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A PREDICTIVE MODEL FOR SITE LOCATION IN THE ALBERTA FOOTHILLS

by

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ABSTRACT

In response to imminent annexation, 44 km^2 of the lower Simons Valley was subjected to foot survey. The resulting data were used to develop a predictive model for foothills site location, using physiographic zones as the independent variable. Statistical testing shows that the size of the site is related to the physiographic zone it occupies. For habitation sites, it is hypothesized that this variation in size and placement reflects summer and winter occupations, with large summer-winter sites located on low river terraces and congregating in the southern (sheltered) portion of the survey area, while smaller summer sites are spread throughout the survey area. Although no significant relationship was discovered between site type, site size, and the distance of the site from permanent water, the density of the total number of sites was related to this variable.

INTRODUCTION

The Beddington Creek survey was undertaken in response to imminent annexation of a large portion of the lower Simons Valley by the City of Calgary. The survey area is situated at the eastern margin of the foothills belt of the Rocky Mountains, where that belt contacts the third prairie level (Williams and Dyer 1930). Within the prairie section of the province this belt is approximately 80 km wide by 320 km long, trending NW to SE. The total area covered by foothills is approximately 256,000 km^2.

The survey covered a total of 44.0 km^2, of which 17 km^2 have since been annexed (Fig. 1). Although the annexed area has no proposed development for at least ten years, it was thought necessary to gain an idea of the archaeological resources present, so that proper mitigation procedures could be undertaken. To meet this objective, a corridor approximately 14.5 km long by 3.0 km wide, centered on Beddington Creek, was subjected to a 100% foot survey. Approximately 12 passes per section were made, an average of one pass every 130 meters. In addition to these passes, high potential areas, such as secondary stream valleys, were walked over their entire length. The resulting data set provides an excellent opportunity for the development of a predictive model for foothills site location.

It can be posited that the location of sites within a specific area is determined, to a great

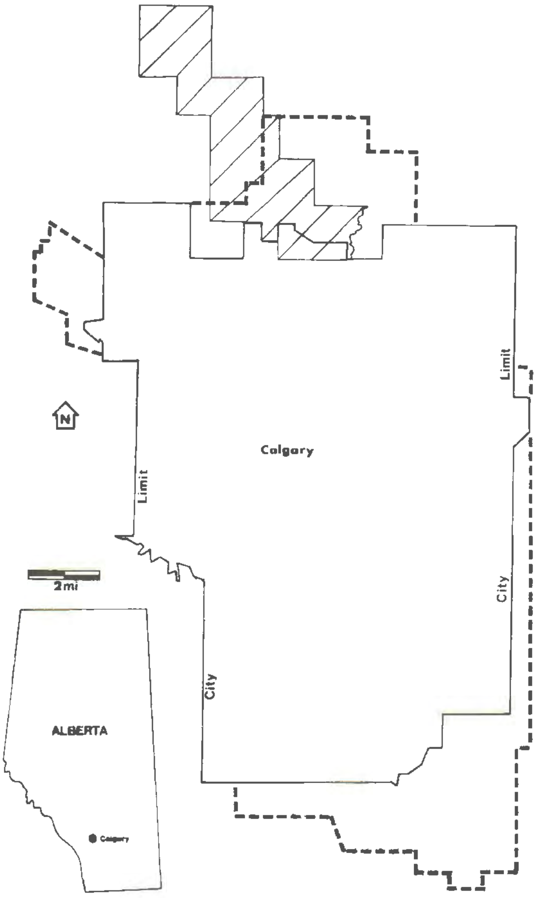

Fig. 1. Map showing the relation of the Beddington Creek survey area (hatched) to proposed annexation areas by the City of Calgary (dashed lines) Base map from City of Calgary Planning Department (1977).

degree, by their relationship with certain physiographic features present within the landscape, rather than with reference to problems of resource procurement. Although these problems are undeniably important, they assume secondary importance in an area such as the Northern Plains, where the major procurement activities of the aboriginal inhabitants were focused upon the acquisition of bison. The reason for this single resource focus is clear, given the estimate of 40 to 60 million bison on the Great Plains during historic times (Reher 1977:29). Archaeological evidence also indicates the incidental use of mule deer, whitetail deer, elk, moose, and pronghorn antelope, all of which are known to have been present in the Calgary area during historic times (Wilson 1973).

VEGETATION

Modern farming practices have resulted in the disturbance of large portions of the survey area and in the widespread introduction of nonlocal plant species. However, enough of the native vegetation remains intact so as to allow for a general reconstruction of the vegetational distribution. Within the survey area, vegetation is dominated by a mixed grassland, composed of short (15-45 cm) and mid (60-120 cm) height grasses. This grassland falls within two types: the Short Grass Prairie, containing Blue Grass, June Grass, and sedges; and the Fescue Prairie, with Rough Fescue, Blue Grass, Stipa, and June Grass. Maturation dates for these grass species range from early May to mid-July. However, the degree of overlap in separate species ranges indicates that both of the grassland types will have grasses simultaneously available for animal consumption. Since all of these grass species maintain high protein to carbohydrate ratios after drying on the stem, neither of the two types would present a more attractive source of summer/fall forage than the other.

Two other minor vegetation associations are also present. The first of these is a shrub-grassland association, which is found on moister north and east facing slopes that are sheltered from the west wind. This community is composed of thickets of Saskatoon berry, Buffalo berry, Buckbrush, Willow, and Wilverberry, which are interspersed with grassland. The second is an Aspen-Willow community, which is found on the north facing slopes of deep coulees, where sufficient moisture is available (Carma Developers Ltd. 1977).

The Coulee System south of Beddington Creek is the only major physiographic category not dominated by grassland. Within this coulee system, the coulee walls tend to be vegetated by a shrub-grassland association, with Aspen-Willow thickets appearing in the steeper walled upper sections of the coulees. All other physiographic zones are dominated by grassland, with the occurrence of isolated shrub-grassland thickets on appropriate slopes. These minor associations, while not arealy extensive, did provide important resources to the native inhabitants. Several of the shrubs yielded berries which were heavily used as a secondary food source, while Aspen was a primary source of firewood (Johnston 1969). However, distributional evidence as it has been reconstructed indicates that the possible biasing effects that consideration of these economic factors would have had upon the choice of site location would have been minimal. The shrub-grassland association is known to have existed throughout the survey area. Although detailed distributional information is not available, any areas of concentration other than on coulee walls is unlikely. The Aspen-Willow association is confined exclusively to the coulee system, and is, therefore, concentrated largely in the southwest portion of the survey area (Fig. 2). The probable interaction of these vegetation distribution patterns with physiographic variables will be addressed in more detail in the discussion.

From these vegetation distributional data, it can be seen that grazers (such as bison, elk, and antelope) would not be severely restricted in their ability to range throughout the survey area, while browsers (such as mule deer and white-tail deer) would be quite restricted, due to the limited extent of available habitat necessary for their survival. This generally unrestricted distribution of bison (the prime faunal resource) leads to the tentative hypothesis that bison kill sites will be situated in topographic situations that provide the greatest efficiency in acquisition of bison, but, since the prey animals are unrestricted in their distribution, these sites should be located throughout the survey area wherever suitable situations occur. It is further postulated that, for other site types, site location within the landscape in response to such variables as seasonal climatic variation and site function will assume primary importance.

SITE AND PHYSIOGRAPHIC DIVISIONS

The Beddington Creek survey resulted in the location of a total of 75 sites which can be grouped into three functional categories. These are:

1) habitation sites, including buried deposits, surface scatters, and tipi rings (Fig. 3);
2) kill sites, characterized by a definable bone bed (Fig. 4); and
3) cairns and rock alignments, including isolated rock cairns or groups of cairns, and those linear and/or geometric rock alignments that are not associated with tipi rings (Fig. 5).

Altogether, 56 habitation sites, 8 kill sites, and 11 cairns and rock alignments were located.

Physiographic features as defined by Adams (1976) will be used in this study. These

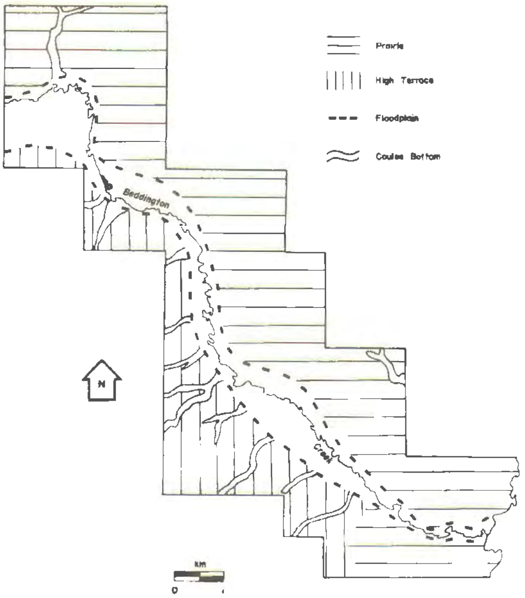

Fig. 2. Distribution of major physiographic zones within the survey area.

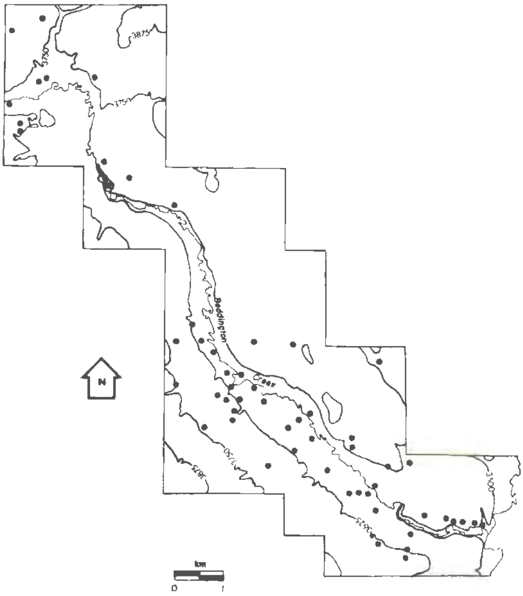

Fig. 3. The distribution of habitation sites located during survey. Contour intervals in feet.

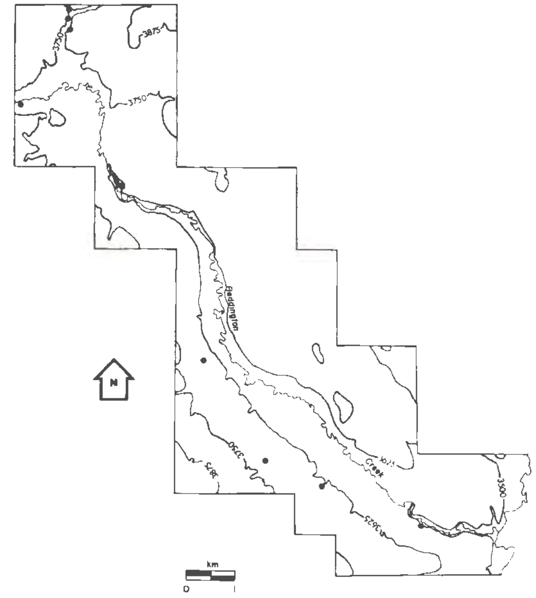

Fig. 4. The distribution of kill sites located during survey. Contour intervals in feet.

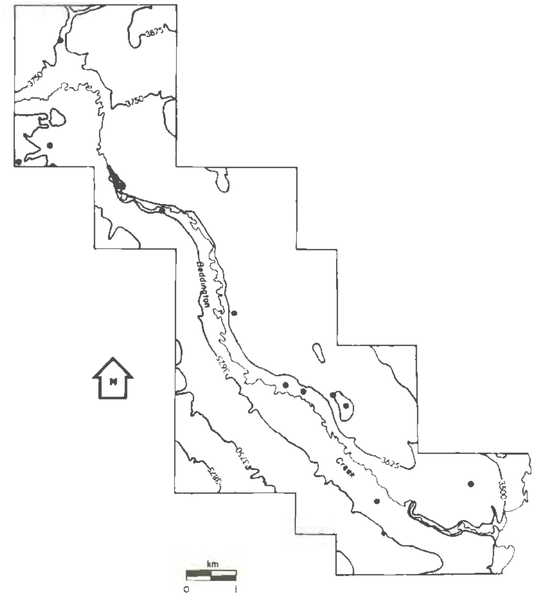

Fig. 5. The distribution of cairns and rock alignments located during survey. Contour intervals in feet.

features can be divided into four broad physiographic zones:

1) Prairie, including prairie level, rim of bluff, and coulee rim;
2) Coulee Bottom, including main coulee, transverse coulee, and drainage cut;
3) High Terrace; and
4) Floodplain, including both floodplain and low terrace.

PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The distribution of the four main physiographic zones can be seen in Figure 2. Coulees are concentrated on the south side of Beddington Creek, where the land rises toward Nose Hill, which reaches a maximum elevation of 1257 meters to the southwest of the survey area. The high terrace system is located in the same area and is the result of downcutting by a proglacial stream which formed Simons Valley. The areas of prairie are composed of a silty sand ground moraine known as Balzac Till. Ground relief is moderate, generally less than 60 meters. The floodplain is composed of alluvium derived from Beddington Creek, and alluvial fans and aprons building out from the coulee mouths (Carma Developers Ltd. 1977). Although not indicated in the figure, sandstone of the Porcupine Hills Formation (Carrigy 1970) outcrops along most of the northeastern rim of Simons Valley. These outcrops vary between 3 meters and 7.5 meters in height and greatly restrict access to the Beddington Creek floodplain from north and east.

CLIMATE

Climate and weather strongly influenced human settlement patterns in prehistoric and early historic times in the Calgary area. Long, often severe winters reduced people's mobility and made shelter a prime concern.

Climate in this region of the plains is a result of the interaction of three major air masses: the Mild Pacific which intrudes from the west, the Tropical Maritime to the south, and the Arctic to the north. Of the three, the most important is the Mild Pacific air mass, which dominates the plains during both summer and winter (Bryson 1966). Since this air mass is a warm/dry system, precipitation values on the plains are generally low. Most of the precipitation occurs when the Mild Pacific air is displaced by either the Arctic or the Tropical Maritime air masses.

Spring on the plains is a short event, sometimes lasting as few as two weeks. On the average, the snow cover in the Calgary area has disappeared by the end of March, although in sheltered areas it may linger on (Longley 1972). Temperatures in the spring rise rapidly from their winter values, and, by April, the mean daily temperature for Calgary is 2° C, with a mean range of 12° C. Precipitation values mirror the rising temperatures and also rise rapidly from their winter levels. In Calgary, total precipitation for the spring is approximately 114 mm.

The warmest period of the summer is from mid-June to mid-August. Frosts and snow flurries are common in areas over 1060 meters until mid-June and are possible again toward the end of August. Daily temperatures in Calgary average 17° C during July, the warmest month, with a mean range of 16° C. Precipitation values are normally greatest at this time of year, with a mean summer total of 203 mm.

Like spring, the autumn season is a period of rapid change on the plains. Even the warmest portions of the province are normally snow-covered by mid-November. Mean daily temperature at Calgary during October is 5° C, with a range of 15° C. Precipitation values decrease rapidly from the summer maximum and, during autumn, change in character from almost all rain in September to nearly completely snow by November. The mean precipitation value for autumn is 76 mm.

Winter in Calgary is approximately four months, which is the length of time the ground is covered by snow. This is somewhat shorter than is the case in areas farther to the east and is the result of chinook activity which can remove much or all of the snow cover, even during midwinter. However, if we disregard chinooks, whose effects, although important are temporary, winter on the plains is quite cold, due to the continental nature of the climate. Normally, a high pressure ridge will develop from the Gulf of Alaska to Hudson's Bay, resulting in light winds and clear skies. Heat loss from the ground through radiation causes a marked cooling of the surface. In Calgary, the mean daily temperature during January is -10° C. This mean daily range cannot be defined accurately, since topographic conditions have a great influence locally. In general, ranges vary from 9° C to 11° C. Precipitation values are quite low, with all the precipitation normally falling as snow. The mean precipitation value in Calgary during the winter is 76 mm.

RESULTS

Sites located in the Beddington Creek survey were coded for a number of variables, to examine their relationship with the physiographic features present in the survey area. The variables used were:

1) site type;
2) specific physiographic category associated;
3) distance to permanent water (in m); and
4) site area (in m²).

In addition to these four variables, visual examination of distance to water and site area data indicated that the sites were not distributed evenly with respect to these variables, but rather, had a clustered distribution. To further investigate this distribution, SAS procedure CLUSTER was used. This is a hierarchical, single-link cluster analysis program, where each higher level is constructed by a fusion between the closest pair of unlinked units or clusters (Doran and Hodson 1975:176). The clusters are constructed using the algorithm presented in Johnson (1967). This algorithm has the advantage of being invariant under monotone transformations, which is considered to be an essential requirement for numerical clustering (Jardine and Sibson 1971). The SAS procedure also provides a measure of the ratio of distances within clusters and within the whole data set, that is one way to objectively determine an optimum number of clusters in the data (SAS Institute Inc. 1979:157-161). On separate runs for distance to water and site area, it was found that dividing the values for these two variables into three clusters each provided the best results. For distance to water, these clusters were:

1) a low cluster, composed of 61 sites, with an average distance of 205 m;
2) a middle cluster, composed of 10 sites, with an average distance of 961 m;
3) a high cluster, composed of four sites, with an average distance of 1600 m.

For site area the clusters were:

1) composed of 72 sites, with an average area of 13,238 m²;
2) composed of two sites, with an average area of 195,000 m²; and
3) a single site, having an area of 320,000 m².

Five hypotheses were developed for testing using the Beddington Creek data:

1) There is a relationship between the site type and the physiographic zone(s) these sites are associated with.
2) There is a relationship between the site size and the physiographic zone(s) these sites are associated with.
3) There is a relationship between the site type and the distance to permanent water.
4) There is a relationship between the site size and the distance to permanent water.
5) Habitation sites are not randomly distributed.

Hypothesis one was originally tested using SAS procedure FREQ to generate a cross-tabulation table and associated statistics to determine significance and strength of association. A $\underline{X}^2$ value of 51.726 (with 14 degrees of freedom) was determined, which is significant of the .01 level. Two strength of association measures were used, Cramer's V, and Goodman and Kruskal's Lambda. Both of these measures indicate a moderate strength of association, with V = .587 and Lambda = .316 (with site type dependant). However, the determination of a significant $\underline{X}^2$ value from this table is highly suspect, since more than 5% of the cells in the table have expected values of less than five. This will have the effect of decreasing the alpha level and making the results appear more significant than they actually are. Therefore, further testing by the use of binomial distribution was deemed advisable. It was possible to test the distribution of habitation sites and cairns and rock alignments. However, the sample of kill sites was too small for valid testing.

Binomial testing can be used to determine if the number of sites within a specific category varies significantly from a random distribution, and the degree of that significance (Steel and Torrie 1960:353-354). As used here, however, the multiple testing of data for different physiographic zones violates the assumption of independence since the sites cannot be redistributed between each test. This will also tend to deflate the alpha level and increase the significance of the results. To counteract this problem, tests were conducted with a more stringent alpha level of .01. Binomial confidence limits around the observed values for site distribution were calculated from the table presented in Steel and Torrie (1960:454-457). Using the distribution of habitation sites as an example, the expected frequency of sites in each specific physiographic zone was first found (under a null hypothesis of random distribution). Then the confidence limits around the observed frequency were calculated and the values of these limits compared to the expected frequency. A significant variability between the observed and expected values for site frequency existed when the expected value fell either above or below the confidence limits. Values for expected frequencies in each specific physiographic zone are calculated from the percentage of relative area of each zone within the survey area.

When the distributions of habitation sites were tested, nonrandom distributions of sites, significant at the .01 level, were found for the prairie rim, rim of bluffs, and low terrace (Table 1). Both the rim of bluff and low terrace were over-represented, while the prairie level was under-represented. Testing of the distribution of cairns and rock alignments did not yield any results that could not be explained as the result of a random distribution (Table 2). Although the distribution of kill sites could not be subjected to quantitative analysis (due to the small sample size), it should be noted that six of the eight located sites were situated in coulee bottoms.

Hypothesis two (a relationship between site size and the physiographic zone(s) the sites are associated with) was tested using SPSS subroutine NPAR TESTS, to generate a Kruskal-Wallis One-Way Analysis of Variance (Hull and Nie 1979). This is a nonparametric test which compares the sum of the rankings for each of the categories of a nominal scale variable. The computed statistic measures the degree to which the sums of ranks differ from the null hypothesis (Blalock 1960:349). While this test is not as powerful as a parametric ANOVA, it allows the directionality of the relationship to be examined, which ANOVA does not. The calculated $\underline{X}^2$ value of 14.630 is significant at the .05 level, indicating that there is a relationship between site size and physiographic zone. Examination of Table 3 shows that the physiographic zones can be ordered by site size into three groups. These are drainage cut and main coulee with small

Table 1. Binomial Testing of Habitation Sites by Specific Physiographic Zone.

Physiographic Zone	Observed[(a)] Frequency	99% CI	Expected Frequency
Prairie Level	9*	3.30-17.86	28.84
Rim of Bluff	8*	2.70-16.68	1.03
Coulee Rim	3	0.34-10.16	0.39
Main Coulee	0	0.00-5.02	1.76
Transverse Coulee	0	0.00-5.02	0.27
Drainage Cut	0	0.00-5.02	0.10
High Terrace	10	3.93-19.02	11.35
Floodplain	3	0.34-10.16	4.98
Low Terrace	23*	11.86-30.02	7.46

(a) Values marked with an asterisk (*) are significant at the .01 level.

sites; rim of bluffs, high terrace, and floodplain with intermediate size sites; and low terrace, prairie level, and coulee rim with large sites.

Hypothesis three (relationship between site type and distance to permanent water) was also tested by use of a Kruskal-Wallis One-Way ANOVA. It was found that the null hypothesis of no relationship could not be rejected in this case. The derived $\underline{X}^2$ value of 2.618 yielded a calculated significance level of .27. There does not appear to be any significant relationship between site type and distance to permanent water. However, there is an apparent relationship between the density of all sites and the distance to permanent water (Fig. 6). This relationship was tested by use of a Kolmogorov-Smirnov One-Sample Test (Blalock 1960:262-265). This test compares the difference between observed and expected cumulative proportions, with the null hypothesis being that these are independent random samples drawn from identical populations. This test is preferable to the $\underline{X}^2$ test, since it will provide an exact probability, even with small expected N values (Thomas 1976:336). The test statistic used is the maximum difference between the two cumulative distributions. If this difference is larger than expected under the null hypothesis, then the null hypothesis can be rejected. The scores for the Kolmogorov-Smirnov Test are shown in Table 4. The maximum difference of 0.374 exceeds the critical value of 0.188 (alpha = .01), and the null hypothesis can be rejected. There is a significant relationship between total site density and the distance to permanent water.

Hypothesis four (relationship between site size and the distance to permanent water) was tested using SPSS subroutine SCATTERGRAM (Nie et al. 1975), which plots a scattergram of designated values and calculates the Pearson Product-Moment Coefficient and its significance for the bivariate relationship. A significance of .791 was calculated, indicating that the null hypothesis cannot be rejected. There does not appear to

Table 2. Binomial Testing of Cairns and Rock Alignments by Specific Physiographic Zone.

Physiographic Zone	Observed Frequency	99% CI	Expected Frequency
Prairie Level	2	0.11-6.48	5.63
Rim of Bluff	2	0.11-6.48	0.20
Coulee Rim	0	0.00-4.11	0.08
Main Coulee	1	0.005-5.44	0.34
Transverse Coulee	0	0.00-4.11	0.05
Drainage Cut	0	0.00-4.11	0.02
High Terrace	1	0.005-5.44	2.23
Floodplain	2	0.11-6.48	0.98
Low Terrace	3	0.37-7.35	1.47

Table 3. Kruskal-Wallis One-Way ANOVA.

Physiographic Zone	Number of Sites	Mean(a) Size Rank
Drainage Cut	1	12.50
Main Coulee	6	12.50
Floodplain	5	29.90
Rim of Bluff	10	33.70
High Terrace	11	36.50
Low Terrace	28	43.20
Prairie Level	11	47.18
Coulee Rim	3	48.67

(a) An increasing value for mean size rank indicates an increase in site size within the class.

be a significant relationship between site size and distance to permanent water.

Hypothesis five (a nonrandom distribution of habitation sites in the survey area) was tested by the use of Nearest-Neighbour Analysis. This test measures the distance between points on a plane surface and compares the ratio of observed mean distance to random mean distance to determine if the distribution shown by the data points is clustered, random, or dispersed. Using the formulae published by Pinder et al. (1979), which are designed to correct for edge effect, a nearest-neighbour statistic of .854 was calculated. Such a value could be computed on a sample of this size, drawn from a truly randomly-located population of sites, less than 5% of the time. This result indicates that habitation sites have a significantly clustered distribution, and confirms the visual impression (see Fig. 3).

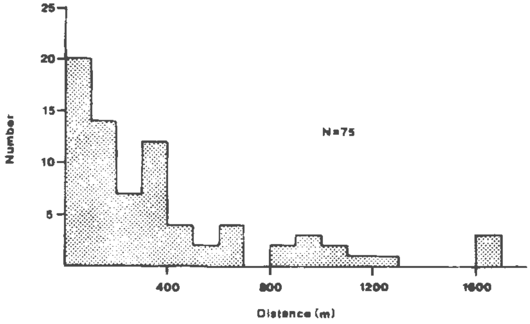

Fig. 6. Histogram of site density versus distance from permanent water.

DISCUSSION

A model may be defined as "a representation of an object, system, or an idea in some form other than that of the entity itself" (Shannon 1975:4). This definition implies that some degree of abstraction will exist in any model and, in most real world situations, the complexity is so great and the range of possible variables so large, that the amount of abstraction is high. However, if correctly constructed, the model will provide a useful approximation of the real situation. Also implied in the definition is that there is no single "correct" model for any situation. Indeed, there are as many possible models as there are combinations of variables, and the selection of the type of model used depends on the data available and the types of questions that the researcher wished to address using the data.

A second consideration in model develop-

Table 4. Results of Kolmogorov-Smirnov One-Sample Test.

Distance Class (m)	Frequency	Cumulative Frequency	Cumulative Proportion	Expected Proportion	Difference
0-200	34	34	0.453	0.180	0.273
201-400	19	53	0.707	0.333	0.374
401-600	6	59	0.787	0.481	0.306
601-800	4	63	0.840	0.604	0.236
801-1000	5	68	0.907	0.708	0.199
1001-1200	3	71	0.947	0.796	0.151
1201-1400	1	72	0.960	0.865	0.095
1401-1600	0	72	0.960	0.917	0.043
1601-1800	3	75	1.00	0.954	0.046
1801-2000	0	75	1.00	0.977	0.023
2001-2200	0	75	1.00	0.994	0.006
2201-2400	0	75	1.00	0.999	0.001
2401-2600	0	75	1.00	1.00	0.00

for $N = 75$, critical limit $= \frac{1.63}{\sqrt{75}} = 0.188$ (alpha = .01) ment is the degree of simplification which should be involved. A model should only be as complex as is required to address research objectives (Gullahorn and Gullahorn 1972: 184). If needed, the complexity of the model can be increased at a later date to provide a more precise approximation of the observed phenomena. Models which are initially overly complex can be as hard to interpret as the system that prompted the development of the model (Zubrow 1976), clearly a self-defeating course.

The steps of model identification and variable selection constitute the first two stages of model development, those of goals and analysis. The third step involves synthesis, where the structuring and implementation of the model is done. The fourth stage is system verification, which consists of the location and elimination of logical flaws within the structure of the model (Zimmerman 1977:23). After verification has been accomplished, validation of the model is undertaken. This is done by comparing the results predicted by the model with the actual system modeled, and noting the degree of correspondence between the two. At this stage the number and/or type of variables being used in the model can be modified, if it is thought necessary to increase the fit between the model and the system under examination.

For the model being developed here, system validation has not been attempted, since only a single data set is available for examination. To attempt validation of the model using the same data which was employed to construct the model would be a clear case of circular reasoning (Clarke 1972:41; LeBlanc 1973) and logically invalid. However, the model is developed to the point where validation using independent data sets can be accomplished.

Analysis of the data provided by the Beddington Creek survey shows that, of the five hypotheses originally proposed, it was possible to reject the null hypothesis for three of them. Site size appears to be related in some way with the physiographic zone the site occupies, and the distribution of habitation sites is significantly clustered. Also, for habitation sites, there is a significant nonrandom relationship between those sites and the specific physiographic zones the sites are located in.

If the preponderance of kill sites located in coulees is not the result of a location bias due to exposure by erosion, then there is a possibility that there is a relationship between kill sites and that particular physiographic zone. The requirements for a successful communal kill tend to support the relationship. Three things are generally considered necessary: (1) a gathering basin, where the animals will congregate;(2) an approach; and (3) a jump-off point. All of these requirements can be met at this locality where the floodplain of Beddington Creek, plus the surrounding prairie, can serve as gathering basins, while the coulees can serve either as jumps, or as natural traps up which the bison can be driven. Although the number of kill sites located was small, their presence throughout the survey area in what can be interpreted as appropriate topographic situations appears to support the tentative hypothesis that was suggested above.

Binominal testing shows that habitation sites are vastly over-represented on low terraces. This over-representation can perhaps be related to the use of low terraces as a preferred location for winter camps. Further support for this idea is provided by the distribution of sites of different sizes. Low terrace sites have the third highest average site size, exceeded only by prairie level and coulee rim, which are skewed toward a large average size by the presence of sites over 100,000 m² within those zones. The presence of these very large sites is an artifact of the limited access to the Beddington Creek floodplain from the north and east, and small sample within those zones. In areas where access to the floodplain is possible extremely large sites are found. These sites probably represented multiple occupations within a restricted area, caused by the funneling effect of the limited number of access points. Small sample size is particularly important for the coulee rim, where only three sites were located.

It may be reasonable to assume that, with the colder weather and snow, habitation sites would tend to be inhabited for longer periods of time than during periods when mobility was easier. Also, bison tended to congregate in areas of high chinook frequency (such as the Calgary area), and this increased density of a major resource would allow longer, larger, population aggregates. This should result in winter sites that are more extensive than summer ones. The clustered distribution of habitation sites also lends support to this idea, with the majority of sites located in the southern portion of the survey area where they are protected from winter winds by Nose Hill. Sites with smaller areas are distributed across the floodplain, rim of bluffs, and low terrace, as well as being present in the prairie level and coulee rim. If the above argument can be accepted, then these sites represent summer occupations. Vegetation resources (such as berries and firewood) may also have provided some attraction to the southern part of the survey area, since they are concentrated within the coulee system which dominates the southwest part of the area. However, these resources, since they are concentrated within an area that provides shelter from winter winds, are variables that covary positively with physiographic variables under consideration, and it is not possible at this time to assess their relative importance. This can only be done during testing and verification of the model.

While there was no significant relationship between site type and distance to permanent water, it was found that there is a relationship between total site density and the distance to permanent water.

The distribution of cairns and rock alignments are random in nature. Since cairns are constructed for a number of purposes (such as drive lines, trail markers, and monuments) and their destruction has been an essentially random event, this is a natural outcome. Significant association in the placement of cairns and rock alignments may be determined if an area that has not been intensively cultivated can be subjected to analysis.

The following general, predictive statements can be made for foothills site location, from the analysis of the Beddington Creek data:

(1) Summer habitation sites will be distributed fairly evenly across all physiographic zones, with the exception of coulee bottoms. The following test implications should identify these sites:
   i) the identification of seasonality of faunal remains will indicate a late spring to early fall occupation;
   ii) the faunal assemblage should be more diversified (include more species), due to the lower concentration of bison within the area during the summer and the relatively greater abundance of other faunal resources;
   iii) the density of artifactual remains should be low, due to the short term nature of the site occupation; and
   iv) the site should show little or no evidence for reoccupation (such as overlapping stone rings or rings that have been partially dismantled). Since physiographic factors exert little control over summer site location, the possible space that a site can be located in is relatively large, and the probability of two different occupations being located in the same spot is relatively low.

(2) Winter habitation sites will tend to congregate on low terraces, in areas that are protected from high winds. The following characteristics should distinguish these sites:
   i) the seasonality of the faunal material will indicate a late fall to early spring occupation;
   ii) the faunal assemblage should be composed almost exclusively of bison;
   iii) the density of artifactual remains, and the range of different types of artifacts, will be high, because of the longer term of occupancy; and
   iv) the site should show numerous signs of reoccupation, due to the limited area available that will satisfy the need of protection from the elements. In this case, the probability of two separate occupations being located in the same spot will be relatively high.

(3) Site density will increase with approach to permanent water sources.

In addition, the following negative statements can be made:

(4) In cultivated areas, cairns and rock alignments will be distributed at random.

(5) There is no significant relationship between site type or site area, and the distance of that site to permanent water.

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