Projectile Points (Metric and Non-metric Variables)

	Lakehead		Caribou Lake		Grant Lake	
	M	SD	M	SD	M	SD
Length	69.28	22.13	57.91	15.98	59.74	12.20*
Width	25.69	6.00	24.45	3.51	21.63	2.78*
Thickness	8.67	2.37	8.73	2.82	7.65	2.38
Weight	17.82	13.03	11.63	5.21	11.55	4.03
Left Haft	14.71	14.72	8.59	9.14	22.89	7.75*
Right Haft	15.43	13.66	9.50	10.04	21.02	6.87*
Distance to Maximum Width	22.64	12.87	24.37	8.37	26.08	6.02
Distance to Maximum Thick.	31.59	15.32	24.98	8.86	29.50	9.10
Width of Right Haft	16.23	13.83	10.44	10.45	20.21	6.06
Basal Width	20.34	4.98	14.34	5.74	12.66	2.01*
Basal Edge Shape						
Concave	0.10526		0.20000		0.00000	
Longitudinal X-Section						
Concave Convex	0.00000		0.00000		0.00000	
Flaking I (Ventral)						
Expanding	0.42105		0.60000		0.21429*	
Pattern (Ventral)						
2	0.21053		0.00000		0.00000*	
4	0.00000		0.06667		0.07143	
5	0.10526		0.00000		0.07143*	
Flaking II (Dorsal)						
Thin	0.21053		0.06667		0.21429	
Pattern (Dorsal)						
6	0.05263		0.00000		0.00000	
13	0.05263		0.00000		0.00000*	
Basal Grinding	0.36842		0.13333		0.85714*	

Table 67 (continued).

	Wasden M	Wasden SD	Agate Basin M	Agate Basin SD
Length	45.75	13.82	73.ØØ	15.53*
Width	2Ø.Ø6	1.44	2Ø.54	5.85*
Thickness	6.83	4.Ø7	7.9Ø	3.24
Weight	6.3Ø	2.47	21.29	36.72
Left Haft	2Ø.43	5.53	34.54	12.94*
Right Haft	18.27	3.18	33.45	13.1Ø*
Distance to Maximum Width	19.98	2.16	41.Ø5	8.12
Distance to Maximum Thick.	19.27	6.95	42.34	1Ø.68
Width of Right Haft	19.69	1.18	2Ø.14	5.88
Basal Width	13.23	1.66	11.86	2.93*
Basal Edge Shape				
Concave	Ø.11111		Ø.15ØØØ	
Longitudinal X-Section				
Concave Convex	Ø.ØØØØØ		Ø.ØØØØØ	
Flaking I (Ventral)				
Expanding	Ø.11111		Ø.ØØØØØ*	
Pattern (Ventral)				
2	Ø.11111		Ø.Ø5ØØØ*	
4	Ø.ØØØØØ		Ø.Ø5ØØØ	
5	Ø.44444		Ø.55ØØØ*	
Flaking II (Dorsal)				
Thin	Ø.44444		Ø.7ØØØØ	
Pattern (Dorsal)				
6	Ø.ØØØØØ		Ø.ØØØØØ	
13	Ø.33333		Ø.1ØØØØ*	
Basal Grinding	Ø.55556		Ø.3ØØØØ*	

All measurements are in millimeters except Weight which is in grams.

* Denotes a discriminating variable.

ventral flake scars but had little chance of having any of the ventral or dorsal flaking patterns. Grant Lake points had a greater likelihood, than any of the other complexes, of having basal edge grinding.

4. Wasden points were relatively short narrow points with moderately long, wide haft elements and moderately wide basal edges. Expanding ventral flake scars were not common but horizontal-chevron ventral flaking patterns and oblique-chevron dorsal patterning were, as was basal edge grinding.

5. Agate Basin points were long but relatively narrow points with large haft element lengths and width. They tended to have very narrow basal widths with a moderate chance of basal edge grinding. Expanding flake scars were not common but horizontal-chevron ventral patterning and oblique-chevron dorsal patterning is moderately present.

The standard deviations for the metric variables showed the same general trends of central clustering as the metric run did. The magnitude of the standard deviations was the same for length, width, and basal width, but were of different magnitudes for the haft element lengths and width.

Overall, the results agreed with those of the other runs and the cluster analysis with the only major difference being an improvement in the classification rate. The results revealed that the Lakehead complex was only split two ways instead of three, thus weakening a possible relationship with the Beverly Unit. The results also show that Caribou Lake, Grant Lake, and Agate Basin were the most distinct, and that the Wasden site artifacts, despite being statistically different, were similar to Grant Lake points when it came to classification.

From the combined run there is evidence that different complexes produced different sized points with different techniques, reflected by the flaking patterns and flake scar types. These results also suggested that using a combined set of metric and non-metric variables was the best way to discriminate between the points.

SUMMARY AND CONCLUSIONS

The results of the two multivariate statistical procedures tended to support one another in almost every instance. In the non-metric variable analysis of both the bifaces and endscrapers however, the results contradicted the other analyses of these tool groups. In the former the results showed that a difference, although weak, existed between the bifaces in the complexes, while the cluster and other discriminant biface analyses revealed similarities.

In the latter case the non-metric analysis of the endscrapers showed no difference existed between the complexes, while the metric, combined and cluster analyses showed that differences did exist.

Overall, the results showed that cores and bifaces were similar between Lakehead, Caribou Lake, and Grant Lake; while, the edge retouched flakes, endscrapers, and projectile points all suggested distinct differences existed between the complexes. The difference noted in the sizes of the cores was explained as due to the type of lithic acquistioning that took place in the complex. This was confirmed by the nominal variables which showed very little difference existed in the types of cores present in the complexes. The bifaces on the other hand showed similar sized artifacts but a difference in the manufacturing techniques of the culture. This similarity in size can be explained as due to the limitations of working in stone.

Throughout this section I have presented interpretations that explain the statistical results in terms of my hypothesis that these complexes were related to each other. These were speculations based on the postulate that lithic tool assemblages will reflect cultural similarities or differences. Assuming this as true, the discriminant function analysis supports the cluster analysis interpretations that there is little evidence that Grant Lake, Caribou Lake, and Lakehead are culturally related, at least closely, and that based solely on the projectile points Grant Lake, Wasden and possibly part of the Lakehead complex may be cultural descendents of the Plains Agate Basin complex. This latter relationship may be somehow connected with the development of the Beverly Unit from Agate Basin since the discriminant analysis shows Lakehead being misclassified as Grant Lake and the cluster analysis as Agate Basin. A more detailed summary as well as conclusions drawn from these results will be discussed in the next section.

CHAPTER FIVE

CONCLUSIONS

Due to the nature of the statistics used in this study the results and their interpretations have been couched in qualified terms, inferring averages and probablilites. In this concluding section I will state my conclusions more concretely with the understanding that the qualifiers do exist. First though, I would like to note several observations that occurred to me during the analysis and writing of this research.

STATISTICAL AND STYLISTIC IMPLICATIONS

Some serendipitous results came to light from this study. The first two of these secondary conclusions are methodological in nature. First, is the statistical fact that the prior probabilities card, as shown by the non-metric run on the projectile points, should be set at equal to the size of each groups contribution to the overall data set instead of being arbitrarily set at equal for each complex. This should be done when the size of the largest group (complex) is nine times the size of the smallest group (complex) and not at 1Ø times the size as I had originally planned. Second, it would also seem that breaking the discriminant analysis into three separate runs is an effective but time consuming procedure, and that the combined variable analysis gives the best discrimination, at least in three of the five tool groups, and in only one instance (bifaces) did it give the worse discrimination.

These latter observations, of the different discrimination power of different kinds of variables, reflects the "multidimensional nature of style" (Plog 1983:129) that has been noted in ceramic studies of style. Such studies have stressed that "variation in specific aspects, levels, or attributes of style may be explained by different factors" (Plog 1983: 129,131), assuming style is conceived as being hierarchical in nature. There are still arguments as to what causes the variation in the different levels of design: that is, what affects metric and what affects nominal level variables, and how lithic styles fit into these theoretical considerations of style (see Plog 1983: 125-142 for a review of theories on styles). The fact that some tool groups were better differentiated by metric variables, some by non-metric variables, and some by a combination of the two may be a reflection of the different levels of style being affected by different processes.

Third, the six discriminant analyses on the edge retouched flake tools, as well as showing differences between the complexes, also show a less distinct differentiation when viewed from the original tool groups. This shows that cultural and functional differences and similarities crosscut each other. Similar results might also be predicted from the biface analysis, although the cluster analysis shows a very poor clustering between complexes. A second set of discriminant analyses was not run on the bifaces.

CULTURAL IMPLICATIONS

In this study I wished to see statistically if a close similarity existed among the lithic tools of the three Canadian Plano complexes, if as researchers had stated, there were cultural relationships between them. The present research is based on the postulate that lithic artifact patternings reveal cultural similarities or differences of the makers of these assemblages. Also, I wished to compare the projectile points from sites on the Plains, to determine if a close cultural relationship existed between the latter sites and the other three Plano complexes. This is something that has been inferred by previous researchers based on projectile point morphology (Wright 1976:78; Steinbring and Buchner 1980:25,27,29; Buchner 1981:81-99; MacNeish 1953:28-29; Fox 1975:44; Reid

1980:34; Buchner 1978:3-4; Miller and Dort 1978:37; Dawson 1983:25-26; Pettipas and Buchner 1983:439,443; Buchner 1984:89-100; Pettipas 1985:43-49).

The Cluster analysis revealed conflicting information by showing that cores and bifaces were similar, while edge retouched flake tools, endscrapers, and projectile points were different. The differences noted in the latter three tool categories are interesting, and since there is no evidence of the retouched flakes or endscrapers performing different tasks or similar tasks on different material, no other explanation other than cultural differences of style can be inferred.

It is especially interesting that the edge retouch flake tools are clustered by the metric variables into their respective complexes since this indicates that each complex used a different sized flake for these tools. Although this may reflect the differences in the lithic procurement, the fact that the three original tool groups also showed clustering tends to throw doubt on this interpretation and supports a cultural difference.

The projectile points show a definite separation between Grant Lake and Caribou Lake as well as a somewhat surprising grouping of Grant Lake, Wasden, and Agate Basin, while Lakehead is split between clustering with Caribou Lake and Agate Basin. These results disprove my hypothesis of cultural similarities between the three Plano complex, but do support to some extent a cultural relationship between the Plains and some of the Plano complexes, principally Grant Lake.

Of course the two tool groups that show similarities contradict the above conclusions, but it should be remembered that the cores showed a fair degree of clustering by complex that was explained by differences in lithic procurement activities that are also related to the availability of the lithic material. In the case of the bifaces the results may either reflect the sample size of the artifacts or functional and manufacturing restraints causing similar sized artifacts. The fact that the bifaces clustered much more effectively by the two original tool types (preforms and knives) than by complex supports the latter explanation.

Based on these cluster analysis results I suggest that the three Plano complexes are not similar in their tool forms and are not culturally related, and that based on the projectile points the Grant Lake site, Wasden site and part of the Lakehead complex are descended from the Agate Basin complex. This latter relationship may be related to the development of the Beverly Unit of the Agate Basin complex(see Figure 37), but the other tool group comparisons would suggest this is not the case. The

Caribou Lake complex and another part of the Lakehead complex also clustered closely together suggesting the relationship that other researchers have noted (Dawson 1983:27; Pettipas 1985:49-53). The similarity in the cores and bifaces may reflect an association between these two cultural groupings that dates back prior to the formation of the Agate Basin complex proper and its subsequent divergence.

As noted previously the metric, non-metric and combined variable discriminant function analyses on the assemblages corresponded quite well with the cluster analyses. Only two analyses completely contradicted the cluster analyses and several gave partial support.

In both instances the contradictory analysis involved the binomial variables. They were in the endscrapers and biface tool category comparisons. In the latter case the contradictory analysis shows that a difference between the complexes does exist. This is interpreted as different manufacturing techniques being used to make similar sized bifaces as discussed above in the cluster analysis. The larger sample size of the non-metric run, however, may have had an effect in this analysis. The only interpretation I can offer for the endscrapers is that although the complexes used different sized flakes for making endscrapers they tended to produce them in the same way which may be due to the functional constraints of the tool. It should also be noted that the endscrapers do not totally contradict the other results since the Lakehead complex binomial variables were significantly different from those of the Caribou Lake complex. Finally, the combined analysis showed a quite strong separation.

It becomes apparent that again I must reject my original premise that the three Canadian Plano complexes are culturally related. Figures 35 and 36 depict previous researchers interpretations of cultural relationships and the ones drawn from this analysis, respectively. This conclusion is strengthened by the fact that the tool groups are discriminated both in terms of size (metric variables) and in binomial variables that may reflect technological manufacturing decisions by the manufacturers or at least different levels of style. The binomial discriminant analysis on cores shows that similar types of cores were present in all three complexes which supports a pattern of core type heterogenety on Palaeo-Indian sites that is noted by other authors (Irwin 1967: 280-281,298-300; Knudson 1983: 18,26,76-84, 161), as well as my notion that no difference in cores, except that of size, is apparent between the complexes and the difference in size is explainable.

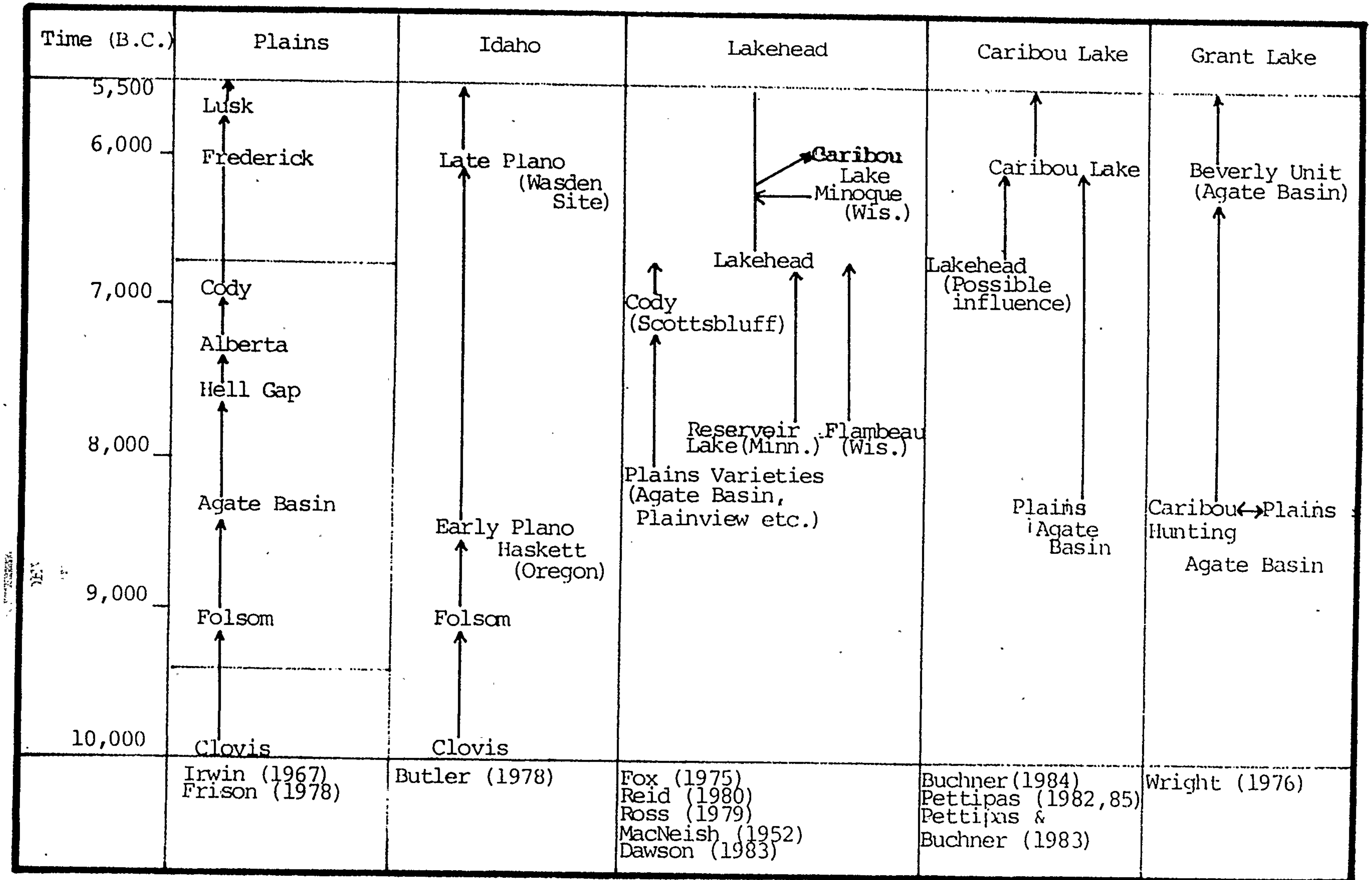


Figure 35. Cultural Sequences by Previous Researchers

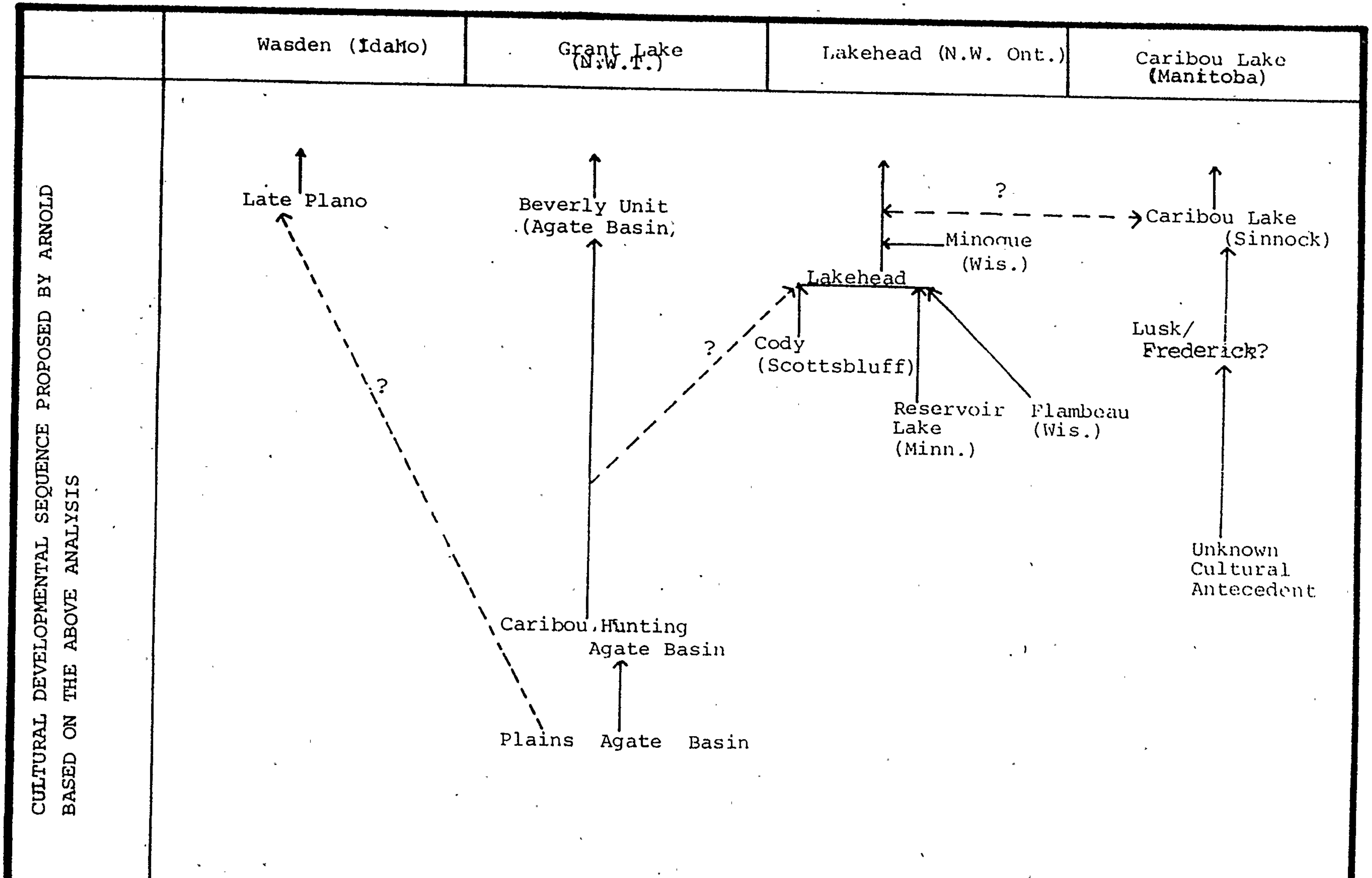


Figure 36. Proposed Cultural Sequences

Although, rejecting the idea of tool assemblage and therefore cultural similarity among the Plano complexes. I do accept that a cultural relationship exists between the Grant Lake site and Wasden site and the Agate Basin complex and that Wright has properly named the Beverly Unit, from the Grant Lake site, as part of the Agate Basin complex. Both the Grant Lake and the Wasden sites Grant Lakee would seem to represent local descendent complexes of the Plains Agate Basin. I speculate that at sometime prior to the formation of the Agate Basin the cultural ancestors of the latter and Caribou Lake may have diverged. This ancestral culture may have been Folsom, if we accept Irwin's interpretation (1967:90-105) of cultural development, or potentially even Clovis. There is at present, however, no evidence for either relationship since this is purely speculation on my part. The Lakehead complex may have been partly influenced by these same cultural developments as well as by the later Agate Basin complex, this is based solely on the projectile points since the other tools show little or no similarity between the Lakehead complex and Grant Lake or Caribou Lake.

Based on the similarity of the projectile points from the Grant Lake site, Wasden site, and the Agate Basin complex, and on the fact that the Grant Lake site inhabitants were forest dwellers as suggested by Wright's interpretation that the tree line was 60 miles south of Grant Lake during the occupation of the site (Wright 1976:84-85; Ebell 1982b:96-97), there is then no proof for the claim that the difference between Caribou Lake and Agate Basin points is due to the adapation of Plains bison hunters to forest conditions. The Caribou Lake points may reflect the influence of other late Plano complexes such as Lusk or Frederick, but Caribou Lake points do not quite fit the descriptions of these point styles (Irwin 1967: 233-237; Irwin and Wormington 1970: 27-28; Frison 1978: 34-40). The closest would seem to be Lusk, but since no collections identified as Lusk were available for comparison this must remain conjecture. Admittedly, these latter interpretations of wider cultural associations must be considered less concrete since only one tool group was compared. I would however, predict that Agate Basin cores, bifaces, edge retouched flake tools, and endscrapers would show the greatest similarities to Grant Lake site artifacts.

These results support the typological evidence, noted previously, of the multi-cultural influences that shaped the formation of the Lakehead complex that ought to provide extremely interesting, complicated, intriguing and possibly unique evidence of cultural development processes. These influences would seem to show both local regional and western origins. These regional influences stem from the Flambeau and Minoque phases (Salzer 1974:43-45) in Wisconsin and the Reservoir Lake phase (Steinbring 1974:67) in Minnesota. Like the Lakehead complex each of these phases is at present poorly defined. Although these relationships were not tested the fact that approximately one third of the points were not misclassified as either Caribou Lake or Grant Lake would suggest a third influence not associated with the Plains. The possibility of a connection between Caribou Lake and Lakehead has been suggested by Pettipas (1985:49-52)and Dawson (1983:27) but not greatly explored. The evidence from the other tool types would suggest a very weak relationship indicating cultural interaction but not necessarily culturally related groups such regional as expressions of the same culture. The relationship of Lakehead, Grant Lake and Agate Basin is also tentative since the other comparisons show a weak similarity between Lakehead and Grant Lake. As I have shown in Figure 22 Lakehead may have been influenced at some stage in the development of the Beverly Unit by the latter but like the Caribou Lake relactionship I believe this was an interaction and does not show evidence of cultural relatedness.

Finally, these results indicating that the Caribou Lake as not being related to any of the other complexes would in general contradict Pettipas typology of co-tradition point sequence (Pettipas 1982:51-57), or at least that Caribou Lake is the last of the Niobrara tradition (Pettipas 1985:49). In defence of Pettipas the results do support to some extent the general concept of co-traditions existing contemporaneously since Caribou Lake and Lakehead had to come from somewhere even if it was not the Agate Basin complex on the Plains.

Overall the results support the concept of a movement of peoples with an Agate Basin complex north following the receding glacier as envisioned by Ebell (1980; 1982b:96-103). There is no proof yet that all Agate Basin people had origianally been bison hunters and then switched to caribou or whether some Agate Basin populations had been adapted to caribou herds for a considerable period of time.

Both the cluster and discriminant analyses reveal obvious changes in the metric and non-metric variables between Grant Lake and Wasden points and those from the Agate Basin site, suggesting that temporal differentiation had occurred slowly over the 2000 year time span that separated the former two from the latter. These changes are however, nowhere near the magnitude of differences noted in the Caribou Lake complex points, and no adequate explanation can at present be put forward to account for the occurrence of these changes if the Caribou Lake did indeed descend from the Agate Basin complex as did Wasden and Grant Lake technologies.

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