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CRANIOMETRIC RELATIONSHIPS OF ABORIGINAL SPECIMENS FROM MANITOBA

BY

JEFFREY M. WYMAN

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

Department of Anthropology
University of Manitoba
Winnipeg, Manitoba

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JEFFREY M. WYMAN

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree of Doctor of Philosophy

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INTRODUCTION

This dissertation came about through a combination of circumstances and through the encouragement and cooperation of a number of people. As early as 1992 it was apparent that, in either the long or short term, an arrangement was going to be reached with Aboriginal groups in Manitoba for the repatriation of cultural and biological materials. Through my employment at the University of Winnipeg I had been involved in the forensic study of human remains from Manitoba, many of which were Aboriginal in origin. It was becoming obvious that the study of these remains had to be accelerated. Otherwise, we risked the repatriation of materials that had been in our possession, often for many years, but upon which no analysis was conducted.

The physical remains in question came from a number of sources. Some came from deliberate excavations of burials conducted mainly during the early part of the century. While deliberate exhumations of non-threatened burials had long ceased by 1992, salvage excavations of threatened sites have continued, and some of these have yielded human remains. Furthermore, the annual processes of erosion had uncovered skeletal remains, revealed by chance and collected or excavated and sent to the University Of Winnipeg for analysis. Thus, there was a considerable body of data available for study and some urgency about doing the analysis before the materials were returned. I knew that many crania had been recovered from Manitoba over the years. A compilation of existing specimens yielded a total of 150 specimens which provided a number sufficiently large for analysis.

Upon my initial appraisal it was apparent that there were too many data for a single dissertation. Rather than studying all of the skeletal material that had been recovered, I decided to limit myself to a study of the cranial remains. This tied in very nicely with the work I had been doing with Chris Meiklejohn on the study of crania primarily from the Mesolithic period of Europe (Meiklejohn et al 1997, Jacobs et al 1997).

The focus of my research was to attempt to find out who these people were that were represented by these remains. A number of archaeological cultures and historic or ethnic groups were resident here in the past, a fact established by archaeological and historic sources. The crania and other remains recovered from Manitoba represent individuals from these and/or other groups. Only one published study (Ossenberg 1974) has used some of these remains to define biological components associated with the known cultures. This work will provide an addition to and comparison with Ossenberg's research, using a different approach from the one that she took.

The primary hypothesis developed here is that it may be possible, using appropriate techniques, to identify within a large sample of human crania from a variety of contexts, significant clusters or groups that might represent different biological populations that inhabited this region in the past. A series of questions arise from this hypothesis and will be addressed throughout the thesis. When clusters appear, can they be identified as representing specific archaeological or ethnic groups? Can relationships between the different identified groups be defined in biological terms and will this be reflective of defined cultural differences? Can ancestor/descendent links between archaeological and more recent ethnic groups be established?

One major problem had to be immediately addressed. Although initially I had hoped to make primary divisions or sub-sets in the data based upon archaeological parameters, it soon became apparent that most specimens in the sample did not have adequate provenience for such an identification. The large number of unprovenienced cases meant that specimens could not be divided into sub-sets on archaeological or ethnic lines. Furthermore, the general lack of radiocarbon dates for most of the cases meant that divisions along temporal lines would not be possible except in the most general sense.

Most applicable statistical clustering techniques require that the specimens be divided into groups. To be included, each specimen must be identified as a particular group member. In the absence of appropriate archaeological data, I decided to use a geographical/ecological framework for dividing the cases into groups. I divided the province into five zones, following to some degree the natural vegetation zones of the province as defined by Weir (1983). Thus, the northern Manitoba (Norman) region corresponds approximately to the boreal forest zone, the western Manitoba (Westman) region the plains/prairie zone, the southcentral region to the combination of the wooded grassland, broadleaf forest and mixed woods zones (given the general term of parkland here) and the eastern Manitoba (Eastman) region again generally represents boreal forest. The single exception to this was the Red River valley region, which was selected as a topographic feature rather than as a vegetation zone. The Red River valley was singled out because it was used as a travel corridor in the past and contains some archaeologically unique sites that may be associated with types of specimens not seen in other parts of the province (Buchner 1988).

This dissertation is organized into six subsequent chapters. Chapter two discusses the methodology used and the reasons for selecting each mode of analysis. Chapter three provides a brief thumbnail sketch of some of the groups and cultures that were present in this region. Although the Native presence here stretches back to the Paleo-Indian Period, only groups likely to be represented in the cranial remains, both in the main and comparative samples, were discussed. This section looks at archaeological, historical and linguistic evidence in the attempt to identify specific cultures that existed here and which might be represented in the cranial data.

Chapter four discusses the sources of the samples used in this dissertation. In this chapter, I describe where I acquired the specimens used in the primary analysis and the sources of my comparative data. In this section I also detail the division of the sample into groups as discussed above.

The fifth chapter deals with data collection, sex and age assessment of the specimens, measurement and the estimation of missing variables. The sixth chapter covers the results of the many computer runs. The final chapter gives my conclusions.

Overall, it is my hope that this dissertation will add to our knowledge of the past in this region. Were there geographic or regional barriers between groups in the past? Did a single group make the burial mounds that dot the southern portion of the province? Is there evidence to suggest immigration of peoples or migration from place to place over time? Can biological links to other groups from outside the region be established? Is it possible to discern the origins of the groups that lived here?

All of these questions require attention, and the use of some form of biological analysis is necessary to provide the answers.

CHAPTER 1

METHODOLOGY

One of the goals of physical anthropology is the definition of the biological parameters of cultural, ethnic or archaeological groups. Within this general goal, the approaches used and materials studied by various group of scientists, of course, differs. For extant cultural groups, physical anthropologists may make comparisons through studies of genetic divergence. There are many such studies, including recent ones by Lorenz and Smith (1994) and Merriwether et al (1995) on North American Natives and Llop (1996) on Chilean Aboriginal populations. Group difference among the living may also be assessed through direct physical measurements (anthropometry), although this seems less common today than in the past (Wilson and Loesch 1989, Loukopoulou and Pentzou-Daponte 1995).

For the study of the biological component of past cultures, however, different methods must be applied. The assessment of affinities between groups based on osteological or skeletal information has a long history in physical anthropology (Armelagos et al 1982). Such osteological studies fall into two general groups: the study of non-metric traits (Prowse and Lovell 1996, El-Najjar and McWilliams 1978, Corruccini 1976, Ossenberg 1974) and the study of metric traits, the focus of this dissertation (Howells 1966, 1973, Key 1983, Heathcote 1986).

On occasion, a biological population, as defined by a physical anthropologist, can be "married" to a cultural entity as defined by an archaeologist. One good example of such congruence is the study of skeletons from the Wadi Halfa area of ancient Nubia. This population, originally excavated in the 1960's, is now very well known both physically and demographically, and has yielded an enormous amount of information about several ancient Nubian cultures (Carlson and Van Gerven 1977, Armelagos et al 1981, Greene 1982). Another example is the analysis of the population from the Libben Site in Ohio (Lovejoy et al 1977, Lovejoy 1985).

The precontact history of Manitoba contains a number of identified and named cultural units. Some of these refer to social/linguistic groups who were present at the time Europeans arrived and whose location, habits and possessions were recorded by early observers. These include various bands of Cree and Ojibwa, Dakota, Assiniboin and Plains Cree. Other cultural entities have been identified by archaeologists from material remains, usually lithic and ceramic artifacts.

One attempt has already been made to define the biological parameters of these archaeological groups. In 1974 Ossenberg published her definition of groups from the northeastern plains region and discussed relationships between them, based upon the study of non-metric traits. Since my current research deals with many of the same specimens and seeks many of the same goals as Ossenberg's, her methodology is discussed here.

Ossenberg studied 26 discrete (non-metric) traits of the skull in 942 cases representing 19 different groups (Ossenberg 1974:15). She assessed many of the same specimens that I have measured and was able to collect data from many cases too incomplete for me to measure. Each of her specimens was provided with a group affiliation as interpreted or provided by the archaeologists who excavated them. Thus, Ossenberg was able to develop within-group trait frequencies for the nineteen populations she studied and to do between-group distance analyses based upon these frequencies.

Ossenberg's study gave an indication of biological relationships between the various archaeological populations she studied, and her results will be compared to those from this study in the conclusions section. However, her approach, using discrete (non-metric) trait analysis, is limited in one key way. With her type of analysis, only groups and the relationships between them can be studied. Individuals can never become single components of the study, but rather contribute to group frequencies. It is these group frequencies that can be studied (Zar 1974:3-8).

As specimens are not studied as individuals, non-metric analysis is not appropriate for samples of unknown group or population affinity. In non-metric or discrete trait analysis variables are measured in nominal, usually binary, form: 1/0 = present/absent for each trait. The variables studied are not obviously correlated to one another and may be completely independent. Although each of the twenty-six traits Ossenberg selected are assumed to be the result of genetic inheritance, the heritability of each trait must be assessed independently. It is known that mechanical, functional or environmental factors can influence non-metric traits (Ossenberg 1974:15-16). Discrete trait data are most suited for a frequency analysis, and many types of statistical methods cannot be applied to them (Zar 1974:4).

In contrast, metric variables, the ones used in this thesis, allow for the study of the positioning of individuals, per se, or as members of groups, on a scatterplot. Metric analysis uses continuous variables, that is variables that have a positive value measured on a defined scale (Zar 1974:2-3). In craniometric analysis, the variables are known to be correlated with one another as they all come from a single organism and measurements of length, breadth, height and shape are related to one another. Thus, each specimen can be assessed in terms of its mathematical relationship with all of the other cases used in an analysis.

It is not necessary to make a value comparison between non-metric and metric forms of analysis. Both exist and both are valid forms of studying the similarities and differences between groups. However, they differ both in their approaches to data collection and analysis and may yield different results even when the same specimens are studied. It is interesting to note that Ossenberg, herself, suggested that for future research in the study of Woodland and historic groups, "a rigorous multivariate analysis would be worthwhile. Ideally such a study should be based on measurements taken by one investigator" (Ossenberg 1974:16). Finally, it is important to note that non-metric analysis, in being a distance measure, will always find differences between samples, whether or not they are meaningful or interpretable.

CRANIOMETRIC ANALYSIS

The technique used here to define biological groups is the analysis of cranial metric variation (craniometric analysis) (Howells 1966). This is a technique that has proved effective in population analyses since the 1960's (Howells 1966, 1973, 1989, 1995; Pietrusewsky 1974, 1984, 1990; Key 1983; Heathcote 1986; Brace et al 1989; Brace and Hunt 1990). This is, according to Howells (1973):

> "Because measurements are continuous and correlated variables, they are amenable to the best methods of multivariate analysis, and thus are able to furnish objective statements in population comparisons and estimates of distance, and to do this better than anthroposcopic or serological data".

The study of the human skull has been a part of physical anthropology for as long as the science has existed. The reasons for this lengthy association were ably outlined by Brothwell (1972:73) and include: the ease of recognition of cranial features, the definition of fairly concise points from which measurements could be taken and the tendency for skulls to accumulate in museum collections.

The mathematical analysis of crania is a logical extension of this interest. The general purpose of this type of mathematical/craniometric analysis is to assess, define and measure inter- and intra-group variability between populations (Howells 1973, 1989, 1995, Key 1983, Heathcote 1986, Wyman 1993).

To paraphrase Howells (1973), an analysis of a biological population through cranial measurements will reveal patterns or clusters in the data. These patterns are believed to be reflective of population affinities. However, the patterns will only emerge if the variability between two populations is greater than the variability within each group. If the within-group variation is equal or greater than the between-group variation the method will not work.

Within any group, similarities are expected due to the fact that people are genetically more related or similar to each other than they are to people from other groups. This assumes that the features in question are under genetic control and are inherited by children from their parents. Sjovold (1984:243), after looking at several lineages of crania from Hallstatt, Austria, came to the conclusion that: "most of the (cranial) measurements, but not all, are significantly hereditary characteristics". Sjovold (1984) also found that a variety of cranial non-metric traits were inherited, a point previously posited by Ossenberg (1974). Furthermore, Corruccini (1976:285) concluded that cranial non-metric and cranial metric traits are, in many cases, statistically significantly associated, suggesting that both are under genetic control.

It seems probable that the internal genetic structures of groups, in all areas, including cranial features, can be complicated by the fissioning and fusioning of groups, marriage patterns and migrations. Nevertheless, a study of genetic distances between and within linguistic stocks of North American Natives suggests that the within-group distances were much less than the between-group distances (Spuhler 1972:87-88).

In fact, as a test of the approach, craniometric analysis has been used in all parts of the world, on living and extinct populations, and has generally proved to be effective in delimiting groups (Howells 1973, 1989, 1995). In my own research I have been able to successfully separate the crania of North Dakota Plains Natives from Central Manitoba Saulteaux from Northern Manitoba Cree (Wyman 1993).

There will, however, always be overlap between groups, and this overlap increases, at least slightly, with geographic closeness (Spuhler 1972:88-89). However, this problem can be minimised by using multivariate methodology to assess samples. As Howells says, samples are treated:

> "not as centroids or means, but as swarms of the varying individuals who compose them; and the differentiation of these swarms from one another constitutes a statement of the degree and nature of the difference between the populations" (Howells 1973:4).

MULTIVARIATE ANALYSIS

The results portrayed in this dissertation were computed using multivariate analysis. Multivariate analysis, in this case of the cranium, is a technique used to study complicated data. It allows a researcher to simultaneously study a large number of variables without regard to, or even knowledge of, whether they are independent or dependent of one another (Tabachnick and Fidell 1989:2). In a multivariate approach "causality", in the relationships between variables, is difficult to assess. Instead, variables are shown to be related, but the cause of the relationship is unclear (Tabachnick and Fidell 1989:3).

In the computer assessment, each skull becomes a case (or a record) and each measurement a variable of that case. The multivariate technique effects the simultaneous assessment of each variable so that the relationship between the cases can be assessed (Brothwell and Krzanowski 1974:252). The multivariate analysis itself, involving many cases and variables, must be done by computer. I used the SAS, SPSS, BMDP and SYSTAT software programs at various stages of the research (SAS Institute 1985, SPSS Inc. 1986, Dixon 1985, Wilkinson 1986).

At the present time there are several prominent multivariate techniques currently available for use, each having specific uses, advantages and drawbacks. All of these methods, with one exception, can be employed through the use of common statistical computer packages.

MULTIVARIATE METHODOLOGIES

PRINCIPAL COMPONENTS

Perhaps the most commonly used multivariate technique is principal component analysis (PCA). The principal components technique measures variables for relatedness, to assess which ones form coherent subsets within the whole. These underlying constructs may account for the main sources of variation in a complex set of correlations (Corruccini 1975, Stevens 1986:337). The constructs derived, called principal components, are linear combinations of the original variables (Stevens 1986:337). A small number of principal components may account for most of the variation, or the pattern of correlations, seen in a run (Stevens 1986:338). The underlying idea is to represent a multivariate data set in terms of a smaller number of variables (the principal components), which might be more readily interpreted (Krzanowski and Marriott 1994:75).

The procedure partitions the total variance (the sum of the variances of the original variables) into the principal components (Stevens 1986:328, Krzanowski and Marriott 1994:76). In doing so, it initially finds the linear combination of variables which account for the maximum amount of variance (Stevens 1986:328, Krzanowski and Marriott 1994:76). This becomes the first principal component. The procedure then finds the second linear combination, orthogonal to the first component, so that it accounts for the next largest amount of variance (after the variance from the first principal component has been removed)(Stevens 1986:338, Krzanowski and Marriott 1994:76). The number of components that will be identified is one less than the number of variables used in the analysis, with each variable contributing a unit of variance to every component and completely expending all of its variance throughout all of the components.

Because the amount of variance contained in a particular component declines as each successive principal component is derived, most of them account for little variance (Stevens 1986:338-339). In fact, the first five components generally account for at least 75% of the entire variance (Stevens 1986:339).

The analysis produces a bivariate plot of the principal components, i.e. Prin 1 x Prin 2. This plot can compare any two components at a time, but typically only the first 2 or 3 are used because they are the only ones that actually explain a significant amount of variation in the sample. The plot generated is a scatter plot with each individual being marked by a point.

In practice, the program often seems unable to clearly define boundaries or markers between samples. The reason for this may well be that the plotting of the first few principal components in pairs shows only some of the structure of the data (Krzanowski and Marriott 1994:76). Further, much of the variation shown, usually on prin 1, is size related, as can be seen on plots including both males and females.

In terms of output, since variation is spread throughout so many components, a portrayal of any two components, even those containing the greatest variance, Prin 1 and Prin 2, displays only a portion of the total variation. This makes the interpretation of the results a little more difficult and subjective. On the other hand, this problem is more or less common to all programs using the bivariate plotting system. It is possible to plot the first 3 principal components in a tri-variate plot but the resulting plot is not necessarily more interpretable (Hausman,1982:321).

However, PCA gives an 'honest' assessment of the actual appearance of each case used in the analysis. That is, each case is plotted by its variables with no prior assumption of group membership having been used in the analysis. Thus, if two cases fall near one another in a plot, it is because they share a similar appearance, presumably due to a shared gene pool. Because of the variability of human populations and the almost certainty of overlap between them, the somewhat blurred clusters produced by PCA may be a relatively accurate portrayal of reality. It must be stressed that this is the only multivariate technique used here that does not require the identification of the group affinity for each specimen.

CANONICAL DISCRIMINANT ANALYSIS

Canonical discriminant analysis is primarily a technique whose purpose is to describe and classify individuals on whom a large number of variables have been measured (Klecka 1980, Lebart et al 1984:69). The goal of the method is to predict group membership from a set of predictors (Tabachnick and Fidell (1989:505). The primary difference between this and a principal components analysis is that in a canonical analysis the group membership of each case has to be specified before the analysis begins (Tabachnick and Fidell 1989:505). In a principal components analysis, the computer treats each case as an unknown in regards to group affinity. Also, canonical discriminant analysis differs from cluster analysis because the former requires prior knowledge of the classes while the latter does not include information on class membership (SAS Institute 1985:42). Since, in the discriminant procedure, the population affinity has been identified, the canonical analysis gives a full set of statistics describing within-group and between-group variability.

Like principal components analysis, discriminant analysis finds a set of linear combinations of the quantitative variables, called canonical variates in this case, whose values are as close as possible within groups and as far as possible between groups (Lebart et al 1984:70). In fact, these variates summarize the between-class variation of the samples used (SAS Institute 1985).

Canonical analysis also allows for tests of significance in terms of the discrimination made between groups. Specifically, there is a T test of differences between the mean values for any pair of groups and a likelihood ratio which tests the equation for overall differences between the means of all of the groups (SAS Institute 1985).

While canonical analysis is a useful tool, there are a couple of drawbacks to the technique which have been raised in the literature. These limitations include the fact that canonical analysis works best if the data follow a multivariate normal distribution pattern and if the sample size is adequate (Stevens 1986:205). In anthropological data, there is no way of assuring the normal distribution of data, and, as to sample sizes, there is no general agreement on "adequacy" (Howells 1973:7). However, to avoid "overfitting", false positive results which do not generalize a population, the number of cases in each group should comfortably exceed the number of predictors in the smallest group (Tabachnick and Fidell 1989:511). Thus, groups should be defined that are adequate in size, with none being excessively small.

Like principal components analysis, canonical analysis produces a bivariate plot. However, the group membership of each case is known, and the computer seeks the maximum separation between groups (Lebart et al 1984:70). Also, since there are usually fewer canonical variates than principal components, each plot explains more variation. Thus, interpretability is one real advantage of canonical analysis. The danger is that in seeking to maximise the distance between groups, the computer can give misleading impressions concerning associations between populations. The statistics of significance must be carefully examined to insure that apparent differences between groups and individuals are real.

CLASSIFICATION

Classification is a statistical procedure that also falls under the general heading of canonical analysis. In this procedure, an unknown individual can be added into an analysis in which the parameters of two or more groups have already been defined by a number of cases (Stevens 1986:248-249, Tabachnick and Fidell 1989:516). The classification procedure will then indicate which population the unknown individual most resembles (Stevens 1986:248-249). The best classification procedures for small to medium sample sizes use a "jackknife" method and the Mahalanobis distance to test the relatedness of individuals to group centroids (Stevens 1986:253). The results include a probability of whether an individual actually belongs to any particular group. One useful feature of the classification procedure in SAS is that the method classifies both "known" and "unknown" individuals, Also, the functioning of the procedure can be tested by the percentage of correct allocations of the "known" cases (SAS Institute 1985). In this research, the classification procedure was used to check the sex assessments made from cranial criteria and to assign a sex to "unknown" cases.

SCATTERPLOTS

Both the principal components and canonical discriminant procedures produce bivariate scatterplots of the principal components and the canonical variates respectively. Any component or variate may be plotted against each other but given that the greatest amount of information is always contained in the first two or three, these are usually selected for plotting. It is worth noting that both these procedures attempt to plot the points in "hyper-space", a multi-dimensional space. However, since a piece of paper is a two dimensional object the plot has to be compressed and somewhat distorted to fit on a page (Brothwell and Krzanowski 1974:254, Stevens 1986).

All cases used in an analysis appear as a point on the scatterplot. In the SAS plotting procedure, any letter or symbol can be used to portray any particular point and, in general, different symbols correspond to different groups. When two points fall directly on top of one another, only one is plotted and the other is "hidden" (SAS Institute 1985).

CONFIDENCE INTERVALS

Following Brothwell and Krzanowski (1974:253) and Wilson (1984:267-268) I use confidence intervals in the interpretation of scatterplots. I use this approach because when a point such as the mean of a group is plotted:

> "the vagaries of sampling will ensure that it is almost always "wrong" in absolute terms. Many statisticians therefore prefer to identify a region (interval)... within which the true value of the parameter is almost certain to lie" (Krzanowski and Marriott 1994:156).

The confidence[1] level can be expressed as a circle drawn on the scatterplot. The

---

[1] 1.96*(sd/sr rt(n))(formula for the 95% confidence interval)

actual level of confidence expressed by the circle is determined by the researcher. For example, both Brothwell and Krzanowski (1974) and Wilson (1984) use a 90% interval. This implies that the interval drawn will include the actual group mean 90% of the time (Blalock 1979:210).

The circles drawn on the plot are centred on the group means as calculated by the canonical discriminant program. The size of the circle drawn reflects two variables. The first is the scaling of the plot, which is provided by the analysis. The second is the number of cases in each group.

The calculation of the confidence interval is made using a standard formula which varies with the percent of confidence expressed (Blalock 1979:208). As such, the smaller the n (number of cases in a group), or greater the standard deviation, the larger the size of the circle that has to be drawn to reflect a particular confidence level. This reflects the fact that with fewer cases or more variable groups, the actual location of the group mean in multi-dimensional space is less certain. Conversely as n increases and/or the standard deviation decreases, the size of the circle drawn becomes smaller as the program produces results that are more confident.

Although Brothwell and Krzanowski (1974) and Wilson (1984) both chose the 90% confidence interval, I have chosen to use the 95% confidence interval. My intention is to reduce specious overlaps between the means of different groups. It is worth noting that the confidence intervals for CAN 1 and CAN 2 for each group on each plot, are calculated separately and may or may not be the same value. Also, the scaling of the CAN 1 and CAN 2 axes are usually different on each plot. This means that the actual shape of the confidence interval could vary between an oval and a circle. Because there could have been a virtually infinite number of different oval/circular shapes, I chose to draw all the intervals as circles scaled to the smaller confidence interval value on the smaller axis.

With this conservative approach, no two intervals could overlap speciously.

DENDROGRAM PLOTS

Both SAS and SPSS produced scatterplots of the data used in each analysis. These plots are useful for interpreting group relationships, but they are less than satisfactory for understanding where each individual falls on the plot. Dendrogram plots are better for assessing individual relationships, so I produced these as well.

The dendrogram plots in this report were produced using a statistical package called SYSTAT. SYSTAT has a cluster routine, based upon the Euclidean distances between cases that produces the plots (Wilkinson 1986). Although several programs are available, the method that I chose to use for plotting was Ward's Minimum Variance method (Romesburg 1984:129-135, Wilmink and Uytterschaut 1984:157-163). According to Wishart (1987) this method: "... will generally find tight minimum-variance spherical clusters.".

This method produced plots which accounted for all of the variation in the sample. Unlike the canonical program, there was no *a priori* assumption of group affiliation for the cases, and the program simply assessed all of the variables, placed cases that were similar to each other side-by side, and built up clusters in a hierarchical manner. The program decided how many clusters were apparent and how many cases went into each cluster (Romesburg 1984:129). Primary clusters were built up into secondary and then tertiary clusters, in a pyramidal fashion, until all individuals fell into one single large cluster (Romesburg 1984:129).

C-SCORE ANALYSIS

A final area of multivariate analysis used here is a relatively new technique developed by Howells called c-score analysis (Howells 1989:13-15). This technique requires that the variables associated with each case be standardized to the appropriate group means in a three stage format. The result is a single list of figures constituting an individual's c-score. The c-score for a whole population can be derived by taking the mean of the c-scores for all of the individuals in the population (Howells 1989:13-15).

The aim of c-score analysis is to achieve a separation of size from shape and to measure relative rather than absolute sizes (Howells 1989:9). In this way it is hoped to remove the effects of size, which can overwhelm more subtle features and which may be a problem in multivariate analyses, from the effects of shape (Howells 1989:9-10). Because the c-scores can be averaged for all individuals in a group, a single set of c-score variables can be produced to identify each sex of any population (Howells 1989:9). The results are portrayed in a dendrogram plot.

I used c-scores to plot my samples in various combinations or configurations. In general, when I compared populations, I put both male and female c-scores into a run, then just males, and finally, just females. The most complete, and best, results came from runs in which both genders were included. These are displayed and discussed in chapter 5. Overall, though, the c-score results did not differ significantly from the canonical results, and in the end I placed more emphasis on the results from the latter program.

In summary, several multivariate techniques were brought to bear on questions raised here requiring the analysis of multiple cases and variables. Each technique has different uses. Principal components analysis and classification were useful in defining the population affinity and gender of various cases. Canonical discriminant and c-score analysis proved useful in portraying the relationships between groups.

CHAPTER 2

THE PAST PRESENCE OF NATIVE GROUPS ON THE NORTHEASTERN PLAINS

There are several lines of evidence which reveal information about the past presence of particular Native groups in particular places within this region in the past. This information can come through four channels: historic sources, archaeological research, ethnohistoric data and linguistic analysis. The historic evidence comes from the observations of early travellers and traders on the Northeastern Plains. They made notations in diaries and journals as they travelled, often including the names of groups they encountered, and the location in which the meetings took place. This information may be reliable, but there are problems with it, as discussed below. These same problems, and more, apply to ethnohistoric data, and this source of information is not utilized here.

The archaeological information comes from investigations conducted at various sites in Manitoba and the surrounding area. The definition of particular past (archaeological) groups is generally an interpretation on the part of the archaeologist excavating or investigating a site or a group of sites. This is the best source of information available concerning past cultural groups. Further opinions come from synthesising archaeologists and researchers, who take a broader view, reviewing data from many sites and sources, and drawing conclusions concerning past peoples and movements (Schlesier 1994, Syms 1985).

The fourth line of information is linguistic. While linguistic information cannot help to demonstrate the particular locations of specific groups at particular times, it does help researchers understand and define large population blocks and some significant events which happened within these blocks. These events would relate to approximately when one part of a group separated from another - indicating migration and movement.

All of these lines of evidence must be considered if any understanding of the events of the past is to be reached. Unfortunately, there are problems with the reliability of all of these approaches, and they may contradict one another. The problems of understanding populations in the past are magnified by the depth of time. It is more likely that we will understand what was happening here in the nineteenth century than the eighteenth. It is more likely we will correctly interpret the eighteenth than the fifteenth, and so on.

People have been living in this part of the Northeastern Plains for at least 12,000 years (Wright 1974:8). Excluding the linguistic evidence, the lines of information are particularly relative to the last 2,000 years in general and the last 500 years in particular. The reality of this for the historic evidence is obvious, but even archaeological information may be more reflective of the recent past than the distant past. It is easier to find recent sites than older ones. Of the 150 or so crania I assessed for this report, only 7 came from sites dating to the Archaic period or earlier (2,000+ years). While some of the undated specimens may be Archaic, the associated artifacts, and context of these specimens, suggest a Woodland affiliation (2,000-300 bp) for most of them.

Because most of the biological specimens used in this analysis came from the Woodland Period, it is this era that will be the focus of my archaeological discussion. In fact, in an attempt to minimise the chronological depth of the specimens used in the analysis, I eliminated all known Archaic specimens from the data sets. These specimens (n=7), too few in number to be used here, will be the focus of future research.

RESEARCH PROBLEMS

Who could have been resident on the Northeastern Plains in the last 2,000 years. Who may have visited here? Were they annual or irregular visitors? Who may have migrated through this part of the continent, possibly being resident for a while?

A significant problem that has to be disentangled is the fact that the peoples who lived here were given a variety of names by themselves, by their allies and enemies, and by early European visitors and traders (Bishop 1974). Since then, other names may have been assigned to the same groups by linguists, ethnologists and archaeologists. Even without this proliferation of external names, groups may have had several valid contextual names. These names identified social groupings, beginning with small units such as bands. However, band identification names changed, in historic times, from "traditional" appellations to a pattern in which the group was identified by the name of the chief (Syms 1991:3-8 discussing the Assiniboin). Further, the same groups had other identifying names that were broader in scope and are what could be referred to as tribal names. Still others are linguistic groupings, reflective of a broader perspective in which bands or tribes are seen as being linked at some level by having related languages.

Unfortunately, a single group may have been given different names, reflecting these different contexts. A group might have a band name as well as a tribal name, or even a territorial name (Greenberg and Morrison 1982:77). They may be given a different name by their enemies from the name they use themselves. Thus, it was possible for a traveller or a trader to inadvertently record several different names for the same group. For example, in her discussion of the western Ojibwa, Peers (1994:xv-xviii) suggests that the names western Ojibwa, Saulteaux, plains Ojibwa, Bungi, Anishinabeg and Chippewa all refer to closely related groups, leading to some confusion concerning the exact identification of "Ojibwa" societies.

We have to interpret historical accounts and ethnohistorical information, and we have to reconcile, if possible, these data with the groupings identified by scientists: archaeologists, ethnologists and linguists. From the present time looking into the past we have to try to identify less significant social distinctions, say between two bands of the same tribe, and more significant distinctions, between completely different linguistic or "tribal" groups.

A further range of difficulties is presented simply by the definitions of group structures, and the assumptions underlying many terms. For example, the Assiniboin are often described as being a tribe (Syms 1991) but their actual groupings fell into a variety of categories, depending on many factors, making the term "tribe" misleading. According to Syms(1991):

> "The Assiniboin represented: a) numerous autonomous groups, many of whom never appear to have come together on a regular basis, b) large numbers of people representing 10's of 1000's, c) groups with different histories, d) groups with language variation and e) groups stretched across a vast area of land from the Red River to the Rockies and the Saskatchewan River to the Missouri River. The Assiniboins did not represent a single, homogeneous monolithic unit that can be treated as a single unit as a cultural group or as a historic group undergoing a variety of changes."

Since all of these factors will make conclusions about individual groups somewhat questionable, it seems better to concentrate on the biology of larger/broader social groupings, such as major "tribes" or large linguistic blocks, rather than trying to disentangle references to individual bands.

THE DISTINCTIVENESS OF GROUPS

Concentrating on larger social or linguistic groups as opposed to small groups is doubly logical if exogamy was a common social practice among past groups in this region. Intermarriage between bands would have the effect of reducing genetic distance between them, making them less distinguishable as separate biological entities.

Although there is not a great deal of evidence about precontact marriage practices in this region, in theory exogamy must have been common. As Murdock pointed out (in Damas 1969:158):

> "The archaeologist can use the following as a guideline: if the community is small, that is, under 50 or even under one hundred, there is bound to be local exogamy and concomitant diffusion over a wide area."

After a review of the literature, Meiklejohn (1974:341) reached the same conclusion: "Exogamy appears to be a dominating characteristic of hunter-gatherer societies prior to the development of contact-induced sedentism". The work of Rogers (1969) illustrates the significance of exogamy among the Ojibwa. Rogers (1969:25-26) details endogamous and exogamous marriages among the Caribou Lake and Round Lake Ojibwa of northwestern Ontario (from AD 1900-1945). For the Caribou Lake group, of a total of 52 wives, 32 (61%) were local women, representing endogamous (within the group) marriages and 20 (39%) were from different bands, representing exogamous marriages (Rogers 1969:25). For the smaller Round Lake group, 15/34 (44%) were from the local group, while 19/34 (56%) were from neighbouring groups (Rogers 1969:26). While the figures for exogamous marriage cited here (39% and 56%) are not an overwhelming frequency, even 1-2% gene flow between groups is very significant (Brues 1972).

Groups distinguished at a broader social level may not have had as much gene flow and thus may be more readily distinguished by genetic/biological markers. Such distinctions, however, may be related more to distance than demographic factors. Following Roth (1980:198) distinct, bounded "ethnic" groups may never have existed among hunting and gathering populations. A level of exogamy among such groups, through marriage or capture, is to be expected. For example, gene flow has been demonstrated between a Yanomamo group under study and its non-Yanomamo neighbours (Chagnon et al 1970, Spielman 1973, Spielman et al 1972). Similarly, Burch and Correll (1972:36) demonstrated that partnerships and co-marriages existed both within and between regional groups in north Alaska. They concluded that: "The famed Indian-Eskimo boundary - more specifically, the Athapaskan-Eskimo boundary, all but vanishes from sight".

Thus, social connections and relationships probably bring scattered hunter-gatherer groups closer together genetically. However, even keeping this in mind, it still seems likely that there will be more gene flow within certain groups than between. And, certainly, groups will differ with greater geographic distance between them. It remains to be seen if linguistic differences will serve to distinguish groups as well.

LINGUISTIC EVIDENCE

Currently, linguists are able to make estimates as to the length of separation between groups who are linguistically different (Trask 1994:46-48, Haviland 1993:101). This yields a starting point for a discussion of group divergence and biological distance. Biological distinctiveness should be most evident between individuals and groups belonging to different major language families of North American Natives, such as Siouan speakers and Algonkian speakers. These have the greatest linguistic difference and probably, therefore, the most significant biological distance as well.

Thus, it may be that on some level, linguistic divergence may parallel biological distance. However, it is not as good an analogy of biological distance as might be hoped for because the measurement of linguistic distance and particularly the time frame of linguistic change are complex matters. For example, both Springer and Witkowski (1982) and Carter (cited in Syms 1991:16) place all modern/historic Siouan languages in a number of groups, all of which are derived from the Proto-Siouan language. The Proto-Siouan language itself seems to have originated in the time period of 2,000-2,500 bp.

But Proto-Siouan did not simply appear at this time; it was itself derived from another, more ancient language. This is attested to by the fact that the Siouan language family as a whole is related to the Caddoan and Iroquoian language families (Chafe 1973:1164). In fact, Chafe (1973:1198) refers to these three families as a single group, using the term "Macro-Siouan". Further, he speculates that "Macro-Siouan" is related to the Nadene languages (Athapaskan and Tlingit) and the "Gulf" languages (the Muskogean family plus Natchez, Tunica, Chitimacha and Atakapa)(Chafe 1973:1198, Krauss et al 1981). Since Haas (1973:682) argues for a connection between the "Gulf" languages and the Algonkian language family, it may well be, as Chafe states (1973:1198): "[for North American Natives] ... there is essentially but one superstock of languages east of the Rocky Mountains".

Thus, given the possibility that all languages in this region are somewhat related, this implies, likewise, a certain degree of biological similarity between groups as well. The linguistic evidence is somewhat ambivalent: groups are all separate but all related. This uncertainty is magnified by the lack of hard dates which can be attributed to linguistic events.

Still, even without a reliable time scale, linguistic differences do have inherent meaning and some clear implications for biological differences between groups. Even within a single language family it is likely that there will be greater and lesser distances between groups. Thus, there is likely greater distance between a group that speaks Cree and another that speaks Ojibwa, than between two groups of Cree speakers. This, despite the fact that both Cree and Ojibwa are part of the Algonkian language family. Language barriers, however, do not necessarily impede gene flow, as has been demonstrated by Burch and Correll (1972) and Melartin and Blumberg (1966).

LINGUISTIC GROUPINGS

At the present time, and in the relatively recent past, Native residents of southern Manitoba have spoken a variety of languages. These fall into two main language families: the Algonkian and the Siouan. The Algonkian speakers include linguistic and cultural groups such as Cree (several dialects), Ojibwa, Saulteaux, Bungi and Blackfoot. The Siouan speakers include the Dakota (several groups), the Lakota (several groups), the Nakota (Assiniboin/Stony) and the Mandan/Hidatsa (Kroeber 1953:80,84, Syms 1991:4).

Dialects of Cree are common throughout a wide band of central Canada including northern Ontario, central Manitoba and Saskatchewan (Rhodes and Todd 1981:53). Dialects of Ojibwa are common south of the Cree area, in Ontario, Manitoba, and the northern states of the United States. The Ojibwa "zone" is bordered on the north by Cree, the west by Siouan peoples, the east by Iroquoian and the south by a variety of groups, including the Cheyenne, another Algonkian group (Rhodes and Todd 1981:53).

Cree and Ojibwa have developed as separate languages for "many hundreds of years", yet they are joined by a number of "phonological phenomena" (Rhodes and Todd 1981:58), which betrays their common heritage from Proto-Algonkian. Using reconstructive techniques, Siebert (1967:39) placed the homeland of the Proto-

Algonkians in southern Ontario, perhaps around 1200 BC. Snow (1976), however, sees the Proto-Algonkian homeland as being much larger, and sees the 1200 BC date as very conjectural.

It is presumed that the Proto-Algonkians were nomadic hunter gatherers who ranged over large areas. The Proto-Algonkian language would have had a number of dialects, two of which developed into Cree and Ojibwa (Rhodes and Todd 1981:60). The Cree moved in a northerly direction, eventually forming into two large groups (Eastern and Western Cree), occupying territories on either side of James Bay. The Ojibwa remained closer to the original homeland (Rhodes and Todd 1981:60). Following Voorhis (1978) the Cree-Ojibwa split may have occurred about 1,000 years ago.

For both the Cree and the Ojibwa, extensive westward movement seems to have been a relatively recent phenomenon, based upon a linguistic analysis of the complexity of the dialects in each language (Rhodes and Todd 1981:60). Nicholson (1996:72-73) suggests that the movement began or intensified after about AD 1650.

The Siouan language family, in the form of Proto-Siouan, may date to around 500 BC (Springer and Witkowski 1982, Syms 1991, Pettipas 1992:12). After this time, one group, comprising the Proto-Western-Siouan language group may have begun moving westwards and northwards. The Crow, Mandan and Hidatsa languages/people derive from this group (ibid.).

Two other main groups descend from the Proto-Siouan in the time period of 500 BC to AD 500 (Carter 1980 cited in Syms 1991, Springer and Witkowski 1982). These are the Proto-Eastern-Siouan (or southeastern) family, ancestral to Siouan languages spoken by groups far to the south of Manitoba and the Proto-Central-Siouan language family, the ancestor of the Stoney, Yankton, Yanktonai, Santee and probably Assiniboin languages (Springer and Witkowski 1982, Syms 1991).

Since Algonkian and Siouan are different language families, it is possible that individuals belonging to either group will be more distinct from each other than they are from other groups within their language family. This difference should be reflected in biological as well as linguistic terms and thus craniometric analysis should theoretically be able to distinguish between these two broad groups.

HISTORIC GROUPS

Probably the best evidence available concerning the presence or absence of particular Native groups on the Northeastern Plains in general, and the Manitoba area in particular, is the historic record. In general, this record concerning population presence and movements in the eighteenth and early nineteenth centuries is a collection of diary and journal entries and reports, usually related to the fur trade. The most crucial information, for the purposes of this report, is contained in the earliest reports from this part of the New World. These point to the groups which were resident, or semi-resident at the point that Europeans arrived. They also suggest the configuration of groups in the years preceding the Europeans' arrival (Peers 1994, Gough 1992, Burpee 1968).

This section also includes the protohistoric period, the evidence for which is more speculative. Reconstructed events in the protohistoric are conjectural in that they include extrapolations of things that happened in the historic period, mixed with ethnohistoric tradition and some archaeology. However, the historic events for which there is reasonable certainty are best seen in the context of what probably occurred in the preceding protohistoric period.

DAKOTA

Before AD 1600, the Dakota were woodland people, located between Lake Michigan and the Red River and centered in Minnesota along the upper Mississippi River (Ossenberg 1974:20, Laviolette 1991:2). Prior to this, their origins are obscure (Ossenberg 1974:20) but may lie to the south and east of Minnesota/Wisconsin (Satterlee and Malan 1974).

The Dakota are divided into three distinct groups, each speaking a different dialect: Eastern Dakota - (the Santee) speak *Dakota*; Middle Yankton, Yanktonais, Stony and Assiniboin speak *Nakota;* and the Western Dakota (the Tetons) speak *Lakota* (Laviolette 1991:3).

The Teton Dakota left their ancestral lands and began a westwards migration between 1680-1750 (Laviolette 1991:7, Mooney 1896 - cited in Kroeber 1953:81). By AD 1730, some of the Teton were visiting, and may have been resident, about the Red River region (Laviolette 1991:7), but, in general they were found in parts of North Dakota, South Dakota, Wyoming and Montana. Their migration eventually ended in the Black Hills region of South Dakota. The second group, the Yankton, followed, taking up residence along the southern border of South Dakota, near the James River (Satterlee and Malan 1974). The third branch of the Dakota (the Santee) remained primarily in the Minnesota region until AD 1800 (Laviolette 1991:7).

The Dakota are an important group in the history of the northeastern plains and are represented in this thesis by specimens measured by Key (1983) as part of my comparative sample. It is certainly possible that some of the Manitoba crania are Dakota in affiliation. However, southern Manitoba was primarily occupied by the Cree, Assiniboin and Ojibwa in the protohistoric and historic periods, and these groups were commonly enemies of the Dakota, (Tanner 1994, Milloy 1988, Peers 1994). This may have made the Dakota presence in Manitoba less significant throughout these periods.

ASSINIBOIN

The Assiniboin are a Siouan group whose tradition suggests that they broke away from another Siouan group after a dispute (Syms 1991, 1997, Nicholson 1996). While the tale of this breakup may be allegorical, the linguistic evidence suggests that the Assiniboin language is related to the Santee (Dakota) and Teton (Lakota), but to the Yankton and Yanktonai (Nakota) dialects in particular (Springer and Witkowski 1982, Syms 1991). This separation between the Assiniboin and other Siouan groups may have occurred around AD 1500 (Springer and Witkowski 1982, Syms 1991).

Kroeber (1953:83) considers the Assiniboin to have been late entrants onto the plains. Lowie (1909:7) disagrees and places the Assiniboin in the area between the Lake of the Woods and Lake Nipigon around AD 1600. He believes that during the 1600's the Assiniboin were gradually moving westwards, in concert with the Cree (with whom they were usually allied). A primary forest/woodland adaptation for the Assiniboin is also suggested by Nicholson (1996:72).

Before AD 1700 some Assiniboin forged an alliance with the Ojibwa/Cree and moved into the parklands and prairie region of Western Manitoba and South Saskatchewan where they were well established before AD 1700 (Nicholson 1996). As evidence of this, Henry Kelsey spent the winters of 1690 and 1691 with the Assiniboin in southern Saskatchewan (Schlesier 1994:308, Nicholson 1996:72). By AD 1800 the Assiniboin were found as far west as central Saskatchewan and as far south as Yellowstone. As fast as their influence fluoresced, however, it also declined. Decimated by epidemics, warfare and the disappearance of large bison herds the Assiniboin were greatly reduced by AD 1850 (Syms 1991, 1997). By AD 1900, the largest surviving group was in Fort Belknap, Montana (Lowie 1909:8).

The Assiniboin became a separate group around AD 1500 and become a presence in this region after this date (Springer and Witkowski 1982, Syms 1991). But their ancestors' presence may have been felt here for several centuries before this. Syms (1991:14) suggests that a variety of archaeological materials on the northeastern plains, dating to AD 1200-1500, will be identified in the future as being a product of the Assiniboin or a related group. This means that they may well have been associated with sites in western Manitoba dated in the time period of AD 1500-1850. Even earlier sites, though, may have an Assiniboin or Proto-Assiniboin affiliation. Further, it has been suggested that the many burial mounds of southwestern Manitoba may have been the product of the Assiniboin (MacNeish 1958, Capes 1963). Such a connection, even though made many years ago, is worth exploring from a biological perspective. Unfortunately, in terms of this analysis, there is no available comparative cranial metric samples that could be absolutely attributed to the Assiniboin.

MANDAN/HIDATSA

These were village tribes, inhabitants of the tall grass plains along the Missouri, in modern North Dakota. Although they utilized the adjacent plains, both the Mandan and the Hidatsa primarily derived sustenance from domestic plant cultivation (Pettipas 1992:11, Flynn and Syms 1996:8).

Kroeber (1953:83) believes that the Mandan/Hidatsa were formerly prairie peoples who either came from the south along the Missouri or a short way due west from the eastern prairie regions. Pettipas (1992:12) suggests a possible link to the Effigy Mound Culture, centred in Wisconsin, in the time period AD 300-1000. These groups may have moved west at a relatively early date and thus the Mandan may have been the earliest Siouan people in the Northern Plains. While the date of their first appearance is not known for sure, they were settled along the middle reaches of the Missouri River in the North Dakota region by AD 1740 (Holder 1970:68).

The Hidatsa were frequently resident with the Mandan but, in the eighteenth century, may have been recent immigrants (Holder 1970:68-69). There is no certainty as to the question of the presence of Hidatsa in Manitoba. They may have had a brief presence in southwestern Manitoba, before moving to the Devil's Lake region of North Dakota (Pettipas 1992:13-14, Winham and Lueck 1994:162). It is possible that they may have even maintained a presence in southwestern Manitoba, perhaps at Star Mound, Calf Mountain, the Lowton site and at the confluence of the Souris River and the North Antler Creek (Pettipas 1992:17).

Nicholson suggests that the Vickers Focus, created by a hunting/gathering and gardening society in southern Manitoba about AD 1400-50, may represent an ancestral Hidatsa occupation (1996:72, 1988:363).

Thus, some sites in southwestern Manitoba may have been created by, or have, a Hidatsa component. However, the Hidatsa per se are not likely to have appeared in this region much before AD 1400, and therefore can not have been responsible for any sites of great antiquity. On the other end, after AD 1500 or so, the Assiniboin were becoming established in the areas north of most of the settled Mandan and Hidatsa areas, and this probably limited the ability of the latter groups to establish a larger presence in this province.

WOODLAND CREE

These Cree were a forest people, with a presence in a broad band of boreal forest in Central Canada north of Lake Superior (Fisher 1969). In the mid-seventeenth century, they were well established throughout the forest along the coast of Hudson Bay and along the major river systems of northern Ontario, central Manitoba and into Saskatchewan (Bishop 1981:158, Nicholson 1996:72). Throughout the late seventeenth and early eighteenth centuries they pushed into most of the Manitoba region, becoming established in both the forests and parklands of central Manitoba (Meyer and Russell 1987:26).

Throughout the fur trade period the Cree occupied the territory where they are found today with the Ojibwa and other Algonkians to the southeast of them and the Assiniboin to the southwest (Honigmann 1981:218, Bishop 1981:158). However, their range may have been even wider in the past. They were reported as inhabiting the shores of Lake Superior, at least seasonally, in the 1700's (Bishop 1981 citing Blair 1911-1912). As a result of their middle-man position in the fur trade they were a strong presence in the parklands, at least north of the Assiniboine River (Nicholson 1996:73).

Alexander Henry the Elder encountered a "Cree" village at the mouth of the Winnipeg River in 1775 (Steinbring 1981:245). By the nineteenth century this would have been well within Ojibwa lands. According to Ewers (1974:18), though, this must have been near the limit of Cree expansion. He suggests that they stayed primarily in the forest and were not generally resident on the plains west of the Red River.

There are a number of distinct Cree groups today, but the identification and placement of the various groups prior to 1821 has been somewhat of a mystery (Meyer and Russell 1987:26, Bishop 1981:158). Smith (1976) identifies the current residents of the boreal forest of central Manitoba, Saskatchewan and eastern Alberta as the Western Woods Cree. This comprises the Rocky Cree, the Strongwoods Cree and the Swampy Cree. Although the links have not yet been well established, it is possible that these specific groups may be linked to various complexes of precontact Selkirk ceramics (Meyer and Russell 1987:26).

Smith (1976) argues that the Swampy Cree were immigrants to Manitoba in the late eighteenth and early nineteenth centuries, although other groups had been resident in northern Manitoba and Saskatchewan for many years. This corresponds with data provided by Wright (1971:4) who suggests continuous Cree occupation at South Indian lake from AD 900. Ongoing investigations (Riddell: personal communication) support this contention and even take the date further into the past, to AD 800 or so. Today, South Indian Lake is occupied by Rocky Cree, and it is possible that they have been there for many centuries.

It seems likely that the modern Cree and their ancestors have been resident in the boreal forest for a long time. It is hard to say with certainty how far back in time this connection might be drawn, as dates for occupations in northern and eastern Manitoba go well back into the Archaic Period. There is nothing to link Archaic sites with the Woodland Period Cree or the modern Cree, but it is interesting to speculate about such links. It is assumed here that most specimens recovered from northern Manitoba and used in the analysis represent Cree or ancestral Cree individuals. As far as is known, no groups other than the Woodland Cree were commonly resident in this area in the past. Thus, the Woodland Cree have likely been a continuous presence in the boreal forest region of northern Manitoba for up to one thousand years. Those who ventured out of the forest, becoming adapted to the Plains lifestyle were called the Plains Cree. It is this latter group that is linked with plains/prairie sites in western and much of southern Manitoba.

PLAINS CREE

Cree expansion westward into the plains began with the fur trade, in the early part of the seventeenth century (Milloy 1988:5). Prior to this, these peoples were located in an area stretching from the East Main River (Ontario) to the Winnipeg River (Milloy 1988:5). They are best viewed as an offshoot of the Woodland Cree, who generally remained in the forest. The separation between the two groups was probably relatively recent, as the Plains Cree dialect is intelligible to other Cree speakers (Wolfart 1973:11).

Wissler (1922) recognized that the Plains Cree possessed many traits characteristic of forest tribes, even though they were no longer necessarily resident there. He suggests that in historic times they pushed westwards at the expense of Athabascan tribes, the Dakota and the Assiniboin. Their apparently late westwards migration onto the plains, after the arrival of Europeans, was also stressed by Mandelbaum (1940:18).

The Plains Cree were encountered in this region by La Verendrye in 1733 (Mandelbaum 1940:19). At this time they were pedestrian hunter/gatherers and canoeists. The Plains Cree indicated to La Verendrye at the time that their range extended only as far west as Lake Manitoba. By 1800, however, they occupied a large section of western Manitoba and central Saskatchewan.

In sum, the Plains Cree were late arrivals into the prairie/plains biome, and, in Manitoba at least, they probably stayed relatively close to main watercourses. Their distribution in Saskatchewan may have been more general. They acted as middlemen in the fur trade (Mandelbaum 1940:187, Milloy 1988), either moving goods by canoe from southern locations to fur trade posts in the north, or simply moving trade goods from one group to another as part of the larger fur trade pattern. Their westwards movement was also promoted by warfare, variously at the side of, or against, the Blackfeet (Milloy 1988).

For the perspective of biological or genetic distance, they would likely be indistinguishable from other Cree peoples. Their language was intelligible with other Cree tongues, which suggests that their separation from them was not of great duration. Therefore, their genetic separation would not be great either. At the same time, they probably arrived on the plains too late to be associated with larger sites and mounds found there.

OJIBWA

With the Cree (and the Plains Cree), the Ojibwa (locally called Saulteaux and Chippewa) were primarily forest dwellers prior to the Protohistoric Period (Hickerson 1962, Nicholson 1996:73). They were probably resident in the northern Great Lakes area by AD 1500 and were encountered along the St. Mary's River in AD 1634-1670 (Greenberg and Morrison 1982:91, Dawson 1987:146, Nicholson 1996:73).

The number of groups in the area north of Lake Superior seems to have increased in the late seventeenth and early eighteenth centuries. In the early 1730's, missionaries reported many new groups resident in this area, some of which appear to have been new arrivals from the east (Bishop 1981:160). For example, the Sturgeon and the Quace were probably both Ojibwa groups who had moved from the area north of Lake Huron (Bishop 1981:160). This suggests that at least some of the Ojibwa were relatively late arrivals in this area, probably arriving in response to two factors in particular: the movement of the Cree to the north and west for fur trading; and warfare with the Dakota, who were slowly being pushed to the west.

Roughly between AD 1680-1720 the Ojibwa rapidly expanded to the north and west, in Ontario and into Manitoba (Steinbring 1981:244, Rogers and Taylor 1981:231, Nicholson 1996:73). Those moving west expanded into most of eastern and southern

Manitoba, often accompanied by, and sharing territory with, the Cree and Assiniboin, with whom they were allied (Nicholson 1996:73).

Those moving north became known as Northern Ojibwa (Rogers and Taylor 1981:231). During the fur trade period (1670-1821) the Northern Ojibwa gradually became dependant upon the fur trade, particularly at posts on the James and Hudson bays. They also traded to the south and east with the French near Lake Nipigon (Rogers and Taylor 1981:231). Today, their descendants are resident in the Patricia portion of the Precambrian Uplands, where they display some linguistic and cultural differences from the southern Ojibwa (Rogers and Taylor 1981:231).

Some of the Ojibwa moving west, the Saulteax, settled into a position to the south and southeast of the Northern Ojibwa. The Saulteaux should not be seen as an entirely culturally and linguistically unique group (Steinbring 1981:244). Their name itself is one that refers to self-identification; Saulteaux elders readily identified themselves as Ojibwa (Steinbring 1981:244). The Saulteaux (Ojibwa) from southeastern Manitoba were probably not the same people as the Northern Ojibwa, and several cultural traits separate these two groups but link the Saulteaux with the southern Ojibwa, or Chippewa (Steinbring 1981:244).

The Ojibwa expansion seems to have been rapid. They moved to the west and southwest at the expense of the Dakota, occupying north-central Minnesota and the Boundary Waters area by AD 1760 (Nicholson 1996:73). In 1794, they were reported at The Pas (in western Manitoba and even up the Saskatchewan River into Saskatchewan (Hallowell 1936:35)). By 1800, they were in the Red River Valley and had expanded into the plains in Western Manitoba, moving along the Assiniboin River (Tanner 1994, Nicholson 1996:73). This expansion into the parkland, prairie and plains biomes, which peaked at about AD 1870, was likely in response to factors such as bison hunting, the availability of horses and the fur trade (Kroeber 1953:84).

An alternative hypothesis is that the term Ojibwa diffused to a number of Algonkian speaking groups in the eighteenth and nineteenth centuries (Greenberg and Morrison 1982). In this view, the expansion and increase in numbers of the Ojibwa may represent that more people/groups were being called or identified as Ojibwa, rather than a great increase in population (Greenberg and Morrison 1982:91).

One Ojibwa group, the Saulteaux, became resident in the Winnipeg River area around AD 1760 (Nicholson 1996:73). They, or their ancestors, were likely visitors in these areas before they became resident. Therefore many of the human remains from these regions, including samples used in this analysis, may be Ojibwa in origin.

PLAINS OJIBWA

This group was also called the Bungi and may as well have been a group referred to as the "Snakes" by Alexander Henry the Younger (Skinner 1914:477). Today, they are found near Portage la Prairie and Swan Lake in Manitoba and in the Turtle Mountains of North Dakota.

The Plains Ojibwa speak a dialect of Ojibwa, and the languages are similar enough that the separation was probably relatively recent (Skinner 1914:477). Howard (1965:5-6) suggests that the Bungi were an offshoot of the Woodland Chippewa (Ojibwa) only in historic times. They maintained the woodland attribute of travelling by canoe and were found primarily along river systems, including the Assiniboine and Souris rivers, where they could take advantage of Native/European trade opportunities (Hickerson 1956:301).

Significant biological distance is unlikely between the Bungi and the Chippewa or Ojibwa groups in the region. The linguistic similarities between the groups suggest that they were not separated for a great length of time before the arrival of Europeans. In fact, it is obvious that Peers (1994:xvi-xvii) considers the term Bunji to be synonymous with western Ojibwa and Saulteaux. This raises the question of the validity of the identification of Plains Ojibwa and/or Bungi. Were they really separate groups, or manifestations of larger Ojibwa groups? Problems in the identification of Ojibwa groups are common (Greenberg and Morrison 1982) but as none of the terms or synonyms are likely to reflect, or be the result of, great genetic differentiation, their distinction is not necessary for a biological analysis. In any event, the Plains Ojibwa do not appear to have been a numerous or widely distributed group in the past, nor one responsible for older sites in the prairie/plains biome. Furthermore, their similarity to related Ojibwa groups would likely make them biologically indistinguishable from these groups.

BLACKFOOT

Kroeber believes that the Blackfeet speak an Algonkian dialect, but one which is highly diversified from the great body of Algonkian speakers (1953:81). This linguistic divergence is confirmed by Proulx (1980:13) in his placement of the Blackfoot language outside of either the central or eastern Algonkian language families. In fact, Proulx (1980:13) suggests that there was a split between the Blackfoot and the main Proto-Algonkian languages at an early date although he did not speculate what this date was.

In the late protohistoric period, between AD 1690 - 1720, the Blackfeet were situated in the Northern Plains, specifically around the Eagle Hills of south Saskatchewan. Kroeber (1953:82) saw the Blackfeet as long time prairie/plains residents, a position also taken by Ossenberg (1974:21) who considered both linguistic and serological traits. Walde et al (1995:50-53) suggest that the ancient Blackfoot were responsible for the Old Woman Phase, which began about AD 1000 in southern Alberta southern Saskatchewan, and Montana. This follows the work of McCullough (1982:55-57) who suggested that this phase represents the movement of the Blackfoot and other groups out of the forest and onto the plains.

In this scenario, the origins of the Blackfoot would be in the forests north of the plains, from Alberta to Manitoba (Walde et al 1995:25). However, the heartland of the Old Women's Phase/Blackfoot is clearly in Alberta and Saskatchewan, and Manitoba is only on the periphery of the range. This means that there is a possibility that specimens recovered from the plains, prairie or Red River Valley regions of Manitoba could be Blackfoot in ancestry.

ARCHAEOLOGICAL EVIDENCE

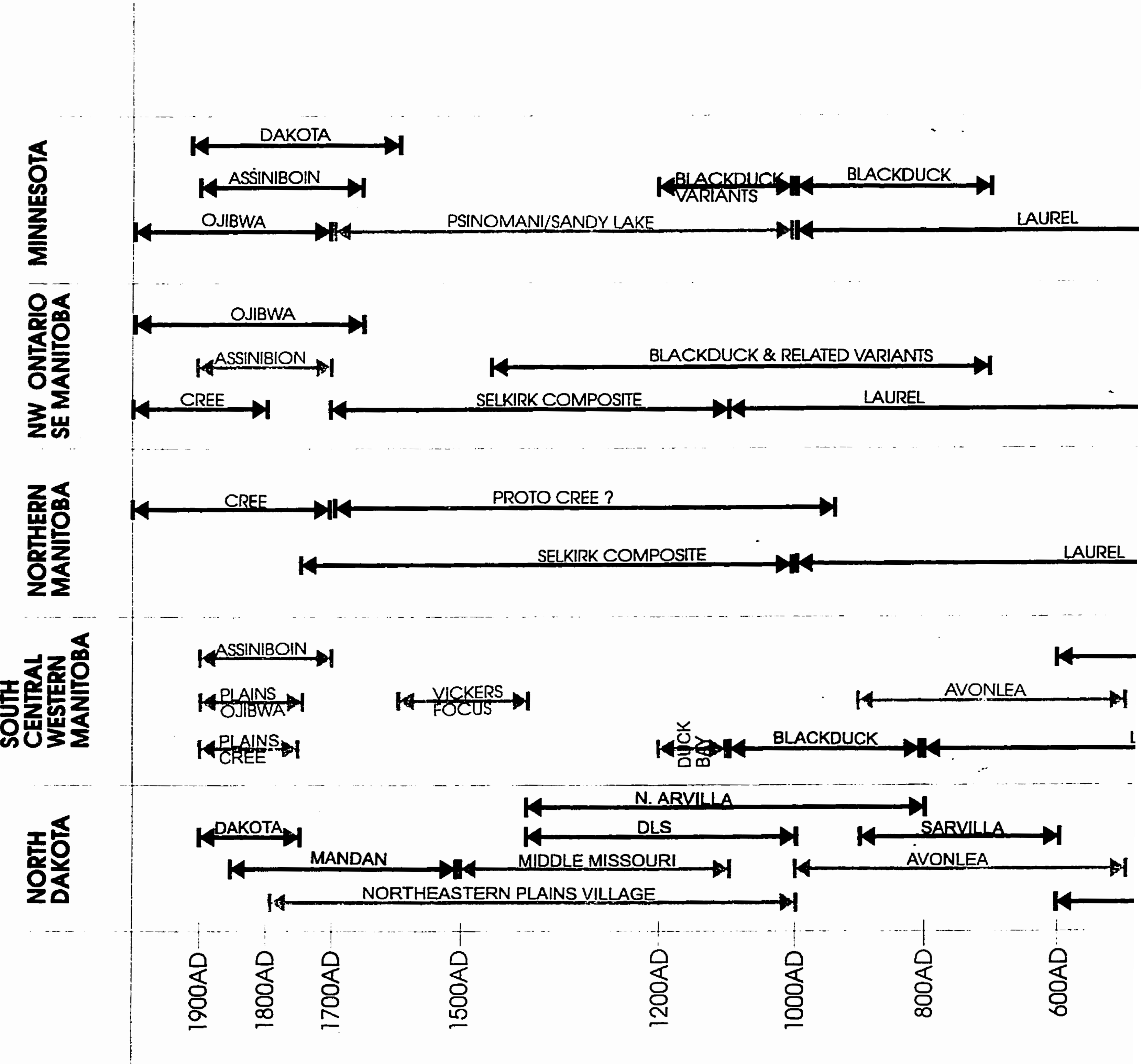
The precontact history of Manitoba is relatively well understood in a broad pattern, although much of the fine detail is yet to be discovered. Although it is not the intention of this paper to detail the history of archaeological effort in this province, a brief mention of the important contributions made by some researchers should be noted.

Significant archaeological research in this province began with the excavation of burial mounds in southern Manitoba in the early part of the century by Henry Montgomery (1908) and W.B. Nickerson (Capes 1963). Since then, major contributions through new theoretical perspectives and/or through synthesizing the work of others have been made by MacNeish (1958), Pettipas (1970,1980) and Syms (1977, 1980b). Important regional works and summaries have been completed by Nash (1970, 1975) on northern Manitoba, Buchner (Buchner 1979, Steinbring and Buchner 1980) on eastern and central Manitoba and Vickers (Syms 1980a) and Nicholson (1991) on western Manitoba.

A number of archaeological cultures that have been identified from Manitoba and the surrounding region will not be discussed in detail here because they are apparently not represented by cranial specimens used in the analysis. These cultures are listed here together with some references that describe each. These cultures are shown in light text in Figure 2.0. Those in dark text are discussed briefly in the following section.

The former group includes: Duck Bay (Meyer and Hamilton 1994, Lenius and Olinyk 1990, Arthurs 1986, Hanna 1982, Snortland-Coles 1979), Psinomani (Walde et al 1995, Meyer and Hamilton 1994, Gregg 1994, Gibbon 1994, Arthurs 1986, Michlovic 1983), Avonlea (Walde et al 1995, Meyer and Hamilton 1994, Vickers 1994, Gregg 1990, Joyes 1988), Plains Village (Gregg 1995, 1990), Middle Missouri (Gregg 1995, 1990, Walde et al 1995, Pettipas 1992, Schneider 1988, Buchner 1988), Northeastern Plains Village (Nicholson 1996, Walde et al 1995, Gregg 1994, Michlovic and Schneider 1993, Gregg 1990, Syms 1979) and the Vickers Focus (Nicholson 1996, Walde et al 1995, Nicholson 1991, 1990).

In addition, the Paleo-Indian and Archaic periods are not discussed here because no specimens from these periods were included in the analysis, as far as is known. Only seven crania that dated to greater than 2000 years in age were measured. Because this number was so low, and since the specimens came from a variety of regions, they were deleted from the analysis. In so doing, I hoped to limit the amount of time depth represented by the specimens which were included in this research. A goal of future research would be to expand the number of Archaic specimens and compare their morphology to that of later, Woodland, groups



MINNESOTA
DAKOTA
ASSINIBOIN
BLACKDUCK VARIANTS
BLACKDUCK
OJIBWA
PSINOMANI/SANDY LAKE
LAUREL
NW ONTARIO SE MANITOBA
OJIBWA
ASSINIBION
BLACKDUCK & RELATED VARIANTS
CREE
SELKIRK COMPOSITE
LAUREL
NORTHERN MANITOBA
CREE
PROTO CREE ?
SELKIRK COMPOSITE
LAUREL
SOUTH CENTRAL WESTERN MANITOBA
ASSINIBOIN
PLAINS OJIBWA
VICKERS FOCUS
AVONLEA
PLAINS CREE
DUCK BAY
BLACKDUCK
NORTH DAKOTA
N. ARVILLA
DAKOTA
DLS
SARVILLA
MANDAN
MIDDLE MISSOURI
AVONLEA
NORTHEASTERN PLAINS VILLAGE
1900AD
1800AD
1700AD
1500AD
1200AD
1000AD
800AD
600AD

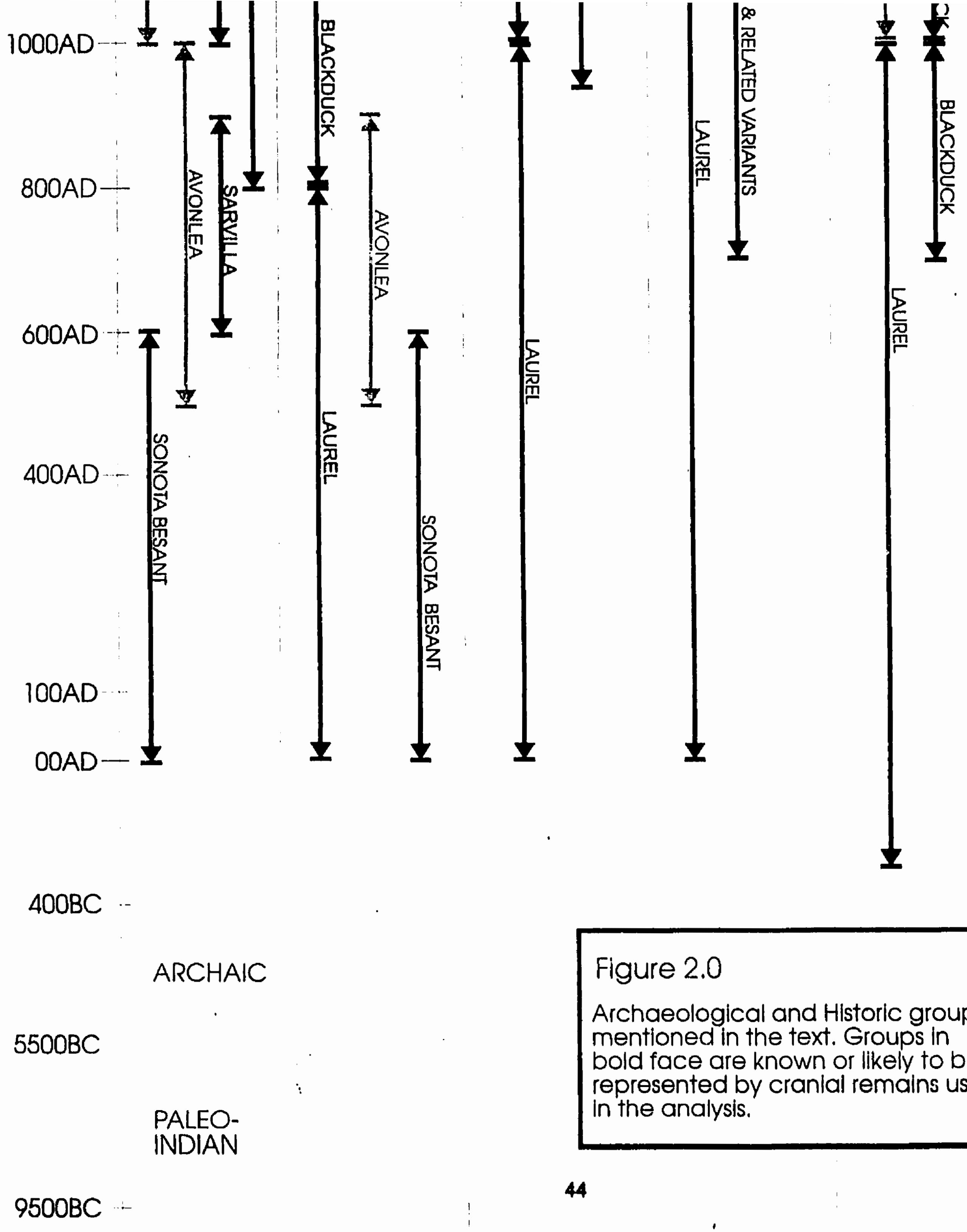


Figure 2.0

Archaeological and Historic groups mentioned in the text. Groups in bold face are known or likely to be represented by cranial remains used in the analysis.

ARCHAEOLOGICAL CULTURES REPRESENTED BY SPECIMENS

MIDDLE WOODLAND PERIOD

LAUREL CULTURE

In the forests of eastern and northern Manitoba, the Archaic is succeeded by the Middle Woodland Period, the boundary marked by the appearance of pottery (Wright 1981:89). The Laurel culture was found from south-central Saskatchewan, through Manitoba into northwestern Ontario, appearing as far east as Quebec and as far south as Minnesota and Michigan, although some of the far flung branches were aceramic (Wright 1981:90). Figure 2.1 shows the approximate extent of Laurel distribution, circa AD 500-750. The overall dates run from around 100 BC to AD 900-1100 (Meyer and Hamilton 1994:115, Mantey and Pettipas 1996:5). In the United States, radiocarbon dates place the temporal boundaries of the Laurel culture at 300 BC to AD 500, a little earlier than the Canadian dates (Wright 1981:90).

Syms (1977:80-81) summarized the basic traits that characterize Laurel assemblages as follows:

> "...toggle head harpoons, overlapping projectile point typologies, and conical ceramic vessels with varying frequencies of pseudoscallop shell stamping, linear stamping and stab-and-drag stamping decorative techniques applied to the upper third of the vessel."

Syms goes on to note other characteristics which mark Laurel sites, but which are not ubiquitous. These include burial mounds, cold hammered copper tools and ornaments and hafted beaver incisor tools (Syms 1977:81).

The most significant Laurel cultural features, especially the Laurel ceramic itself and the burial mounds, probably resulted from southern influences, specifically the

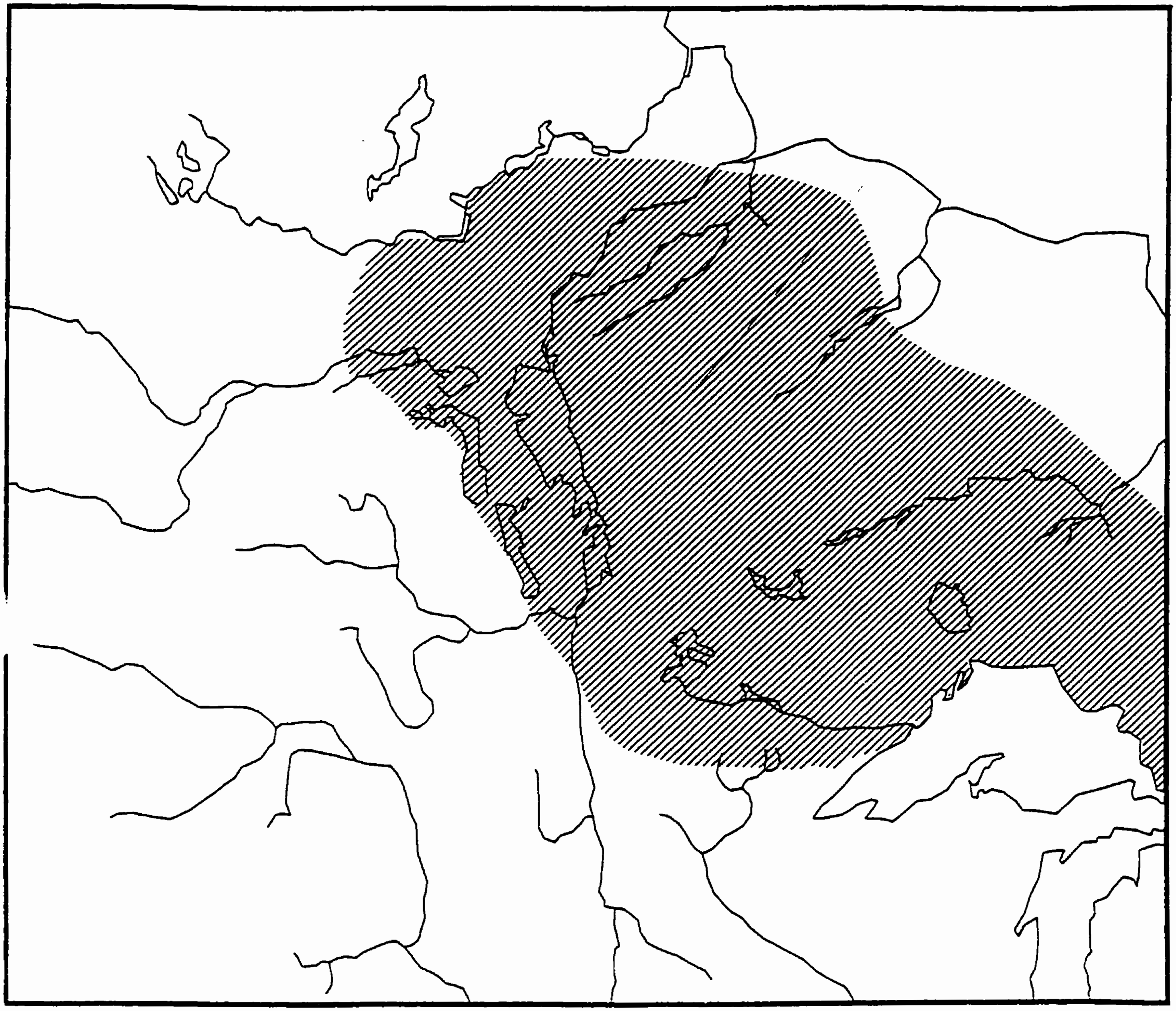


Figure 2.1. Approximate extent of Laurel distribution ca. A. D. 500 - 750
(after Meyer and Hamilton 1994).

"Hopewellian Interaction Sphere" (Meyer and Hamilton 1994:106). The Laurel pottery is obscure in terms of its stylistic origins, but at the very least the idea of manufacturing ceramics must have diffused from the south. Based upon the continuity of many artifact styles, however, the Archaic population of the shield may develop in situ to become the Laurel population of the Woodland period, defined by the appearance of Laurel pottery (Wright 1981:89). In this scenario, the southern influences would have to be seen as diffused elements. Buchner (1979), however, disagrees with this scenario. He sees the appearance of Laurel as a expansion of people, with their particular cultural ideas, from points to the south and east of Manitoba. Thus, people infiltrated into the boreal forest of Minnesota and Manitoba from points of origin in the Upper Great Lakes area. Over a relatively short period of time, they replaced the remains of the Late Archaic populations and established effective control over the area. In this, they may have been aided by a possible depopulation of this region at the end of the Pelican Lake period (Buchner 1997: personal communication).

The expansion of the Laurel people through all contiguous forested territory in this region must have been rapid. The middle Laurel component from The Pas, Manitoba, has yielded dates of 1820 ± 150 bp (A-1424) and 1590 ± 50 bp (A-1368), and site UNR 26, on Wapisu Lake, Manitoba has early/middle Laurel pottery associated with a radiocarbon date of 1645 ± 195 bp (S959) (Meyer and Hamilton 1994:103).

In the southern periphery of their range, the Laurel people begin to construct burial mounds; this concept almost certainly diffused to them from peoples immediately to the south (Wilford 1955:131-2). For reasons not yet known, this practice was not extended up the Winnipeg River into Manitoba. No Laurel burial mounds have been found here.

Beginning around AD 700, the Blackduck cultural unit begins to take form in northwest Ontario and northern Minnesota (Meyer and Hamilton 1994:112, Walde et al 1995:24). By AD 1000, the Laurel culture had apparently been displaced from Minnesota, the Boundary waters area and southeastern Manitoba, but was still present in areas to the north of the Blackduck culture.

The Laurel tradition remained strong in northern Manitoba and in northwest Ontario, north of the boundary waters area, through to AD 1100 or so (Meyer and Hamilton 1994:115). After this time, Selkirk pottery becomes common in the same areas, leading to speculation that there is continuity of population but a shift in the style of ceramic that is being produced (Meyer and Russell 1987:24).

The amount of Laurel ceramic from South Indian Lake and other northern sites demonstrates that the Laurel peoples were not restricted to the southern Manitoba, northwest Ontario, northern Minnesota "heartland" area (Riddle 1996). Laurel was a boreal forest culture which expanded within a particular ecological zone. Since the Cree, from historical times at least, have occupied this same environment, it seems possible that there is a connection between the two groups (Meyer and Russell 1987:27. It has not been demonstrated, though, that this connection existed. There may have been discontinuities in the occupation at South Indian Lake, with re-occupations by different groups. When the Rocky Cree occupied South Indian Lake they may have been the last of several waves of Cree; they may have found residents with whom they settled; or they may have found the area uninhabited.

No burials with a clear Laurel association have been recovered from Manitoba and therefore none of the cranial specimens can be identified as Laurel. The Laurel craniometric sample used here was provided by Ms. Sue Myster, to be used as a comparative group. The specimens she measured come from northern Minnesota and have a clear Laurel provenience.

SELKIRK COMPOSITE

The Laurel tradition declined in northern Manitoba and in northwest Ontario, north of the boundary waters area, around AD 1000 (Mantey and Pettipas 1996:30) to 1100 (Meyer and Hamilton 1994:115). After AD 1100, Selkirk composite ceramics became common in the same areas, leading to speculation that there is continuity of population but a change in style (Meyer and Russell 1987:24). Figure 2.2 shows the approximate extent of Selkirk Composite distribution, circa AD 1500. The Selkirk style appears to develop first in north central Manitoba, where is associated with radiocarbon dates in the AD 1000-1100 range (Meyer and Russell 1987:27, Mantey and Pettipas 1996:30). From here, it spreads slowly in the boreal forest ecozone, becoming established in Saskatchewan, southeast Manitoba and northwest Ontario by about AD 1300 (Meyer and Russell 1987:15).

The taxonomy of Selkirk Composite ceramics was significantly revised by Meyer and Russell in 1987. In their revision, Meyer and Russell suggest that the Selkirk Composite as a whole is comprised of five regional complexes: the Pehonan and Kisis Complexes of northern Saskatchewan, the Clearwater Lake and Kame Hills Complexes from northern Manitoba and the Winnipeg River Complex from southeastern Manitoba. They noted, however, that there were significant stylistic differences between the Winnipeg River Complex and the others, especially in that ceramics from this complex show some Blackduck inspired motifs (Meyer and Russell 1987:27).

In a second major revision, Lenius and Olinyk (1990:101) suggest that Winnipeg River Complex should be grouped with the Duck Bay and Bird Lake complexes in a larger unit that they refer to as the Rainy River Composite. The other four Selkirk ceramic complexes mentioned above are retained in the Selkirk Composite. Lenius and Olinyk

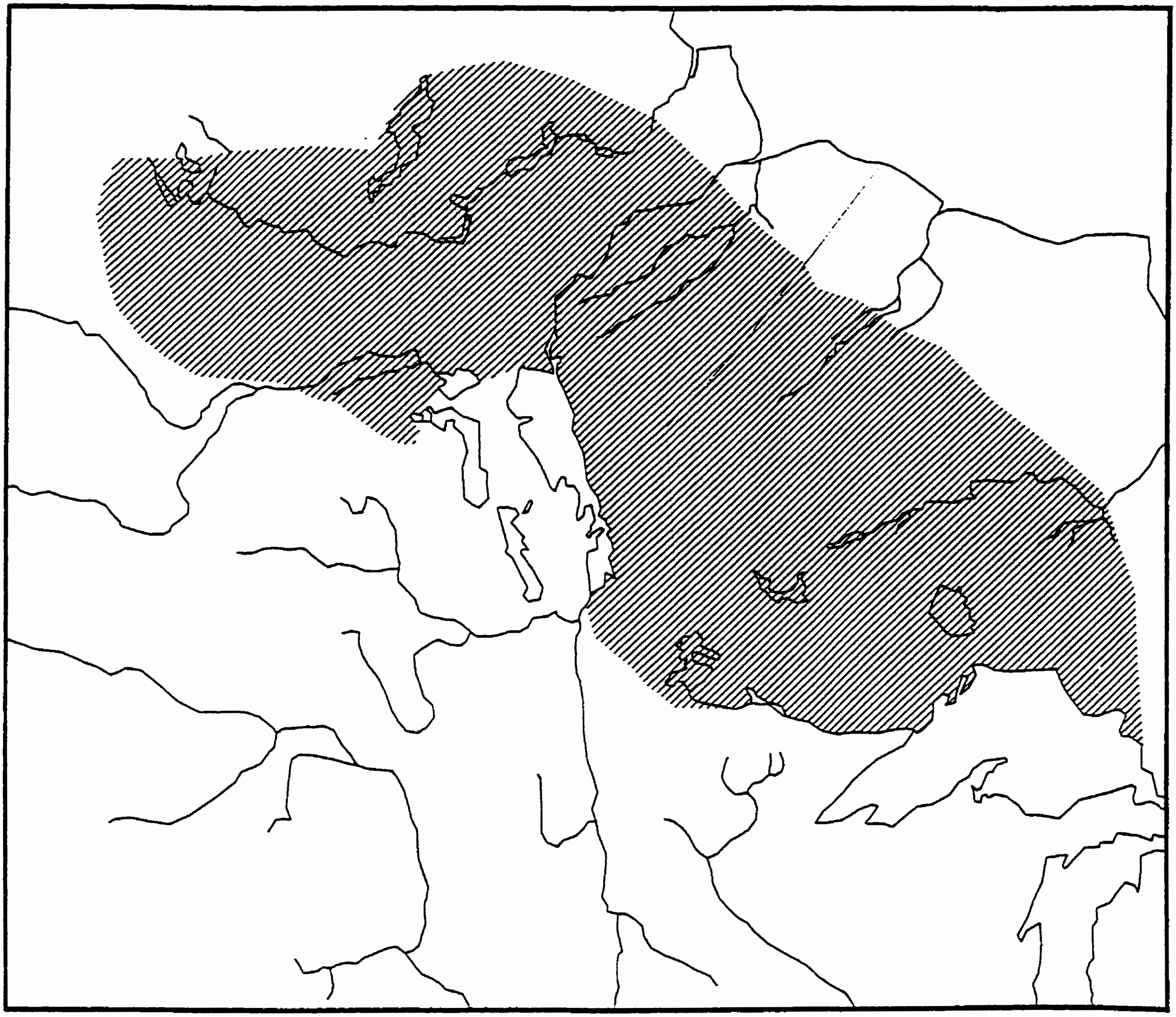


Figure 2.2. Approximate extent of Selkirk Composite distribution ca. A. D. 1500 (after Meyer and Hamilton 1994).

(1990:101) then subsume both the Selkirk Composite and the Rainy River Composite into a broad unit called the Western Woodland Algonkian Configuration.

Unlike Laurel and Blackduck, Selkirk developments are particularly associated with northern sites, and this ceramic is found much farther to the west, in Saskatchewan, than are the other two (Meyer and Hamilton 1994:127). As time went on some Plains traits began to seep into Selkirk ceramics, and some Selkirk traits began to appear in neighbouring Plains wares (Meyer and Hamilton 1994:127). While this speaks to interactions between groups, it does not alter the essential distributions. Those who made Selkirk Complex ceramics stuck generally to the forests of central and northern Manitoba and Saskatchewan, while those who made the Plains ceramics stuck to that biome. To the south and east considerable interaction occurred between Selkirk and Blackduck pottery makers (Rajnovich and Reid 1978:46).

A reasonable case can be made for a cultural connection in northern and central Manitoba stretching from those who made Laurel ceramic through the manufacturers of Selkirk ceramic to groups related to the historically known Cree of the region today (Meyer and Russell 1987:27). In fact, the connection between Selkirk Composite ceramics and the Cree has been suggested by several authors (MacNeish 1958:67, Hlady 1970:111-115, Dawson 1987:1255, Meyer and Russell 1987:27. However, this connection should not be drawn to the level of specific Cree groups, many of whom may have moved into this area only in the last 300 years, particularly in response to fur trade pressures. The earlier groups (Laurel and Selkirk peoples) in the area may be seen as Proto-Algonkians or Proto-Cree, probably generally ancestral to Cree peoples, but not necessarily the direct ancestors of the current Cree inhabitants.

BLACKDUCK CULTURE

Around AD 700-750, the Blackduck culture begins to fluoresce in northern Minnesota, although this event may occur earlier, perhaps as early as AD 600 (Gibbon 1994, Mantey and Pettipas 1996:22) or even AD 500 (Lenius and Olinyk 1990:82). From AD 800 to 1000 Blackduck is very common in central and southeast Manitoba, the Red River valley, northwest Ontario and Minnesota (Lenius and Olinyk 1990, Mantey and Pettipas 1996:22). Figure 2.3 shows the approximate extent of late Blackduck (currently included in the Rainy River Composite by Lenius and Olinyk (1990)) distribution, circa AD 1000-1250. The Blackduck culture occupies much of the area previously inhabited by the Laurel people, and they display similar cultural attributes (i.e. burial mound building) in the same areas (Wright 1981:94). However, from AD 800 to 900 Blackduck is also found in western Manitoba, particularly at the Stott site (Tisdale 1978:100, Badertscher et al 1987, Meyer and Hamilton 1994, Walde et al 1995). At this site, from AD 800 to 900, and again from AD 1100-1200, Blackduck peoples came onto the plains to hunt bison (Meyer and Hamilton 1994). The traits characteristic of the Blackduck cultural unit were outlined by Syms (1977:104):

> "The Blackduck Horizon has been identified primarily on the basis of distinctive decorative traits on thin walled, globular vessels with flared rims; however other traits are small triangular notched and unnotchedprojectile points, end and side scrapers, awls, tubular pipes, occasional unilateral harpoon and socketed bone projectile points, bone spatulates, fleshers,copper beads and awls, beaver incisor gouges and burial mounds generally containing seated burials."

According to Meyer and Hamilton (1994), the most significant and identifiable of these features are those stylistic traits (distinctive decorative traits) particularly associated with

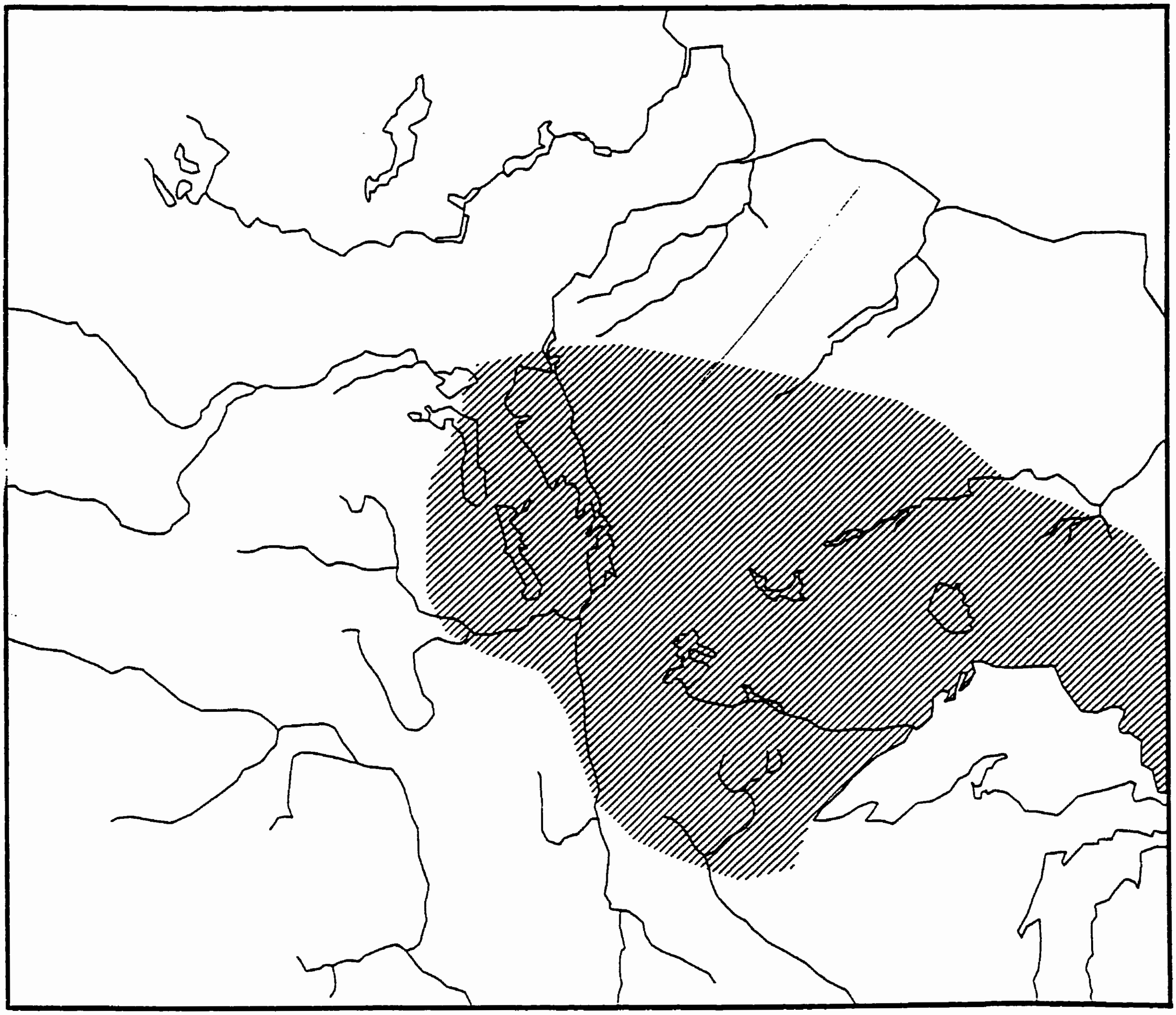


Figure 2.3. Approximate extent of Blackduck distribution ca. A. D. 1000 - 1250
(after Meyer and Hamilton 1994).

the ceramics. These stylistic traits were defined by Lenius and Olinyk (1990:79):

> "Exterior decoration consisting of cord wrapped object impression together with either circular punctate or exterior boss decoration, and exterior neck treatment with vertical brushing or combing."

Evans (1961) proposed that the Blackduck culture evolved out of the earlier Laurel base. This was also the opinion expressed by Buchner (1982:116). Wright (1981:94) supports this concept, noting that the dates for the two cultures make such a conclusion reasonable. However, since the Laurel culture lasts until AD 1100 (see above) it is evident that the two cultures exist simultaneously for a length of time, casting some doubt on a straightforward ancestor-descendant relationship (Lenius and Olinyk 1990).

Further, in the Rainy River district, both the Blackduck and Laurel complexes are succeeded by the Rainy River Composite, a ceramic style which seems to be an amalgam of the two earlier forms (Lenius and Olinyk 1990:82-83). In a sense, this implies that two separate groups may have amalgamated, affecting the biological distinctiveness of each.

A different position was taken by Hlady (1970) and Syms (1977) who argued against continuity between the two cultures, raising the possibility that Blackduck was intrusive into Minnesota. A comprehensive analysis of Blackduck pottery, conducted in the 1970's, was somewhat inconclusive, although it suggested that in situ development of Blackduck out of Laurel was a reasonable probability (Lugenbeal 1976, cited in Meyer and Hamilton 1994:112).

Arguing against this is distribution. Blackduck sites are found south into central Minnesota, an area apparently never penetrated by Laurel people. Moreover, in terms of overall style there seems to be connections between Blackduck and cultures to the south and east, more than to the north and west. For example Lugenbeal (1976 cited by Meyer and Hamilton 1994:115) points out a number of features of ceramic vessel shape and manufacture that are consistent between Blackduck and cultures of the Upper Great Lakes.

However it originated, it seems relatively clear that Blackduck expanded quite quickly from its area of origin to the north and west, into Ontario and southeast Manitoba (Meyer and Hamilton 1994:113). By AD 800, Blackduck pottery began to appear in the Red River valley, possibly marking the replacement of Laurel peoples (Buchner 1988:27-31). The Blackduck penetration continued into southwestern Manitoba, apparently moving west and south along the Pembina and Assiniboine rivers (Syms 1977).

There is no conclusive evidence that this penetration of southwestern Manitoba was of a widespread or deep nature. The Stott site is at an advantageous hunting location on the Assiniboin River (Tisdale 1978). It may represent a location that could be easily reached by canoe from eastern Manitoba for a few weeks in the summer and fall. In fact, the dates for the earlier Blackduck occupation at Stott are sufficiently close together that they might represent a single event (an instant in time)(Tisdale 1978:112). Further, there is a gap of up to 400 years before the next Blackduck occupation at the site (Tisdale 1978), indicating that trips out to the plains, for these essentially forest people, may have been the exception rather than the rule.

A distribution map of significant Blackduck sites prepared by Lenius and Olinyk (1990:80) demonstrates that while Blackduck peoples may have penetrated the plains, by canoe travel on the rivers, they were not frequently resident there. Of the 27 Blackduck sites listed on their map, only one, the Stott site, lies in western Manitoba. Four others are in the Red River valley and all the rest are in the forest regions of northern and eastern Manitoba, northwest Ontario and northern Minnesota. Even at Stott, Plains influences are readily apparent (Meyer and Hamilton 1994:117) and the burial mound itself probably pre-dates the Blackduck occupation (Badertscher et al 1987:346-348).

After AD 1000 or so, Blackduck was superseded in Minnesota, in the Boundary waters region of northwest Ontario and in most of southern Manitoba by new ceramic complexes (Lenius and Olinyk 1990, Mantey and Pettipas 1996). However, it was still found in most of northwestern Ontario, up to Hudson's Bay, and in Manitoba, east of Lake Winnipeg (Meyer and Hamilton 1994:118). Its northward spread did not extend as far as the preceding Laurel culture; Blackduck is commonly found only up to the north end of Lake Winnipeg and into the adjacent Saskatchewan River delta (Meyer and Hamilton 1994:117).

In south central, and particularly in eastern Manitoba, Blackduck or its descendant or related variants persists until AD 1450 or so (Syms 1975:18). In northwestern Ontario it may last even later, given the ceramics from the Long Sault Site (Arthurs 1986).

Considering the widespread and deep nature of the occupation of this region by the Blackduck and descendant/related peoples, it is likely that many Manitoban cranial specimens represent this group. Unfortunately, no Manitoba burials have yet been found that exhibit the "classic" Blackduck pattern (seated burials in conical mounds) seen in Minnesota (Syms 1977). The Blackduck cranial sample used here was measured and provided by Susan Myster, the specimens themselves having come from mound sites (S. Myster 1993 - personal communication).

MIDDLE PLAINS WOODLAND PERIOD

BESANT PHASE

The earliest Middle Plains Woodland culture to appear, around 200-100 BC, is the Besant culture (Gregg 1990:B8, Walde et al 1995:16). Figure 2.4 shows the approximate extent of Besant distribution. This culture, along with the Sonota mortuary complex, was summed up nicely by Gregg (1990:B29):

"Sonota and Besant are two very closely related and generally contemporary archaeological complexes ... Together they have an extensive geographic distribution. The geographic distributions of distinctive material traits of these two complexes overlap such that only some of the westernmost Besant components out in the Northwestern Plains are readily distinguishable from Sonota components in the eastern portions of the Northeastern Plains. In the broad zone of overlap, Besant components are indistinguishable from Sonota."

Gregg (1990:B29) believes that the Sonota/Besant culture(s) evolved out of an Early Plains Woodland cultural base, represented by such sites as the Naze site in North Dakota. This origination may have been as early as 250 BC, given evidence from the Boundary Mounds in North Dakota (Schlesier 1994:320). The location of most of the sites attributed to Sonota is in the United States, but Besant Phase sites are common on the Canadian Plains, including western Manitoba (Vehik 1982, Walde et al 1995:17).

Distinguishing between these two complexes has been a thorny problem (Neuman 1975, Reeves 1983, Gregg 1990, Walde et al 1995), but, to date, the most clearly distinguishing feature is the mortuary mound building associated with the Sonota complex (Neuman 1975), something not found at Besant sites (Gregg 1994:72-79, 1990:B30). Considering the continuity of lifeways (Nicholson 1996:68), lithic and ceramic styles (Walde et al 1995:17), it will be considered here that Sonota and Besant are part of the same cultural expression.

The Besant/Sonota phase lasts on the Canadian Plains until AD 500 (Walde et al 1995) but until AD 800 or so in the Dakotas (Winham and Lueck 1994, Gregg 1994). These dates suggest a long period of co-incidence with the Laurel culture in the neighbouring woodland. It is reasonable to assume a degree of interaction, perhaps even hostility, between them, although this has not clearly been demonstrated archaeologically.

The Sonota/Besant culture is particularly noteworthy in that it represents the earliest mound burial mortuary ceremonialism on the northeastern Plains (Gregg 1990). However, none of the Manitoba burial mounds has been classified as Sonota

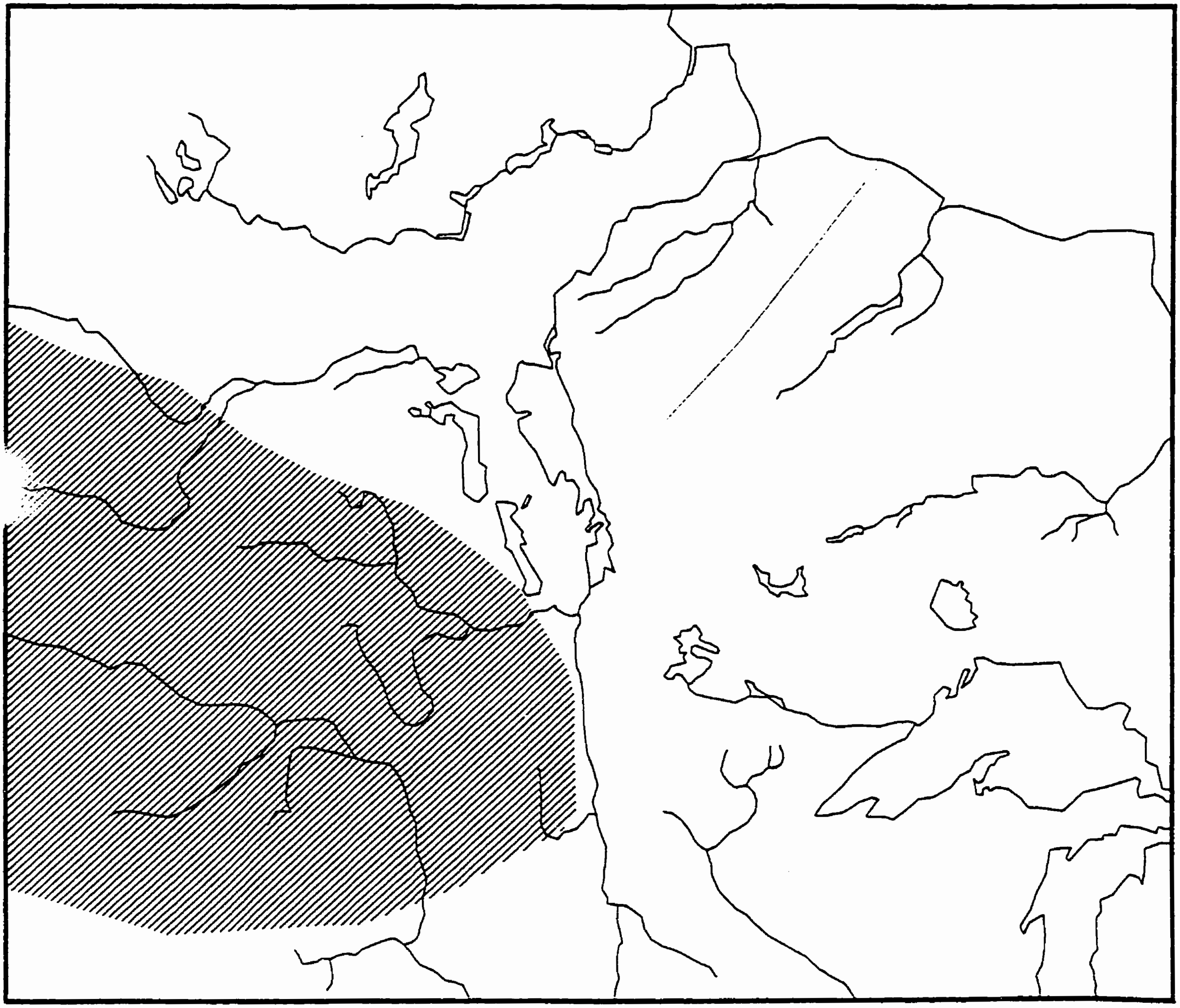


Figure 2.4. Approximate extent of Besant distribution (after Meyer and Russell 1987).

(Syms 1978), and there are no clearly provenienced Besant burials from Manitoba. On the other hand, some of the larger burial mounds from south central Manitoba have characteristics similar to those of Sonota mounds, and so it must at least be considered that they may have a Sonota connection. Furthermore, the Sonota/Besant people occupied much of southern Manitoba from AD 200-750 (Nicholson 1996:68) and thus may well be represented in non-provenienced specimens.

Thus, some of the sample crania that come from south central or southwestern Manitoba may represent Sonota/Besant individuals. A comparative sample of Sonota crania from Sonota mounds in the Dakotas was provided by P. Key.

ARVILLA

Several burial mound complexes, probably dating from 600 AD (Johnson 1973:3, Syms 1982) to 800 AD onwards (Gregg 1994:81), have been described as representative of the Arvilla complex. Sites reputed to be Arvilla burial mounds are generally found in the Red River valley, but may extend up along the Pembina valley into south central Manitoba, and into central Minnesota (Johnson 1973:2, 62). There are no clear living sites associated with the burial mounds, and thus a wider affinity of this "culture" becomes problematic. The most complete definition of the Arvilla Complex was provided by Johnson (1973:62):

> "The Arvilla Burial Complex as a consistent, recurring pattern consisting of linear and circular mounds, subsoil burial pits, flexed and disarticulated primary and bundled secondary burials, frequent use of red and yellow ochre, associated utilitarian and ornamental grave goods dominated by bone and shell artifacts, Prairie side-notched and Broad side-notched projectile points, blade side-scrapers of brown chalcedony, and mortuary vessels of St. Croix stamped or Blackduck ware is a diagnostic cultural complex in the sense that Irving Rouse defines this concept."

Johnson (1973) suggests that the end date for burials in the Arvilla pattern was about AD 900. This is consistent with the fact that Laurel pottery is found beneath Arvilla material. In the United States, radiocarbon dates place the terminal boundary of the Laurel culture at between AD 500 (Wright 1981:90) and AD 900 (Meyer and Hamilton 1994). This is also consistent with the dates for Blackduck pottery, as the Blackduck culture originates around AD 700. This is significant when considering that Blackduck ceramics are sometimes found in Arvilla mounds.

While not discussing ethnic affiliations per se, Johnson (1973:66) is unequivocal in stating that the Arvilla Complex is northern in nature, and that southern influences are intrusive, and should not be over-emphasized. He links the Arvilla Complex to the contemporaneous and following Blackduck culture in Minnesota, suggesting that the mound burial practices found there, although different, were related. This opinion was also expressed by Ossenberg (1974:19), who suggested that Arvilla, Blackduck and Laurel were all closely interrelated.

Despite Johnson's (1973) contention that Arvilla extended into southern Manitoba there has been no demonstrated evidence of this. However, Arvilla sites do extend to the south along the Red River. A southern cluster of mounds, found in South Dakota and western Minnesota is sometimes referred to as Southern Arvilla, and seems to be earlier (AD 500-1000)(Ossenberg 1974:19). Those mounds from northern North Dakota/Minnesota are seen as Northern Arvilla, and may be later in time (AD 800-1400)(Ossenberg 1974:19). These later dates are similar to those cited by Syms (1978:74), who suggests that (northern ?) Arvilla is contemporaneous with Devil's Lake-Sourisford, therefore dating to circa AD 900-1400.

A review of Arvilla mortuary ceremonialism and traits was completed by Syms (1982). In comparison to Devil's-Lake Sourisford mounds, Syms concluded that Arvilla mounds demonstrate neither unique construction elements nor uniquely identifiable traits

(Syms 1982:151-152). These factors add to the confusion over the affiliation of mounds, as they have to be identified by packages of traits. However, Syms suggests that the Arvilla mounds may have been created by Algonkian peoples while the Devils-Lake Sourisford mounds were built by Siouan peoples (Syms 1982:162-163)

There are no clear Arvilla burials from Manitoba. A craniometric sample of specimens from Arvilla mounds in the southern group was provided by Pat Key. Another sample, from the northern group of mounds was provided by Ms. S. Myster.

DEVIL'S LAKE SOURISFORD

The Devil's Lake-Sourisford Burial Complex was defined by Syms (1978, 1979). The defining features include:

- small incised vessels with smooth surface finish; conch shell mask-gorgets with and without the weeping-eye motif; long conch columella pendants; short columella beads; flat incised tablets (most having angular representations of animals); tubular pipes of catlinite and steatite; curved "wristlets and anklets" of incised bone; notched trapezoidal shell pendants; washer shaped shell beads, and copper bands and beads as a core of traits."

Syms (1978:69) sees general Mississippian traits in Devil's Lake-Sourisford mound burials. He dates the beginnings of the complex at about AD 900-1000, near the generally accepted terminus of the southern Arvilla Complex , and sees it lasting until AD 1400 or so, with a few items persisting into the historic period (Syms 1978:69). These dates are nearly identical to those given by Ossenberg (1974) for the northern Arvilla Complex.

Syms' assessment of the overall DLS traits, with particular emphasis on a certain consistency in the ceramics, and particularly on associated motifs, led him to the conclusion that this complex was made by a Siouan group. He sees this as being a Plains group involved in a seasonal round of bison hunting. He emphasises that these sites are not associated with Blackduck (or Algonkian) materials (Syms 1978:73).

Syms (1978, 1979) assigns most of the Manitoba burial mounds, including all of the larger, accumulative mounds, to the DLS Burial Complex. If correct, this means that the affinities of this Complex are most important for the interpretation of biological remains from Manitoba, many of which came from these mound sites. The time period of AD 900-1400 predates any known Siouan group, and if they are Siouan in affiliation, only speculative considerations of specific ethnicity may be assigned. Of course, the term Proto-Siouan may be appropriate here.

CULTURAL CONNECTIONS

One of the problems with the definition of an archaeological culture is that it is difficult for researchers to leave it in a cultural "vacuum". The presence of exotics and trade items often identify a culture's contemporaries, allowing for a reasonable temporal and geographic fix on a particular society. In general, though, researchers are on less secure ground when they begin to discuss a culture's antecedents and descendants. It is tempting to draw connections between cultures that are temporally successive, and there is nothing inherently wrong with this because we know that every culture has to have had an ancestor, and probably has one, or several, descendants. On the other hand, population movements and migrations have occurred, and simple temporal and/or geographic proximity does not necessarily imply biological continuity.

The suggested connections begin with temporal succession but are actually proposed on the basis of stylistic and material continuities between groups. The problems begin to multiply at this point because the stylistic and material elements of cultures can be evaluated differently by different researchers. Further, where one person sees continuity of style another may not. Where one researcher sees a material influence another will propose a different cultural influence.

The archaeology of the northeastern Plains and Parkland interface has seen many such speculations, all of which are relevant to this thesis. Whether Devil's Lake Sourisford was related to the Northeastern Plains Village complex or the Scattered Village Complex and is Proto-Siouan or whether it was related to the Arvilla and the Cheyenne, and is Proto-Algonkian, influences the possible biological interpretations of the physical remains.

Taken to its logical conclusion, it is not uncommon for archaeologists and anthropologists to make speculations concerning the relationship between archaeological cultures and known ethnic groups (see Schlesier 1994, Walde et al 1995). This is simply an extension of the analysis of the relationships between archaeological cultures. The pattern is the same, in which temporal difference is assessed in the light of geographic congruence and stylistic "continuity". Needless to say, different researchers may interpret the same information in different ways and draw different connections between archaeological cultures and known ethnic groups (Brumley and Dau 1988, Reeves 1983, Byrne 1973).

Schlesier (1994: 308-382) has speculated widely concerning connections between groups, both archaeological and ethnic, and his work provides a good jumping off point for a discussion of such relationships. In the time period from 200 BC to AD 500, Schlesier sees two main cultures, Besant and Avonlea, on this part of the northeastern Plains, and a third, the Laurel culture, constituting a significant presence in the adjacent forests.

Schlesier (1994:320-321) makes a distinction between Western Besant and Eastern Besant. He links Western Besant with the Old Woman's Complex, found to the west of Manitoba (Walde et al 1995:25), and the modern Blackfeet; and links Eastern

Besant with the Arvilla Complex and the modern Cheyenne. Both of these modern peoples are in the Algonkian language family and this scenario would place all the mentioned archaeological cultures in the Proto-Algonkian language family.

In contrast, however, a few scholars see Avonlea as an Athapaskan group, possibly related to the Sarcee and the Apache (Wilcox 1988:273, 277, Schlesier 1994:325). If these hypotheses are correct there would be a strong likelihood of distinguishing an Avonlea or later Athapaskan remains from those of the other groups, who were all Algonkian or Proto-Algonkian.

It is the position of this paper that the link between the Laurel culture, the Selkirk culture and the modern Cree is established. While the connection between Laurel and Selkirk may not be certain, the attribution of Selkirk Composite ceramics to the Cree is supported by many authors (Wright 1971:23-34, Meyer and Russell 1987:25-26, Meyer and Hamilton 1994:126). The fact that the Cree is an Algonkian group indicates that this designation, or more properly Proto-Algonkian, may be applied to the Selkirk Composite and Laurel cultures.

Unfortunately, if all these connections are valid, they would place Western and Eastern Besant, Arvilla, Laurel, the Blackfeet, the Cheyenne and the Cree (not to mention all other Algonkian groups) in a single linguistic group, albeit one with a time depth of about 2000 years. This suggests that biological distinctions between these groups may be difficult to demonstrate.

The Sonota/Besant culture disappears from southern Manitoba before AD 1000 (Reeves 1983, Syms 1977), possibly even before AD 850 or so (Gregg 1994). Meyer and Hamilton (1994) note that during the time period of AD 750-1000 there is evidence that Blackduck people are moving out of the forest and into southwestern Manitoba, at least along the rivers. This movement appears to have been coincident with the disappearance of Sonota/Besant and the latter group may have been displaced or forced to retreat southwards and westwards.

The incursion of Blackduck onto the plains in central and western Manitoba not only is coincident with the retreat of Besant to the south, but also ties in to the Arvilla Complex in North Dakota. Both Schlesier (1994) and Johnson (1973) suggest that there was some connection between the Blackduck and Arvilla cultures. Ossenberg (1974:38-39), after studying non-metric cranial traits, concluded that Arvilla was, in fact, Algonkian in nature (as is Blackduck).

This is all somewhat contradictory. Can Sonota and Arvilla both be Proto-Algonkian cultures, as suggested by Schlesier? The Sonota culture seems to have originated in the central United States, while Arvilla seems to be of local derivation (Gregg 1990:B29, Schlesier 1994). The general feeling among scholars seems to be that Proto-Algonkian and assumed/known Algonkian cultures, including Laurel, Blackduck, Blackfeet and Cheyenne, all originate to the east of the Red River, as opposed to further south in the United States (Walde et al 1995).

It seems unlikely for an Algonkian culture to have originated south of South Dakota in the time range of 250 BC. The fact that there are similarities between some Besant mounds and Arvilla mounds may indicate cultural continuity, but could just as easily reflect cultural contact and the exchange of ideas concerning mortuary ritual. Syms (1982) notes some significant differences between Sonota and Arvilla mounds, but these distinctions less clearly separate Arvilla from Devil's-Lake Sourisford mounds.

Overall, it seems that the main reason there is confusion about mortuary mound cultures on the Plains is that there is not a great deal of difference between most of the mounds that have been excavated in regards to burial style and associated artifacts. Although there are some similarities between Sonota and Arvilla mounds, this is not necessarily an indication of cultural continuity.

Gibbon (1994:139-143) also discusses the relationship between Arvilla and Blackduck. He agrees that some Arvilla mounds have yielded both Blackduck ware and St. Croix stamped ware, and this is obviously an indication of some connection between them. Like Johnson (1973:65) he believes, though, that the Arvilla burial program was almost certainly associated with a series of different cultures over a 400 year time span. While some St. Croix Phase, Brainerd Phase (and Blackduck) burial mounds were in or like the Arvilla pattern, many were not. Thus, some Arvilla mounds show a Blackduck association, but this does not necessarily demonstrate that "Arvilla" and "Blackduck" are related cultures. In fact, Gibbon (1994:145) assesses the Blackduck mound burial style as being somewhat different than the Arvilla. Blackduck mounds are relatively small and contain primary burials, probably in a seated position. As mentioned above, there is little of this type of consistency to Arvilla burials.

Continuing with his theme that Eastern Besant and Arvilla were both Algonkian cultures, Schlesier (1994:321) suggests that the Arvilla culture was ancestral to the modern Cheyenne. In fact, following Ossenberg (1974), he says Arvilla burials constitute ancestral Cheyenne individuals. Given the above assessment by Gibbon and Johnson that Arvilla was associated with many different groups, it might be more realistic to say that some Arvilla burials might be ancestral Cheyenne.

As the eastern Besant and Arvilla cultures developed, possibly into the Cheyenne, along the Red River in eastern North Dakota, a different set of cultures were developing in the central portions of both Dakotas. This region, with its focus on the Missouri River and its tributaries, has come to be called the Middle Missouri study area (Winham and Lueck 1994:150). This portion of the northeastern Plains has seen intensive use over the last 1500 years, and shows evidence of the past presence of many cultures.

At around AD 500, the Middle Missouri region was occupied by several groups who practised a "Plains Woodland" lifestyle (Winham and Lueck 1994:151). They were essentially hunter gatherers along the late Archaic pattern, but they had already begun to experiment with ceramics and horticulture (as evidenced by storage pits).The next 500 years or so (AD 500-1000) saw the transformation of the Plains Woodland cultural pattern to the Plains Village cultural pattern. By AD 1000 a semi-sedentary way of life, with a certain degree of reliance on horticultural crops, had developed in the whole Middle Missouri area (Winham and Lueck 1994:159). These early Plains village groups have been assigned to the Initial Middle Missouri (IMM) and Extended Middle Missouri (EMM) variants, both of which are seen as in some way ancestral to the historic Mandan and Hidatsa tribes (Winham and Lueck 1994:162-163). There are a bewildering array of intermediate IMM and EMM cultures, however, so direct connections are difficult to prove. The most recent of these are the Heart River Phase, The Scattered Village Complex, the Thomas Riggs focus (southern EMM) and the Fort Yates phase (northern EMM)(Winham and Lueck 1994:169). The latter two, in particular, are considered to be directly linked to the Mandan and Hidatsa respectively, by Winham and Lueck (1994:169).

This position is not entirely supported by Schlesier (1994:340). While this author agrees that the Middle Missouri variants are related to the Mandan, he does not associate these cultures with the Hidatsa. In fact, Schlesier sees the development of the Middle Missouri cultures/Mandan as a central North/South Dakota phenomenon, while he connects the Devil's Lake Sourisford variant (from the northern and eastern portions of the state) with the Hidatsa (Schlesier 1994:340). Gregg (1994) also takes the position that developments in the eastern portion of North Dakota (the Northeastern Plains Village complex, Devil's Lake Sourisford burial complex) are separate from the Middle Missouri developments, with the exception of trading relationships.

The possibility of separate archaeological associations for Mandan (Middle Missouri variants) and Hidatsa (Northeastern Plains Village, Devil's Lake Sourisford) is supported somewhat by glottochronologic evidence. Hollow and Parks (1980:80), after conducting a linguistic analysis, suggest that the Mandan and the Hidatsa shared a language (Siouan or Proto-Siouan) with the Dakota as recently as two millennia ago and have been separate languages from each other since about AD 500. As linguistic separation suggests geographic and cultural separation, there is no reason we should not see archaeological distinction between Proto-Mandan and Hidatsa beginning about AD 500 or so.

Syms (1979) argues that the affinities of the Devil's Lake Sourisford Burial Complex are Siouan. Schlesier concurs, and in his model, Devil's Lake Sourisford is seen as being Proto-Hidatsa, directly ancestral to the historically known Hidatsa people (Schlesier 1994:340). This is in direct contrast to the position of Gregg (1994:93) who generally links the Northeastern Plains Village Culture and the Devil's Lake Sourisford complex to the Algonkian Cheyenne.

In Minnesota, a variety of archaeological cultures appear between AD 100 and AD 1000. There are conflicting views of the relationships between these cultures and those that followed. Schlesier (1994:340) posits that the Brainerd and St. Croix phases are all Proto-Siouan and lead, respectively, to the Kathio and Clam River complexes. These, in turn, lead to the more widespread Psinomani (Sandy Lake) culture, beginning around AD 1100. Different variants of Psinomani eventually manifest themselves as Dakota and Assiniboin, among other related Siouan groups (Schlesier 1994:345).

Gibbon (1994:142-145) disagrees with much of this scenario. He points out that there was a close relationship between the St. Croix phase and the Arvilla complex, which was probably Algonkian. He believes that the Clam River and Kathio phases are related to the Blackduck phase and represent Algonkians:

> "The Clam River phase...the closely related Kathio phase...the(early) Blackduck phase...Differences between these phases, although not pronounced, are primarily defined in terms of decorative motifs on pottery vessels" (Gibbon 1994:143-144).

In this scenario, the Siouan Psinomani culture is seen as clearly intrusive into Minnesota, initially displacing the indigenous cultures, and eventually forcing the retreat of Blackduck peoples to the north (Gibbon 1994:145). The Psinomani culture, associated with Sandy lake ceramics, is seen as ancestral Dakota in this model, as in Schlesier's model and Meyer and Hamilton (1994:127). The main difference between these two models speaks to the question of the depth of the Siouan occupation in Minnesota. If all of the earlier Minnesotan cultures (St. Croix, Brainerd, Clam River, Kathio) were Algonkian, this supports notions that cultures in the AD 100 to AD 1000 time period in the Dakotas and Manitoba, such as Arvilla, were Algonkian as well. If these early Minnesotan cultures were Siouan, as Schlesier suggests, then the situation is significantly altered.

Several authors have attempted to develop some type of ethnic relationship between the Blackduck culture and various modern ethnic groups. This is not an unreasonable idea, given that some Blackduck sites date to near AD 1600 or later and contain European fur trade goods, and we have named ethnic groups appearing in the historic record as of AD 1720.

A variety of early archaeologists who discussed this subject drew a connection between the Blackduck culture and the Assiniboin Natives (Wilford 1955, MacNeish 1958, Hlady 1964). Taking an opposing view, J.V. Wright has argued that the Ojibwa are better descendants of the Blackduck people than are the Assiniboin (Wright 1965, 1967, 1968, 1971, 1981). In support of this link, Wright has offered evidence in both direct archaeological and historic archaeological veins, as well as some supporting linguistic, rock art and ethnologic data. The attribution of Blackduck ceramics to the Ojibwa is also supported by Syms (1977) and Dawson (1987:155).

SUMMARY

There are many conflicting theories regarding the relationships between different cultures that inhabited this region in the past. As the data collection for this project commenced, it was hoped that the samples would be of sufficient number and quality to allow the biological distinctions between different groups to be demonstrated. As the number of possible groups that may have lived here in the past increased, and the possibilities for ancestor/descendant relationships mushroomed, it began to appear unlikely that it was going to be possible to separate individual archaeological groups on a biological basis. However, it remains possible that groups associated with larger social units, such as language families, may still be distinguished. Even if it is not possible to separate Cree from Ojibwa, or Assiniboin from Dakota perhaps it was still possible to distinguish Algonkian speakers from Siouan speakers. Then, it might be possible to answer several questions raised in this section. For example, can Sonota/Besant be said to be Siouan or Algonkian, or neither? Is the Arvilla complex Algonkian, related to the Cheyenne and the Blackduck culture? Are Laurel, Blackduck, the Cree and the Ojibwa all related, in the way most researchers feel? Is the Devil's Lake-Sourisford Complex Siouan, an ancestor of the Hidatsas, or is it Algonkian, related to the Arvilla Complex and the Northeastern Plains Village Complex?

The organization of the available data into a variety of configurations was attempted in order to answer these and other questions. The actual combinations of data used in the various groupings, and the philosophy behind each, is discussed in Chapter four which deals with methodology. In addition, full listings appear in the appendices.

CHAPTER 3

SAMPLE ACQUISITION AND DIVISION

One of the primary goals of this dissertation from its inception has been to assess and measure all human crania recovered from Manitoba. The circumstances of the recovery of the specimens varied, but in general they were less satisfactory than I had hoped. Some of the specimens came from controlled and professional archaeological excavations; others came from "controlled" and less professional operations. Unfortunately, the remainder of the specimens were simply acquired with no provenience or no meaningful archaeological provenience.

The starting point for the sample acquisition was to assess and measure all of the crania from the collections in the University of Winnipeg. The methodology which was to become standard was worked out on these specimens. This collection was soon expanded by the acquisition of numerous human crania from the Manitoba Museum of Man and Nature.

I then travelled to Ottawa to measure the specimens in the collections of the Canadian Museum of Civilization. There were forty or more crania in the collection, all with some sort of archaeological provenience. From there I travelled to the Royal Ontario Museum in Toronto. The ROM yielded more crania from Manitoba and I was able to measure an excellent comparative sample from Hungry Hall in northwestern Ontario.

Following my return to Winnipeg I (with the assistance of the Historic Resources Branch of the provincial government) contacted by letter all of the small community museums from around the province. They were asked to send in any human remains that they had in their collection. The response, over the next year, was the addition of a half-dozen skulls. Finally, as the writing of my dissertation continued, specimens trickled into the lab through the usual means: archaeological excavation, erosion and accidental disinterment.

Regardless of origin, each specimen was treated in an identical manner and was measured consistently. Each was assessed in the same manner with regards to age standards, sexing and pathology.

The distribution of the sample into groups or populations was a much more difficult issue (see Appendix A for the group attribution of all specimens). As mentioned in the introduction it would have been ideal if archaeological provenience could have been used to make a primary distribution of specimens into groups. In this case, however, there was such a small percentage of the sample with a good provenience, that this did not seem the best place to start. As a result, I divided the whole sample into subsets based upon a combination of natural vegetation zones and topographic features. Figure 3.1 shows the geographic boundaries of the subsets that were used in the analysis. In gross outline, these areas follow the natural vegetation zones of Manitoba, as defined by Weir (1983:11).

The obvious exception to this pattern is the Red River Valley region. This region is defined by the topographic feature of the valley itself, rather than on the basis of natural vegetation. The valley is singled out because the Red River was a major transportation corridor in the past and it would be reasonable to assume that a variety of groups may be represented here, including groups not widely distributed elsewhere in the province. For example, the presence and dating of the horticultural component at the Lockport site on the Red River is unique in this province (Buchner 1988).

My total data base consists of specimens measured both personally and by colleagues in the United States. Those measured personally were divided into seven primary groups while the comparative samples, measured by Dr. Pat key and Ms. Susan

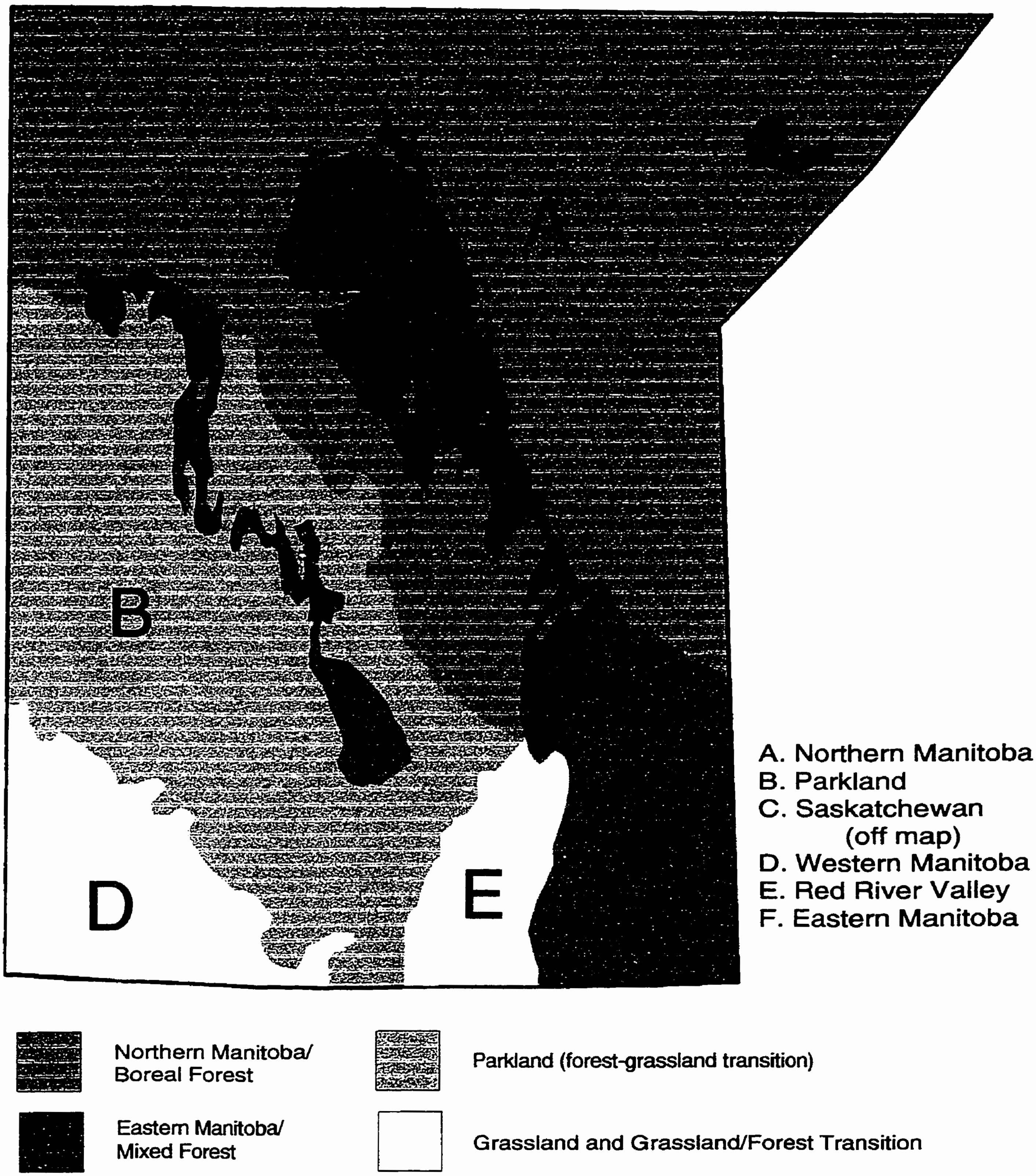


Figure 3.1. Geographic Zones, generally following the Physiographic Subdivisions of Weir (1983).

Myster, were included in eight additional groups. A final comparative group, the Caucasians, were measured personally.

TABLE 3.1 - SAMPLE DISTRIBUTION		
CODE	NAME	LOCATION
A	NORMAN	NORTHERN MANITOBA
B	PARKLAND	S.CENTRAL MANITOBA
C	SASKATCHEWAN*	SASKATCHEWAN
D	WESTMAN	WESTERN MANITOBA
E	RED RIVER	RED RIVER VALLEY
F	EASTMAN	EASTERN MANITOBA
G	HUNGRY HALL	N.WESTERN ONTARIO
I	SIOUX	N./S. DAKOTA
J	SONOTA	N./S. DAKOTA
K	S. ARVILLA	N./S. DAKOTA
L	MANDAN	N./S. DAKOTA
M	DLS	N./S. DAKOTA
Q	CAUCASIAN	MANITOBA

X	ARVILLA	MINNESOTA
Y	BLACKDUCK	MINNESOTA
Z	LAUREL	MINNESOTA
*= subsumed into the Westman sample		

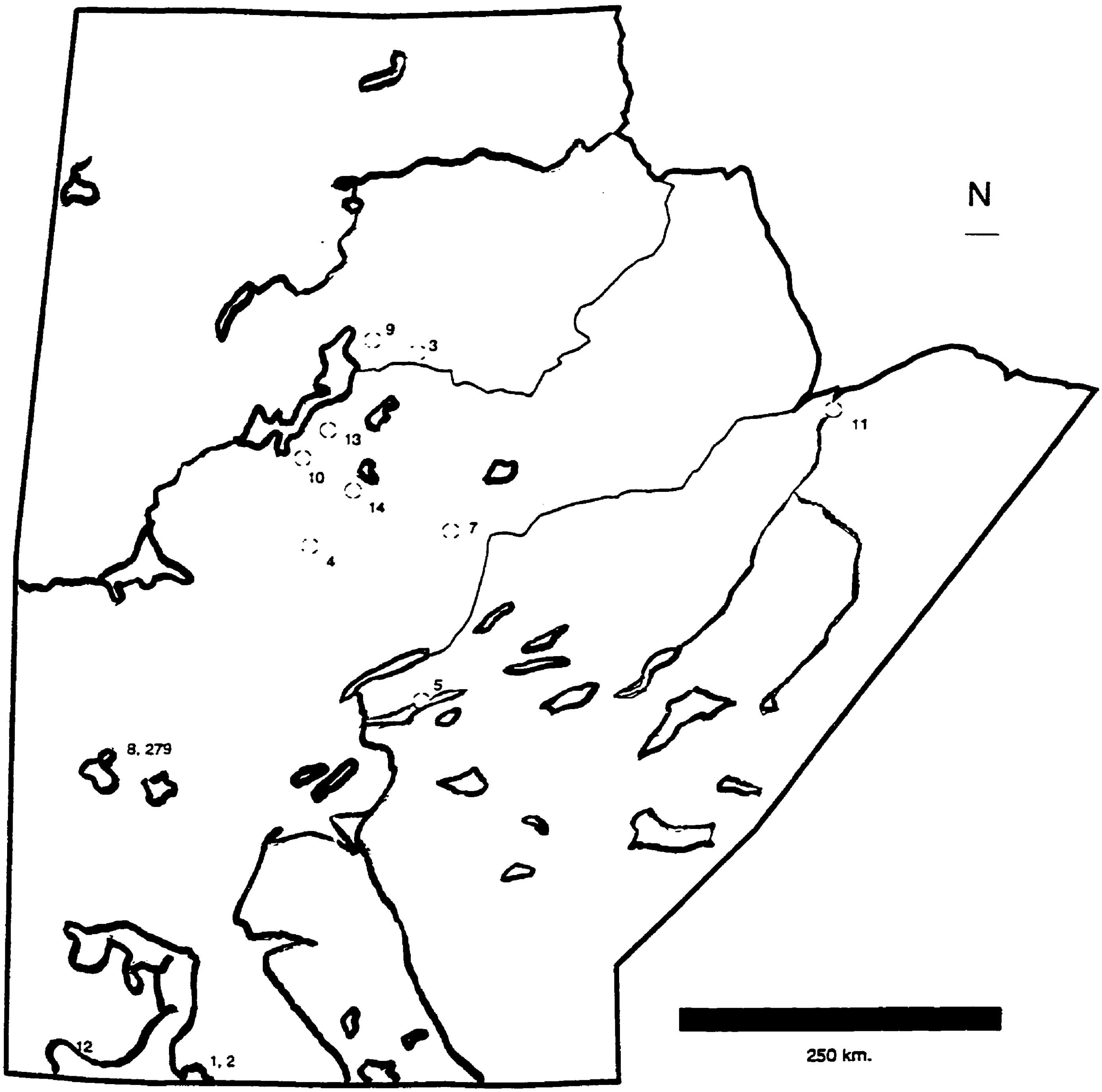
Specimens found in northern Manitoba (essentially north of the 52nd parallel) were assigned to the A (Norman) sub set (table 3.2). In terms of natural vegetation, this region basically corresponds to most of the northern part of the northern coniferous forest (Weir 1983). Figure 3.2 shows the distribution of the sample A. Unfortunately, the ages and provenience of many of these specimens were unknown, and the sample could not be divided into temporal groups within the boreal forest environment. Thus, this group may contain individuals from Laurel, Selkirk Composite or ethnic Cree contexts.

TABLE 3.2 - A (NORMAN) SUB SET

#	CODE	NAME	LOCATION
1	110A	SKOWNAN-1	SKOWNAN - WATERHEN LAKE
2	110A	SKOWNAN-2	SKOWNAN - WATERHEN LAKE
3	110A	CHURCHILL R	ALONG CHURCHILL RIVER
4	110A	NELSONH	NELSON HOUSE

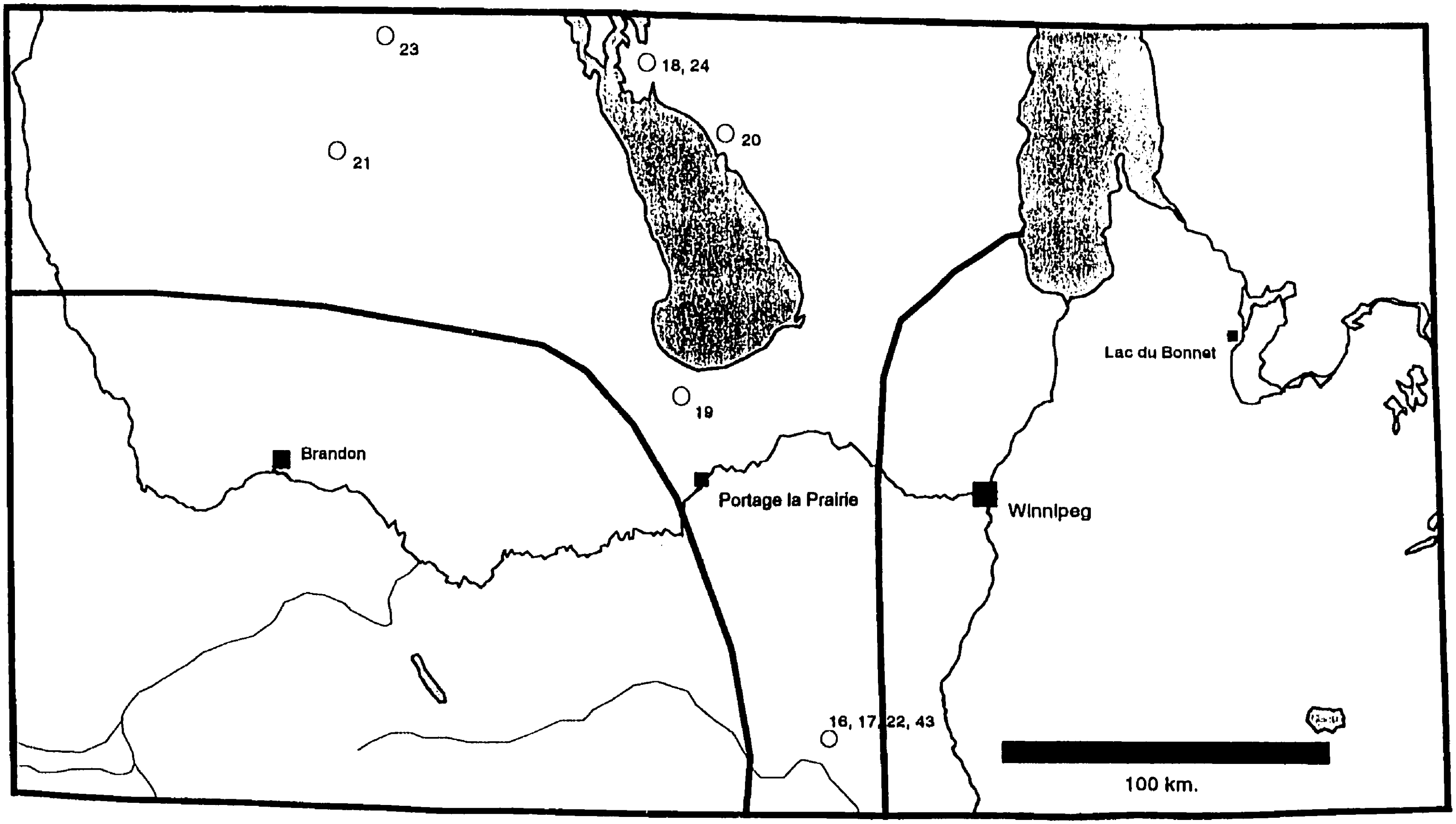
5	110A	CROSSLA	CROSS LAKE
6	110A	MANHATT	MANHATTAN ISLAND
7	110A	BRNTWOD	BURNTWOOD RIVER
8	110A	PAS	THE PAS
9	110A	MISSI	FALLS ALONG MISSI RIVER
10	110A	RAT RIVER	ALONG RAT RIVER
11	210a	YORK-1	YORK FACTORY
12	210a	KENVILL	KENVILLE - NEAR SWAN R.
13	210a	HGLT-1	BORDEN # HgLt
14	210a	BIRCHTREE	BIRCHTREE ISLAND
279	110A	PN-21-15A	THE PAS (MUSEUM)
132	210a	PILT2-106	LAB SPECIMEN - CREE

The Parkland (B) sample (Table 3.3) comes from areas of central Manitoba encompassing a mixture of forest and grassland. Following Weir (1983) this area encompasses the mixed woods, broadleaf forest and wooded grasslands zones, excluding the Red River Valley. This region is quite narrow at the American border, as it stretches only from the Red River valley to about Swan Lake in the western part of the province. However, the zone broadens to the north and eventually includes the Interlake, the south central region and the western portion of the province, north of the southern border of Lake Manitoba. Figure 3.3 shows the distribution of the B sample.



1, 2 Skownan - Waterhen
3 Churchill River Site
4 Nelson House
5 Cross Lake
6 Manhattan Island
7 Burntwood River
8 The Pas
9 Missi River Falls
10 Rat River
11 York Factory
12 Kenville
13 HgLt-1
14 Birchtree Island
279 Sam Waller Museum

Figure 3.2. Distribution of the "A" sample.



16, 17, 22, 43 Darlingford
18, 24 Eriksdale
19 Westbourne
20 Lundar
21 Keeseekouninin Reserve
23 Dauphin

Figure 3.3. Distribution of the "B" sample.

I decided to amalgamate these somewhat different vegetation zones into a single regional category to: a) distinguish specimens found here from those of the clear boreal forest to the north and the true prairie to the south and west and b) to make a decent sized group in terms of the number included in the sample. Otherwise, I would have ended up with a large number of groups from this region with only a few cases in each. The cases and sites that were included in this group are:

TABLE 3.3 - B (PARKLAND) SUB SET

#	CODE	NAME	LOCATION
16	120B	HDM-41-3	DARLINGFORD
17	120B	HDM-41-7	DARLINGFORD
18	120B	ERICSDALE-1	ERICSDALE
19	120B	WESTBN-A0428	WESTBOURNE
20	120B	LUNDAR	LUNDAR
21	120B	KEESEEK	KEESEEKOUNININ RESERVE
22	220b	HDM-41-4	DARLINGFORD
23	220b	DAUPHIN	DAUPHIN
24	220b	ERICSDALE-2	ERICSDALE
43	140B	HDM-39-6	DARLINGFORD

The third geographic region (the C sample) was the prairie region of Saskatchewan. By the termination of the project I was able to get only two specimens from here, and eventually I ended up placing them into the prairie region sample (D sub set) from Manitoba. The region (C) was eliminated from further analyses due to small sample size.

The fourth sub set (D sample) is the Prairie Region (Westman - including Saskatchewan) sample (Table 3.4). These specimens came from sites in the southwest corner of the province, corresponding with the tall grass and mixed grass prairie vegetation zones (Weir 1983). Figure 3.4 shows the distribution of the D sample. This is one of the smallest regions in size, but because of the large number of archaeological sites, including burial mounds, found here, it constitutes the largest Manitoba sub set in the study. This sample includes:

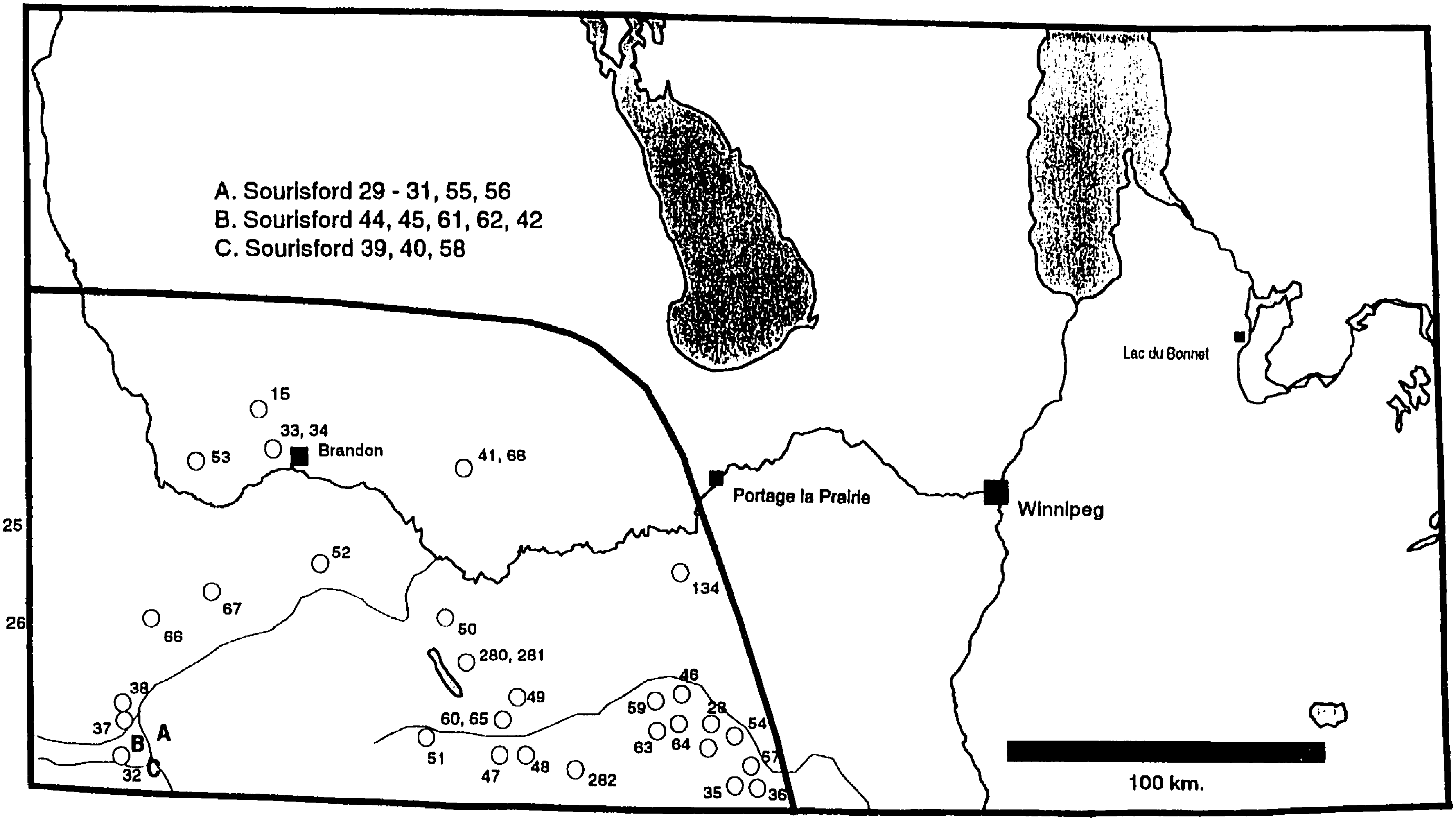
TABLE 3.4 - D (WESTMAN) SUB SET			
#	CODE	NAME	LOCATION
25	240d	HOWARD-1	HOWARD, SASKATCHEWAN
26	140D	BUEN VISTA-1	BUENA VISTA, SK
27	140D	SIMS-8	SIMS MOUND
28	140D	SIMS-4	SIMS MOUND
29	140D	SRSFORD-13	SOURISFORD

30	140D	SRSFORD-3	SOURISFORD
31	140D	SRSFORD-1	SOURISFORD
32	140D	ANT CREEK-1	ALONG THE ANTLER CREEK
33	140D	STOTT-2	STOTT MOUND
34	140D	STOTT-1	STOTT MOUND
35	140D	STAR MND-5	STAR MOUND
36	140D	STAR MND-1	STAR MOUND
37	240d	MORS MND-B2	MOORES MOUND
38	140D	MORS MND-B	MOORES MOUND
39	140D	HDM-13-1	SOURISFORD
40	140D	HDM-15-1	SOURISFORD
41	140D	HDM-30-1	ARDEN
42	140D	HDM-36-2	SOURISFORD
44	140D	HDM-47-1	SOURISFORD
45	140D	HDM-47-2	SOURISFORD
46	140D	S5-HK-1278	PILOT MOUND
47	240D	GY HIL-III	GUY HILL

48	140D	GY HIL-III-2	GUY HILL
49	140D	VICKERS-4376	NORTH OF AVERY SITE
50	140D	HILTON-B	HILTON
51	140D	KILLARNEY	KILLARNEY
52	140D	SOURIS	SOURIS
53	140D	RM DALY	RURAL MUNICIP OF DALY
54	240d	SIMS-14	SIMS MOUND
55	240d	SRSFORD-2	SOURISFORD
56	240d	MCGORMAN-1	MCGORMAN MOUND
57	240d	STAR MND-6	STAR MOUND
58	240d	HDM-22-2	SOURISFORD
59	240d	HDM-31-2	PILOT MOUND
60	240d	HDM-37-1	ROCK LAKE
61	240d	HDM-43-1	SOURISFORD
62	240d	HDM-47-3	SOURISFORD
63	240d	P MND-MC1	PILOT MOUND
64	240d	S4-HK-1277	PILOT MOUND

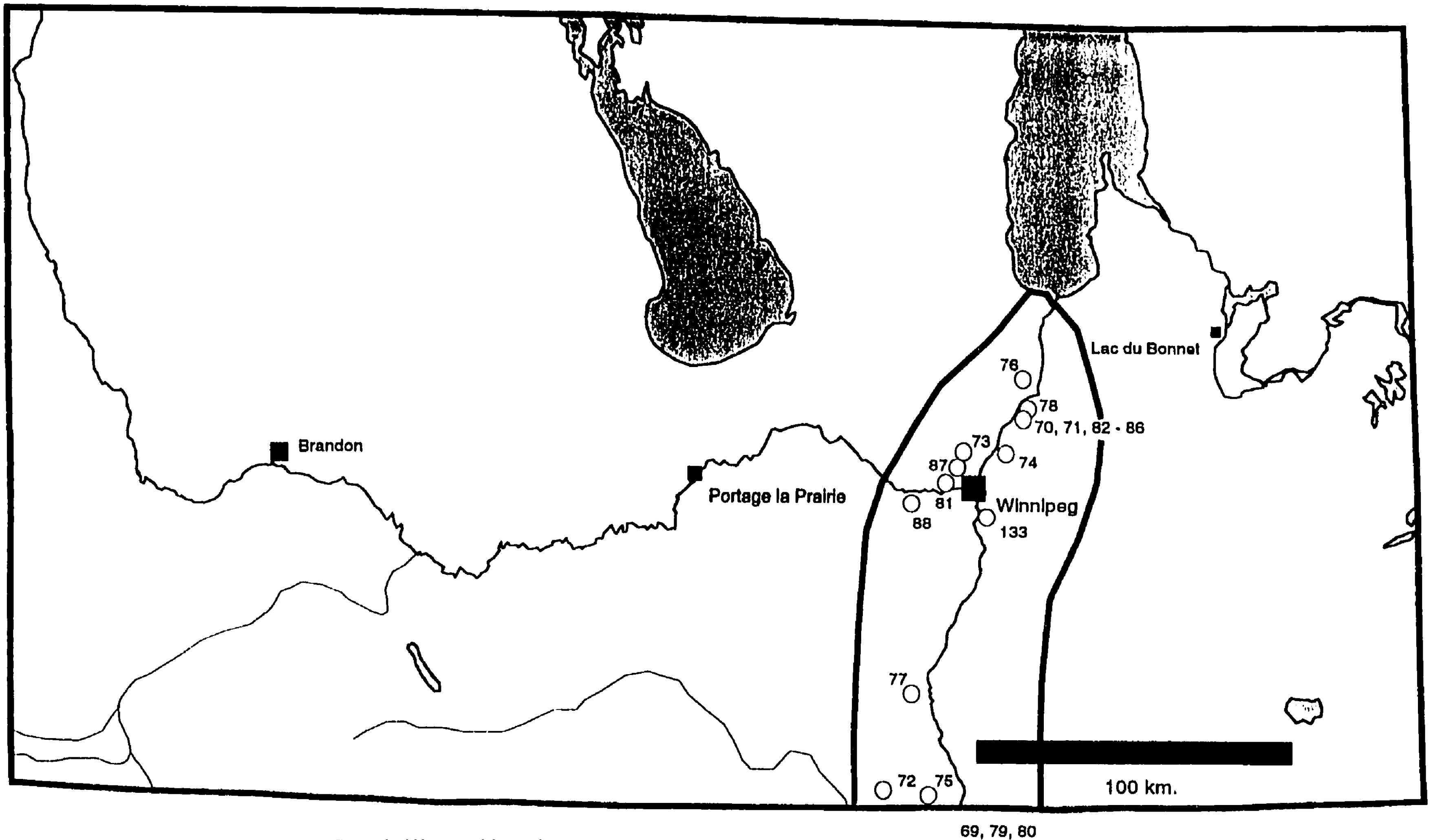
65	240d	VICKERS-1108	NORTH OF AVERY SITE
66	240d	RESTON	RESTON
67	240d	ELLIS ELLIOT	NEAR PIPESTONE
68	240d	HDM-30-3	ARDEN
280	140D	BELMONT-1	BELMONT
281	140D	BELMONT-C3	BELMONT
282	140d	YULE-MD-807-1	NEAR MATHER
134	240d	PILT2-97	HOLLAND MB
135	240d	PILT2-107	BLACKFOOT
15	140D	LONE MND-1	LONE MOUND
131	240d	PILT2-109	DAKOTA SIOUX

The E sub set was the Red River Valley sample. As the name implies, all of the specimens in this group came from the valley proper, or the immediately adjacent area. Figure 3.5 shows the distribution of the E sample. A significant number of specimens came from this area, including those from large mound sites such as the Dennis Warner mound and the Fidler mounds. Specimens from this region include (Table 3.5):



15 Lone Mound
25, 26 In SE Saskatchewan
27, 28, 54 Sims Mound
32 Antler Creek
33, 34 Stott
35, 36, 57 Star Mound
37, 38 Moore's Mound
41, 68 Arden
46, 59, 63, 64 Pilot Mound
47, 48 Guy Hill
49, 65 Vickers
50 Hilton
51 Killarney
52 Souris
53 Daly
60 Rock Lake
66 Reston
67 Ellis Point
134 Holland
280, 281 Belmont
282 Yule

Figure 3.4. Distribution of the "D" sample.



69, 79, 80 Dennis Warner Mound
72 Morden
73, 81, 87 Winnipeg - St. James
74 Pine Ridge
75 Wiebe Mound
76 Selkirk
77 Red River Sites
78 Lockport
88 Starbuck
133 Winnipeg - St. Boniface
70, 71, 82 - 86 Fidler Mounds

Figure 3.5. Distribution of the "E" sample.

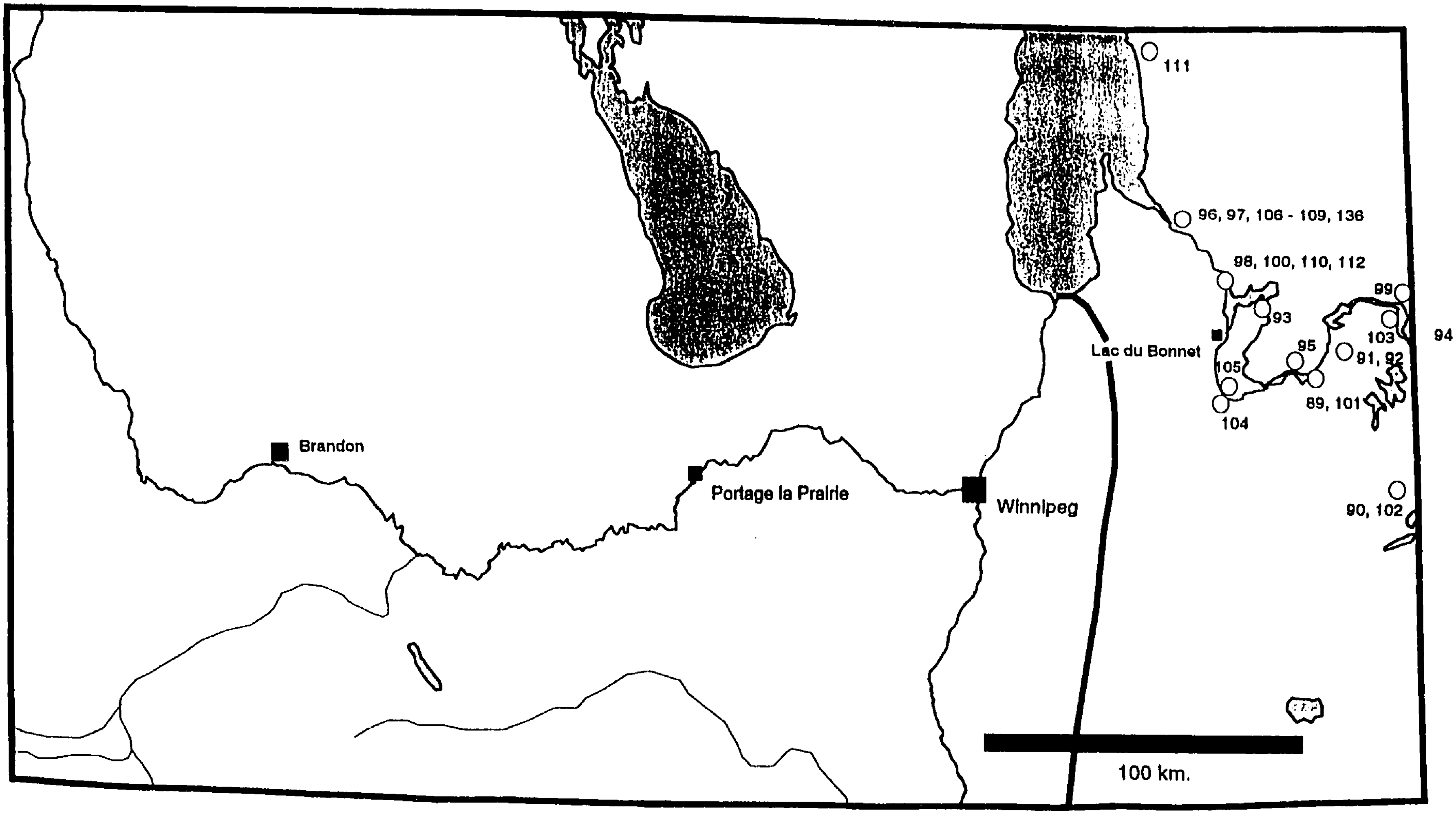
TABLE 3.5 E (RED RIVER VALLEY) SUB SET			
#	**CODE**	**NAME**	**LOCATION**
69	150E	WARNER MND-1	DENNIS WARNER MOUND
70	150E	FIDLER-7	FIDLER MOUND
71	150E	FIDLER-16	FIDLER MOUND
72	150E	MORDEN-116-1	MORDEN
73	150E	ASSINB-104-1	ST. JAMES
74	150E	PINE RIDGE	NEAR BIRD'S HILL
75	150E	WIEBE-A0418	WIEBE MOUND
76	150E	SELKIRK	SELKIRK
77	250e	RED RIV-1	ALONG THE RED RIVER
78	250e	LKPRT-SKEL-4	LOCKPORT
79	250e	WARNER MND-2	DENNIS WARNER MOUND
80	250e	WARNER-11	DENNIS WARNER
81	250e	HIST ASSINB	ST. JAMES
82	250e	FIDLER-12	FIDLER MOUND

83	250e	FIDLER-15	FIDLER MOUND
84	250e	FIDLER-17A	FIDLER MOUND
85	250e	FIDLER-19	FIDLER MOUND
86	250e	FIDLER-21	FIDLER MOUND
87	250e	ASSINB-104-4	ST. JAMES
88	250e	STARBUCK	STARBUCK
133	150E	PILT2-101	ST. BONIFACE

The Eastman (F) sub set comes from the southeastern part of the province, primarily the area along the Winnipeg River (Table 3.5). This was selected as a separate region due to sample size and the particular documented connection of some of the sites with the Ojibwa people. Figure 3.6 shows the distribution of the F sample.

TABLE 3.6 F (EASTMAN) SUB SET			
#	**CODE**	**NAME**	**LOCATION**
89	160F	CEM PNT-1993	CEMETERY POINT
90	160F	CADDY LAKE-2	CADDY LAKE
91	160F	WHSHEL-A0417	WHITESHELL
92	160F	K & J	WHITESHELL

93	160F	RIVERMO	RIVERMOUTH
94	160F	MINAKI	MINAKI
95	160F	NUTIMIK	NUTIMIK LAKE
96	160F	A_13_23	FORT ALEXANDER
97	260F	FA3 410	FORT ALEXANDER
98	160F	WHALEY1	WHALEY
100	160F	WHAF1I1	WHALEY
101	260f	CEM PNT-90-2	CEMETERY POINT
102	260f	CADDY LAKE-1	CADDY LAKE
103	260f	EAGLENE	EAGLENEST LAKE
106	260f	FA3 101	FORT ALEXANDER
107	260f	FA3 409	FORT ALEXANDER
108	260f	FA3 411	FORT ALEXANDER
109	260f	FA3 412	FORT ALEXANDER
110	260f	WHALEY2	WHALEY
111	260f	EGLA_10	EgLa_10
112	260f	WHAF2I1	WHALEY
136	160F	FA-FONT	FORT ALEXANDER



89, 101 Cemetery Point - Nutimik
90, 102 Caddy Lake
91, 92 Whiteshell
93 Rivermouth
94 Minaki
95 Nutimik Lake
99 Slave Falls
103 Eaglenest Lake
104 Whitemouth
105 Bjorklund
111 EgLa-10
96, 97, 106 - 109, 136 Fort Alexander
98, 100, 110, 112 Whaley

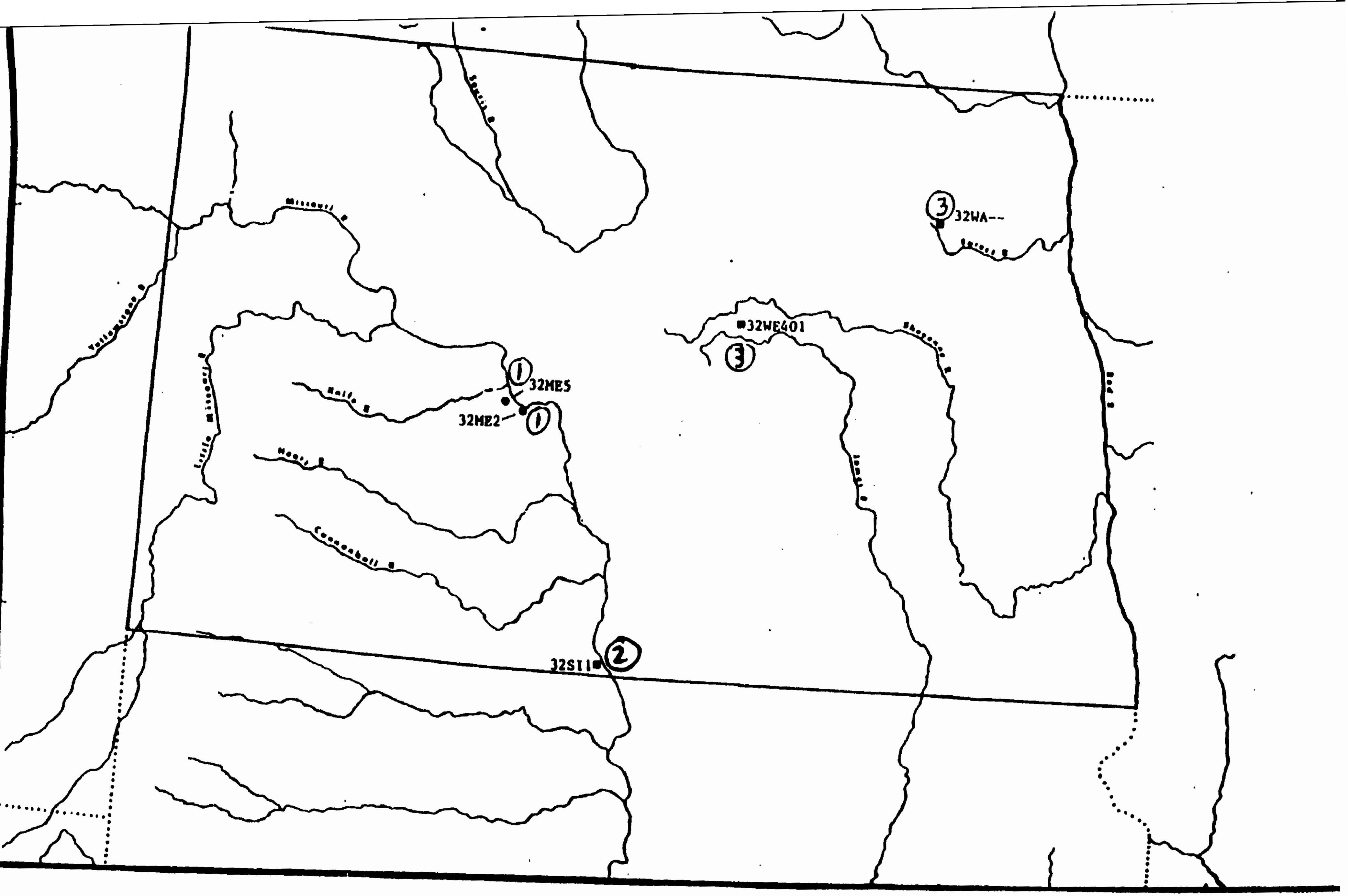
Figure 3.6. Distribution of the "F" sample.

COMPARATIVE SAMPLES

I drew on three sources for comparative specimens to be used in the analysis. The first source was crania from the Hungry Hall Mounds in northwestern Ontario (Kenyon 1986). These mounds are considered to be Blackduck or Blackduck influenced (Kenyon 1986). Both Mound I (1130 ± 65) and Mound II (1190 ± 60) have subsequently been assigned to the Rainy River Composite by Lenius and Olinyk (1990:81). I measured specimens from both mounds in the Royal Ontario Museum, and they became the G sub set in the analysis.

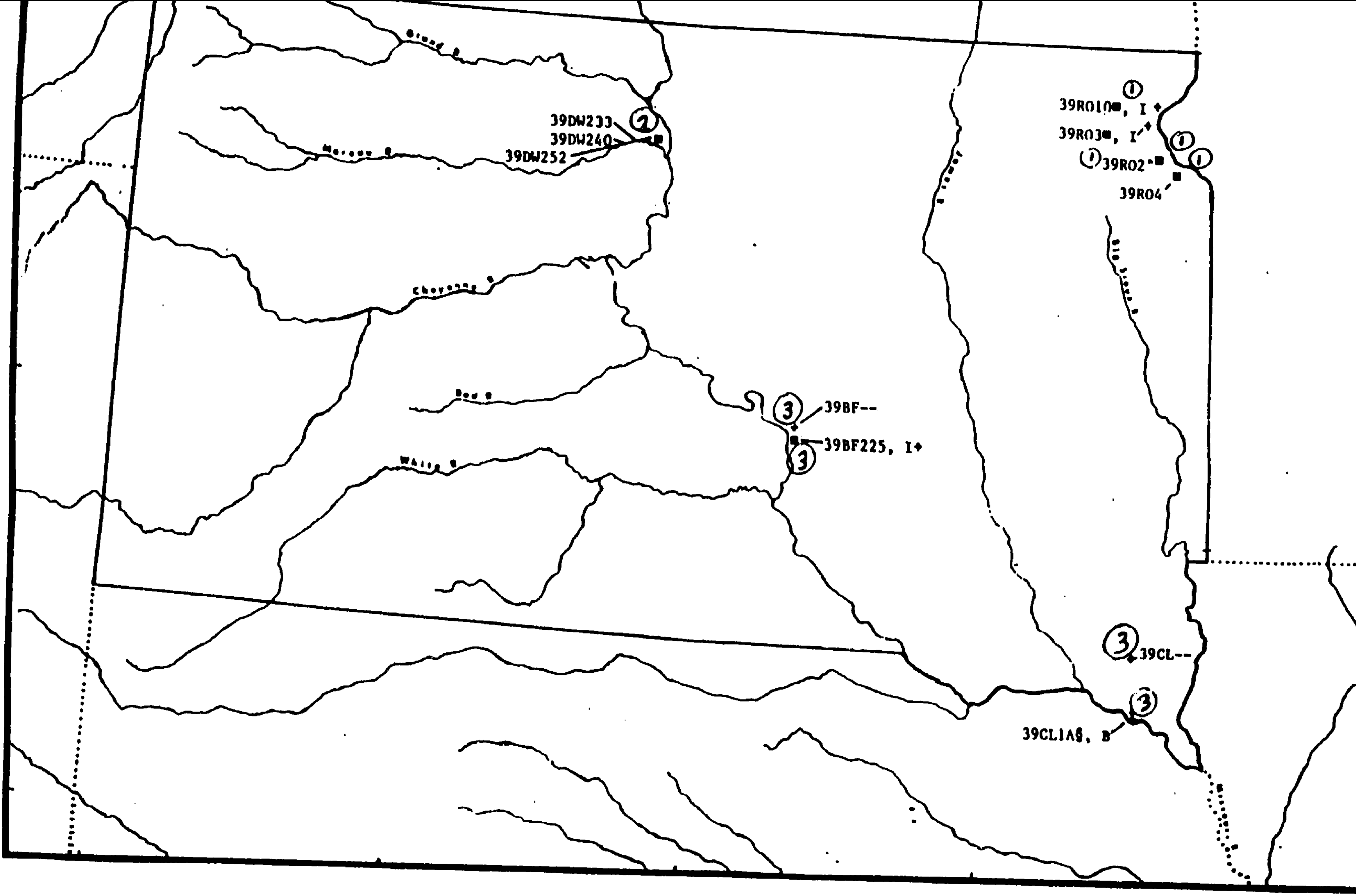
The second source was data published by Patrick Key in his dissertation (Key 1983). Dr. Key was kind enough to allow me to use his measurements and provided the metrics on a disk. Each specimen in Key's data was identified as having real or supposed archaeological provenience. This allowed me to extract important cranial samples from the areas immediately south of Manitoba, particularly those identified as having come from cultures that may have been present here in the past. Table 3.7 shows the comparative samples, their size and source (see also Appendix A for individual listings). Figure 3.7 shows the distribution of sites from North Dakota that yielded comparative samples and Figure 3.8 shows the distribution of sites from South Dakota.

The final source of samples was Ms. Susan Myster from Hamline University in St. Paul, Minnesota. Ms. Myster collected measurements from many crania from Minnesota prior to their reburial. She also provided samples with an archaeological provenience, divided by cultural association (Table 3.7) (see also Appendix A for individual listings). The distribution of the Minnesota sites that yielded comparative samples can be seen in Figure 3.9



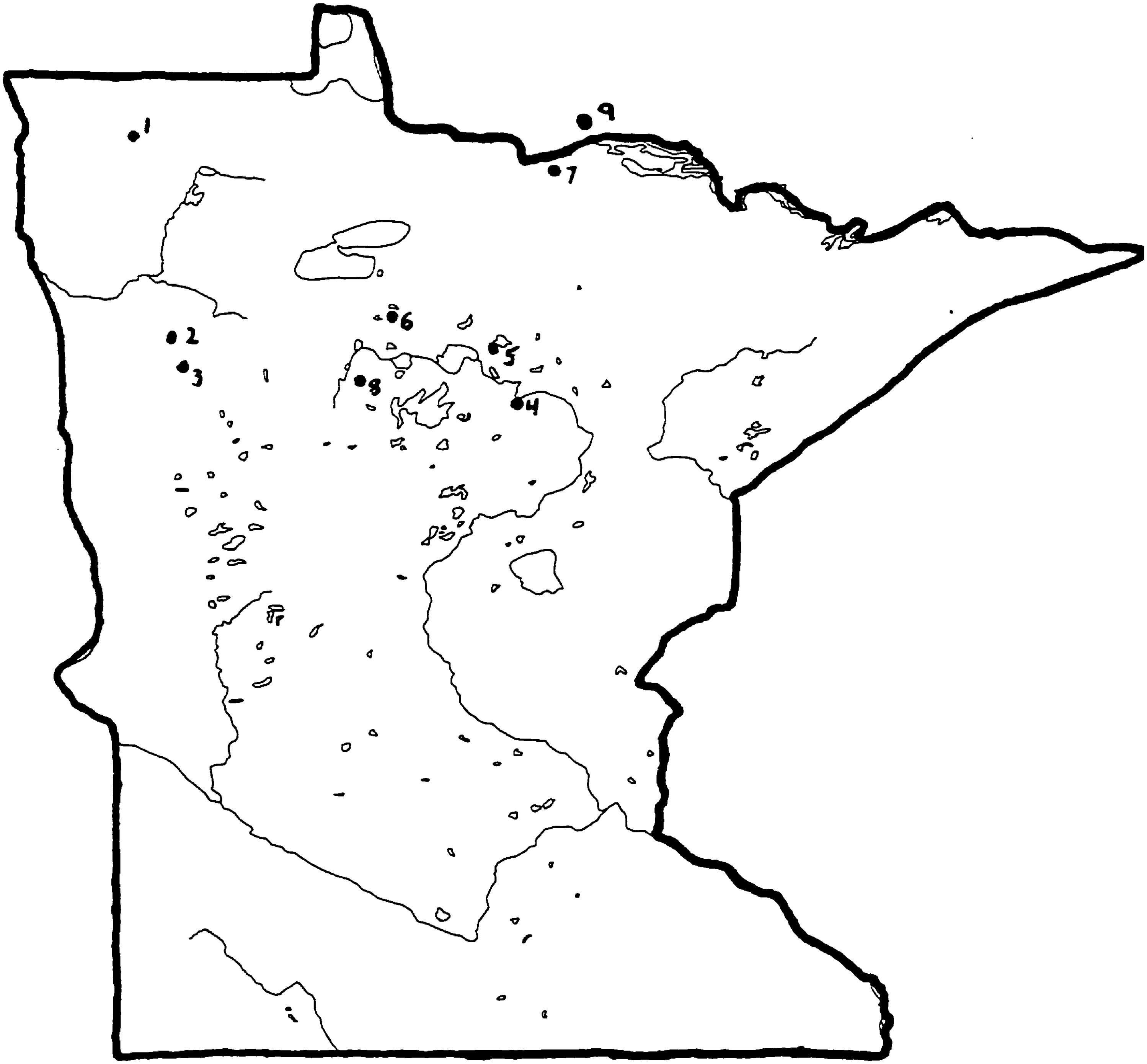
1 - MANDAN SITES (L)
2 - SONOTA SITES (J)
3 - DEVIL'S LAKE SOURISFORD SITES (M)

FIGURE 3.7 NORTH DAKOTA SITES YIELDING SKELETAL MATERIALS USED IN THE ANALYSIS
(Source: Key, 1983)



1 - SOUTH ARVILLA SITES (K)
2 - SONOTA SITES (J)
3 - HISTORIC SIOUX SITES (I)

FIGURE 3.8 SOUTH DAKOTA SITES YIELDING SKELETAL MATERIALS USED IN THE ANALYSIS
(Source: Key, 1983)



1 - BRONSON (X)
2 - RED LAKE FALLS (X)
3 - WARNER (X)
4 - WHITE OAK POINT (Y)
5 - OSUFSEN (Y)
6 - SCHOCKER (Y)
7 - McKINSTRY (X) & (Z)
8 - BAGLEY (Y)
9-HUNGRY HALL (Y?)

FIGURE 3.9 MINNESOTA/NW ONTARIO SITES YIELDING SKELETAL MATERIALS USED IN THE ANALYSIS

X=N. ARVILLA, Y=BLACKDUCK, Z=LAUREL

TABLE 3.7 COMPARATIVE SAMPLES			
GROUP	CODE	#	SOURCE
PROTO/HISTORIC SIOUX	I	15 CASES	KEY
SONOTA	J	12 CASES	KEY
SOUTH ARVILLA	K	22 CASES	KEY
PROTO/HISTORIC MANDAN	L	33 CASES	KEY
DEVIL'S LAKE SOURISFORD	M	9 CASES	KEY
ARVILLA	X	15 CASES	MYSTER
BLACKDUCK	Y	20 CASES	MYSTER
LAUREL	Z	6 CASES	MYSTER
HUNGRY HALL	G	18 CASES	WYMAN
CAUCASIAN	Q	4 CASES	WYMAN

REVISED GROUPINGS

While the sub sets used in the analysis were defined on a non-cultural basis, I remained interested, of course, in the cultural affiliations of the specimens. Most of the specimens from Manitoba were unknown culturally. Others came from excavations, but unless there were diagnostic artifacts in association with the interments, they, too, were essentially unknowns. Further, very few of the cranial specimens from Manitoba have been recovered from sites in which they were in clear association with a particular ceramic type. In fact, most burial sites from Manitoba, including burial mounds, have little ceramic content, and the ceramics that are present are not the "everyday" wares that are common in archaeological sites in this province.

There are several possible explanations for this. First, some mounds might pre-date the introduction/invention of pottery in this part of the world. Second, the cultures who built the mounds may have been aceramic, even if their neighbours used ceramic technology. Third, cultures may have used ceramics but did not include them in burials because it was not part of their mortuary tradition. Or, fourth, some cultures made special or unique ceramics for interments, and these do not match established ceramic typologies.

Thus, when Syms (1978) defines the Devil's Lake-Sourisford mortuary complex partly on the basis of the ceramic miniature mortuary vessels that are found in some of the mounds, this is more useful for grouping mounds into the DLS complex than it is for determining the relationships of the DLS complex to other defined archaeological cultural entities. However, the DLS remains, by far, the archaeological culture most clearly associated with crania used in my analysis. This makes it a logical starting point to derive an archaeological/biological sample. Further, since Syms (1978:73) considers DLS mounds to have been the product of a Siouan group and in no way related to the Blackduck culture, a straightforward approach seemed to be to extract a DLS sample and compare it to clear Blackduck and other Algonkian samples on one hand and known Siouan samples on the other.

Therefore, I defined a DLS sub set which included Manitoba crania from sites designated as DLS by Syms (1978, 1979) and the entire DLS sample provided by Pat Key. The composition of this sub set (and the other sub sets defined below) cross-cuts the groups based on non-cultural criteria. The DLS sub set includes the following Manitoba specimens (Table 3.8) along with the 10 specmiens identified as DLS by Key in his data set.

TABLE 3.8 DEVILS' LAKE-SOURISFORD SUB SET			
#	CODE	NAME	LOCATION
15	140D	LONE MND-1	LONE MOUND
16	120B	HDM-41-3	DARLINGFORD
17	120B	HDM-41-7	DARLINGFORD
19	120B	WESTBN-A0428	WESTBOURNE
22	220b	HDM-41-4	DARLINGFORD
27	140D	SIMS-8	SIMS MOUND
28	140D	SIMS-4	SIMS MOUND
29	140D	SRSFORD-13	SOURISFORD
30	140D	SRSFORD-3	SOURISFORD
31	140D	SRSFORD-1	SOURISFORD

35	140D	STAR MND-5	STAR MOUND
36	140D	STAR MND-1	STAR MOUND
39	140D	HDM-13-1	SOURISFORD
40	140D	HDM-15-1	SOURISFORD
42	140D	HDM-36-2	SOURISFORD
43	140D	HDM-39-6	DARLINGFORD
44	140D	HDM-47-1	SOURISFORD
45	140D	HDM-47-2	SOURISFORD
46	140D	S5-HK-1278	PILOT MOUND
54	240d	SIMS-14	SIMS MOUND
55	240d	SRSFORD-2	SOURISFORD
57	240d	STAR MND-6	STAR MOUND
58	240d	HDM-22-2	SOURISFORD
59	240d	HDM-31-2	PILOT MOUND
61	240d	HDM-43-1	SOURISFORD
62	240d	HDM-47-3	SOURISFORD
63	240d	P MND-MC1	PILOT MOUND

64	240d	S4-HK-1277	PILOT MOUND
66	240d	RESTON	RESTON
70	150E	FIDLER-7	FIDLER MOUND
71	150E	FIDLER-16	FIDLER MOUND
82	250e	FIDLER-12	FIDLER MOUND
83	250e	FIDLER-15	FIDLER MOUND
84	250e	FIDLER-17A	FIDLER MOUND
85	250e	FIDLER-19	FIDLER MOUND
86	250e	FIDLER-21	FIDLER MOUND
220	100M	WA--S228876	FOREST R. MOUNDS
221	100M	WA--S228878	FOREST R. MOUNDS
222	100M	WA--S228880	FOREST R. MOUNDS
223	200m	WA--S228884	FOREST R. MOUNDS
224	200m	WA--S228885	FOREST R. MOUNDS
225	200m	WA--S228886	FOREST R. MOUNDS
226	200m	WA--S228889	FOREST R. MOUNDS
227	100M	WA--S228890	FOREST R. MOUNDS

228	100M	WE401-4319	HEIMDAHL MOUND
270	100M	WE401-4320	HEIMDAHL MOUND

Another large group that deserved special consideration was the collection of crania from the Sourisford location. These specimens come from a number of mounds in the Sourisford area, as opposed to coming from a specific site, but it seems possible that they represent a single culture (Table 3.9). In total, 15 specimens came from Sourisford or the immediate area and were placed in the Sourisford sub set.

TABLE 3.9 SOURISFORD SUB-SET

#	CODE	NAME	LOCATION
29	140D	SRSFORD-13	SOURISFORD
30	140D	SRSFORD-3	SOURISFORD
31	140D	SRSFORD-1	SOURISFORD
32	140D	ANT CREEK-1	ANTLER CREEK
37	240d	MORS MND-B2	MOORES MOUND
38	140D	MORS MND-B	MOORES MOUND
39	140D	HDM-13-1	SOURISFORD
40	140D	HDM-15-1	SOURISFORD

42	140D	HDM-36-2	SOURISFORD
44	140D	HDM-47-1	SOURISFORD
45	140D	HDM-47-2	SOURISFORD
55	240d	SRSFORD-2	SOURISFORD
58	240d	HDM-22-2	SOURISFORD
61	240d	HDM-43-1	SOURISFORD
62	240d	HDM-47-3	SOURISFORD

A secondary division was made of these crania by the grouping of the Sourisford mounds into the North Antler group and the South Antler group (Tables 3.10 and 3.11). This grouping was suggested by Capes (1963) following notes and reports by Montgomery from 1907 and 1908. The North Antler group consists of numbers HDM 43-48 (from Thompson's farm).[2]

TABLE 3.10 NORTH ANTLER GROUP SUB SET			
#	CODE	NAME	LOCATION
44	140D	HDM-47-1	SOURISFORD

[2]NOTE: The last specimen on the following list (HDM-36-2) was almost certainly mis-labelled at some point, and should probably have been HDM-46-2. The HDM-36 number should refer to the Calf Mountain mound but the labelling with the skull in the ROM, "section 10, T2, R27" and the Thompson's farm designation both consistently point to a Sourisford location.

45	140D	HDM-47-2	SOURISFORD
61	240d	HDM-43-1	SOURISFORD
62	240d	HDM-47-3	SOURISFORD
42	140D	HDM-36-2	SOURISFORD

The South Antler group consists of numbers HDM 13-26 (Essensy's, Gould's and Elliott's farms).

TABLE 3.11 SOUTH ANTLER GROUP SUB SET			
#	**CODE**	**NAME**	**LOCATION**
39	140D	HDM-13-1	SOURISFORD
40	140D	HDM-15-1	SOURISFORD
58	240d	HDM-22-2	SOURISFORD

CHAPTER 4

DATA COLLECTION

In chapter three the origins of the specimens used in this analysis and the methods used to group them were discussed. Each specimen used in the primary analysis was seen and assessed personally. The only specimens that were not personally assessed were those that came from outside Manitoba and were used for comparative purposes. Data from these specimens were gathered electronically as e-mails of craniometric data from colleagues in the United States.

Each primary specimen was treated in an identical fashion. I examined the cranium in a superficial manner to see if it appeared complete enough to yield an acceptable number of measurements. Those that were clearly too damaged or fragmentary were not discarded immediately. I made note of these specimens for possible future analysis, particularly of non-metric data. In addition, I took what measurements were available even though I knew the specimens would not be used in the analysis. I did this for completeness of information, for the possibility of future research projects and because it is probable that many of these specimens will soon be re-buried.

The specimens that were complete, or complete enough to yield a considerable number of measurements, were assessed in the following way. The cranium was placed on foam or in a sand box and a series of diagrams, on an inventory sheet, were shaded in to indicate exactly which portions of the skull were present, which were absent and which were damaged. There were four diagrams on the sheet, each from a different perspective: front view, right view, left view and basal view. These allowed for the shading of the whole skull, making the dorsal and occipital views redundant.

This first inventory sheet also contained a form allowing for a complete description of the skull, bone by bone. Once the form was filled out, it provided descriptions associated with the shading of the diagrams (see Figure 4.1 for a sample inventory sheet). The status of each bone (or side of larger bones) of the specimen was indicated on the form as: (i) intact, (d) damaged, (f) fragmentary, (ff) very fragmentary or (-) missing. This system, the dental scoring routine and the metric measurement list, shown below, were developed for the analysis of specimens at the University of Winnipeg. Continuation of this recording practice allowed for the comparison of new specimens with previously examined pieces. In addition, this inventory sheet also contained tables for the description of teeth, both deciduous and permanent. The presence and condition of the teeth was recorded, although this information was not going to be used in this analysis, to be available for possible future research. The table for the deciduous teeth was rarely used, as I was not assessing children, but it was used in a few cases where an adult person retained a deciduous tooth. The 32 teeth of entire dentition were individually recorded as:

0. NO TOOTH OR ALVEOLUS
1. PRESENT IN ALVEOLUS
2. TOOTH INTACT BUT LOOSE
3. TOOTH LOST PREMORTEM/PATHOLOGY
4. TOOTH CONGENITALLY ABSENT
5. TOOTH ABSENT/ALVEOLUS PRESENT
6. TOOTH FRACTURED IN ALVEOLUS
7. UNERUPTED
8. ERUPTING.
9. FRACTURED LOOSE
10. AREA/TOOTH NOT PRESENT

The first inventory sheet also contained a comments section, in which brief notes about the specimen could be recorded. These notes usually related to pathological or unusual conditions which could be seen on the skull. A full description of the observed trait was made in my notebook.

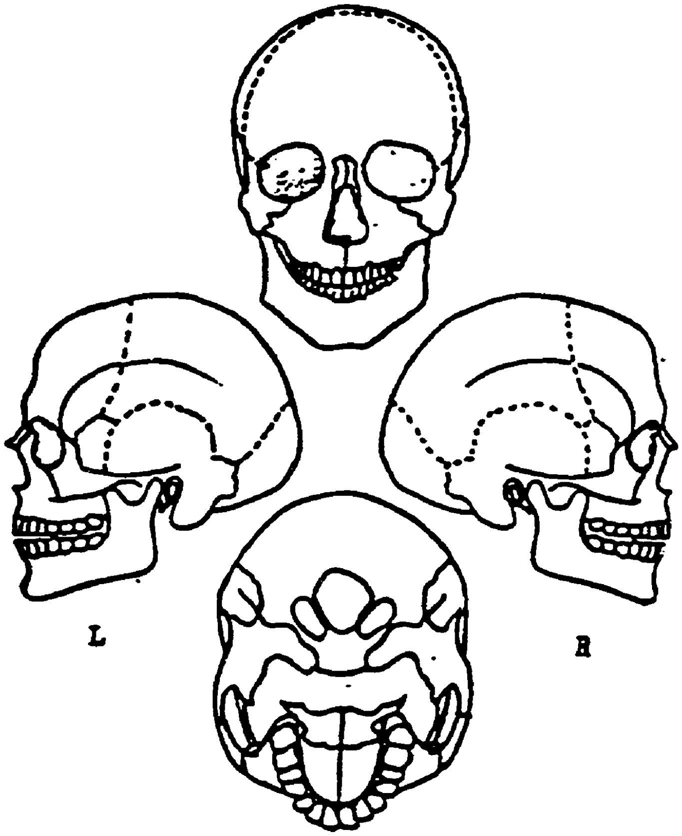
INVENTORY:

individual: ____________

sex: ____________

age: ____________

status: ____________



bone	right	left	frags
frontal			
parietal			
temporal			
mastoid			
occipital			
occ. condyle			
sphenoid			
ethmoid			
orbit			
nasal			
malar			
maxilla			
mand. body			
ramus			
unidentifiable			

DENTITION:

deciduous:

	m2	m1	c	i2	i1	i1	i2	c	m1	m2	
max.											
mand.											

r l

permanent:

	M3	M2	M1	P4	P3	C	I2	I1	I1	I2	C	P3	P4	M1	M2	M3
max.																
mand.																

r l

COMMENTS:

FIGURE 4.1 - CRANIAL INVENTORY SHEET

The second inventory sheet was used for the assessment of sex (Figure 4.2), the full description of which can be seen below. The third inventory sheet was used for the recording of the actual metric data (Figure 4.3). This sheet is a form with spaces for the 33 cranial measurements used in the analysis plus spaces for a number of additional measurements which were either not taken, or not used here.

The full list of measurements and their descriptions can be found in Appendix B. Only one set of tools was used in measuring the crania and an identical procedure was used for each specimen. Generally, breadth and height measurements were taken with a spreading caliper, length measurements with a sliding caliper, depth measurements with a coordinate caliper and arced measurements with a tape measure. Although this is primarily a computer research project, all of the original inventory sheets and my original notebooks have been retained as backup information.

SEX AND AGE ASSESSMENT

Each specimen was sexed.Where possible, post-cranial (pelvic) elements were used (Shipman et al 1985:274-277, Steele and Bramblett 1988:197-207). Otherwise (as in most cases) the cranial standards of Ferembach et al (1980) and Krogman (1962) were followed.

Aging of specimens was not necessary for this research beyond the fact that only adults were included. Adolescents, with third molars in crypts or partially erupted, were included at my discretion. If I believed that the skull appeared to be fully formed and had reached or very nearly reached its adult size it was included. Figure 4.2 shows a sample recording form for cranial sex identification.

SEX DIAGNOSIS:

character	weight	score	w x s
glabella	3		
mastoid proc.	3		
nuchal relief	3		
zygo. proc.	3		
brow ridge	2		
bossing	2		
occ. protub.	2		
os zygomaticum	2		
frontal inclin.	1		
orbital shape	1		
MANDIBLE:			
total aspect	3		
mentum	2		
mand. angle	1		
inferior margin	1		
Σ =			

Average score: ______

Sex diagnosis: ______

Comments: ______

SUTURE CLOSURE:

ENDOCRANIAL

coronal	R	
	L	
sagittal	A	
	P	
lamboidal	R	
	L	

Average score: ______

Phase: ______

EXOCRANIAL

coronal	L	
	R	
sagittal	A	
	P	
lamboidal	L	
	R	

Avergge score: ______

Phase: ______

Individual: ______

FIGURE 4.2 - CRANIAL SEX DIAGNOSIS

CRANIAL VAULT METRICS:(mm):

GOL	
XCB	
WFB	
XFB	
STB	
ASB	
AUB	
BBH	
BNL	
FRA	not used
FRC	
FRS	
PAA	NOT USED
PAC	
PAS	
OCA	NOT USED
OCC	
OCS	
FOL	
FOB	
BPL	

CRANIAL FACE METRICS (mm):

M48		
NPL		
FMB		
NAS		
DKB		
OBH		
OBB		
ZYB		
NLH		
NLB		
ZMB		
ZMS		
MAL		
MAB		
PAB	NOT USED	
PAL	NOT USED	
EKB		

MANDIBULAR METRICS (mm):
(NOT USED/TAKEN)

GO <		
BGB		
TLEN		
COLE		
BM		
M1/2 H		
M1/2 B		
RH		
RB		
BCB		

Individual: ____________________

Sex: __________

FIGURE 4.3 - CRANIAL METRICS SHEET

COMPUTERIZED SEX CLASSIFICATION

One of the problems with sex assessments from cranial information alone is that they are not 100% reliable. In fact, probably 10-20% of all assessments will be in error using visual methods (Krogman 1962:112-113, White and Folkens 1991:320). As a consequence, the formula used to make sex assessments allows for those that fall clearly into the male (computer scoring = 1) range as well as those that fall clearly into the female (computer scoring = 2) range. The remainder are indeterminant, and do not clearly score as either sex (computer scoring = 0).

The sex assessment was not a critical issue for computer runs comparing whole populations. For example, if I ran an analysis comparing the Norman sample as a whole against the entire samples from Westman and Eastman, the sex distinction was immaterial, as the group/region identification was the main codifying factor. However, if I wished to compare these three groups by sex, then obviously the assessments were more important.

When it became apparent that a sizeable number (in the neighbourhood of 15%) of my whole sample was scoring in the indeterminant range, I decided to use a multivariate sex assessment approach. Giles and Elliot (1963:53-68) pioneered the use of discriminant analysis to determine the sex of "unknown" skulls. The use of their, or a related methodology, is recommended by Shipman et al (1985:274) and Steele and Bramblett (1988:54-55). The latter authors, however, offer a strong caution:

> "Such samples ... do not reflect the variance that one might find in archaeological materials or at other geographical locations. Therefore, the discriminant functions will most accurately predict the gender of unknown individuals from the same population from which the study sample was drawn. How well they can predict the gender of individuals from a different population depends upon how close the anatomy of the study population is to the second population. The procedure is useful enough to be of general value, but direct observation should always

supplement discriminant function determinations."

Their results are supported by the findings of Meindl et al (1985:79) who used discriminant functions and had a 5-10% error rate in blind sex assessments of crania of documented gender.

Following the recommendation of Steele and Bramblett (1988:54-55) I realized that the procedure would be most reliable if sex assessments were made within clearly defined populations. However, since I did not have clearly defined populations, this was impossible. Therefore, I entered all my data, including cases from the comparative samples I had assembled, into the program as a single group. Since the prime discriminators of sex in the skull are size related (Brothwell 1972:51, Meindl et al 1985:79-80), I felt there was a reasonable chance the program would work successfully, especially if there were many "known" cases (Tabachnick and Fidell 1989:544-545). Further, by using the whole sample, I felt the characteristics of sex would be emphasized and the characteristics of population de-emphasized.

To do the computerized sex assessments I chose the BMDP CLASSIFICATION program, specifically the jackknife procedure (Dixon 1985). This procedure minimizes the bias that can enter a classification if the coefficients used to assign a case to a group are derived, in part, from that case (Tabachnick and Fidell 1989:545). Therefore, the data from the case are left out when the coefficients used to assign it to a group are computed (Tabachnick and Fidell 1989:545).

A priori membership in two groups was specified, as most cases had been scored as male or female. A third group, the unknowns, was entered and the program was asked to classify the unknowns as either males or females. With just two groups the classification procedure had to be at least 50% successful, although, of course, I was hoping for 100%.

The following is a list of the individuals sexed by the BMDP Classification procedure:

TABLE 4.1. RE-CLASSIFICATION OF CASES BY SEX.		
ID. #	NAME	RE-CLASSIFICATION
#24	Ericsdale-2	classified as (2) Female.
#37	Moores Mound-B2	classified as (1) Male.
#41	HDM-30-1	classified as (1) Male.
#43	HDM-39-6	classified as (1) Male.
#44	HDM-47-1	classified as (1) Male.
#68	HDM-30-3	classified as (2) Female.
#69	Warner Mound-1	classified as (1) Male.
#71	Fiddler-16	classified as (1) Male.
#75	Wiebe-A0418	classified as (1) Male.
#76	Selkirk	classified as (1) Male.
#77	Red River-1	classified as (2) Female.
#79	Warner Mound-2	classified as (2) Female.
#88	Starbuck	classified as (2) Female.

#94	Minaki	classified as (1) Male.
#101	Cemetery Point-90-2	classified as (2) Female.
#102	Caddy Lake-1	classified as (2) Female.
#114	Hungry-Hall-94	classified as (1) Male.
#117	Hungry-Hall-S10	classified as (1) Male.
#122	Hungry-Hall-S34	classified as (1) Male.

The classification procedure assigned all cases to one of the two groups (sexes) specified. In addition to the classification of unknowns, the procedure also indicated the success rate of the assignation of males to the male group and females to the female group. The results suggested that some of the specimens had been inaccurately sexed by the visual cranial and post-cranial methods used. With each of these assessments came a percent chance of a specimen being of the opposite sex.

I looked at these cases very closely, being aware of the inadequacies of the cranial sexing method. The cases indicated as possible mis-classifications, however, did not display a high enough probability of being in error for me to make any changes. I felt that there was a certain accuracy (unmeasurable) to a sex identification if I had looked at a specimen and made an assessment. When the classification procedure indicated that there was a 74% or less chance that my assessment was wrong, this did not strike me as being strong enough to make a change. At 75% or greater probability, I probably would have changed my assessment, depending on the certainty of my initial impression. Overall, I would rate the classification as being very successful. Of the 285 cases entered, 19 unknowns were classified with a good percentage chance of being correct (75%+), and only four still remained as unknowns, i.e. the probability of being either sex was between 25% - 75%. In addition, only seven cases of known sex were identified as being mis-classified as the wrong sex, and none of these were strongly mis-identified, in terms od percent chance. I did not change the sex on any of these specimens.

CRANIAL MEASUREMENT

Each complete skull was assessed using a standard battery of 33 measurements. These measurements covered the most important dimensions of length, breadth and height of both the vault and the face. They also assessed the shape of the skull in a number of places. The 33 measurements taken were selected from a list of many possible measurements and indices that could have been used. For example, both Key (1983:40) and Heathcote (1986:53) used a total of 80 measurements and indices in their assessments of the affinities of Plains Natives in North America and Eskaleutian Natives of the Arctic respectively. They did not, however, use the same 80 variables. In fact, Heathcote (1986:53) states that "61% (of his measurements) are less-conventional or individualistic".

Both of the above authors acknowledged that they used Howells (1973) monograph as a basic starting point for their conventional craniofacial measurements. Howells' monograph also provides the starting point for the set of measurements used here. However, while he defined a set of 57 measurements, I have used a set of only 33, 28 of which come from Howells. I took an additional 5 measurements which were derived from other sources (Martin and Saller 1957, Brothwell 1972).

The measurements that were selected were chosen for several reasons, the most important being that they were commonly used in cranial studies (Broste and Jorgensen

1956, Howells 1966, 1973, Key 1983, Heathcote 1986), particularly those in which a restricted list of measurements was taken (Brothwell and Krzanowski 1974, Brothwell 1981, Petersen 1988). These measurements are those most likely to be taken and published by researchers, and this would allow for more compatibility of data sets and, therefore, comparisons between groups. The selection of variables was heavily weighted by the set of measurements taken for previous work in this province and in Europe (Wyman 1993). Second, since some of my recent work has been with European specimens (Jacobs et al 1997) I collected a data set which would be compatible with both American and European data. This also accounts for the appearance of "European" measurements in an essentially "North American" scheme. Third, some measurements were collected because of their significance, by my assessment. Fourth, and important, is the fact that every variable added to the list increases the probability of having to drop specimens from the analysis due to incompleteness. Therefore, restricting variables is a way in which sample sizes can be maximized.

In my experience (Wyman 1993, Jacobs et al 1997), adding additional measurements or variables beyond a certain number does not necessarily increase the sensitivity of the analysis. In fact, Brothwell and Krzanowski (1974:250) demonstrated that significant results could be achieved in craniometric analysis using only 11 measurements. Other studies have been conducted with less than 40 craniofacial variables. As examples, Pietrusewsky (1974) used 13 cranial variables in his study of Neolithic and modern populations from Southeast Asia; Pietrusewsky (1984:55, 1990) used 36 measurements (from both Howells and Martin) in his assessment of Australian aboriginal and Australasian populations; Hausman (1982:320) used 37 variables in his assessment of Khoisan populations; Sjovold (1984:227-228) used 29 variables (mainly calculated) in his study of the skulls from Hallstatt, Austria; Lubell et al (1984:158) used

28 variables in their evaluation of North African Epipalaeolithic crania; Rothhammer and Silva (1990) used only 7 craniofacial variables in their study of South American prehistoric populations; Sciulli (1990) used 13 craniometric traits in his analysis of the remains from the Duff Site in Ohio; Brace et al (1989) collected data for 18 variables in their study of the descent of Asian groups and Brace and Hunt (1990) used 24 variables in their analysis of cranial variation world wide.

Beyond a point, only slight improvements can be gained from the addition of more variables (Tabachnick and Fidell 1989:13). Indeed, overfitting, a form of a false positive result, can be a drawback to using too many variables, relative to the total sample size (Tabachnick and Fidell 1989:13). Van Vark (1976) also argues against using too many variables, as does Stevens (1986:187):

> "If a large number of dependant variables are included without any strong rationale...then small or negligible differences on most of them may obscure a real difference(s) on a few of them"

As a general rule, multivariate analyses should use a number of variables less than the sample sizes used in the analysis (Oxnard 1978 cited in Heathcote 1986:159).

Figure 4.1 is a sample recording sheet for vault and face metric measurements. All of the measurements, along with the gender, name of the specimen and a series of codes that would allow for the grouping of specimens, were entered into the mainframe UNIX computer at the University of Winnipeg. Each individual was included in three basic files, if possible, a file of vault measurements, a file of face measurements and a file of combined vault/face measurements.

Unfortunately, not all specimens ended up in all three files. Many of the cases used in the analysis were cranial vault remains with no facial bones remaining. A few specimens were faces only with none of the vault bones remaining. Specimens with both complete face and vault metrics were added to the "total" datasets. Thus, the "total" dataset had the least number of individuals, as specimens with only vault or only face metrics had to be eliminated from this file. In summation, only those crania that had both complete face and vault metrics could be added to all three files.

A total of 286 cases[3] were entered into the vault database. Of these, 143 were the primary cases used in this analysis, while the remaining 143 were the comparative cases from the surrounding region (n=134) and "control" cases (Caucasian specimens). Only 196 individuals[4] had facial metrics entered in the database. The reduction of 90 cases was due to the number of remains that were vaults only. Of the 196 faces, only[5] 4 did not have a vault as well. In other words, the face database had 196 cases, 192 of which were associated with a vault - i.e. a complete cranium. The "total" dataset therefore, comprising individuals with a full set of vault and face metrics, totalled 192. Of these, 111 were from my primary sample, while the remaining 81 were from the comparative sample.

DELETIONS FROM THE ANALYSIS

The total primary sample of 143 crania mentioned above does not constitute all of the specimens I assessed during this project. Initially, after all of the data had been entered into the computer, a few cases had to be dropped from the analysis. Each individual was supposed to be represented by 37 variables, but, due to the nature of archaeological samples, many had been broken or damaged. Thus, not all of the measurements could be taken on all of the crania.

I measured all specimens that were reasonably complete adults, even some that were obviously damaged. I did not measure crania that clearly would not yield at least 20

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[3] Cases with measurable vaults = 286 = Cranial data base

[4] Cases with measurable vaults and measurable faces = 192 = Total data base

[5] Cases with measurable faces but not measurable vaults = 4 = Not used in the analysis.

measurements overall, or at least 15 from either the vault or face. Specimens with less than 30 measurements overall, or with less than 15 measurements individually from the vault or the face had to be dropped from the analysis. Other damaged specimens yielded a partial set of measurements in the hopes that missing elements might turn up in a different museum collection in the future. When this did not happen, they too had to be dropped from the analysis. Specimens in the latter category included:

HDM-31-19 (Pilot Mound)
HDM-47-156 (Sourisford)
HDM-39-3 (Darlingford)
HDM-40-2 (Darlingford)
Hilton-A (Hilton)
Beausejour (Beausejour)
HDM-41-5 (Darlingford ?)
Woodlands (R.M. of Woodlands)
Star Mound 10 (Star Mound).

ESTIMATION OF MISSING VARIABLES

For crania displaying minor damage in which only a few measurements were not possible, the appropriate BMDP missing variables program was used (Dixon 1985). This program uses a multivariate routine in which missing variables in one case are estimated from all of the remaining cases in a population. In the case of the estimate of missing variables I was more concerned with retaining a feeling of "population" than was the case in estimating sex. Therefore, the sample was divided into initial "populations" based upon a physiographic scheme (the details and rationale of this are outlined in chapter 3). Specimens with missing values were grouped only with specimens of the same gender from the same region. The computer program then estimated missing variables within each of these smaller regional groupings. In no case did estimated measurements make up more than 20% of the values for any single case.

In fact, a large number of specimens had to have at least one variable estimated, attesting to the fact that relatively few completely intact crania are recovered from archaeological sites. The list of specimens and their estimated values are too large to fit into the body of this report, but it can be seen in Appendix E. It should be pointed out that the estimation of missing values was undertaken primarily because both the SAS and SPSS computer programs that were used for multivariate analysis require that the data be integral, with no missing values. To perform the multivariate analysis, it was necessary to either drop the majority of cases from my sample, or estimate some values and retain the bulk of the sample in the analysis.

UNIVARIATE ANALYSIS

Both the vault data set and the total data set were assessed by univariate statistics. The group means, standard deviations and other summary statistics were calculated for all 15 groups used in the analysis (5 groups from Dr. P. Key (1983), 3 from Ms S. Myster (nd), 1 "control" group and 6 primary groups. These results can be seen in full in Appendix C. A brief summary is presented in table 4.2. This table shows the means of the first five variables for each group from the cranial data set. It can be seen that there is a degree of difference between the groups, as evidenced from the minimum and maximum values for the means of each variable. The variability is evident despite the fact that the use of mean scores tends to smooth out or reduce apparent differences between groups. The full range of variability within the groups, as shown by the standard deviations, minimum and maximum values, can be seen in Appendix C.

The variability of the samples was further assessed by the calculation of coefficients of variation (sd/mean) for each group, by variable (Blalock 1979:84). The resulting coefficients were uniformly low, suggesting that all of the samples had at least a degree of internal consistency (Blalock 1979:84).

A Duncan multiple range test was used to ascertain whether or not significant differences existed between the groups used in the analysis (SAS Institute 1985:117). This procedure compares the means of variables by groups identified in the data and assesses if they are significantly different (at the .05 level)(Dowdy and Wearden 1991:306-307). The discovery of such significant differences suggests that the use of more sophisticated multivariate analyses is warranted and likely to be fruitful. The Duncan procedure for the cranial sample used the means of 18 variables, by group, and the procedure for the cranio-facial sample used 34 variables, by group.

TABLE 4.2 MEANS OF SAMPLE VARIABLES BYGROUP

GROUP	NO	GOL	XCB	WFB	XFB	STB
DLS	10	184	140	92	113	104
N. ARVILLA	15	180	140	88	117	96
BLACKDUCK	20	183	140	94	116	110
LAUREL	6	179	146	96	122	109
NORMAN	15	185	144	97	117	107
MANDAN	34	181	137	91	112	108
PARKLAND	11	183	144	96	118	104
CAUCASIAN	5	182	145	98	123	117

SIOUX	15	177	141	92	114	108
WESTMAN	51	182	139	94	116	103
RED RIVER	21	180	141	93	116	105
EASTMAN	27	182	140	95	114	106
HUNGRY HALL	18	183	145	96	118	106
S. ARVILLA	22	182	139	89	113	103
SONOTA	12	185	142	92	115	106
MIN X FOR VAR		177	137	88	112	96
MAX X FOR VAR		185	146	98	123	117

In terms of the cranial data, the Duncan test detected numerous significant differences between the groups used in the analysis. In fact, only the means of two variables, PAS and FOL, did not show significant differences between at least two of the groups entered. All other 19 cranial variables showed significant divergence between at least two groups. For many of the variables the test indicated that one or two groups were significantly different from all of the other groups. The groups most frequently identified as being significantly different were Sioux, Northern Ontario, Caucasian, Norman and Blackduck. This suggests that these groups will be less likely to cluster with the others during the multivariate analyses.

In the total sample, the Duncan procedure indicated that significant differences existed between groups in regard to 30 variables. Only the variables GOL, PAC, PAS and FOL did not vary significantly between at least two groups. The groups most frequently identified as being significantly different were: Mandan, Caucasian, Laurel and Arvilla, suggesting that these groups may not cluster frequently with other groups in the total sample.

Overall, the Duncan Multiple Range Test suggested that the groups used in both the cranial and total analyses were significantly different from one another. The multivariate methodologies used here should indicate which groups are the most distinct, and which groups cannot easily be distinguished from one another.

CHAPTER 5

RESULTS

As discussed in chapter 5, both the vault and total data sets were assessed by univariate statistics. The group means, standard deviations and other summary statistics were calculated for all 16 groups used in the analysis (Appendix C). The variability of the samples was further assessed by the calculation of coefficients of variation, and a Duncan multiple range test was used to ascertain whether or not significant differences existed between the groups used in the analysis. Overall, a considerable amount of between group variation was evident, with significant differences between group means apparent. On the other hand, the samples had at least a degree of internal consistency, as assessed by the coefficients of variation (Blalock 1979:84).

The remaining and primary analyses used in this project are multivariate in nature. The advantage of multivariate programs is that they simultaneously account for all individuals (cases) and all of the variables used in any particular analysis or run. Any change in the data inputted will affect the result of the run. For example, if a run has 100 cases inputted, the plot of these cases will be 100 points arranged in a particular pattern (hopefully clusters) which reflects the program's interpretation of the nature of the relationships between all of the cases. If one case is removed, and the rest run, the resulting plot will be somewhat different from the previous one. Not only is there one case less in the analysis, but the program now evaluates the nature of the relationship between the 99 remaining cases. Depending on the "weight" or importance of the one case that was dropped, the output may be significantly altered.

In some of the runs discussed below, cases were dropped from the analysis. The programs would interpret and plot the relationships between all of the individuals remaining in each run. For example, once I had seen how the programs interpreted the relationships between all of the cases, I would drop the individuals from North/South Dakota sites to see how the programs would interpret the relationships between the remaining individuals. The specimens could be grouped in a variety of ways, but I endeavoured to make the divisions used sensible and pointed towards particular questions that I wanted to address.

A total of 40 principal components and canonical discriminant analyses are discussed here. Some of these runs were conducted on the cranial vault data base, while others used the total (vault and face measurements) data set. The cranial data base, which included all specimens that were vaults only, maximized the number of cases available for analysis. The total data base was selected to maximize the number of cranio-facial variables available. The face data only, in that it was neither the largest in cases nor the largest in variables, was not analysed separately.

The legend of each plot indicates which (VAULT or TOTAL) data base was used. The vault data base has a greater number of individuals and more groups than the total data base. Some of the comparison groups do not appear in the total data base because they were not represented by enough cases.

A full listing of the computer runs can be seen in Appendix D. To summarize, though, analyses (and plots) are defined by the method (program) and data base used. Thus, a run will have used either the canonical discriminant or principal components program. Runs 1-8 are PCA procedures, and will have been based either on the vault or total data sets. Runs 9-16 are canonical discriminant, but plot only the means of groups, rather than individual cases. Because there are fewer points to these latter plots, I elected to use a three dimensional plot, in which can 3 (the third canonical variate) could be shown. This variate runs vertically off the page, while can 1 and can 2 occupy the "x" and "y" axes respectively.

Unfortunately, this plotting method proved ineffective for runs with many cases on the scatterplot, as individual points were largely obscured. Therefore, runs 17-40, all canonical discriminant runs, were portrayed on a two dimensional plot, of can 1 and can 2 only.

PLOTTING RESULTS

Most of the computer runs produced scatterplots as output. These can be interpreted in two ways. First, did the program separate or cluster the individuals from one group sufficiently apart from those of other groups that it was apparent that these individuals/groups were dissimilar from most of the other cases? This would be interpreted as an indication of dissimilarity and assumed genetic distance between groups. Alternately, did the individuals from one group overlap sufficiently with individuals from another group that the computer was unable to distinguish between them? This would be interpreted as a strong indication of genetic similarity between the two groups.

Beyond this, however, the positioning of each group on a scatterplot also reveals information. If the means of two groups fall close together, and the distributions of the individual cases overlap, this indicates a measure of similarity between them. Likewise, groups which fall far apart on plots are less similar. All groups whose means do not overlap (using a 95% confidence interval) are statistically significantly different from one another. There are degrees of difference, though, and the canonical discriminant routine attempts to portray these in the plot.

Most of the canonical discriminant scatterplots display 95% confidence intervals for the groups (group means) used in a particular analysis. I considered groups to have clustered together when the confidence intervals for their means overlapped, regardless of the dispersion of their particular cases (see section on confidence intervals in chapter 4). In such a case, the computer is essentially unable to distinguish between the groups.

An interesting situation occurred when the confidence interval for one group, (group A), overlapped with that of another (group B) and that, in turn, overlapped with a third (group C). From a statistical perspective, all of these groups have clustered, even if group A did not overlap with group C. The assumption here would be that if the program could not distinguish between A and B, or between B and C, then it could not effectively distinguish between A and C.

From an alternate perspective, though, it must be noted that the mean of Group A did not, in fact, overlap with the mean of Group C. They both overlapped with Group B. Without the presence of Group B, Groups A and C would have been discrete clusters. This type of situation may be the result of variation between groups which was more clinal than discrete. If there was gene flow in space, and isolation between groups occurred primarily as an effect of distance, adjacent groups would be more similar than distant ones.

The concept of isolation by distance is an important one, and is very pertinent to the results shown here. For the purposes of summarising all of the overlaps between all of the groups, though, the statistical model (A=B, B=C, A=C) mentioned above will be followed. The results were varied enough that it was not always groups A-B-C, in geographical proximity to one another, that overlapped. The groups that overlapped in larger clusters were diverse, and ignoring statistical overlapping would possibly have meant overlooking significant information.

The runs were all done in groups of three. For example, runs 1.1 to 1.3 constitute a unit or group. For each group of three, the .1 suffix indicates that the plot represents the total cases from that run (both sexes), the .2 suffix indicates a plot of only the males from the run and the .3 suffix indicates a plot of only the females from the run.

Since the overall focus of the dissertation is on the differences and similarities between defined groups, the runs ending in .1, including both sexes, are emphasized in this results section. By looking at both sexes combined, some information may be obscured, particularly that which is sex-based. However, inclusion of both sexes allowed for greater sample sizes and better results overall. The individual sex information shows up in the runs that deal with the sexes separately.

The results for the individual male and female runs were assessed, and these are discussed in a separate section below. However, not all of the sex-specific plots are shown here, due to space limitations. If, in a set of runs, there were significant differences in terms of how the males and females grouped, these differences will be pointed out. I paid particular attention to runs in which two groups clustered for one sex but not for the other. Such cases might indicate factors such as inter-marriage between groups.

RESULTS OF RUNS INCLUDING BOTH SEXES

PRINCIPAL COMPONENTS ANALYSIS

Run 1 (Fig. 5.1) was the principal components analysis of the vault data base. This run includes all of the Manitoba cases, as well as all of the comparative samples. This initial run was conducted to assess whether any obvious clusters emerged using the principal components procedure. In fact, an appraisal of Fig. 5.1 demonstrates no clear clusters, although a division along sex lines is apparent (note that males are indicated by capital letters while females are represented by lower-case letters). Most of the females are located on the left side and slightly to the bottom of the centre of the plot while most of the males are on the right and to the top of the centre.

Likewise, no clusters other than sex emerge in Fig. 5.2, the principal components analysis of the Manitoba vaults, not including any comparative cases. Nor do clusters appear in Fig.. 5.3 or Fig. 5.4, in which the Manitoba cases are joined selectively by those from northwest Ontario and Minnesota (Fig. 5.3) and from North Dakota (primarily) respectively.

The next 4 runs (Figs 5.5 - 5.8) were principal components analyses of the total data set. As such, they utilized approximately twice as many variables as the cranial data. However, the results of these total runs do not differ markedly from the cranial runs. Fig. 5.5 (Run 5.1) shows all of the cases from the total data set (smaller in both number of cases and number of groups than the cranial sample). The sexes are more clearly distinguished along PRIN 1 than they were in the cranial sample, with nearly all of the females falling on the left side of the plot. Other than this size related sorting, the individual cases are well scattered, with no apparent clusters. Essentially the same results are seen in Fig. 5.6 (Run 6.1), showing Manitoba cases only, Fig. 5.7 (Run 7.1) showing Manitoba/ northwest Ontario/Minnesota cases and Fig 5.8 (Run 8.1) showing Manitoba/North Dakota cases.

CANONICAL DISCRIMINANT ANALYSIS

The next sixteen analyses (Figures 5.9 to 5.24) all use the canonical discriminant procedure. The first eight of these plots (Figures 5.9 to 5.16) show only the means of the groups used in each analysis, as opposed to showing the position of each individual case. Because these plots are portrayed from an angled view, it was not possible to accurately place the 95% confidence interval circles on them. However, they do allow for a rapid appraisal of the basic similarities and dissimilarities between groups, with the advantage of displaying the third dimension of CAN 3 coming vertically off the page.

These runs are duplicated in Figures 5.17 to 5.24, but as scatterplots of individual points, with the 95% confidence intervals displayed.

VAULT DATA

Figures 5.9 (Run 9.1) and 5.17 (run 17.1) show the means/distributions of all of the groups appearing in the cranial data set, in two different formats. Figure 5.9 suggests that there is a relatively large cluster of groups near the centre of the plot, surrounded by a number of outlying groups. Figure 5.17, though, shows that there are actually two large clusters apparent. The first of these is a tight cluster comprised of four groups, the Westman, Red River and Parkland samples from Manitoba and the Hungry Hall group from Ontario. The second cluster is somewhat more diffuse, but is linked by interlocking confidence intervals. This cluster contains the Sonota, DLS and South Arvilla groups from North/South Dakota together with the Eastman sample from Manitoba. The most obvious outliers are the Caucasian, Arvilla and Mandan samples. Somewhat surprisingly, the means of the Sioux and Blackduck groups overlapped on Fig. 5.17, although they differ along can 3, as seen in Fig. 5.9.

Figures 5.10 (run 10.1) and 5.18 (run 18.1) display the means/distributions of only the Manitoba groups. No groups overlap, and although Fig. 5.18 suggests that the Red River sample is similar the Westman group, they are very different along can 3, as seen in Fig. 5.10.

Figures 5.11 (run 11.1) and 5.19 (run 19.1) show all of the Manitoba groups together with the comparative samples from northwest Ontario and Minnesota only. Figure 5.11 suggests that the Westman, Red River, Parkland and Eastman samples from Manitoba are similar in all three dimensions shown on the plot. In Figure 5.19, however, it can be seen that actually only the means of the Westman and Red River samples overlap, and the others remain singular, although close on the plot. None of the other groups overlap, although it can be noted that the Blackduck and Hungry Hall groups are quite similar along all three axes. The Arvilla sample is a clear outlier on this run, and the Norman sample lies at a greater distance from the other Manitoba groups than they are from each other.

Figures 5.12 (run 12.1) and 5.20 (run 20.1) portray the plots of all of the Manitoba samples together with the samples from North and South Dakota. Figure 5.20 shows that there are two main clusters each formed by the overlapping confidence intervals of four groups. One cluster contains the Manitoba samples from the Westman, Red River valley, Parkland and Norman regions. It should be noted, though, that the sample from the Norman region differs considerably from the others along can 3, as can be seen in Fig. 5.12. The other cluster contains most of the cases from the United States, specifically the Sioux, Sonota, S. Arvilla and DLS groups. In this case, the S. Arvilla group differs from the others along can 3 (Fig. 5.12). The Manitoba Eastman group and the Mandan sample are outliers in these plots.

TOTAL DATA

Figures 5.13 to 5.16 and 5.21 to 5.24 all refer to runs (runs 13.1 to 16.1 and 21.1 to 24.1) conducted on the total data set. As such, the number of groups and cases is reduced from that seen in the runs conducted on the cranial data set. Figure 5.13 (run 13.1) demonstrates that there is a cluster of groups, comprised of the Westman, Red River, Parkland, Eastman and Norman samples from Manitoba, and the North Arvilla sample, all of which appear similar on all three canonical axes. However, closer appraisal, on Figure 5.21, shows that only the Westman, Norman and Red River samples overlap in their confidence intervals, although the Parkland sample lies close by. No other groups overlap with one another on these plots, but the Caucasian, Hungry Hall and Laurel groups are all outliers.

Figures 5.14 (run 14.1) and 5.22 (run 22.1) plot the means/distributions of the Manitoba samples only, from the total data set. None of the group means overlap, which mirrors the result from these groups from the cranial runs. The Westman and Red River groups plot close to one another, and this is consistent with earlier results in which the groups appear to be similar. The Norman group is an outlier in this plot and seems to be dissimilar from the other Manitoba samples in these runs.

Figures 5.15 (run 15.1) and 5.23 (run 23.1) plot the means/distributions of the Manitoba samples together with those from the Minnesota and northwest Ontario regions, using the total data set. The Parkland, Red River and Eastman groups appear to be similar on all three axes (Fig. 5.15) but their means do not overlap (Fig. 5.23). The Laurel group is a clear outlier, as is the Arvilla sample.

A similar pattern emerges from runs 16.1 (Fig. 5.16) and 24.1 (Fig. 5.24), conducted on the Manitoba and North/South Dakota groups, using the total data set. None of the groups appear to be very similar in Fig. 5.16, and although most of the Manitoba samples fall close to one another in Fig. 5.24, none of the group means overlap. The Sonota and Mandan samples fall close to one another, but are well apart from the Manitoba case. Again, it can be noted that the Norman sample is a clear outlier, along the can 3 axis, from the other Manitoba groups.

FURTHER CANONICAL DISCRIMINANT ANALYSES

In the principal components analysis (Figures 5.1-5.8) the Westman individuals showed a great degree of dispersion in the scatterplots. This dispersion, coupled with the large number of cases in this group, strongly influences the positioning of all of the groups in a plot. Therefore, I conducted several runs in which this group was deleted, to see how the others reacted in the absence of the Westman cases.

Figure 5.25 (run 25.1) shows the plot of all of the other groups, based on the vault data set. Two large clusters emerged; the first being comprised of the Parkland and Red River samples together with the Hungry Hall, Blackduck and Sioux groups. The placement of the Sioux group in this cluster is unexpected, given earlier results, and may be noteworthy if these results are duplicated in other runs. The other is a more linear cluster, comprised of the Eastman group together with the Sonota, South Arvilla and DLS groups. This second cluster is really linked by the mean of the Sonota group, and may have resulted from the large confidence circle representing this group. Likewise, the overlap between the Caucasian group and the Laurel sample is likely an artifact of the small sample size, and large confidence interval, of the Caucasian group. Overall, the Caucasian group is an outlier on this plot, along with the N. Arvilla and Mandan samples.

Figure 5.26 (run 26.1) shows the plot of the four remaining Manitoban groups, after the removal of the Westman sample. It can be seen that the four groups do not overlap, and are generally evenly spaced from one another. Although the Eastman (F) sample appears to be somewhat of an outlier this is not the case. The Eastman group is actually closer to the Red River (E) group than the Norman (A) sample is.

Figure 5.27 (run 27.1) shows the plot of the remaining Manitoba groups together with the Minnesota and northern Ontario cases. The means of the Red River and Parkland samples overlap on this plot, this conjunction partly due the removal of the Westman sample. In Figure 5.19 (run 19.1), the same analysis including the Westman group, the Westman and Red River samples overlapped, but this cluster did not included the Parkland group. A second cluster appears in Figure 5.27, formed between the Blackduck and Hungry Hall groups. The Arvilla sample is a clear outlier on this plot.

Figure 5.28 (run 28.1) shows the plot of the remaining Manitoba groups together with the groups from North/South Dakota. One large cluster contains the DLS, S. Arvilla and Sonota groups while a second, smaller, cluster contains the Norman and Red River Manitoba samples. The placement of the Norman group is unusual here, as it rarely clusters with other Manitoba samples. The Mandan group is an outlier on this plot.

Figures 5.29 to 5.32 plot the vault results of all the cases, with a focus on the Devil's-Lake Sourisford group. Cases from DLS sites in Manitoba were combined with the DLS cases from North Dakota to make a new DLS group. This new combination required modifications to the Westman, Red River and Parkland Manitoban groups, as cases were removed from each and added to the new DLS sample.

The plot of all groups can be seen in Figure 5.29 (run 29.1). In this plot, five different clusters appear. The clustering of the S. Arvilla and Sonota groups, the Norman and Parkland groups and the Eastman, Hungry Hall and Blackduck groups are not unexpected. However, the fact that the means of the new DLS group (R) and the Sioux group (I) are virtually identical is interesting. In fact the confidence interval for the DLS sample falls entirely within the confidence interval for the Sioux group. This may indicate a strong connection between the two.

Despite the removal of many cases, the remaining Westman sample still overlaps with the Red River group. The Caucasian, N. Arvilla and Mandan samples are all outliers on this plot.

When only Manitoba cases are used (Fig. 5.30) the mean of the new DLS sample overlaps with the mean of the Red River group, while the remaining Westman cases fall very close by. Otherwise the positions of the samples are similar to where they were located in Figures 5.22 and 5.26.

When cases from Minnesota and northwest Ontario are returned to the analysis

(Fig. 5.31) the means of the new DLS and Red River samples again overlap. A second cluster appears here, consisting of the Norman, Eastman and Parkland groups from Manitoba. As is common, the N. Arvilla group is an outlier.

Figure 5.32 plots the result when the North/South Dakota cases are returned to the analysis (and the Minnesota/Ontario cases are dropped). The new DLS group does not overlap with the Red River group, as it did in Figures 5.30 and 5.31 but neither does it cluster with the Sioux group, as seen in Figure 5.29. However, the remaining Westman cases cluster with the Red River valley group, the Norman and Parkland groups cluster together and the means of the Sonota and S. Arvilla samples overlap with one another. The Mandan group is an outlier in this plot.

Figures 5.33 to 5.36 plot the vault results of all the cases, with a focus on the Sourisford location. This is the most prominent Manitoba "site" (actually a number of related sites), in terms of the number of specimens recovered. Cases from the Sourisford location were removed from the Westman group, in order to make the new Sourisford group. This redistribution of cases required modifications only to the Westman sample.

The first run (run 33.1), including all groups, produced two clusters, including one very large grouping (Figure 5.33). This cluster included the Sourisford group along with the Eastman, Blackduck, Sioux, S. Arvilla, Sonota and DLS groups. The smaller second cluster contains the Parkland and Red River specimens. The fact that so many group means overlap to form the main cluster is surprising, especially given that many of these groups have not overlapped with one another in any of the previous runs.

The second, smaller, cluster is formed by the Parkland and Red River groups, with the mean of the remaining Westman cases falling very close by. The North Arvilla, Laurel and Mandan groups are all outliers in this analysis.

Figure 5.34 (run 34.1) plots the new Sourisford group in comparison with the rest of the Manitoba specimens. The mean of the Sourisford sample overlaps with the mean of the Red River valley sample. This is inconsistent with the result of the previous run (Fig. 5.33) in which the Red River sample was one of the few that did not overlap with the Sourisford group.

In Figure 5.35 (run 35.1) the Manitoba specimens are plotted against those from Minnesota and northwest Ontario. One large cluster forms, containing the Sourisford specimens along with the Red River valley and Parkland groups. The Eastman and Blackduck means fall close to this cluster, while the Norman and N. Arvilla groups plot as outliers.

Figure 5.36 (run 36.1) plots the Manitoba cases along with the groups from North and South Dakota. Two main clusters appear, one containing the Sioux, Sonota, S. Arvilla and DLS cases, and the other comprised of the Parkland, Red River and Westman groups. The Sourisford group does not cluster with any other sample, but falls in a position intermediate between the Manitoba and North Dakota cases. The Norman and Mandan groups are outliers in this run.

A final redistribution was made, in which individuals were drawn out of the Westman sample and assigned to two new groups, based on whether they came from the North Antler or South Antler Creek locations. The individuals from these two areas have been plotted separately in order to see if they are significantly different from one another.

The result of the first of the runs involving these locations can be seen in Figure 5.37 (run 37.1). As in previous runs on the same data (Figures 5.17, 5.25, 5.29, 5.33) two large clusters appear. One contains all of the North Dakota groups (except the Mandan), the Blackduck and the Eastman samples, while the other is comprised of the Parkland, Red River, Westman and Laurel groups. What is noteworthy is that the North Antler group is attached to this latter cluster while the South Antler group is attached to the former cluster. This suggests that there may be some differences in the specimens from these two locations. As usual, the Mandan and N. Arvilla samples are outliers.

Figure 5.38 (run 38.1) portrays the Antler Creek locations plotted with the other Manitoba groups. The North Antler group mean overlaps with the mean of the Westman group that it was initially derived from. The South Antler group, on the other hand, does not cluster with, or even fall particularly close to, any other group. This again suggests that there are differences in the specimens from these two locations.

Figure 5.39 (run 39.1) includes all of the Manitoba groups together with the Minnesota and Ontario samples. Again, the North and South Antler means fall well apart from one another, but in this instance neither overlap with any of the other groups. In this run, the Westman, Red River and Parkland groups cluster together. The Norman and N. Arvilla samples are outliers.

When the Minnesota and Ontario groups are dropped and the North/South Dakota groups are added (Figure 5.40), two clusters appear. The first is a large linear cluster containing all of the Manitoba cases and the North Antler group, and the second has all of the North/South Dakota groups, minus the Mandan. The South Antler group does not cluster with any of the others, but falls closer to the Manitoba samples.

Information about the relationships between these groups is conveyed in each of the above forty plots. But, it is sometimes contradictory, and it is difficult to get a sense of patterns emerging from this large mass of information. As a method of summarizing the results, I tabulated the number of occasions in which each group clustered with each other group, throughout the whole set of runs. This count was undertaken in order to get a relative measure of similarity between all of the groups.

Of the Manitoba samples, the Red River (E) group clustered most frequently (29 occasions) with the other samples (considering multiple overlaps as separate clusters between each group in a large cluster). It commonly grouped with the Parkland (B) (10 occasions) and Westman (D)(10 occasions) samples, but only infrequently with the Norman (A)(3 occasions) and Eastman (F) samples (1 occasion).

The Parkland group clustered twenty-seven times, frequently with the Red River (E) (10 occasions) and Westman (6 occasions) groups, and less frequently with the Norman (4 times) and Eastman (2 times) samples. Overall, the Westman group clustered relatively frequently (21 times), especially with the Red River (10 occasions) and Parkland (6 occasions) samples, but only once and twice with the Eastman and Norman groups respectively.

The Norman group clustered on just ten occasions, and only with other Manitoba groups (Parkland - 4 times, Red River - 3, Westman - 2 and Eastman - 1). This is consistent with the fact that the Norman group was occasionally an outlier in this series of plots. It seems clear that this group is not as similar to most of the Other Manitoba groups (Parkland, Westman and Red River), as they are to each other.

The position of the final Manitoba group, the Eastman, is more enigmatic in these results. This group clusters a total of twenty-three times with other samples, but only infrequently with the other Manitoba groups (Parkland - 2, Norman - 1, Westman - 1 and Red River - 1). It clusters most frequently with the Sonota, S. Arvilla and DLS samples from North and South Dakota (4 times each), with the Blackduck sample from Minnesota (3 occasions) and with the Sioux (twice). This frequency of clustering is a little misleading, as the three samples from the Dakotas are very similar to one another, and frequently clustered together. When the Eastman group clustered with one, it grouped with the others simultaneously. Nevertheless, is seems apparent that the Eastman group has affiliations not common to the other Manitoba samples.

As I discussed each run above, I noted that some groups could be considered as outliers on most plots. The group that most commonly plotted as an outlier was the Mandan sample. Not only was this group often an outlier, it did not cluster with any other group on any occasion throughout these runs. It is clear that the Mandan were not closely affiliated with any of the other groups used in this analysis. Other groups commonly plotting as outliers were the Caucasian, Laurel and N. Arvilla samples; less commonly were the Norman and Eastman groups.

DENDROGRAM PLOTS

In an effort to further try to understand the relationships between all of these cases, separate dendrogram plots were prepared for the males and the females. Figure 5.41 is the dendrogram plot of all of the male vaults used in the analysis. Although many clusters are formed, none of them appear to be particularly meaningful. One cluster of 21 individuals, at the right end of the plot, contains about half of the Norman cases, but also specimens from nine other groups. Almost all of the Caucasian males fall in the cluster next to this one, but specimens from eight other groups also appear in this cluster. Overall, no group appears to dominate any of the clusters, and all of the clusters contain cases from many groups. This plot suggests that there is a great degree of homogeneity to these data, particularly in the male sample. The clear outlier on this plot, a specimen from The Pas, Manitoba, is of known date, and is one of the earliest in the sample.

The dendrogram plotting the females, Figure 5.42, has some more interesting results. The large cluster at the right of the plot contains 36 individuals, including 14 from the Sioux group along with about half (5) of the females from the Eastman group and 4 of the 11 red River valley females. The cluster to the left, containing 24 cases, has almost all (6/8) of the N. Arvilla and (4/5) Norman females. The cluster adjacent to this, to the left, has 19 cases including 6 of 8 females from the Hungry Hall group. The four primary clusters at the left side of the plot, taken as a whole (they are all clustered together as a tertiary cluster), contain the vast majority of the Westman females (13/18) and seven out of eight S. Arvilla cases.

Thus, in this case, the program seems better able to distinguish between specific groups, particularly the Mandan, N. Arvilla, Hungry Hall and S. Arvilla samples. It is probably no coincidence that most of these groups were often outliers in the canonical analyses, and their distinctiveness has been noted earlier. On the other hand, the program is less able to distinguish between individuals from most of the groups, furthering the suggestion that there is a considerable degree of homogeneity to these data.

Unfortunately, the SYSTAT program was unable to handle the number of variables, combined with the number of cases, in the total data set. Therefore, dendrogram plots of the total data base were not done.

SEX DIFFERENCES BETWEEN GROUPS

Other than for the dendrograms, the runs discussed above were all conducted on the combined sex data set. For each of these runs, two additional plots were created, one each for the males and females. These plots were studied for differences between the clustering patterns of the males and females of each group. Not all of the plots contained significant information, as there were no apparent differences in many of the runs. Consequently, not all of the plots are shown here. I have included the plots from the major runs from both the vault and total data set, so that the single sex patterns may be assessed. Figures 5.43 to 5.50 show the plots of the vault data set for specimens used in the analysis, divided by sex, while Figures 5.51 to 5.58, portray the results from the total data set.

Figures 5.43 (run 17.2) and 5.44 (run 17.3) plot the clustering pattern of all of the male/female cranial specimens. In both cases large clusters formed, involving a large number of groups, with generally the same pattern being seen in both the male and female runs. The Caucasian, Laurel, North Arvilla, Mandan and Norman groups, often outliers in the runs involving both sexes, appear as outliers in the single sex runs as well.

Figures 5.45 (run 18.2) and 5.46 (run 18.3), plotting Manitoba groups only, show no clusters. Figure 5.47 (run 19.2), plotting Manitoba/Minnesota/Ontario groups, shows clustering between the males of the Red River, Eastman, Blackduck and Hungry Hall groups. The corresponding female plot (run 19.3), shown in Figure 5.48, shows clustering only between the Westman and Parkland groups.

The Manitoba cases are plotted versus the North/South Dakota cases in Figures 5.49 (run 20.2 males) and 5.50 (run 20.3 females). The males form two large clusters, following geographic lines, with the Red River, Parkland and Westman groups falling in one and the DLS, Sioux, Sonota and S. Arvilla groups falling in the other. Only one cluster, including the Norman and Red River groups, appears on the female plot (Fig. 5.50).

The single sex runs based on the total set begin with Figures 5.51 (run 21.2 - males) and 5.52 (run 21.3 - females). These figures show the plots of all of the groups from the total data set. Only one clear cluster emerges on Fig. 5.51, involving the Norman and Laurel males. Yet, although clustered, both of these groups are outliers in this plot. One large cluster forms on the plot of females, Figure 5.52, involving the Red River, Hungry Hall, Norman, Westman, Eastman and Parkland groups. The Blackduck, N. Arvilla and Mandan groups are outliers on this plot.

When only the Manitoba groups are plotted, none of the female samples cluster

(Figure 5.54) while the Parkland and Red River males overlap (Figure 5.53). When cases from Minnesota and Ontario are added, no clusters are apparent among the males (Figure 5.55) but a large cluster, involving the Norman, Eastman, Hungry Hall and Red River groups, forms among the females (Figure 5.56).

Figure 5.57 shows the plot of the Manitoba cases together with the specimens from North/South Dakota. One cluster is apparent, involving the Eastman, Sonota and Mandan groups, although these are joined by the large confidence circle of the Sonota group. On the female plot of the same data, Figure 5.58, the Norman and Parkland groups overlap, but the others are all spaced well apart.

Taken as a whole, these 16 plots (Figures 5.43 - 5.58) reveal some interesting patterns. First, neither the males nor the females from the N. Arvilla and Laurel groups ever cluster with any other group, except for one occasion in which the Laurel males clustered with the Norman males; and another, certainly specious, cluster between Laurel and Caucasian males. This emphasises the distinctiveness of these samples in comparison to the other cases used in the analysis.

The males from the Blackduck group cluster with males from other groups on nine occasions (considering multiple overlaps as separate clusters between each group in a large cluster). These overlaps are widely dispersed, occurring with eight other groups, including some from Manitoba (Westman, Eastman, Red River), North Dakota (DLS, Sioux, Sonota, S. Arvilla) and Ontario (Hungry Hall). The female Blackduck sample, on the other hand, clusters with only one other group (Red River), on one occasion.

The opposite pattern emerges for the Norman group. The males from this group cluster only with the males from the Laurel sample, on one occasion. The females, though, cluster with other groups on ten occasions, including the Parkland (twice), Westman, Red River (three times), Eastman (twice) and Hungry Hall (twice) groups. This is doubly interesting, given that the Norman sample as a whole (males and females combined) was often an outlier in the first set of results above. From these results, it is apparent that it was the males from the Norman sample that were responsible for the lack of clusters involving the Norman group. When the males are removed, the females are generally similar to those of the other Manitoba groups.

C-SCORE ANALYSIS

Six dendrogram plots, three each for the vault and total data sets were constructed using the c-score procedure (Howells 1995). The first of these, shown in Figure 5.59, plots the male c-score results created by the vault data set. The males fall into two clusters, with three groups falling as outliers. The first cluster contains the N. Arvilla, Hungry Hall, Blackduck, Eastman, Sioux and Red River groups. The second contains the South Arvilla, Sonota, Westman, Parkland, DLS and Mandan groups. The outliers are the Caucasian, Laurel and Norman males.

These groupings are interesting. The first cluster contains essentially eastern groups, from woodland/forest vegetation zones, with the Sioux being an apparent exception and the Red River group occupying an intermediate position between east and west, and between forest and plains. The N. Arvilla sample, commonly an outlier in earlier analyses, is less closely bound to the cluster than are the other groups.

The six groups from the second cluster all came from the south and western portion of the study area, from the parkland through prairie vegetation zones. Somewhat surprisingly, this group includes the Mandan, which was an outlier in almost all of the earlier plots.

Unfortunately, the male c-scores derived from the total data set (Figure 5.61) are not consistent with the vault results. While the Caucasian and Laurel groups remain as outliers, and two clusters form on the plot, the groups contained in each cluster differ considerably. In the first cluster, the Red River, Blackduck and N. Arvilla groups are joined by the Norman and Mandan groups. In the second cluster, the Sonota, Parkland and Westman groups are joined by the Hungry Hall and Eastman samples.

Figure 5.60 shows the c-score plots of the females, using the vault data. In this plot, two clusters form, and there are no obvious outliers (there were not enough Caucasian females to be used in this analysis). The first cluster contains the Norman, Parkland, Hungry Hall, Arvilla and Laurel groups. The second cluster contains the Sonota, South Arvilla, DLS and Mandan groups, as a sub-cluster, as well as the Eastman, Westman, Red River and Sioux groups. One noteworthy pairing is the close association between the Red River and Sioux groups, which mirrors the result of the male run (Fig. 5.59).

The results of the female c-scores derived from the total data set (Fig. 5.62) show two clusters with the Blackduck group as an outlier. The first cluster contains the Eastman, Red River, Mandan and Westman groups, while the second holds the Arvilla, Sonota, Hungry Hall and Parkland samples. Again, these results are not consistent with those from the vaults, nor are the groupings consistent with the earlier analyses.

The final pair of c-scores shows the results when both sexes are plotted together. Figure 5.63 shows the vault data results. Three main clusters are apparent, with the middle one consisting of essentially outlying groups such as the Caucasian and Laurel males and the Blackduck females. The main cluster to the right of the plot contains four primary clusters, two of which neatly group all of the Sonota, DLS, Mandan and South Arvilla cases, both male and female. The remaining two primary clusters contain both Westman sexes, the Red River, Sioux and Eastman females and the Blackduck and Parkland males.

The other Manitoba cases, including both Norman sexes, the Parkland females and the Red River and Eastman males fall into the main cluster to the left of the plot. This cluster also contains the Sioux males and the majority of specimens from Minnesota and Ontario. As seen before, the Sioux group does not follow the same pattern as the other specimens from North and South Dakota, and it seems clear that this group has closer biological ties to Manitoba populations than is true for most of the plains groups.

Figure 5.64 is the c-score plot of both sexes using the total data set. Three main clusters are apparent, with the Blackduck females and Caucasian males falling as outliers. The main cluster to the left of the plot contains only Manitoba groups, including the Norman, Red River and Eastman females, along with the Parkland and Westman males. Other Manitoba groups, including the Red River and Eastman males as well as the Parkland females, fall into the right hand main cluster. The remaining Manitoba groups, the Norman males and Westman females fall into the middle main cluster.

Overall, the c-scores essentially confirm that there is a considerable degree of homogeneity among these samples. There is little consistency in the patterns of clustering, making conclusions somewhat difficult. The c-score analysis does confirm that the Caucasians, outliers in the other forms of analysis, are significantly different from the other samples. But, it does not indicate that the Mandan are outliers, although this was the case in the canonical discriminant runs. The association between the Sioux sample, the Red River group in particular, and most of the Manitoba groups in general, is interesting. This association was hinted at in the canonical runs, is apparent on many of the c-score results, and is worth exploring further.

CHAPTER 6

CONCLUSIONS

The most obvious conclusion to be drawn from all of the forms of analysis outlined in the previous chapter is that, overall, there is not a great degree of biological difference demonstrable between and among the former inhabitants of this region. The principal components analysis demonstrated no clear clusters in the data. Using the canonical discriminant procedure, the Manitoba samples all clustered, at least occasionally, with each other, and some of the groups could not be distinguished from one another on many occasions. Overall, only a minority of the groups examined could consistently be distinguished from the others by the programs used.

When I undertook this project, I was confident, with a somewhat Boasian attitude, that if I collected enough data, the patterns of the past would be revealed to me. Well, like Boas, I feel that these patterns have not completely emerged from the data I collected. However, I feel that there are glimmers of understanding which reveal some insights about the patterns of the past.

Thus, the essential finding of this research is a largely negative one. I cannot clearly and consistently define many distinct populations from the Pre-contact history of Manitoba. No combination of individuals leapt from my stacks of scatterplots to announce that here indeed was a definable population, with clearly demarcated geographic and temporal boundaries.

There are several possible reasons why these methods may not have been able to derive clear biological populations from this data set. The first of these, quite simply, is that the method was inadequate to identify specific populations - that the approach was inadequate and yielded less than satisfactory results. I do not really accept this. While the results were not what I had hoped they would be, there is no reason to think that, in general, the method was incorrect. In fact, the ability of the principal components analysis to distinguish the gender of each case, the ability of the canonical discriminant program to isolate Caucasians from Native Americans and the ability of the c-scores analysis to point out some unexpected relationships between groups all attest to the fact that the programs functioned properly.

The second possible explanation is that there were not many different groups here in the past, and that the results are reflective of within-group variation over a relative large area, as opposed to between-group differences. However, as discussed in chapter two, the archaeological evidence clearly suggests that there were different groups here, and it seems likely that these groups would, in general, be represented by the crania used in this analysis. Still, given that many of the crania used here had no certain provenience, I cannot be certain that a specific number of "populations" are represented here.

The third possible explanation is that there may never have been a great degree of *biological* separation between aboriginal groups in this region. There is no doubt that there were significant cultural differences between Native groups at the time of contact, when historical records first began to appear. These cultural differences were noted not only by Europeans but also by the Natives themselves, who had clear ideas of themselves as peoples and their friends, allies and enemies as other peoples. But whether these could be equated with biological uniqueness is a question requiring further analysis.

It is probable that these cultural differences mentioned above stretch into the past. When archaeologists define an archaeological focus or tradition on the basis of cultural material factors, they are implicitly stating that this group was a cultural entity distinct from other previously defined entities. This automatically supposes that there were different cultures, who considered themselves distinct "peoples" five hundred, a thousand, two thousand and even four-thousand years ago. This, in essence, is our interpretation of different lithic and ceramic technologies. Artifacts that look and are constructed "the same" were made by one culture whereas artifacts that were constructed in a different fashion and have a different appearance were made by different cultures.

In reality, of course the definition of "cultures" on this basis has a myriad of problems. Peoples can "borrow", trade for or steal material culture from each other. In fact, they can even borrow a whole style or technique of manufacturing material cultural artifacts from one another. Different stylistic traditions can join, fusing into a amalgam different from previous entities. And people can change the way they do things over time, leading to the perception that there were many groups with many styles whereas there may have been only a few groups with evolving stylistic traditions.

Well, so what? This is certainly nothing new in archaeological theory. Scientists realized years ago that a purely typological approach to identifying cultures had inherent limitations. The point is that, despite the knowledge of these limitations, there is still a perception that these archaeological cultures were also biological entities. There is an assumption throughout the archaeological literature that a defined "culture" equals a defined biological population. And it is easy for us to imagine this. We picture small, somewhat isolated band level societies in the past, and see them as being unique from one another in all aspects.

But biological distance and difference may be more illusory than cultural difference. For example Canadians and Americans see themselves as being unique and distinct from one another. They see political, societal and cultural distinctiveness, coupled with a limited degree of uniqueness in material culture, and proclaim that they are different. But are they physically or biologically different? No, not in any quantifiable way. How can they be? They both come essentially from the same origins, and have only been politically and culturally separated from one another for a couple of hundred years.

Many of the groups from the past, particularly in the Manitoba region, were small and nomadic in nature. These may never have been the autonomous, clearly bounded entities that we might imagine them to have been, looking back from the present. Following Roth (1980), even if these populations had a degree of political distinctiveness, this might not have translated into a bounded, stable biological unit.

When we talk about biological factors, we are often referring to things that are under genetic control, they are encoded into the human organism. These things can only be modified by selective factors at a rate determined by the degree of the selective pressure and the generation length of the organism. It is axiomatic that with a generation length of twenty years or so, the human organism will not be able to modify itself very quickly, even under strong selective pressures.

There is no question that, given long enough, enough generations, the human form will develop into genetic patterns unique to specific groups. However, this is only true if there is little or no gene flow between them. It is over 25 years since Brues (1972) showed that over time as little as 1-2% gene flow between groups per generation would homogenize all human populations. Many of the runs shown in chapter 5 demonstrate that it is possible to distinguish between Caucasians and Native Americans relatively easily. But, Caucasians and North American Aboriginal peoples, overall, have more than ten thousand years of separate evolution between them.

Even this ten thousand years was insufficient to make the two groups biologically incompatible. There are some external (and internal) physical differences between them, but they are genetically 100% compatible. This is a testament to the fact that genetic change is relatively slow in the human lineage.

All of this stands as a preamble to the question: could the inability of my computer programs to clearly define biological groups from the data presented be the result of the fact that there really were no unique biological groups to define? I assume that many different (archaeological) cultural groups are represented in my data. Some of the groups, although listed as separate cultural entities, almost certainly could not have been unique biologically. The Assiniboin and the Dakota viewed themselves as unique groups, but they only separated some 400 years ago. This represents only twenty generations, probably insufficient time to accumulate significant genetic distance between the two, even if there was no gene flow.

Current theory holds that humans arrived in the New World somewhat more than 11,000 years ago (Hoffecker et al 1993, Meltzer 1995, Patterson and Larsen 1997). Using linguistic and dental evidence, Greenberg et al (1986) and Turner (1986, 1987) suggest that all Amerindians can be subdivided into three groups: Eskaleut, Nadene and Macro-Indian, each possibly representing a separate migration event from Asia. The Macro-Indian cluster contains all North, Central and South American Native groups, except those from the far north and northwestern parts of North America and groups derived from them, such as the Athapaskan speakers of the American southwest. All groups appearing in this analysis would therefore fall into the Macro-Indian group.

Analysis of mtDNA confirms the distinctiveness of Macro-Indian and Nadene genetic systems, but also suggests that there are more founding lineages (4) than were posed by the earlier work (Torroni et al 1993). If these large categories are valid, how unique or distinct can individual populations be, particularly in a specific region of the continent?

The answer to this seems to be that, despite genetic similarities, a considerable amount of variation still exists between human populations, and this variation can be detected by studies of cranial shape (Larsen 1997:303). This has been demonstrated by the studies cited in chapter 4, including those by Howells (1973, 1989), Key (1983), Heathcote (1986) and Sjovold (1984). Therefore, while broad genetic similarity between groups of North American Natives is certain, microevolution over the last 11,000 years has been enough to create measurable differences between groups. If such differences are not greatly apparent, genetic similarity due to common inheritance is probably not the reason.

The fourth and final explanation considers that there might have been many different groups which appeared in the data, and they may have been genetically distinct from one another, but that the biological distance between them was reduced by inter-marriage and the capture of females in war. Thus, groups living in the same region, if they exchange genetic material freely and have sufficient gene flow, can become genetically more similar, rather than less similar, over time. Given that band level societies, in general, are often associated with exogamous marriage patterns, such exchanges probably did occur among peoples in this part of the world in the past.

This is not a new concept. Meiklejohn (1977) has discussed the nature of marriage patterns and gene flow between band level societies. His conclusion, based in part on Rogers (1969:25-26) work among the Ojibwa, is that gene flow between groups is inversely related to group size (Meiklejohn 1977:109). Thus, as group size becomes smaller, group mobility becomes higher, outbreeding becomes more common, and gene flow becomes a significant factor in joining many small groups together. Further, Meiklejohn (1977:108) states that: "it still remains to be shown that such extended systems have effective limiting, outer boundaries." This was also Roth's (1980:198) opinion, after his study of the demography of Old Crow Village, a Kutchin Athapaskan

Indian community in the northern Yukon. He concluded: "... earlier human populations may no longer be viewed as autonomous, bounded entities, but rather as representing fluid, dynamic aggregates, in which flux, rather than stability, is the general rule."

Patterns of co-marriages between hunting and gathering groups in northern Alaska were continuous across regional boundaries and carried on throughout alliance and warfare (Burch and Correll 1972:35). Studies by Melartin and Blumberg (1966) on human serum albumin variants suggests that gene flow is even continuous between groups in completely different language families.

In summation, the programs used were generally unable to consistently define distinct biological groups from these data. This occurred because there was not enough biological difference among many of the samples used in the analysis. Whether this was due to the fact that too few groups were sampled, or due the fact that groups reduced their biological distance by inter-marriage, is unknown at this time.

A complicating factor was that there was not enough temporal control in the specimens used. Most of the specimens appearing in my data set were not dated. They could have been 500 or 5000 years old. Going on the assumption that older specimens are going to be much less common than relatively recent ones, I eliminated known archaic cases from the analysis. Others, though, might have been unknowingly included.

The lack of temporal controls made devising starting populations much more difficult than it should have been. Specimens from along the Winnipeg River were grouped together for geographic reasons, but would this single division be maintained if the cases could be shown to fall into distinct temporal categories? The answer is no, because the relationship between these temporal groups would be unknown. Maybe they would have all been related to one another in an ancestor-descendant relationship, or perhaps as offshoots of a larger population to the south and east. But maybe they would have been completely unrelated to one another. A lack of good temporal information associated with specimens must be seen as a drawback to this type of biological analysis.

In fact, some considerable success in craniometric analysis has resulted from the ability to clearly discuss ancestor-descendant relationships between groups. Using craniometrics, Key (1983) identified a biological discontinuity between the Central Plains tradition groups and those of the Woodland period in North Dakota. Discontinuities were also discovered, using population distance analysis, among Illinois River valley groups (Konigsberg and Buikstra 1995, Larsen 1997).

Another possibly influential factor is inter-observer error. All of the groups used in this analysis were subjected to a series of univariate tests, which did not point out any glaring inconsistencies. Nevertheless, data used here came from three different sources, and a degree of inter-observer error is likely. Three of the groups provided by Dr. Key, the Sonota, DLS and S. Arvilla, tended to cluster with one another, but were generally separate from other groups. This distinctiveness from the Manitoba sample might have been accentuated by inter-observer error. However, these three groups fell very close to one another in Key's analysis, when plotted with ten other groups from south of North Dakota (Key 1983:81). Thus, their dissimilarity to the Manitoba data is likely a true one, not an artifact of inter-observer error.

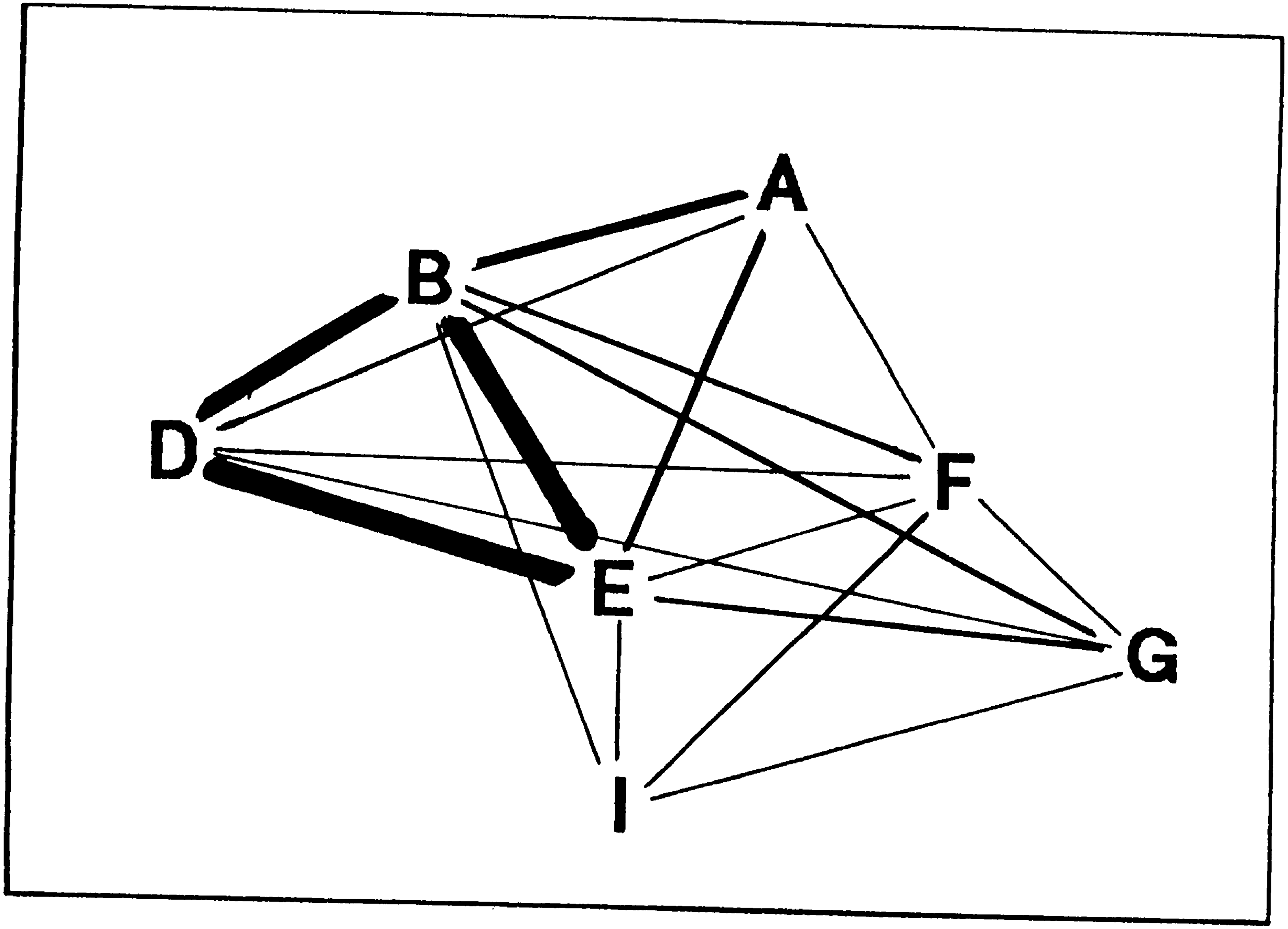
Further, the mean of the Sioux group, also measured by Key, overlapped with the means of each of the Manitoba samples (except Norman) at least once. Thus, the separation of the two data streams was not complete. It is interesting to note, as well, that the Sioux group was quite distinct from other southern samples in Key's research, as it was here (Key 1983:94).

Of the three samples provided by Ms. Myster, there is no doubt that both the

Laurel and N. Arvilla samples were consistently outliers. The Laurel sample was a small one, and most likely comes from a somewhat earlier time period than most of the specimens, and its status as an outlier is therefore not surprising. The N. Arvilla group simply seemed to be very different from the other samples, including the S. Arvilla group. It is possible that some of this difference is due to inter-observer error. However, the Blackduck sample, measured by Myster, clustered with Manitoba groups (5 times) almost as often as the Hungry Hall sample did (6 times), although I personally measured the latter group. Overall, I therefore do not think that inter-observer error had an undue influence on the results shown here.

One form of positive outcome from these analyses was the identification of outlying groups, samples that are very different from the bulk of the groups, and from each other as well. The Caucasian sample, although not used in every run, was almost invariably an outlier, as was expected. The Laurel and Arvilla groups, as discussed above, were both generally outliers, for uncertain reasons. Finally, the Mandan group was a consistent outlier, never clustering with any other sample. This certainly suggests that the Mandan were not closely related to other Siouan groups, despite being in the same language family.

There were additional positive outcomes, in that some consistent patterning emerged concerning the relationships between the Manitoba groups, and between Manitoba and comparative samples. Figure 6.1 graphically summarizes the results from the runs discussed in chapter 6. In this figure, the different samples are identified by letter codes and the lines running between each pair indicate the number of times the means of the groups overlapped. Thinner lines indicate that the means overlapped infrequently while thicker lines indicate that the means overlapped frequently. While conclusions about specific connections and separations between groups will be outlined below, these must



A=NORMAN B=PARKLAND D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL I=SIOUX

FIGURE 6.1 TOTAL DENSITY OF ASSOCIATIONS BETWEEN MANITOBA REGIONS AND SELECTED OTHER GROUPS be considered within an entire framework of data which does not display a great degree of variability. These results are suggestive, though not conclusive, of connections and discontinuities between groups as they existed in the past. There is no doubt that the Red River, Parkland and Westman samples show a great degree of similarity to one another. The means of at least two of these three overlap on fifteen of the twenty canonical plots in which all three groups were included. In the plots showing all cases (Figures 17.1, 21.1, 29.1, 33.1 and 37.1) the means of these three groups overlap consistently. In fact, it is my opinion that the majority of these specimens represent a single biological population. I say majority because there is sufficient variation and dispersion to the cases from all three of these groups to suggest that several biological groups occur in these samples. Most, though, likely fall into one group.

These similarities are consistent with the findings of Ossenberg (1974:37). Using discrete trait analysis, Ossenberg concluded that specimens from the Melita Phase (many of which are in my Westman sample) were linked to those from the Manitoba Phase (many of which are in my Parkland and Red River samples) and the Devil's Lake sites in North Dakota. Since my results show similarities between the Devil's Lake, North Dakota specimens and DLS specimens from the Westman region these relationships seem consistent regardless of approach.

However, Ossenberg (1974:37) also concluded that these three groups, Melita Phase, Manitoba Phase and Devil's Lake specimens cluster with the Laurel, Blackduck and Arvilla archaeological samples, and that these six groups as a whole can be linked to the Dakota, Assiniboin, Cheyenne and possibly Blackfoot ethnic groups. These conclusions are more general and sweeping than can be supported by the multivariate methodologies employed here. Her specific conclusion that the Manitoba phase (generally Parkland+Red River samples) was proto-Assiniboin remains a possibility, but cannot be tested further until a clear Assiniboin sample is obtained.

Although acknowledging that the data were inadequate, Ossenberg speculates that the Laurel sample was most closely related to the Manitoba Phase specimens and south Blackduck specimens and that Laurel was ancestral to both of these complexes. These conclusions are not supported here, as Laurel is generally an outlier. However, the Laurel data are still poor and are not suited to strong conclusions.

The somewhat enigmatic position of the Blackduck sample in the results portrayed here may reflect Ossenberg's conclusion (1974:37) that there were two separate Blackduck populations, each of which had a distinct origin. However, the Blackduck sample used here was too small to show sub-clusters, if such did exist.

Overall, though, Ossenberg's conclusion that many of the groups she studied cluster together is consistent with my conclusion that many of the samples I analysed could not clearly be distinguished from one another. In fact, her chart of mean (genetic) distance between groups can be interpreted as being the result of geographic distance, one of the conclusions reached in this thesis.

The similarity between the three Manitoba groups mentioned above does not extend to the Norman and Eastman samples. The Norman group mean overlapped with that of other groups a total of just ten times throughout the canonical runs involving both sexes. This is low compared with the other Manitoba groups (Parkland overlaps a total of 27 times, Westman 21 times, Red River 29 times and Eastman 23 times). The Norman sample overlapped most frequently with the Parkland (4 times), followed by Red River (3), Westman (2) and Eastman (1). The mean of this group never overlapped with that of any of the comparative samples.

The overall pattern is that the Norman sample is somewhat distinct from the other Manitoba groups. However, in the single sex runs (Figures 5.43-5.58) it was apparent that the distinctiveness of the Norman sample was due to the contribution of the males, while the females were quite similar to the bulk of the Manitoba sample. For the runs involving both sexes, the Norman group would have been much more different from the other Manitoba groups if it were not for the contribution of the females.

It is tempting to speculate that these data have sampled two essentially different groups (northern and central) that were undergoing a process of genetic convergence due to gene flow. Such gene flow may have started with the co-exchange of females, a trend being picked up by the analysis. However, if such exchanges were a relatively recent phenomenon, the gene flow many not yet have been sufficient to influence the main bodies of the two groups.

The Eastman sample also occupies a unique position. The mean of this group overlaps with those of the other Manitoba samples a total of only five times. On the other hand, its mean overlaps with that of the Sonota, S. Arvilla and DLS groups four times each, the Blackduck sample three times, the Sioux twice and Hungry Hall once. In fact, the Eastman group is the only Manitoba sample to cluster with the Sonota, DLS and S. Arvilla groups at all. The fact that this happened four times for each of these groups is surprising. However, the numbers are a little misleading here. As discussed above, the Sonota, DLS and S. Arvilla samples are very similar to one another and often grouped together. The Eastman mean actually overlapped with this entire trio simultaneously on only four plots (Figures 5.17, 5.25, 5.33 and 5.37), thus accounting for all twelve clustering events. These four plots, further, were all similar in that they included both sexes and all the groups.

The position of the Eastman sample, though, is also influenced by the position of the Blackduck and Hungry Hall groups. When these are removed, as in Figures 5.20, 5.28, 5.36 and 5.40, the Eastman sample no longer overlaps with the groups from the

Dakotas. This push and pull effect is much more evident for the Eastman sample than for the other Manitoba cases.

Connections between the Eastman group and the Blackduck and Hungry Hall groups were anticipated, and are supportable archaeologically. Connections with groups like the Sonota and S. Arvilla, though, are much more problematic. I think, in fact, that these connections are specious. On two occasions, the Eastman group overlaps with the Sioux group, which in turn overlaps with the other groups from the Dakotas. I do consider that these groups have all clustered, but in this case, I think the clustering is largely coincidental.

The relationship of the Eastman to the Sioux group can not be easily dismissed. Although they do not frequently overlap, the confidence interval for the Eastman group falls completely within the confidence interval of the Sioux sample on Figures 5.33 and 5.37. This implies some degree of similarity between the two groups.

Unlike the other North Dakota samples, the Sioux group also overlaps on four occasions with the Blackduck sample, and once with the Hungry Hall group, both of which are unexpected. Further, the Sioux group overlaps once with each of the Parkland and Red River samples, a connection again not seen between the other samples from the Dakotas and the Manitoba groups.

Thus, the Sioux group has a greater degree of similarity to the Manitoba, Blackduck and Hungry Hall samples than was seen for the other southern groups, the S. Arvilla, DLS, Sonota and Mandan. The reason for this similarity lies in the nature of the Sioux sample. The Sioux sample used here, according to Key (1983:25): "... appears to be Dakota Siouan, specifically the Eastern (Santee) and Middle (Wiciyela) divisions of the Sioux." The Assiniboin people was derived from these groups, specifically the Santee, some 400-500 years ago (Syms 1991, 1997, Nicholson 1996). The Assiniboin, not identified here as a specific biological sample, were consistent inhabitants of Southern Manitoba by AD 1700 (Schlesier 1994:308, Nicholson 1996:72). I believe that some of the specimens from all of the southern Manitoba groups were Assiniboin individuals, and the similarities between them and the Sioux from the south are being picked up by the canonical procedure.

The Sioux sample did not overlap with the Westman group directly on any of the plots. In fact, when the Westman group was removed from the analysis (Figure 5.25), the Sioux clustered firmly with a number of groups, including the Parkland and Red River samples. Similarities between the Sioux and the Westman sample are revealed in Fig. 5.29. In this plot, the DLS sample from North Dakota was merged with the cases from DLS sites in Manitoba. The new DLS group overlapped completely with the Sioux sample, while the remaining Westman (from non-DLS sites) cases clustered with the Red River valley group. This suggests that the Westman group contains at least two separate biological groups - one which can be identified as DLS and one which is the common population found in the Parkland and Red River regions as well.

The above confirms Syms' (1978) contention that the Devil's Lake- Sourisford complex was essentially Siouan in nature, and that the people themselves were probably Proto-Siouan. They could not have been Assiniboin, of course, as the DLS Complex predates the appearance of this group. It also strongly suggests that the DLS was a separate population from the people inhabiting the rest of southcentral Manitoba, some of whom also appear in the Westman sample used here.

The Blackduck group occupies a rather enigmatic position in these results. In the canonical analyses, this group never overlapped with the Norman or Westman groups, but did overlap with all of the other groups used here on at least one occasion each. It clustered most often with the Sioux (4 times), Eastman (3) and Hungry Hall (3) groups.

As discussed in the results section, most of the clustering of the Blackduck group as a whole is due to the contribution of the males (as in Figure 5.47). The Blackduck females are rather distinct, and do not cluster with other females, while the males cluster relatively frequently.

Blackduck ceramic is widespread throughout southeastern and south central Manitoba, and it seems likely that the Blackduck people overall foraged widely in this region. It is possible that they are being sampled as part of the specimens recovered in each region. This would account for the observed similarities. This would be particularly true if Blackduck males foraged more widely than females, and were therefore more likely to be found outside the Blackduck "homeland" in the Minnesota/Rainy River region.

The final question, then, is, can some identity be assigned to the bulk of non DLS specimens from the Parkland, Red River valley and Westman regions? The answer is - not with certainty. This group displays connections with the Sioux, probably reflective of the presence of some Assiniboin crania in the sample. And some connections to the Blackduck are apparent, although these are not strong enough to clearly imply some sort of ancestor-descendant relationship.

On the other hand, the low frequency of clustering between this group as a whole and the Norman and Eastman regions argues against this population being either Cree or Ojibwa in nature. It may well be that this group is not a group in any real sense but is a mixture of a specimens from many populations. This mixing may have created a sample reflecting many of the surrounding groups in the region, but not particularly similar to any of these groups.

Alternatively, perhaps connections exist with groups not appearing in this research. The Blackfeet or Proto-Blackfeet may have lived here in the past, and may have contributed to this sample, but this cannot be demonstrated because I did not have a Blackfoot sample to include here.

SUMMARY

1. These data did not display a great degree of heterogeneity. This is consistent with groups that were fluid in membership, marriage patterns and mobility. Ethnic barriers do not appear to have been a factor impeding gene flow in the past.

2. There is an overall decline in the similarity between groups with distance. Many of the Manitoba groups are more similar to each other than they were to the comparative groups from the south and east. The same holds true for the groups from North and South Dakota. This is likely a function of local gene flow, and the decline of gene flow over distance. Even within the Manitoba groups, the Norman sample is more distant both geographically and biologically. The Eastman group is an exception to this conclusion, as it shows little similarity to its Manitoba neighbours.

3. The Sioux group was more similar to the Manitoba samples than was the case for the other North and South Dakota groups. I believe that this is due to the presence of the Assiniboin, a Siouan group known to have been resident here in the last 250 years.

4. The canonical discriminant program consistently identified several groups as outliers. For the most part, these distinctions were consistent with known biological and temporal factors, as with the Caucasians and the Laurel group. The presence of the N. Arvilla and Mandan groups as outliers is more problematic. These groups were likely immigrants to this region, with origins considerably different from that of other groups used here.

5. Many of the specimens from the Red River valley, the Parkland and part of the Westman region represent a single biological group. Without data from temporally successive groups, the origin of this population remains obscure. It is not clearly linked to the Eastman sample (including the Ojibwa) nor to the Sioux. While the ties between this group and the northern (Cree) sample are a little stronger, this connection is not firmly established.

6. The females from the Norman group are much more similar to those from the other Manitoba groups than are the males. This may be an indication of marital exchange patterns running in a north-south direction within Manitoba.

7. The position of the Eastman group is enigmatic. On one hand, this sample contains some known Ojibwa individuals and shows similarities to the Blackduck and Hungry Hall samples. On the other hand it was equally tied to the Sioux and other North Dakota groups. I believe that this sample is mixed and contains individuals from several groups. The Winnipeg River system, the location of most of the specimens, was widely used as a travel, trading and warfare route in the past, and the sample may reflect this.

8. The Devils Lake-Sourisford group was a biological population which was found in both North Dakota and Manitoba. This group was Proto-Siouan in nature, and was responsible for many of the burial mounds found in southwest and southcentral Manitoba. There is some evidence of a biological connection between the DLS and the South Arvilla group.

9. The Westman sample is primarily comprised of individuals from two groups, the DLS and the central Manitoba group. When the DLS cases (from known DLS sites) were extracted, the remaining cases showed clear ties to the Parkland and Red River groups.

10. There are connections between the Blackduck and Hungry Hall groups and it is likely that the Hungry Hall mounds were made by Blackduck individuals or the descendants of Blackduck peoples.

11. The burial mounds in Manitoba are either of DLS or unknown origins. There is no

apparent connection between Manitoba mound specimens and samples from mound building cultures elsewhere. Thus, there does not appear to be any Sonota or Laurel individuals in the Manitoba sample.

12. It is not possible to make firm conclusions about the origins of many of the groups assessed here. These origins will remain obscure until samples of a series of time-successive populations becomes available. It is only with this type of information that firm connections and clear discontinuities will be revealed.

13. There is no reason to think that specimens from northern Manitoba represent groups other than the Cree or ancestral Cree. Older specimens from this region, however, such as The Pas, are different from the bulk of the northern cases.

A Danish acquaintance once asked me to define the differences between Americans and Canadians. I gave him a list of social, material and attitudinal differences that I considered to be distinctive between the two groups. Ultimately, though, it became apparent that these perceived differences, as seen by a member of one of the groups in question, were insufficient grounds for an outsider to see the distinctiveness I felt.

There can be no doubt that Native North Americans in the past would have had a sense of ethnicity, a sense of belonging to a particular defined group. They likely viewed differences between groups from an us/them perspective. Probably, to them, the differences between groups were clear and definable. But to an outsider, a person from the present looking back, would these self-perceived differences be remarkable? Or, like my Danish colleague, would we be left with the thought that: "I know you see the difference, but ..."

The data analysed here shows that any modern concept of boundary, as applied to peoples from the past, may be incorrect and misleading. This applies most particularly to contemporary populations within a given region. I believe, though, that given sufficient dimension of time or space, boundaries and discontinuities between groups will become apparent.

It is interesting to compare the perspective of a demographer, Roth, with that of an archaeologist, Syms. Roth (1980) prefers to view past North American Native populations as fluid, dynamic aggregates in a continual state of flux. Syms (1991) says of the Assiniboine people: "The Assiniboins did not represent a single, homogeneous monolithic unit that can be treated as a single unit ..." Although in different contexts, these two views express essentially the same position.

The results discussed here show that gene flow between groups, particularly within a region, make biological distinctions between contemporary populations difficult to demonstrate. The fact that most of the Manitoba groups display biological similarities is likely the result of connections, in the form of gene flow, between them.

REFERENCES CITED

Armelagos, George J., K.H. Jacobs and D.L. Martin, 1981. Death and demography in prehistoric Sudanese Nubia. In: S.C. Humphries and H. King Eds., *Mortality and Immortality: The Archaeology of Death.* Orlando:Academic Press, 33-57.

----D.S. Carlson and D.P. Van Gerven, 1982. The Theoretical foundations and development of skeletal biology. In: F. Spencer Ed., *A History of American Physical Anthropology 1930-1980.* New York:Academic Press, 305-328.

Arthurs, David, 1986. *Archaeological Investigations at the Long Sault Site (Manitou Mounds).* Northwestern Region Conservation Archaeology Report 7. Toronto.

Badertscher, Patricia, Linda J. Roberts and Stephen L.A. Zoltai, 1987. Hill of the Buffalo Chase: 1982 Excavations at the Stott Site, D1Ma-1. *Papers in Manitoba Archaeology.* 18.

Bishop, Charles A., 1974. *The Northern Ojibwa and the Fur trade: An Historical and Ecological Study.* Toronto:Holt, Rinehart and Winston.

----, 1981. Territorial groups before 1821: Cree and Ojibwa. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 158-160.

Blalock, Hubert M, 1979. *Social Statistics.* New York:McGraw Hill.

Brace C.L., M.L. Brace and W.R. Leonard, 1989. Reflections on the face of Japan: A multivariate craniofacial and odontometric perspective. *American Journal of Physical Anthropology* 78:93-114.

Brace, C.L. and Kevin D. Hunt, 1990. A nonracial craniofacial perspective on human variation A(ustralia) to Z(uni). *American Journal of Physical Anthropology* 82:341-360.

Broste, Kurt and J. Balslev Jorgensen, 1956. *Prehistoric Man in Denmark - A study of Physical Anthropology.* Copenhagen:Einar Munksgaard.

Burpee, Laurence J. (Ed,), 1968. *Journals and Letters of Pierre Gaultier de Varennes de La Verendrye and his sons.* New York: Greenwood Press.

Brothwell, Donald A., 1972. *Digging up Bones: The Excavation, Treatment and Study of Human Skeletal Remains.* London: British Museum.

—, 1981. *Digging up Bones: The Excavation, Treatment and Study of Human Skeletal Remains*. Third ed. Ithaca:Cornell University Press.

— and Wojtek Krzanowski, 1974. Evidence of biological differences between early British populations from neolithic to medieval times, as revealed by eleven commonly available cranial vault measurements. *Journal of Archaeological Science* 1:249-260.

Brues, Alice M, 1972. Models of Race and Cline. *American Journal of Physical Anthropology* 37:389-401.

Brumley, John H., and Barry J. Dau, 1988. *Historical Resource Investigations within the Forty Mile Coulee Reservoir.* Archaeological Survey of Alberta Occasional Paper 13.

Buchner, Anthony P. 1979. The 1978 Caribou Lake Project, including a summary of the prehistory of east-central Manitoba. *Papers in Manitoba Archaeology* 8.

—, 1982. Material culture of the Bjorklund Site. *Papers in Manitoba Archaeology* 13.

—, 1988. The geochronology of the Lockport Site. *Manitoba Archaeological Quarterly* 12:27-31.

Buikstra, Jane E and Douglas H. Ubelaker, 1994. Standards for data collection from human skeletal remains. *Arkansas Archaeological Survey Research Series* 44.

Burch, Ernest S., Jr. and Thomas C. Correll, 1972. Alliance and Conflict: Inter-regionalrelations in north Alaska. In Guemple, D.L., ed., Alliance in Eskimo Society. *Proceedings of the American Ethnological Society*, 1971, supplement, 17-39.

Byrne, William J., 1973. The Archaeology and Prehistory of Southern Alberta as Reflected by Ceramics. *Archaeological Survey of Canada Paper 14.*

Cameron, Nancy S., 1962. *An Osteological Analysis of an Early Manitoba Population.* Unpublished dissertation, University of Toronto.

Capes, Katherine, 1963. The W.B. Nickerson survey and excavations, 1912-15, of the southern Manitoba mounds region. *National Museum of Man Anthropological Papers* 4.

Carlson, David and Dennis P. Van Gerven, 1977. Masticatory function and post-Pleistocene evolution in Nubia. *American Journal of Physical Anthropology* 46:495-508.

Chafe, Wallace L., 1973. Siouan, Iroquoian and Caddoan. *Current Trends in Linguistics* 10:1164-1209.

Chagnon, Napoleon A, James V. Neel, Lowell Weitkamp, Henry Gershowitz and Manuel Ayres, 1970. The influence of cultural factors on the demography and pattern of gene flow from the Makiritare to the Yanomama Indians. *American Journal of Physical Anthropology* 32:339-351.

Corruccini, Robert S., 1975. Multivariate analysis in biological anthropology: some consideratons. *Journal of Human Evolution* 4:1-19.

-----, 1976. The interaction between non-metric and metric cranial variation. *American Journal of Physical Anthropology* 44:285-294.

Damas, David (editor), 1969. Contributions to anthropology: ecological essays. *National Museums of Canada Bulletin* 230.

Dawson, Kenneth, C.A., 1987. Northwestern Ontario and the early contact period: The Northern Ojibwa from 1615-1715. *Canadian Journal of Archaeology* 11:143-181.

Dixon, W.J.,(editor) 1985; *BMDP Statistical Software: 1985 Printing*. Berkeley:University of California Press.

Dowdy, Shirley and Stanley Wearden, 1991. *Statistics for Research*. New York:John Wiley and Sons.

El-Najjar, M.Y. and K.R. McWilliams, 1978. *Forensic Anthropology*. Springfield, Illinois:C.C. Thomas.

Evans, C.E., 1961. Prehistoric Blackduck-Assiniboine: A reassessment. *Plains Anthropologist* 6:271-275.

Ewers, John C., 1974. Ethnological report on the Chippewa Cree tribe of the Rocky Boy Reservation and the Little Shell Band of the Indians. In David Agee Horr ed., *American Indian Ethnohistory: North Central and Northeastern Indians*. New York:Garland, 9-182.

Ferembach, Denise, I. Schwidetsky and M. Stloukal, 1980. Recommendations for age and sex diagnosis of skeletons. *Journal of Human Evolution* 9:517-549.

Fisher, Anthony D, 1969. The Cree of Canada: Some Ecological and Evolutionary Considerations. *Western Canadian Journal of Anthropology* 1:7-19.

Flynn, Catherine and E. Leigh Syms, 1996. Manitoba's First Farmers. *Manitoba History* 31:4-12.

Gibbon, Guy, 1994. Cultures of the Upper Mississippi River Valley and adjacent prairies in Iowa and Minnesota. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500*. Norman: University of Oklahoma Press, 128-148.

Giles, E. and O. Elliot, 1963. Sex determination by discriminant function analysis of crania. *American Journal of Physical Anthropology* 21:53-68.

Gough, Barry M. (Ed.), 1992. *The Journal of Alexander Henry the Younger, 1799-1814*. Toronto: Champlain Society.

Greenberg Adolph M. and James Morrison, 1982. Group identities in the boreal forest: the origin of the Northern Ojibwa. *Ethnohistory* 29: 75-102.

Greenberg, Joseph H., C.G. Turner II and S.L. Zegura, 1986. The settlement of the Americas: a combination of the linguistic, dental, and genetic evidence. *Current Anthropology* 27:477-497.

Greene, D.L., 1982. Discrete dental variations and biological distances of Nubian populations. *American Journal of Physical Anthropology* 58:75-79.

Gregg, M.L. 1985. Named archeological units in a chronology for central and western North Dakota prehistory. In Michael L. Gregg, compiler, *An Overview of the Prehistory of Western and Central North Dakota*. Bureau of Land Management: Cultural Resource Series 1, 79-98.

----, 1990. Untitled manuscript on file at the Manitoba Museum of Man and Nature.

----, 1994. Archaeological complexes of the northeastern Plains and Prairie-Woodland border. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500*. Norman: University of Oklahoma Press, 71-95.

Haas, Mary R., 1973. The southeast. *Current Trends in Linguistics* 10:1210-1249

Hallowell, A. Irving, 1936. The passing of the Midewiwin in the Lake Winnipeg region. *American Anthropologist* 38:32-51.

Hanna, M.G. 1976. *The Moose Bay Burial Mound*. Regina: Saskatchewan Department of Tourism and Renewable Resources.

----, 1982. *Pots and Populations: Alternate Analytical Techniques for Using Ceramics as Indicators of Social Units*. Unpublished Ph.D. Dissertation, University of Calgary.

Hausman, A.J., 1982. The biocultural evolution of Khoisan populations of South Africa. *American Journal of Physical Anthropology* 58:316-330.

Haviland, William A., 1993. *Cultural Anthropology.* Fort Worth: Harcourt Brace.

Heathcote, Gary M., 1986. *Exploratory Human Craniometry of Recent Eskaleutian Regional Groups from the Western Arctic and Subarctic of North America.* BAR International Series 301. Oxford.

Hickerson, Harold, 1956. The genesis of a trading post band: The Pembina Chippewa. *Ethnohistory* 3:289-345.

—–, 1962. The southwestern Chippewa: An ethnohistorical study. *Memoirs of the American Anthropological Association* 92.

Hlady, Walter M, 1964. Indian migrations in Manitoba and the west. Winnipeg: *Manitoba Historical and Scientific Society.* Series III, 17:24-53.

—–, 1970. The northern woodlands. In Walter Hlady ed., *10,000 Years of History in Manitoba.* Winnipeg:Manitoba Historical and Scientific Society, 93-122.

Hoffecker, J.F., W.R. Powers and T. Goebel, 1993. The colonization of Beringia and the peopling of the New World. *Science* 259:46-53.

Holder, Preston, 1970. *The Hoe and the Horse on the Plains.* Lincoln:University of Nebraska Press.

Hollow, Robert and Douglas R. Parks, 1980. Studies on plains linguistics. In W. Raymond Wood and Margaret Liberty eds., *Anthropology on the Great Plains.*Lincoln: University of Nebraska Press, 68-97.

Honigmann, John J., 1981. West Main Cree. In William C. Sturdevant ed. *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 217-230.

Howard, James H., 1965. The Plains Ojibwa or Bungi: Hunters and warriors of the northern prairie, with special reference to the Turtle Mountain Band. *University of South Dakota Anthropological Papers* 1.

Howells, W.W., 1966. The Jomon population of Japan. A study by discriminant analysis of Japanese and Ainu crania. *Papers of the Peabody Museum* 42. pp 1-43. Cambridge: Harvard University.

—–, 1973. Cranial variation in man. A study by multivariate analysis of patterns of difference among recent human populations. *Papers of the Peabody Museum* 67. Cambridge: Harvard University.

—–, 1989. Skull shapes and the map. Craniometric analyses in the dispersion of modern Homo. *Papers of the Peabody Museum* 79. Cambridge:Harvard University.

----, 1995. Who's who in skulls. *Papers of the Peabody Museum of Archaeology and Ethnology* 82. Cambridge:Harvard University.

Jacobs, Ken, Jeffrey M. Wyman and Christopher Meiklejohn, 1997. Pitfalls in the Search for Ethnic Origins: a Cautionary Tale regarding the Construction of "Anthropological Types". In Karlene Jones-Bley and Martin E. Huld eds. *The Indo-Europeanization of Northern Europe*. Washington:Institute for the Study of Man, 285-305.

Johnson, E. 1973. The Arvilla Complex. *Minnesota Prehistoric Archaeology Series* 9. Minneapolis:Minnesota Historical Society.

Joyes, Dennis C., 1988. A summary and evaluation of Avonlea in Manitoba. In L.B. Davis ed., *Avonlea Yesterday and Today: Archaeology and Prehistory*. Saskatoon:Saskatchewan Archaeological Society, 227-36.

Kenyon, Walter A, 1986. Mounds of sacred earth: Burial mounds of Ontario. *Archaeology Monograph* 9, Toronto:Royal Ontario Museum.

Key, Patrick, J., 1983. Craniometric relationships among Plains Indians: culture-historical and evolutionary implications. *Report of Investigations* 34. University of Tennessee, Department of Anthropology.

Klecka, William R., 1980. Discriminant analysis. In John L. Sullivan ed., *Quantitative Applications in the Social Sciences*, Beverly Hills:Sage Publications, 1-71.

Konigsberg, Lyle W. And Jane E. Buikstra, 1995. Regional approaches to the investigation of past human biocultural structure. In L.A. Beck ed., *Regional Approaches to Mortuary Practices*, New York: Plenum Press, 191-220.

Krauss, Michael E. and Victor K. Golla. 1981. Northern Athapaskan Languages. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 67-85.

Kroeber, Alfred L., 1953. *Cultural and Natural Areas of Native North America*. Los Angeles:University of california Press.

Krogman, W.M., 1962. *The Human Skeleton in Forensic Medicine*. Springfield, IL.:Charles C. Thomas.

Krzanowski, W.J. and F.H.C. Marriott, 1994. *Multivariate Analysis: Distributions, Ordination and Inference*. London:Edward Arnold.

Larsen, Clark Spencer, 1997. *Bioarchaeology: Interpreting behavior from the human skeleton*. Cambridge: Cambridge University Press.

Laviolette, Gontran, 1991. *The Dakota Sioux in Canada*. Winnipeg:DLM Publications.

Lebart, Ludovic, Alain Morineau and Kenneth M Warwick, 1984. *Multivariate Descriptive Statistical Analysis*. New York:John Wiley and Sons.

Lenius, Brian and Dave Olinyk, 1990. The Rainy River Composite: revisions to Late Woodland taxonomy. In Guy E. Gibbon ed., The Woodland tradition in the Western Great Lakes: Papers presented to Elden Johnson. *University of Minnesota Publications in Anthropology* 4, 77-113.

Llop, Elena, 1996. Genetic composition of Chilean Aboriginal populations: HLA and other genetic marker variation. *American Journal of Physical Anthropology* 101:325-332.

Lorenz, Joseph G. And David Glenn Smith, 1996. Distribution of four founding mtDNA haplogroups among Native North Americans. *American Journal of Physical Anthropology* 101:307-324.

Loukopoulou, M. And A. Pentzou-Daponte, 1995. A craniofacial morphological study of a population of northern Greek children. *International Journal of Anthropology* 10:133-142.

Lovejoy, C. Owen, 1985. Dental wear in the Libben population: It's functional pattern and role in the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68:47-56.

----, R.S. Meindl, T.R. Pryzbeck, T.J. Barton, K.G. Heiple and D. Kotting, 1977. The paleodemography of the Libben Site, Ottowa County, Ohio. *Science* 198:291-293.

Lowie, Robert H., 1909. The Assiniboin. *Anthropological Papers of the American Museum of Natural History* vol. 4 part 1.

Lubell, David, Peter Sheppard and Mary Jackes, 1984. Continuity in the Epipaleolithic of Northern Africa with emphasis on the Maghreb. *Advances in World Archaeology* 3:143-190.

MacNeish, Richard S., 1958. An Introduction to the Archaeology of Southeast Manitoba. *National Museum of Canada Bulletin*. No. 157.

Mandelbaum, David G., 1940. The Plains Cree. *American Museum of Natural History Anthropological Papers* vol xxxvii, part 2.

Mantey, Jacquelynn and Leo Pettipas, 1996. An Overview of Western Algonkian Ceramic Traditions, with Special Reference to Manitoba. *Manitoba Archaeological Journal* 6:1-65.

Martin, R. And K. Saller, 1957. *Lehrbuch der Anthropologie*. Jena: Gustav Fischer.

McCullough, Edward J., 1982. Prehistoric Cultural Dynamics of the Lac La Biche Region. *Archaeological Survey of Alberta Occasional Paper* 18.

Meiklejohn, Christopher, 1974. *The Bio-Social Basis of Upper Palaeolithic and Mesolithic Man in Western Europe.* Unpublished Ph.D. thesis, University of Toronto.

----, 1977. Genetic differentiation and deme structure: Considerations for an understanding of the Athapaskan/Algonkian continuum. In J.W. Helmer, S. Van Dyke and F.J Kense eds., *Problems in the Prehistory of the North American Subarctic: The Athapaskan Question*, The University of Calagry Archaeology Association, 106-110.

C. Meiklejohn, J.M. Wyman, K. Jacobs and M.K. Jackes, 1997. Issues in the Archaeological Demography of the Agricultural Transition in Western and Northern Europe: a View from the Mesolithic. In R. Paine, ed., *Integrating Archaeological Demography: Multidisciplinary Approaches to prehistoric Population.* Carbondale: center for Archaeological Investigations, Occasional paper 24: 311-326.

Meindl, Richard S., C. Owen Lovejoy, Robert P. Mensworth and Lydia Don Carlos, 1985. Accuracy and direction of error in the sexing of the skeleton: Implications for paleodemography. *American Journal of Physical Anthropology* 68:79-85.

Melartin, L. And B.S. Blumberg, 1966. Albumin Naskapi: A new Variant of Serum Albumin. *Science* 153:1664-1666.

Meltzer, D.J, 1995. Clocking the first Americans. *Annual review of Anthropology* 24:21-45.

Merriwether, D.A., F. Rothhammer and R.E. Ferrell, 1995. Distribution of the four founding lineage haplotypes in Native Americans suggests a single wave of migration for the New World. *American Journal of Physical Anthropology* 98:411-430.

Meyer, David and Dale Russell, 1987. The Selkirk composite of central Canada: A Reconsideration. *Arctic Anthropology* 24:1-31.

Meyer, David and Scott Hamilton, 1994. Neighbours to the north: peoples of the boreal forest. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500.* Norman: University of Oklahoma Press, 96-128.

Michlovic, M.G., 1983. The Red River Valley in the prehistory of the northern Plains. *Plains Anthropologist* 28:23-31.

——, 1990. Northern Plains-Woodland interaction in prehistory. In: Guy E. Gibbon ed., The Woodland tradition in the western Great Lakes: Papers presented to Elden Johnson. *University of Minnesota Publications in Anthropology* 4, 45-54.

Michlovic, Michael G. And Fred Schneider, 1993. The Shea Site: A prehistoric fortified village on the northeastern Plains. *Plains Anthropologist* 38:117-137.

Milloy, John S., 1988. *The Plains Cree, Trade, Diplomacy and War 1790 to 1870.* Winnipeg:University of Manitoba Press.

Montgomery, Henry, 1908. Prehistoric man in Manitoba and Saskatchewan. *American Anthropologist* 10:33-40.

Nash, Ronald J., 1970. The Prehistory of northern Manitoba. in: W. Hlady ed. *Ten Thousand Years: Archaeology in Manitoba.* Winnipeg:Manitoba Archaeological Society, 77-92.

——, 1975. *Archaeological Investigations in the Transitional Forest Zone: Northern Manitoba, Southern Keewatin, N.W.T. Manitoba.* Winnipeg:Museum of Man and Nature.

Neuman, R.W. 1975. The Sonota Complex and Associated Sites on the Northern Great Plains. *Nebraska State Historical Society Publications in Anthropology* 6.

Nicholson, B.A., 1988. Modeling Subsistence Strategies in the Forest/Grassland Transition Zone of Western Manitoba During the Late Prehistoric and Early Historic Periods. *Plains Anthropologist* 33:351-369.

——, 1990. Ceramic affiliations and the case for incipient horticulture in southwestern Manitoba. *Canadian Journal of Archaeology* 14:33-59.

——, 1991. Modelling a horticultural complex in south-central Manitoba during the late prehistoric period - The Vickers Focus. *Midcontinental Journal of Archaeology* 16:163-188.

——, 1996. Late prehistoric and protohistoric settlement and subsistence in southern Manitoba. In Welsted, John, John Everett and Christoph Stadel eds., *The Geography of Manitoba: Its Land and its People.* Winnipeg, 65-78.

Ossenberg, N. 1974. Origins and relationships of Woodland peoples: the evidence of cranial morphology. In E. Johnson ed., Aspects of Upper Great Lakes Anthropology: papers in honor of Lloyd A. Wilford. *Minnesota Prehistoric Archaeology Series* 11, 15-39.

Patterson, T.C. and C.S. Larsen, 1997. Americas: Paleoanthropology. In F. Spencer ed., *History of Physical Anthropology: An Encyclopedia*, New York: Garland Publishing, 68-74.

Peers, Laura, 1994. *The Ojibwa of Western Canada 1780 to 1870.* Winnipeg:University of Manitoba Press.

Petersen, Hans Chr, 1988. *Studier Over Dansk Stenalders Biologiske Antropologi.* Institut for Genetik og Okologi, Au. Copenhagen.

Pettipas, Leo, 1970. Early man in Manitoba. In W.M. Hlady ed. *Ten Thousand Years: Archaeology in Manitoba*, Winnipeg:MAS, 5-28.

----, 1980. Cultural dynamics of the Late Woodland period of southern Manitoba. In Leo Pettipas ed., *Directions in Manitoba Prehistory - Papers in Honour of Chris Vickers.* Winnipeg:MAS, 141-168.

----, 1992. The Hidatsas in Manitoba. *The Manitoba Archaeological Journal* 2.

Pietrusewsky, Michael, 1974. Neolithic populations of southeast Asia studied by multivariate craniometric analysis. *Homo* 25:207-250.

----, 1984. Metric and non-metric cranial variation in Australian Aboriginal populations compared with populations from the Pacific and Asia. Australian Institute of Aboriginal Studies *Occasional Papers in Human Biology* 3.

----, 1990. Craniofacial variation in Australasian and Pacific populations. *American Journal of Physical Anthropology* 82:319-340.

Proulx, Paul, 1980. The linguistic evidence on the Algonquian-Iroquoian encounter. In Margaret G. Hanna and Brian Kooyman eds., *Approaches to Algonquian Archaeology.* Calgary:The University of Calgary Archaeological Association, 189-212.

Prowse, Tracy L and Nancy C. Lovell, 1996. Concordance of cranial and dental morphological traits and evidence for endogamy in ancient Egypt. *American Journal of Physical Anthropology* 101:237-246.

Rajnovich, G and C.S. Reid, 1978. Selkirk and Clearwater ceramics on Lake of the Woods: An overview. *Archae-Facts* 5:43-48.

Reeves, Brian O.K., 1983. Culture change in the northern Plains: 1000 B.C. - A.D. 1000. *Archaeological Survey of Alberta, Occasional Paper* 20.

Rhodes, Richard A. and Evelyn M. Todd. 1981. Subarctic Algonquian Languages. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 52-66.

Riddle, David, 1996. *Final Report on Results of Field Investigations in the Nelson House Area of the Lower Churchill River Diversion in 1995.* Manuscript on file in the Historic Resources Branch - Government of Manitoba, Winnipeg.

Rogers, Edward S, 1969. Band Organization among the Indians of Eastern Subarctic Canada. *National Museums of Canada Bulletin* 228:21-50.

Rogers, Edward S and J. Garth Taylor. 1981. Northern Ojibwa. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 231-243.

Romesburg, H. Charles, 1984. *Cluster Analysis for Researchers.* Belmont, CA.:Lifetime Learning Publications.

Roth, Eric A., 1980. *Historic demography and population structure of subarctic isolate: Old Crow Village, Yukon Territory.* Unpublished Ph.D. dissertation, University of Toronto.

Rothhammer, Francisco and Claudio Silva, 1990. Craniometrical variation among South American prehistoric populations: climatic, altitudinal, chronological and geographic contributions. *American Journal of Physical Anthropology* 82:9-18.

SAS Institute, 1985; *SAS Users Guide: Statistics, Version 5* edition. Cary, NC.: SAS Institute Inc.

Satterlee James, L and Vernon D. Malan, 1974. *History and Acculturation of the Dakota Indians.* Brookings:South Dakota State University.

Schlesier, Karl H., 1994. Commentary: A History of Ethnic Groups in the Great Plains, AD 150-1550. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500.* Norman: University of Oklahoma Press, 308-381.

Schneider, Fred. 1988. Prehistoric Plant use in Eastern North Dakota: Evidence and Interpretation. Paper presented at the Forty-sixth Annual Plains Anthropological Conference, Wichita, Kansas.

Sciulli, Paul W., 1990. Cranial metric and discrete trait variation and biological differentiation in the terminal Late Archaic of Ohio; The Duff Site cemetery. *American Journal of Physical Anthropology* 82:19-30.

Shipman, Pat, Alan Walker and David Bichell, 1985. *The Human Skeleton.* Cambridge Massachusetts: Harvard University Press.

Siebert, Frank T., 1967. The Original Home of the Proto-Algonkian People. In Contributions to Anthropology: Linguistics I (Algonkian). *National Museum of Canada Bulletin, Anthropological Series* 78:13-47.

Sjovold, Torstein, 1984. A report on the heritability of some cranial measurement and non-metric traits. In G.N. van Vark and W.W. Howells eds., *Multivariate Statistical methods in Physical Anthropology*. Dordrecht/Boston:D. Reidel.

Skinner, Alanson B., 1914. *Political Organization, cults and Ceremonies of the Plains Ojibway and Plains Cree*. New York:The Trustees.

Smith, James G.E., 1976. Territorial distribution of the Western Woods Cree. In William Cowan ed., *Papers of the Seventh Algonquian Conference*, 1975. Ottawa:Carleton University, 414-435.

Snortland-Coles, J. Signe, 1979. The Duck River or Aschkibokahn Site of west-central Manitoba: The role of the northern marsh in the subsistence of Late Woodland peoples. *Papers in Manitoba Archaeology* 7.

Snow, Dean R., 1976. The archaeological implications of the Proto-Algonkian urheimat. In William Cowan ed., *Papers of the Seventh Algonquian Conference*, 1975. Ottawa:Carleton University, 339-346.

Spielman, Richard S., 1973. Differences among Yanomama Indian villages: Do the patterns of allele frequencies, anthropometrics and map locations correspond? *American Journal of Physical Anthropology* 39:461:480.

----, F.J. Da Rocha, Lowell R. Weitkamp, Richard H. Ward, James V. Neel and Napoleon A. Chagnon, 1972. The genetic structure of a tribal population, the Yanomama Indians. VII. Anthropometric differences among Yanomama villages. *American Journal of Physical Anthropology* 37:345:356.

Springer, James W. And Stanley K. Witkowski, 1980. Siouan Historical Linguistics and Oneota Archaeology. *Oneota Studies* 1:69-83.

SPSS Inc, 1986; *SPSS Users Guide, Edition 2*. New York:McGraw Hill.

Spuhler, J. N., 1972. Genetic, linguistic and geographical distances in native North America. In J.S. Weiner and J. Huizinga Eds., *The Assessment of Population Affinities in Man*. Oxford:Clarendon Press, 72-95.

Steele, D. Gentry and Claud A. Bramblett, 1988. *The Anatomy and Biology of the Human Skeleton*. Texas A and M University Press.

Steinbring, Jack H., 1981. Saulteaux of Lake Winnipeg. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 244-255.

Steinbring, Jack H. And Anthony P. Buchner, 1980. The Caribou Lake Complex: A provisional definition. In: Leo Pettipas ed., *Directions in Manitoba Prehistory - Papers in Honour of Chris Vickers*. Winnipeg:MAS, 25-36.

Stevens, James, 1986. *Applied Multivariate Statistics for the Social Sciences.* Hillsdale, New Jersey:Lawrence Erlbaum Associates.

Syms, E.L. 1975. An assessment of the archaeological resources of the Cherry Point Site in southwestern Manitoba. *Archae-facts* 5: Pp 29-56.

----, 1977. Cultural ecology and ecological dynamics of the ceramic period in southwestern Manitoba. *Plains Anthropologist Memoir* 12.

----, 1978. Aboriginal mounds in southern Manitoba: an evaluative overview. *Parks Canada Manuscript Report* 323.

----. 1979. The Devils Lake-Sourisford burial complex on the northeastern Plains. *Plains Anthropologist* 24:283-308.

----, 1980a. Chris Vickers: In Search of Manitoba's Cultural History. In Leo Pettipas ed., *Directions in Manitoba Prehistory - Papers in Honour of Chris Vickers.* Winnipeg:MAS,1-24.

----, 1980b. The co-influence sphere model: A new paradigm for Plains developments and Plains-Parkland-Woodland processual inter-relationships. In Leo Pettipas ed., *Directions in Manitoba Prehistory - Papers in Honour of Chris Vickers.* Winnipeg:MAS, 111-140.

----. 1982. The Arvilla Burial Complex: A re-assessment. *Journal of the North Dakota Archaeological Association* 1:135-166.

----. 1985. Fitting people into the late prehistory of the northwestern Plains: A need to return to a holistic anthropological approach, In J. Spector and E. Johnson eds, *Archaeology, Ecology and Ethno-history of the Prairie-Forest Border Zone of Minnesota and Manitoba.* Lincoln:Reprints in Anthropology 31, 73-107.

----, 1991. *The Important Role of the Assiniboin Nation in Manitoba's History.* Summary paper presented to the Manitoba Heritage Council.

----, 1997. *Assiniboin (Nakota) First Nation.* Winnipeg:Manitoba Culture, Heritage and Citizenship Branch.

Tabachnick, Barbara G. and Linda S. Fidell, 1989. *Using Multivariate Statistics.* New York:Harper and Row.

Tanner, John, 1830 (1994 ed). *The Falcon. A Narrative of the Captivity and Adventures of John Tanner During Thirty Years Residence Among the Indians in the Interior of North America.* Harmonsworth, England:Penguin Books.

Tisdale, Mary Ann, 1978. Investigations at the Stott Site: A review of research from 1947 to 1977. *Papers in Manitoba Archaeology* 5.

Torroni, A., T.G. Schurr, M.F. Campbell, M.D. Brown, J.V. Neel, M. Larsen, D.G. Smith, C.M. Vullo and D.C. Wallace, 1993. Asian affinities and continental radiation of the four founding Native American mt DNAs. *American Journal of Human Genetics* 53:563-590.

Trask, R.L., 1974. *Language Change*. London: Routledge.

Turner, C.G., II, 1986. Dentochronological separation estimates for Pacific rim populations. *Science* 232:1140-1142.

----, 1987. Late Pleistocene anf Holocene population history of East Asia based on dental variation. *American Journal of Physical Anthropology* 73:305-321.

Van Vark, G.N., 1976. A critical evaluation of the application of multivariate statistical methods to the study of human populations from their skeletal remains. *Homo* 27:94-114.

Vehik, S.C. 1982. Social determinants of Middle Woodland mortuary practices on the northeastern plains periphery: A consideration of Hopewellian Relationships. *Journal of the North Dakota Archaeological Association* 1:135-166.

Vickers, Roderick J. 1994. Cultures of the northwestern plains: from the boreal forest edge to Milk River. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500*. Norman: University of Oklahoma Press, 3-33.

Voorhis, Paul H., 1978. Some Glottochronologic dates for Algonquian and Siouan Peoples. *Archae-Facts* 5:8-18.

Walde, Dale, David Meyer and Wendy Unfreed, 1995. The Late period on the Canadian and adjacent plains. *Revista de Arqueologia Americana* 9:7-66.

Weir, Thomas R., 1983. *Atlas of Manitoba*. Winnipeg:Surveys and Mapping Branch, Province of Manitoba.

White, Tim D. And Pieter A. Folkens, 1991. *Human Osteology*. San Diego:Academic Press.

Wilcox, David R, 1988. Avonlea and southern Athapaskan migrations. In Leslie B. Davis ed. *Avonlea Yesterday and Today: Archaeology and Prehistory*. Saskatoon: Saskatchewan Archaeological Society, 273-280.

Wilford, L.A. 1955. A revised classification of the prehistoric cultures of Minnesota. *American Antiquity* 22:130-142.

Wilkinson, L., 1986; *SYSTAT:The System for Statistics*. Evanson, Illinois:SYSTAT Inc..

Wilmink, F.W. and H.T. Utterschaut, 1984; Cluster analysis, history, theory and applications. In G.N. van Vark and W.W. Howells eds., *Multivariate Statistical methods in Physical Anthropology*. Dordrecht/Boston:D. Reidel, 135-176.

Wilson, Susan R., 1984. Towards an understanding of data in physical anthropology. In G.N. van Vark and W.W. Howells eds., *Multivariate Statistical methods in Physical Anthropology*. Dordrecht/Boston:D. Reidel, 261-282.

----- and Loesch, D.Z., 1989. Principal component analysis of shape in adult individuals. *Annals of Human Biology* 16:361-368.

Winham, R. Peter and Edward J. Lueck, 1994. Cultures of the Middle Missouri. In Karl H. Schlesier ed., *Plains Indians, A.D. 500-1500*. Norman: University of Oklahoma Press, 149-175.

Wishart, David, 1987. *Clustan Users Manual*. St. Andrews, Scotland: University of St. Andrews.

Wissler, F.C., 1922. *The American Indian: An Introduction to the Anthropology of the New World*. 2nd ed. New York:Oxford University Press.

Wolfart, H. Christopher, 1973. Plains Cree: A grammatical study. *Transactions of the American Philosophical Society* n.s. 63.

Wright, James V., 1965. A regional examination of Ojibwa culture history. *Anthropologica* 7:189-227.

----, 1967. The Laurel Tradition and the Middle Woodland period. *National Museum of Canada Bulletin* 217.

----, 1968. The application of the direct historical approach to the Iroquois and the Ojibwa. *Ethnohistory* 15:96-111.

----, 1971. Cree culture history in the Southern Indian Lake Region. *National Museum of Canada Bulletin*, 224:1-85.

----, 1981. Prehistory of the Canadian Shield. In: William C. Sturtevant ed., *Handbook of North American Indians* 6 (Subarctic). Washington:Smithsonian Institution, 86-96.

Wyman, Jeffrey M., 1993. Affinities of skeletal material from the Winnipeg River system. *Plains Anthropologist* 38:65-78.

Zar, Jerrold R., 1974. *Biostatistical Analysis.*: Englewood Cliffs, N.J:Prentice-Hall.

CRANIOMETRIC RELATIONSHIPS OF ABORIGINAL SPECIMENS FROM MANITOBA

FIGURES AND APPENDICES

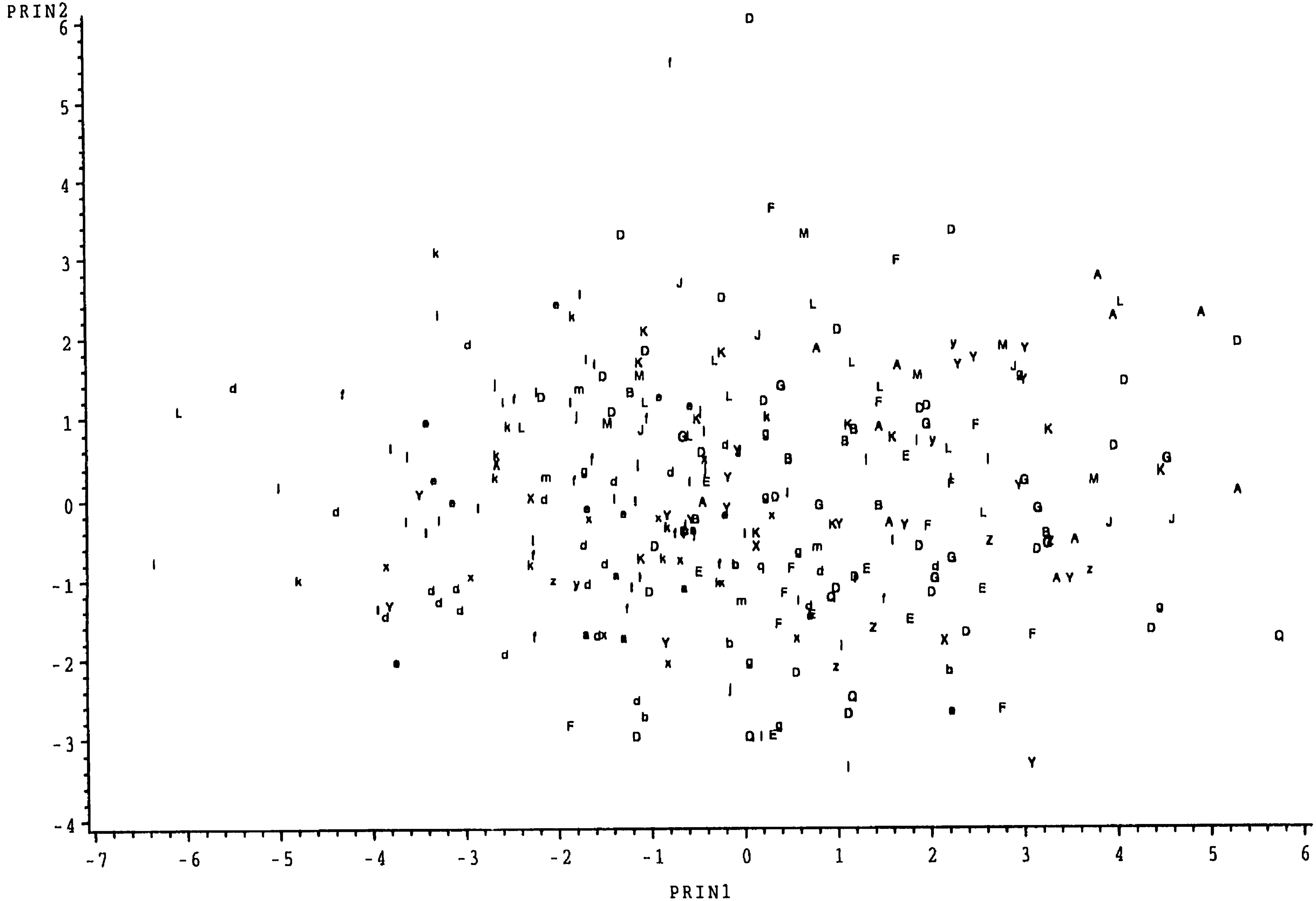


FIG. 5.1. RUN 1.1 PRINCIPAL COMPONENTS ALL GROUPS BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

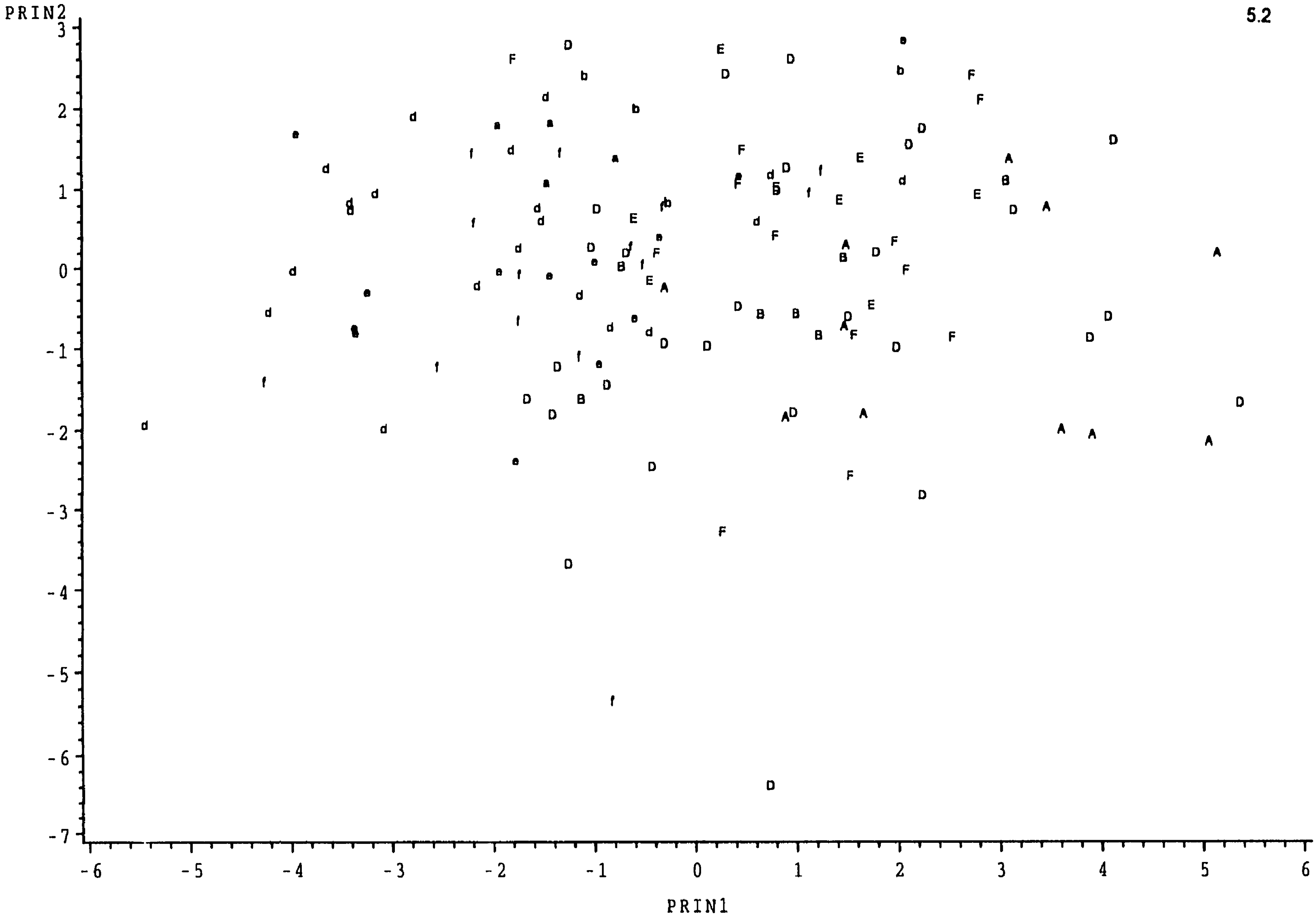


FIG. 5.2. RUN 2.1 PRINCIPAL COMPONENTS MANITOBA CASES BOTH SEXES

A = NORMAN B = INTERLAKE D = WESTMAN E = REDRIVER F = EASTMAN G = HUNGRY HALL
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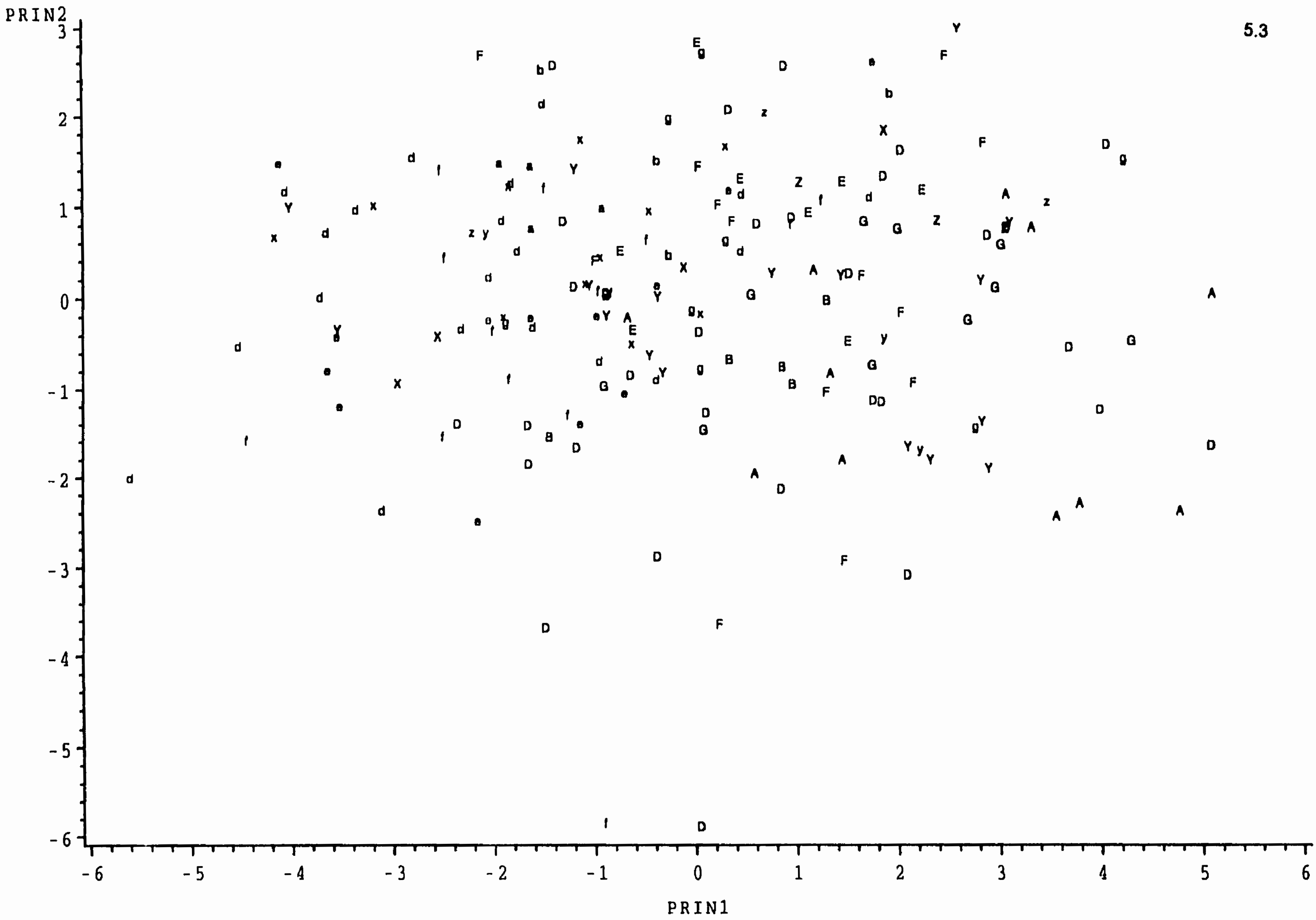

FIG. 5.3. RUN 3.1 PRINCIPAL COMPONENTS MANITOBA PLUS MINNESOTA/ONTARIO CASES BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
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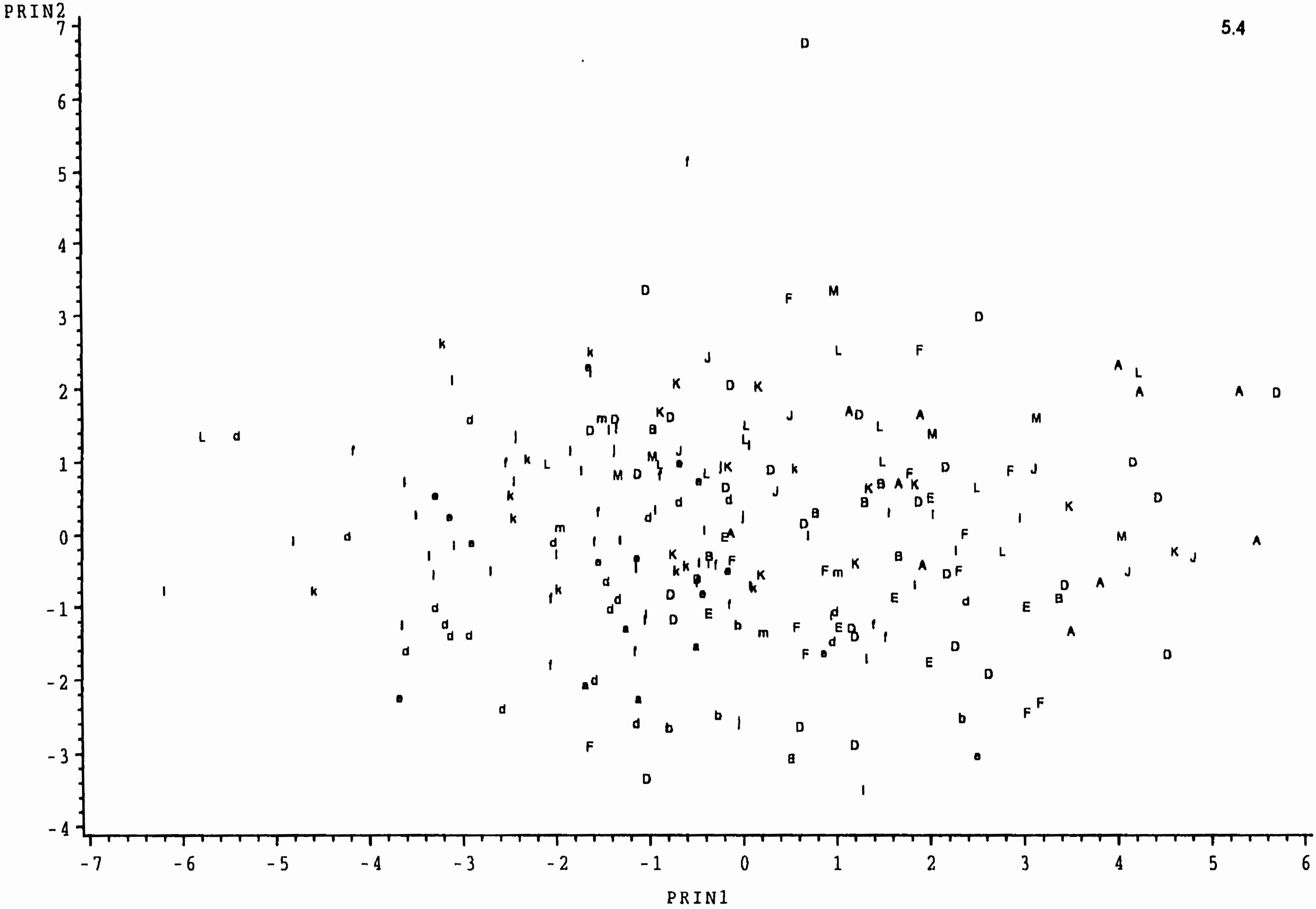

FIG. 5.4. RUN 4.1 PRINCIPAL COMPONENTS MANITOBA PLUS NORTH DAKOTA CASES BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

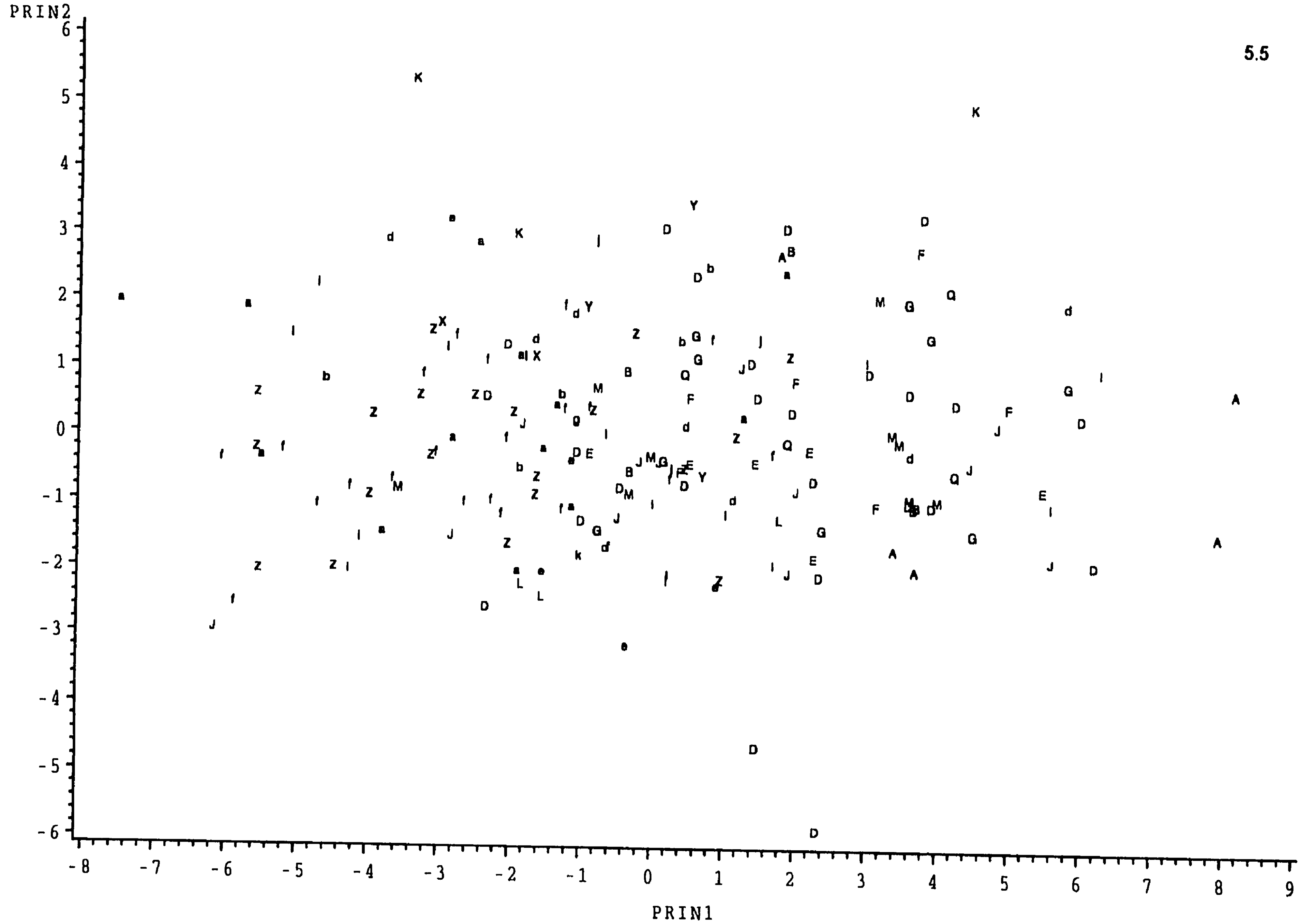

FIG. 5.5. RUN 5.1 PRINCIPAL COMPONENTS ALL GROUPS BOTH SEXES TOTAL DATA

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

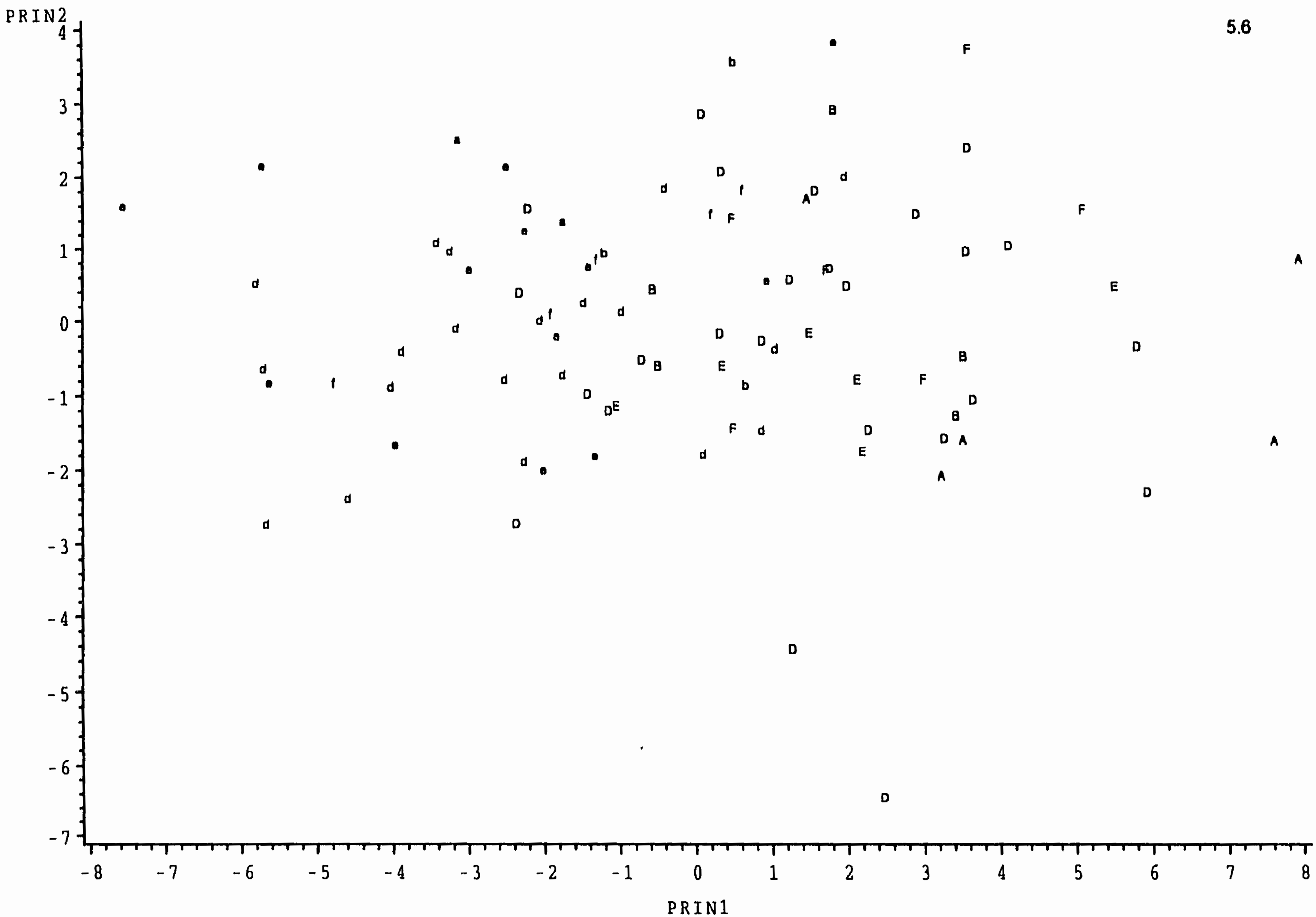

FIG. 5.6. RUN 6.1 PRINCIPAL COMPONENTS MANITOBA CASES BOTH SEXES TOTAL DATA

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I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

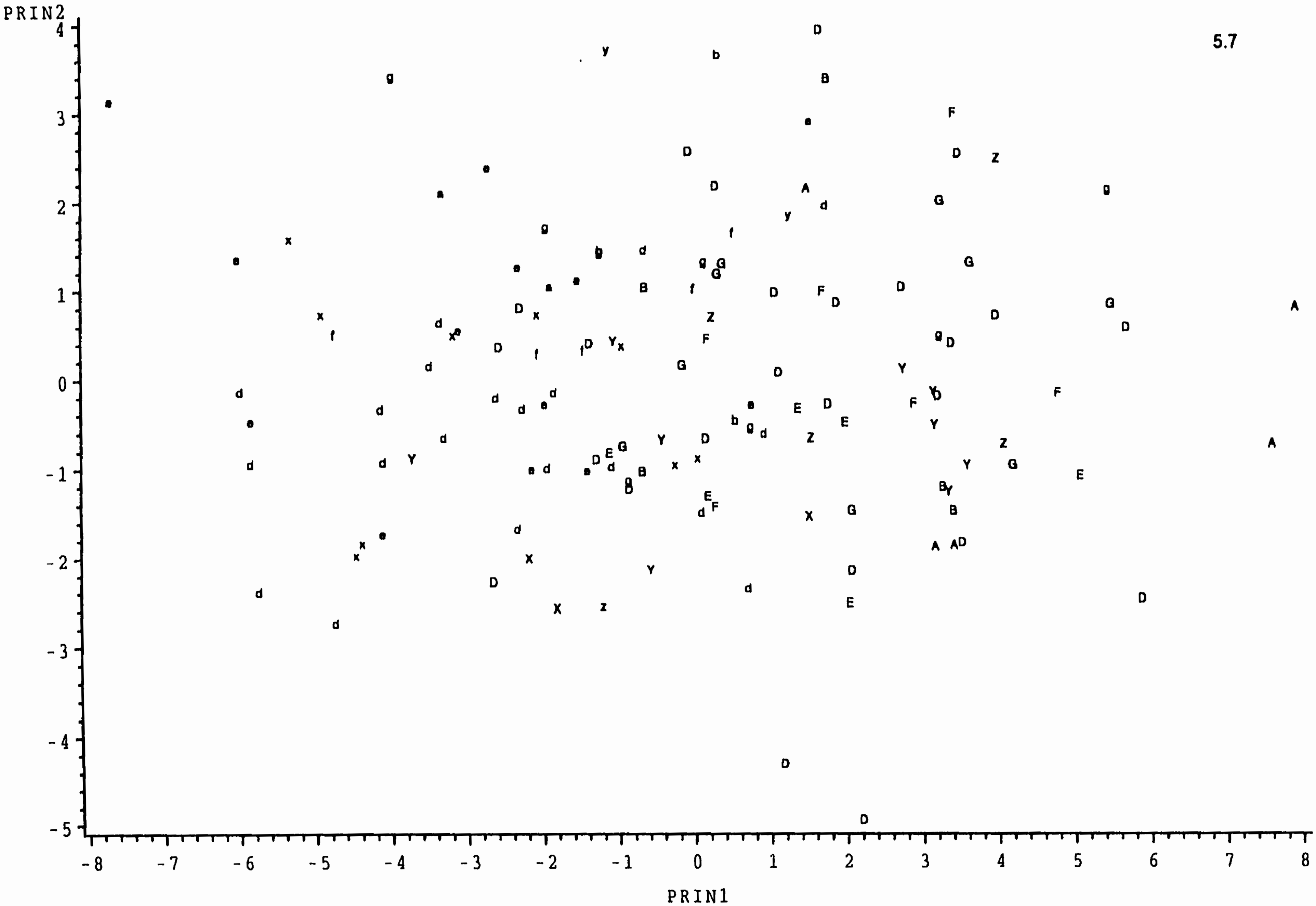


FIG. 5.7. RUN 7.1 PRINCIPAL COMPONENTS MANITOBA PLUS MINNESOTA/ONTARIO CASES BOTH SEXES TOTAL DATA

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

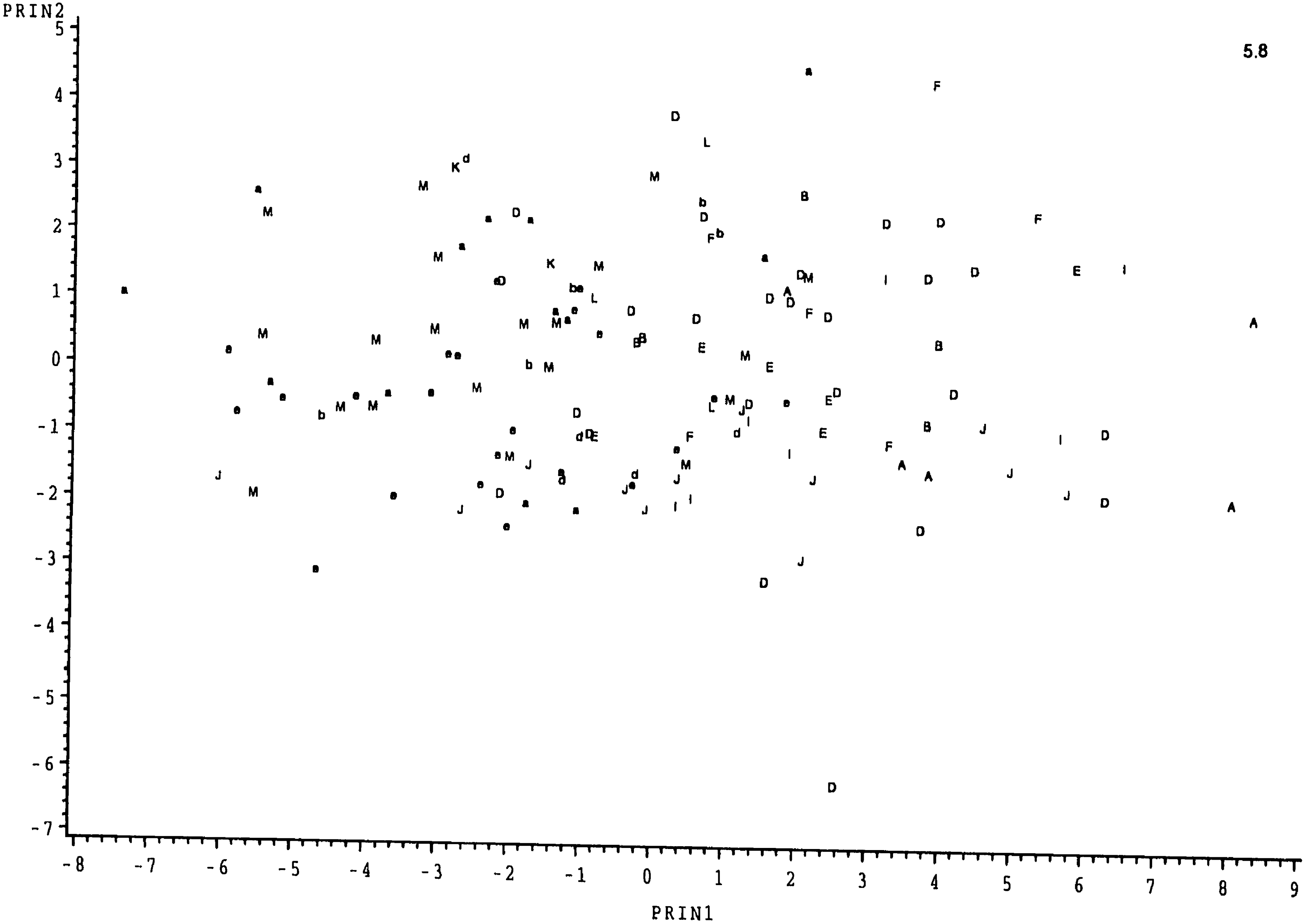


FIG. 5.8. RUN 8.1 PRINCIPAL COMPONENTS MANITOBA PLUS NORTH DAKOTA CASES BOTH SEXES TOTAL DATA

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

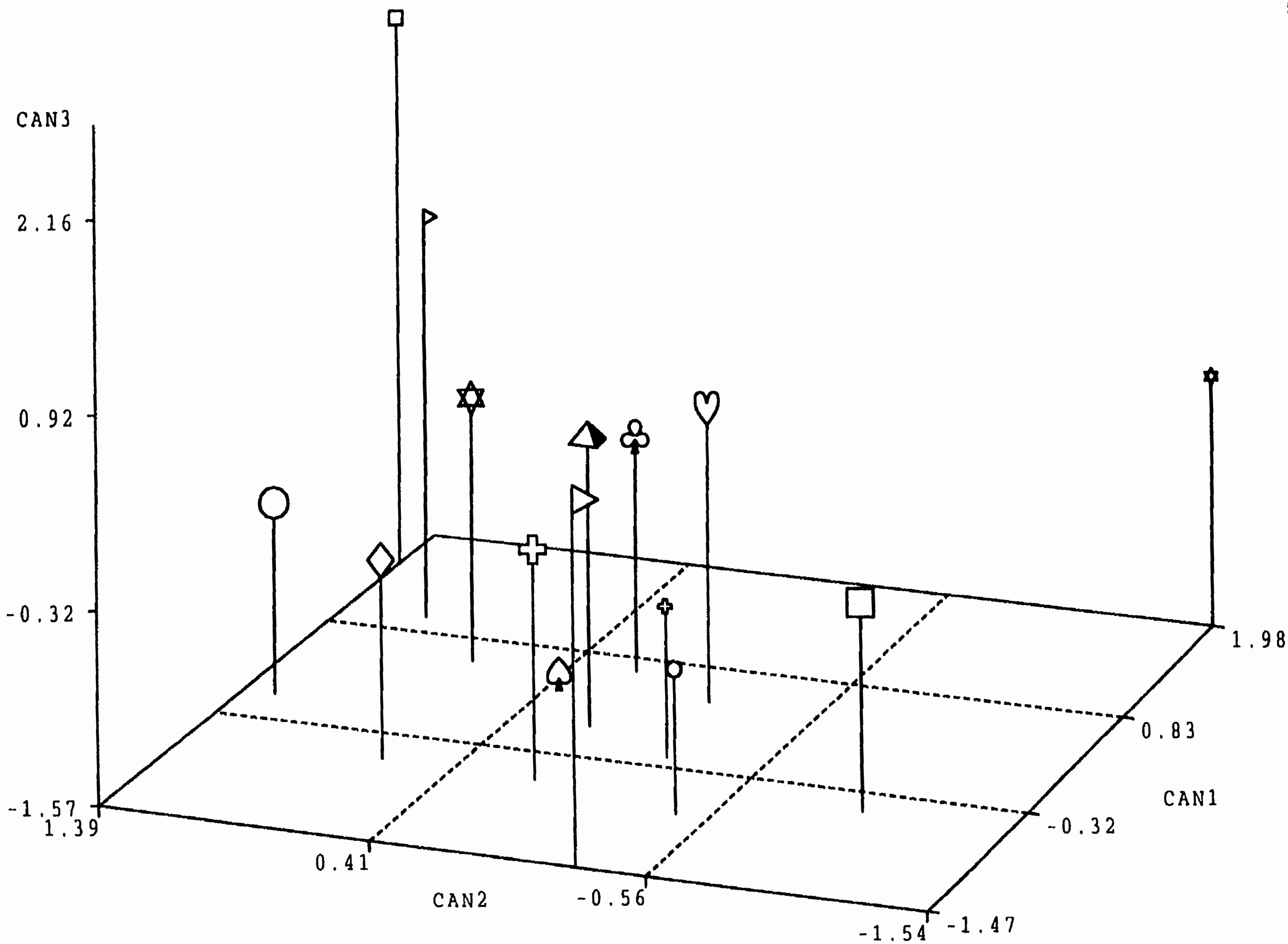


FIG. 5.9. RUN 9.1 CANONICAL PLOT OF CRANIAL VAULT DATA – MEANS OF ALL GROUPS – BOTH SEXES

LG BALLOON=NORMAN LG STAR=INTERLAKE LG HEART=PLAINS LG CLUB=RED RIVER LG DIAMOND=EASTMAN LG SPADE=NONTARIO
LG CROSS=DLS LG FLAG=MANDAN LG SQUARE=SARVILLA LG PYRAMID=SIOUX SM BALLOON=SONOTA SM STAR=MARVILLA
SM CROSS=BLACKDUCK SM FLAG=LAUREL SM SQUARE=CAUCASIAN

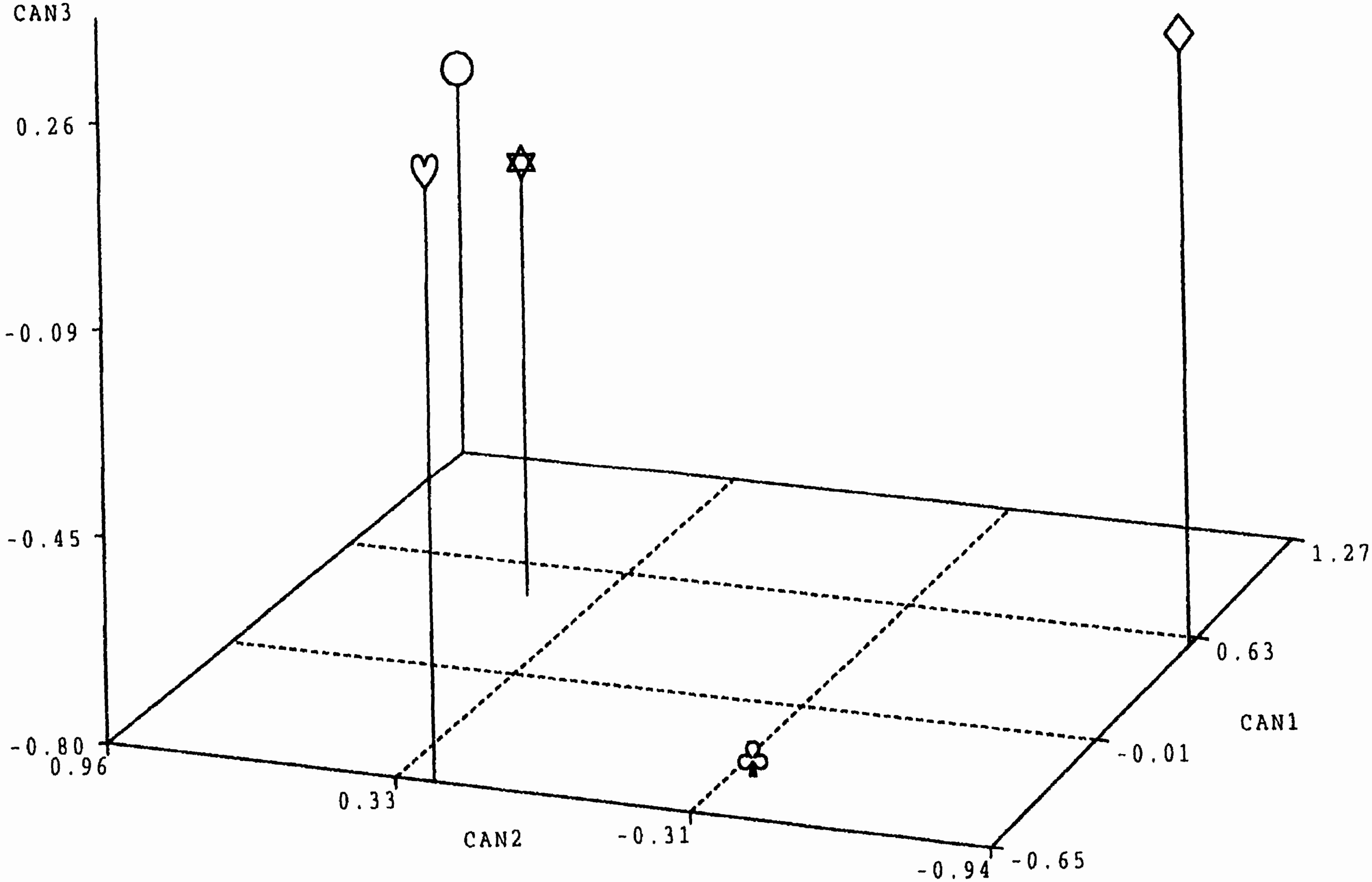


FIG. 5.10. RUN 10.1 CANONICAL PLOT OF CRANIAL VAULT DATA – MEANS OF MANITOBA GROUPS – BOTH SEXES

LG BALLOON = NORMAN LG STAR = INTERLAKE LG HEART = PLAINS LG CLUB = RED RIVER LG DIAMOND = EASTMAN LG SPADE = NONTARIO
LG CROSS = DLS LG FLAG = MANDAN LG SQUARE = SARVILLA LG PYRAMID = SIOUX SM BALLOON = SONOTA SM STAR = MARVILLA
SM CROSS = BLACKDUCK SM FLAG = LAUREL SM SQUARE = CAUCASIAN

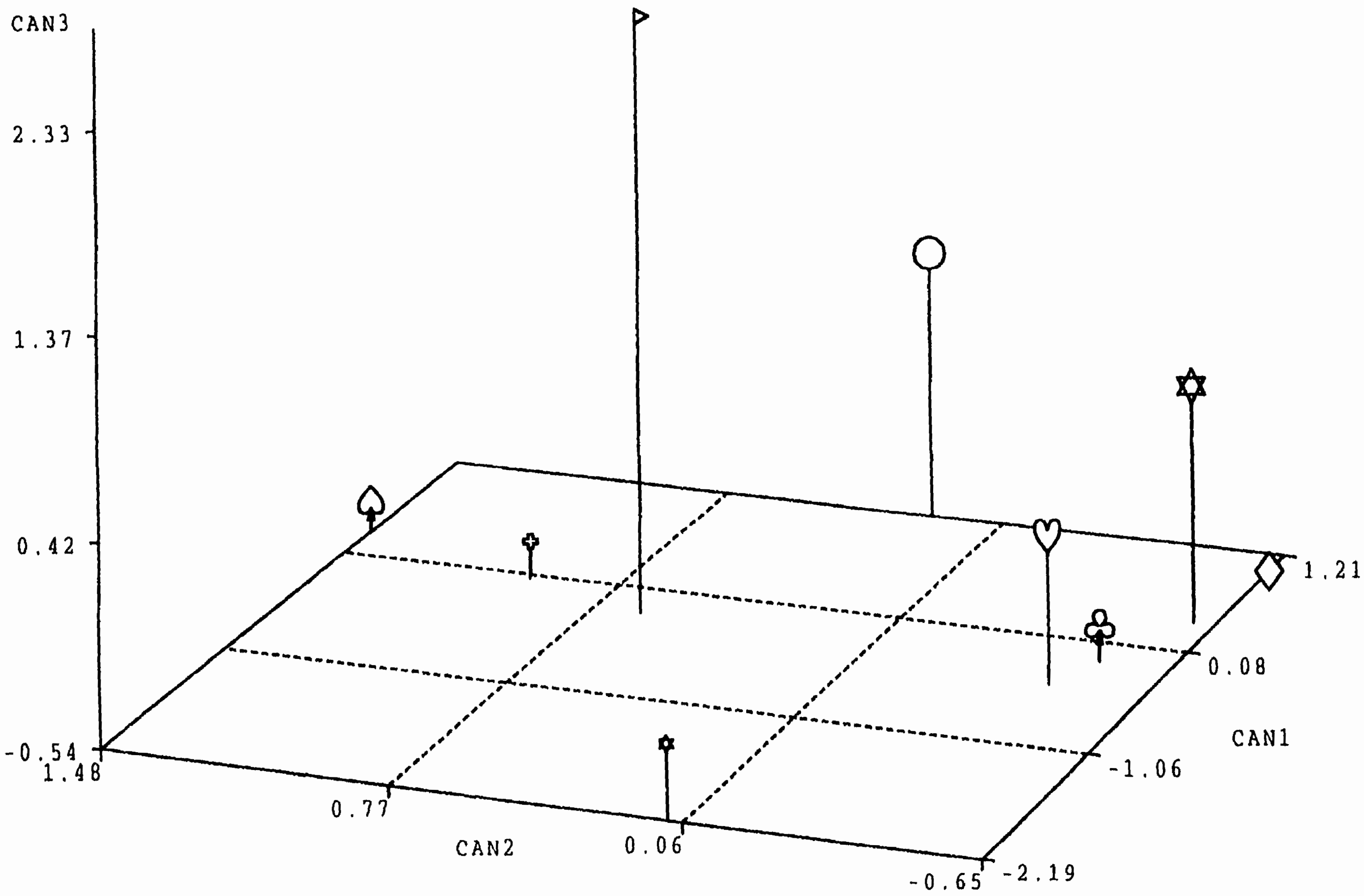


FIG. 5.11. RUN 11.1 CANONICAL PLOT OF VAULT DATA – MEANS OF MANITOBA/MINNESOTA/ONTARIO GROUPS – BOTH SEXES

LG BALLOON = NORMAN LG STAR = INTERLAKE LG HEART = PLAINS LG CLUB = RED RIVER LG DIAMOND = EASTMAN LG SPADE = NONTARIO
LG CROSS = DLS LG FLAG = MANDAN LG SQUARE = SARVILLA LG PYRAMID = SIOUX SM BALLOON = SONOTA SM STAR = MARVILLA
SM CROSS = BLACKDUCK SM FLAG = LAUREL SM SQUARE = CAUCASIAN

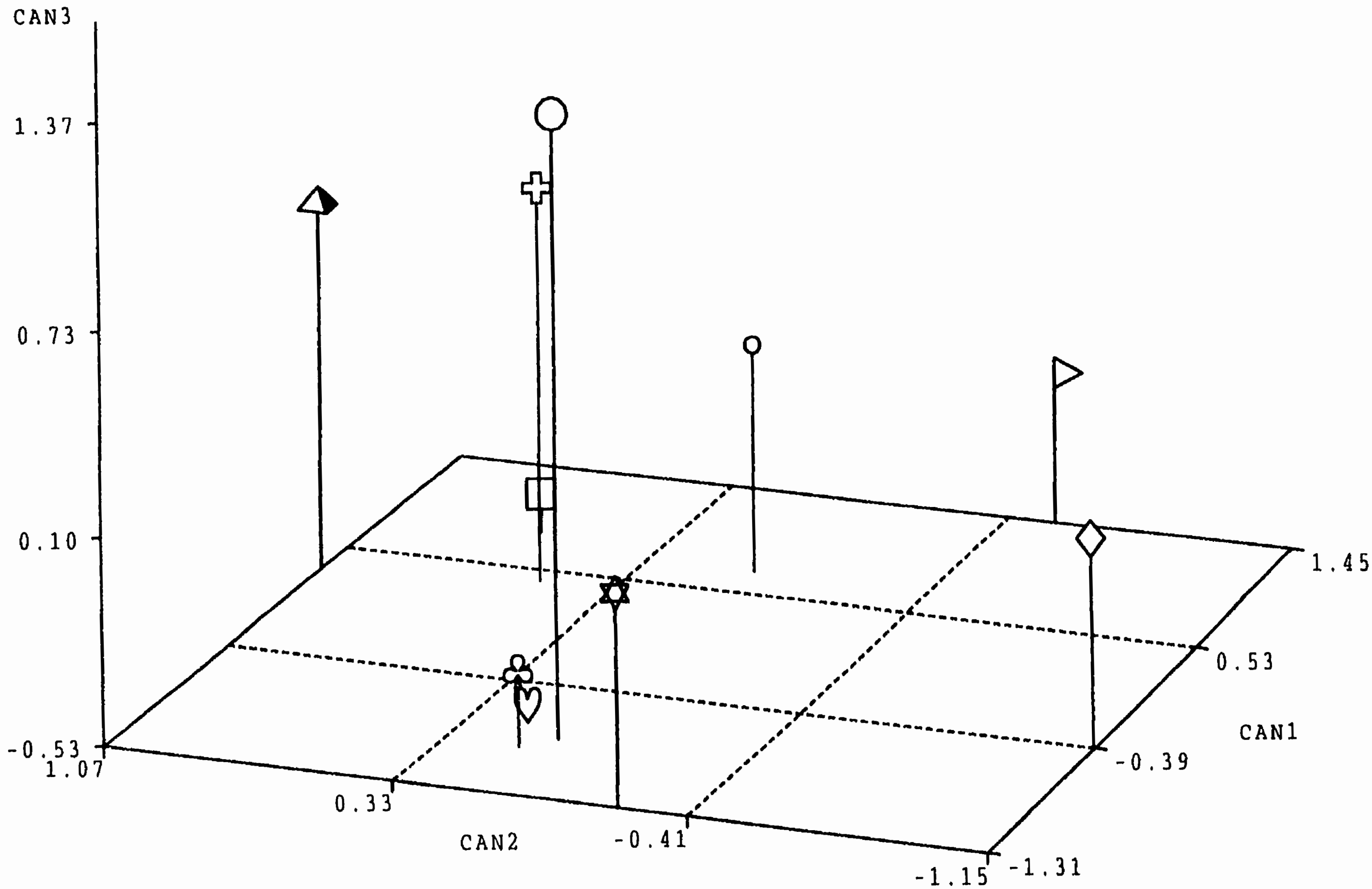


FIG. 5.12. RUN 12.1 CANONICAL PLOT OF CRANIAL VAULT DATA – MEANS OF MANITOBA/NORTH DAKOTA GROUPS – BOTH SEXES

LG BALLOON=NORMAN LG STAR=INTERLAKE LG HEART=PLAINS LG CLUB=RED RIVER LG DIAMOND=EASTMAN LG SPADE=NONTARIO
LG CROSS=DLS LG FLAG=MANDAN LG SQUARE=SARVILLA LG PYRAMID=SIOUX SM BALLOON=SONOTA SM STAR=MARVILLA
SM CROSS=BLACKDUCK SM FLAG=LAUREL SM SQUARE=CAUCASIAN

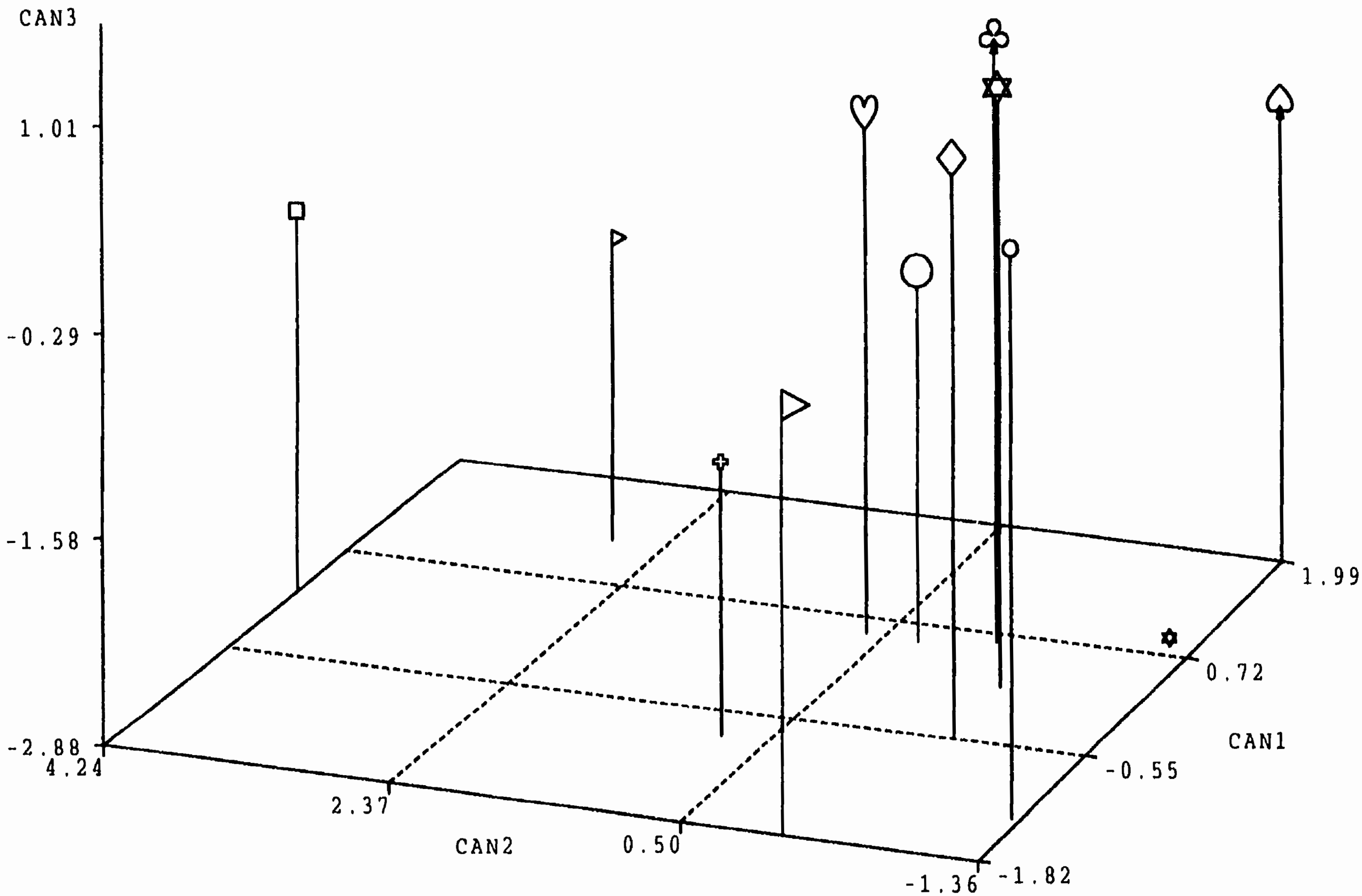


FIG. 5.13. RUN 13.1 CANONICAL PLOT OF TOTAL DATA – MEANS OF ALL GROUPS – BOTH SEXES

LG BALLOON = NORMAN LG STAR = INTERLAKE LG HEART = PLAINS LG CLUB = RED RIVER LG DIAMOND = EASTMAN LG SPADE = NONTARIO
LG CROSS = DLS LG FLAG = MANDAN LG SQUARE = SARVILLA LG PYRAMID = SIOUX SM BALLOON = SONOTA SM STAR = MARVILLA
SM CROSS = BLACKDUCK SM FLAG = LAUREL SM SQUARE = CAUCASIAN

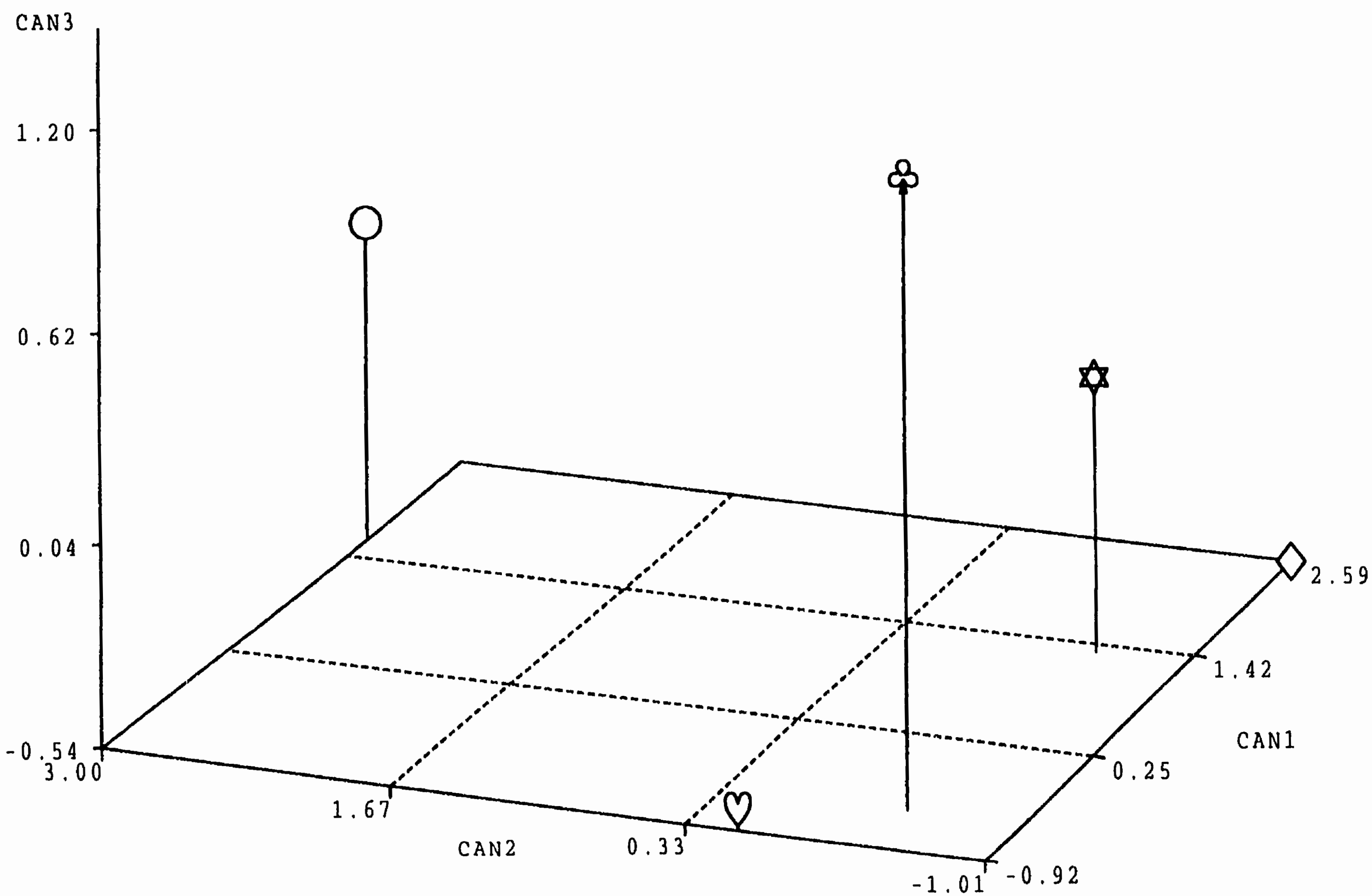


FIG. 5.14. RUN 14.1 CANONICAL PLOT OF TOTAL DATA – MEANS OF MANITOBA GROUPS – BOTH SEXES

LG BALLOON = NORMAN LG STAR = INTERLAKE LG HEART = PLAINS LG CLUB = RED RIVER LG DIAMOND = EASTMAN LG SPADE = NONTARIO
LG CROSS = DLS LG FLAG = MANDAN LG SQUARE = SARVILLA LG PYRAMID = SIOUX SM BALLOON = SONOTA SM STAR = MARVILLA
SM CROSS = BLACKDUCK SM FLAG = LAUREL SM SQUARE = CAUCASIAN

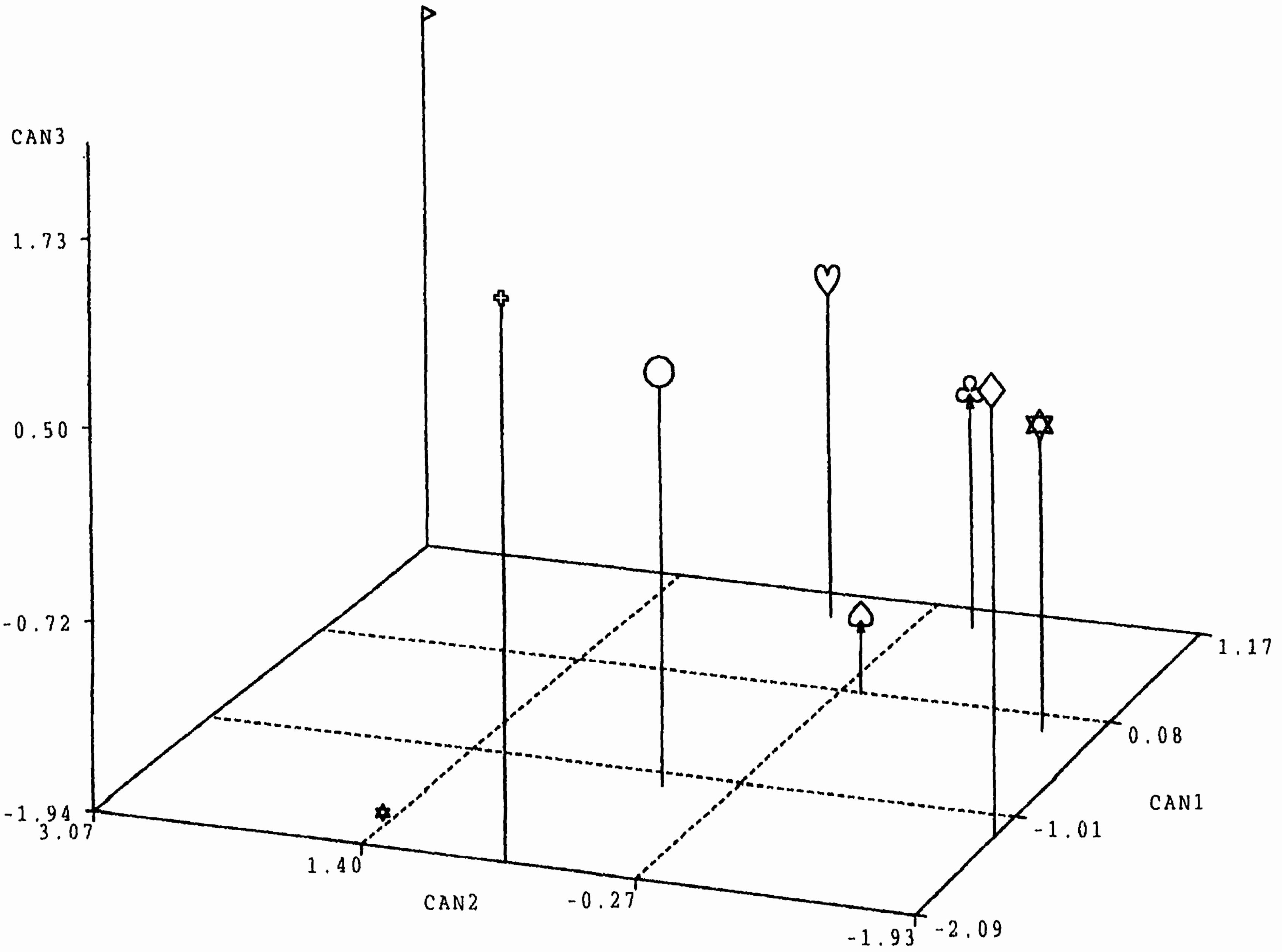


FIG. 5.15. RUN 15.1 CANONICAL PLOT OF TOTAL DATA – MEANS OF MANITOBA/MINNESOTA/ONTARIO GROUPS – BOTH SEXES

LG BALLOON = NORMAN LG STAR = INTERLAKE LG HEART = PLAINS LG CLUB = RED RIVER LG DIAMOND = EASTMAN LG SPADE = NONTARIO
LG CROSS = DLS LG FLAG = MANDAN LG SQUARE = SARVILLA LG PYRAMID = SIOUX SM BALLOON = SONOTA SM STAR = MARVILLA
SM CROSS = BLACKDUCK SM FLAG = LAUREL SM SQUARE = CAUCASIAN

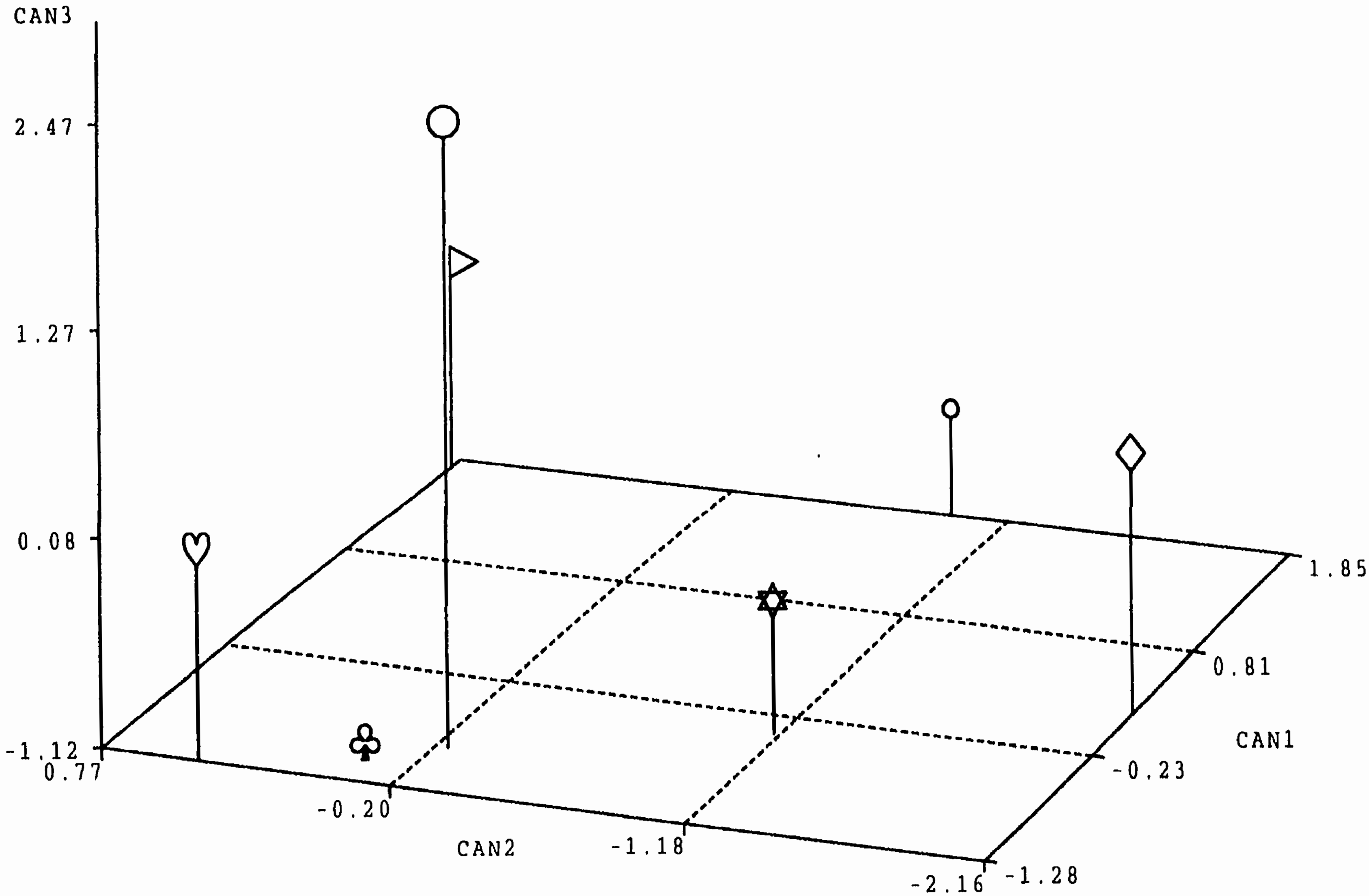


FIG. 5.16. RUN 16.1 CANONICAL PLOT OF TOTAL DATA – MEANS OF MANITOBA/NORTH DAKOTA GROUPS – BOTH SEXES

LG BALLOON=NORMAN LG STAR=INTERLAKE LG HEART=PLAINS LG CLUB=RED RIVER LG DIAMOND=EASTMAN LG SPADE=NONTARIO
LG CROSS=DLS LG FLAG=MANDAN LG SQUARE=SARVILLA LG PYRAMID=SIOUX SM BALLOON=SONOTA SM STAR=MARVILLA
SM CROSS=BLACKDUCK SM FLAG=LAUREL SM SQUARE=CAUCASIAN

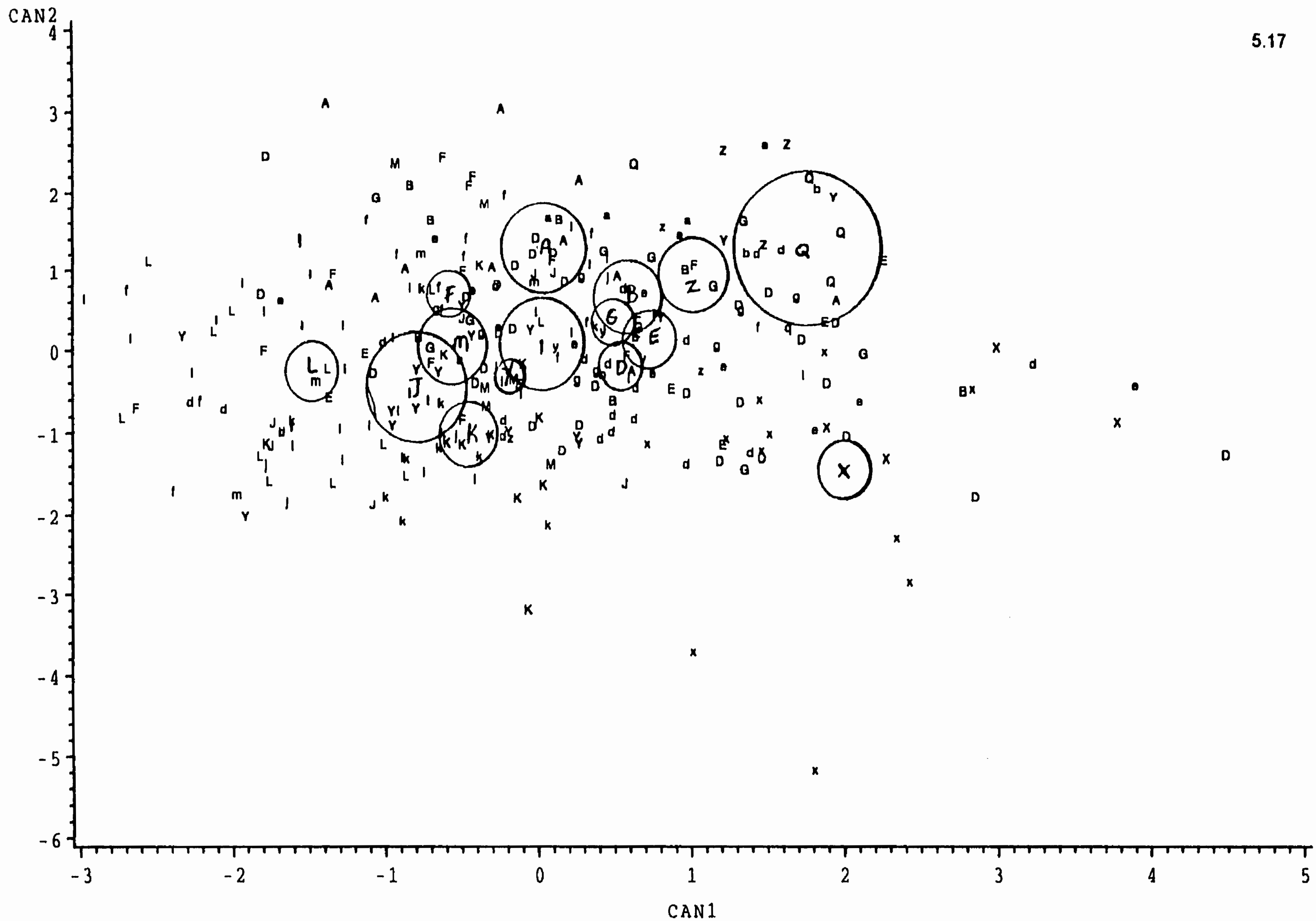


FIG. 5.17. RUN 17.1 CANONICAL VAULT DATA – ALL GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

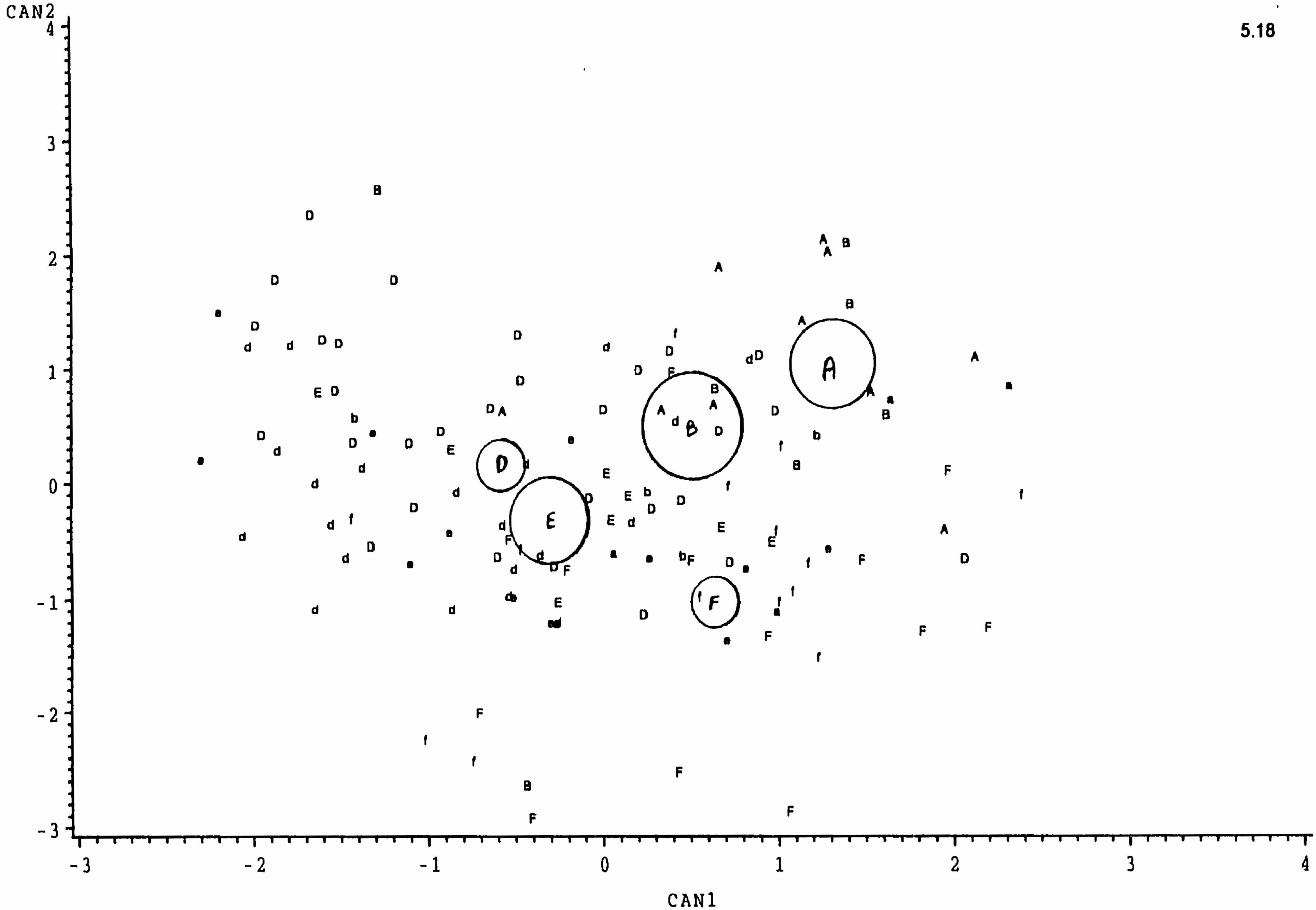


FIG. 5.18. RUN 18.1 CANONICAL VAULT DATA – MANITOBA GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

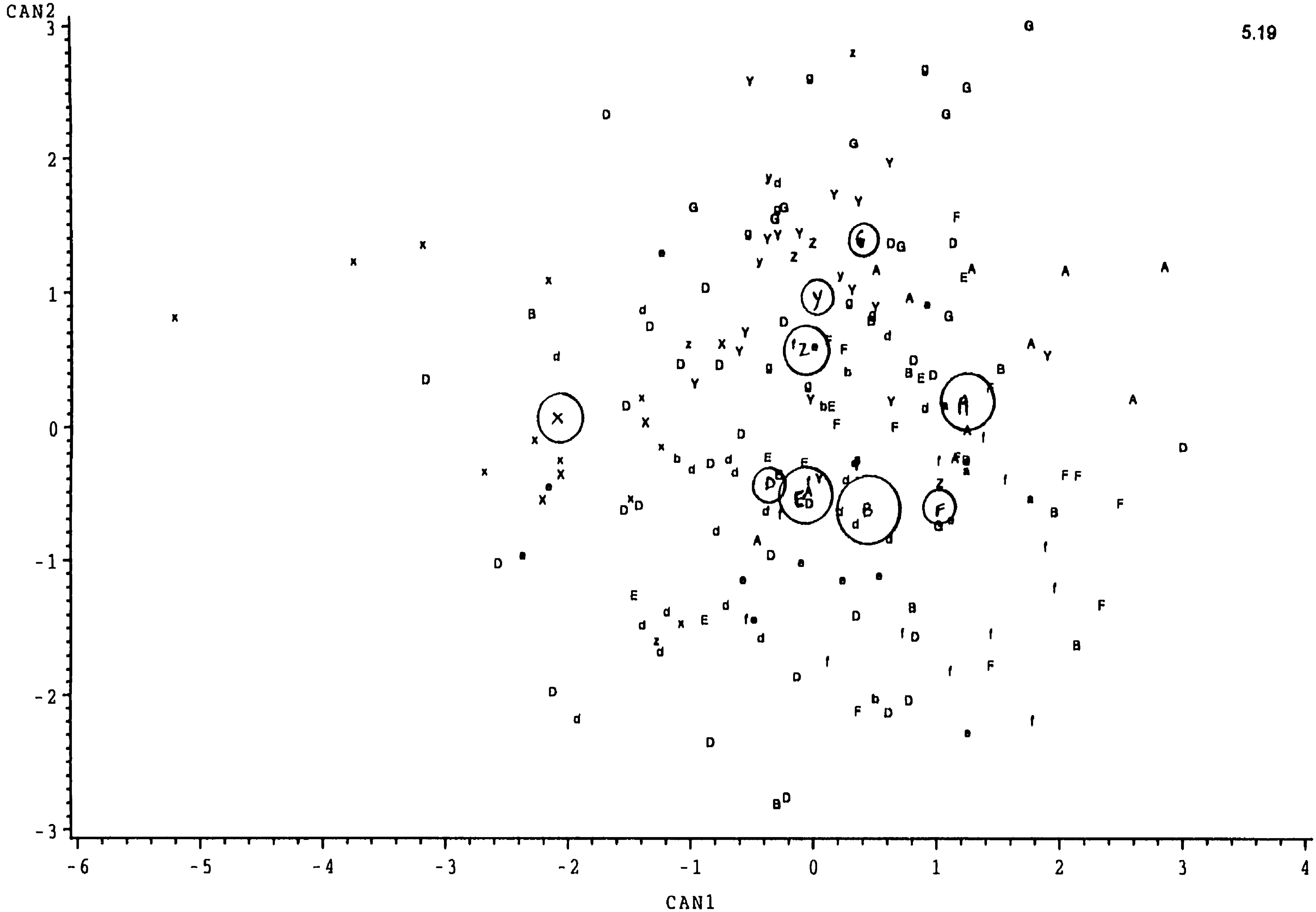


FIG. 5.19. RUN 19.1 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO CASES – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

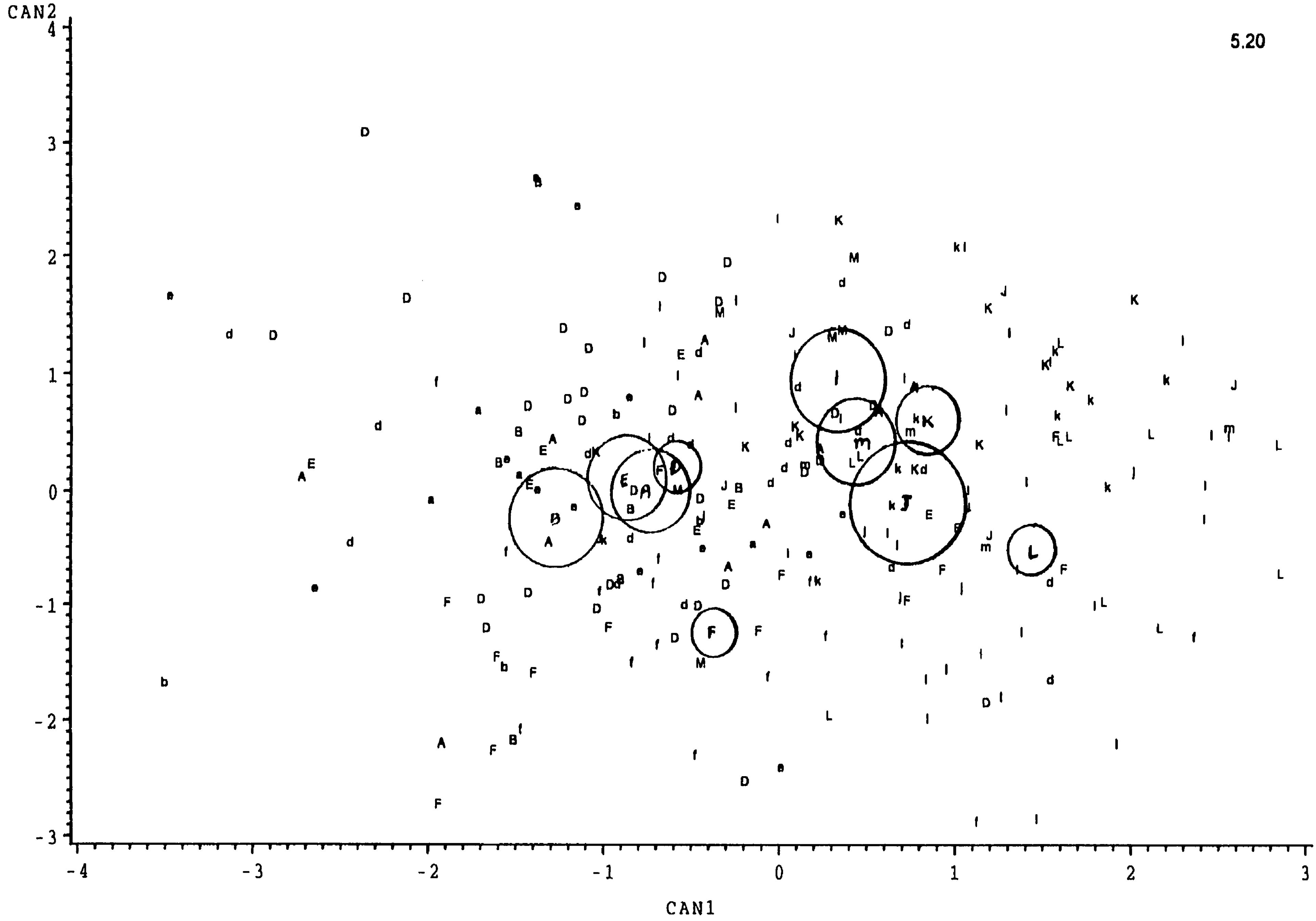


FIG. 5.20. RUN 20.1 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

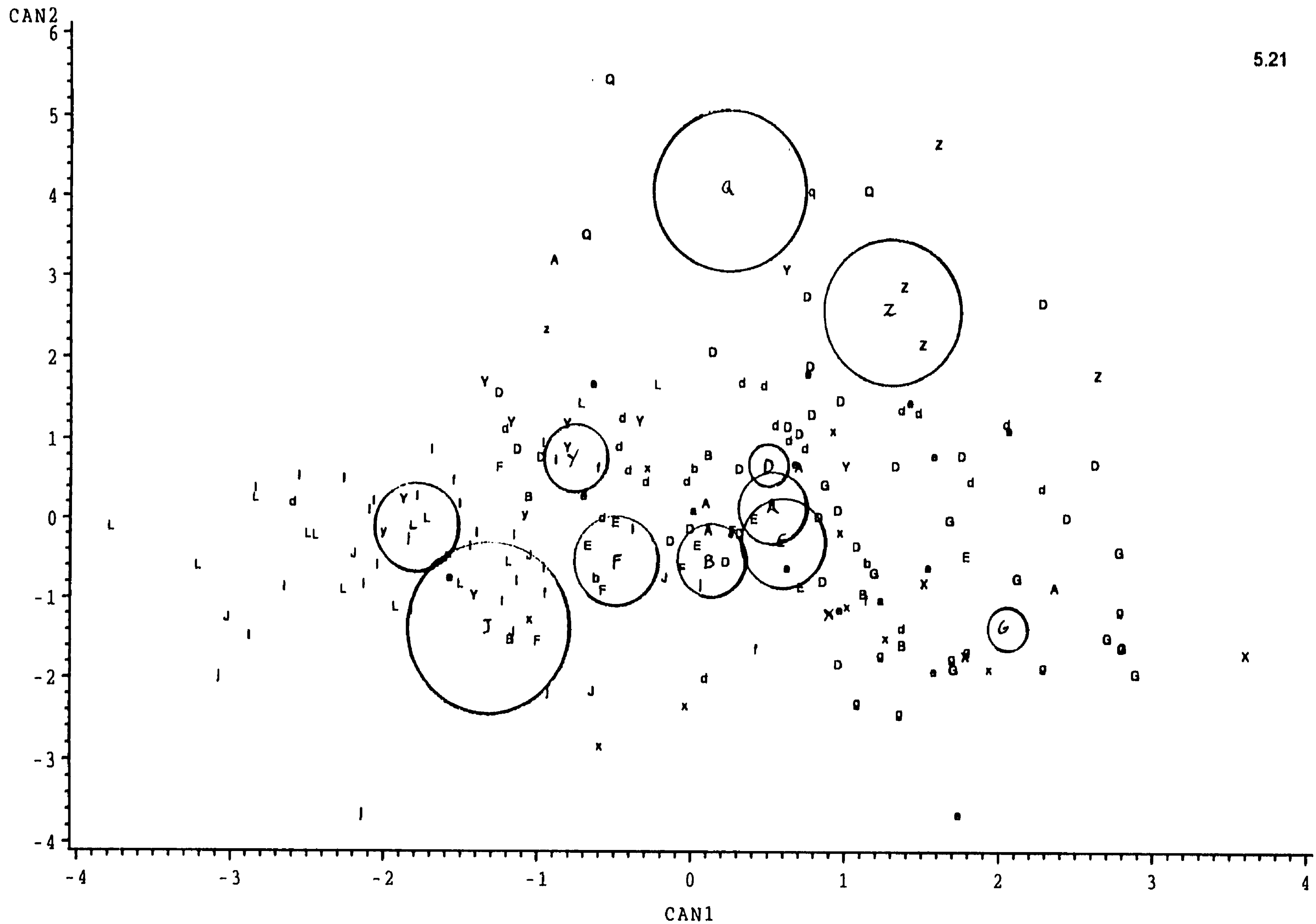


FIG. 5.21. RUN 21.1 CANONICAL TOTAL DATA – ALL GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

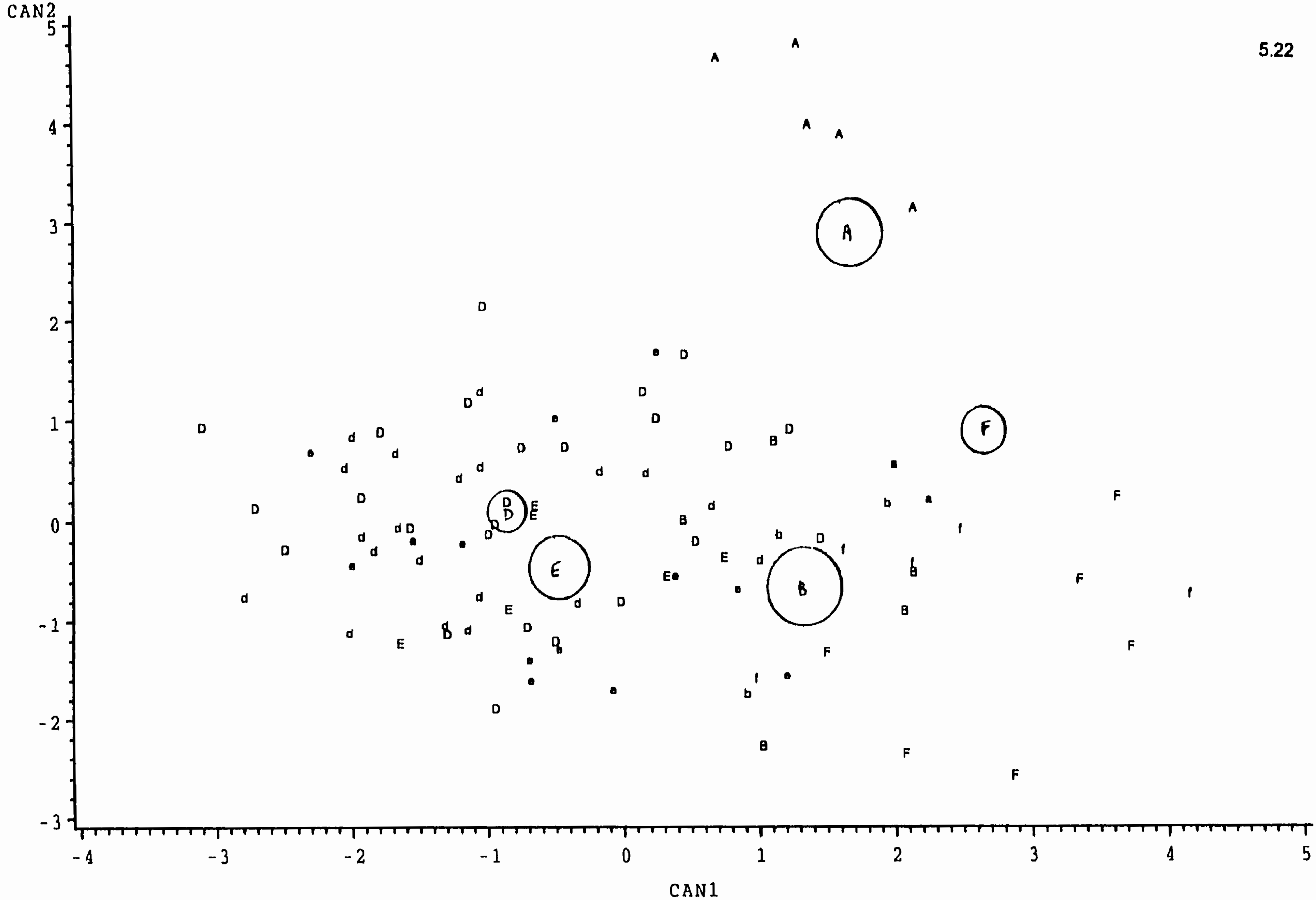


FIG. 5.22. RUN 22.1 CANONICAL TOTAL DATA – MANITOBA GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

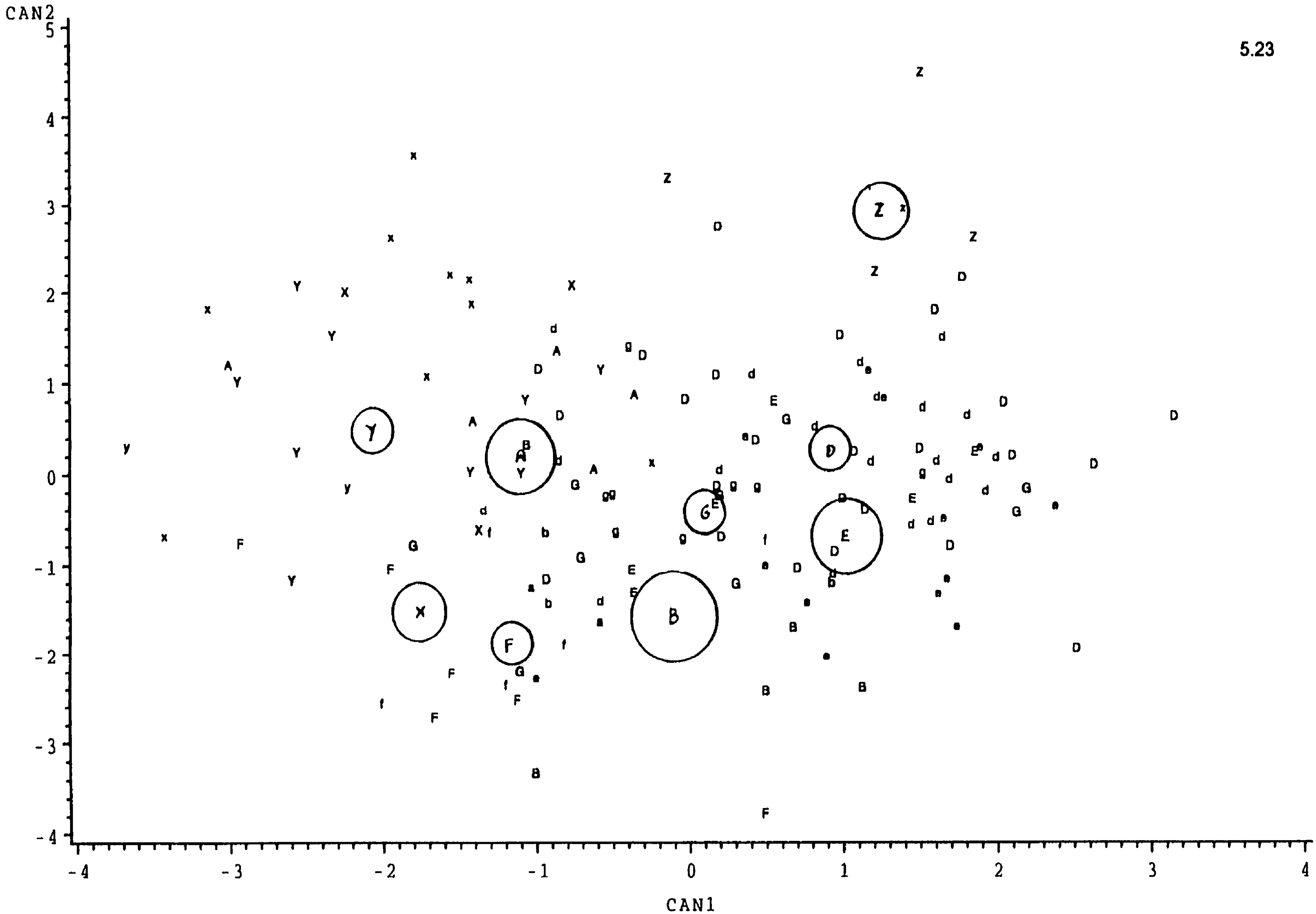


FIG. 5.23. RUN 23.1 CANONICAL TOTAL DATA – MANITOBA/MINNESOTA/ONTARIO CASES – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

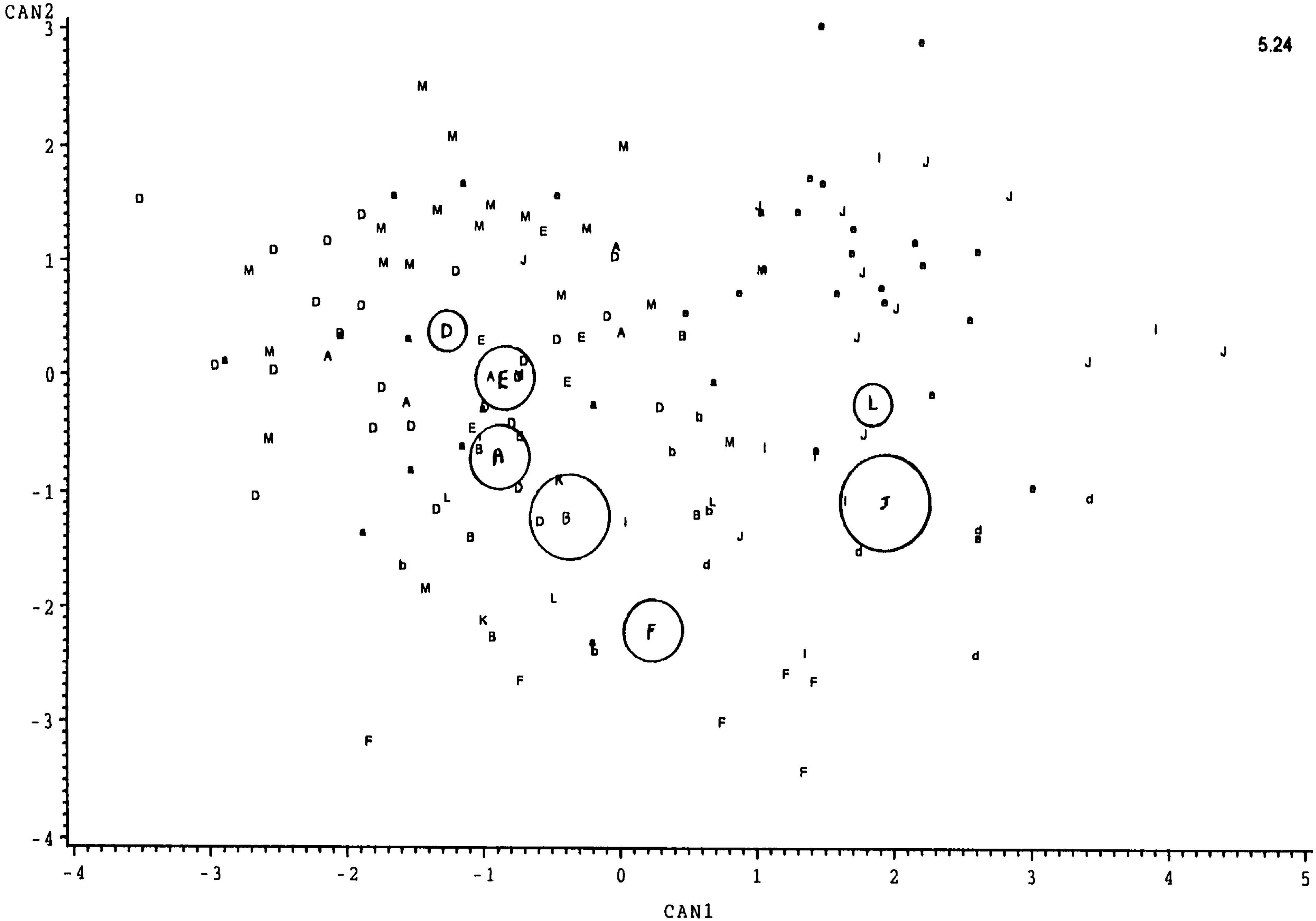


FIG. 5.24. RUN 24.1 CANONICAL TOTAL DATA – MANITOBA/NORTH DAKOTA GROUPS – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

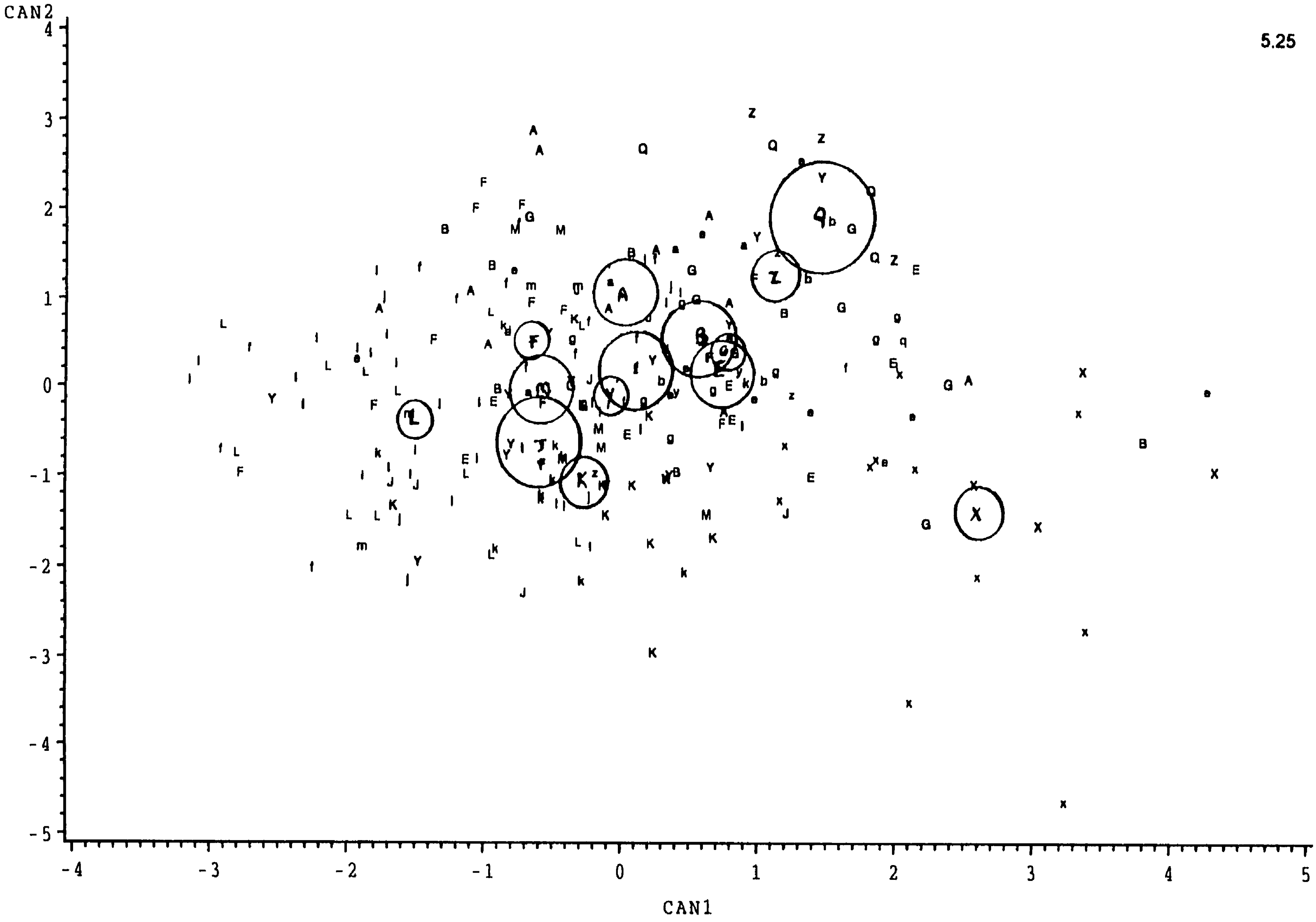


FIG. 5.25. RUN 25.1 CANONICAL VAULT DATA – ALL GROUPS – NO WESTMAN – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

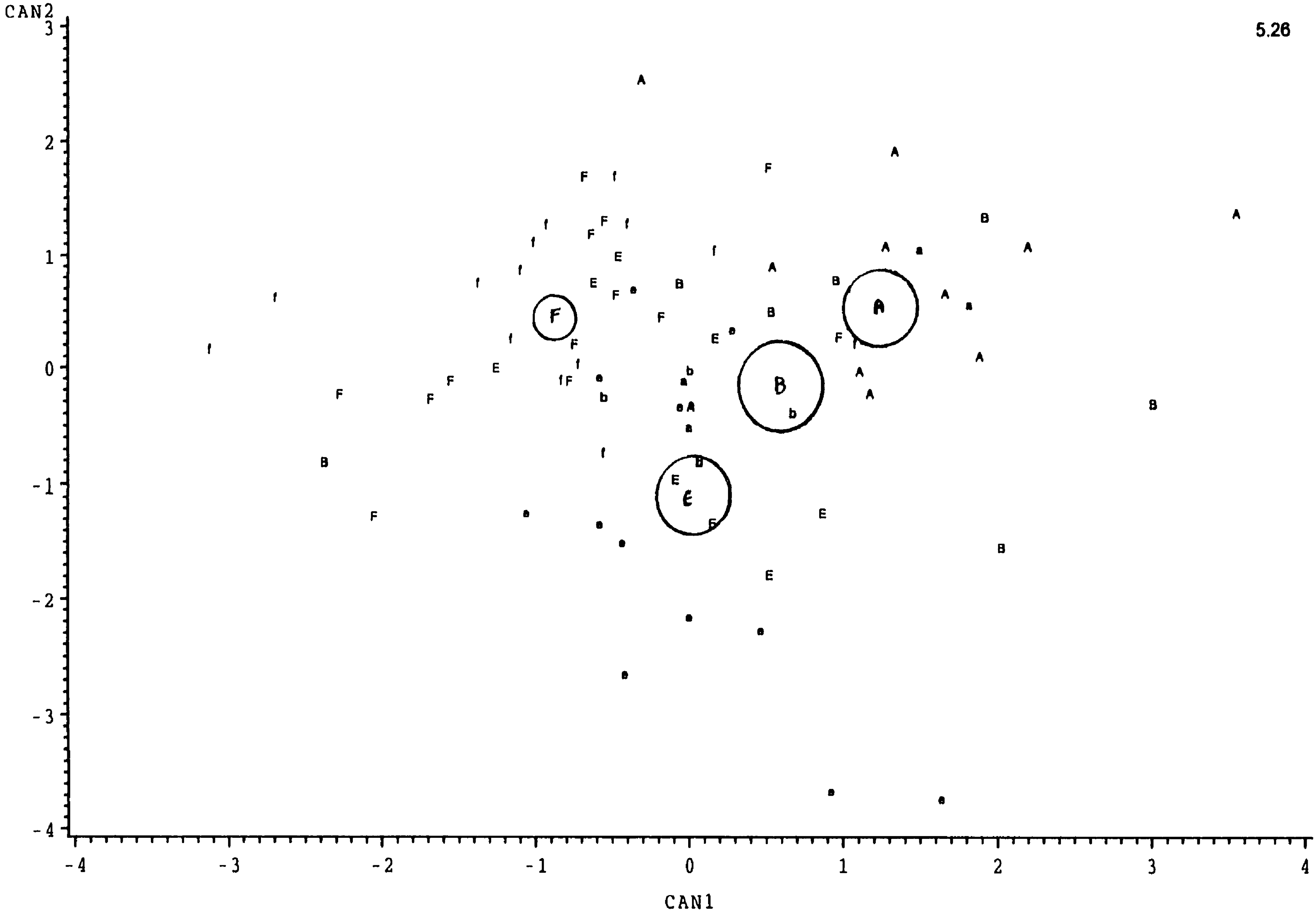


FIG. 5.26. RUN 26.1 CANONICAL VAULT DATA – MANITOBA GROUPS – NO WESTMAN – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

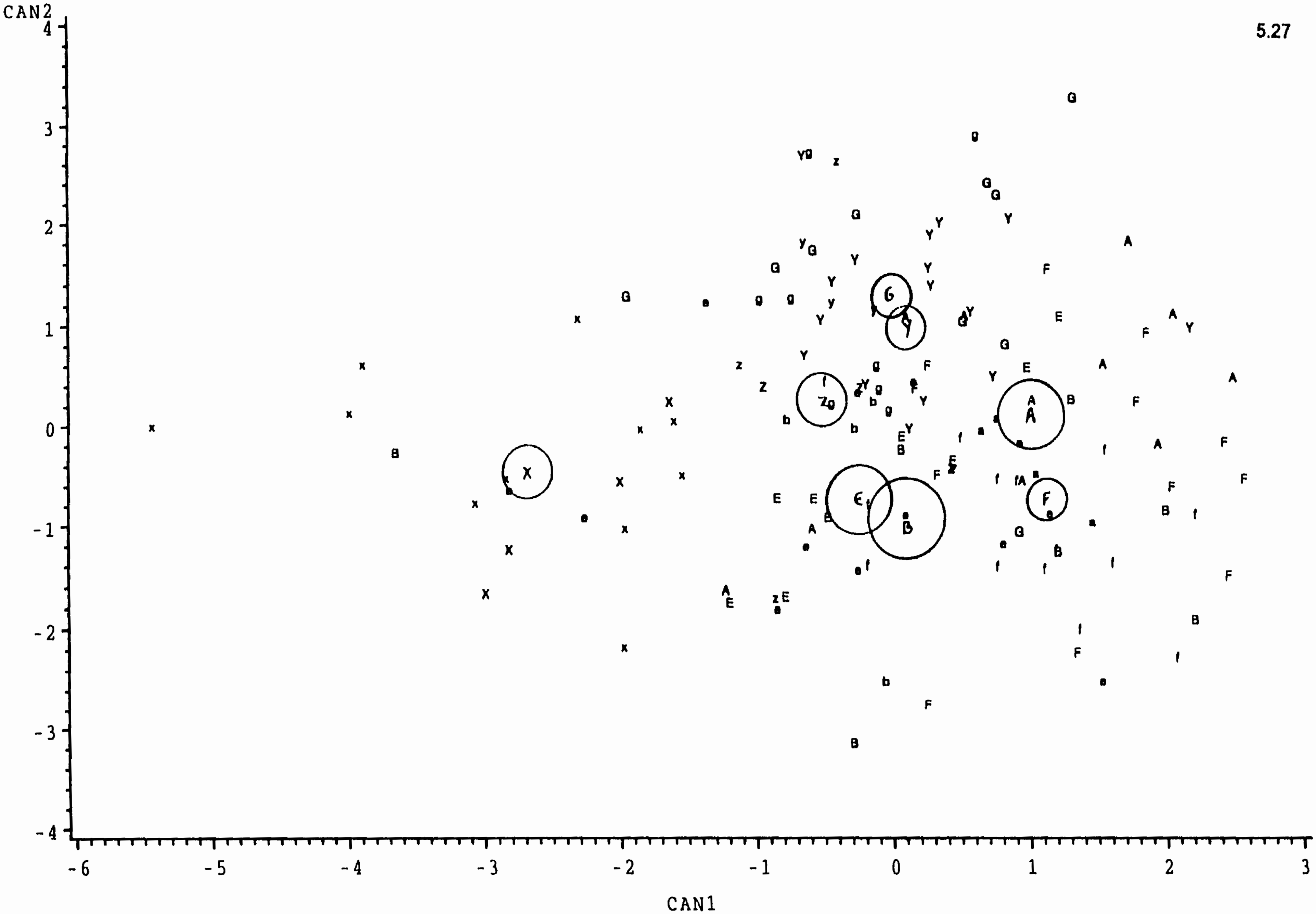


FIG. 5.27. RUN 27.1 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO GROUPS – NO WESTMAN – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

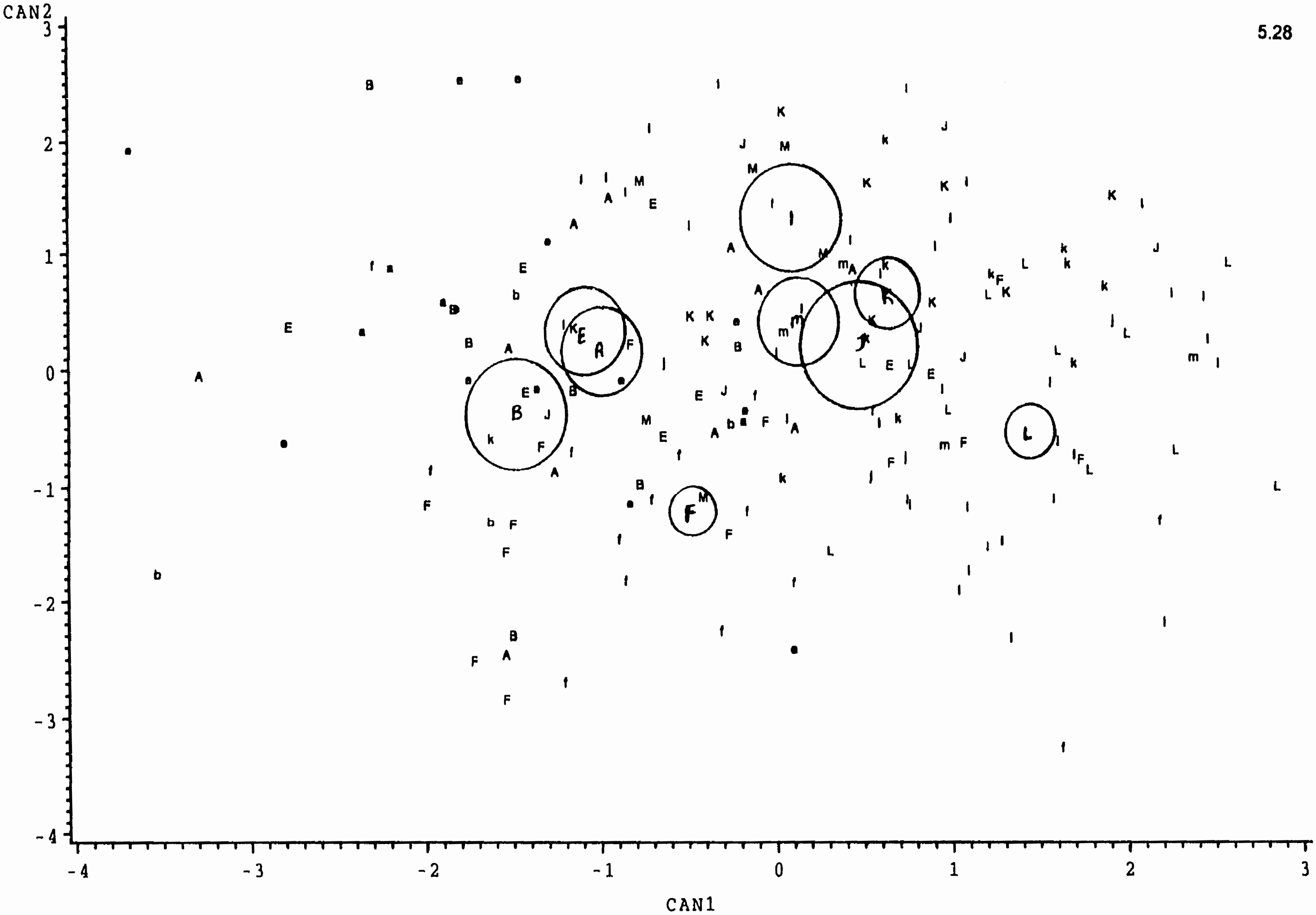


FIG. 5.28. RUN 28.1 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – NO WESTMAN – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

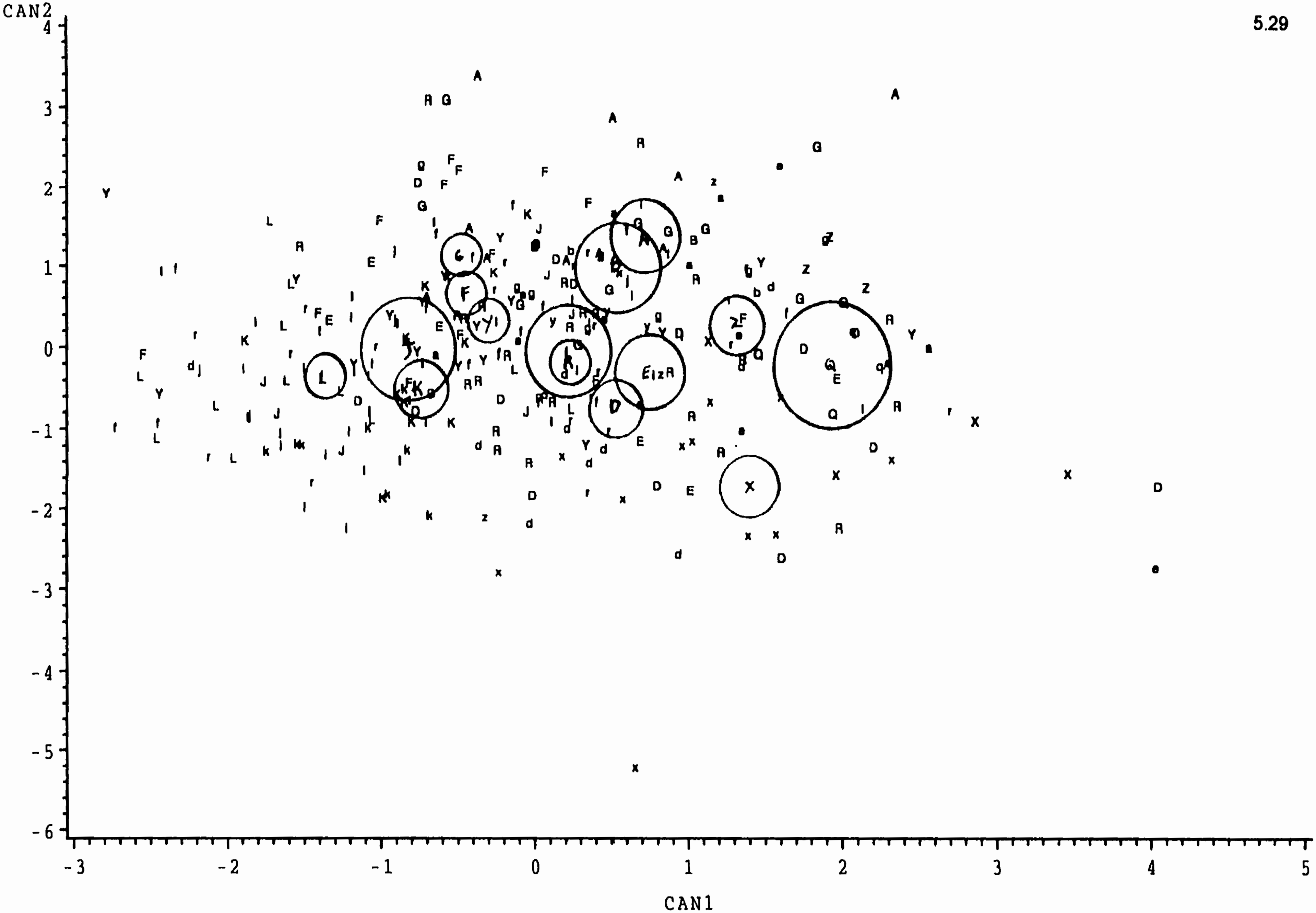


FIG. 5.29. RUN 29.1 CANONICAL VAULT DATA – ALL GROUPS – NEW DLS (R) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

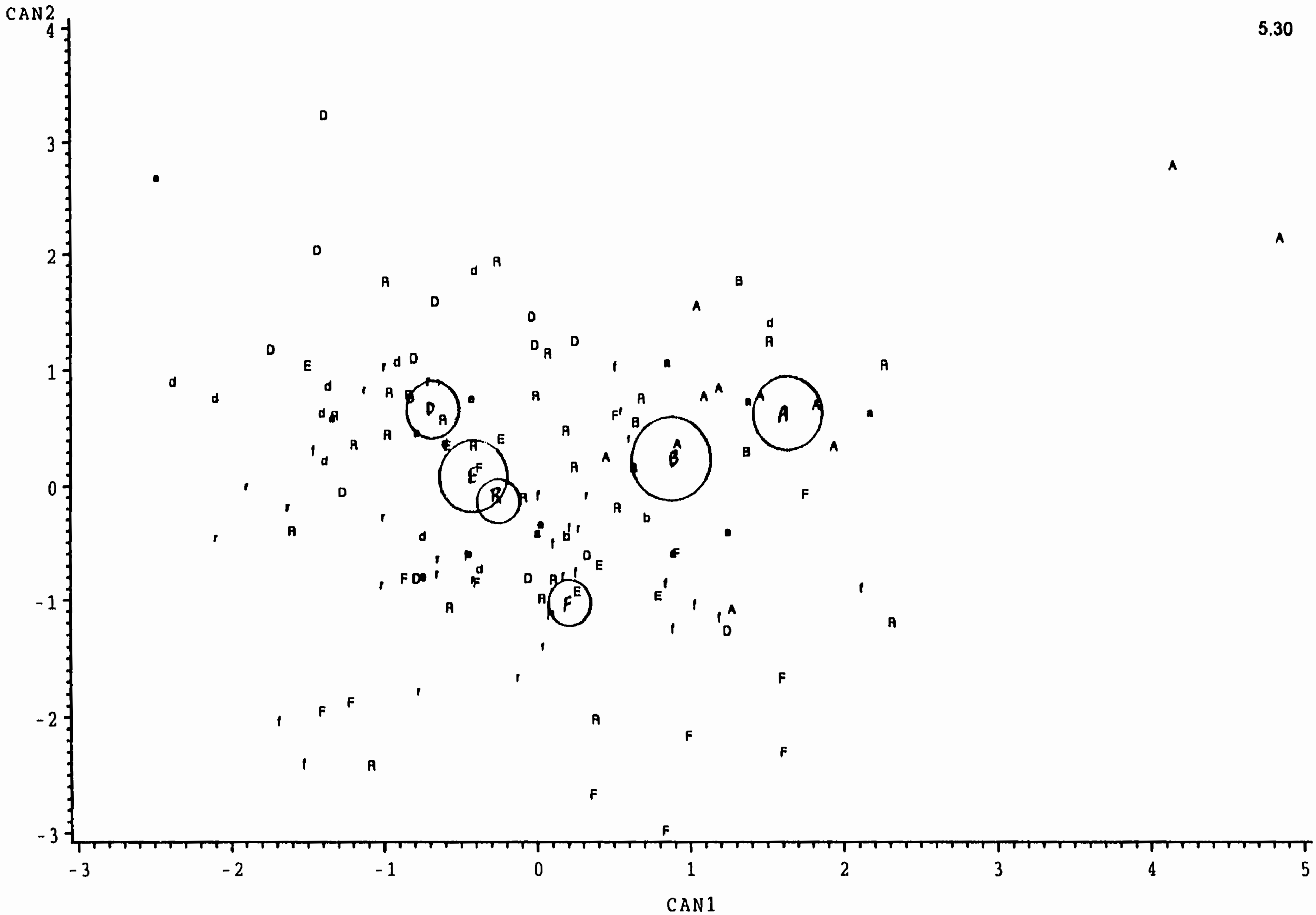


FIG. 5.30. RUN 30.1 CANONICAL VAULT DATA – MANITOBA GROUPS – NEW DLS (R) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

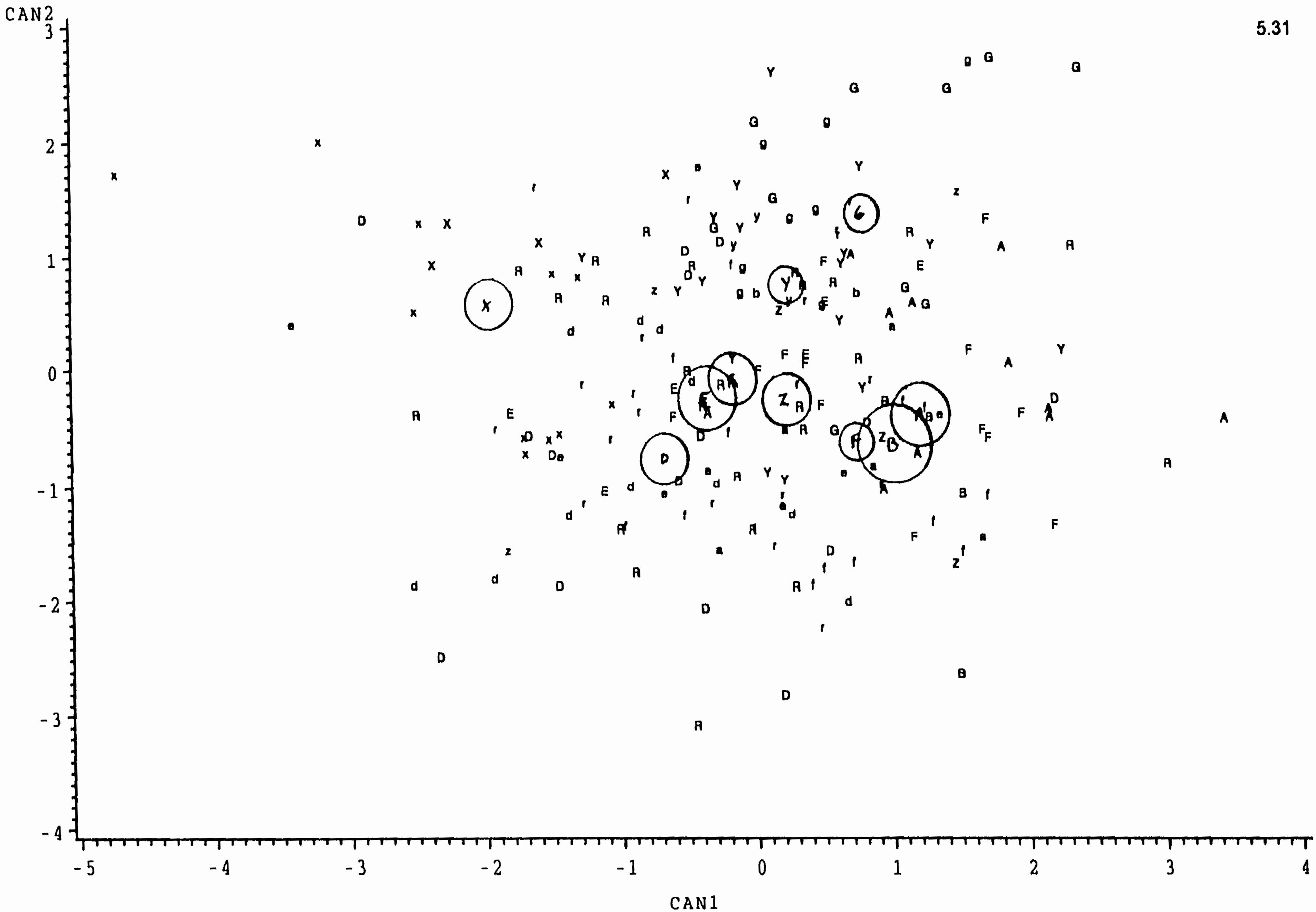


FIG. 5.31. RUN 31.1 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO GROUPS – NEW DLS (R) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

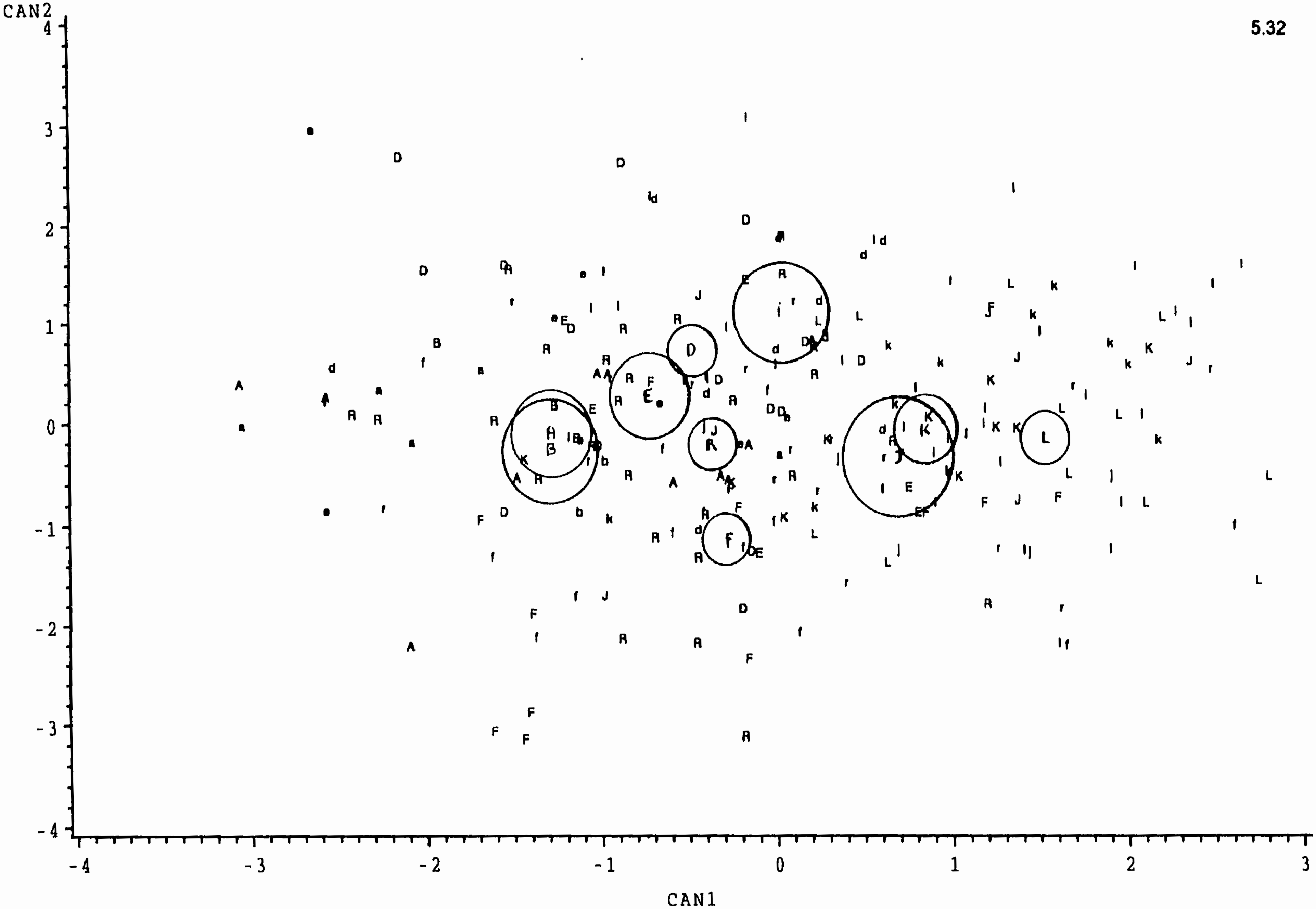


FIG. 5.32. RUN 32.1 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – NEW DLS (R) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

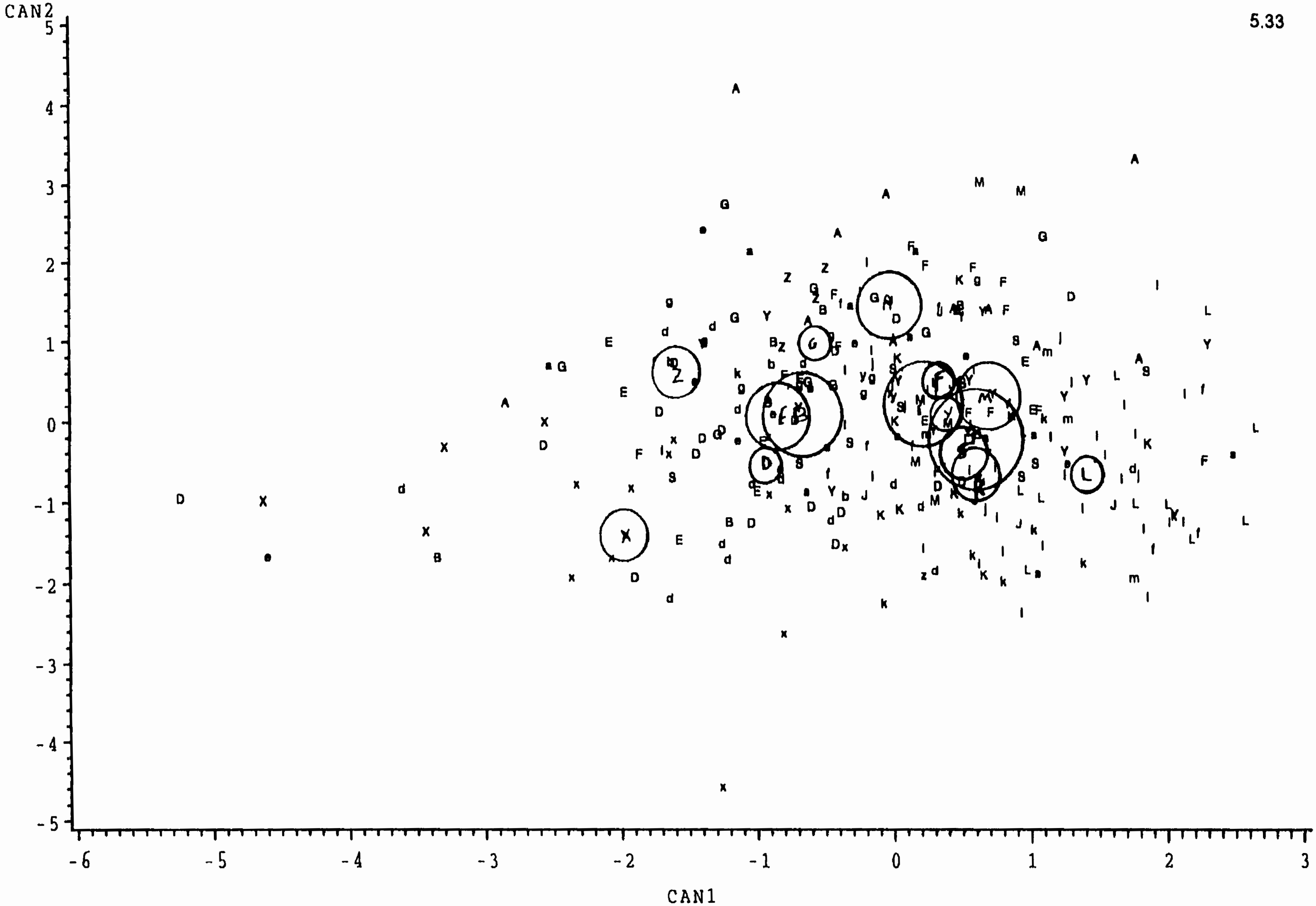


FIG. 5.33. RUN 33.1 CANONICAL VAULT DATA – ALL GROUPS – SOURISFORD (S) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

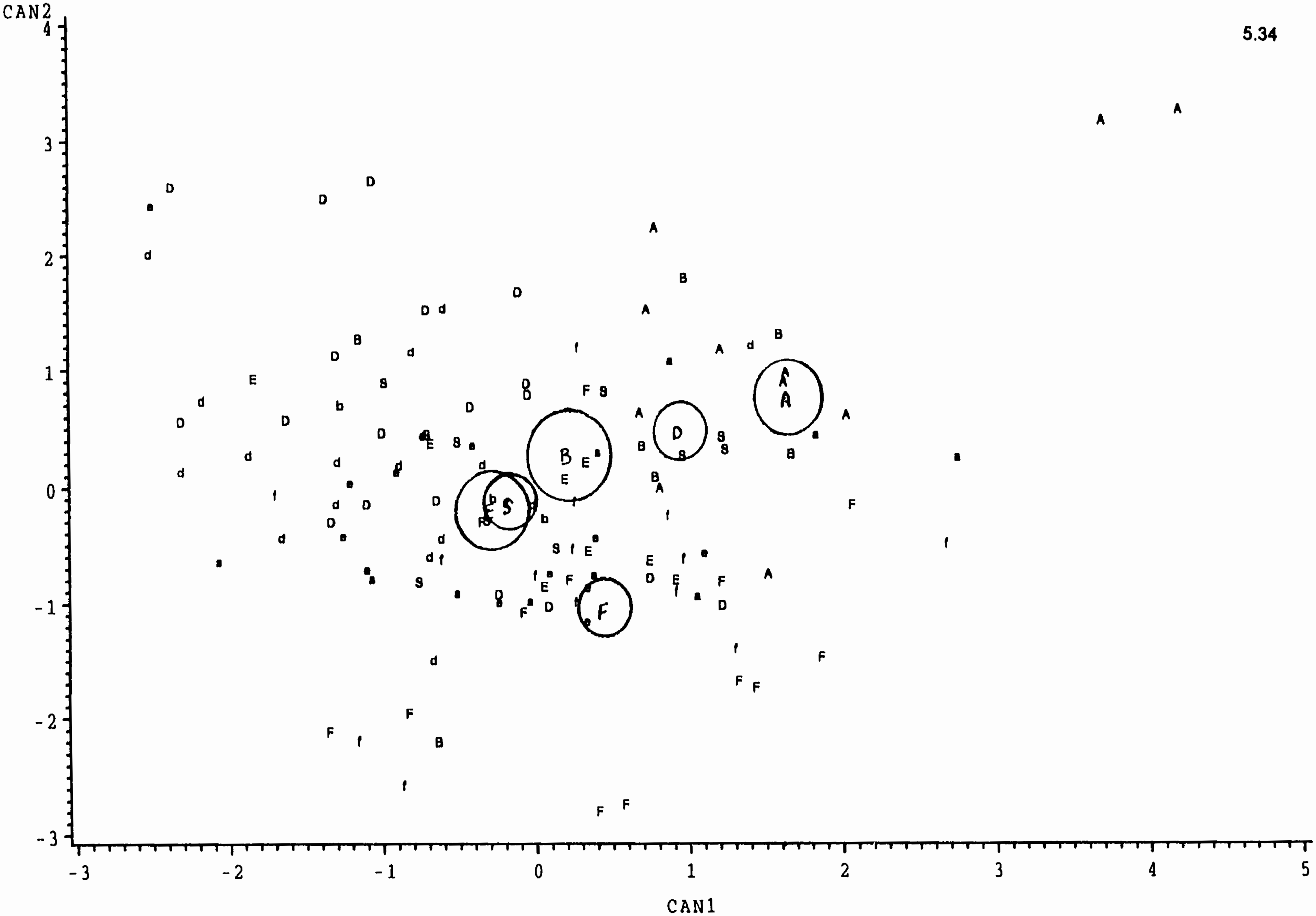


FIG. 5.34. RUN 34.1 CANONICAL VAULT DATA – MANITOBA GROUPS – SOURISFORD (S) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

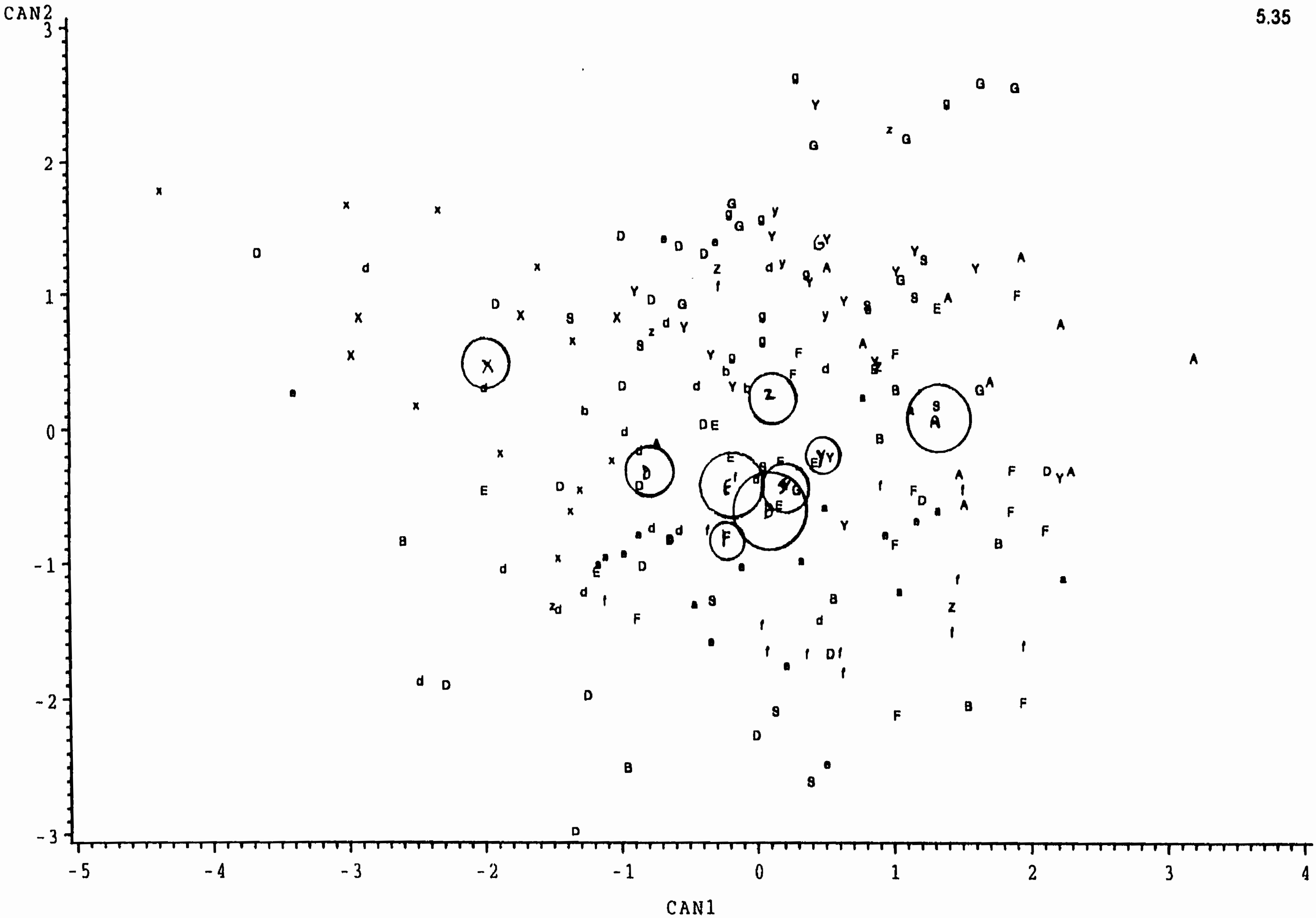


FIG. 5.35. RUN 35.1 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO GROUPS – SOURISFORD (S) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

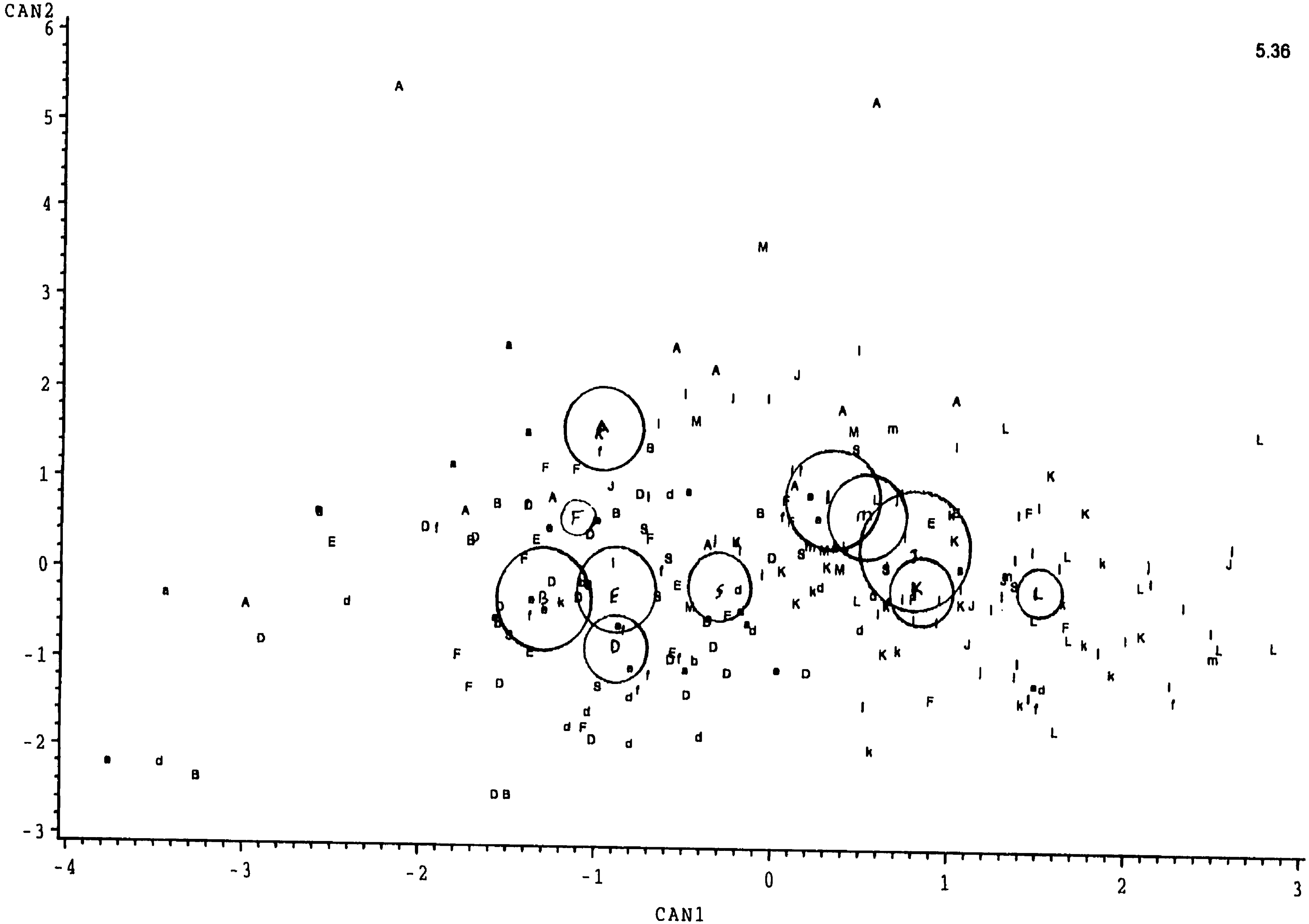


FIG. 5.36. RUN 36.1 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – SOURISFORD (S) IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

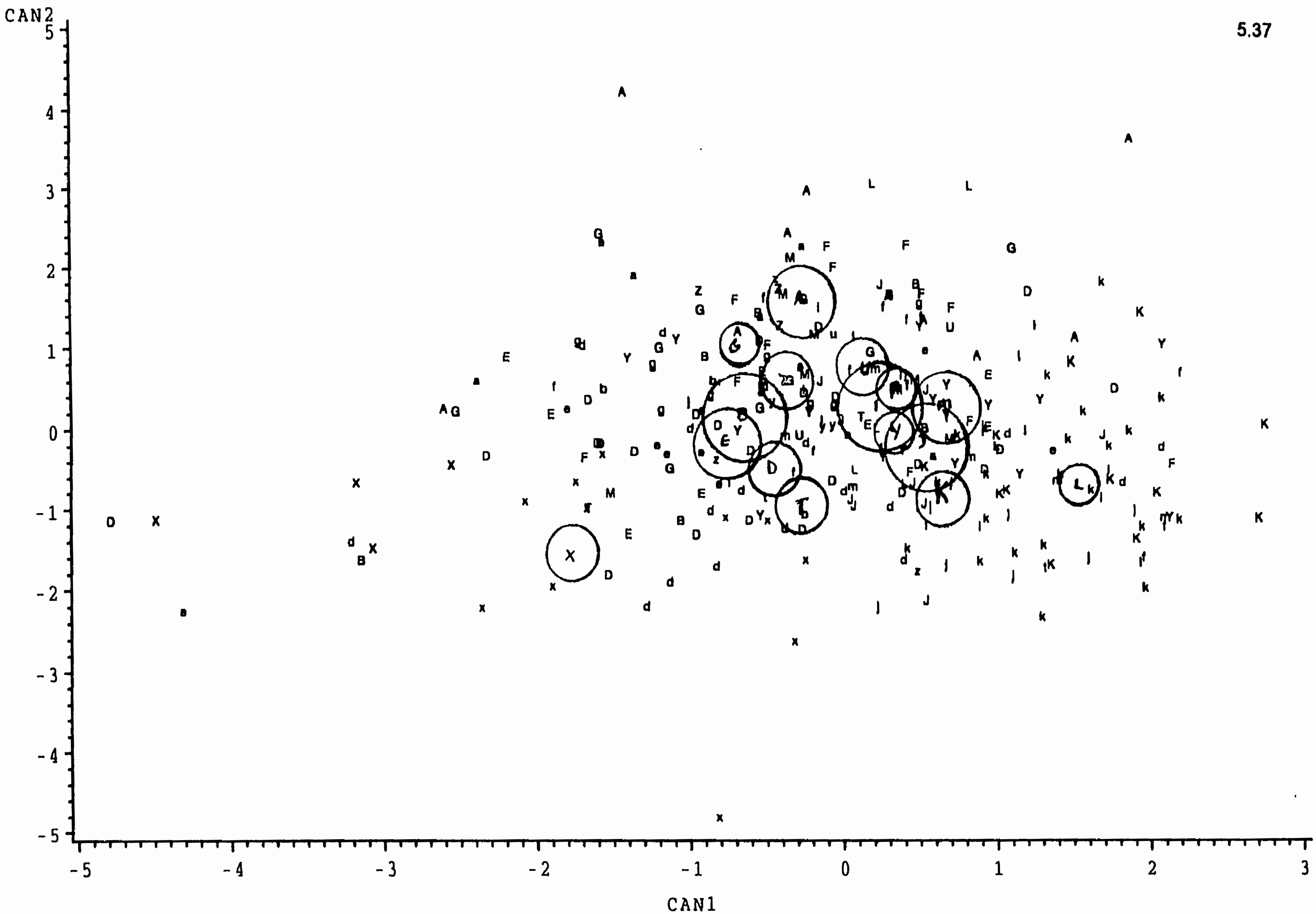


FIG. 5.37. RUN 37.1 CANONICAL VAULT DATA – ALL GROUPS – NORTH (T) AND SOUTH (U) ANTLER IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

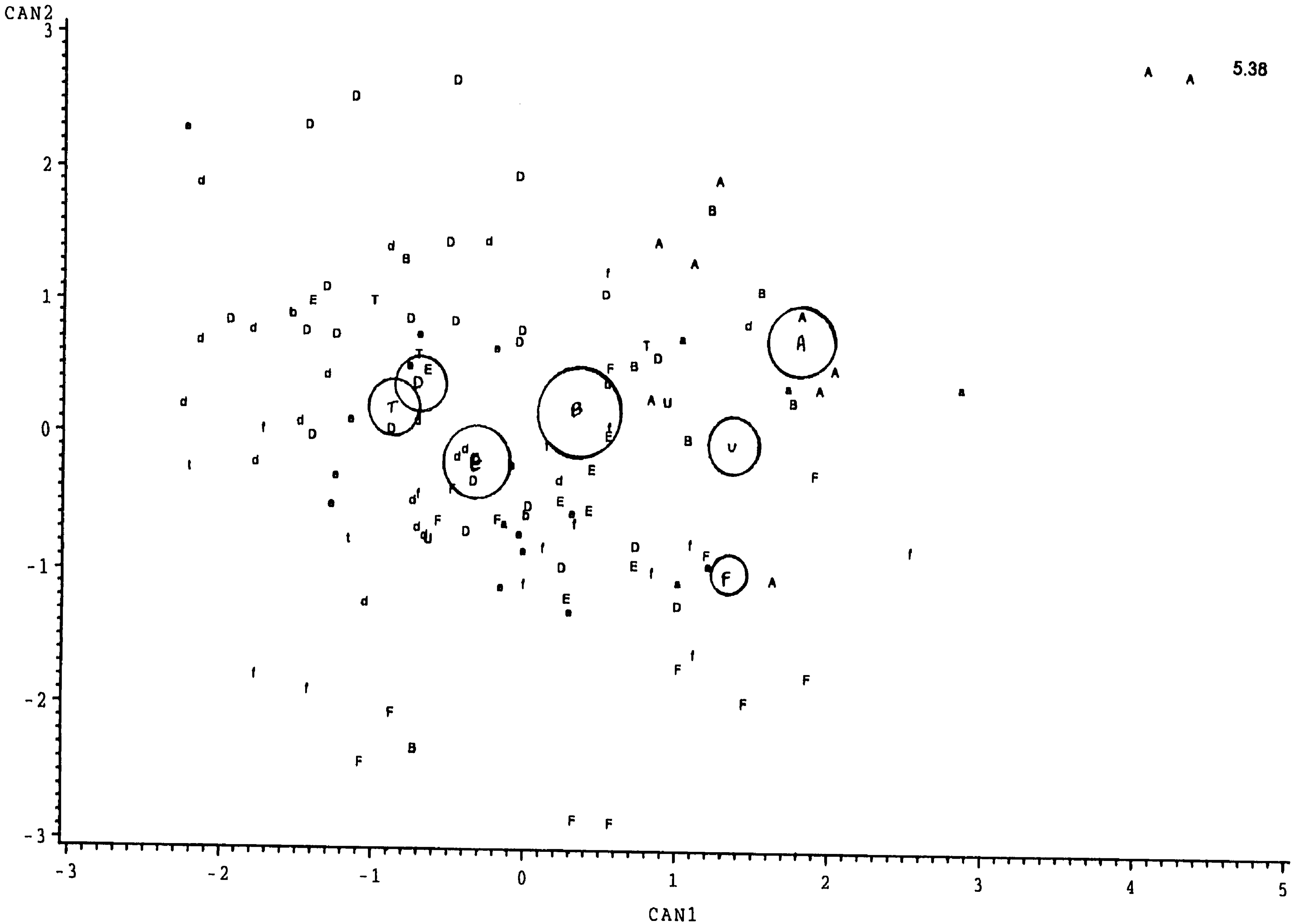


FIG. 5.38. RUN 38.1 CANONICAL VAULT DATA – MANITOBA GROUPS – NORTH (T) AND SOUTH (U) ANTLER IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

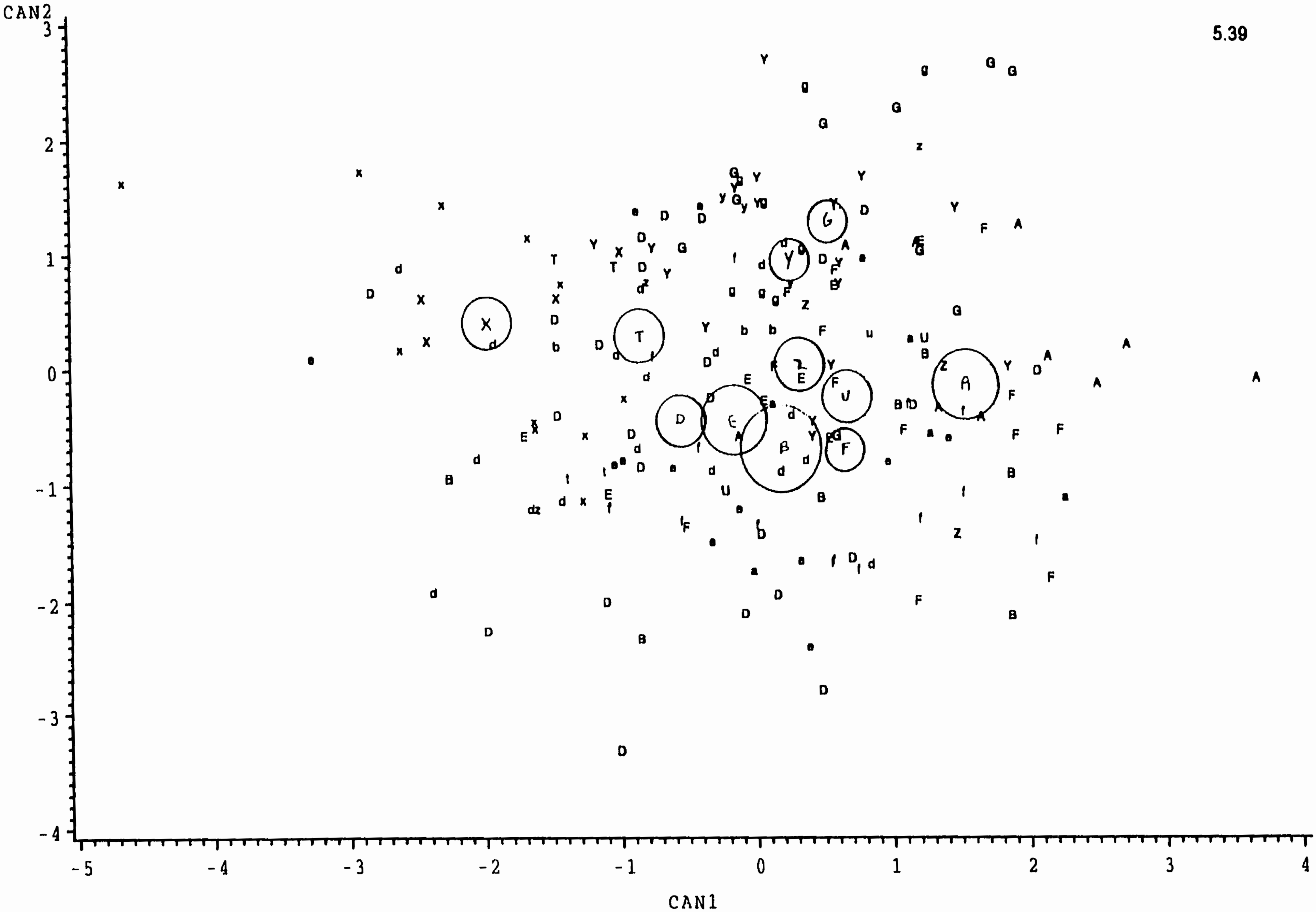


FIG. 5.39. RUN 39.1 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO GROUPS – NORTH (T) AND SOUTH (U) ANTLER IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

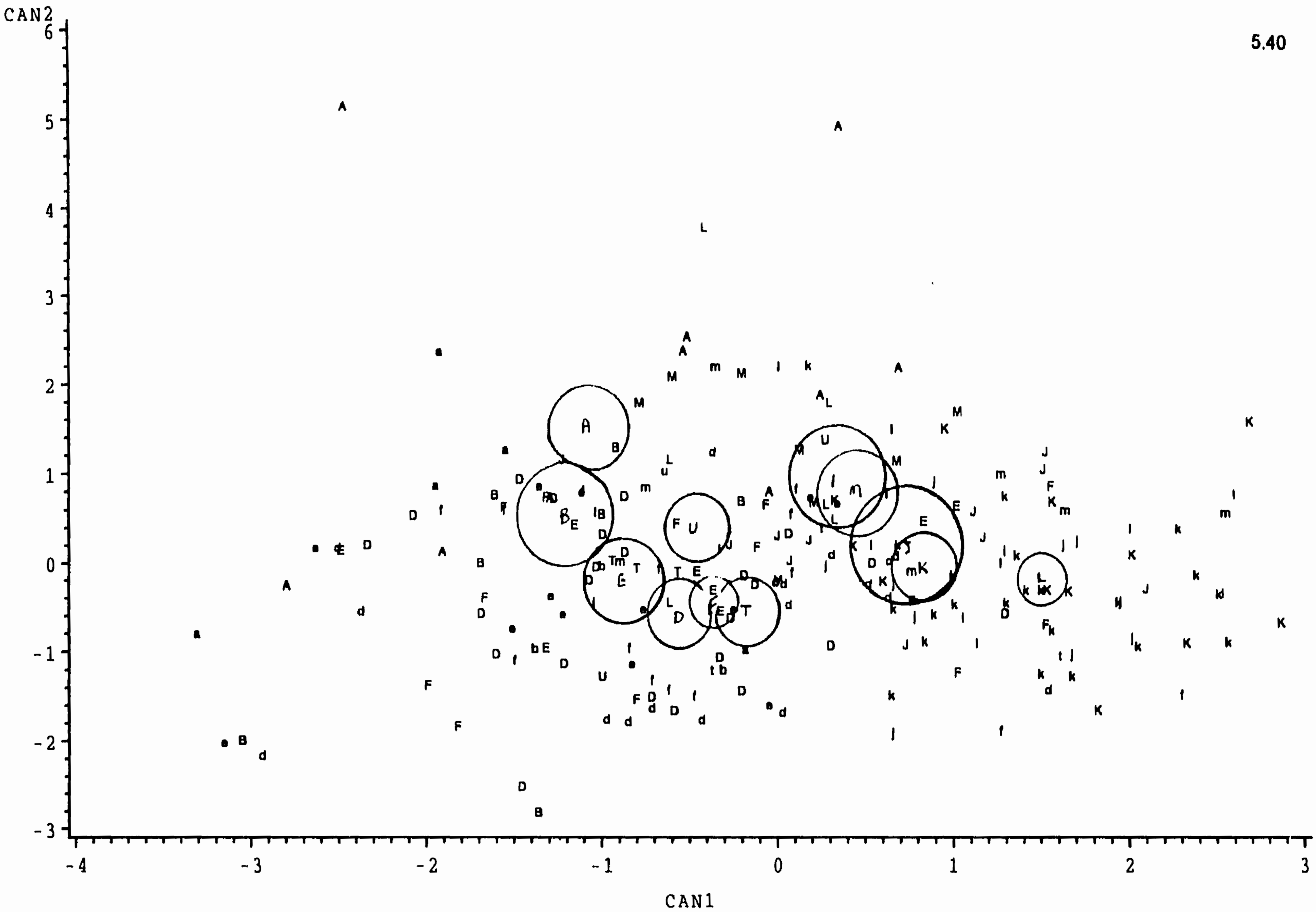


FIG. 5.40. RUN 40.1 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – NORTH (T) AND SOUTH (U) ANTLER IDENTIFIED – BOTH SEXES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN R=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

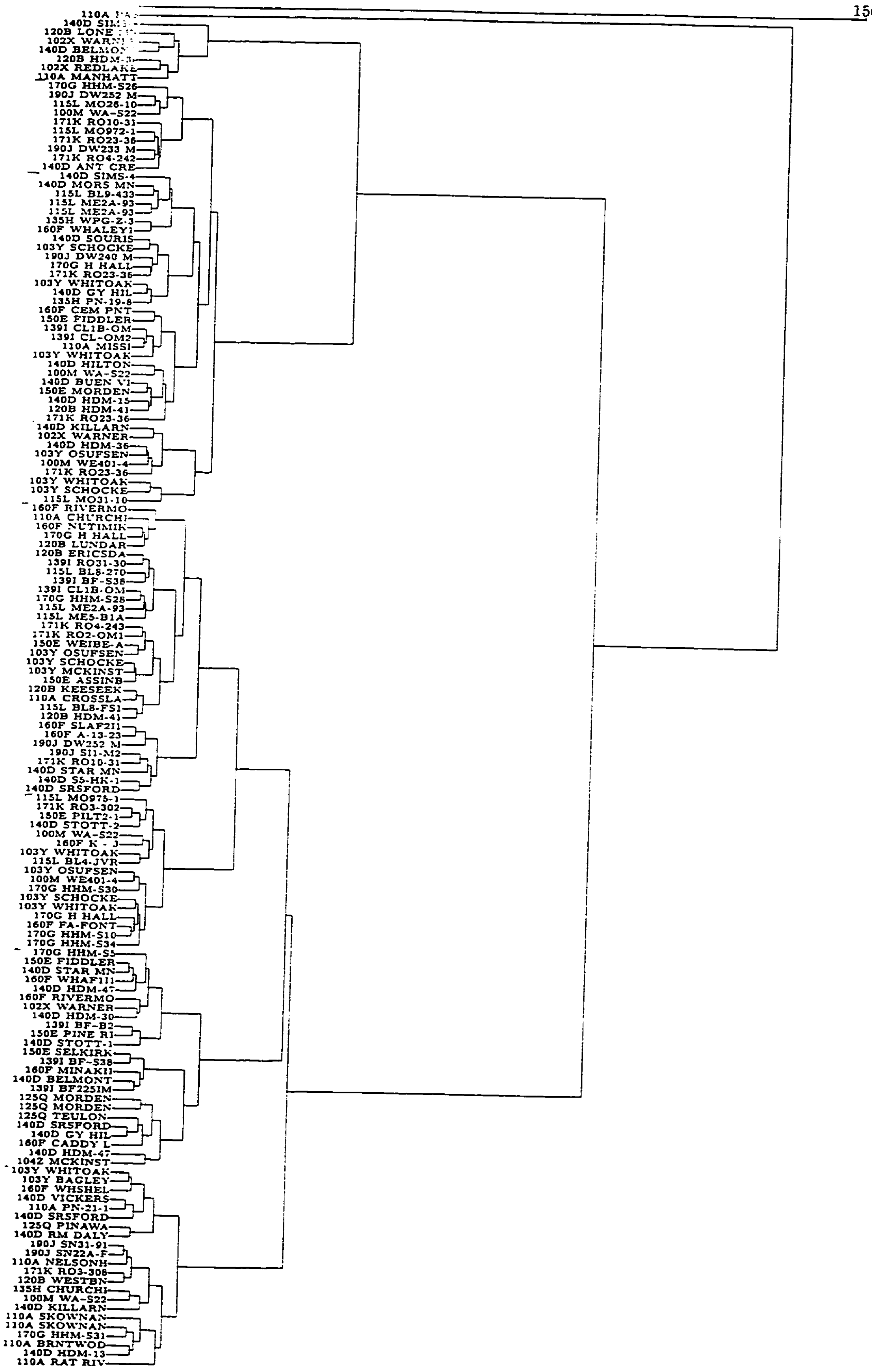


FIG. 5.41. DENDROGRAM PLOT OF VAULT DATA – MALES

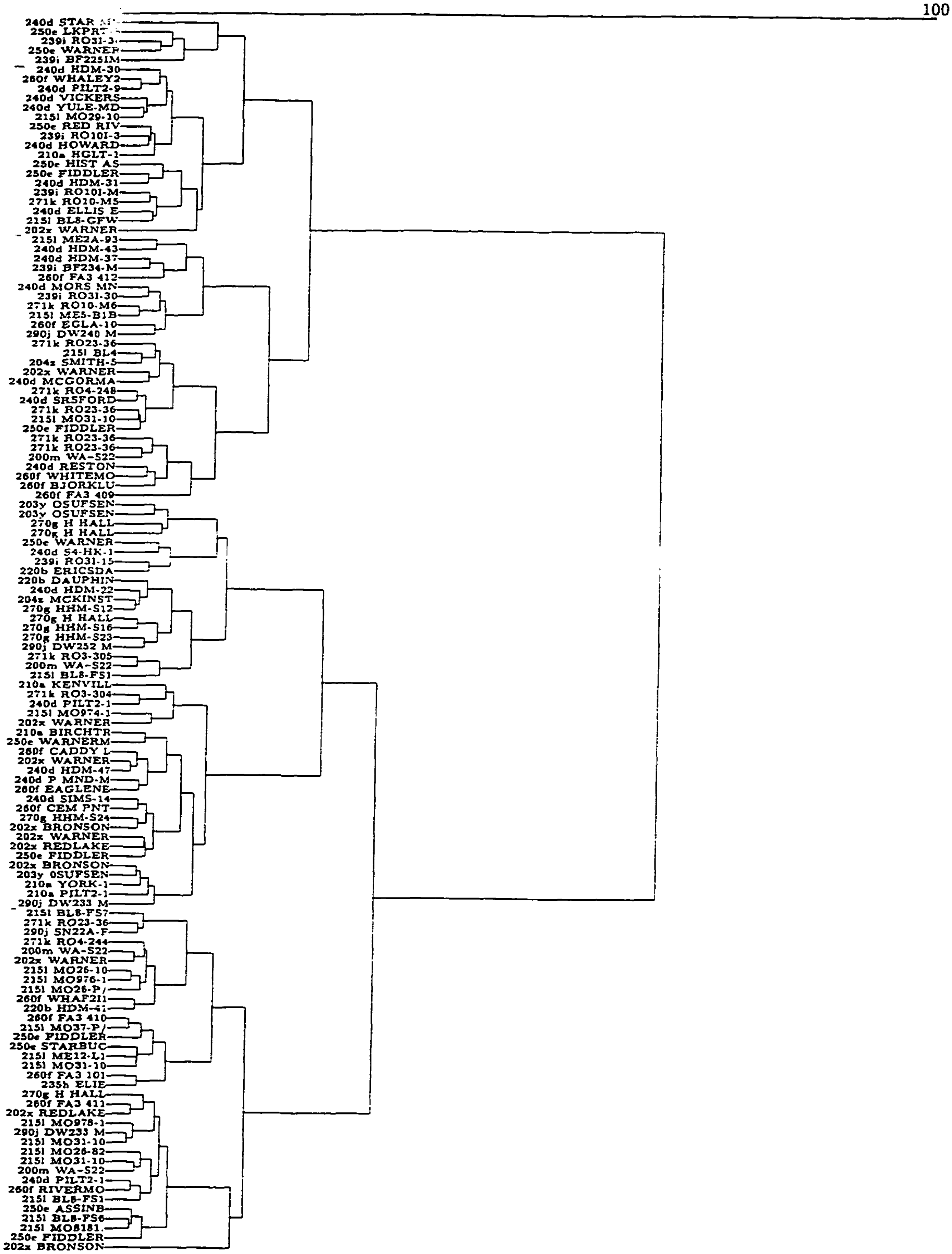


FIG. 5.42. DENDROGRAM PLOT OF VAULT DATA — FEMALES

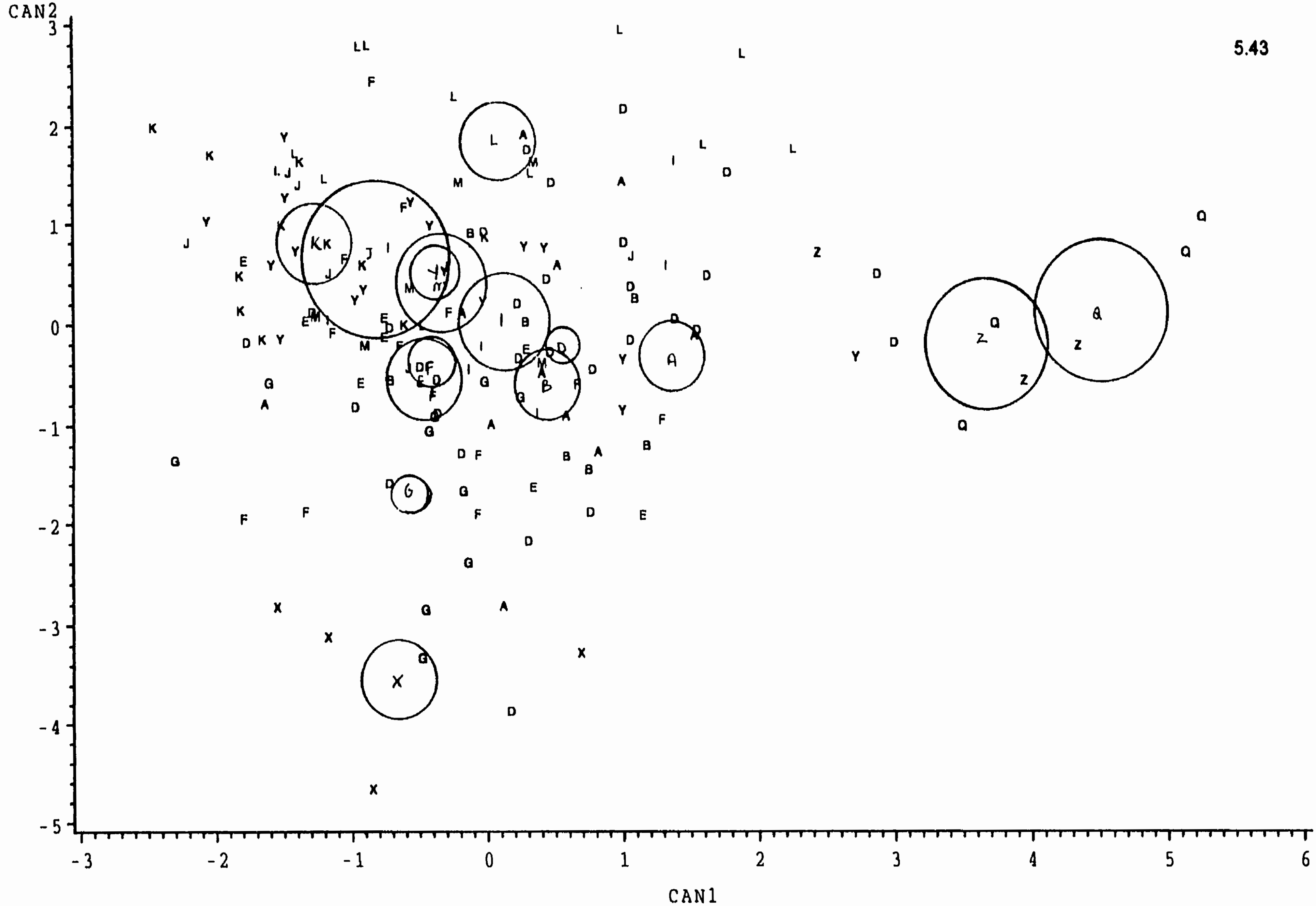


FIG. 5.43. RUN 17.2 CANONICAL VAULT DATA – ALL GROUPS – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

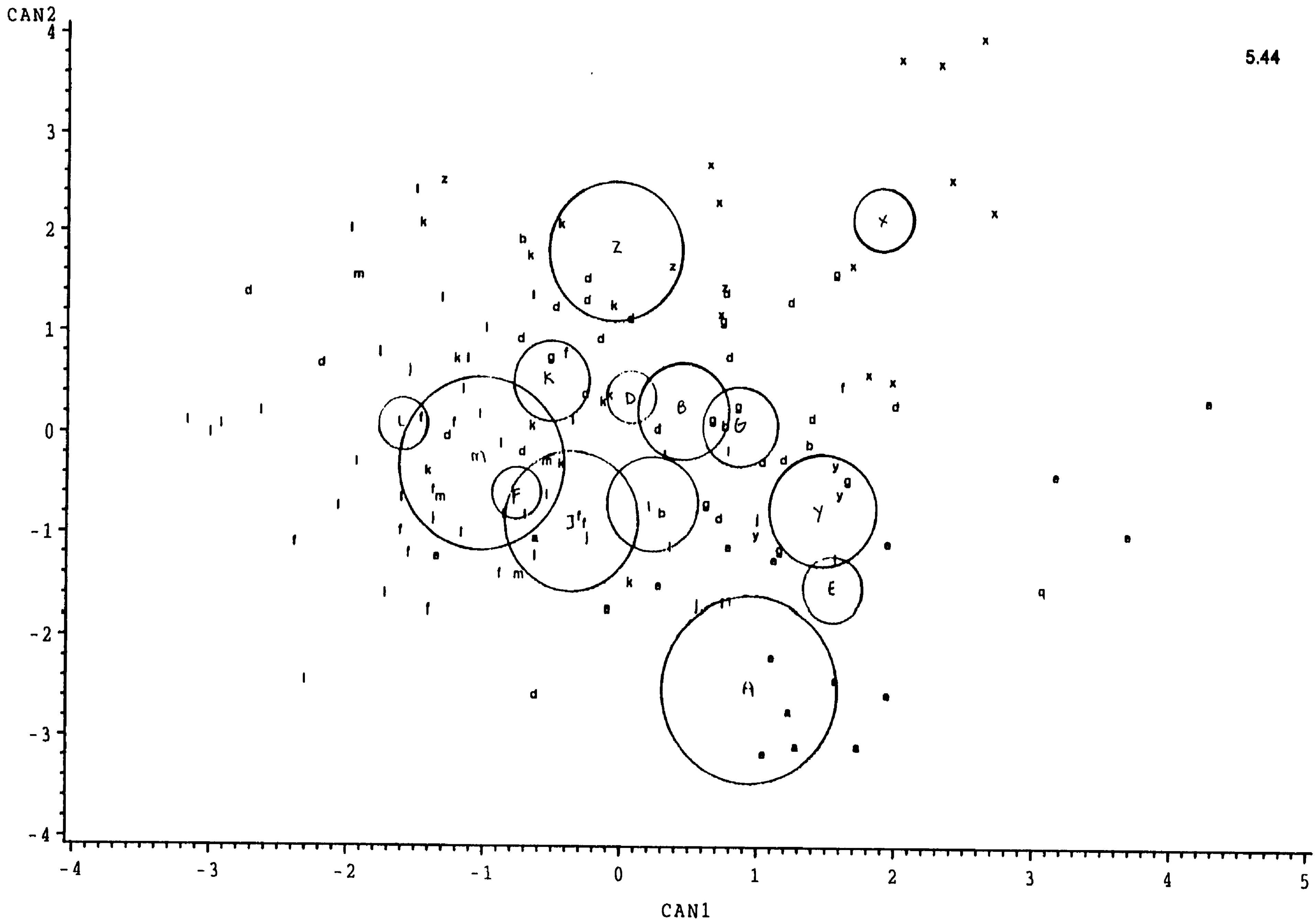


FIG. 5.44. RUN 17.3 CANONICAL VAULT DATA – ALL GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

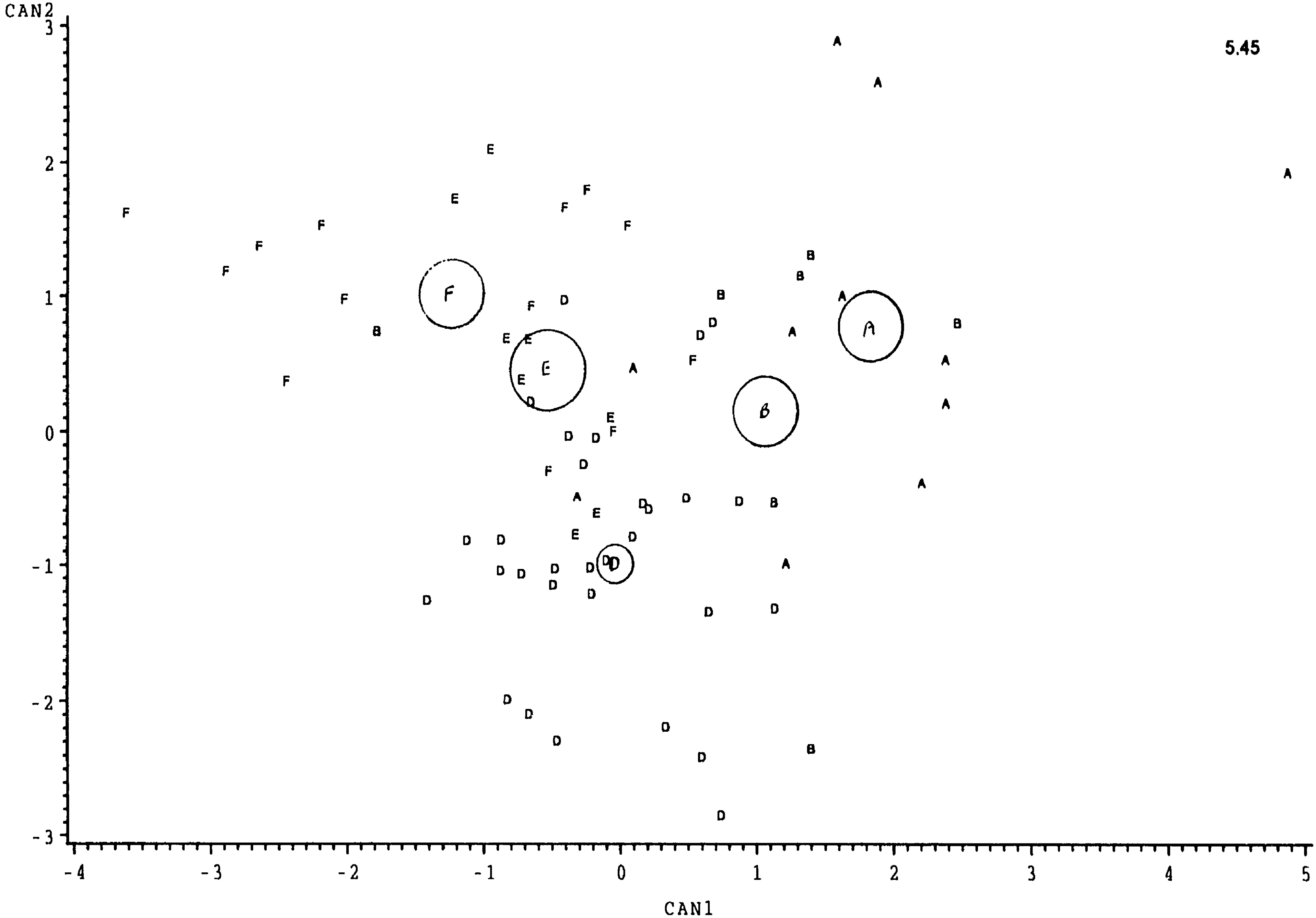


FIG. 5.45. RUN 18.2 CANONICAL VAULT DATA – MANITOBA GROUPS – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

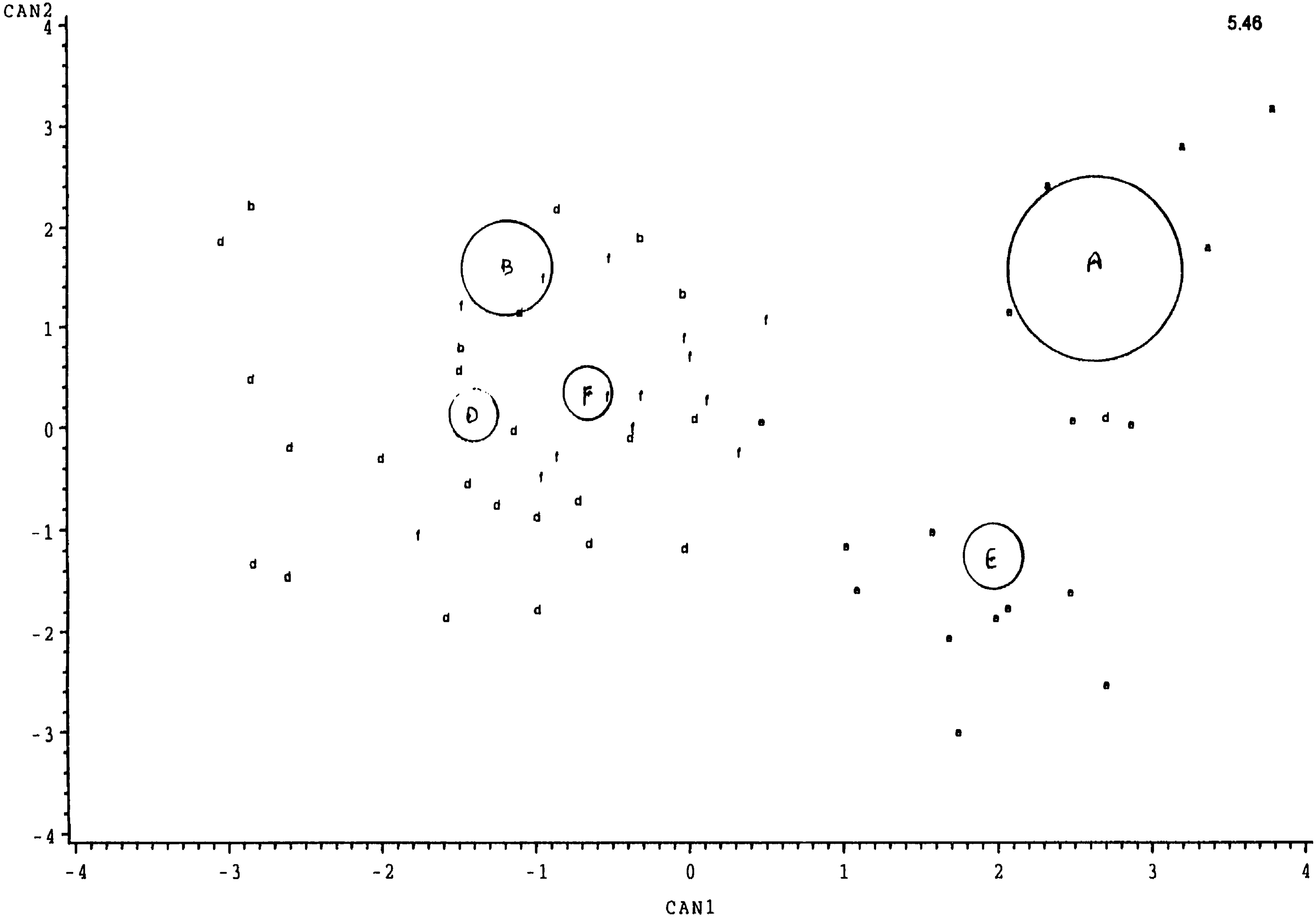


FIG. 5.46. RUN 18.3 CANONICAL VAULT DATA – MANITOBA GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

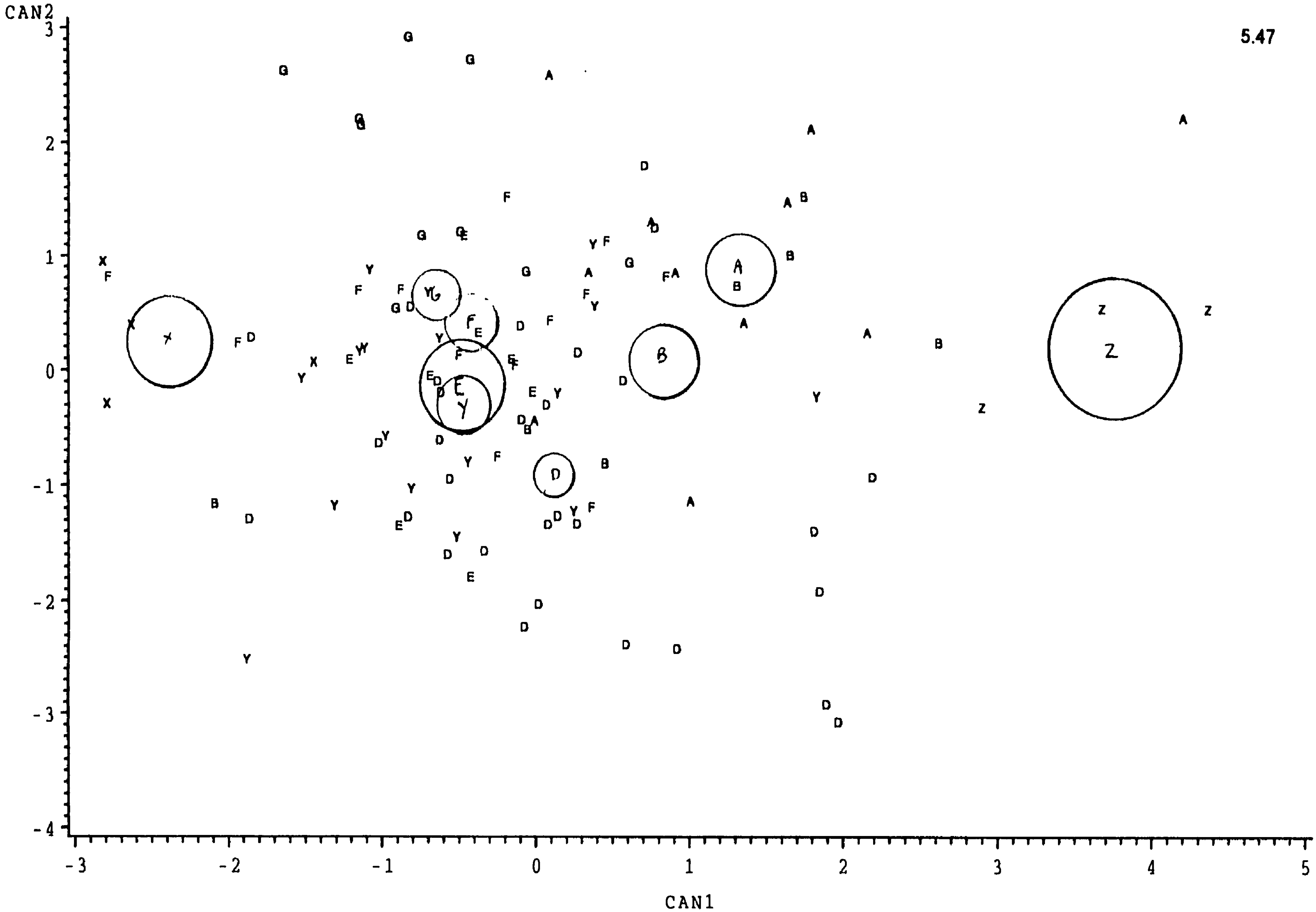


FIG. 5.47. RUN 19.2 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO CASES – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

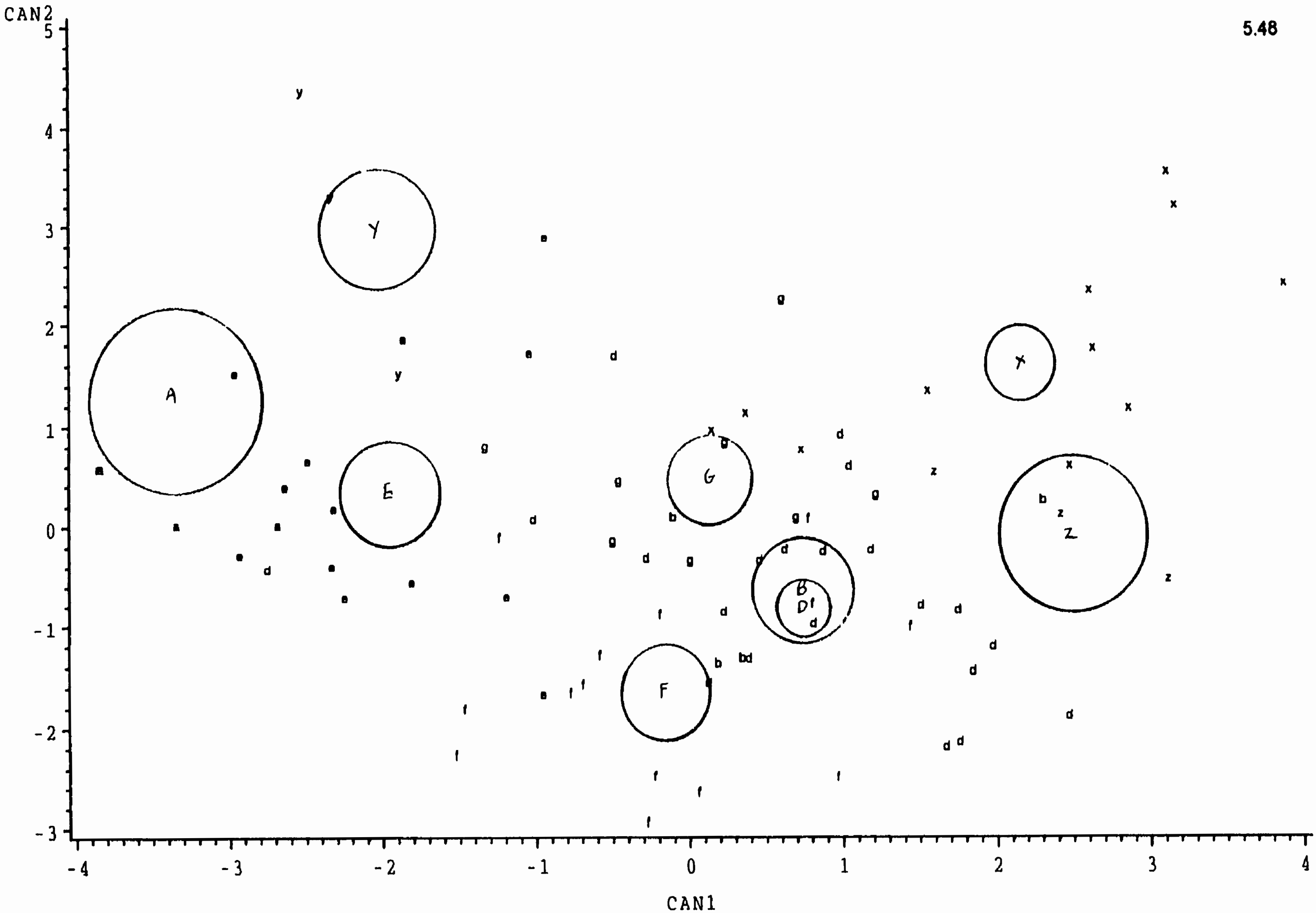


FIG. 5.48. RUN 19.3 CANONICAL VAULT DATA – MANITOBA/MINNESOTA/ONTARIO – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

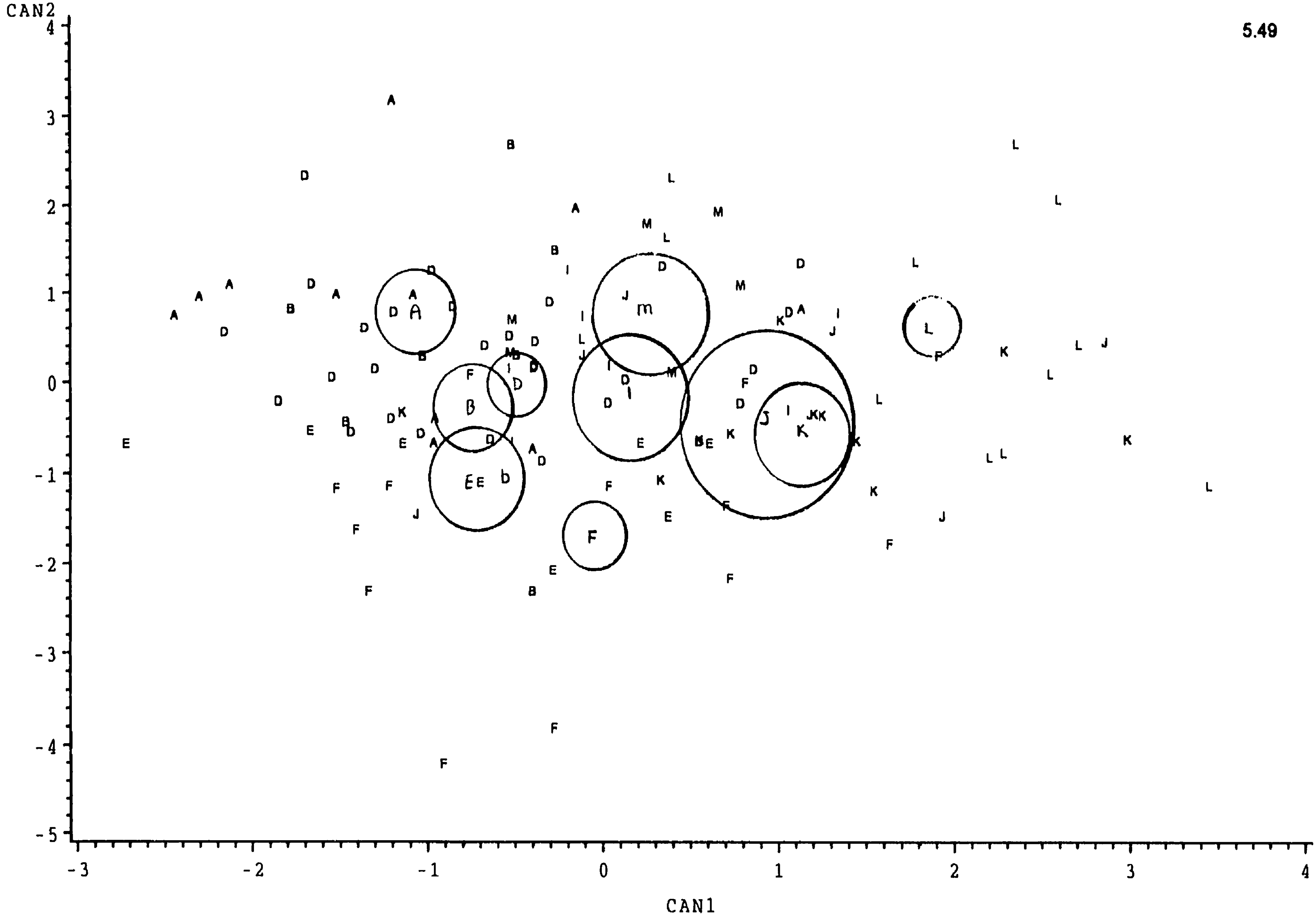


FIG. 5.49. RUN 20.2 CANONICAL VAULT DATA — MANITOBA/NORTH DAKOTA GROUPS — MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

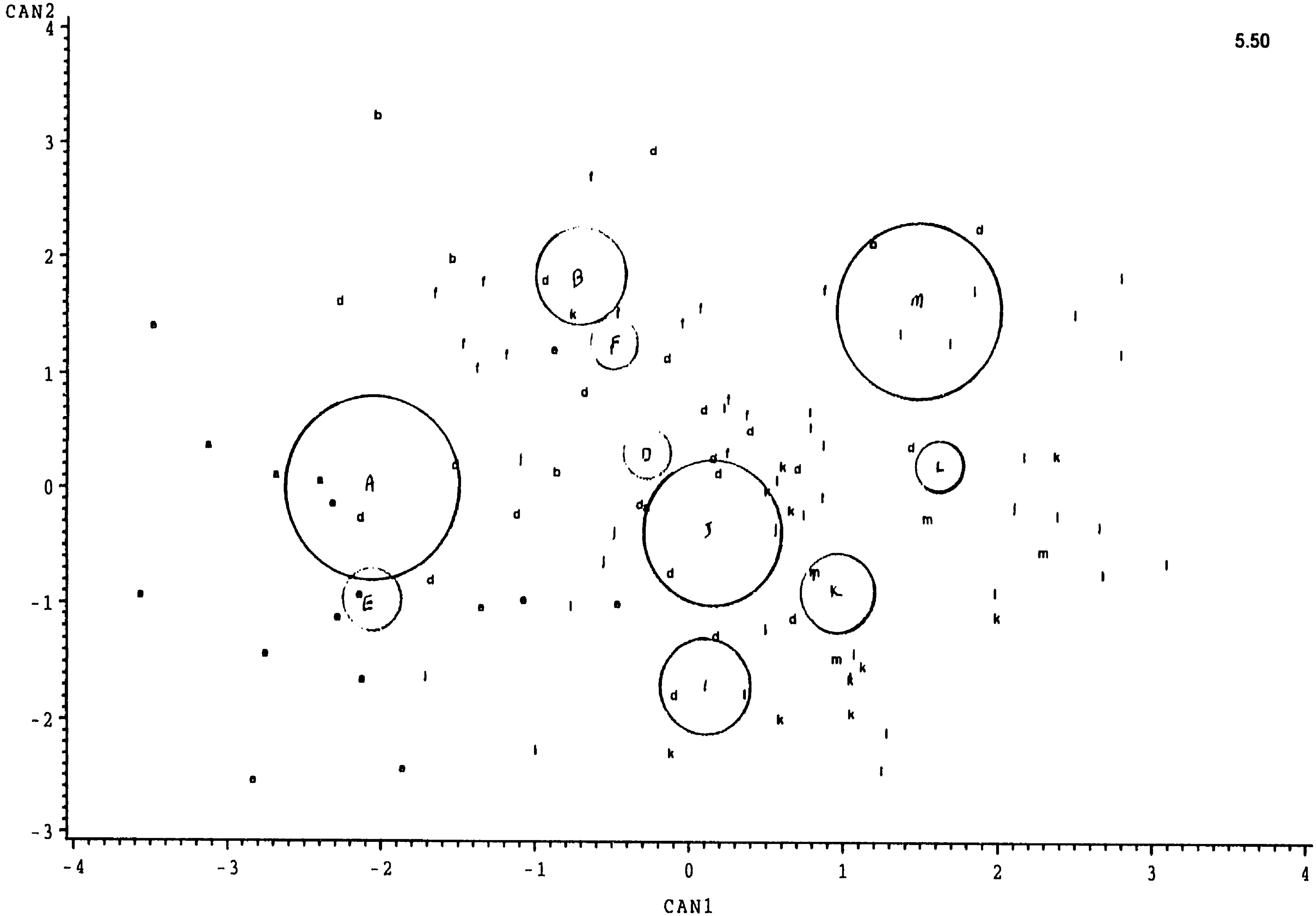


FIG. 5.50. RUN 20.3 CANONICAL VAULT DATA – MANITOBA/NORTH DAKOTA GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

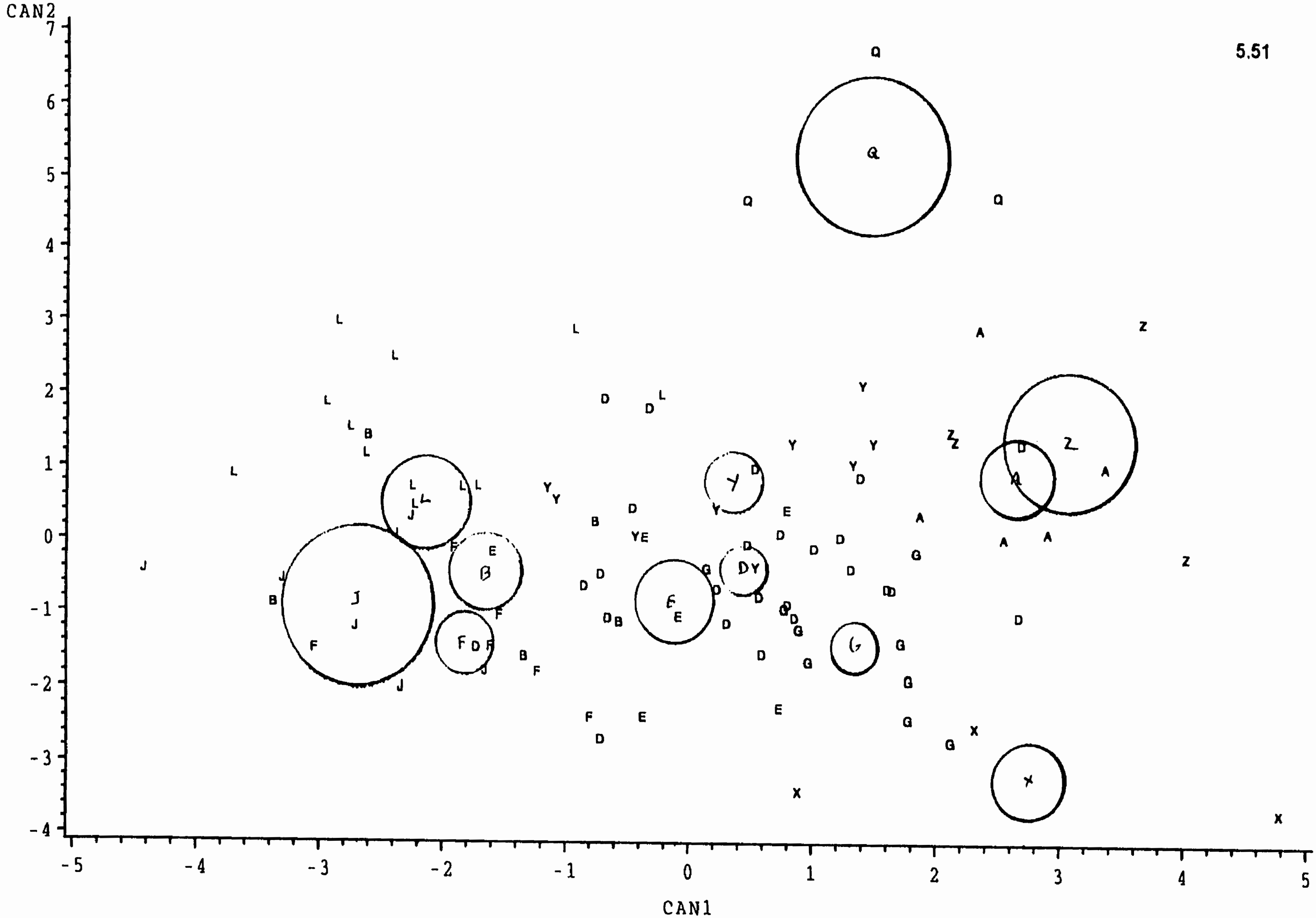


FIG. 5.51. RUN 21.2 CANONICAL TOTAL DATA – ALL GROUPS – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

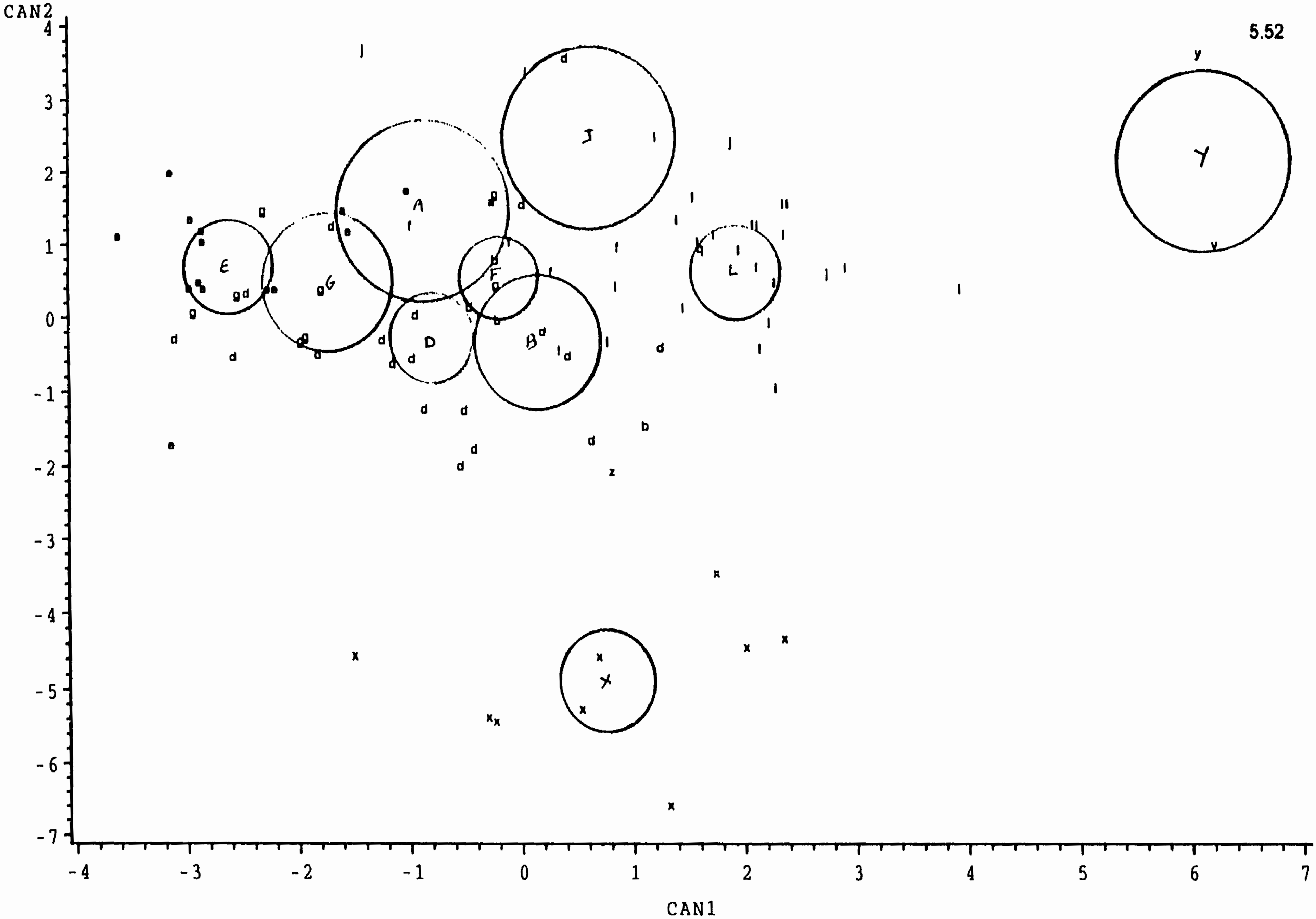


FIG. 5.52. RUN 21.3 CANONICAL TOTAL DATA – ALL GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

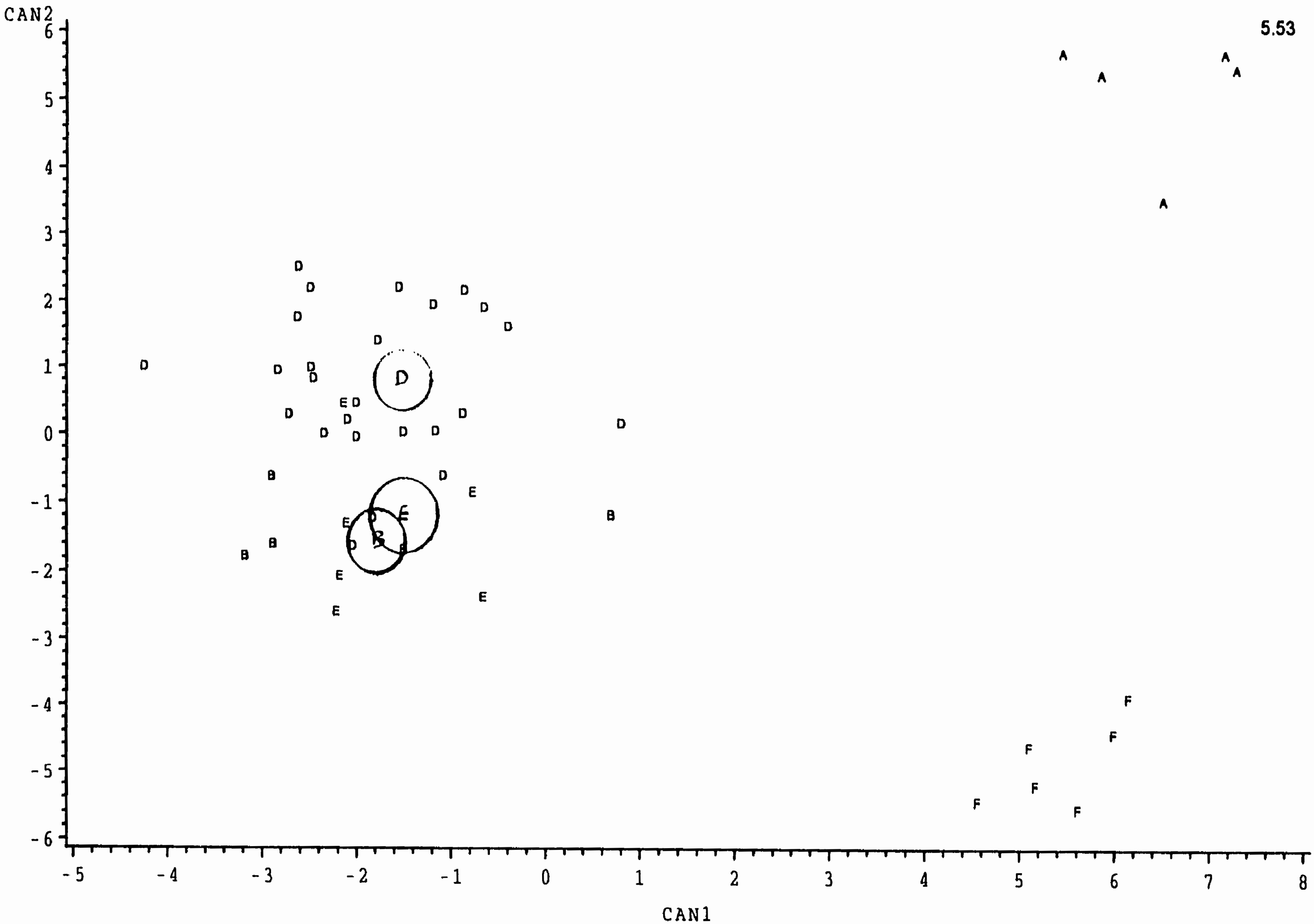


FIG. 5.53. RUN 22.2 CANONICAL TOTAL DATA – MANITOBA GROUPS – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

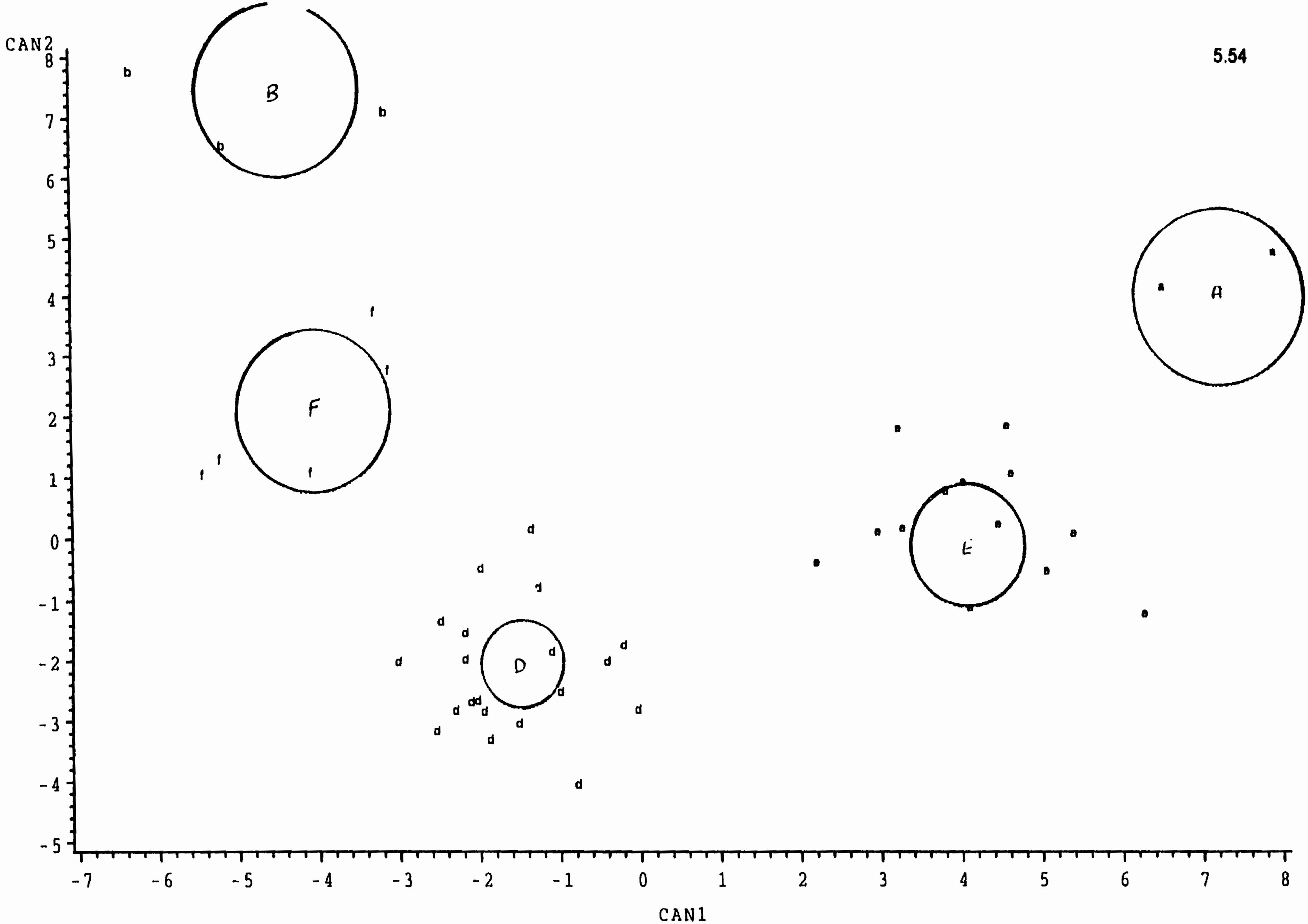


FIG. 5.54. RUN 22.3 CANONICAL TOTAL DATA – MANITOBA GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

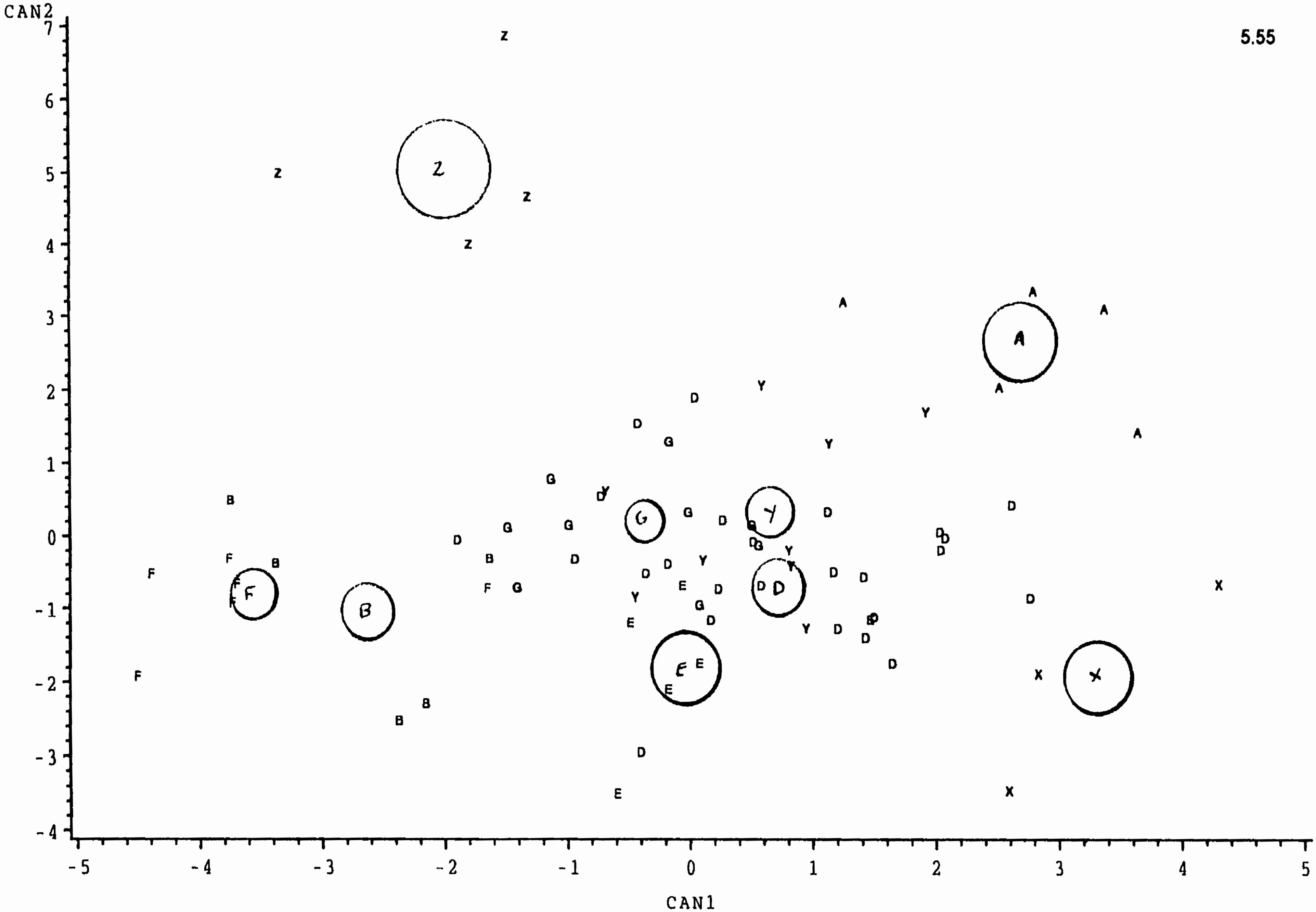


FIG. 5.55. RUN 23.2 CANONICAL TOTAL DATA – MANITOBA/MINNESOTA/ONTARIO CASES – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

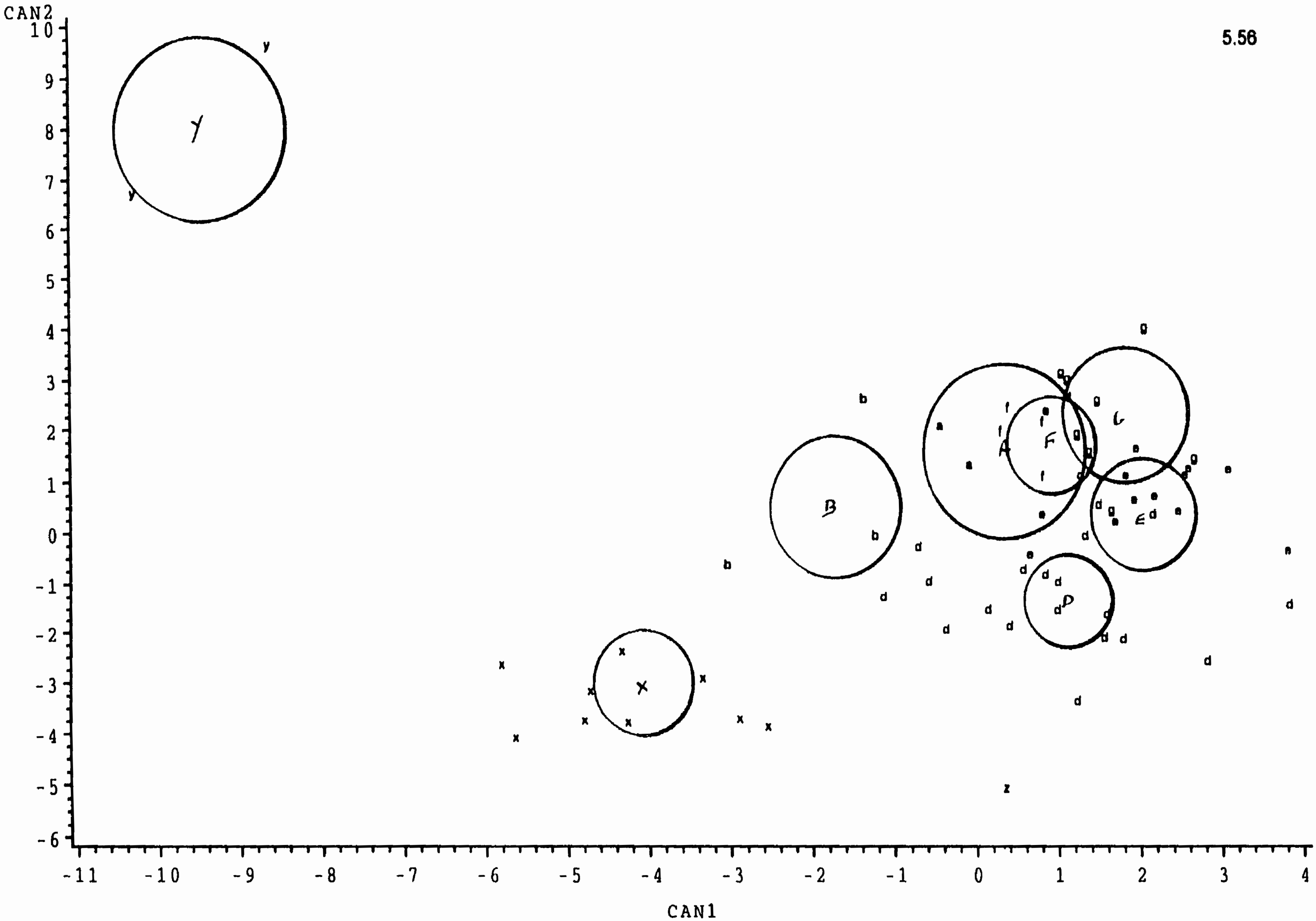


FIG. 5.56. RUN 23.3 CANONICAL TOTAL DATA – MANITOBA/MINNESOTA/ONTARIO – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

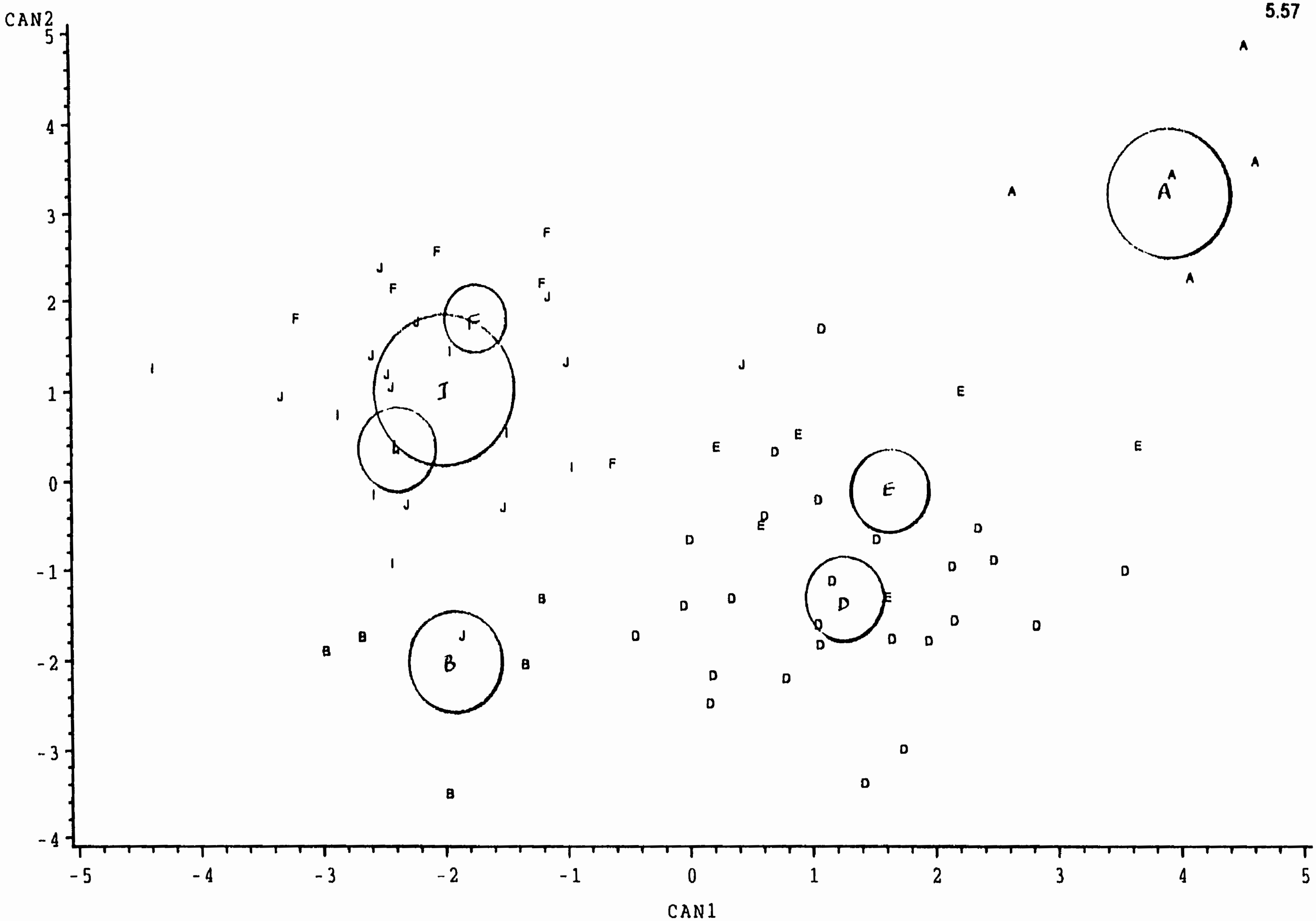


FIG. 5.57. RUN 24.2 CANONICAL TOTAL DATA – MANITOBA/NORTH DAKOTA GROUPS – MALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

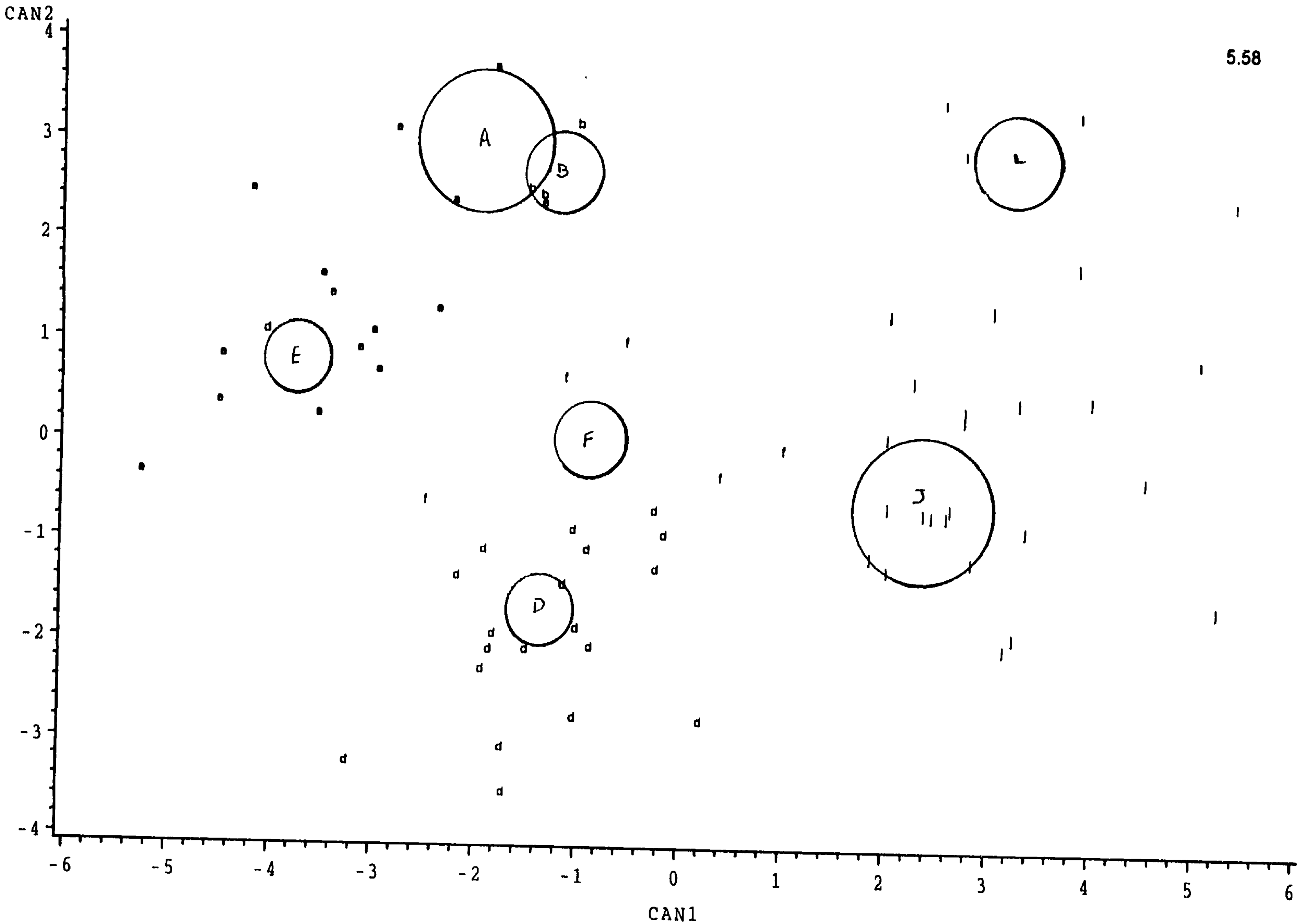


FIG. 5.58. RUN 24.3 CANONICAL TOTAL DATA – MANITOBA/NORTH DAKOTA GROUPS – FEMALES

A=NORMAN B=INTERLAKE D=WESTMAN E=RED RIVER F=EASTMAN G=HUNGRY HALL
I=SIOUX J=SONOTA K=S.ARVILLA L=MANDAN M=DLS X=ARVILLA Y=BLACKDUCK Z=LAUREL Q=CAUCASIAN

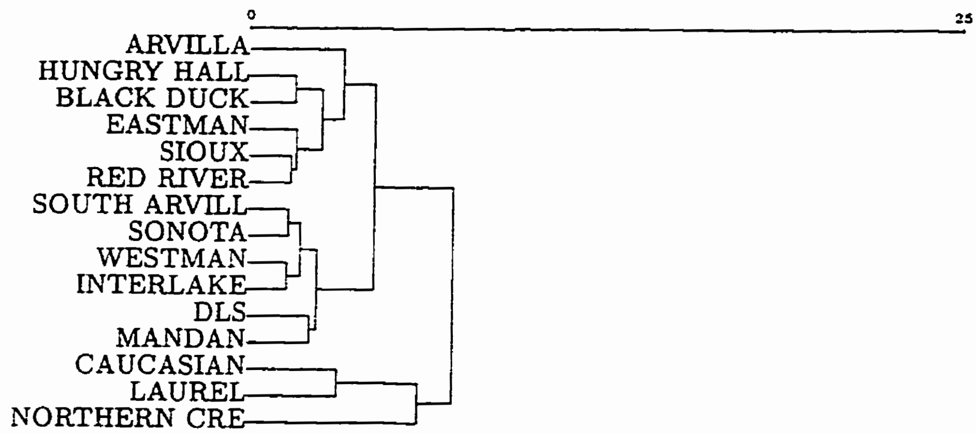


Figure 5.59: Dendogram of male vault C-score data.

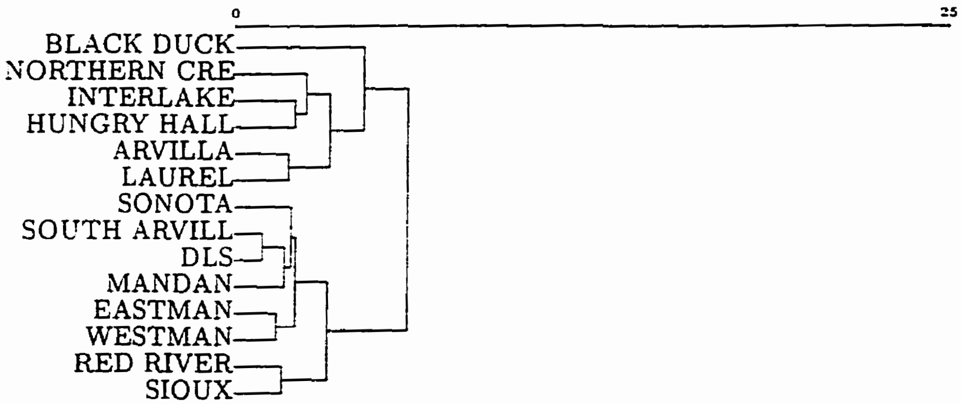


Figure 5.60: Dendogram of female vault C-score data.

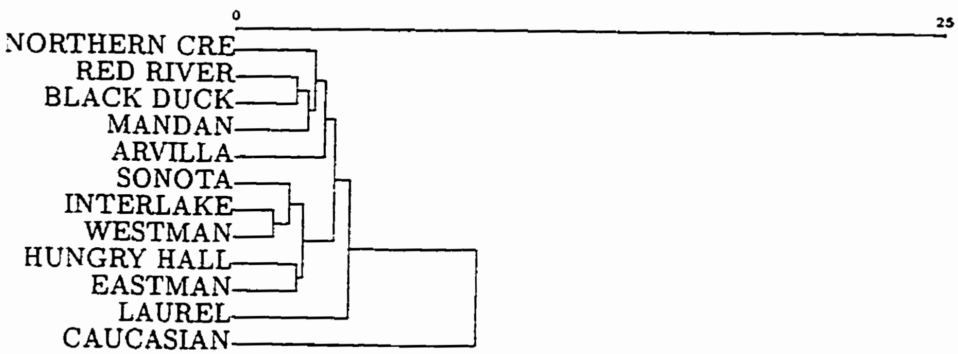


Figure 5.61: Dendogram of male total C-score data.

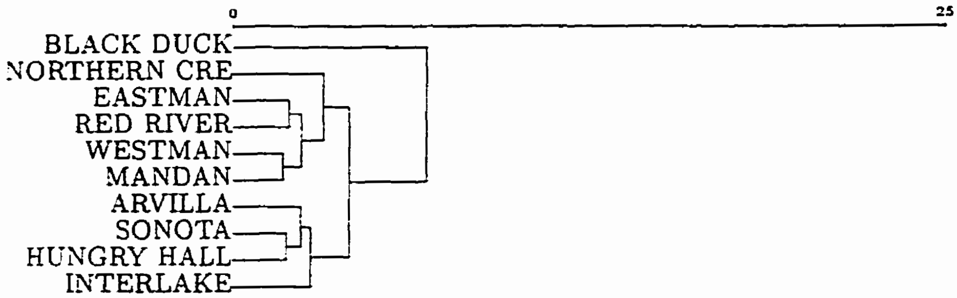


Figure 5.62: Dendogram of female total C-score data.

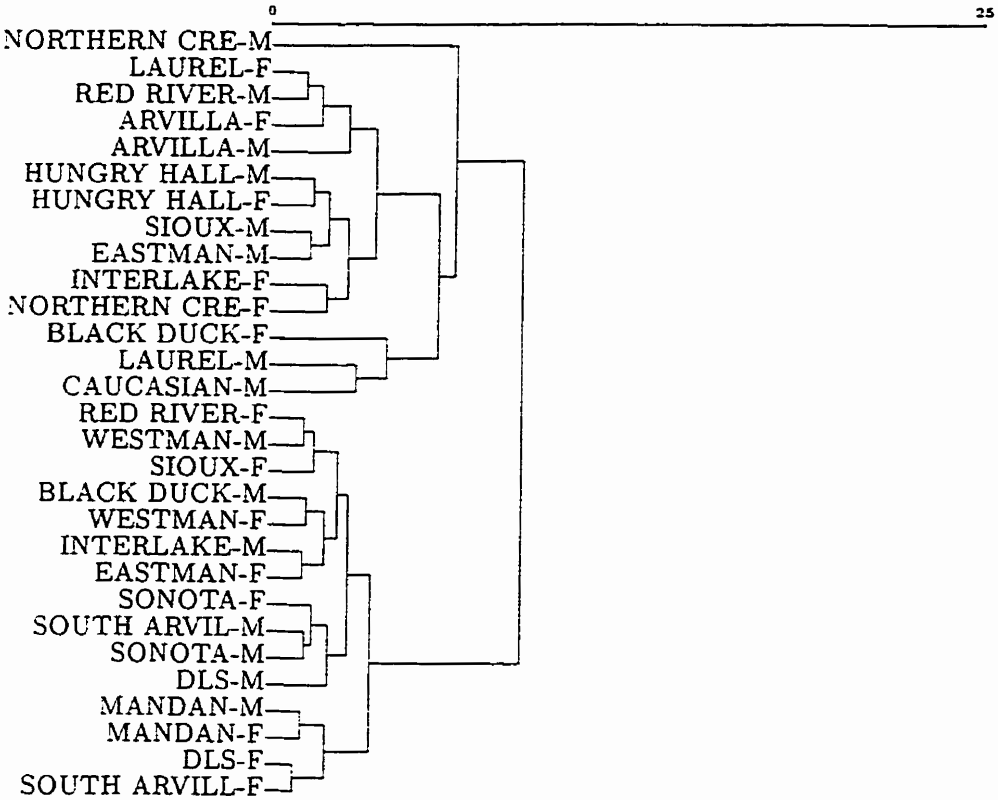


Figure 5.63: Dendogram of vault C-score data, both sexes.

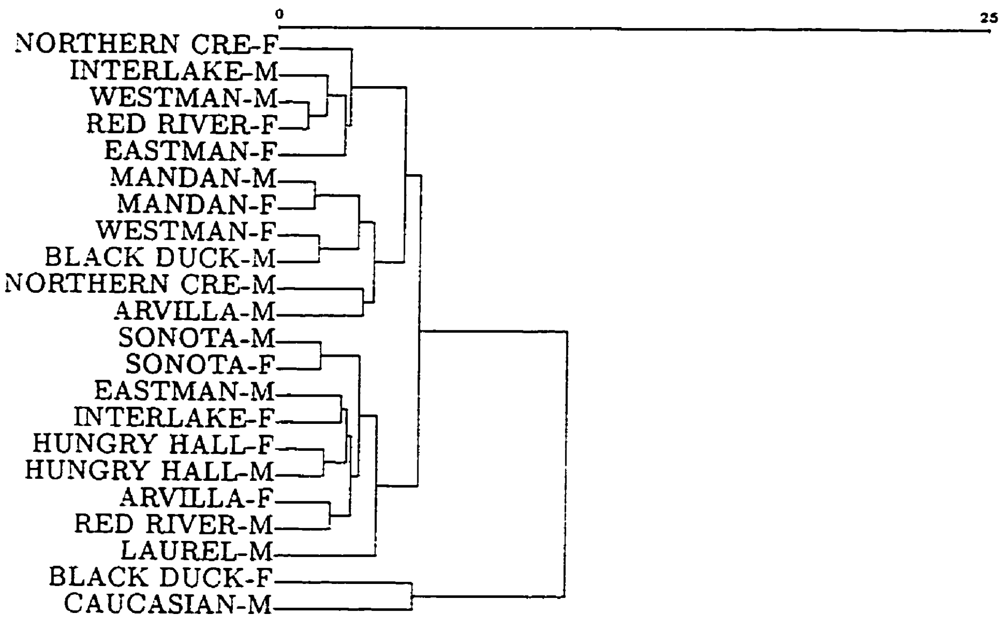


Figure 5.64: Dendogram of total C-score data, both sexes.

APPENDIX A

SPECIMENS INCLUDED IN THE VAULT AND TOTAL DATA SETS

APPENDIX A

SPECIMENS IN THE CRANIAL DATA SET

#	CODE	NAME	LOCATION
1	110A	SKOWNAN-1	SKOWNAN - WATERHEN LAKE
2	110A	SKOWNAN-2	SKOWNAN - WATERHEN LAKE
3	110A	CHURCHILL R	ALONG CHURCHILL RIVER
4	110A	NELSONH	NELSON HOUSE
5	110A	CROSSLA	CROSS LAKE
6	110A	MANHATT	MANHATTAN ISLAND
7	110A	BRNTWOD	BURNTWOOD RIVER
8	110A	PAS	THE PAS
9	110A	MISSI	ALONG MISSI RIVER
10	110A	RAT RIVER	ALONG RAT RIVER
11	210a	YORK-1	YORK FACTORY
12	210a	KENVILL	KENVILLE - NEAR THE SWAN RIVER
13	210a	HGLT-1	BORDEN # HgLt
14	210a	BIRCHTREE	BIRCHTREE ISLAND
15	120B	LONE MND-1	LONE MOUND
16	120B	HDM-41-3	DARLINGFORD
17	120B	HDM-41-7	DARLINGFORD
18	120B	ERICSDALE-1	ERICSDALE
19	120B	WESTBN-A0428	WESTBOURNE
20	120B	LUNDAR	LUNDAR
21	120B	KEESEEK	KEESEEKOUNININ RESERVE - NR ELPHINSTONE
22	220b	HDM-41-4	DARLINGFORD
23	220b	DAUPHIN	DAUPHIN
24	220b	ERICSDALE-2	ERICSDALE
25	240d	HOWARD-1	HOWARD, SASKATCHEWAN
26	140D	BUEN VISTA-1	BUENA VISTA, SASKATCHEWAN
27	140D	SIMS-8	SIMS MOUND
28	140D	SIMS-4	SIMS MOUND
29	140D	SRSFORD-13	SOURISFORD
30	140D	SRSFORD-3	SOURISFORD
31	140D	SRSFORD-1	SOURISFORD
32	140D	ANT CREEK-1	ALONG THE ANTLER CREEK
33	140D	STOTT-2	STOTT MOUND
34	140D	STOTT-1	STOTT MOUND
35	140D	STAR MND-5	STAR MOUND
36	140D	STAR MND-1	STAR MOUND
37	240d	MORS MND-B2	MOORES MOUND
38	140D	MORS MND-B	MOORES MOUND
39	140D	HDM-13-1	SOURISFORD
40	140D	HDM-15-1	SOURISFORD (GOULD'S FARM)
41	140D	HDM-30-1	ARDEN
42	140D	HDM-36-2	SOURISFORD (THOMPSON'S FARM?) MOUND 2
43	140D	HDM-39-6	DARLINGFORD
44	140D	HDM-47-1	SOURISFORD (THOMPSON'S FARM) MOUND 5
45	140D	HDM-47-2	SOURISFORD

46	140D S5-HK-1278	PILOT MOUND
47	240D GY HIL-III	GUY HILL - ROCK LAKE NEAR CARTWRIGHT
48	140D GY HIL-III-2	GUY HILL - ROCK LAKE NEAR CARTWRIGHT
49	140D VICKERS-4376	100 YARDS NORTH OF AVERY SITE
50	140D HILTON-B	HILTON
51	140D KILLARNEY	KILLARNEY
52	140D SOURIS	SOURIS
53	140D RM DALY	RURAL MUNICIPALITY OF DALY
54	240d SIMS-14	SIMS MOUND
55	240d SRSFORD-2	SOURISFORD
56	240d MCGORMAN-1	MCGORMAN MOUND
57	240d STAR MND-6	STAR MOUND
58	240d HDM-22-2	SOURISFORD (ELLIOT'S FARM)
59	240d HDM-31-2	PILOT MOUND
60	240d HDM-37-1	ROCK LAKE (MORRISON'S FORM)
61	240d HDM-43-1	SOURISFORD (THOMPSON'S FARM) MOUND 1
62	240d HDM-47-3	SOURISFORD
63	240d P MND-MC1	PILOT MOUND
64	240d S4-HK-1277	PILOT MOUND
65	240d VICKERS-1108	100 YARDS NORTH OF AVERY SITE
66	240d RESTON	RESTON
67	240d ELLIS ELLIOT	ELLIS ELLIOT NEAR PIPESTONE
68	240d HDM-30-3	ARDEN
69	250E WARNER MND-1	DENNIS WARNER MOUND
70	150E FIDDLER-7	FIDDLER MOUND
71	150E FIDDLER-16	FIDDLER MOUND
72	150E MORDEN-116-1	MORDEN
73	150E ASSINB-104-1	WINNIPEG - ST. JAMES
74	150E PINE RIDGE	PINE RIDGE NEAR BIRD'S HILL
75	150E WEIBE-A0418	WEIBE MOUND
76	150E SELKIRK	SELKIRK
77	250e RED RIV-1	ALONG THE RED RIVER
78	250e LKPRT-SKEL-4	LOCKPORT
79	250e WARNER MND-2	DENNIS WARNER MOUND
80	250e WARNER-11	DENNIS WARNER
81	250e HIST ASSINB	WINNIPEG - ST. JAMES ?
82	250e FIDDLER-12	FIDDLER MOUND
83	250e FIDDLER-15	FIDDLER MOUND
84	250e FIDDLER-17A	FIDDLER MOUND
85	250e FIDDLER-19	FIDDLER MOUND
86	250e FIDDLER-21	FIDDLER MOUND
87	250e ASSINB-104-4	WINNIPEG - ST. JAMES
88	250e STARBUCK	STARBUCK
89	160F CEM PNT-1993	CEMETERY POINT - NUTIMIK
90	160F CADDY LAKE-2	CADDY LAKE - WHITESHELL
91	160F WHSHEL-A0417	WHITESHELL
92	160F K & J	WHITESHELL - NW ONTARIO
93	160F RIVERMO	RIVERMOUTH
94	160F MINAKII	MINAKII
95	160F NUTIMIK	NUTIMIK LAKE
96	160F A_13_23	FORT ALEXANDER
97	260F FA3 410	FORT ALEXANDER
98	160F WHALEY1	WHALEY
99	160F SLAF2I1	SLAVE FALLS

100	160F	WHAF1I1	WHALEY
101	260f	CEM PNT-90-2	CEMETERY POINT - NUTIMIK
102	260f	CADDY LAKE-1	CADDY LAKE - WHITESHELL
103	260f	EAGLENE	EAGLENEST LAKE
104	260f	WHITEMO	WHITEMOUTH
105	260f	BJORKLU	BJORKLUND
106	260f	FA3 101	FORT ALEXANDER
107	260f	FA3 409	FORT ALEXANDER
108	260f	FA3 411	FORT ALEXANDER
109	260f	FA3 412	FORT ALEXANDER
110	260f	WHALEY2	WHALEY
111	260f	EGLA_10	BORDEN EgLa
112	260f	WHAF2I1	WHALEY
113	170G	H HALL-92	HUNGRY HALL 2
114	170G	H HALL-94	HUNGRY HALL 2
115	170G	H HALL-95	HUNGRY HALL 2
116	170G	HHM-S5	HUNGRY HALL 1
117	170G	HHM-S10	HUNGRY HALL 1
118	170G	HHM-S26	HUNGRY HALL 1
119	170G	HHM-S28	HUNGRY HALL 1
120	170G	HHM-S30	HUNGRY HALL 1
121	170G	HHM-S31	HUNGRY HALL 1
122	170G	HHM-S34	HUNGRY HALL 1
123	270g	H HALL-93	HUNGRY HALL 2
124	270g	H HALL-96	HUNGRY HALL 2
125	270g	H HALL-97	HUNGRY HALL 2
126	270g	H HALL-98	HUNGRY HALL 2
127	270g	HHM-S12	HUNGRY HALL 1
128	270g	HHM-S16	HUNGRY HALL 1
129	270g	HHM-S23	HUNGRY HALL 1
130	270g	HHM-S24	HUNGRY HALL 1
131	240d	PILT2-109	LAB SPECIMEN - DAKOTA SIOUX
132	210a	PILT2-106	LAB SPECIMEN - CREE
133	150E	PILT2-101	LAB SPECIMEN - FROM ST. BONIFACE
134	240d	PILT2-97	LAB SPECIMEN - FROM HOLLAND MB
135	240d	PILT2-107	LAB SPECIMEN - BLACKFOOT
136	160F	FA-FONT	FORT ALEXANDER
137	139I	BF--B2	SIOUX (FROM P. KEY)
138	139I	BF--S380272	SIOUX (FROM P. KEY)
139	139I	BF--S380273	SIOUX (FROM P. KEY)
140	239i	BF225IM1F5 B4	SIOUX (FROM P. KEY)
141	139I	BF225IM2F1B1	SIOUX (FROM P. KEY)
142	239i	BF234-M1F2 16	SIOUX (FROM P. KEY)
143	139I	CL--OM2212	SIOUX (FROM P. KEY)
144	139I	CL1B-OM17876	SIOUX (FROM P. KEY)
145	139I	CL1B-OM17877	SIOUX (FROM P. KEY)
146	239i	RO10I-310	SIOUX (FROM P. KEY)
147	239i	RO10I-M2 315	SIOUX (FROM P. KEY)
148	239i	RO3I-301	SIOUX (FROM P. KEY)
149	139I	RO31-300	SIOUX (FROM P. KEY)
150	239i	RO3I-307	SIOUX (FROM P. KEY)
151	239i	RO3I-15689	SIOUX (FROM P. KEY)
152	290j	DW233 M2 B5	SONOTA (FROM P. KEY)
153	290J	DW233 M2 B6	SONOTA (FROM P. KEY)

154	290j	DW233 M2 B3	SONOTA (FROM P. KEY)
155	290j	DW240 M1 B2	SONOTA (FROM P. KEY)
156	190J	DW240 M2B2180	SONOTA (FROM P. KEY)
157	190J	DW252 M1B164A	SONOTA (FROM P. KEY)
158	290j	DW252 M1B164B	SONOTA (FROM P. KEY)
159	190J	DW252 M1B2 66	SONOTA (FROM P. KEY)
160	190J	SI1-M2-B2	SONOTA (FROM P. KEY)
161	290j	SN22A-F12-17A	SONOTA (FROM P. KEY)
162	190J	SN22A-F12-9B	SONOTA (FROM P. KEY)
163	190J	SN31-91	SONOTA (FROM P. KEY)
164	171K	RO10-313	S. ARVILLA (FROM P. KEY)
165	271k	RO10-M6 DA7	S. ARVILLA (FROM P. KEY)
166	271k	RO10-M5 DA10	S. ARVILLA (FROM P. KEY)
167	171K	RO10-319	S. ARVILLA (FROM P. KEY)
168	171K	RO2-OM15003	S. ARVILLA (FROM P. KEY)
169	171K	RO23-369-26E	S. ARVILLA (FROM P. KEY)
170	271k	RO23-369-26D	S. ARVILLA (FROM P. KEY)
171	171K	RO23-369-26C	S. ARVILLA (FROM P. KEY)
172	271k	RO23-369-26A	S. ARVILLA (FROM P. KEY)
173	271k	RO23-369-26B	S. ARVILLA (FROM P. KEY)
174	171K	RO23-369-40A	S. ARVILLA (FROM P. KEY)
175	271k	RO23-369-40B	S. ARVILLA (FROM P. KEY)
176	171K	RO23-369-38C	S. ARVILLA (FROM P. KEY)
177	271k	RO23-369-38A	S. ARVILLA (FROM P. KEY)
178	271k	RO3-304	S. ARVILLA (FROM P. KEY)
179	171K	RO3-302	S. ARVILLA (FROM P. KEY)
180	271k	RO3-305	S. ARVILLA (FROM P. KEY)
181	171K	RO3-308	S. ARVILLA (FROM P. KEY)
182	171K	RO4-242	S. ARVILLA (FROM P. KEY)
183	271k	RO4-248	S. ARVILLA (FROM P. KEY)
184	271k	RO4-244	S. ARVILLA (FROM P. KEY)
185	171K	RO4-243	S. ARVILLA (FROM P. KEY)
186	115L	BL4-JVR1903	MANDAN (FROM P. KEY)
187	215l	BL4	MANDAN (FROM P. KEY)
188	215l	BL8-FS11-3A	MANDAN (FROM P. KEY)
189	115L	BL8-FS13-8	MANDAN (FROM P. KEY)
190	215l	BL8-FS6-5	MANDAN (FROM P. KEY)
191	115L	BL8-2707	MANDAN (FROM P. KEY)
192	215l	BL8-FS7 B6	MANDAN (FROM P. KEY)
193	215l	BL8-FS14B7	MANDAN (FROM P. KEY)
194	215l	BL8-GFW1936	MANDAN (FROM P. KEY)
195	115L	BL9-4337	MANDAN (FROM P. KEY)
196	215l	ME12-L1304	MANDAN (FROM P. KEY)
197	115L	ME2A-9321	MANDAN (FROM P. KEY)
198	115L	ME2A-9325	MANDAN (FROM P. KEY)
199	115L	ME2A-9326	MANDAN (FROM P. KEY)
200	215l	ME2A-9327	MANDAN (FROM P. KEY)
201	115L	ME5-B1A	MANDAN (FROM P. KEY)
202	215l	ME5-B1B	MANDAN (FROM P. KEY)
203	115L	MO26-10756	MANDAN (FROM P. KEY)
204	215l	MO26-8290	MANDAN (FROM P. KEY)
205	215l	MO26-10755	MANDAN (FROM P. KEY)
206	215l	MO26-P/K 1	MANDAN (FROM P. KEY)
207	215l	MO29-10757	MANDAN (FROM P. KEY)

208	115L	MO31-10751	MANDAN (FROM P. KEY)
209	2151	MO31-10747	MANDAN (FROM P. KEY)
210	2151	MO31-10748	MANDAN (FROM P. KEY)
211	2151	MO31-10749	MANDAN (FROM P. KEY)
212	2151	MO31-10752	MANDAN (FROM P. KEY)
213	2151	MO37-P/K 1	MANDAN (FROM P. KEY)
214	2151	MO8181.98.1	MANDAN (FROM P. KEY)
215	115L	MO972-12-B	MANDAN (FROM P. KEY)
216	2151	MO974-14-D	MANDAN (FROM P. KEY)
217	115L	MO975-15-E	MANDAN (FROM P. KEY)
218	2151	MO976-16-F	MANDAN (FROM P. KEY)
219	2151	MO978-18-H	MANDAN (FROM P. KEY)
220	1 0M	WA--S228876	DLS (FROM P. KEY)
221	1 0M	WA--S228878	DLS (FROM P. KEY)
222	1 0M	WA--S228880	DLS (FROM P. KEY)
223	2 0m	WA--S228884	DLS (FROM P. KEY)
224	2 0m	WA--S228885	DLS (FROM P. KEY)
225	2 0m	WA--S228886	DLS (FROM P. KEY)
226	2 0m	WA--S228889	DLS (FROM P. KEY)
227	1 0M	WA--S228890	DLS (FROM P. KEY)
228	1 0M	WE401-4319	DLS (FROM P. KEY)
229	1 2X	WARNER-57	ARVILLA (FROM S. MYSTER)
230	2 2x	WARNER-60B	ARVILLA (FROM S. MYSTER)
231	2 2x	WARNER-62	ARVILLA (FROM S. MYSTER)
232	1 2X	WARNER-63	ARVILLA (FROM S. MYSTER)
233	2 2x	WARNER-65	ARVILLA (FROM S. MYSTER)
234	1 2X	WARNER-66	ARVILLA (FROM S. MYSTER)
235	2 2x	WARNER-73	ARVILLA (FROM S. MYSTER)
236	2 2x	WARNER-79	ARVILLA (FROM S. MYSTER)
237	2 2x	REDLAKEF-25	ARVILLA (FROM S. MYSTER)
238	2 2x	REDLAKEF-29	ARVILLA (FROM S. MYSTER)
239	2 2x	BRONSON-5	ARVILLA (FROM S. MYSTER)
240	2 2x	BRONSON-11	ARVILLA (FROM S. MYSTER)
241	2 2x	WARNER-61	ARVILLA (FROM S. MYSTER)
242	1 2X	REDLAKEF-32	ARVILLA (FROM S. MYSTER)
243	2 2x	BRONSON-2A	ARVILLA (FROM S. MYSTER)
244	1 3Y	SCHOCKER-33-4	BLACKDUCK (FROM S. MYSTER)
245	1 3Y	SCHOCKER-33-5	BLACKDUCK (FROM S. MYSTER)
246	1 3Y	SCHOCKER-33-7	BLACKDUCK (FROM S. MYSTER)
247	1 3Y	SCHOCKER-33-1	BLACKDUCK (FROM S. MYSTER)
248	0 3Y	BAGLEY-3	BLACKDUCK (FROM S. MYSTER)
249	1 3Y	BAGLEY-4	BLACKDUCK (FROM S. MYSTER)
250	1 3Y	WHITOAK-12	BLACKDUCK (FROM S. MYSTER)
251	1 3Y	WHITOAK-14	BLACKDUCK (FROM S. MYSTER)
252	1 3Y	WHITOAK-22	BLACKDUCK (FROM S. MYSTER)
253	1 3Y	WHITOAK-32	BLACKDUCK (FROM S. MYSTER)
254	1 3Y	WHITOAK-33	BLACKDUCK (FROM S. MYSTER)
255	1 3Y	WHITOAK-24	BLACKDUCK (FROM S. MYSTER)
256	2 3y	OSUFSEN-21	BLACKDUCK (FROM S. MYSTER)
257	1 3Y	OSUFSEN-23	BLACKDUCK (FROM S. MYSTER)
258	2 3y	OSUFSEN-26	BLACKDUCK (FROM S. MYSTER)
259	1 3Y	OSUFSEN-28	BLACKDUCK (FROM S. MYSTER)
260	2 3y	OSUFSEN-43	BLACKDUCK (FROM S. MYSTER)
261	1 3Y	OSUFSEN-49	BLACKDUCK (FROM S. MYSTER)

262	0 3Y	MCKINSTRY-54	BLACKDUCK (FROM S. MYSTER)
263	1 3Y	MCKINSTRY-71	BLACKDUCK (FROM S. MYSTER)
264	0 4Z	MCKINSTRY-13	LAUREL (FROM S. MYSTER)
265	1 4Z	MCKINSTRY-14	LAUREL (FROM S. MYSTER)
266	0 4Z	MCKINSTRY-34	LAUREL (FROM S. MYSTER)
267	0 4Z	MCKINSTRY-36	LAUREL (FROM S. MYSTER)
268	2 4z	MCKINSTRY-78	LAUREL (FROM S. MYSTER)
269	2 4z	SMITH-57	LAUREL (FROM S. MYSTER)
270	1 0M	WE401-4320	DLS (FROM P. KEY)
271	125Q	PINAWA	PINAWA
272	025q	PN-10-44	THE PAS (SAM WALLER MUSEUM)
273	125Q	MORDEN-1	MORDEN
274	125Q	MORDEN-2	MORDEN
275	135H	WPG-Z-38-1	WINNIPEG
276	135H	CHURCHILL	CHURCHILL
277	235h	ELIE	ELIE
278	135H	PN-19-89A	THE PAS (SAM WALLER MUSEUM)
279	110A	PN-21-15A	THE PAS (SAM WALLER MUSEUM)
280	140D	BELMONT-1	BELMONT
281	140D	BELMONT-C3	BELMONT
282	140d	YULE-MD-807-1	YULE SITE - NEAR MATHER
283	125Q	TEULON_1	TEULON
284	260f	RIVERMOU2	RIVERMOUTH-2
285	160F	RIVERMOU3	RIVERMOUTH-3
286	140D	KILLARNEY	KILLARNEY-1

SPECIMENS IN THE TOTAL DATA SET

#	CODE	NAME	LOCATION
1	110A	SKOWNAN-1	SKOWNAN - WATERHEN LAKE.
2	110A	CHURCHILL R	ALONG CHURCHILL RIVER.
3	110A	MANHATT	MANHATTAN ISLAND.
4	110A	BRNTWOD	BURNTWOOD RIVER.
5	210a	YORK-1	YORK FACTORY.
6	120B	LONE MND-1	LONE MOUND.
7	120B	HDM-41-3	DARLINGFORD.
8	120B	HDM-41-7	DARLINGFORD.
9	120B	ERICSDALE-1	ERICSDALE.
10	120B	WESTBN-A0428	WESTBOURNE.
11	120B	LUNDAR	LUNDAR.
12	220b	HDM-41-4	DARLINGFORD.
13	220b	DAUPHIN	DAUPHIN.
14	240d	HOWARD-1	HOWARD, SASKATCHEWAN.
15	140D	BUEN VISTA-1	BUENA VISTA, SASKATCHEWAN.
16	140D	SIMS-8	SIMS MOUND.
17	140D	SIMS-4	SIMS MOUND
18	140D	SRSFORD-13	SOURISFORD.
19	140D	SRSFORD-3	SOURISFORD.

20	140D SRSFORD-1	SOURISFORD.
21	140D STOTT-2	STOTT MOUND.
22	140D STOTT-1	STOTT MOUND.
23	140D STAR MND-5	STAR MOUND.
24	140D STAR MND-1	STAR MOUND.
25	240d MORS MND-B2	MOORES MOUND.
26	140D MORS MND-B	MOORES MOUND.
27	140D HDM-13-1	SOURISFORD.
28	140D HDM-15-1	SOURISFORD (GOULD'S FARM).
29	140D HDM-30-1	ARDEN.
30	140D HDM-36-2	SOURISFORD (THOMPSON'S FARM?) MOUND 2.
31	140D HDM-47-1	SOURISFORD (THOMPSON'S FARM) MOUND 5.
32	140D HDM-47-2	SOURISFORD.
33	140D S5-HK-1278	PILOT MOUND.
34	240D GY HIL-III	GUY HILL - ROCK LAKE NEAR CARTWRIGHT.
35	140D GY HIL-III-2	GUY HILL - ROCK LAKE NEAR CARTWRIGHT.
36	140D VICKERS-4376	100 YARDS NORTH OF AVERY SITE.
37	140D KILLARNEY	KILLARNEY.
38	140D SOURIS	SOURIS.
39	140D RM DALY	RURAL MUNICIPALITY OF DALY.
40	240d SIMS-14	SIMS MOUND.
41	240d SRSFORD-2	SOURISFORD.
42	240d MCGORMAN-1	MCGORMAN MOUND.
43	240d HDM-22-2	SOURISFORD (ELLIOT'S FARM).
44	240d HDM-31-2	PILOT MOUND.
45	240d HDM-37-1	ROCK LAKE (MORRISON'S FORM).
46	240d HDM-43-1	SOURISFORD (THOMPSON'S FARM) MOUND 1.
47	240d HDM-47-3	SOURISFORD.
48	240d P MND-MC1	PILOT MOUND.
49	240d S4-HK-1277	PILOT MOUND.
50	240d VICKERS-1108	100 YARDS NORTH OF AVERY SITE.
51	240d RESTON	RESTON.
52	240d ELLIS ELLIOT	ELLIS ELLIOT NEAR PIPESTONE.
53	240d HDM-30-3	ARDEN.
54	150E WARNER MND-1	DENNIS WARNER MOUND.
55	150E FIDDLER-7	FIDDLER MOUND.
56	150E MORDEN-116-1	MORDEN.
57	150E ASSINB-104-1	WINNIPEG - ST. JAMES.
58	150E PINE RIDGE	PINE RIDGE NEAR BIRD'S HILL.
59	150E WEIBE-A0418	WEIBE MOUND.
60	250e RED RIV-1	ALONG THE RED RIVER.
61	250e LKPRT-SKEL-4	LOCKPORT.
62	250e WARNER MND-2	DENNIS WARNER MOUND.
63	250e WARNER-11	DENNIS WARNER.
64	250e HIST ASSINB	WINNIPEG - ST. JAMES ?.
65	250e FIDDLER-12	FIDDLER MOUND.
66	250e FIDDLER-15	FIDDLER MOUND.
67	250e FIDDLER-17A	FIDDLER MOUND.
68	250e FIDDLER-19	FIDDLER MOUND.
69	250e FIDDLER-21	FIDDLER MOUND.
70	250e ASSINB-104-4	WINNIPEG - ST. JAMES.
71	250e STARBUCK	STARBUCK.
72	160F CEM PNT-1993	CEMETERY POINT - NUTIMIK.
73	160F CADDY LAKE-2	CADDY LAKE - WHITESHELL.

74	160F WHSHEL-A0417	WHITESHELL.
75	160F RIVERMO	RIVERMOUTH.
76	160F NUTIMIK	NUTIMIK LAKE.
77	260F FA3 410	FORT ALEXANDER.
78	260f CEM PNT-90-2	CEMETERY POINT - NUTIMIK.
79	260f FA3 101	FORT ALEXANDER.
80	260f FA3 411	FORT ALEXANDER.
81	260f FA3 412	FORT ALEXANDER.
82	170G H HALL-92	HUNGRY HALL 2.
83	170G H HALL-94	HUNGRY HALL 2.
84	170G H HALL-95	HUNGRY HALL 2.
85	170G HHM-S5	HUNGRY HALL 1.
86	170G HHM-S10	HUNGRY HALL 1.
87	170G HHM-S26	HUNGRY HALL 1.
88	170G HHM-S28	HUNGRY HALL 1.
89	170G HHM-S30	HUNGRY HALL 1.
90	170G HHM-S31	HUNGRY HALL 1.
91	270g H HALL-93	HUNGRY HALL 2.
92	270g H HALL-96	HUNGRY HALL 2.
93	270g H HALL-97	HUNGRY HALL 2.
94	270g H HALL-98	HUNGRY HALL 2.
95	270g HHM-S12	HUNGRY HALL 1.
96	270g HHM-S16	HUNGRY HALL 1.
97	270g HHM-S23	HUNGRY HALL 1.
98	270g HHM-S24	HUNGRY HALL 1.
99	240d PILT2-109	LAB SPECIMEN - DAKOTA SIOUX.
100	210a PILT2-106	LAB SPECIMEN - CREE.
101	150E PILT2-101	LAB SPECIMEN - FROM ST. BONIFACE.
102	240d PILT2-97	LAB SPECIMEN - FROM HOLLAND MB.
103	240d PILT2-107	LAB SPECIMEN - BLACKFOOT.
104	160F FA-FONT	FORT ALEXANDER.
105	290j DW233 M2 B5	SONOTA (FROM P. KEY).
106	290J DW233 M2 B6	SONOTA (FROM P. KEY).
107	290j DW233 M2 B3	SONOTA (FROM P. KEY).
108	290j DW240 M1 B2	SONOTA (FROM P. KEY).
109	190J DW240 M2B2180	SONOTA (FROM P. KEY).
110	190J DW252 M1B164A	SONOTA (FROM P. KEY).
111	290j DW252 M1B164B	SONOTA (FROM P. KEY).
112	190J DW252 M1B2 66	SONOTA (FROM P. KEY).
113	190J SI1-M2-B2	SONOTA (FROM P. KEY).
114	290j SN22A-F12-17A	SONOTA (FROM P. KEY).
115	190J SN22A-F12-9B	SONOTA (FROM P. KEY).
116	190J SN31-91	SONOTA (FROM P. KEY).
117	115L BL4-JVR1903	MANDAN (FROM P. KEY).
118	215l BL4	MANDAN (FROM P. KEY).
119	215l BL8-FS11-3A	MANDAN (FROM P. KEY).
120	115L BL8-FS13-8	MANDAN (FROM P. KEY).
121	215l BL8-FS6-5	MANDAN (FROM P. KEY).
122	115L BL8-2707	MANDAN (FROM P. KEY).
123	215l BL8-FS7 B6	MANDAN (FROM P. KEY).
124	215l BL8-FS14B7	MANDAN (FROM P. KEY).
125	215l BL8-GFW1936	MANDAN (FROM P. KEY).
126	115L BL9-4337	MANDAN (FROM P. KEY).
127	215l ME12-L1304	MANDAN (FROM P. KEY).

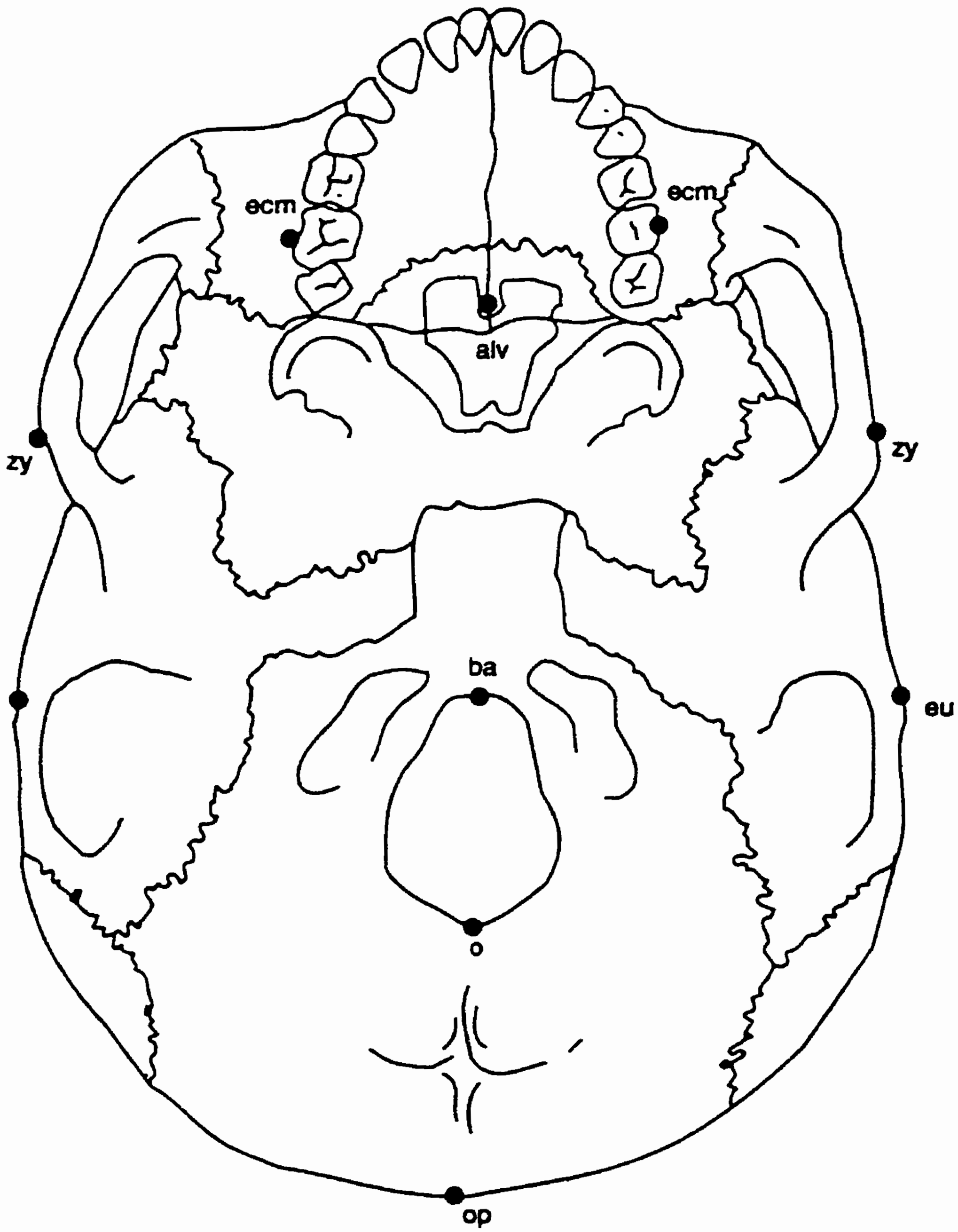
128	115L	ME2A-9321	MANDAN (FROM P. KEY).
129	115L	ME2A-9325	MANDAN (FROM P. KEY).
130	115L	ME2A-9326	MANDAN (FROM P. KEY).
131	215l	ME2A-9327	MANDAN (FROM P. KEY).
132	115L	ME5-B1A	MANDAN (FROM P. KEY).
133	215l	ME5-B1B	MANDAN (FROM P. KEY).
134	115L	MO26-10756	MANDAN (FROM P. KEY).
135	215l	MO26-8290	MANDAN (FROM P. KEY).
136	215l	MO26-10755	MANDAN (FROM P. KEY).
137	215l	MO26-P/K 1	MANDAN (FROM P. KEY).
138	215l	MO29-10757	MANDAN (FROM P. KEY).
139	115L	MO31-10751	MANDAN (FROM P. KEY).
140	215l	MO31-10747	MANDAN (FROM P. KEY).
141	215l	MO31-10748	MANDAN (FROM P. KEY).
142	215l	MO31-10749	MANDAN (FROM P. KEY).
143	215l	MO31-10752	MANDAN (FROM P. KEY).
144	215l	MO37-P/K 1	MANDAN (FROM P. KEY).
145	215l	MO8181.98.1	MANDAN (FROM P. KEY).
146	115L	MO972-12-B	MANDAN (FROM P. KEY).
147	215l	MO974-14-D	MANDAN (FROM P. KEY).
148	115L	MO975-15-E	MANDAN (FROM P. KEY).
149	215l	MO976-16-F	MANDAN (FROM P. KEY).
150	215l	MO978-18-H	MANDAN (FROM P. KEY).
151	2 2x	WARNER-60B	ARVILLA (FROM S. MYSTER).
152	2 2x	WARNER-62	ARVILLA (FROM S. MYSTER).
153	1 2X	WARNER-63	ARVILLA (FROM S. MYSTER).
154	2 2x	WARNER-65	ARVILLA (FROM S. MYSTER).
155	1 2X	WARNER-66	ARVILLA (FROM S. MYSTER).
156	2 2x	WARNER-79	ARVILLA (FROM S. MYSTER).
157	2 2x	REDLAKEF-25	ARVILLA (FROM S. MYSTER).
158	2 2x	REDLAKEF-29	ARVILLA (FROM S. MYSTER).
159	2 2x	BRONSON-5	ARVILLA (FROM S. MYSTER).
160	2 2x	BRONSON-11	ARVILLA (FROM S. MYSTER).
161	2 2x	WARNER-61	ARVILLA (FROM S. MYSTER).
162	1 2X	REDLAKEF-32	ARVILLA (FROM S. MYSTER).
163	1 3Y	WHITOAK-12	BLACKDUCK (FROM S. MYSTER).
164	1 3Y	WHITOAK-14	BLACKDUCK (FROM S. MYSTER).
165	1 3Y	WHITOAK-22	BLACKDUCK (FROM S. MYSTER).
166	1 3Y	WHITOAK-32	BLACKDUCK (FROM S. MYSTER).
167	1 3Y	WHITOAK-33	BLACKDUCK (FROM S. MYSTER).
168	1 3Y	WHITOAK-24	BLACKDUCK (FROM S. MYSTER).
169	2 3y	OSUFSEN-21	BLACKDUCK (FROM S. MYSTER).
170	2 3y	OSUFSEN-26	BLACKDUCK (FROM S. MYSTER).
171	1 3Y	OSUFSEN-49	BLACKDUCK (FROM S. MYSTER).
172	0 3Y	MCKINSTRY-54	BLACKDUCK (FROM S. MYSTER).
173	1 3Y	MCKINSTRY-71	BLACKDUCK (FROM S. MYSTER).
174	0 4Z	MCKINSTRY-13	LAUREL (FROM S. MYSTER).
175	1 4Z	MCKINSTRY-14	LAUREL (FROM S. MYSTER).
176	0 4Z	MCKINSTRY-34	LAUREL (FROM S. MYSTER).
177	0 4Z	MCKINSTRY-36	LAUREL (FROM S. MYSTER).
178	2 4z	SMITH-57	LAUREL (FROM S. MYSTER).
179	125Q	PINAWA	PINAWA.
180	025q	PN-10-44	THE PAS (SAM WALLER MUSEUM).
181	125Q	MORDEN-1	MORDEN.

182	125Q	MORDEN-2	MORDEN.
183	135H	WPG-Z-38-1	WINNIPEG.
184	135H	CHURCHILL	CHURCHILL.
185	235h	ELIE	ELIE.
186	135H	PN-19-89A	THE PAS (SAM WALLER MUSEUM).
187	110A	PN-21-15A	THE PAS (SAM WALLER MUSEUM).
188	140D	BELMONT-1	BELMONT.
189	140D	BELMONT-C3	BELMONT.
190	140d	YULE-MD-807-1	YULE SITE - NEAR MATHER.
191	125q	TEULON_1	TEULON.
192	260f	RIVERMOU2	RIVERMOUTH.
193	160F	RIVERMOU3	RIVERMOUTH.
194	125Q	TEULON_1	TEULON
195	260f	RIVERMOU2	RIVERMOUTH-2
196	160F	RIVERMOU3	RIVERMOUTH-3
197	140D	KILLARNEY	KILLARNEY-1

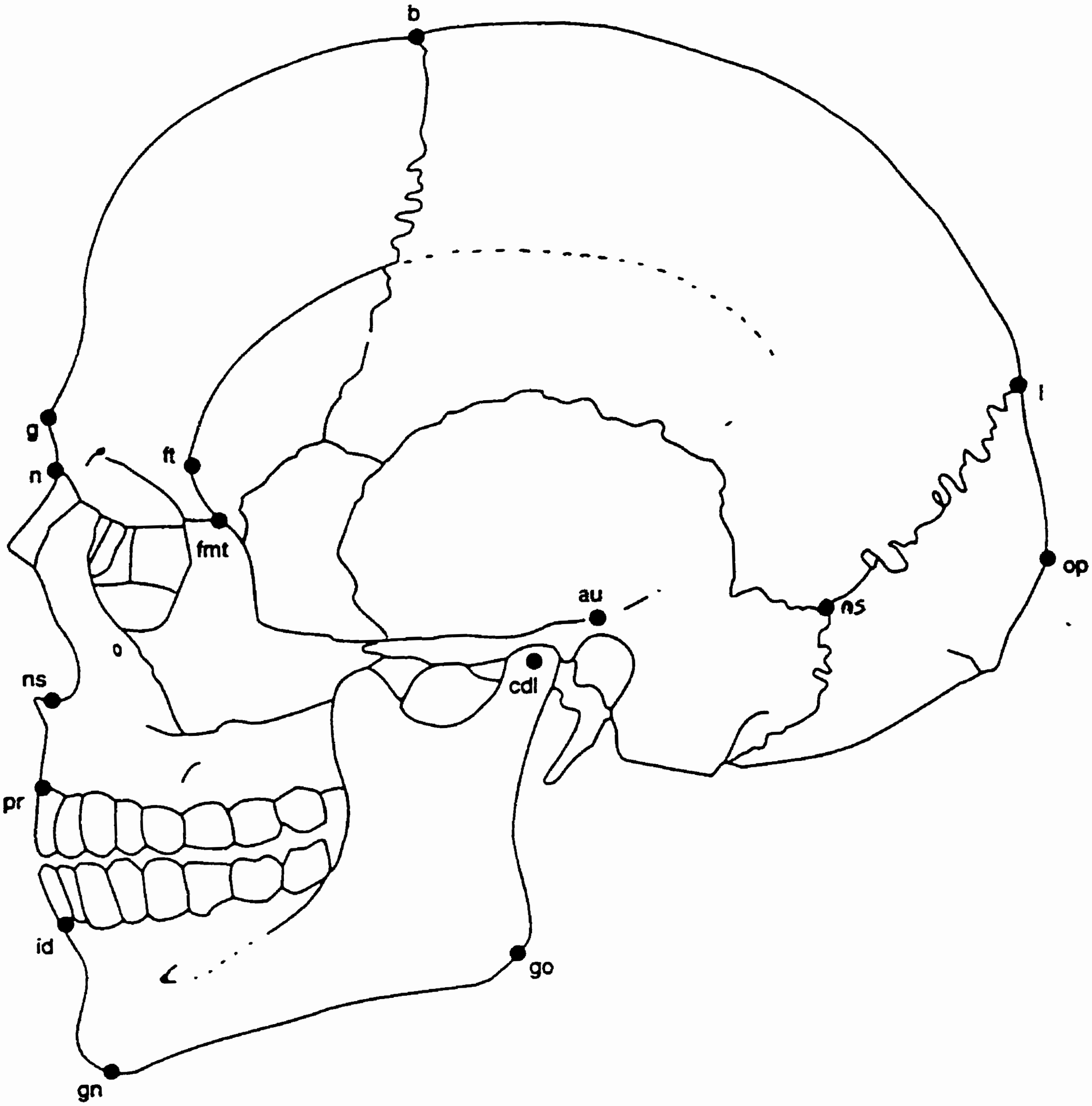
APPENDIX B

MEASUREMENTS AND DESCRIPTIONS

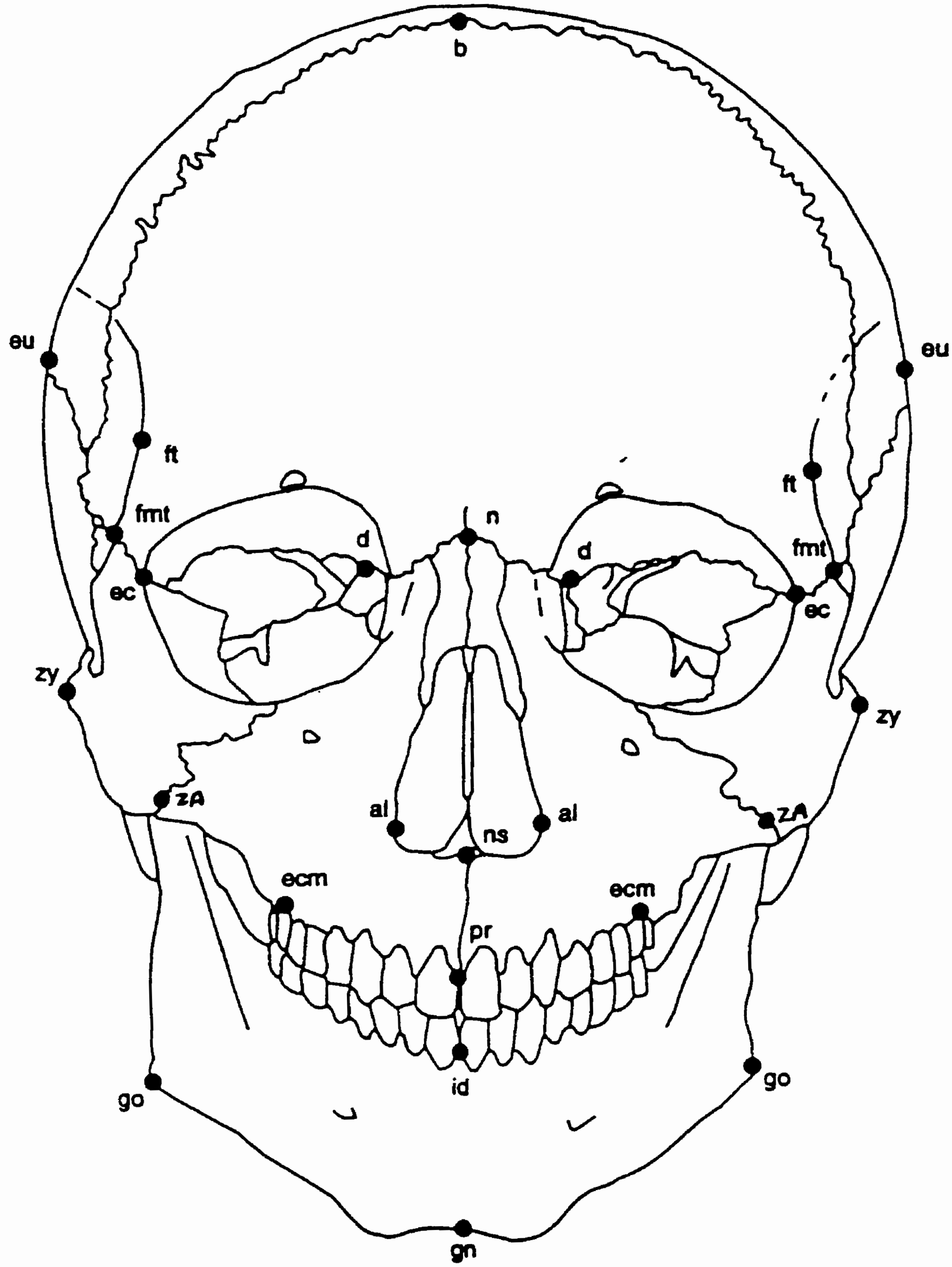
APPENDIX B
MEASUREMENTS AND DESCRIPTIONS



(al) Alare (b) Bregma (d) Dacryon (ec) Ectoconchion (eu) Euryon
(fmt) Frontomalare Temporale (ft) Frontotemporale
(gn) Gnathion (go) Gonion (id) Infradentale (n) Nasion
(ns) Nasospinale (pr) Prosthion (zy) Zygion (au) Auriculare
(b) Bregma (cdl) Condylion Laterale (g) Glabella (l) Lambda
(op) Opisthocranion (alv) Alveolion (ba) basion
(alv) Alveolon (ba) Basion (ecm) Ectomolare (as) Asterion (o) Opisthion
(za) Zygomaxillare Anterior



(al) Alare (b) Bregma (d) Dacryon (ec) Ectoconchion (eu) Euryon
(fmt) Frontomalare Temporale (ft) Frontotemporale
(gn) Gnathion (go) Gonion (id) Infradentale (n) Nasion
(ns) Nasospinale (pr) Prosthion (zy) Zygion (au) Auriculare
(b) Bregma (cdl) Condylion Laterale (g) Glabella (l) Lambda
(op) Opisthocranion (alv) Alveolion (ba) basion
(alv) Alveolon (ba) Basion (ecm) Ectomolare (as) Asterion (o) Opisthion
(za) Zygomaxillare Anterior



(al) Alare (b) Bregma (d) Dacryon (ec) Ectoconchion (eu) Euryon
(fmt) Frontomalare Temporale (ft) Frontotemporale
(gn) Gnathion (go) Gonion (id) Infradentale (n) Nasion
(ns) Nasospinale (pr) Prosthion (zy) Zygion (au) Auriculare
(b) Bregma (cdl) Condylion Laterale (g) Glabella (l) Lambda
(op) Opisthocranion (alv) Alveolion (ba) basion
(alv) Alveolon (ba) Basion (ecm) Ectomolare (as) Asterion (o) Opisthion
(za) Zygomaxillare Anterior

MEASUREMENTS USED

GOL	GLABELLA-OPISTHOCRANION LENGTH (maximum cranial length)
XCB	EURYON-EURYON (maximum cranial breadth)
WFB	FRONTOTEMPORALE-FRONTOTEMPORALE (minimum frontal breadth)
XFB	(Maximum frontal breadth - along coronal suture)
STB	(Stephanion-stephanion breadth - the position of stephanion, the intersection of the temporal line with the coronal suture, varies from individual to individual)
ASB	ASTERION-ASTERION (breadth of the occiput)
AUB	AURICULARE-AURICULARE (breadth of the inferior skull)
BBH	BASION-BREGMA HEIGHT (height of the cranium)
BNL	BASION-NASION LENGTH (transverse facial length)
FRC	FRONTAL CHORD (length from nasion to bregma)
FRS	FRONTAL SUBTENSE (height of the frontal)
PAC	PARIETAL CHORD (length from bregma to lambda)
PAS	PARIETAL SUBTENSE (height of the parietals)
OCC	OCCIPITAL CHORD (length from lambda to opisthion)
OCS	OCCIPITAL SUBTENSE (height of the occipital)
FOL	FORAMEN MAGNUM LENGTH
FOB	FORAMEN MAGNUM BREADTH
BPL	BASION-PROSTHION LENGTH (lower facial length)
M48	NASION-ALVEOLARE HEIGHT(upper facial height)
NPH	NASION-PROSTHION LENGTH
FMB	FRONTO-MALAR BREADTH (upper facial breadth)
NAS	NASO-FRONTAL SUBTENSE (upper facial projection)

DKB	DACRYON-DACRYON BREADTH (inter-orbital breadth)
OBH	ORBIT HEIGHT
OBB	ORBIT BREADTH
ZYB	ZYGION-ZYGION BREADTH (facial breadth at zygomatics)
NLH	NASION-NASOSPINALE (nasal height)
NLB	ALARE-ALARE (nasal breadth)
ZMB	ZYGOMAXILLARY ANTERIOR-ZYGOMAXILLARY ANTERIOR (breadth of lower face)
ZMS	ZYGOMAXILLARE SUBTENSE (projection of lower face)
MAL	PROSTHION ALVEOLON LENGTH (length of the palate)
MAB	ECTOMOLARE-ECTOMOLARE (palate breadth)
EKB	ECTOCONCHION-ECTOCONCHION BREADTH (breadth across the eye orbits)

APPENDIX C
(PART 1)

VARIABLE STATISTICS BY GROUP
(VAULT DATA)

The SAS System 14:34 Thursday, May 21, 1998 1

Devil's Lake Sourisford

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	10	184.2000000	7.0047603	171.0000000	195.0000000
XCB	10	140.3000000	5.0563491	133.0000000	151.0000000
WFB	10	91.8000000	5.9217115	85.0000000	104.0000000
XFB	10	113.0000000	3.2998316	109.0000000	119.0000000
STB	10	104.8000000	7.3454445	96.0000000	114.0000000
ASB	10	110.5000000	6.4161255	100.0000000	123.0000000
AUB	10	128.7000000	6.0562181	121.0000000	140.0000000
BBH	10	132.0000000	4.0824829	127.0000000	139.0000000
BNL	10	104.4000000	3.4058773	100.0000000	112.0000000
FRC	10	112.5000000	5.0166390	105.0000000	121.0000000
FRS	10	22.5000000	1.5092309	19.0000000	24.0000000
PAC	10	107.6000000	4.8350572	99.0000000	114.0000000
PAS	10	21.1000000	2.3781412	18.0000000	25.0000000
OCC	10	95.4000000	5.1033758	85.0000000	102.0000000
OCS	10	30.8000000	2.6997942	26.0000000	35.0000000
FOL	10	37.0000000	4.1096093	29.0000000	41.0000000
FOB	10	30.5000000	2.4152295	28.0000000	35.0000000
BPL	10	99.4000000	4.0055517	94.0000000	107.0000000

Northern Arvilla

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	15	179.8000000	7.2229792	170.0000000	193.0000000
XCB	15	139.6000000	3.9242834	132.0000000	148.0000000
WFB	15	89.7333333	8.1544612	64.0000000	97.0000000
XFB	15	117.4000000	3.9785137	111.0000000	125.0000000
STB	15	96.4000000	10.6086218	72.0000000	110.0000000
ASB	15	111.5333333	4.1207951	103.0000000	121.0000000
AUB	15	127.2666667	3.9182114	118.0000000	134.0000000
BBH	15	124.0666667	2.7115274	120.0000000	131.0000000
BNL	15	99.2000000	2.9808915	96.0000000	108.0000000
FRC	15	107.2666667	4.1138558	100.0000000	113.0000000
FRS	15	23.0666667	2.6040262	19.0000000	27.0000000
PAC	15	108.8666667	5.2217494	100.0000000	115.0000000
PAS	15	22.2000000	2.6240645	18.0000000	26.0000000
OCC	15	90.8000000	3.7071360	82.0000000	100.0000000
OCS	15	28.3333333	2.0236695	25.0000000	32.0000000
FOL	15	36.2000000	2.8081514	30.0000000	40.0000000
FOB	15	31.2666667	1.2227993	30.0000000	34.0000000
BPL	15	97.7333333	9.8956460	90.0000000	131.0000000

Blackduck

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	20	182.7500000	6.6243172	170.0000000	193.0000000
XCB	20	140.4000000	5.3252131	129.0000000	150.0000000
WFB	20	93.5000000	3.3950428	88.0000000	98.0000000
XFB	20	116.1000000	5.5620897	107.0000000	128.0000000
STB	20	109.5500000	7.0298237	95.0000000	122.0000000
ASB	20	114.4000000	4.3091091	104.0000000	122.0000000
AUB	20	129.5500000	4.1100006	122.0000000	137.0000000
BBH	20	132.2000000	5.8183014	122.0000000	141.0000000
BNL	20	101.0500000	3.8726436	91.0000000	107.0000000
FRC	20	110.8000000	4.6859252	100.0000000	117.0000000
FRS	20	23.1500000	2.6611236	19.0000000	28.0000000
PAC	20	109.8500000	4.6597380	100.0000000	116.0000000
PAS	20	21.6500000	2.5807995	14.0000000	25.0000000
OCC	20	97.6000000	5.9329588	88.0000000	109.0000000
OCS	20	29.8000000	3.6792448	22.0000000	36.0000000
FOL	20	36.8000000	3.0366186	30.0000000	40.0000000
FOB	20	30.7000000	4.0665516	20.0000000	39.0000000
BPL	20	96.5500000	4.1482400	89.0000000	104.0000000

Laurel

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	6	178.6666667	1.6329932	177.0000000	181.0000000
XCB	6	146.3333333	7.7114633	132.0000000	152.0000000
WFB	6	96.5000000	3.4496377	92.0000000	102.0000000
XFB	6	121.5000000	4.0373258	114.0000000	126.0000000
STB	6	109.1666667	5.9805239	103.0000000	118.0000000
ASB	6	112.6666667	4.3204938	105.0000000	118.0000000
AUB	6	127.8333333	9.5794920	110.0000000	136.0000000
BBH	6	135.0000000	5.4772256	128.0000000	139.0000000
BNL	6	102.6666667	4.7187569	97.0000000	111.0000000
FRC	6	112.3333333	4.4572039	107.0000000	119.0000000
FRS	6	25.0000000	1.5491933	22.0000000	26.0000000
PAC	6	111.5000000	2.2583180	108.0000000	115.0000000
PAS	6	23.5000000	0.5477226	23.0000000	24.0000000
OCC	6	93.5000000	7.0639932	83.0000000	104.0000000
OCS	6	28.5000000	0.5477226	28.0000000	29.0000000
FOL	6	37.0000000	1.5491933	36.0000000	40.0000000
FOB	6	30.8333333	1.6020820	28.0000000	32.0000000
BPL	6	100.3333333	22.5181408	67.0000000	137.0000000

Norman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	15	185.4000000	8.6668498	172.0000000	200.0000000
XCB	15	144.1333333	3.9436507	136.0000000	151.0000000
WFB	15	96.8666667	7.1500916	88.0000000	117.0000000
XFB	15	117.2666667	5.6879153	105.0000000	127.0000000
STB	15	107.4000000	10.0910144	80.0000000	121.0000000
ASB	15	113.9333333	4.3665394	106.0000000	121.0000000
AUB	15	132.0000000	3.8172541	125.0000000	138.0000000
BBH	15	133.0666667	6.8605150	119.0000000	145.0000000
BNL	15	107.2666667	11.2343012	91.0000000	136.0000000
FRC	15	112.2000000	5.2942017	102.0000000	121.0000000
FRS	15	22.7333333	2.1536237	19.0000000	27.0000000
PAC	15	109.0666667	4.5113613	103.0000000	120.0000000
PAS	15	22.3333333	2.8702082	16.0000000	26.0000000
OCC	15	95.9333333	3.8259764	90.0000000	103.0000000
OCS	15	30.1333333	2.2635833	26.0000000	33.0000000
FOL	15	35.8666667	2.6956755	31.0000000	40.0000000
FOB	15	30.5333333	1.3557637	28.0000000	34.0000000
BPL	15	96.8000000	6.5378022	85.0000000	109.0000000

Mandan

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	34	180.7647059	7.1055199	164.0000000	197.0000000
XCB	34	136.5588235	4.8504369	123.0000000	148.0000000
WFB	34	90.8235294	4.2101651	83.0000000	102.0000000
XFB	34	112.3823529	4.2140796	103.0000000	121.0000000
STB	34	107.6764706	6.4324960	92.0000000	118.0000000
ASB	34	105.6764706	4.3395335	97.0000000	115.0000000
AUB	34	124.7647059	4.6453550	115.0000000	136.0000000
BBH	34	130.8823529	4.5511551	122.0000000	142.0000000
BNL	34	101.8235294	4.5823812	93.0000000	113.0000000
FRC	34	108.7647059	5.7316708	100.0000000	122.0000000
FRS	34	24.0294118	2.5641502	18.0000000	29.0000000
PAC	34	106.1176471	5.1213440	97.0000000	115.0000000
PAS	34	21.7941176	2.1430566	17.0000000	26.0000000
OCC	34	95.2941176	4.6288254	85.0000000	104.0000000
OCS	34	30.6764706	3.5566463	25.0000000	41.0000000
FOL	34	35.5588235	3.0470172	30.0000000	42.0000000
FOB	34	28.5882353	3.1345354	20.0000000	35.0000000
BPL	34	98.6176471	3.8298248	91.0000000	107.0000000

Parkland

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	183.3636364	4.6319052	177.0000000	192.0000000
XCB	11	143.8181818	5.6889047	136.0000000	154.0000000
WFB	11	95.7272727	3.4667249	91.0000000	103.0000000
XFB	11	117.9090909	4.8673308	112.0000000	127.0000000
STB	11	103.9090909	10.1040046	77.0000000	112.0000000
ASB	11	108.9090909	4.5045432	99.0000000	114.0000000
AUB	11	129.5454545	3.6705214	121.0000000	135.0000000
BBH	11	129.7272727	6.1170403	120.0000000	136.0000000
BNL	11	102.9090909	4.0609000	97.0000000	110.0000000
FRC	11	111.0000000	4.8579831	101.0000000	117.0000000
FRS	11	23.6363636	3.8281256	18.0000000	30.0000000
PAC	11	108.3636364	6.0045437	98.0000000	118.0000000
PAS	11	22.3636364	2.6934263	19.0000000	28.0000000
OCC	11	93.0909091	4.1582339	85.0000000	98.0000000
OCS	11	29.0000000	2.9325757	23.0000000	33.0000000
FOL	11	35.7272727	1.7939292	32.0000000	39.0000000
FOB	11	30.8181818	2.4007575	28.0000000	37.0000000
BPL	11	95.1818182	4.4680685	86.0000000	103.0000000

Caucasian

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	181.8000000	7.5960516	173.0000000	193.0000000
XCB	5	144.8000000	3.0331502	141.0000000	149.0000000
WFB	5	97.6000000	4.9295030	93.0000000	105.0000000
XFB	5	123.2000000	5.7619441	114.0000000	129.0000000
STB	5	117.2000000	9.0939540	102.0000000	126.0000000
ASB	5	116.2000000	6.1806149	108.0000000	124.0000000
AUB	5	121.4000000	7.2663608	110.0000000	129.0000000
BBH	5	129.8000000	10.4737768	113.0000000	139.0000000
BNL	5	100.8000000	4.0865633	97.0000000	106.0000000
FRC	5	110.6000000	9.3701654	100.0000000	121.0000000
FRS	5	26.2000000	3.1937439	22.0000000	30.0000000
PAC	5	112.6000000	7.0213959	102.0000000	119.0000000
PAS	5	24.0000000	2.0000000	22.0000000	26.0000000
OCC	5	94.4000000	4.8270074	86.0000000	98.0000000
OCS	5	30.2000000	2.1679483	28.0000000	33.0000000
FOL	5	37.0000000	2.5495098	34.0000000	40.0000000
FOB	5	32.0000000	4.3588989	27.0000000	37.0000000
BPL	5	92.6000000	6.6181568	88.0000000	104.0000000

Sioux

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	15	176.6666667	8.1911683	160.0000000	194.0000000
XCB	15	140.8666667	5.5015149	126.0000000	148.0000000
WFB	15	91.9333333	4.5742551	84.0000000	98.0000000
XFB	15	114.0000000	6.6975475	101.0000000	125.0000000
STB	15	108.3333333	6.4990842	99.0000000	119.0000000
ASB	15	110.8666667	5.1943192	103.0000000	119.0000000
AUB	15	127.2666667	6.0882400	116.0000000	138.0000000
BBH	15	127.4000000	4.7779254	117.0000000	135.0000000
BNL	15	99.2000000	4.9309518	92.0000000	110.0000000
FRC	15	108.8000000	4.6475800	103.0000000	116.0000000
FRS	15	22.3333333	1.9880596	20.0000000	25.0000000
PAC	15	106.6666667	8.1998839	87.0000000	122.0000000
PAS	15	21.8666667	3.7959879	15.0000000	28.0000000
OCC	15	92.4666667	4.4379317	83.0000000	98.0000000
OCS	15	30.0000000	3.4226139	24.0000000	34.0000000
FOL	15	35.5333333	2.6690466	31.0000000	39.0000000
FOB	15	30.2666667	2.2189659	26.0000000	34.0000000
BPL	15	97.8000000	4.5071372	89.0000000	104.0000000

Westman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	51	181.9803922	7.3579622	165.0000000	196.0000000
XCB	51	139.2549020	5.9121676	126.0000000	150.0000000
WFB	51	93.6666667	4.9826365	82.0000000	104.0000000
XFB	51	116.0000000	5.9933296	102.0000000	131.0000000
STB	51	102.6862745	12.5880740	58.0000000	123.0000000
ASB	51	109.0196078	6.9612935	95.0000000	125.0000000
AUB	51	126.7647059	6.8105455	102.0000000	140.0000000
BBH	51	129.1176471	6.5776806	117.0000000	147.0000000
BNL	51	101.7058824	6.3946669	85.0000000	127.0000000
FRC	51	108.9411765	4.0517244	100.0000000	118.0000000
FRS	51	22.8627451	2.4084817	18.0000000	29.0000000
PAC	51	107.9019608	6.0967365	93.0000000	127.0000000
PAS	51	21.6274510	2.5374064	16.0000000	27.0000000
OCC	51	94.0196078	5.8463329	82.0000000	105.0000000
OCS	51	29.5882353	4.1093867	17.0000000	38.0000000
FOL	51	36.6078431	2.5696570	30.0000000	41.0000000
FOB	51	30.9803922	2.4289108	27.0000000	39.0000000
BPL	51	96.0980392	6.4846123	83.0000000	117.0000000

Red River Valley

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	21	180.3333333	5.9273378	167.0000000	192.0000000
XCB	21	141.3333333	4.4981478	131.0000000	148.0000000
WFB	21	93.3333333	5.1704287	87.0000000	112.0000000
XFB	21	115.5238095	5.0360604	107.0000000	126.0000000
STB	21	105.1904762	4.6542351	96.0000000	115.0000000
ASB	21	110.3809524	5.5269901	98.0000000	119.0000000
AUB	21	127.0952381	6.9921725	114.0000000	137.0000000
BBH	21	127.1428571	5.9269361	118.0000000	137.0000000
BNL	21	100.5714286	4.5450130	90.0000000	108.0000000
FRC	21	106.8571429	4.7883788	96.0000000	115.0000000
FRS	21	22.8571429	1.6818357	19.0000000	27.0000000
PAC	21	107.0952381	7.0349468	92.0000000	118.0000000
PAS	21	21.5714286	2.5213375	16.0000000	26.0000000
OCC	21	93.3809524	5.2960003	80.0000000	100.0000000
OCS	21	28.9523810	2.8368326	23.0000000	35.0000000
FOL	21	35.2380952	3.3151887	29.0000000	41.0000000
FOB	21	31.7619048	3.5483061	23.0000000	39.0000000
BPL	21	96.1428571	4.7041016	88.0000000	106.0000000

Eastman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	27	182.2222222	6.8125074	164.0000000	192.0000000
XCB	27	140.4814815	5.9831197	129.0000000	153.0000000
WFB	27	95.4814815	4.8940338	85.0000000	105.0000000
XFB	27	113.8148148	5.0614458	102.0000000	122.0000000
STB	27	105.8518519	6.0491812	95.0000000	116.0000000
ASB	27	108.0000000	4.9613894	99.0000000	117.0000000
AUB	27	128.6666667	5.1590100	116.0000000	141.0000000
BBH	27	131.8148148	5.5749235	123.0000000	144.0000000
BNL	27	101.9629630	6.1361569	93.0000000	119.0000000
FRC	27	108.5555556	4.8779987	98.0000000	116.0000000
FRS	27	23.2962963	2.3989551	18.0000000	29.0000000
PAC	27	108.0740741	7.4158143	96.0000000	123.0000000
PAS	27	21.7777778	2.9526173	15.0000000	29.0000000
OCC	27	94.1111111	6.1289561	86.0000000	108.0000000
OCS	27	28.7407407	3.0330562	24.0000000	35.0000000
FOL	27	35.4074074	2.6203238	30.0000000	40.0000000
FOB	27	30.2592593	1.7886951	27.0000000	35.0000000
BPL	27	96.9259259	4.9762971	90.0000000	109.0000000

Hungry Hall

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	18	183.4444444	6.7929221	171.0000000	196.0000000
XCB	18	145.0000000	4.1159660	134.0000000	150.0000000
WFB	18	96.3333333	3.6941926	92.0000000	104.0000000
XFB	18	118.2222222	4.4265982	108.0000000	128.0000000
STB	18	106.1111111	4.1711740	100.0000000	117.0000000
ASB	18	116.3333333	7.0959806	102.0000000	130.0000000
AUB	18	130.8333333	5.0671955	117.0000000	137.0000000
BBH	18	131.3333333	4.8385705	122.0000000	139.0000000
BNL	18	102.2222222	4.1946122	94.0000000	109.0000000
FRC	18	111.6666667	4.2564829	105.0000000	120.0000000
FRS	18	23.0000000	2.5437351	18.0000000	27.0000000
PAC	18	109.7222222	5.9784471	98.0000000	117.0000000
PAS	18	21.9444444	2.7753584	17.0000000	25.0000000
OCC	18	99.1111111	5.1778816	88.0000000	110.0000000
OCS	18	27.6666667	2.0579830	24.0000000	32.0000000
FOL	18	36.6111111	2.1999703	31.0000000	39.0000000
FOB	18	31.0000000	1.8149704	27.0000000	35.0000000
BPL	18	100.4444444	4.4881835	91.0000000	107.0000000

South Arvilla

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	22	182.0454545	5.3137492	171.0000000	191.0000000
XCB	22	138.6363636	6.0595887	130.0000000	153.0000000
WFB	22	89.3636364	4.6654296	81.0000000	98.0000000
XFB	22	113.2272727	4.8396361	106.0000000	124.0000000
STB	22	102.5454545	7.9804957	86.0000000	115.0000000
ASB	22	107.6363636	3.8980515	101.0000000	116.0000000
AUB	22	128.1363636	7.0528309	118.0000000	144.0000000
BBH	22	129.8181818	5.3151747	121.0000000	138.0000000
BNL	22	101.9545455	4.2591892	92.0000000	109.0000000
FRC	22	108.0454545	4.4772150	101.0000000	120.0000000
FRS	22	21.6818182	2.3378126	18.0000000	27.0000000
PAC	22	109.5454545	5.0306420	97.0000000	119.0000000
PAS	22	22.2272727	2.6891638	15.0000000	28.0000000
OCC	22	96.5000000	4.6573035	88.0000000	105.0000000
OCS	22	30.0909091	3.7277478	24.0000000	39.0000000
FOL	22	37.1363636	2.4161255	33.0000000	42.0000000
FOB	22	29.9090909	2.1360643	27.0000000	33.0000000
BPL	22	98.0454545	3.9457907	91.0000000	107.0000000

Sonota

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	12	184.6666667	4.5593726	180.0000000	194.0000000
XCB	12	141.6666667	5.8672176	132.0000000	150.0000000
WFB	12	91.9166667	4.6212618	81.0000000	98.0000000
XFB	12	114.6666667	5.5976185	105.0000000	124.0000000
STB	12	105.8333333	6.6309650	95.0000000	116.0000000
ASB	12	110.6666667	4.1633320	104.0000000	117.0000000
AUB	12	131.8333333	6.6034885	122.0000000	142.0000000
BBH	12	130.4166667	5.4013186	126.0000000	142.0000000
BNL	12	102.6666667	5.1049590	92.0000000	111.0000000
FRC	12	108.8333333	5.7970735	101.0000000	119.0000000
FRS	12	22.6666667	2.2696949	19.0000000	25.0000000
PAC	12	107.5833333	7.3045233	97.0000000	118.0000000
PAS	12	22.0000000	2.7961012	18.0000000	26.0000000
OCC	12	96.5000000	2.3159526	92.0000000	100.0000000
OCS	12	31.4166667	2.9374799	28.0000000	37.0000000
FOL	12	35.5000000	2.3931721	32.0000000	40.0000000
FOB	12	30.1666667	2.9180733	26.0000000	35.0000000
BPL	12	100.5833333	3.9186810	91.0000000	105.0000000

Devil's Lake Sourisford - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	6	187.6666667	5.5737480	180.0000000	195.0000000
XCB	6	141.8333333	5.2313160	137.0000000	151.0000000
WFB	6	92.6666667	7.2018516	85.0000000	104.0000000
XFB	6	113.1666667	2.7141604	110.0000000	116.0000000
STB	6	102.0000000	7.0992957	96.0000000	111.0000000
ASB	6	112.5000000	6.8337398	102.0000000	123.0000000
AUB	6	131.3333333	5.7503623	125.0000000	140.0000000
BBH	6	132.6666667	4.7609523	127.0000000	139.0000000
BNL	6	105.5000000	3.9874804	100.0000000	112.0000000
FRC	6	115.8333333	3.1885211	113.0000000	121.0000000
FRS	6	22.5000000	1.8708287	19.0000000	24.0000000
PAC	6	107.8333333	6.2423286	99.0000000	114.0000000
PAS	6	19.5000000	1.2247449	18.0000000	21.0000000
OCC	6	95.5000000	6.4109282	85.0000000	102.0000000
OCS	6	32.0000000	2.5298221	29.0000000	35.0000000
FOL	6	36.6666667	4.2268980	29.0000000	40.0000000
FOB	6	30.5000000	2.6645825	28.0000000	35.0000000
BPL	6	100.1666667	4.7081490	94.0000000	107.0000000

Devil's Lake Sourisford - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	179.0000000	5.9441848	171.0000000	184.0000000
XCB	4	138.0000000	4.3969687	133.0000000	143.0000000
WFB	4	90.5000000	3.8729833	87.0000000	96.0000000
XFB	4	112.7500000	4.5000000	109.0000000	119.0000000
STB	4	109.0000000	6.2182527	100.0000000	114.0000000
ASB	4	107.5000000	5.0662281	100.0000000	111.0000000
AUB	4	124.7500000	4.5000000	121.0000000	131.0000000
BBH	4	131.0000000	3.1622777	128.0000000	135.0000000
BNL	4	102.7500000	1.5000000	101.0000000	104.0000000
FRC	4	107.5000000	1.7320508	105.0000000	109.0000000
FRS	4	22.5000000	1.0000000	21.0000000	23.0000000
PAC	4	107.2500000	2.2173558	104.0000000	109.0000000
PAS	4	23.5000000	1.2909944	22.0000000	25.0000000
OCC	4	95.2500000	3.0956959	91.0000000	98.0000000
OCS	4	29.0000000	2.0000000	26.0000000	30.0000000
FOL	4	37.5000000	4.5092498	31.0000000	41.0000000
FOB	4	30.5000000	2.3804761	29.0000000	34.0000000
BPL	4	98.2500000	2.8722813	95.0000000	102.0000000

Northern Arvilla - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	184.0000000	9.3094934	175.0000000	193.0000000
XCB	4	142.0000000	4.9665548	137.0000000	148.0000000
WFB	4	92.2500000	3.9475731	89.0000000	97.0000000
XFB	4	117.5000000	5.7445626	113.0000000	125.0000000
STB	4	83.7500000	12.8679188	72.0000000	100.0000000
ASB	4	114.5000000	5.4467115	108.0000000	121.0000000
AUB	4	127.7500000	1.7078251	126.0000000	130.0000000
BBH	4	124.5000000	2.0816660	122.0000000	127.0000000
BNL	4	99.0000000	2.1602469	96.0000000	101.0000000
FRC	4	107.5000000	3.6968455	103.0000000	111.0000000
FRS	4	22.0000000	3.5590261	19.0000000	27.0000000
PAC	4	107.2500000	7.2743843	100.0000000	114.0000000
PAS	4	23.0000000	2.8284271	19.0000000	25.0000000
OCC	4	92.7500000	4.9916597	89.0000000	100.0000000
OCS	4	27.2500000	2.6299556	25.0000000	30.0000000
FOL	4	36.5000000	2.8867513	34.0000000	39.0000000
FOB	4	31.2500000	0.5000000	31.0000000	32.0000000
BPL	4	97.0000000	4.0824829	91.0000000	100.0000000

Northern Arvilla - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	178.2727273	6.1170403	170.0000000	192.0000000
XCB	11	138.7272727	3.3193647	132.0000000	144.0000000
WFB	11	88.8181818	9.2175722	64.0000000	96.0000000
XFB	11	117.3636364	3.5006493	111.0000000	124.0000000
STB	11	101.0000000	4.5387223	96.0000000	110.0000000
ASB	11	110.4545455	3.1737560	103.0000000	114.0000000
AUB	11	127.0909091	4.5266885	118.0000000	134.0000000
BBH	11	123.9090909	2.9817627	120.0000000	131.0000000
BNL	11	99.2727273	3.3193647	96.0000000	108.0000000
FRC	11	107.1818182	4.4230800	100.0000000	113.0000000
FRS	11	23.4545455	2.2522716	20.0000000	27.0000000
PAC	11	109.4545455	4.5686680	103.0000000	115.0000000
PAS	11	21.9090909	2.6250541	18.0000000	26.0000000
OCC	11	90.0909091	3.1130225	82.0000000	94.0000000
OCS	11	28.7272727	1.7372915	26.0000000	32.0000000
FOL	11	36.0909091	2.9139165	30.0000000	40.0000000
FOB	11	31.2727273	1.4206273	30.0000000	34.0000000
BPL	11	98.0000000	11.4804181	90.0000000	131.0000000

Blackduck - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	17	182.8823529	6.6977828	170.0000000	193.0000000
XCB	17	139.5294118	5.0758946	129.0000000	149.0000000
WFB	17	93.5294118	3.3188410	88.0000000	98.0000000
XFB	17	115.2941176	4.8959767	107.0000000	124.0000000
STB	17	108.7058824	6.7339133	95.0000000	122.0000000
ASB	17	114.0588235	4.4787078	104.0000000	122.0000000
AUB	17	129.8235294	4.3765753	122.0000000	137.0000000
BBH	17	132.8823529	5.8936656	122.0000000	141.0000000
BNL	17	101.7647059	3.6147167	91.0000000	107.0000000
FRC	17	110.7058824	4.6872794	100.0000000	117.0000000
FRS	17	23.0000000	2.7156951	19.0000000	28.0000000
PAC	17	110.4705882	4.3891578	100.0000000	116.0000000
PAS	17	22.1176471	1.9963201	18.0000000	25.0000000
OCC	17	96.8235294	5.5140196	88.0000000	106.0000000
OCS	17	29.1764706	3.3954988	22.0000000	36.0000000
FOL	17	37.4117647	2.5994909	32.0000000	40.0000000
FOB	17	31.0588235	4.2934629	20.0000000	39.0000000
BPL	17	97.0000000	4.0466035	90.0000000	104.0000000

Blackduck - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	182.0000000	7.5498344	174.0000000	189.0000000
XCB	3	145.3333333	4.5092498	141.0000000	150.0000000
WFB	3	93.3333333	4.6188022	88.0000000	96.0000000
XFB	3	120.6666667	8.0829038	112.0000000	128.0000000
STB	3	114.3333333	8.1445278	105.0000000	120.0000000
ASB	3	116.3333333	3.0550505	113.0000000	119.0000000
AUB	3	128.0000000	1.7320508	126.0000000	129.0000000
BBH	3	128.3333333	4.1633320	125.0000000	133.0000000
BNL	3	97.0000000	3.0000000	94.0000000	100.0000000
FRC	3	111.3333333	5.6862407	105.0000000	116.0000000
FRS	3	24.0000000	2.6457513	21.0000000	26.0000000
PAC	3	106.3333333	5.5075705	101.0000000	112.0000000
PAS	3	19.0000000	4.3588989	14.0000000	22.0000000
OCC	3	102.0000000	7.5498344	94.0000000	109.0000000
OCS	3	33.3333333	3.7859389	29.0000000	36.0000000
FOL	3	33.3333333	3.5118846	30.0000000	37.0000000
FOB	3	28.6666667	1.5275252	27.0000000	30.0000000
BPL	3	94.0000000	4.5825757	89.0000000	98.0000000

Laurel - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	180.0000000	1.0000000	179.0000000	181.0000000
XCB	3	150.0000000	2.6457513	147.0000000	152.0000000
WFB	3	95.6666667	1.5275252	94.0000000	97.0000000
XFB	3	123.6666667	2.0816660	122.0000000	126.0000000
STB	3	113.6666667	4.5092498	109.0000000	118.0000000
ASB	3	115.3333333	2.5166115	113.0000000	118.0000000
AUB	3	124.3333333	12.6622799	110.0000000	134.0000000
BBH	3	139.0000000	0	139.0000000	139.0000000
BNL	3	105.6666667	4.7258156	102.0000000	111.0000000
FRC	3	113.0000000	2.6457513	110.0000000	115.0000000
FRS	3	24.3333333	2.0816660	22.0000000	26.0000000
PAC	3	112.6666667	2.0816660	111.0000000	115.0000000
PAS	3	23.3333333	0.5773503	23.0000000	24.0000000
OCC	3	93.6666667	3.7859389	91.0000000	98.0000000
OCS	3	28.6666667	0.5773503	28.0000000	29.0000000
FOL	3	36.3333333	0.5773503	36.0000000	37.0000000
FOB	3	31.0000000	1.0000000	30.0000000	32.0000000
BPL	3	103.6666667	35.1188458	67.0000000	137.0000000

Laurel - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	177.3333333	0.5773503	177.0000000	178.0000000
XCB	3	142.6666667	10.0664459	132.0000000	152.0000000
WFB	3	97.3333333	5.0332230	92.0000000	102.0000000
XFB	3	119.3333333	4.7258156	114.0000000	123.0000000
STB	3	104.6666667	2.8867513	103.0000000	108.0000000
ASB	3	110.0000000	4.3588989	105.0000000	113.0000000
AUB	3	131.3333333	5.6862407	125.0000000	136.0000000
BBH	3	131.0000000	5.1961524	128.0000000	137.0000000
BNL	3	99.6666667	2.5166115	97.0000000	102.0000000
FRC	3	111.6666667	6.4291005	107.0000000	119.0000000
FRS	3	25.6666667	0.5773503	25.0000000	26.0000000
PAC	3	110.3333333	2.0816660	108.0000000	112.0000000
PAS	3	23.6666667	0.5773503	23.0000000	24.0000000
OCC	3	93.3333333	10.5039675	83.0000000	104.0000000
OCS	3	28.3333333	0.5773503	28.0000000	29.0000000
FOL	3	37.6666667	2.0816660	36.0000000	40.0000000
FOB	3	30.6666667	2.3094011	28.0000000	32.0000000
BPL	3	97.0000000	1.0000000	96.0000000	98.0000000

Norman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	188.7272727	7.2123631	176.0000000	200.0000000
XCB	11	144.1818182	4.4680685	136.0000000	151.0000000
WFB	11	98.0909091	7.7518326	90.0000000	117.0000000
XFB	11	119.1818182	4.8542390	109.0000000	127.0000000
STB	11	107.6363636	11.3514116	80.0000000	121.0000000
ASB	11	114.8181818	4.1908992	108.0000000	121.0000000
AUB	11	133.1818182	3.7634607	125.0000000	138.0000000
BBH	11	136.1818182	3.8162333	132.0000000	145.0000000
BNL	11	112.0909091	8.8820555	101.0000000	136.0000000
FRC	11	114.1818182	4.3547258	108.0000000	121.0000000
FRS	11	22.8181818	2.4420558	19.0000000	27.0000000
PAC	11	109.1818182	4.6003952	104.0000000	120.0000000
PAS	11	22.0000000	3.0659419	16.0000000	26.0000000
OCC	11	97.0000000	3.8209946	91.0000000	103.0000000
OCS	11	30.0000000	2.1447611	26.0000000	33.0000000
FOL	11	37.0000000	2.0976177	34.0000000	40.0000000
FOB	11	30.7272727	1.4893562	28.0000000	34.0000000
BPL	11	100.0909091	3.6456699	97.0000000	109.0000000

Norman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	176.2500000	4.9916597	172.0000000	183.0000000
XCB	4	144.0000000	2.4494897	141.0000000	147.0000000
WFB	4	93.5000000	4.2031734	88.0000000	98.0000000
XFB	4	112.0000000	4.6904158	105.0000000	115.0000000
STB	4	106.7500000	6.7019898	98.0000000	112.0000000
ASB	4	111.5000000	4.4347116	106.0000000	116.0000000
AUB	4	128.7500000	1.2583057	127.0000000	130.0000000
BBH	4	124.5000000	6.1373175	119.0000000	132.0000000
BNL	4	94.0000000	2.4494897	91.0000000	96.0000000
FRC	4	106.7500000	3.6855574	102.0000000	111.0000000
FRS	4	22.5000000	1.2909944	21.0000000	24.0000000
PAC	4	108.7500000	4.9244289	103.0000000	115.0000000
PAS	4	23.2500000	2.3629078	20.0000000	25.0000000
OCC	4	93.0000000	2.0000000	90.0000000	94.0000000
OCS	4	30.5000000	2.8867513	28.0000000	33.0000000
FOL	4	32.7500000	1.2583057	31.0000000	34.0000000
FOB	4	30.0000000	0.8164966	29.0000000	31.0000000
BPL	4	87.7500000	2.5000000	85.0000000	91.0000000

Mandan - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	12	185.6666667	7.5116072	170.0000000	197.0000000
XCB	12	137.5000000	5.3512955	123.0000000	144.0000000
WFB	12	91.1666667	5.3738988	83.0000000	102.0000000
XFB	12	113.1666667	4.8398598	103.0000000	121.0000000
STB	12	107.2500000	6.7840053	92.0000000	116.0000000
ASB	12	107.2500000	4.5552168	99.0000000	115.0000000
AUB	12	126.0833333	5.8225008	115.0000000	136.0000000
BBH	12	133.7500000	3.6958207	128.0000000	142.0000000
BNL	12	103.7500000	3.4145411	99.0000000	109.0000000
FRC	12	110.9166667	6.3883179	101.0000000	122.0000000
FRS	12	23.5833333	2.2343733	21.0000000	27.0000000
PAC	12	109.5000000	3.7779263	104.0000000	115.0000000
PAS	12	22.0833333	1.3113722	19.0000000	23.0000000
OCC	12	97.6666667	4.9969688	88.0000000	104.0000000
OCS	12	32.5833333	4.0778411	25.0000000	41.0000000
FOL	12	36.4166667	3.4761089	31.0000000	42.0000000
FOB	12	29.4166667	4.5418925	20.0000000	35.0000000
BPL	12	100.5000000	2.5761141	97.0000000	106.0000000

Mandan - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	22	178.0909091	5.3444149	164.0000000	186.0000000
XCB	22	136.0454545	4.6030763	128.0000000	148.0000000
WFB	22	90.6363636	3.5529392	85.0000000	97.0000000
XFB	22	111.9545455	3.8849805	103.0000000	120.0000000
STB	22	107.9090909	6.3838270	93.0000000	118.0000000
ASB	22	104.8181818	4.0665460	97.0000000	112.0000000
AUB	22	124.0454545	3.8232033	118.0000000	136.0000000
BBH	22	129.3181818	4.2581727	122.0000000	141.0000000
BNL	22	100.7727273	4.8592751	93.0000000	113.0000000
FRC	22	107.5909091	5.1144901	100.0000000	120.0000000
FRS	22	24.2727273	2.7461110	18.0000000	29.0000000
PAC	22	104.2727273	4.8617243	97.0000000	112.0000000
PAS	22	21.6363636	2.4984844	17.0000000	26.0000000
OCC	22	94.0000000	3.9520941	85.0000000	101.0000000
OCS	22	29.6363636	2.8207641	25.0000000	35.0000000
FOL	22	35.0909091	2.7586935	30.0000000	40.0000000
FOB	22	28.1363636	2.0070223	25.0000000	32.0000000
BPL	22	97.5909091	4.0550861	91.0000000	107.0000000

Parkland - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	7	185.7142857	3.9460649	180.0000000	192.0000000
XCB	7	143.0000000	6.1913919	136.0000000	154.0000000
WFB	7	94.7142857	3.0937725	91.0000000	100.0000000
XFB	7	116.7142857	5.4072262	112.0000000	127.0000000
STB	7	101.8571429	12.2260456	77.0000000	112.0000000
ASB	7	108.2857143	5.2508503	99.0000000	113.0000000
AUB	7	129.8571429	4.2983939	121.0000000	135.0000000
BBH	7	132.2857143	5.7362672	120.0000000	136.0000000
BNL	7	105.2857143	2.8702082	102.0000000	110.0000000
FRC	7	112.2857143	4.1518785	105.0000000	117.0000000
FRS	7	22.4285714	2.2253946	20.0000000	26.0000000
PAC	7	109.0000000	4.2817442	103.0000000	115.0000000
PAS	7	22.2857143	1.6035675	19.0000000	24.0000000
OCC	7	93.5714286	3.9520941	88.0000000	98.0000000
OCS	7	30.2857143	2.2146697	28.0000000	33.0000000
FOL	7	35.5714286	1.7182494	32.0000000	37.0000000
FOB	7	31.1428571	2.9680842	28.0000000	37.0000000
BPL	7	97.4285714	2.8199966	94.0000000	103.0000000

Parkland - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	179.2500000	2.2173558	177.0000000	182.0000000
XCB	4	145.2500000	5.1881275	139.0000000	150.0000000
WFB	4	97.5000000	3.7859389	95.0000000	103.0000000
XFB	4	120.0000000	3.3665016	116.0000000	124.0000000
STB	4	107.5000000	3.7859389	102.0000000	110.0000000
ASB	4	110.0000000	3.1622777	107.0000000	114.0000000
AUB	4	129.0000000	2.7080128	127.0000000	133.0000000
BBH	4	125.2500000	4.1129876	120.0000000	129.0000000
BNL	4	98.7500000	1.5000000	97.0000000	100.0000000
FRC	4	108.7500000	5.7951129	101.0000000	115.0000000
FRS	4	25.7500000	5.4390563	18.0000000	30.0000000
PAC	4	107.2500000	8.9953692	98.0000000	118.0000000
PAS	4	22.5000000	4.3588989	19.0000000	28.0000000
OCC	4	92.2500000	4.9916597	85.0000000	96.0000000
OCS	4	26.7500000	2.8722813	23.0000000	29.0000000
FOL	4	36.0000000	2.1602469	34.0000000	39.0000000
FOB	4	30.2500000	0.9574271	29.0000000	31.0000000
BPL	4	91.2500000	4.2720019	86.0000000	96.0000000

Caucasian - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	181.7500000	8.7702147	173.0000000	193.0000000
XCB	4	144.5000000	3.4156503	141.0000000	149.0000000
WFB	4	98.7500000	4.8562674	94.0000000	105.0000000
XFB	4	125.5000000	3.0000000	123.0000000	129.0000000
STB	4	121.0000000	3.7416574	117.0000000	126.0000000
ASB	4	114.2500000	5.0579970	108.0000000	120.0000000
AUB	4	119.5000000	6.8068593	110.0000000	126.0000000
BBH	4	134.0000000	5.3541261	128.0000000	139.0000000
BNL	4	99.5000000	3.3166248	97.0000000	104.0000000
FRC	4	112.7500000	9.2870878	100.0000000	121.0000000
FRS	4	27.2500000	2.5000000	24.0000000	30.0000000
PAC	4	115.2500000	4.3493295	111.0000000	119.0000000
PAS	4	23.5000000	1.9148542	22.0000000	26.0000000
OCC	4	94.2500000	5.5602758	86.0000000	98.0000000
OCS	4	30.0000000	2.4494897	28.0000000	33.0000000
FOL	4	36.5000000	2.6457513	34.0000000	40.0000000
FOB	4	31.0000000	4.3204938	27.0000000	37.0000000
BPL	4	89.7500000	2.0615528	88.0000000	92.0000000

Caucasian - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	1	182.0000000	.	182.0000000	182.0000000
XCB	1	146.0000000	.	146.0000000	146.0000000
WFB	1	93.0000000	.	93.0000000	93.0000000
XFB	1	114.0000000	.	114.0000000	114.0000000
STB	1	102.0000000	.	102.0000000	102.0000000
ASB	1	124.0000000	.	124.0000000	124.0000000
AUB	1	129.0000000	.	129.0000000	129.0000000
BBH	1	113.0000000	.	113.0000000	113.0000000
BNL	1	106.0000000	.	106.0000000	106.0000000
FRC	1	102.0000000	.	102.0000000	102.0000000
FRS	1	22.0000000	.	22.0000000	22.0000000
PAC	1	102.0000000	.	102.0000000	102.0000000
PAS	1	26.0000000	.	26.0000000	26.0000000
OCC	1	95.0000000	.	95.0000000	95.0000000
OCS	1	31.0000000	.	31.0000000	31.0000000
FOL	1	39.0000000	.	39.0000000	39.0000000
FOB	1	36.0000000	.	36.0000000	36.0000000
BPL	1	104.0000000	.	104.0000000	104.0000000

Sioux - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	8	180.5000000	7.1713717	172.0000000	194.0000000
XCB	8	144.1250000	2.5319388	140.0000000	148.0000000
WFB	8	95.0000000	2.6186147	91.0000000	98.0000000
XFB	8	117.5000000	5.0142654	111.0000000	125.0000000
STB	8	110.6250000	5.6552757	102.0000000	119.0000000
ASB	8	114.1250000	4.2236579	106.0000000	119.0000000
AUB	8	131.7500000	3.2841611	128.0000000	138.0000000
BBH	8	130.2500000	3.8078866	125.0000000	135.0000000
BNL	8	101.5000000	4.6291005	96.0000000	110.0000000
FRC	8	112.6250000	2.3867192	109.0000000	116.0000000
FRS	8	23.1250000	1.8850919	20.0000000	25.0000000
PAC	8	109.1250000	2.7998724	104.0000000	113.0000000
PAS	8	23.0000000	2.1380899	20.0000000	26.0000000
OCC	8	92.0000000	4.8403070	83.0000000	98.0000000
OCS	8	29.0000000	3.9279220	24.0000000	34.0000000
FOL	8	36.2500000	2.0528726	33.0000000	39.0000000
FOB	8	31.1250000	2.1671245	27.0000000	34.0000000
BPL	8	100.2500000	3.0118812	96.0000000	104.0000000

Sioux - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	7	172.2857143	7.3872477	160.0000000	184.0000000
XCB	7	137.1428571	5.7279598	126.0000000	144.0000000
WFB	7	88.4285714	3.7352886	84.0000000	95.0000000
XFB	7	110.0000000	6.3508530	101.0000000	120.0000000
STB	7	105.7142857	6.7998599	99.0000000	118.0000000
ASB	7	107.1428571	3.4364988	103.0000000	113.0000000
AUB	7	122.1428571	4.0590874	116.0000000	128.0000000
BBH	7	124.1428571	3.6253079	117.0000000	128.0000000
BNL	7	96.5714286	4.0766466	92.0000000	104.0000000
FRC	7	104.4285714	1.3972763	103.0000000	107.0000000
FRS	7	21.4285714	1.8126539	20.0000000	24.0000000
PAC	7	103.8571429	11.4226175	87.0000000	122.0000000
PAS	7	20.5714286	4.9617585	15.0000000	28.0000000
OCC	7	93.0000000	4.2426407	85.0000000	98.0000000
OCS	7	31.1428571	2.5448360	27.0000000	34.0000000
FOL	7	34.7142857	3.1997024	31.0000000	39.0000000
FOB	7	29.2857143	1.9760470	26.0000000	32.0000000
BPL	7	95.0000000	4.4347116	89.0000000	102.0000000

Westman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	30	185.8666667	6.1964024	171.0000000	196.0000000
XCB	30	141.3000000	4.4501065	133.0000000	147.0000000
WFB	30	95.6000000	4.4225129	88.0000000	104.0000000
XFB	30	118.3666667	5.0136595	110.0000000	131.0000000
STB	30	103.1000000	15.8382993	58.0000000	123.0000000
ASB	30	111.1333333	7.6281391	95.0000000	125.0000000
AUB	30	129.1000000	5.7075268	109.0000000	140.0000000
BBH	30	131.2666667	6.9675768	118.0000000	147.0000000
BNL	30	103.6000000	7.2473539	85.0000000	127.0000000
FRC	30	109.9666667	3.8280573	103.0000000	118.0000000
FRS	30	22.8666667	2.8006567	18.0000000	29.0000000
PAC	30	109.1333333	6.6318632	98.0000000	127.0000000
PAS	30	21.3000000	2.8180453	16.0000000	27.0000000
OCC	30	94.9333333	6.1134861	82.0000000	105.0000000
OCS	30	31.2666667	3.5616088	24.0000000	38.0000000
FOL	30	36.9000000	2.2946715	31.0000000	40.0000000
FOB	30	31.1000000	2.2644174	27.0000000	35.0000000
BPL	30	97.9333333	6.8073659	83.0000000	117.0000000

Westman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	21	176.4285714	4.9655959	165.0000000	183.0000000
XCB	21	136.3333333	6.5903971	126.0000000	150.0000000
WFB	21	90.9047619	4.4822401	82.0000000	102.0000000
XFB	21	112.6190476	5.7400017	102.0000000	127.0000000
STB	21	102.0952381	5.6383044	90.0000000	117.0000000
ASB	21	106.0000000	4.5276926	98.0000000	113.0000000
AUB	21	123.4285714	6.9897885	102.0000000	134.0000000
BBH	21	126.0476190	4.5768569	117.0000000	136.0000000
BNL	21	99.0000000	3.6055513	93.0000000	107.0000000
FRC	21	107.4761905	3.9952353	100.0000000	116.0000000
FRS	21	22.8571429	1.7687768	20.0000000	26.0000000
PAC	21	106.1428571	4.8609229	93.0000000	116.0000000
PAS	21	22.0952381	2.0470653	18.0000000	26.0000000
OCC	21	92.7142857	5.3117121	84.0000000	105.0000000
OCS	21	27.1904762	3.6826491	17.0000000	36.0000000
FOL	21	36.1904762	2.9260733	30.0000000	41.0000000
FOB	21	30.8095238	2.6947922	28.0000000	39.0000000
BPL	21	93.4761905	5.0657581	84.0000000	102.0000000

Red River Valley - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	8	184.1250000	5.0267143	178.0000000	192.0000000
XCB	8	143.1250000	3.0443155	138.0000000	147.0000000
WFB	8	94.0000000	2.9277002	90.0000000	99.0000000
XFB	8	117.7500000	4.1661904	112.0000000	126.0000000
STB	8	105.2500000	4.5903626	98.0000000	113.0000000
ASB	8	111.0000000	4.3424812	105.0000000	119.0000000
AUB	8	133.0000000	2.6726124	129.0000000	137.0000000
BBH	8	131.1250000	4.2236579	126.0000000	137.0000000
BNL	8	103.5000000	3.1622777	97.0000000	108.0000000
FRC	8	110.3750000	2.6152028	107.0000000	115.0000000
FRS	8	23.3750000	1.7677670	21.0000000	27.0000000
PAC	8	111.1250000	4.0155946	105.0000000	118.0000000
PAS	8	23.1250000	1.7268882	21.0000000	26.0000000
OCC	8	89.1250000	5.6678920	80.0000000	98.0000000
OCS	8	27.1250000	2.6958964	23.0000000	31.0000000
FOL	8	37.5000000	2.3904572	34.0000000	40.0000000
FOB	8	31.3750000	1.7677670	28.0000000	33.0000000
BPL	8	98.6250000	4.7490601	91.0000000	106.0000000

Red River Valley - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	13	178.0000000	5.3229065	167.0000000	185.0000000
XCB	13	140.2307692	4.9858775	131.0000000	148.0000000
WFB	13	92.9230769	6.2511537	87.0000000	112.0000000
XFB	13	114.1538462	5.1776145	107.0000000	126.0000000
STB	13	105.1538462	4.8793127	96.0000000	115.0000000
ASB	13	110.0000000	6.2849025	98.0000000	118.0000000
AUB	13	123.4615385	6.3062850	114.0000000	135.0000000
BBH	13	124.6923077	5.5735180	118.0000000	134.0000000
BNL	13	98.7692308	4.3998834	90.0000000	104.0000000
FRC	13	104.6923077	4.5713713	96.0000000	112.0000000
FRS	13	22.5384615	1.6132464	19.0000000	25.0000000
PAC	13	104.6153846	7.4558530	92.0000000	116.0000000
PAS	13	20.6153846	2.5012817	16.0000000	26.0000000
OCC	13	96.0000000	2.9154759	92.0000000	100.0000000
OCS	13	30.0769231	2.3615510	27.0000000	35.0000000
FOL	13	33.8461538	3.0780447	29.0000000	41.0000000
FOB	13	32.0000000	4.3588989	23.0000000	39.0000000
BPL	13	94.6153846	4.1339743	88.0000000	105.0000000

Eastman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	13	184.0000000	6.9282032	164.0000000	192.0000000
XCB	13	144.2307692	4.1863637	136.0000000	153.0000000
WFB	13	96.5384615	5.0598976	88.0000000	105.0000000
XFB	13	116.7692308	2.7127430	113.0000000	122.0000000
STB	13	109.7692308	3.8547340	103.0000000	116.0000000
ASB	13	109.6923077	4.7325929	103.0000000	117.0000000
AUB	13	132.1538462	3.8480764	125.0000000	141.0000000
BBH	13	134.3846154	5.4089195	126.0000000	144.0000000
BNL	13	102.1538462	5.1614945	93.0000000	112.0000000
FRC	13	109.1538462	5.9700105	98.0000000	116.0000000
FRS	13	23.0000000	2.3804761	18.0000000	26.0000000
PAC	13	109.5384615	8.5109281	96.0000000	123.0000000
PAS	13	21.9230769	3.3030677	16.0000000	29.0000000
OCC	13	94.6923077	7.0164642	86.0000000	107.0000000
OCS	13	28.3846154	3.5482029	24.0000000	35.0000000
FOL	13	35.6923077	2.2130151	32.0000000	39.0000000
FOB	13	31.1538462	1.9513309	29.0000000	35.0000000
BPL	13	100.2307692	4.9015958	91.0000000	109.0000000

Eastman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	14	180.5714286	6.5128782	170.0000000	191.0000000
XCB	14	137.0000000	5.3204974	129.0000000	145.0000000
WFB	14	94.5000000	4.7026997	85.0000000	102.0000000
XFB	14	111.0714286	5.2545114	102.0000000	121.0000000
STB	14	102.2142857	5.4656771	95.0000000	111.0000000
ASB	14	106.4285714	4.7992673	99.0000000	117.0000000
AUB	14	125.4285714	4.0137128	116.0000000	133.0000000
BBH	14	129.4285714	4.7347209	123.0000000	138.0000000
BNL	14	101.7857143	7.1163795	93.0000000	119.0000000
FRC	14	108.0000000	3.7416574	102.0000000	115.0000000
FRS	14	23.5714286	2.4718192	19.0000000	29.0000000
PAC	14	106.7142857	6.2441181	96.0000000	118.0000000
PAS	14	21.6428571	2.7063215	15.0000000	25.0000000
OCC	14	93.5714286	5.3882248	86.0000000	108.0000000
OCS	14	29.0714286	2.5559669	26.0000000	34.0000000
FOL	14	35.1428571	3.0091436	30.0000000	40.0000000
FOB	14	29.4285714	1.1578684	27.0000000	31.0000000
BPL	14	93.8571429	2.5071327	90.0000000	98.0000000

Hungry Hall - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	10	186.7000000	6.0562181	178.0000000	196.0000000
XCB	10	143.7000000	4.9452559	134.0000000	150.0000000
WFB	10	96.7000000	3.4657050	92.0000000	103.0000000
XFB	10	118.1000000	4.7714428	108.0000000	127.0000000
STB	10	104.7000000	3.1287200	100.0000000	110.0000000
ASB	10	118.1000000	7.7380733	102.0000000	130.0000000
AUB	10	130.0000000	5.7348835	117.0000000	137.0000000
BBH	10	134.3000000	2.4966644	130.0000000	139.0000000
BNL	10	104.2000000	3.2591751	98.0000000	109.0000000
FRC	10	113.0000000	3.7118429	109.0000000	119.0000000
FRS	10	22.4000000	2.7162065	18.0000000	27.0000000
PAC	10	112.2000000	4.5898439	101.0000000	117.0000000
PAS	10	22.7000000	2.4517567	19.0000000	25.0000000
OCC	10	100.0000000	4.9665548	93.0000000	110.0000000
OCS	10	27.7000000	1.9465068	25.0000000	32.0000000
FOL	10	36.7000000	2.0027759	32.0000000	39.0000000
FOB	10	31.3000000	1.4944341	29.0000000	34.0000000
BPL	10	100.9000000	5.5866905	91.0000000	107.0000000

Hungry Hall - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	8	179.3750000	5.5533130	171.0000000	189.0000000
XCB	8	146.6250000	2.0658793	144.0000000	150.0000000
WFB	8	95.8750000	4.1554611	92.0000000	104.0000000
XFB	8	118.3750000	4.2740914	115.0000000	128.0000000
STB	8	107.8750000	4.8236767	103.0000000	117.0000000
ASB	8	114.1250000	5.9386747	104.0000000	123.0000000
AUB	8	131.8750000	4.2236579	125.0000000	137.0000000
BBH	8	127.6250000	4.5336047	122.0000000	137.0000000
BNL	8	99.7500000	4.0620192	94.0000000	108.0000000
FRC	8	110.0000000	4.5355737	105.0000000	120.0000000
FRS	8	23.7500000	2.2519833	21.0000000	27.0000000
PAC	8	106.6250000	6.3231434	98.0000000	117.0000000
PAS	8	21.0000000	3.0237158	17.0000000	25.0000000
OCC	8	98.0000000	5.5549206	88.0000000	106.0000000
OCS	8	27.6250000	2.3260942	24.0000000	30.0000000
FOL	8	36.5000000	2.5634798	31.0000000	39.0000000
FOB	8	30.6250000	2.1998377	27.0000000	35.0000000
BPL	8	99.8750000	2.8504386	95.0000000	105.0000000

South Arvilla - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	185.5454545	4.3442752	177.0000000	191.0000000
XCB	11	142.0000000	5.8309519	133.0000000	153.0000000
WFB	11	90.7272727	4.7768381	85.0000000	98.0000000
XFB	11	114.9090909	5.9068527	106.0000000	124.0000000
STB	11	102.4545455	9.1363410	86.0000000	115.0000000
ASB	11	109.3636364	3.2333490	106.0000000	116.0000000
AUB	11	133.0000000	5.5856960	128.0000000	144.0000000
BBH	11	130.5454545	5.4104276	122.0000000	138.0000000
BNL	11	103.5454545	4.6553976	92.0000000	109.0000000
FRC	11	109.9090909	4.7634976	102.0000000	120.0000000
FRS	11	22.0000000	2.7568098	19.0000000	27.0000000
PAC	11	111.3636364	3.6406793	104.0000000	117.0000000
PAS	11	22.5454545	2.6215887	19.0000000	28.0000000
OCC	11	98.3636364	3.7221695	90.0000000	105.0000000
OCS	11	31.2727273	2.7601054	25.0000000	35.0000000
FOL	11	37.5454545	2.6594600	33.0000000	42.0000000
FOB	11	31.0000000	1.6124515	27.0000000	33.0000000
BPL	11	98.5454545	4.2979911	94.0000000	107.0000000

South Arvilla - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	178.5454545	3.6705214	171.0000000	186.0000000
XCB	11	135.2727273	4.2682762	130.0000000	144.0000000
WFB	11	88.0000000	4.3358967	81.0000000	97.0000000
XFB	11	111.5454545	2.8412545	108.0000000	116.0000000
STB	11	102.6363636	7.0890440	91.0000000	113.0000000
ASB	11	105.9090909	3.8588741	101.0000000	113.0000000
AUB	11	123.2727273	4.6063198	118.0000000	133.0000000
BBH	11	129.0909091	5.3750264	121.0000000	138.0000000
BNL	11	100.3636364	3.2946237	95.0000000	106.0000000
FRC	11	106.1818182	3.4298158	101.0000000	112.0000000
FRS	11	21.3636364	1.9116865	18.0000000	24.0000000
PAC	11	107.7272727	5.7112330	97.0000000	119.0000000
PAS	11	21.9090909	2.8444523	15.0000000	26.0000000
OCC	11	94.6363636	4.9045433	88.0000000	101.0000000
OCS	11	28.9090909	4.3001057	24.0000000	39.0000000
FOL	11	36.7272727	2.1950357	34.0000000	41.0000000
FOB	11	28.8181818	2.0889319	27.0000000	32.0000000
BPL	11	97.5454545	3.6976651	91.0000000	104.0000000

Sonota - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	7	187.2857143	4.2314019	181.0000000	194.0000000
XCB	7	143.0000000	5.8594653	135.0000000	150.0000000
WFB	7	93.2857143	4.0296520	86.0000000	98.0000000
XFB	7	117.4285714	4.6853368	111.0000000	124.0000000
STB	7	107.7142857	5.8797473	99.0000000	116.0000000
ASB	7	111.1428571	3.7161168	105.0000000	116.0000000
AUB	7	133.7142857	6.3170216	123.0000000	142.0000000
BBH	7	131.2857143	6.7259271	126.0000000	142.0000000
BNL	7	105.1428571	3.7161168	100.0000000	111.0000000
FRC	7	110.4285714	6.1334369	104.0000000	119.0000000
FRS	7	23.0000000	2.3094011	19.0000000	25.0000000
PAC	7	108.4285714	7.7428923	98.0000000	118.0000000
PAS	7	22.0000000	3.2145503	18.0000000	26.0000000
OCC	7	98.0000000	1.4142136	96.0000000	100.0000000
OCS	7	32.8571429	3.0237158	28.0000000	37.0000000
FOL	7	35.5714286	3.0472470	32.0000000	40.0000000
FOB	7	31.0000000	3.2659863	26.0000000	35.0000000
BPL	7	101.5714286	2.9358215	97.0000000	105.0000000

Sonota - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	181.0000000	1.2247449	180.0000000	183.0000000
XCB	5	139.8000000	5.9749477	132.0000000	145.0000000
WFB	5	90.0000000	5.1478151	81.0000000	94.0000000
XFB	5	110.8000000	4.6043458	105.0000000	117.0000000
STB	5	103.2000000	7.3620649	95.0000000	113.0000000
ASB	5	110.0000000	5.0990195	104.0000000	117.0000000
AUB	5	129.2000000	6.7230945	122.0000000	140.0000000
BBH	5	129.2000000	3.0331502	126.0000000	134.0000000
BNL	5	99.2000000	5.0199602	92.0000000	104.0000000
FRC	5	106.6000000	5.0299105	101.0000000	114.0000000
FRS	5	22.2000000	2.3874673	19.0000000	25.0000000
PAC	5	106.4000000	7.3348483	97.0000000	116.0000000
PAS	5	22.0000000	2.4494897	20.0000000	26.0000000
OCC	5	94.4000000	1.5165751	92.0000000	96.0000000
OCS	5	29.4000000	1.1401754	28.0000000	31.0000000
FOL	5	35.4000000	1.3416408	34.0000000	37.0000000
FOB	5	29.0000000	2.1213203	27.0000000	32.0000000
BPL	5	99.2000000	5.0199602	91.0000000	103.0000000

APPENDIX C
(PART 2)

VARIABLE STATISTICS BY GROUP
(TOTAL DATA)

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Northern Arvilla

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	12	178.9166667	7.3541372	170.0000000	193.0000000
XCB	12	138.5833333	3.2039275	132.0000000	144.0000000
WFB	12	88.0833333	8.3498322	64.0000000	96.0000000
XFB	12	116.2500000	3.0785179	111.0000000	120.0000000
STB	12	95.2500000	11.6081868	72.0000000	110.0000000
ASB	12	110.7500000	3.5194266	103.0000000	116.0000000
AUB	12	127.2500000	4.2238500	118.0000000	134.0000000
BBH	12	123.7500000	2.8959219	120.0000000	131.0000000
BNL	12	99.2500000	3.2787193	96.0000000	108.0000000
FRC	12	106.7500000	4.3926592	100.0000000	113.0000000
FRS	12	22.6666667	2.5702258	19.0000000	27.0000000
PAC	12	107.7500000	5.2070756	100.0000000	115.0000000
PAS	12	21.9166667	2.8109634	18.0000000	26.0000000
OCC	12	90.8333333	4.1523998	82.0000000	100.0000000
OCS	12	27.9166667	2.0652243	25.0000000	32.0000000
FOL	12	36.5000000	3.0600059	30.0000000	40.0000000
FOB	12	31.3333333	1.3706888	30.0000000	34.0000000
BPL	12	98.1666667	11.0850705	90.0000000	131.0000000
M48	12	68.4166667	3.7527767	61.0000000	75.0000000
NPH	12	65.0833333	3.9418116	58.0000000	72.0000000
FMB	12	96.3333333	5.1049590	90.0000000	106.0000000
NAS	12	18.0833333	2.1087839	15.0000000	22.0000000
DKB	12	20.0000000	2.7303013	17.0000000	27.0000000
OBH	12	33.9166667	1.5050420	32.0000000	36.0000000
OBB	12	39.9166667	1.8319554	36.0000000	43.0000000
ZYB	12	133.4166667	3.5791907	125.0000000	138.0000000
NLH	12	51.4166667	3.6296339	46.0000000	57.0000000
NLB	12	24.6666667	2.1033883	20.0000000	28.0000000
ZMB	12	95.0000000	5.7682517	86.0000000	103.0000000
ZMS	12	23.5000000	1.7320508	20.0000000	26.0000000
MAL	12	53.0833333	1.9752253	50.0000000	57.0000000
MAB	12	61.4166667	2.9374799	56.0000000	66.0000000
EKB	12	95.2500000	3.5707142	90.0000000	100.0000000

Blackduck

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	182.5454545	7.4211001	170.0000000	193.0000000
XCB	11	140.9090909	5.1663245	134.0000000	150.0000000
WFB	11	95.1818182	2.0889319	92.0000000	98.0000000
XFB	11	117.2727273	5.8837218	107.0000000	128.0000000
STB	11	110.1818182	8.4477001	95.0000000	122.0000000
ASB	11	113.5454545	5.0668262	104.0000000	122.0000000
AUB	11	129.3636364	4.9045433	122.0000000	137.0000000
BBH	11	133.0909091	5.8898989	122.0000000	141.0000000
BNL	11	101.4545455	4.6768288	91.0000000	107.0000000
FRC	11	111.3636364	4.8015149	102.0000000	117.0000000
FRS	11	23.3636364	2.2482316	20.0000000	28.0000000
PAC	11	109.8181818	4.7290207	101.0000000	115.0000000
PAS	11	21.1818182	3.2501748	14.0000000	25.0000000
OCC	11	98.3636364	6.8010694	88.0000000	109.0000000
OCS	11	29.7272727	4.1735095	22.0000000	36.0000000
FOL	11	36.6363636	3.5006493	30.0000000	40.0000000
FOB	11	30.9090909	3.5903912	26.0000000	39.0000000
BPL	11	95.8181818	3.3412028	90.0000000	100.0000000
M4B	11	75.6363636	3.6131075	68.0000000	80.0000000
NPH	11	72.0909091	3.5624302	66.0000000	77.0000000
FMB	11	99.1818182	3.3111382	94.0000000	105.0000000
NAS	11	18.6363636	2.1105794	16.0000000	22.0000000
DKB	11	21.0000000	1.5491933	18.0000000	24.0000000
OBH	11	34.2727273	2.0538213	31.0000000	38.0000000
OBB	11	39.8181818	1.6011360	38.0000000	43.0000000
ZYB	11	135.9090909	9.1701095	118.0000000	146.0000000
NLH	11	55.1818182	2.8219916	49.0000000	59.0000000
NLB	11	25.5454545	1.4396969	23.0000000	27.0000000
ZMB	11	99.8181818	4.9359534	93.0000000	107.0000000
ZMS	11	24.2727273	3.1651512	21.0000000	32.0000000
MAL	11	51.7272727	2.1019471	48.0000000	55.0000000
MAB	11	63.9090909	2.8793939	58.0000000	68.0000000
EKB	11	99.5454545	2.9787124	95.0000000	104.0000000

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Laurel

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	179.0000000	1.5811388	177.0000000	181.0000000
XCB	5	146.8000000	8.5264295	132.0000000	152.0000000
WFB	5	96.2000000	3.7682887	92.0000000	102.0000000
XFB	5	121.6000000	4.5055521	114.0000000	126.0000000
STB	5	109.4000000	6.6558245	103.0000000	118.0000000
ASB	5	112.8000000	4.8166378	105.0000000	118.0000000
AUB	5	126.8000000	10.3295692	110.0000000	136.0000000
BBH	5	136.4000000	4.7749346	128.0000000	139.0000000
BNL	5	103.8000000	4.2661458	100.0000000	111.0000000
FRC	5	113.0000000	4.6368092	107.0000000	119.0000000
FRS	5	24.8000000	1.6431677	22.0000000	26.0000000
PAC	5	111.6000000	2.5099801	108.0000000	115.0000000
PAS	5	23.4000000	0.5477226	23.0000000	24.0000000
OCC	5	93.6000000	7.8930349	83.0000000	104.0000000
OCS	5	28.6000000	0.5477226	28.0000000	29.0000000
FOL	5	37.0000000	1.7320508	36.0000000	40.0000000
FOB	5	30.6000000	1.6733201	28.0000000	32.0000000
BPL	5	107.2000000	17.1813853	97.0000000	137.0000000
M48	5	73.8000000	3.4205263	69.0000000	78.0000000
NPH	5	69.6000000	2.9664794	66.0000000	74.0000000
FMB	5	100.0000000	5.0497525	94.0000000	107.0000000
NAS	5	15.0000000	3.0000000	11.0000000	18.0000000
DKB	5	21.2000000	4.7644517	17.0000000	29.0000000
OBH	5	34.4000000	3.2863353	30.0000000	38.0000000
OBB	5	40.2000000	1.4832397	38.0000000	42.0000000
ZYB	5	138.0000000	4.4158804	133.0000000	145.0000000
NLH	5	52.2000000	2.6832816	48.0000000	55.0000000
NLB	5	26.8000000	1.6431677	25.0000000	29.0000000
ZMB	5	104.0000000	4.5276926	97.0000000	108.0000000
ZMS	5	29.0000000	1.8708287	27.0000000	32.0000000
MAL	5	53.2000000	2.1679483	50.0000000	56.0000000
MAB	5	64.2000000	2.3874673	61.0000000	67.0000000
EKB	5	99.6000000	5.9413803	95.0000000	109.0000000

Norman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	7	183.5714286	9.8464400	172.0000000	200.0000000
XCB	7	145.1428571	3.1847853	140.0000000	148.0000000
WFB	7	100.5714286	7.9970233	94.0000000	117.0000000
XFB	7	119.5714286	4.6853368	114.0000000	127.0000000
STB	7	108.0000000	13.3166562	80.0000000	121.0000000
ASB	7	115.1428571	4.4131837	108.0000000	121.0000000
AUB	7	133.0000000	2.7080128	129.0000000	137.0000000
BBH	7	133.4285714	8.6382317	119.0000000	145.0000000
BNL	7	105.2857143	7.8891124	93.0000000	113.0000000
FRC	7	112.2857143	6.8243262	102.0000000	121.0000000
FRS	7	23.7142857	1.7994708	22.0000000	27.0000000
PAC	7	108.2857143	5.7652489	103.0000000	120.0000000
PAS	7	22.2857143	3.3523268	16.0000000	26.0000000
OCC	7	96.2857143	2.7516229	93.0000000	100.0000000
OCS	7	29.8571429	2.6726124	26.0000000	33.0000000
FOL	7	34.8571429	2.6095064	31.0000000	39.0000000
FOB	7	31.2857143	1.3801311	30.0000000	34.0000000
BPL	7	97.7142857	7.1580790	88.0000000	109.0000000
M48	7	74.8571429	6.3094789	63.0000000	81.0000000
NPH	7	70.7142857	5.9080252	60.0000000	77.0000000
FMB	7	101.1428571	5.7858613	95.0000000	111.0000000
NAS	7	18.5714286	1.8126539	16.0000000	22.0000000
DKB	7	24.0000000	3.6514837	18.0000000	27.0000000
OBH	7	34.8571429	1.5735916	33.0000000	37.0000000
OBB	7	40.7142857	2.5634798	38.0000000	46.0000000
ZYB	7	141.1428571	6.6440091	132.0000000	150.0000000
NLH	7	55.2857143	5.5291436	48.0000000	61.0000000
NLB	7	26.2857143	1.8898224	23.0000000	29.0000000
ZMB	7	100.1428571	5.4902511	91.0000000	106.0000000
ZMS	7	25.7142857	2.9840848	23.0000000	31.0000000
MAL	7	56.2857143	7.0406980	47.0000000	64.0000000
MAB	7	65.2857143	4.8205908	58.0000000	73.0000000
EKB	7	101.1428571	5.2734736	97.0000000	110.0000000

Mandan

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	34	180.7647059	7.1055199	164.0000000	197.0000000
XCB	34	136.5588235	4.8504369	123.0000000	148.0000000
WFB	34	90.8235294	4.2101651	83.0000000	102.0000000
XFB	34	112.3823529	4.2140796	103.0000000	121.0000000
STB	34	107.6764706	6.4324960	92.0000000	118.0000000
ASB	34	105.6764706	4.3395335	97.0000000	115.0000000
AUB	34	124.7647059	4.6453550	115.0000000	136.0000000
BBH	34	130.8823529	4.5511551	122.0000000	142.0000000
BNL	34	101.8235294	4.5823812	93.0000000	113.0000000
FRC	34	108.7647059	5.7316708	100.0000000	122.0000000
FRS	34	24.0294118	2.5641502	18.0000000	29.0000000
PAC	34	106.1176471	5.1213440	97.0000000	115.0000000
PAS	34	21.7941176	2.1430566	17.0000000	26.0000000
OCC	34	95.2941176	4.6288254	85.0000000	104.0000000
OCS	34	30.6764706	3.5566463	25.0000000	41.0000000
FOL	34	35.5588235	3.0470172	30.0000000	42.0000000
FOB	34	28.5882353	3.1345354	20.0000000	35.0000000
BPL	34	98.6176471	3.8298248	91.0000000	107.0000000
M48	34	70.9705882	4.1522925	62.0000000	80.0000000
NPH	34	67.6176471	4.3832650	58.0000000	77.0000000
FMB	34	96.3529412	4.1842588	86.0000000	106.0000000
NAS	34	18.5000000	2.1355576	14.0000000	24.0000000
DKB	34	21.7058824	1.9310762	18.0000000	27.0000000
OBH	34	34.4411765	1.5213865	31.0000000	37.0000000
OBB	34	38.7941176	1.9034166	34.0000000	43.0000000
ZYB	34	132.9705882	5.4909584	125.0000000	145.0000000
NLH	34	52.2941176	3.4512133	45.0000000	61.0000000
NLB	34	24.4705882	1.8947342	20.0000000	28.0000000
ZMB	34	96.1470588	4.1788236	89.0000000	105.0000000
ZMS	34	24.5000000	2.8524312	19.0000000	30.0000000
MAL	34	53.3235294	3.1210001	47.0000000	60.0000000
MAB	34	62.9411765	3.2468276	58.0000000	73.0000000
EKB	34	96.6176471	3.4729666	90.0000000	106.0000000

Parkland

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	8	184.5000000	4.9280538	177.0000000	192.0000000
XCB	8	143.1250000	6.2891630	136.0000000	154.0000000
WFB	8	96.2500000	3.9551052	91.0000000	103.0000000
XFB	8	118.8750000	5.1112621	113.0000000	127.0000000
STB	8	107.2500000	5.4445254	95.0000000	112.0000000
ASB	8	108.7500000	5.0920105	99.0000000	114.0000000
AUB	8	130.2500000	3.3273756	124.0000000	135.0000000
BBH	8	132.1250000	3.6030741	128.0000000	136.0000000
BNL	8	102.3750000	4.2740914	97.0000000	110.0000000
FRC	8	111.8750000	3.9074105	105.0000000	117.0000000
FRS	8	24.1250000	2.9970223	20.0000000	29.0000000
PAC	8	109.0000000	4.9856938	102.0000000	115.0000000
PAS	8	21.5000000	2.4494897	18.0000000	24.0000000
OCC	8	93.5000000	3.6645015	88.0000000	98.0000000
OCS	8	30.2500000	2.7124054	28.0000000	35.0000000
FOL	8	35.6250000	2.0658793	32.0000000	39.0000000
FOB	8	30.6250000	2.8753882	28.0000000	37.0000000
BPL	8	96.0000000	3.6645015	90.0000000	103.0000000
M48	8	70.1250000	4.3239367	65.0000000	78.0000000
NPH	8	66.7500000	3.9910614	62.0000000	74.0000000
FMB	8	99.8750000	3.0443155	96.0000000	106.0000000
NAS	8	21.1250000	3.3990545	18.0000000	28.0000000
DKB	8	24.3750000	1.7677670	22.0000000	27.0000000
OBH	8	35.1250000	2.5319388	32.0000000	39.0000000
OBB	8	40.1250000	2.3566017	37.0000000	44.0000000
ZYB	8	139.6250000	5.1806646	133.0000000	147.0000000
NLH	8	51.2500000	2.5495098	49.0000000	57.0000000
NLB	8	25.1250000	1.4577380	22.0000000	27.0000000
ZMB	8	98.8750000	3.6815175	94.0000000	103.0000000
ZMS	8	24.0000000	2.8284271	20.0000000	27.0000000
MAL	8	53.2500000	2.1213203	51.0000000	58.0000000
MAB	8	63.3750000	3.7392704	58.0000000	71.0000000
EKB	8	100.8750000	2.9970223	97.0000000	107.0000000

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Caucasian

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	183.0000000	8.2056891	173.0000000	193.0000000
XCB	4	144.7500000	3.5000000	141.0000000	149.0000000
WFB	4	97.0000000	5.4772256	93.0000000	105.0000000
XFB	4	122.2500000	6.1846584	114.0000000	129.0000000
STB	4	116.2500000	10.2102889	102.0000000	126.0000000
ASB	4	115.2500000	6.7019898	108.0000000	124.0000000
AUB	4	121.2500000	8.3815273	110.0000000	129.0000000
BBH	4	129.5000000	12.0692447	113.0000000	139.0000000
BNL	4	101.0000000	4.6904158	97.0000000	106.0000000
FRC	4	113.2500000	8.3815273	102.0000000	121.0000000
FRS	4	26.7500000	3.4034296	22.0000000	30.0000000
PAC	4	113.0000000	8.0415587	102.0000000	119.0000000
PAS	4	24.0000000	2.3094011	22.0000000	26.0000000
OCC	4	94.0000000	5.4772256	86.0000000	98.0000000
OCS	4	30.7500000	2.0615528	28.0000000	33.0000000
FOL	4	37.0000000	2.9439203	34.0000000	40.0000000
FOB	4	32.2500000	4.9916597	27.0000000	37.0000000
BPL	4	93.0000000	7.5718778	88.0000000	104.0000000
M48	4	73.2500000	5.3150729	69.0000000	81.0000000
NPH	4	69.2500000	4.7871355	65.0000000	76.0000000
FMB	4	96.0000000	3.1622777	92.0000000	99.0000000
NAS	4	20.0000000	3.5590261	15.0000000	23.0000000
DKB	4	20.5000000	5.2599113	16.0000000	28.0000000
OBH	4	35.0000000	1.1547005	34.0000000	36.0000000
OBB	4	38.0000000	0	38.0000000	38.0000000
ZYB	4	130.2500000	6.1846584	121.0000000	134.0000000
NLH	4	52.5000000	3.0000000	51.0000000	57.0000000
NLB	4	23.2500000	3.0956959	19.0000000	26.0000000
ZMB	4	89.0000000	4.1633320	84.0000000	94.0000000
ZMS	4	25.2500000	2.5000000	24.0000000	29.0000000
MAL	4	44.0000000	4.8304589	40.0000000	51.0000000
MAB	4	61.0000000	3.3665016	57.0000000	65.0000000
EKB	4	97.0000000	3.8297084	92.0000000	100.0000000

Westman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	45	181.1111111	7.1516757	165.0000000	196.0000000
XCB	45	139.4666667	5.8293926	126.0000000	150.0000000
WFB	45	94.0000000	5.0497525	82.0000000	104.0000000
XFB	45	116.2000000	6.2870719	102.0000000	131.0000000
STB	45	102.3333333	13.2167249	58.0000000	123.0000000
ASB	45	109.2444444	6.3716544	98.0000000	122.0000000
AUB	45	127.4888889	5.1593790	114.0000000	137.0000000
BBH	45	129.4000000	6.7500842	118.0000000	147.0000000
BNL	45	100.9111111	6.1341897	85.0000000	127.0000000
FRC	45	108.8222222	4.2334646	100.0000000	118.0000000
FRS	45	22.9333333	2.4808356	18.0000000	29.0000000
PAC	45	107.6666667	6.2740447	93.0000000	127.0000000
PAS	45	21.7555556	2.6038045	16.0000000	27.0000000
OCC	45	94.0666667	5.7500988	84.0000000	105.0000000
OCS	45	29.5777778	3.7324674	23.0000000	38.0000000
FOL	45	36.5333333	2.4826672	30.0000000	41.0000000
FOB	45	30.9555556	2.0884483	27.0000000	35.0000000
BPL	45	95.9111111	6.2734006	83.0000000	117.0000000
M48	45	71.8444444	4.9541331	62.0000000	85.0000000
NPH	45	67.5555556	5.4211520	53.0000000	80.0000000
FMB	45	98.7555556	3.5301014	90.0000000	107.0000000
NAS	45	18.2888889	1.9261622	14.0000000	22.0000000
DKB	45	23.9111111	2.8189474	15.0000000	30.0000000
OBH	45	34.5333333	1.9609831	31.0000000	39.0000000
OBB	45	39.2444444	1.8727175	35.0000000	44.0000000
ZYB	45	136.4222222	6.3011142	125.0000000	150.0000000
NLH	45	51.0444444	2.9692022	42.0000000	60.0000000
NLB	45	26.0666667	1.9817348	22.0000000	31.0000000
ZMB	45	99.1777778	6.2642162	84.0000000	111.0000000
ZMS	45	24.9111111	2.3531625	20.0000000	31.0000000
MAL	45	51.7111111	4.6496443	42.0000000	59.0000000
MAB	45	62.8222222	3.8452384	52.0000000	70.0000000
EKB	45	99.8444444	3.6491316	92.0000000	110.0000000

Red River Valley

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	19	180.1052632	6.1454114	167.0000000	192.0000000
XCB	19	140.8421053	4.4380070	131.0000000	148.0000000
WFB	19	93.0526316	5.2754535	87.0000000	112.0000000
XFB	19	115.1578947	5.1236181	107.0000000	126.0000000
STB	19	105.1052632	4.8864295	96.0000000	115.0000000
ASB	19	109.7368421	5.3524875	98.0000000	118.0000000
AUB	19	126.6842105	7.2422574	114.0000000	137.0000000
BBH	19	127.1052632	6.2262414	118.0000000	137.0000000
BNL	19	100.6842105	4.7028671	90.0000000	108.0000000
FRC	19	106.3157895	4.6073930	96.0000000	113.0000000
FRS	19	22.5789474	1.4265650	19.0000000	25.0000000
PAC	19	106.7368421	7.3169674	92.0000000	118.0000000
PAS	19	21.4736842	2.5899039	16.0000000	26.0000000
OCC	19	94.3684211	4.3103303	86.0000000	100.0000000
OCS	19	29.2105263	2.8201447	23.0000000	35.0000000
FOL	19	35.1578947	3.4199278	29.0000000	41.0000000
FOB	19	31.6842105	3.7275645	23.0000000	39.0000000
BPL	19	96.0000000	4.9103066	88.0000000	106.0000000
M4B	19	69.0000000	5.2387445	61.0000000	80.0000000
NPH	19	65.3157895	5.0995929	56.0000000	76.0000000
FMB	19	97.0526316	4.6244962	87.0000000	109.0000000
NAS	19	17.9473684	1.5082618	15.0000000	21.0000000
DKB	19	24.0526316	2.1723946	22.0000000	30.0000000
OBH	19	35.1052632	2.4012667	30.0000000	39.0000000
OBB	19	38.8947368	1.7917942	36.0000000	43.0000000
ZYB	19	134.7894737	9.0035730	120.0000000	151.0000000
NLH	19	50.0526316	3.7486840	42.0000000	55.0000000
NLB	19	25.1578947	2.7134062	19.0000000	29.0000000
ZMB	19	97.5789474	6.3448648	88.0000000	114.0000000
ZMS	19	23.3157895	3.0560074	19.0000000	28.0000000
MAL	19	52.1052632	4.1216870	40.0000000	57.0000000
MAB	19	62.1052632	4.2149830	55.0000000	68.0000000
EKB	19	98.0526316	5.0163475	88.0000000	110.0000000

Eastman

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	11	184.0909091	4.8673308	173.0000000	191.0000000
XCB	11	143.2727273	5.8496309	131.0000000	153.0000000
WFB	11	96.5454545	4.6981621	88.0000000	102.0000000
XFB	11	115.2727273	5.4788851	102.0000000	122.0000000
STB	11	107.8181818	5.4003367	99.0000000	116.0000000
ASB	11	109.6363636	4.9854333	103.0000000	117.0000000
AUB	11	129.6363636	6.7568147	116.0000000	141.0000000
BBH	11	131.8181818	6.5240813	123.0000000	144.0000000
BNL	11	99.8181818	3.1565228	95.0000000	107.0000000
FRC	11	110.8181818	5.2691210	98.0000000	116.0000000
FRS	11	24.1818182	2.8919952	18.0000000	29.0000000
PAC	11	112.0000000	6.3087241	103.0000000	123.0000000
PAS	11	22.2727273	2.9695424	19.0000000	29.0000000
OCC	11	93.3636364	4.0809981	86.0000000	101.0000000
OCS	11	28.2727273	2.6491851	24.0000000	34.0000000
FOL	11	35.9090909	3.0807319	30.0000000	39.0000000
FOB	11	29.7272727	1.6180797	27.0000000	32.0000000
BPL	11	96.6363636	5.6262372	91.0000000	108.0000000
M48	11	70.4545455	2.8412545	66.0000000	77.0000000
NPH	11	66.7272727	3.6356818	61.0000000	73.0000000
FMB	11	100.3636364	4.1778637	92.0000000	108.0000000
NAS	11	19.3636364	2.6181187	15.0000000	23.0000000
DKB	11	23.0909091	2.9480348	19.0000000	30.0000000
OBH	11	34.3636364	1.6895400	32.0000000	37.0000000
OBB	11	40.6363636	2.6181187	37.0000000	47.0000000
ZYB	11	137.0909091	8.3000548	122.0000000	154.0000000
NLH	11	51.5454545	3.5032452	46.0000000	57.0000000
NLB	11	25.3636364	2.0135902	22.0000000	30.0000000
ZMB	11	100.1818182	6.1938386	91.0000000	112.0000000
ZMS	11	23.7272727	2.7961012	18.0000000	28.0000000
MAL	11	52.7272727	4.9616713	44.0000000	62.0000000
MAB	11	63.1818182	4.7501196	51.0000000	70.0000000
EKB	11	101.7272727	5.9513177	92.0000000	114.0000000

Hungry Hall

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	17	182.8823529	6.5563171	171.0000000	196.0000000
XCB	17	145.1764706	4.1718595	134.0000000	150.0000000
WFB	17	96.2352941	3.7836724	92.0000000	104.0000000
XFB	17	118.1764706	4.5584440	108.0000000	128.0000000
STB	17	106.3529412	4.1674509	100.0000000	117.0000000
ASB	17	115.7647059	6.8786755	102.0000000	130.0000000
AUB	17	131.0588235	5.1292128	117.0000000	137.0000000
BBH	17	131.1176471	4.8974783	122.0000000	139.0000000
BNL	17	101.8235294	3.9565657	94.0000000	109.0000000
FRC	17	111.6470588	4.3866442	105.0000000	120.0000000
FRS	17	23.0000000	2.6220221	18.0000000	27.0000000
PAC	17	109.2941176	5.8711658	98.0000000	117.0000000
PAS	17	21.7647059	2.7506684	17.0000000	25.0000000
OCC	17	98.9411765	5.2852458	88.0000000	110.0000000
OCS	17	27.6470588	2.1195865	24.0000000	32.0000000
FOL	17	36.5882353	2.2654697	31.0000000	39.0000000
FOB	17	31.0000000	1.8708287	27.0000000	35.0000000
BPL	17	100.4117647	4.6241056	91.0000000	107.0000000
M48	17	70.1764706	4.8119031	60.0000000	77.0000000
NPH	17	66.1176471	4.5809709	56.0000000	72.0000000
FMB	17	99.1176471	4.2409072	90.0000000	106.0000000
NAS	17	18.7647059	2.3326329	13.0000000	23.0000000
DKB	17	24.3529412	2.3168183	21.0000000	29.0000000
OBH	17	33.4117647	1.6605279	31.0000000	36.0000000
OBB	17	41.2352941	3.1330778	35.0000000	47.0000000
ZYB	17	139.8235294	4.5447125	133.0000000	147.0000000
NLH	17	51.5294118	3.6420744	43.0000000	59.0000000
NLB	17	26.7058824	1.8962036	24.0000000	31.0000000
ZMB	17	97.1176471	4.3715322	89.0000000	104.0000000
ZMS	17	26.1764706	2.5796147	20.0000000	31.0000000
MAL	17	54.8235294	3.2061522	48.0000000	59.0000000
MAB	17	65.2941176	3.7377250	58.0000000	72.0000000
EKB	17	99.8235294	4.2900363	93.0000000	108.0000000

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Sonota

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	12	184.6666667	4.5593726	180.0000000	194.0000000
XCB	12	141.6666667	5.8672176	132.0000000	150.0000000
WFB	12	91.9166667	4.6212618	81.0000000	98.0000000
XFB	12	114.6666667	5.5976185	105.0000000	124.0000000
STB	12	105.8333333	6.6309650	95.0000000	116.0000000
ASB	12	110.6666667	4.1633320	104.0000000	117.0000000
AUB	12	131.8333333	6.6034885	122.0000000	142.0000000
BBH	12	130.4166667	5.4013186	126.0000000	142.0000000
BNL	12	102.6666667	5.1049590	92.0000000	111.0000000
FRC	12	108.8333333	5.7970735	101.0000000	119.0000000
FRS	12	22.6666667	2.2696949	19.0000000	25.0000000
PAC	12	107.5833333	7.3045233	97.0000000	118.0000000
PAS	12	22.0000000	2.7961012	18.0000000	26.0000000
OCC	12	96.5000000	2.3159526	92.0000000	100.0000000
OCS	12	31.4166667	2.9374799	28.0000000	37.0000000
FOL	12	35.5000000	2.3931721	32.0000000	40.0000000
FOB	12	30.1666667	2.9180733	26.0000000	35.0000000
BPL	12	100.5833333	3.9186810	91.0000000	105.0000000
M48	12	70.0000000	3.1333978	64.0000000	74.0000000
NPH	12	66.0833333	2.9987371	59.0000000	70.0000000
FMB	12	99.5833333	3.7769236	94.0000000	107.0000000
NAS	12	18.6666667	2.5702258	15.0000000	22.0000000
DKB	12	22.3333333	2.6400184	19.0000000	28.0000000
OBH	12	35.5833333	1.8319554	31.0000000	38.0000000
OBB	12	40.6666667	1.9227506	38.0000000	44.0000000
ZYB	12	141.1666667	7.8836232	127.0000000	151.0000000
NLH	12	54.1666667	2.9797295	47.0000000	59.0000000
NLB	12	26.5833333	1.6213537	23.0000000	28.0000000
ZMB	12	102.5833333	5.7439032	90.0000000	110.0000000
ZMS	12	25.0833333	3.3154825	20.0000000	31.0000000
MAL	12	52.6666667	3.7009417	46.0000000	58.0000000
MAB	12	64.7500000	3.3878124	60.0000000	70.0000000
EKB	12	100.4166667	3.7527767	96.0000000	108.0000000

Northern Arvilla - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	181.6666667	9.8657657	175.0000000	193.0000000
XCB	3	140.0000000	3.6055513	137.0000000	144.0000000
WFB	3	90.6666667	2.8867513	89.0000000	94.0000000
XFB	3	115.0000000	3.4641016	113.0000000	119.0000000
STB	3	78.3333333	8.5049005	72.0000000	88.0000000
ASB	3	112.3333333	4.0414519	108.0000000	116.0000000
AUB	3	127.0000000	1.0000000	126.0000000	128.0000000
BBH	3	124.3333333	2.5166115	122.0000000	127.0000000
BNL	3	98.6666667	2.5166115	96.0000000	101.0000000
FRC	3	106.3333333	3.5118846	103.0000000	110.0000000
FRS	3	20.3333333	1.5275252	19.0000000	22.0000000
PAC	3	105.0000000	7.0000000	100.0000000	113.0000000
PAS	3	22.3333333	3.0550505	19.0000000	25.0000000
OCC	3	93.6666667	5.6862407	89.0000000	100.0000000
OCS	3	26.3333333	2.3094011	25.0000000	29.0000000
FOL	3	37.3333333	2.8867513	34.0000000	39.0000000
FOB	3	31.3333333	0.5773503	31.0000000	32.0000000
BPL	3	96.6666667	4.9328829	91.0000000	100.0000000
M48	3	71.0000000	3.4641016	69.0000000	75.0000000
NPH	3	68.0000000	3.6055513	65.0000000	72.0000000
FMB	3	100.0000000	4.5825757	96.0000000	105.0000000
NAS	3	18.3333333	1.1547005	17.0000000	19.0000000
DKB	3	22.3333333	4.0414519	20.0000000	27.0000000
OBH	3	33.6666667	1.5275252	32.0000000	35.0000000
OBB	3	41.0000000	1.7320508	40.0000000	43.0000000
ZYB	3	135.6666667	1.5275252	134.0000000	137.0000000
NLH	3	54.3333333	2.5166115	52.0000000	57.0000000
NLB	3	26.3333333	1.5275252	25.0000000	28.0000000
ZMB	3	100.0000000	3.0000000	97.0000000	103.0000000
ZMS	3	25.0000000	1.0000000	24.0000000	26.0000000
MAL	3	54.0000000	3.0000000	51.0000000	57.0000000
MAB	3	62.0000000	2.0000000	60.0000000	64.0000000
EKB	3	98.3333333	1.5275252	97.0000000	100.0000000

Northern Arvilla - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	9	178.0000000	6.8007353	170.0000000	192.0000000
XCB	9	138.1111111	3.1402406	132.0000000	142.0000000
WFB	9	87.2222222	9.5102284	64.0000000	96.0000000
XFB	9	116.6666667	3.0413813	111.0000000	120.0000000
STB	9	100.8888889	4.9103066	96.0000000	110.0000000
ASB	9	110.2222222	3.4197141	103.0000000	114.0000000
AUB	9	127.3333333	4.9244289	118.0000000	134.0000000
BBH	9	123.5555556	3.1269438	120.0000000	131.0000000
BNL	9	99.4444444	3.6094013	96.0000000	108.0000000
FRC	9	106.8888889	4.8333333	100.0000000	113.0000000
FRS	9	23.4444444	2.4037009	20.0000000	27.0000000
PAC	9	108.6666667	4.6097722	103.0000000	115.0000000
PAS	9	21.7777778	2.9059326	18.0000000	26.0000000
OCC	9	89.8888889	3.4075081	82.0000000	94.0000000
OCS	9	28.4444444	1.8104634	26.0000000	32.0000000
FOL	9	36.2222222	3.2317866	30.0000000	40.0000000
FOB	9	31.3333333	1.5811388	30.0000000	34.0000000
BPL	9	98.6666667	12.7180973	90.0000000	131.0000000
M48	9	67.5555556	3.6094013	61.0000000	73.0000000
NPH	9	64.1111111	3.7230513	58.0000000	70.0000000
FMB	9	95.1111111	4.8847836	90.0000000	106.0000000
NAS	9	18.0000000	2.3979158	15.0000000	22.0000000
DKB	9	19.2222222	1.8559215	17.0000000	23.0000000
OBH	9	34.0000000	1.5811388	32.0000000	36.0000000
OBB	9	39.5555556	1.8104634	36.0000000	42.0000000
ZYB	9	132.6666667	3.8078866	125.0000000	138.0000000
NLH	9	50.4444444	3.5039660	46.0000000	55.0000000
NLB	9	24.1111111	2.0275875	20.0000000	26.0000000
ZMB	9	93.3333333	5.5677644	86.0000000	102.0000000
ZMS	9	23.0000000	1.6583124	20.0000000	26.0000000
MAL	9	52.7777778	1.6414763	50.0000000	56.0000000
MAB	9	61.2222222	3.2702361	56.0000000	66.0000000
EKB	9	94.2222222	3.4920545	90.0000000	100.0000000

Blackduck - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	9	181.7777778	7.9337535	170.0000000	193.0000000
XCB	9	139.4444444	4.3043905	134.0000000	148.0000000
WFB	9	95.0000000	2.2912878	92.0000000	98.0000000
XFB	9	115.5555556	4.7726070	107.0000000	124.0000000
STB	9	108.2222222	8.0743077	95.0000000	122.0000000
ASB	9	113.2222222	5.5176485	104.0000000	122.0000000
AUB	9	129.4444444	5.4797607	122.0000000	137.0000000
BBH	9	133.7777778	6.1801654	122.0000000	141.0000000
BNL	9	102.1111111	4.9103066	91.0000000	107.0000000
FRC	9	110.6666667	5.0249378	102.0000000	117.0000000
FRS	9	22.8888889	2.2047928	20.0000000	28.0000000
PAC	9	110.5555556	4.1264728	103.0000000	115.0000000
PAS	9	22.0000000	2.4494897	18.0000000	25.0000000
OCC	9	96.6666667	6.1441029	88.0000000	106.0000000
OCS	9	28.4444444	3.3952581	22.0000000	33.0000000
FOL	9	37.7777778	2.5873624	32.0000000	40.0000000
FOB	9	31.4444444	3.7118429	26.0000000	39.0000000
BPL	9	95.6666667	3.6400549	90.0000000	100.0000000
M48	9	76.3333333	2.8722813	72.0000000	80.0000000
NPH	9	72.6666667	3.2787193	67.0000000	77.0000000
FMB	9	100.0000000	3.0000000	96.0000000	105.0000000
NAS	9	18.7777778	2.1081851	16.0000000	22.0000000
DKB	9	21.1111111	1.6914819	18.0000000	24.0000000
OBH	9	34.5555556	1.9436506	32.0000000	38.0000000
OBB	9	40.0000000	1.6583124	38.0000000	43.0000000
ZYB	9	138.7777778	6.9241927	129.0000000	146.0000000
NLH	9	55.0000000	3.1224990	49.0000000	59.0000000
NLB	9	25.3333333	1.5000000	23.0000000	27.0000000
ZMB	9	100.5555556	4.9018137	93.0000000	107.0000000
ZMS	9	24.7777778	3.3082389	21.0000000	32.0000000
MAL	9	51.7777778	1.5634719	50.0000000	54.0000000
MAB	9	63.3333333	2.7838822	58.0000000	67.0000000
EKB	9	100.2222222	2.7738862	96.0000000	104.0000000

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Blackduck - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	2	186.0000000	4.2426407	183.0000000	189.0000000
XCB	2	147.5000000	3.5355339	145.0000000	150.0000000
WFB	2	96.0000000	0	96.0000000	96.0000000
XFB	2	125.0000000	4.2426407	122.0000000	128.0000000
STB	2	119.0000000	1.4142136	118.0000000	120.0000000
ASB	2	115.0000000	2.8284271	113.0000000	117.0000000
AUB	2	129.0000000	0	129.0000000	129.0000000
BBH	2	130.0000000	4.2426407	127.0000000	133.0000000
BNL	2	98.5000000	2.1213203	97.0000000	100.0000000
FRC	2	114.5000000	2.1213203	113.0000000	116.0000000
FRS	2	25.5000000	0.7071068	25.0000000	26.0000000
PAC	2	106.5000000	7.7781746	101.0000000	112.0000000
PAS	2	17.5000000	4.9497475	14.0000000	21.0000000
OCC	2	106.0000000	4.2426407	103.0000000	109.0000000
OCS	2	35.5000000	0.7071068	35.0000000	36.0000000
FOL	2	31.5000000	2.1213203	30.0000000	33.0000000
FOB	2	28.5000000	2.1213203	27.0000000	30.0000000
BPL	2	96.5000000	2.1213203	95.0000000	98.0000000
M48	2	72.5000000	6.3639610	68.0000000	77.0000000
NPH	2	69.5000000	4.9497475	66.0000000	73.0000000
FMB	2	95.5000000	2.1213203	94.0000000	97.0000000
NAS	2	18.0000000	2.8284271	16.0000000	20.0000000
DKB	2	20.5000000	0.7071068	20.0000000	21.0000000
OBH	2	33.0000000	2.8284271	31.0000000	35.0000000
OBB	2	39.0000000	1.4142136	38.0000000	40.0000000
ZYB	2	123.0000000	7.0710678	118.0000000	128.0000000
NLH	2	56.0000000	0	56.0000000	56.0000000
NLB	2	26.5000000	0.7071068	26.0000000	27.0000000
ZMB	2	96.5000000	4.9497475	93.0000000	100.0000000
ZMS	2	22.0000000	0	22.0000000	22.0000000
MAL	2	51.5000000	4.9497475	48.0000000	55.0000000
MAB	2	66.5000000	2.1213203	65.0000000	68.0000000
EKB	2	96.5000000	2.1213203	95.0000000	98.0000000

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Laurel - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	4	179.5000000	1.2909944	178.0000000	181.0000000
XCB	4	150.5000000	2.3804761	147.0000000	152.0000000
WFB	4	97.2500000	3.4034296	94.0000000	102.0000000
XFB	4	123.5000000	1.7320508	122.0000000	126.0000000
STB	4	111.0000000	6.4807407	103.0000000	118.0000000
ASB	4	114.7500000	2.3629078	113.0000000	118.0000000
AUB	4	127.2500000	11.8708326	110.0000000	136.0000000
BBH	4	138.5000000	1.0000000	137.0000000	139.0000000
BNL	4	104.7500000	4.2720019	102.0000000	111.0000000
FRC	4	114.5000000	3.6968455	110.0000000	119.0000000
FRS	4	24.7500000	1.8929694	22.0000000	26.0000000
PAC	4	112.5000000	1.7320508	111.0000000	115.0000000
PAS	4	23.5000000	0.5773503	23.0000000	24.0000000
OCC	4	96.2500000	6.0207973	91.0000000	104.0000000
OCS	4	28.5000000	0.5773503	28.0000000	29.0000000
FOL	4	37.2500000	1.8929694	36.0000000	40.0000000
FOB	4	31.2500000	0.9574271	30.0000000	32.0000000
BPL	4	109.7500000	18.7149673	97.0000000	137.0000000
M48	4	74.2500000	3.7749172	69.0000000	78.0000000
NPH	4	70.0000000	3.2659863	66.0000000	74.0000000
FMB	4	100.5000000	5.6862407	94.0000000	107.0000000
NAS	4	14.2500000	2.8722813	11.0000000	18.0000000
DKB	4	21.5000000	5.4467115	17.0000000	29.0000000
OBH	4	34.0000000	3.6514837	30.0000000	38.0000000
OBB	4	40.7500000	0.9574271	40.0000000	42.0000000
ZYB	4	138.5000000	4.9328829	133.0000000	145.0000000
NLH	4	52.2500000	3.0956959	48.0000000	55.0000000
NLB	4	26.5000000	1.7320508	25.0000000	29.0000000
ZMB	4	103.0000000	4.5460606	97.0000000	108.0000000
ZMS	4	28.2500000	0.9574271	27.0000000	29.0000000
MAL	4	53.2500000	2.5000000	50.0000000	56.0000000
MAB	4	65.0000000	1.8257419	63.0000000	67.0000000
EKB	4	100.5000000	6.4549722	95.0000000	109.0000000

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Laurel - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	1	177.0000000	.	177.0000000	177.0000000
XCB	1	132.0000000	.	132.0000000	132.0000000
WFB	1	92.0000000	.	92.0000000	92.0000000
XFB	1	114.0000000	.	114.0000000	114.0000000
STB	1	103.0000000	.	103.0000000	103.0000000
ASB	1	105.0000000	.	105.0000000	105.0000000
AUB	1	125.0000000	.	125.0000000	125.0000000
BBH	1	128.0000000	.	128.0000000	128.0000000
BNL	1	100.0000000	.	100.0000000	100.0000000
FRC	1	107.0000000	.	107.0000000	107.0000000
FRS	1	25.0000000	.	25.0000000	25.0000000
PAC	1	108.0000000	.	108.0000000	108.0000000
PAS	1	23.0000000	.	23.0000000	23.0000000
OCC	1	83.0000000	.	83.0000000	83.0000000
OCS	1	29.0000000	.	29.0000000	29.0000000
FOL	1	36.0000000	.	36.0000000	36.0000000
FOB	1	28.0000000	.	28.0000000	28.0000000
BPL	1	97.0000000	.	97.0000000	97.0000000
M48	1	72.0000000	.	72.0000000	72.0000000
NPH	1	68.0000000	.	68.0000000	68.0000000
FMB	1	98.0000000	.	98.0000000	98.0000000
NAS	1	18.0000000	.	18.0000000	18.0000000
DKB	1	20.0000000	.	20.0000000	20.0000000
OBH	1	36.0000000	.	36.0000000	36.0000000
OBB	1	38.0000000	.	38.0000000	38.0000000
ZYB	1	136.0000000	.	136.0000000	136.0000000
NLH	1	52.0000000	.	52.0000000	52.0000000
NLB	1	28.0000000	.	28.0000000	28.0000000
ZMB	1	108.0000000	.	108.0000000	108.0000000
ZMS	1	32.0000000	.	32.0000000	32.0000000
MAL	1	53.0000000	.	53.0000000	53.0000000
MAB	1	61.0000000	.	61.0000000	61.0000000
EKB	1	96.0000000	.	96.0000000	96.0000000

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Norman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	187.2000000	9.2032603	176.0000000	200.0000000
XCB	5	145.0000000	3.7416574	140.0000000	148.0000000
WFB	5	102.2000000	9.1214034	94.0000000	117.0000000
XFB	5	121.8000000	3.3466401	118.0000000	127.0000000
STB	5	107.8000000	16.1152102	80.0000000	121.0000000
ASB	5	115.2000000	5.3572381	108.0000000	121.0000000
AUB	5	134.4000000	1.5165751	133.0000000	137.0000000
BBH	5	137.6000000	5.2725705	132.0000000	145.0000000
BNL	5	109.6000000	3.2863353	106.0000000	113.0000000
FRC	5	115.4000000	4.9295030	109.0000000	121.0000000
FRS	5	24.2000000	1.9235384	22.0000000	27.0000000
PAC	5	109.2000000	6.4575537	104.0000000	120.0000000
PAS	5	22.2000000	3.7013511	16.0000000	26.0000000
OCC	5	97.2000000	2.7748874	93.0000000	100.0000000
OCS	5	29.6000000	2.7018512	26.0000000	33.0000000
FOL	5	36.0000000	2.0000000	34.0000000	39.0000000
FOB	5	31.6000000	1.5165751	30.0000000	34.0000000
DPL	5	101.0000000	5.3385391	97.0000000	109.0000000
M48	5	78.2000000	2.1679483	76.0000000	81.0000000
NPH	5	73.8000000	2.4899799	72.0000000	77.0000000
FMB	5	103.2000000	5.5856960	98.0000000	111.0000000
NAS	5	18.6000000	2.1908902	16.0000000	22.0000000
DKB	5	25.0000000	3.9370039	18.0000000	27.0000000
OBH	5	35.0000000	1.5811388	33.0000000	37.0000000
OBB	5	41.2000000	2.9495762	38.0000000	46.0000000
ZYB	5	144.0000000	5.3385391	137.0000000	150.0000000
NLH	5	58.2000000	2.9495762	55.0000000	61.0000000
NLB	5	27.2000000	1.0954451	26.0000000	29.0000000
ZMB	5	101.4000000	6.1886994	91.0000000	106.0000000
ZMS	5	26.8000000	2.8635642	23.0000000	31.0000000
MAL	5	57.8000000	7.8230429	47.0000000	64.0000000
MAB	5	67.4000000	3.6469165	64.0000000	73.0000000
EKB	5	102.8000000	5.4497706	97.0000000	110.0000000

Norman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	2	174.5000000	3.5355339	172.0000000	177.0000000
XCB	2	145.5000000	2.1213203	144.0000000	147.0000000
WFB	2	96.5000000	2.1213203	95.0000000	98.0000000
XFB	2	114.0000000	0	114.0000000	114.0000000
STB	2	108.5000000	4.9497475	105.0000000	112.0000000
ASB	2	115.0000000	1.4142136	114.0000000	116.0000000
AUB	2	129.5000000	0.7071068	129.0000000	130.0000000
BBH	2	123.0000000	5.6568542	119.0000000	127.0000000
BNL	2	94.5000000	2.1213203	93.0000000	96.0000000
FRC	2	104.5000000	3.5355339	102.0000000	107.0000000
FRS	2	22.5000000	0.7071068	22.0000000	23.0000000
PAC	2	106.0000000	4.2426407	103.0000000	109.0000000
PAS	2	22.5000000	3.5355339	20.0000000	25.0000000
OCC	2	94.0000000	0	94.0000000	94.0000000
OCS	2	30.5000000	3.5355339	28.0000000	33.0000000
FOL	2	32.0000000	1.4142136	31.0000000	33.0000000
FOB	2	30.5000000	0.7071068	30.0000000	31.0000000
BPL	2	89.5000000	2.1213203	88.0000000	91.0000000
M48	2	66.5000000	4.9497475	63.0000000	70.0000000
NPH	2	63.0000000	4.2426407	60.0000000	66.0000000
FMB	2	96.0000000	1.4142136	95.0000000	97.0000000
NAS	2	18.5000000	0.7071068	18.0000000	19.0000000
DKB	2	21.5000000	0.7071068	21.0000000	22.0000000
OBH	2	34.5000000	2.1213203	33.0000000	36.0000000
OBB	2	39.5000000	0.7071068	39.0000000	40.0000000
ZYB	2	134.0000000	2.8284271	132.0000000	136.0000000
NLH	2	48.0000000	0	48.0000000	48.0000000
NLB	2	24.0000000	1.4142136	23.0000000	25.0000000
ZMB	2	97.0000000	0	97.0000000	97.0000000
ZMS	2	23.0000000	0	23.0000000	23.0000000
MAL	2	52.5000000	3.5355339	50.0000000	55.0000000
MAB	2	60.0000000	2.8284271	58.0000000	62.0000000
EKB	2	97.0000000	0	97.0000000	97.0000000

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Mandan - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	12	185.6666667	7.5116072	170.0000000	197.0000000
XCB	12	137.5000000	5.3512955	123.0000000	144.0000000
WFB	12	91.1666667	5.3738988	83.0000000	102.0000000
XFB	12	113.1666667	4.8398598	103.0000000	121.0000000
STB	12	107.2500000	6.7840053	92.0000000	116.0000000
ASB	12	107.2500000	4.5552168	99.0000000	115.0000000
AUB	12	126.0833333	5.8225008	115.0000000	136.0000000
BBH	12	133.7500000	3.6958207	128.0000000	142.0000000
BNL	12	103.7500000	3.4145411	99.0000000	109.0000000
FRC	12	110.9166667	6.3883179	101.0000000	122.0000000
FRS	12	23.5833333	2.2343733	21.0000000	27.0000000
PAC	12	109.5000000	3.7779263	104.0000000	115.0000000
PAS	12	22.0833333	1.3113722	19.0000000	23.0000000
OCC	12	97.6666667	4.9969688	88.0000000	104.0000000
OCS	12	32.5833333	4.0778411	25.0000000	41.0000000
FOL	12	36.4166667	3.4761089	31.0000000	42.0000000
FOB	12	29.4166667	4.5418925	20.0000000	35.0000000
BPL	12	100.5000000	2.5761141	97.0000000	106.0000000
M48	12	73.1666667	4.8021460	64.0000000	80.0000000
NPH	12	69.5833333	5.1249538	60.0000000	77.0000000
FMB	12	98.5833333	3.9648073	92.0000000	106.0000000
NAS	12	19.3333333	2.0597146	17.0000000	24.0000000
DKB	12	22.1666667	1.6422453	20.0000000	25.0000000
OBH	12	35.0000000	1.5374122	32.0000000	37.0000000
OBB	12	39.7500000	1.8153387	37.0000000	43.0000000
ZYB	12	136.6666667	6.0653012	125.0000000	145.0000000
NLH	12	54.5833333	3.3427896	48.0000000	61.0000000
NLB	12	24.9166667	1.8319554	22.0000000	28.0000000
ZMB	12	98.7500000	4.3719145	92.0000000	105.0000000
ZMS	12	26.3333333	3.6265018	19.0000000	30.0000000
MAL	12	55.0000000	2.9541958	51.0000000	60.0000000
MAB	12	63.7500000	4.2238500	58.0000000	73.0000000
EKB	12	98.3333333	3.5248039	93.0000000	106.0000000

Mandan - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	22	178.0909091	5.3444149	164.0000000	186.0000000
XCB	22	136.0454545	4.6030763	128.0000000	148.0000000
WFB	22	90.6363636	3.5529392	85.0000000	97.0000000
XFB	22	111.9545455	3.8849805	103.0000000	120.0000000
STB	22	107.9090909	6.3838270	93.0000000	118.0000000
ASB	22	104.8181818	4.0665460	97.0000000	112.0000000
AUB	22	124.0454545	3.8232033	118.0000000	136.0000000
BBH	22	129.3181818	4.2581727	122.0000000	141.0000000
BNL	22	100.7727273	4.8592751	93.0000000	113.0000000
FRC	22	107.5909091	5.1144901	100.0000000	120.0000000
FRS	22	24.2727273	2.7461110	18.0000000	29.0000000
PAC	22	104.2727273	4.8617243	97.0000000	112.0000000
PAS	22	21.6363636	2.4984844	17.0000000	26.0000000
OCC	22	94.0000000	3.9520941	85.0000000	101.0000000
OCS	22	29.6363636	2.8207641	25.0000000	35.0000000
FOL	22	35.0909091	2.7586935	30.0000000	40.0000000
FOB	22	28.1363636	2.0070223	25.0000000	32.0000000
BPL	22	97.5909091	4.0550861	91.0000000	107.0000000
M48	22	69.7727273	3.2795444	62.0000000	75.0000000
NPH	22	66.5454545	3.6085517	58.0000000	73.0000000
FMB	22	95.1363636	3.8581448	86.0000000	102.0000000
NAS	22	18.0454545	2.0811460	14.0000000	21.0000000
DKB	22	21.4545455	2.0639138	18.0000000	27.0000000
OBH	22	34.1363636	1.4571811	31.0000000	37.0000000
OBB	22	38.2727273	1.7776876	34.0000000	41.0000000
ZYB	22	130.9545455	4.0056778	126.0000000	141.0000000
NLH	22	51.0454545	2.8698311	45.0000000	56.0000000
NLB	22	24.2272727	1.9255628	20.0000000	28.0000000
ZMB	22	94.7272727	3.3831771	89.0000000	102.0000000
ZMS	22	23.5000000	1.7113069	20.0000000	27.0000000
MAL	22	52.4090909	2.8728465	47.0000000	58.0000000
MAB	22	62.5000000	2.5773741	58.0000000	67.0000000
EKB	22	95.6818182	3.1378847	90.0000000	102.0000000

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Parkland - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	187.4000000	3.3615473	183.0000000	192.0000000
XCB	5	142.8000000	7.2594766	136.0000000	154.0000000
WFB	5	94.0000000	2.4494897	91.0000000	97.0000000
XFB	5	118.0000000	5.9160798	113.0000000	127.0000000
STB	5	106.0000000	6.7823300	95.0000000	112.0000000
ASB	5	108.4000000	5.3665631	99.0000000	112.0000000
AUB	5	130.2000000	4.0249224	124.0000000	135.0000000
BBH	5	132.8000000	3.4205263	128.0000000	136.0000000
BNL	5	103.6000000	3.8470768	100.0000000	110.0000000
FRC	5	112.4000000	4.7222876	105.0000000	117.0000000
FRS	5	23.4000000	2.4083189	20.0000000	26.0000000
PAC	5	111.2000000	3.8987177	106.0000000	115.0000000
PAS	5	22.0000000	2.3452079	18.0000000	24.0000000
OCC	5	94.4000000	3.7815341	90.0000000	98.0000000
OCS	5	31.2000000	3.1144823	28.0000000	35.0000000
FOL	5	35.2000000	1.9235384	32.0000000	37.0000000
FOB	5	31.0000000	3.6742346	28.0000000	37.0000000
BPL	5	95.8000000	1.4832397	94.0000000	98.0000000
M4B	5	70.0000000	5.4313902	65.0000000	78.0000000
NPH	5	67.0000000	5.0000000	62.0000000	74.0000000
FMB	5	101.2000000	3.0331502	98.0000000	106.0000000
NAS	5	20.6000000	2.3021729	18.0000000	24.0000000
DKB	5	24.4000000	1.8165902	22.0000000	27.0000000
OBH	5	36.4000000	2.3021729	34.0000000	39.0000000
OBB	5	41.4000000	1.9493589	39.0000000	44.0000000
ZYB	5	140.8000000	6.1400326	133.0000000	147.0000000
NLH	5	51.6000000	3.2863353	49.0000000	57.0000000
NLB	5	25.8000000	0.8366600	25.0000000	27.0000000
ZMB	5	100.0000000	3.1622777	95.0000000	103.0000000
ZMS	5	24.2000000	2.7748874	21.0000000	27.0000000
MAL	5	52.8000000	0.8366600	52.0000000	54.0000000
MAB	5	64.0000000	4.6904158	58.0000000	71.0000000
EKB	5	102.0000000	3.1622777	99.0000000	107.0000000

Parkland - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	179.6666667	2.5166115	177.0000000	182.0000000
XCB	3	143.6666667	5.6862407	139.0000000	150.0000000
WFB	3	100.0000000	3.0000000	97.0000000	103.0000000
XFB	3	120.3333333	4.0414519	116.0000000	124.0000000
STB	3	109.3333333	1.1547005	108.0000000	110.0000000
ASB	3	109.3333333	5.6862407	103.0000000	114.0000000
AUB	3	130.3333333	2.5166115	128.0000000	133.0000000
BBH	3	131.0000000	4.3588989	128.0000000	136.0000000
BNL	3	100.3333333	4.9328829	97.0000000	106.0000000
FRC	3	111.0000000	2.6457513	109.0000000	114.0000000
FRS	3	25.3333333	4.0414519	21.0000000	29.0000000
PAC	3	105.3333333	4.9328829	102.0000000	111.0000000
PAS	3	20.6666667	2.8867513	19.0000000	24.0000000
OCC	3	92.0000000	3.6055513	88.0000000	95.0000000
OCS	3	28.6666667	0.5773503	28.0000000	29.0000000
FOL	3	36.3333333	2.5166115	34.0000000	39.0000000
FOB	3	30.0000000	1.0000000	29.0000000	31.0000000
BPL	3	96.3333333	6.5064071	90.0000000	103.0000000
M48	3	70.3333333	2.5166115	68.0000000	73.0000000
NPH	3	66.3333333	2.3094011	65.0000000	69.0000000
FMB	3	97.6666667	1.5275252	96.0000000	99.0000000
NAS	3	22.0000000	5.2915026	18.0000000	28.0000000
DKB	3	24.3333333	2.0816660	22.0000000	26.0000000
OBH	3	33.0000000	1.0000000	32.0000000	34.0000000
OBB	3	38.0000000	1.0000000	37.0000000	39.0000000
ZYB	3	137.6666667	3.0550505	135.0000000	141.0000000
NLH	3	50.6666667	0.5773503	50.0000000	51.0000000
NLB	3	24.0000000	1.7320508	22.0000000	25.0000000
ZMB	3	97.0000000	4.3588989	94.0000000	102.0000000
ZMS	3	23.6666667	3.5118846	20.0000000	27.0000000
MAL	3	54.0000000	3.6055513	51.0000000	58.0000000
MAB	3	62.3333333	1.5275252	61.0000000	64.0000000
EKB	3	99.0000000	1.7320508	97.0000000	100.0000000

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Caucasian - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	3	183.3333333	10.0166528	173.0000000	193.0000000
XCB	3	144.3333333	4.1633320	141.0000000	149.0000000
WFB	3	98.3333333	5.8594653	94.0000000	105.0000000
XFB	3	125.0000000	3.4641016	123.0000000	129.0000000
STB	3	121.0000000	4.5825757	117.0000000	126.0000000
ASB	3	112.3333333	4.0414519	108.0000000	116.0000000
AUB	3	118.6666667	8.0829038	110.0000000	126.0000000
BBH	3	135.0000000	6.0827625	128.0000000	139.0000000
BNL	3	99.3333333	4.0414519	97.0000000	104.0000000
FRC	3	117.0000000	4.5825757	112.0000000	121.0000000
FRS	3	28.3333333	1.5275252	27.0000000	30.0000000
PAC	3	116.6666667	4.0414519	112.0000000	119.0000000
PAS	3	23.3333333	2.3094011	22.0000000	26.0000000
OCC	3	93.6666667	6.6583281	86.0000000	98.0000000
OCS	3	30.6666667	2.5166115	28.0000000	33.0000000
FOL	3	36.3333333	3.2145503	34.0000000	40.0000000
FOB	3	31.0000000	5.2915026	27.0000000	37.0000000
BPL	3	89.3333333	2.3094011	88.0000000	92.0000000
M4B	3	73.6666667	6.4291005	69.0000000	81.0000000
NPH	3	69.3333333	5.8594653	65.0000000	76.0000000
FMB	3	95.3333333	3.5118846	92.0000000	99.0000000
NAS	3	21.6666667	1.5275252	20.0000000	23.0000000
DKB	3	21.3333333	6.1101009	16.0000000	28.0000000
OBH	3	35.3333333	1.1547005	34.0000000	36.0000000
OBB	3	38.0000000	0	38.0000000	38.0000000
ZYB	3	129.3333333	7.2341781	121.0000000	134.0000000
NLH	3	53.0000000	3.4641016	51.0000000	57.0000000
NLB	3	22.3333333	3.0550505	19.0000000	25.0000000
ZMB	3	87.3333333	3.0550505	84.0000000	90.0000000
ZMS	3	25.6666667	2.8867513	24.0000000	29.0000000
MAL	3	44.6666667	5.6862407	40.0000000	51.0000000
MAB	3	60.6666667	4.0414519	57.0000000	65.0000000
EKB	3	96.0000000	4.0000000	92.0000000	100.0000000

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Caucasian - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	1	182.0000000	.	182.0000000	182.0000000
XCB	1	146.0000000	.	146.0000000	146.0000000
WFB	1	93.0000000	.	93.0000000	93.0000000
XFB	1	114.0000000	.	114.0000000	114.0000000
STB	1	102.0000000	.	102.0000000	102.0000000
ASB	1	124.0000000	.	124.0000000	124.0000000
AUB	1	129.0000000	.	129.0000000	129.0000000
BBH	1	113.0000000	.	113.0000000	113.0000000
BNL	1	106.0000000	.	106.0000000	106.0000000
FRC	1	102.0000000	.	102.0000000	102.0000000
FRS	1	22.0000000	.	22.0000000	22.0000000
PAC	1	102.0000000	.	102.0000000	102.0000000
PAS	1	26.0000000	.	26.0000000	26.0000000
OCC	1	95.0000000	.	95.0000000	95.0000000
OCS	1	31.0000000	.	31.0000000	31.0000000
FOL	1	39.0000000	.	39.0000000	39.0000000
FOB	1	36.0000000	.	36.0000000	36.0000000
BPL	1	104.0000000	.	104.0000000	104.0000000
M4B	1	72.0000000	.	72.0000000	72.0000000
NPH	1	69.0000000	.	69.0000000	69.0000000
FMB	1	98.0000000	.	98.0000000	98.0000000
NAS	1	15.0000000	.	15.0000000	15.0000000
DKB	1	18.0000000	.	18.0000000	18.0000000
OBH	1	34.0000000	.	34.0000000	34.0000000
OBB	1	38.0000000	.	38.0000000	38.0000000
ZYB	1	133.0000000	.	133.0000000	133.0000000
NLH	1	51.0000000	.	51.0000000	51.0000000
NLB	1	26.0000000	.	26.0000000	26.0000000
ZMB	1	94.0000000	.	94.0000000	94.0000000
ZMS	1	24.0000000	.	24.0000000	24.0000000
MAL	1	42.0000000	.	42.0000000	42.0000000
MAB	1	62.0000000	.	62.0000000	62.0000000
EKB	1	100.0000000	.	100.0000000	100.0000000

Westman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	25	184.9600000	6.2281618	171.0000000	196.0000000
XCB	25	141.6000000	4.3874822	133.0000000	147.0000000
WFB	25	96.2800000	4.3447286	90.0000000	104.0000000
XFB	25	118.9600000	5.2399109	110.0000000	131.0000000
STB	25	102.4400000	17.1441924	58.0000000	123.0000000
ASB	25	112.0800000	6.3306135	100.0000000	122.0000000
AUB	25	129.8800000	3.8440430	124.0000000	137.0000000
BBH	25	131.7200000	7.5527037	118.0000000	147.0000000
BNL	25	102.7600000	7.2759879	85.0000000	127.0000000
FRC	25	109.9600000	4.0771722	103.0000000	118.0000000
FRS	25	23.0000000	2.9439203	18.0000000	29.0000000
PAC	25	108.8000000	7.0474582	98.0000000	127.0000000
PAS	25	21.4400000	2.9591665	16.0000000	27.0000000
OCC	25	95.5200000	5.9938858	85.0000000	105.0000000
OCS	25	31.0800000	3.6733273	24.0000000	38.0000000
FOL	25	36.9600000	2.0912516	33.0000000	40.0000000
FOB	25	31.4000000	2.1015867	27.0000000	35.0000000
BPL	25	97.4800000	6.9947599	83.0000000	117.0000000
M4B	25	72.6800000	4.7056703	65.0000000	85.0000000
NPH	25	68.9200000	4.6000000	62.0000000	80.0000000
FMB	25	100.5200000	3.0016662	95.0000000	107.0000000
NAS	25	18.7200000	1.8823744	15.0000000	22.0000000
DKB	25	24.6000000	2.7988093	18.0000000	30.0000000
OBH	25	34.8000000	2.0000000	31.0000000	39.0000000
OBB	25	39.5600000	2.0832667	35.0000000	44.0000000
ZYB	25	139.4000000	5.5602758	130.0000000	150.0000000
NLH	25	52.1200000	2.6191602	48.0000000	60.0000000
NLB	25	26.4000000	1.4719601	23.0000000	29.0000000
ZMB	25	101.9600000	6.0517215	92.0000000	111.0000000
ZMS	25	25.5200000	2.2007574	21.0000000	31.0000000
MAL	25	53.6000000	4.4534631	43.0000000	59.0000000
MAB	25	64.0400000	3.1421861	58.0000000	70.0000000
EKB	25	101.5600000	3.2670068	95.0000000	110.0000000

Westman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	20	176.3000000	5.0586039	165.0000000	183.0000000
XCB	20	136.8000000	6.3957223	126.0000000	150.0000000
WFB	20	91.1500000	4.4517885	82.0000000	102.0000000
XFB	20	112.7500000	5.8568448	102.0000000	127.0000000
STB	20	102.2000000	5.7637707	90.0000000	117.0000000
ASB	20	105.7000000	4.4259997	98.0000000	113.0000000
AUB	20	124.5000000	5.1041779	114.0000000	134.0000000
BBH	20	126.5000000	4.1864443	120.0000000	136.0000000
BNL	20	98.6000000	3.1854934	93.0000000	104.0000000
FRC	20	107.4000000	4.0833423	100.0000000	116.0000000
FRS	20	22.8500000	1.8144160	20.0000000	26.0000000
PAC	20	106.2500000	4.9616954	93.0000000	116.0000000
PAS	20	22.1500000	2.0844032	18.0000000	26.0000000
OCC	20	92.2500000	4.9934167	84.0000000	105.0000000
OCS	20	27.7000000	2.9217875	23.0000000	36.0000000
FOL	20	36.0000000	2.8654016	30.0000000	41.0000000
FOB	20	30.4000000	1.9841477	28.0000000	35.0000000
BPL	20	93.9500000	4.6957428	84.0000000	102.0000000
M48	20	70.8000000	5.1768716	62.0000000	83.0000000
NPH	20	65.8500000	5.9848493	53.0000000	79.0000000
FMB	20	96.5500000	2.8741131	90.0000000	101.0000000
NAS	20	17.7500000	1.8883298	14.0000000	21.0000000
DKB	20	23.0500000	2.6650763	15.0000000	27.0000000
OBH	20	34.2000000	1.9084301	31.0000000	38.0000000
OBB	20	38.8500000	1.5312534	37.0000000	43.0000000
ZYB	20	132.7000000	5.1615991	125.0000000	141.0000000
NLH	20	49.7000000	2.8855356	42.0000000	55.0000000
NLB	20	25.6500000	2.4553915	22.0000000	31.0000000
ZMB	20	95.7000000	4.6577609	84.0000000	104.0000000
ZMS	20	24.1500000	2.3680994	20.0000000	30.0000000
MAL	20	49.3500000	3.8013156	42.0000000	56.0000000
MAB	20	61.3000000	4.1688065	52.0000000	70.0000000
EKB	20	97.7000000	2.9397458	92.0000000	102.0000000

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Red River Valley - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	6	184.6666667	5.6095157	178.0000000	192.0000000
XCB	6	142.1666667	2.8577380	138.0000000	146.0000000
WFB	6	93.3333333	2.5033311	90.0000000	97.0000000
XFB	6	117.3333333	4.6761808	112.0000000	126.0000000
STB	6	105.0000000	5.3665631	98.0000000	113.0000000
ASB	6	109.1666667	2.7868740	105.0000000	113.0000000
AUB	6	133.6666667	2.8047579	129.0000000	137.0000000
BBH	6	132.3333333	4.1311822	128.0000000	137.0000000
BNL	6	104.8333333	1.7224014	103.0000000	108.0000000
FRC	6	109.8333333	2.1369761	107.0000000	113.0000000
FRS	6	22.6666667	1.0327956	21.0000000	24.0000000
PAC	6	111.3333333	4.7187569	105.0000000	118.0000000
PAS	6	23.3333333	1.7511901	21.0000000	26.0000000
OCC	6	90.8333333	4.9564772	86.0000000	98.0000000
OCS	6	27.3333333	3.0110906	23.0000000	31.0000000
FOL	6	38.0000000	2.2803509	35.0000000	40.0000000
FOB	6	31.0000000	1.8973666	28.0000000	33.0000000
BPL	6	99.0000000	5.4772256	91.0000000	106.0000000
M48	6	75.0000000	3.3466401	72.0000000	80.0000000
NPH	6	70.8333333	2.8577380	68.0000000	76.0000000
FMB	6	99.0000000	5.2535702	94.0000000	109.0000000
NAS	6	18.1666667	1.9407902	15.0000000	20.0000000
DKB	6	24.6666667	2.7325202	23.0000000	30.0000000
OBH	6	36.5000000	2.5884358	33.0000000	39.0000000
OBB	6	39.1666667	1.9407902	36.0000000	42.0000000
ZYB	6	143.1666667	6.3060817	134.0000000	151.0000000
NLH	6	53.0000000	2.0000000	50.0000000	55.0000000
NLB	6	24.8333333	2.2286020	23.0000000	28.0000000
ZMB	6	102.6666667	7.3393914	96.0000000	114.0000000
ZMS	6	24.6666667	3.2041640	19.0000000	28.0000000
MAL	6	54.6666667	1.8618987	52.0000000	57.0000000
MAB	6	64.3333333	3.3862467	58.0000000	67.0000000
EKB	6	99.5000000	5.5767374	94.0000000	110.0000000

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Red River Valley - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	13	178.0000000	5.3229065	167.0000000	185.0000000
XCB	13	140.2307692	4.9858775	131.0000000	148.0000000
WFB	13	92.9230769	6.2511537	87.0000000	112.0000000
XFB	13	114.1538462	5.1776145	107.0000000	126.0000000
STB	13	105.1538462	4.8793127	96.0000000	115.0000000
ASB	13	110.0000000	6.2849025	98.0000000	118.0000000
AUB	13	123.4615385	6.3062850	114.0000000	135.0000000
BBH	13	124.6923077	5.5735180	118.0000000	134.0000000
BNL	13	98.7692308	4.3998834	90.0000000	104.0000000
FRC	13	104.6923077	4.5713713	96.0000000	112.0000000
FRS	13	22.5384615	1.6132464	19.0000000	25.0000000
PAC	13	104.6153846	7.4558530	92.0000000	116.0000000
PAS	13	20.6153846	2.5012817	16.0000000	26.0000000
OCC	13	96.0000000	2.9154759	92.0000000	100.0000000
OCS	13	30.0769231	2.3615510	27.0000000	35.0000000
FOL	13	33.8461538	3.0780447	29.0000000	41.0000000
FOB	13	32.0000000	4.3588989	23.0000000	39.0000000
BPL	13	94.6153846	4.1339743	88.0000000	105.0000000
M48	13	66.2307692	3.1925394	61.0000000	72.0000000
NPH	13	62.7692308	3.6549931	56.0000000	69.0000000
FMB	13	96.1538462	4.2199161	87.0000000	104.0000000
NAS	13	17.8461538	1.3445045	16.0000000	21.0000000
DKB	13	23.7692308	1.9215378	22.0000000	29.0000000
OBH	13	34.4615385	2.1061570	30.0000000	39.0000000
OBB	13	38.7692308	1.7867030	36.0000000	43.0000000
ZYB	13	130.9230769	7.3310020	120.0000000	142.0000000
NLH	13	48.6923077	3.6144298	42.0000000	55.0000000
NLB	13	25.3076923	2.9828570	19.0000000	29.0000000
ZMB	13	95.2307692	4.3618392	88.0000000	103.0000000
ZMS	13	22.6923077	2.8978330	19.0000000	28.0000000
MAL	13	50.9230769	4.3867516	40.0000000	57.0000000
MAB	13	61.0769231	4.2712515	55.0000000	68.0000000
EKB	13	97.3846154	4.8224900	88.0000000	105.0000000

Eastman - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	6	184.8333333	1.3291601	183.0000000	186.0000000
XCB	6	146.6666667	3.8297084	141.0000000	153.0000000
WFB	6	97.0000000	5.1380930	88.0000000	102.0000000
XFB	6	118.0000000	2.9664794	114.0000000	122.0000000
STB	6	110.0000000	4.6043458	105.0000000	116.0000000
ASB	6	111.3333333	3.9832985	107.0000000	116.0000000
AUB	6	133.1666667	4.6224092	129.0000000	141.0000000
BBH	6	135.1666667	6.2423286	126.0000000	144.0000000
BNL	6	100.5000000	3.6193922	97.0000000	107.0000000
FRC	6	111.1666667	6.5853372	98.0000000	116.0000000
FRS	6	23.3333333	3.0767949	18.0000000	26.0000000
PAC	6	113.3333333	7.2295689	105.0000000	123.0000000
PAS	6	22.6666667	3.3862467	19.0000000	29.0000000
OCC	6	93.3333333	5.7154761	86.0000000	101.0000000
OCS	6	27.5000000	2.5099801	24.0000000	30.0000000
FOL	6	37.0000000	2.0976177	33.0000000	39.0000000
FOB	6	30.3333333	1.2110601	29.0000000	32.0000000
BPL	6	99.3333333	6.1210021	91.0000000	108.0000000
M48	6	72.0000000	2.7568098	70.0000000	77.0000000
NPH	6	69.1666667	2.3166067	67.0000000	73.0000000
FMB	6	102.1666667	3.4880749	98.0000000	108.0000000
NAS	6	18.3333333	3.0767949	15.0000000	23.0000000
DKB	6	23.6666667	3.7237973	19.0000000	30.0000000
OBH	6	34.1666667	1.4719601	32.0000000	36.0000000
OBB	6	41.1666667	3.1251667	38.0000000	47.0000000
ZYB	6	142.3333333	6.5625198	135.0000000	154.0000000
NLH	6	54.0000000	2.3664319	51.0000000	57.0000000
NLB	6	25.8333333	2.1369761	24.0000000	30.0000000
ZMB	6	104.3333333	4.5018515	100.0000000	112.0000000
ZMS	6	23.3333333	3.5023801	18.0000000	28.0000000
MAL	6	52.0000000	6.6932802	44.0000000	62.0000000
MAB	6	64.6666667	3.3266600	61.0000000	70.0000000
EKB	6	104.3333333	6.1210021	97.0000000	114.0000000

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Eastman - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	183.2000000	7.4296702	173.0000000	191.0000000
XCB	5	139.2000000	5.4037024	131.0000000	145.0000000
WFB	5	96.0000000	4.6368092	90.0000000	102.0000000
XFB	5	112.0000000	6.2849025	102.0000000	118.0000000
STB	5	105.2000000	5.5407581	99.0000000	111.0000000
ASB	5	107.6000000	5.7271284	103.0000000	117.0000000
AUB	5	125.4000000	6.8044103	116.0000000	133.0000000
BBH	5	127.8000000	4.5497253	123.0000000	134.0000000
BNL	5	99.0000000	2.6457513	95.0000000	102.0000000
FRC	5	110.4000000	3.8470768	106.0000000	115.0000000
FRS	5	25.2000000	2.5884358	22.0000000	29.0000000
PAC	5	110.4000000	5.3197744	103.0000000	118.0000000
PAS	5	21.8000000	2.6832816	19.0000000	25.0000000
OCC	5	93.4000000	0.8944272	93.0000000	95.0000000
OCS	5	29.2000000	2.7748874	27.0000000	34.0000000
FOL	5	34.6000000	3.7815341	30.0000000	38.0000000
FOB	5	29.0000000	1.8708287	27.0000000	31.0000000
BPL	5	93.4000000	2.8809721	91.0000000	98.0000000
M48	5	68.6000000	1.6733201	66.0000000	70.0000000
NPH	5	63.8000000	2.5884358	61.0000000	68.0000000
FMB	5	98.2000000	4.2071368	92.0000000	103.0000000
NAS	5	20.6000000	1.3416408	20.0000000	23.0000000
DKB	5	22.4000000	1.8165902	20.0000000	25.0000000
OBH	5	34.6000000	2.0736441	32.0000000	37.0000000
OBB	5	40.0000000	2.0000000	37.0000000	42.0000000
ZYB	5	130.8000000	5.2630789	122.0000000	136.0000000
NLH	5	48.6000000	1.9493589	46.0000000	51.0000000
NLB	5	24.8000000	1.9235384	22.0000000	27.0000000
ZMB	5	95.2000000	3.7013511	91.0000000	100.0000000
ZMS	5	24.2000000	1.9235384	21.0000000	26.0000000
MAL	5	53.6000000	1.9493589	51.0000000	56.0000000
MAB	5	61.4000000	5.9413803	51.0000000	66.0000000
EKB	5	98.6000000	4.3931765	92.0000000	103.0000000

Hungry Hall - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	9	186.0000000	5.9791304	178.0000000	196.0000000
XCB	9	143.8888889	5.2068331	134.0000000	150.0000000
WFB	9	96.5555556	3.6438685	92.0000000	103.0000000
XFB	9	118.0000000	5.0497525	108.0000000	127.0000000
STB	9	105.0000000	3.1622777	100.0000000	110.0000000
ASB	9	117.2222222	7.6612300	102.0000000	130.0000000
AUB	9	130.3333333	5.9791304	117.0000000	137.0000000
BBH	9	134.2222222	2.6352314	130.0000000	139.0000000
BNL	9	103.6666667	2.9580399	98.0000000	109.0000000
FRC	9	113.1111111	3.9193253	109.0000000	119.0000000
FRS	9	22.3333333	2.8722813	18.0000000	27.0000000
PAC	9	111.6666667	4.5276926	101.0000000	117.0000000
PAS	9	22.4444444	2.4551533	19.0000000	25.0000000
OCC	9	99.7777778	5.2148293	93.0000000	110.0000000
OCS	9	27.6666667	2.0615528	25.0000000	32.0000000
FOL	9	36.6666667	2.1213203	32.0000000	39.0000000
FOB	9	31.3333333	1.5811388	29.0000000	34.0000000
BPL	9	100.8888889	5.9254629	91.0000000	107.0000000
M48	9	71.5555556	4.0960686	66.0000000	77.0000000
NPH	9	67.7777778	3.8980052	62.0000000	72.0000000
FMB	9	100.4444444	3.5039660	96.0000000	105.0000000
NAS	9	19.2222222	1.7873009	16.0000000	22.0000000
DKB	9	25.0000000	2.5000000	22.0000000	29.0000000
OBH	9	33.6666667	1.6583124	31.0000000	36.0000000
OBB	9	41.2222222	3.3458100	35.0000000	47.0000000
ZYB	9	140.6666667	4.2720019	133.0000000	146.0000000
NLH	9	52.0000000	3.6055513	47.0000000	59.0000000
NLB	9	26.2222222	1.4813657	24.0000000	28.0000000
ZMB	9	96.8888889	3.7230513	93.0000000	102.0000000
ZMS	9	26.7777778	2.2791324	23.0000000	31.0000000
MAL	9	55.0000000	2.9154759	51.0000000	59.0000000
MAB	9	66.4444444	2.6977357	62.0000000	70.0000000
EKB	9	100.8888889	3.8873013	96.0000000	108.0000000

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Hungry Hall - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	8	179.3750000	5.5533130	171.0000000	189.0000000
XCB	8	146.6250000	2.0658793	144.0000000	150.0000000
WFB	8	95.8750000	4.1554611	92.0000000	104.0000000
XFB	8	118.3750000	4.2740914	115.0000000	128.0000000
STB	8	107.8750000	4.8236767	103.0000000	117.0000000
ASB	8	114.1250000	5.9386747	104.0000000	123.0000000
AUB	8	131.8750000	4.2236579	125.0000000	137.0000000
BBH	8	127.6250000	4.5336047	122.0000000	137.0000000
BNL	8	99.7500000	4.0620192	94.0000000	108.0000000
FRC	8	110.0000000	4.5355737	105.0000000	120.0000000
FRS	8	23.7500000	2.2519833	21.0000000	27.0000000
PAC	8	106.6250000	6.3231434	98.0000000	117.0000000
PAS	8	21.0000000	3.0237158	17.0000000	25.0000000
OCC	8	98.0000000	5.5549206	88.0000000	106.0000000
OCS	8	27.6250000	2.3260942	24.0000000	30.0000000
FOL	8	36.5000000	2.5634798	31.0000000	39.0000000
FOB	8	30.6250000	2.1998377	27.0000000	35.0000000
BPL	8	99.8750000	2.8504386	95.0000000	105.0000000
M48	8	68.6250000	5.3435542	60.0000000	76.0000000
NPH	8	64.2500000	4.8032727	56.0000000	69.0000000
FMB	8	97.6250000	4.7188830	90.0000000	106.0000000
NAS	8	18.2500000	2.8660575	13.0000000	23.0000000
DKB	8	23.6250000	1.9955307	21.0000000	27.0000000
OBH	8	33.1250000	1.7268882	31.0000000	36.0000000
OBB	8	41.2500000	3.1052950	36.0000000	45.0000000
ZYB	8	138.8750000	4.9407200	133.0000000	147.0000000
NLH	8	51.0000000	3.8544964	43.0000000	55.0000000
NLB	8	27.2500000	2.2519833	24.0000000	31.0000000
ZMB	8	97.3750000	5.2627396	89.0000000	104.0000000
ZMS	8	25.5000000	2.8784917	20.0000000	30.0000000
MAL	8	54.6250000	3.7008686	48.0000000	58.0000000
MAB	8	64.0000000	4.4721360	58.0000000	72.0000000
EKB	8	98.6250000	4.6579425	93.0000000	107.0000000

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Sonota - males

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	7	187.2857143	4.2314019	181.0000000	194.0000000
XCB	7	143.0000000	5.8594653	135.0000000	150.0000000
WFB	7	93.2857143	4.0296520	86.0000000	98.0000000
XFB	7	117.4285714	4.6853368	111.0000000	124.0000000
STB	7	107.7142857	5.8797473	99.0000000	116.0000000
ASB	7	111.1428571	3.7161168	105.0000000	116.0000000
AUB	7	133.7142857	6.3170216	123.0000000	142.0000000
BBH	7	131.2857143	6.7259271	126.0000000	142.0000000
BNL	7	105.1428571	3.7161168	100.0000000	111.0000000
FRC	7	110.4285714	6.1334369	104.0000000	119.0000000
FRS	7	23.0000000	2.3094011	19.0000000	25.0000000
PAC	7	108.4285714	7.7428923	98.0000000	118.0000000
PAS	7	22.0000000	3.2145503	18.0000000	26.0000000
OCC	7	98.0000000	1.4142136	96.0000000	100.0000000
OCS	7	32.8571429	3.0237158	28.0000000	37.0000000
FOL	7	35.5714286	3.0472470	32.0000000	40.0000000
FOB	7	31.0000000	3.2659863	26.0000000	35.0000000
BPL	7	101.5714286	2.9358215	97.0000000	105.0000000
M48	7	71.4285714	1.9880596	68.0000000	74.0000000
NPH	7	67.5714286	1.7182494	65.0000000	70.0000000
FMB	7	101.2857143	3.1471832	98.0000000	107.0000000
NAS	7	18.8571429	2.7342623	16.0000000	22.0000000
DKB	7	22.8571429	3.1320159	19.0000000	28.0000000
OBH	7	35.7142857	2.2886885	31.0000000	38.0000000
OBB	7	41.2857143	2.1380899	38.0000000	44.0000000
ZYB	7	144.0000000	6.6583281	135.0000000	151.0000000
NLH	7	55.0000000	2.5819889	51.0000000	59.0000000
NLB	7	27.1428571	1.2149858	25.0000000	28.0000000
ZMB	7	105.1428571	2.4784788	102.0000000	110.0000000
ZMS	7	25.4285714	4.1173269	20.0000000	31.0000000
MAL	7	53.5714286	4.2761799	46.0000000	58.0000000
MAB	7	65.7142857	3.3022359	62.0000000	70.0000000
EKB	7	101.8571429	3.8483144	98.0000000	108.0000000

Sonota - females

Variable	N	Mean	Std Dev	Minimum	Maximum
GOL	5	181.0000000	1.2247449	180.0000000	183.0000000
XCB	5	139.8000000	5.9749477	132.0000000	145.0000000
WFB	5	90.0000000	5.1478151	81.0000000	94.0000000
XFB	5	110.8000000	4.6043458	105.0000000	117.0000000
STB	5	103.2000000	7.3620649	95.0000000	113.0000000
ASB	5	110.0000000	5.0990195	104.0000000	117.0000000
AUB	5	129.2000000	6.7230945	122.0000000	140.0000000
BBH	5	129.2000000	3.0331502	126.0000000	134.0000000
BNL	5	99.2000000	5.0199602	92.0000000	104.0000000
FRC	5	106.6000000	5.0299105	101.0000000	114.0000000
FRS	5	22.2000000	2.3874673	19.0000000	25.0000000
PAC	5	106.4000000	7.3348483	97.0000000	116.0000000
PAS	5	22.0000000	2.4494897	20.0000000	26.0000000
OCC	5	94.4000000	1.5165751	92.0000000	96.0000000
OCS	5	29.4000000	1.1401754	28.0000000	31.0000000
FOL	5	35.4000000	1.3416408	34.0000000	37.0000000
FOB	5	29.0000000	2.1213203	27.0000000	32.0000000
BPL	5	99.2000000	5.0199602	91.0000000	103.0000000
M48	5	68.0000000	3.5355339	64.0000000	72.0000000
NPH	5	64.0000000	3.3166248	59.0000000	67.0000000
FMB	5	97.2000000	3.4928498	94.0000000	103.0000000
NAS	5	18.4000000	2.6076810	15.0000000	21.0000000
DKB	5	21.6000000	1.8165902	20.0000000	24.0000000
OBH	5	35.4000000	1.1401754	34.0000000	37.0000000
OBB	5	39.8000000	1.3038405	38.0000000	41.0000000
ZYB	5	137.2000000	8.4083292	127.0000000	147.0000000
NLH	5	53.0000000	3.3911650	47.0000000	55.0000000
NLB	5	25.8000000	1.9235384	23.0000000	28.0000000
ZMB	5	99.0000000	7.3484692	90.0000000	109.0000000
ZMS	5	24.6000000	2.0736441	23.0000000	28.0000000
MAL	5	51.4000000	2.6076810	48.0000000	54.0000000
MAB	5	63.4000000	3.3615473	60.0000000	67.0000000
EKB	5	98.4000000	2.7928480	96.0000000	103.0000000

APPENDIX D

RUNS CONDUCTED

APPENDIX D

RUNS CONDUCTED

RUN #	PROGRAM	GROUPS	DATA	SEX
1.1	PRIN COMP	ALL	CR	BOTH
1.2	PRIN COMP	ALL	CR	MALES
1.3	PRIN COMP	ALL	CR	FEMALES
2.1	PRIN COMP	A,B,D,E,F	CR	BOTH
2.2	PRIN COMP	A,B,D,E,F	CR	MALES
2.3	PRIN COMP	A,B,D,E,F	CR	FEMALES
3.1	PRIN COMP	A,B,D,E,F G,X,Y,Z	CR	BOTH
3.2	PRIN COMP	A,B,D,E,F G,X,Y,Z	CR	MALES
3.3	PRIN COMP	A,B,D,E,F G,X,Y,Z	CR	FEMALES
4.1	PRIN COMP	A,B,D,E,F I,J,K,L,M	CR	BOTH
4.2	PRIN COMP	A,B,D,E,F I,J,K,L,M	CR	MALES
4.3	PRIN COMP	A,B,D,E,F I,J,K,L,M	CR	FEMALES
5.1	PRIN COMP	ALL	TO	BOTH
5.2	PRIN COMP	ALL	TO	MALES
5.3	PRIN COMP	ALL	TO	FEMALES
6.1	PRIN COMP	A,B,D,E,F	TO	BOTH
6.2	PRIN COMP	A,B,D,E,F	TO	MALES
6.3	PRIN COMP	A,B,D,E,F	TO	FEMALES
7.1	PRIN COMP	A,B,D,E,F G,X,Y,Z	TO	BOTH
7.2	PRIN COMP	A,B,D,E,F G,X,Y,Z	TO	MALES
7.3	PRIN COMP	A,B,D,E,F G,X,Y,Z	TO	FEMALES
8.1	PRIN COMP	A,B,D,E,F I,J,K,L,M	TO	BOTH
8.2	PRIN COMP	A,B,D,E,F I,J,K,L,M	TO	MALES
8.3	PRIN COMP	A,B,D,E,F I,J,K,L,M	TO	FEMALES
9.1	CAN DISC	ALL	CR	BOTH
9.2	CAN DISC	ALL	CR	MALES
9.3	CAN DISC	ALL	CR	FEMALES
10.1	CAN DISC	A,B,D,E,F	CR	BOTH
10.2	CAN DISC	A,B,D,E,F	CR	MALES
10.3	CAN DISC	A,B,D,E,F	CR	FEMALES
11.1	CAN DISC	A,B,D,E,F G,X,Y,Z	CR	BOTH
11.2	CAN DISC	A,B,D,E,F	CR	MALES

		G,X,Y,Z		
11.3	CAN DISC	A,B,D,E,F	CR	FEMALES
		G,X,Y,Z		
12.1	CAN DISC	A,B,D,E,F	CR	BOTH
		I,J,K,L,M		
12.2	CAN DISC	A,B,D,E,F	CR	MALES
		I,J,K,L,M		
12.3	CAN DISC	A,B,D,E,F	CR	FEMALES
		I,J,K,L,M		
13.1	CAN DISC	ALL	TO	BOTH
13.2	CAN DISC	ALL	TO	MALES
13.3	CAN DISC	ALL	TO	FEMALES
14.1	CAN DISC	A,B,D,E,F	TO	BOTH
14.2	CAN DISC	A,B,D,E,F	TO	MALES
14.3	CAN DISC	A,B,D,E,F	TO	FEMALES
15.1	CAN DISC	A,B,D,E,F	TO	BOTH
		G,X,Y,Z		
15.2	CAN DISC	A,B,D,E,F	TO	MALES
		G,X,Y,Z		
15.3	CAN DISC	A,B,D,E,F	TO	FEMALES
		G,X,Y,Z		
16.1	CAN DISC	A,B,D,E,F	TO	BOTH
		I,J,K,L,M		
16.2	CAN DISC	A,B,D,E,F	TO	MALES
		I,J,K,L,M		
16.3	CAN DISC	A,B,D,E,F	TO	FEMALES
		I,J,K,L,M		
17.1	CAN DISC	ALL	CR	BOTH
17.2	CAN DISC	ALL	CR	MALES
17.3	CAN DISC	ALL	CR	FEMALES
18.1	CAN DISC	A,B,D,E,F	CR	BOTH
18.2	CAN DISC	A,B,D,E,F	CR	MALES
18.3	CAN DISC	A,B,D,E,F	CR	FEMALES
19.1	CAN DISC	A,B,D,E,F	CR	BOTH
		G,X,Y,9		
19.2	CAN DISC	A,B,D,E,F	CR	MALES
		G,X,Y,Z		
19.3	CAN DISC	A,B,D,E,F	CR	FEMALES
		G,X,Y,Z		
20.1	CAN DISC	A,B,D,E,F	CR	BOTH
		I,J,K,L,M		
20.2	CAN DISC	A,B,D,E,F	CR	MALES
		I,J,K,L,M		
20.3	CAN DISC	A,B,D,E,F	CR	FEMALES
		I,J,K,L,M		
21.1	CAN DISC	ALL	CR	BOTH
21.2	CAN DISC	ALL	CR	MALES
21.3	CAN DISC	ALL	CR	FEMALES
22.1	CAN DISC	A,B,D,E,F	CR	BOTH
22.2	CAN DISC	A,B,D,E,F	CR	MALES
22.3	CAN DISC	A,B,D,E,F	CR	FEMALES
23.1	CAN DISC	A,B,D,E,F	CR	BOTH
		G,X,Y,Z		
23.2	CAN DISC	A,B,D,E,F	CR	MALES

		G,X,Y,Z		
23.3	CAN DISC	A,B,D,E,F G,X,Y,Z	CR	FEMALES
24.1	CAN DISC	A,B,D,E,F I,J,K,L,M	CR	BOTH
24.2	CAN DISC	A,B,D,E,F I,J,K,L,M	CR	MALES
24.3	CAN DISC	A,B,D,E,F I,J,K,L,M	CR	FEMALES
25.1	CAN DISC	A,B,E,F	CR	BOTH
25.2	CAN DISC	A,B,E,F	CR	MALES
25.3	CAN DISC	A,B,E,F	CR	FEMALES
26.1	CAN DISC	A,B,E,F	CR	BOTH
26.2	CAN DISC	A,B,E,F	CR	MALES
26.3	CAN DISC	A,B,E,F	CR	FEMALES
27.1	CAN DISC	A,B,E,F G,X,Y,Z	CR	BOTH
27.2	CAN DISC	A,B,E,F G,X,Y,Z	CR	MALES
27.3	CAN DISC	A,B,E,F G,X,Y,Z	CR	FEMALES
28.1	CAN DISC	A,B,E,F I,J,K,L,M	CR	BOTH
28.2	CAN DISC	A,B,E,F I,J,K,L,M	CR	MALES
28.3	CAN DISC	A,B,E,F I,J,K,L,M	CR	FEMALES
29.1	CAN DISC	ALL (R)	CR	BOTH
29.2	CAN DISC	ALL (R)	CR	MALES
29.3	CAN DISC	ALL (R)	CR	FEMALES
30.1	CAN DISC	A,B,R,E,F,D	CR	BOTH
30.2	CAN DISC	A,B,R,E,F,D	CR	MALES
30.3	CAN DISC	A,B,R,E,F,D	CR	FEMALES
31.1	CAN DISC	A,B,R,E,F G,X,Y,Z,D	CR	BOTH
31.2	CAN DISC	A,B,R,E,F G,X,Y,Z,D	CR	MALES
31.3	CAN DISC	A,B,R,E,F G,X,Y,Z,D	CR	FEMALES
32.1	CAN DISC	A,B,R,E,F I,J,K,L,M,D	CR	BOTH
32.2	CAN DISC	A,B,R,E,F I,J,K,L,M,D	CR	MALES
32.3	CAN DISC	A,B,R,E,F I,J,K,L,M,D	CR	FEMALES
33.1	CAN DISC	ALL (S)	CR	BOTH
33.2	CAN DISC	ALL (S)	CR	MALES
33.3	CAN DISC	ALL (S)	CR	FEMALES
34.1	CAN DISC	A,B,D,E,F,S	CR	BOTH
34.2	CAN DISC	A,B,D,E,F,S	CR	MALES
34.3	CAN DISC	A,B,D,E,F,S	CR	FEMALES
35.1	CAN DISC	A,B,D,E,F, G,X,Y,Z,S	CR	BOTH
35.2	CAN DISC	A,B,D,E,F	CR	MALES

		G,X,Y,Z,S		
35.3	CAN DISC	A,B,D,E,F G,X,Y,Z,S	CR	FEMALES
36.1	CAN DISC	A,B,D,E,F I,J,K,L,M,S	CR	BOTH
36.2	CAN DISC	A,B,D,E,F I,J,K,L,M,S	CR	MALES
36.3	CAN DISC	A,B,D,E,F I,J,K,L,M,S	CR	FEMALES
37.1	CAN DISC	ALL (T,U)	CR	BOTH
37.2	CAN DISC	ALL (T,U)	CR	MALES
37.3	CAN DISC	ALL (T,U)	CR	FEMALES
38.1	CAN DISC	A,B,D,E,F T,U	CR	BOTH
38.2	CAN DISC	A,B,D,E,F T,U	CR	MALES
38.3	CAN DISC	A,B,D,E,F T,U	CR	FEMALES
39.1	CAN DISC	A,B,D,E,F, G,X,Y,Z, T,U	CR	BOTH
39.2	CAN DISC	A,B,D,E,F G,X,Y,Z, T,U	CR	MALES
39.3	CAN DISC	A,B,D,E,F G,X,Y,Z, T,U	CR	FEMALES
40.1	CAN DISC	A,B,D,E,F I,J,K,L,M, T,U	CR	BOTH
40.2	CAN DISC	A,B,D,E,F I,J,K,L,M, T,U	CR	MALES
40.3	CAN DISC	A,B,D,E,F I,J,K,L,M, T,U	CR	FEMALES

A=NORMAN **B**=INTERLAKE **D**=WESTMAN **E**=RED RIVER
F=EASTMAN **G**=HUNGRY HALL **I**=SIOUX **J**=SONOTA
K=S. ARVILLA **L**=MANDAN **M**=DLS **Q**=CAUCASIAN
X=N. ARVILLA **Y**=BLACKDUCK **Z**=LAUREL

CR=CRANIAL (VAULT) DATA **TO**=TOTAL DATA

APPENDIX E

MISSING VALUES ESTIMATED BY CASE

APPENDIX E

MISSING VALUES ESTIMATED BY CASE

ANTLER CREEK-1	BPL								
ELLIS ELLIOT	BPL	M48	ZMB	ZMS	PAB	PAL			
FIDLER-12	BBH	BNL	FOL	FOB	BPL				
FIDLER-16	AUB	BBH	BNL	BPL					
FIDLER-19	BPL								
FIDLER-21	FOL	FOB	BPL	M50	DKB	MAL			
HDM-31-2	GOL	ASB	AUB	FOL	M48				
HDM-36-2	GOL	OCC	OCS						
HDM-37-1	FOB								
HDM-39-6	BPL	FOB	FOL						
HILTON-B	AUB	BPL							
LOCKPORT	AUB	BBH	BNL	BPL	M50	MAL			
KILLARNEY	WFB	STB							
RM DALY	GOL	XCB	AUB	FRC	DKB	ZYB			
SELKIRK	AUB	BPL	FOB						
SIMS 4	OCC	OCS	BPL	FOL					
SIMS-8	FOL								
SOURISFORD-2	AUB	BBH	BNL	FOB	BNL	ZYB			
STARBUCK	BBH	BNL	BPL	FOL	FOB	DKB	OBB	ZMB	ZMS
STAR MOUND-1	GOL	BBH	BNL	BPL					
STAR MOUND-6	BBH	BNL	OCC	OCS					
STOTT-2	FOL								
VICKERS 1108	BBH	BNL	FOL	FOB	BPL				
WARNER-11	GOL	OCS							
WARNER MOUND-2	GOL	BBH	BNL	BPL	FOL				
SKOWNAN-2	FOB	BPL							
CROSS LAKE	STB	AUB	BNL	FOL	FOB				
MANHATTAN IS.	AUB	M48	M50	DKB	PAB	PAL			
THE PAS	BBH	BNL	FOL	FOB					
BURNTWOOD	BPL	M48	M50	DKB	PAB	PAL			
NELSON HOUSE	BPL								
KENVILLE	AUB	BPL							
BIRCHTREE	FOL	FOB	BPL						
ERICSDALE-2	FOL	FOB	BPL						
HDM-41-7	FOL	FOB							
KEESEEK.	AUB	FOL	FOB	BPL					
HHM-S26	WFB	OCS	NAS	M50	OBB	ZMB	ZMS		
HHM-S30	FOL								
HHM-S31	BBH	BNL	OCC	OCS	M50	ZYB	EKB		
HHM-S34	OCC	OCS	FOL	FOB					
HUNGRY HALL-96	BBH	BNL	OCC	OCS					
HUNGRY HALL-93	MAL	PAB	PAL						
HHM-S12	ASB	AUB	BBH	FOL	FOB	ZYB	ZMS		
HHM-S34	OCC	OCS	FOL	FOB					
HHM-S23	BPL	MAL	MAB	PAB	PAL	ZMS			
HHM-S10	WFB	PAS	FRS	XFB	STB	M48	NPL	NAS	M50
HHM-S16	OCS	BPL	GOL	XCB					
CADDY LAKE-1	WFB	BPL							
EAGLENEST	AUB	FOB	BPL						

WHITEMOUTH	AUB	FOB						
BJORKLUND	AUB	FOB						
MINAKII	AUB	FOB						
FA3-409	STB	BPL						
WHALEY-2	WFB	STB	BPL					
WHALEY-F2-I1	FOB	BBH	BNL	FOL				
EGLA-10	AUB	BPL						
CEMETERY POINT	BPL	M50	MAL					
WHALEY-1	AUB	XCB	STB	FOL	FOB			
SLA-F2-I1	AUB	BBH	BNL	FOL	FOB			
WHA-F1-I1	FOB	BPL						
A-13-23	XFB	STB	BPL					
CADDY LAKE-2	XFB	STB	PAS	FMB	NAS	ZYB	ZMB	ZMS
K&J	AUB	BPL						
RIVERMOUTH-1	AUB	BBH	BNL	M48	M50	DKB	ZMS	
CEM POINT 1993	FOL	ZMB	ZMS					
SOURISFORD-1	NAS	M50	DKB	NLH	NLB			
HDM-31-19	FMB	NAS	MAL	MAB	PAB			
HDM-47-156	ZYB							
S5-HK-1278	ZMS	MAL						
KILLARNEY-0	FMB	NAS	DKB	ZMB	ZMS			
HDM-30-3	M48							
RESTON	ZMB	ZMS	MAL	MAB	EKB			
BEAUSEJOUR	DKB	ZYB						
FA3-412	DKB							
FA3-410	DKB							
FA3-411	DKB							
NUTIMIK	DKB							
FA3-101	DKB							