THE UTILIZATION OF SPACE IN AN ISOTROPIC ENVIRONMENT: A PREDICTIVE MODEL OF BEACH USER BEHAVIOUR.

by

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ABSTRACT

A public beach served as the site for a study of the impact of increasing density on human spatial behaviour. This setting provided a unique environment where the range of observed densities was wide, user behaviour could be monitored unobtrusively, and where effects due to the social and physical environment were not confounded. The specific goals of the research were: 1) to test the hypothesis that beach users require a minimum amount of intergroup space and that such distances will be related to proper social functioning (cf. Edward T. Hall's proxemic zones), 2) demonstrate a relationship between the overall spatial pattern of beach users and density, and 3) relate individual personality dispositions, mood states and socio/demographic differences to observed respondent spatial behaviour.

Aerial photography was used to gather data concerning the spatial distribution of 1791 groups located on three public beaches or sunning areas. Coincidental psycho/demographic data were obtained by means of a paper and pencil survey for a subsample of 266 subjects located on the beaches during the 27 photographic sampling runs completed. A Monte Carlo simulation technique coupled with a 'distance to nearest neighbour' model were used to analyse the spatial pattern of beach users over the range of densities observed.

Results indicate that at densities less than 110 groups/hectare the observed spatial pattern does not differ significantly from random. At higher densities however, users tend to maximize the distance to near neighbours which results in a pattern statistically described as uniform. The average distance separating groups at densities greater than 110 groups/hectare approached a constant at 2.7 meters. This latter observation plus Hall's claim that such distances may be utilized to effectively screen or insulate persons from unwanted social interaction suggests that beach users adapt to increasing density by obtaining

just enough space to maintain the social integrity of the group.

Survey results using groups produced few significant correlations and stepwise regression analysis indicated characteristically low predictability of target spatial variables. Analysis of response patterns of lone individuals however, produced a substantial increase in the ability of selected independent variables to account for variance in dependent variables. For example, respondent nearest neighbour distance was predicted moderately well by six independent variables ($R^2 = .47$). Similarly, eight variables accounted for 57% of the variance in the dependent variable which measured the amount of space demarcated by a respondent's personal possessions. These results suggest that at lower densities beach users may choose sites in relation to other users which reflect individual preferences and since preferences are varied a random spatial pattern is observed. However, as space becomes limiting at higher densities such needs and desires may remain unfulfilled.

Finally, based on the above results maximum 'psychological carrying capacity' estimates were calculated and the implications for the planning and design professions discussed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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CHAPTER I

SPATIAL BEHAVIOUR AND THE REGULATION OF SOCIAL INTERACTION

Goals and Objectives

This study focuses on the problem of how users of public beach facilities respond spatially to increasing numbers of individuals in a shared space and how this response is associated with certain personality, socio-economic and demographic characteristics. More specifically the objectives of the study are:

- to develop a methodology for obtaining unobtrusive measures of beach user spatial and group behaviour.
- to describe the pattern or spatial distribution of users as a function of density.
- to determine the extent to which aspects of the physical environment surrounding the beach affect user spatial distribution.
- to delineate how users adapt to decreasing available space as density increases.
- to examine the extent to which personality and socio-economic characteristics could be used as predictors of spatial and group behaviour.

The above goals formed the basis for three general hypotheses and one corrollary which I wished to test. These will be discussed more fully in later sections, however for the present they may briefly be stated as:

1) As space becomes limiting at higher densities the distance between nearest neighbours will approach a minimum value the limit of which will be determined by cultural norms relating to the regulation of social interaction.

   a) Corrollary: The spatial pattern exhibited by beach users will be related to changes in user density.

2) The distances maintained between nearest neighbours will be some function of certain internal psychological dispositions.

3) Nearest neighbor distance will be related to user socio-economic and demographic characteristics.

Although the results of other analyses are also reported, these three hypotheses reflect the major objectives of the study.

These objectives relate to a broader theoretical perspective involving the ways in which space may be used as a regulating mechanism of social interaction. There are many ways in which social animals including man attempt to regulate the kind and intensity of social interaction, however as Kummer (1971) points out, the manipulation of space is the safest technique available. This statement is underlined since close physical proximity in many species carries an implied threat of aggression and such distances bring interactants within the range of whatever weapons are available. Many signals have evolved to counteract aggressive responses between members of a species since activities related to reproduction and social bonding would not be possible were there no mechanism available to counteract such aggressive behaviours. Tinbergen's (1952) now well known description of the zig-zag dance of the male stickleback is an often cited example of signalling devices which serve to inhibit agonistic responses while stimulating reproductive behaviours.

In man, space may still be viewed as an important component relating to regulation of social interaction, however, modern methods of communication complicate the issue. The telephone, newspaper, television, radio, etc., all serve to increase perceived social interaction. Distance, at least for these examples becomes meaningless.

The present research sought to examine some of the ways humans use space where the potential for social interaction increases dramatically. A public beach was chosen as a potentially useful environment in which to conduct the research since densities varied over a wide range and since perceived and actual density could be assumed to be similar if not the same. The rationale for the choice of a beach as a research setting plus issues and concepts relating to distance, crowding and space control will be discussed as they pertain to the study goals.

The beach as an isotropic environment.

Since most studies of spacing behaviour in humans have been conducted under laboratory conditions where the setting is often contrived, is of short duration, or has taken place in complex settings where effects due to the physical environment are not known, I chose a public beach as a site least likely to suffer from shortcomings such as these. A public beach represents a setting which is generally uniform and relatively free from 'artifactual constraints'. Based on the assumption that in such an environment effects due to the physical setting would be minimized I proposed that observed changes in behavioural patterns must result largely from social or interpersonal factors. Such 'free field' settings are referred to as 'isotropic'. An isotropic environment such as a beach thus has the advantage of allowing the investigator to examine behaviour relating to site selection, spacing, and group phenomena in isolation from physical setting effects. By controlling for these effects and by observing behaviour unobtrusively, I hoped to provide 'baseline' results concerning the ways in which people use space under conditions of varying density.

An example may illustrate the point I wish to make. In an uncrowded theater a patron could choose a seat which both satisfied his desired location with respect to the stage as well as his spatial preference vis a' vis other patrons. In contrast when densities are high, few alternatives remain and a choice of seats would require sitting within inches of another patron. Since the seats have been placed as they have by an 'authority', the arrangement acts as a sanction which allows the new arrival to, in effect, invade the 'personal space' of the person already in place. A beach without such constraints should thus provide a way of determining spatial preferences based solely on the internal needs of the individual. It is in this sense that the term 'baseline' is used.

Finally, two other advantages of using a beach as a source for the study of human spatial behaviour are important. First, the actual density of the beach as expressed as individuals or groups/unit area may be assumed to be the same as, or at least close to the density which users perceive. Rapoport (1975) emphasizes the importance of differentiating between perceived and actual density when one looks for effects due to density considerations. He argues that for many environments these two values may be quite different. Of course, methodologically it is far easier to accurately measure the actual number of people in an area than to pin down how many individuals a person believes are there. A beach setting avoids this problem since an individual can visually identify the number of people in the vicinity.

The final aspect of a beach which is important to a study of density effects is that an ethological approach may be used. Using this technique the behaviour of individuals and groups may be observed unobtrusively with little or no bias introduced by the investigator's presence. In this way, observed behaviour may be considered 'natural' for the setting involved and conclusions more easily translateable to everyday (real world) events.

Origin of concepts

Wilson (1975) reviews issues and concepts relating to spacing behaviour as it applies to social organisms and discusses six components of social spacing: 1)total range, 2) home range, 3) core area, 4) territory, 5) individual distance, and 6) dominance. These categories may be briefly summarized in the following manner:

Total range: the area traversed by an individual animal over its entire life cycle (Goin & Goin, 1962).

Home range: the area over which an animal habitually travels (Seton, 1909; Burt, 1962).

Core area: that area of heaviest useage within the home range (Kaufmann, 1962).

Territory: an area occupied more or less exclusively through means of overt defense or advertisement (Noble, 1939; Brown, 1964).

Individual distance: the minimum distance routinely kept between individuals of a species (Hediger, 1941, 1955; Conder, 1949).

Dominance: the assertion of one member of a group over another which gains the dominant individual increased access to resources such as food, water, sleeping sites, space, etc.

With respect to these concepts Wilson (1975) stresses that the behaviour of species in general show a continuously graded series with the boundaries of each of the above classifications becoming blurred and indistinct. The primary point is that variations occur within, as well as between species with each behavioural manifestation serving a distinct biological and/or social function. Thus, a bird may maintain a home range with respect to its feeding activities, a territory surrounding the nest site and individual distance and dominance characteristics within a flock. Other examples of this continuum relate to changes in breeding fluctuations and varying life cycle conditions each requiring different spatial strategies.

In recent years the concept of territoriality has been invoked to explain a variety of human behaviours, most notably Lorenz (1966) and Ardrey (1966). At least one study of beach user behaviour has utilized the territory concept for theoretical constructs (Edney and Jordan - Edney, 1974). Based upon the most commonly accepted definitions of what constitutes a territory this approach seems unwarranted. The point was made by Becker and Mayo (1971) that personal space and individual distance concepts were more appropriate than territory in defining the spacing behaviour of cafeteria patrons since in their study, subjects were not willing to defend the area denoted by their possessions. These authors concluded that individual distance concepts were more parsimonious in that they made fewer assumptions about the relative value of a space. For the

present study the concepts relating to individual distance seemed most closely to reflect the goals of the research as well as the observed behaviour of users.

Individual distance.

In studying the spatial behaviour of beach users, I was predominantly interested in the distances separating individuals and groups of individuals. Studies of spacing mechanisms of social animals have referred to two measures of intraspecific spacing: personal or individual distance and social distance (Hediger, 1941,1955; Conder, 1949). Personal distance refers to a minimum distance which individual animals routinely keep between themselves and others, whereas social distance relates to the distance beyond which an animal apparently experiences a strong attraction to return to its social group. These two concepts underline the dynamic quality of spacing in social animals. In his review of sociobiology, Wilson (1975) highlighted this dynamic characteristic by defining personal distance as "the compromise struck by animals that are both attracted to other members of their own species and repelled by them at short distances." (p. 257).

Much of the literature on social animals is concerned with interindividual spacing behaviour. However, a few studies have indicated that groups may act collectively in maintaining intergroup distances. For example, Blank and Ash (1956) showed that coveys of partridge (P. perdix), although exhibiting overlapping home ranges, normally remain separated by a certain minimum distance. Similarly, both individuals and groups of sandhill cranes (Grus canadensis) space themselves evenly with groups primarily composed of family units (Miller and Stephen, 1966). Other species exhibiting similar patterns are baboons (Hall and Devore, 1965), white-crowned sparrows (Zonotrichia leucophrys) (Blanchard and Erickson, 1949; Morton, 1967) and wintering flocks of juncos (J. hyemalis and J. oregamus) (Sabine, 1956).

Hall (1966) has studied the ways in which humans space themselves in a variety of social situations across several cultures. Hall suggests that for humans, personal distance is but one of four zones. Based on observations of behaviour patterns at various interpersonal distances Hall has termed the other three, 'intimate','social', and 'public'. Table 1 outlines these zones for North Americans and demonstrates the behaviours characteristic of each. Since these zones seem to have functional properties related to the type and form of social interaction permissable for North Americans, I will return to these ideas when discussing the testing of relevant hypotheses.

Table 1. Proxemic zones for North Americans. (from Hall, 1966)

TYPE OF ZONE	DISTANCES (meters)	CHARACTERISTIC BEHAVIOURS
Intimate	0-.46	bodily contact possible, eg. lovemaking, comforting, protecting, wrestling, etc.
Personal	.46-1.22	bodily contact possible at close phase; most encounters between friends and close associates occur in this range.
Social	1.22-3.66	social gatherings, impersonal business dealings, formal business and social events conducted at the far phase.
Public	3.66-7.62	behaviours which do not require interpersonal involvement occur within this range; public speakers and important people are often observed in this range.

Personal space.

To this point I have referred to the spatial characteristics of animals as a linear distance. Excluding territoriality, evidence exists which indicates that members of social species maintain an area or volume around themselves which is relatively exclusive of others. McBride (1964) has studied this phenomenon in various species and terms it a 'social force field'. His research indicates that these areas are not circular and tend to extend further in the direction in which the animal is facing. McBride's social force field has been extensively studied in humans and has been labeled 'personal space' by Sommer (1966; 1969).

As a testimony to the interest in the field of personal space, Altman (1975) has documented over 200 studies conducted since the early 1960's. Most of this work is tangential to the present study. However, research concerning intrusions into personal space boundaries as well as the personality correlates of personal space behaviour is relevant. The former will be discussed below, however the latter will be reviewed later.

Research concerning intrusion of personal space has confirmed the notion that unwarranted crossing of personal space boundaries is a powerful event. Two early studies by Felipe & Sommer (1966) underscore this statement. The first study examined the flight reactions of mental patients when a confederate sat beside a patient at a distance of approximately six inches. In a park setting about one-third of the patients left within two minutes, about one-half left within nine minutes and over two-thirds left within 20 minutes. Many overt signs of discomfort such as fidgeting, mumbling and nervous rubbing of body parts were commonly observed. Similar results were also found in the second study which examined spacing behaviour of students in a library setting. Patterson, Mullens and Romano (1971) added strength to these findings through observations of facial expressions and body orientation of patrons. In this library study, the incidence of such behaviour as blocking themselves off, leaning away, and glaring increased the closer a confederate was to a subject.

In a study of the extent to which level of arousal (as measured by the Galvanic Skin Response-GSR) was correlated with interpersonal distance, McBride, King and James (1965) found that subjects who were approached at distances of 1, 3 and 9 feet showed lower GSR readings as distance increased. Another finding indicated that approaches from the side produced lower readings than those from the front.

In another study of intrusion Efran and Cheyne (1973) observed shopping mall patrons to determine willingness to pass between two confederates standing at varying distances. They found patrons seldom passed between the confederates when they were closer than four feet apart. It is significant that this distance is at the edge of Hall's (1966) personal and social space zones referenced earlier. The above study thus tends to reinforce the functional validity of Hall's zones.

In a later study, Efran and Cheyne (1974) forced subjects to pass between two closely interacting confederates. Results showed that subjects displayed more agonistic facial gestures and later reported less positive mood ratings than did controls. Predicted heart rate changes however, were not obtained. Argyle and Dean (1965) obtained similar results when subjects approached a photograph of a person or an actual person. Eye contact typically decreased as distance decreased and other signs of tension were also reported when subjects were approximately two feet from the target person.

The studies cited above relate to two basic themes. The first is that in general, North Americans maintain similar conventions about the amount of space appropriate for different social and interpersonal occasions. The second is that personal space boundaries do exist and to violate them evokes feelings and bodily symptoms indicative of emotional distress both for the intruder and the person being intruded upon. With respect to the present study, these findings suggest that users of a public beach facility should choose sites which allow for at least a minimum amount of space which is consistent with social norms and personal needs. Hypotheses were generated to test this and other related constructs and will be dealt with in more detail in a later section.

Crowding.

The goals of the project did not include a direct attempt to assess the possible impact of crowding on beach users. This decision was based on the author's belief that although models exist to define various aspects of the crowding experience (Stokols, 1976), the 'state of the art' is such that an accurate assessment of such characteristics remains problematical. Because of the difficulties in defining when crowding may be said to occur, I preferred to concentrate on describing the actual behaviour of users which could be attributed to increasing numbers of others within the beach environment. Such a research strategy, I believe, should serve to produce a baseline indicator of how people actually respond to the amount of space available and precludes the necessity of determining how individuals feel about the experience in question. In addition, a primary hypothesis tested by the study predicted a minimum intergroup distance within which newly arriving users would not situate. Given the confirmation of such a hypothesis, one might conclude that crowding had not occurred since users were able to accrue some minimum amount of space necessary for maintaining a satisfactory experience. In other words, one would not expect respondents to express more than mild dissatisfaction as long as their basic needs for space were being met. Of course, to definitively answer questions relating to crowding it would be necessary to interview potential users who did not participate because of extreme densities. This strategy was not employed since such persons were not easily indentifiable.

Although as I have pointed out, crowding was not a central issue for the present study, two other research efforts directed towards beach users have made attempts in this direction. The first, by Brougham (1968), attempted to assess levels of perceived crowding through a variety of questions relating to the perceived quality of the beach experience. The results of his study indicated that with eighteen independent variables relating to crowding and socio/demographic characteristics of users, only 12% of the variance of the dependent variable (nearest neighbor distance) could be accounted for. Further, the crowding index used by Brougham was significant only at the 0.90 probability level and contrary to expectations

the groups perceiving the beach as overcrowded were found at greater distances than those not objecting to the number of others present.

The second study which attempted to measure perceived crowding in a beach setting was conducted by Edney and Jordan-Edney (1974). The method they used involved asking beach users two questions: 1) How many people did they (the users) think the beach could hold before it became overcrowded? and 2) How did they see the beach at the time - crowded, average, or underpopulated? Responses to these questions were then compared to a measure of nearest neighbor distance. An analysis of responses to the second question which attempted to measure crowding directly, produced no significant differences between the crowding indices and nearest neighbor distance values. The data relating to estimates of the beach capacity was significantly correlated with distance, but only when disaggregated by group size and composition by sex. Although the authors attempt to explain these findings using two alternate hypotheses relating to 'focus of attention' versus 'sense of control' these were not tested.

This section has been included to demonstrate some of the difficulties associated with assessing the crowding experience directly. Because of such problems I chose not to include direct measures of crowding. However, the questionaire designed for the study did include several personality variables which could be used as indirect indices of tolerance to crowding. These will be discussed in a later section.

Space as a limiting factor: The first hypothesis.

In a previous section I briefly referred to Hall's (1966) work in which he classifies observed social behaviours according to the distance separating interactants. Hall's scheme (see Table 1) suggests that certain classes of behaviour characteristic of North Americans can be grouped conveniently into four distance zones. These zones reflect increasing interpersonal and sensory involvement as distance decreases. These observations imply that distance, relative to potential or actual interactants, carries meaning and this meaning relates to the type and quality of

social interaction sought. Similarly, as Rapaport (1975) points out in a recent article, the definition of space by agreed upon rules serves as an organizing element and thus decreases the amount of information needing to be processed at any given time. Thus by dividing classes of behaviours along a space continuum, the need to communicate behavioural intentions, other than by the use of distance, is diminished.

Borrowing from Hall's and Rapaport's assessment of the functional qualities of space use I predicted that people on a public beach maintain basic spatial needs and that these needs are related to the regulation of social interaction. Further, I hypothesized that these needs and preferences are influenced in part by yarious personality and cultural norms. In an attempt to examine the efficacy of these propositions, I chose Hall's (1966) schema of four distance zones as an initial source for theoretical constructs. Referring to Table 1, Hall's zone, 'public' is characterized by behaviours not requiring interpersonal involvement. Since most people were observed to maintain their group identity and since at low densities space was not thought to be limiting, I predicted that under these density conditions most users would locate at nearest neighbor distances greater than 3.7 meters (12 ft.).

Further, as pressures due to increasing density were realized, I also predicted that observed distances would compress to some point within Hall's (1966) 'social distance zone' (far phase). This prediction is based on the argument that users could be expected to adopt various adaptational strategies which would allow somewhat closer intergroup distances. The far phase of the social distance zone (2.1-3.7 meters) is the most likely lower limit of this compressibility since Hall's characterization includes the statement that social distance (far phase), "can be used to insulate or screen people from each other." In contrast, the close phase (1.2 - 2.1 meters) is typified by behaviours which are more casual than the far phase and contains more elements indicative of social involvement, although of an impersonal nature.

Based on the above arguments the following is a statement of the first hypothesis to be tested:

- At low to moderate density, distances to nearest neighbor will be greater than 3.7 meters, however as space becomes limiting at higher densities, distances will approach a minimum value between 2.1 and 3.7 meters.

Such extreme densities would create a situation in which newly arriving groups would be forced to violate spatial norms, seek out another less crowded beach or return home.

The testing of the preceeding hypothesis was carried out with the aid of aerial photography covering three beaches over a broad range of densities for each. This technique allowed for an instantaneous record to be made of the position in space of users of an entire public beach.

Density and spatial pattern.

The dispersion of objects in space and time are studied through pattern analysis. Such analyses are widespread in such fields as ecology (Pielou, 1969; Grieg-Smith, 1964) and social geography (Dacey, 1964; Getis, 1964). The analysis of pattern is contingent upon three types of spatial distribution, of which two, regular and aggregated represent the opposite ends of a continuum. The third type, random, refers to the special case where the placement of a point or individual is uninfluenced by any other point. Aggregated or clumped patterns are exhibited when there is a higher probability that two or more points will be found in close proximity. A perfectly regular or uniform pattern is characterized by a set of points where all distances between points are maximized. In this extreme case, the pattern is expressed as a hexagonal lattice, since this type of distribution is the most efficient way to pack a space or volume. Of course, a distribution may be classified as either regular, random, or aggregated in the statistical sense without totally satisfying the conditions above.

The dispersion of animals in space results from interactions with the physical environment as well as the presence or absence of other individuals (Brown & Orians, 1970). Since for a public beach I have assumed that the environment is structurally uniform (isotropic) then any changes in the spatial pattern as exhibited by beach users can be expected to result from largely social as opposed to environmental sources.

If users of a public beach are viewed as having spatial needs which are manifest as culturally or biologically appropriate interpersonal distance, then one might expect that above a certain overall density the spatial pattern exhibited by the population would be uniform as people strive to maintain the minimum amount of space which they require. The process by which this might occur is easy to visualize since each individual or group arriving at the beach would strive to gain at least the minimum amount of space which was required. Contrarily, at low densities each group could obtain much more than this minimum amount and thus there would be no psychological 'pressure' from other groups that would influence the positioning of new arrivals. Thus at these densities differences related to individual personality characteristics could be manifest. Since the expression of these charateristics may be visualized as many and varied, a pattern approaching random should be observed.

In a study cited previously, Brougham (1968) proposed a similar argument to the one above. Through the use of oblique aerial photographs over a one day period, Brougham sought to examine the effects of density on spatial pattern and perceived crowding at Pinery Provincial Park beach in Ontario. His results seem to indicate that beach users did attempt to maximize the space available to them as evidenced by an 'R' value (a measure of the extent to which the distribution of objects in space conform to one of three patterns, random, regular or aggregated) significant in the direction of a regular pattern. Inexplicably, the 'R' values (although significantly different from a random pattern) tended to decrease as

density increased. These results are not conclusive however, since the use of oblique photographs may not have produced reliable measurements, and since the photographs were taken for a single day only, the sample size, as well as the range of observed densities were relatively small. Since densities were expressed in relative as opposed to absolute units direct comparisons between his study and the present research are not possible.

To test these arguments, an analysis of the spatial distribution of beach users examined the following corollary of the first hypothesis mentioned previously:

- The distribution of groups over the beach surface will approach a random pattern at low densities and as density increases the distribution of groups will exhibit an increasingly regular pattern.

In summary, I predicted that since other studies have shown that humans and other social animals maintain certain spatial requirements which are related to proper social functioning, there should exist a density range over which people on a public beach would maximize the space between themselves and neighboring groups thus resulting in a uniform spatial pattern.

CHAPTER II

INDIVIDUAL DIFFERENCES AND SPATIAL BEHAVIOUR: THE ROLE OF PERSONALITY AND SOCIO-ECONOMIC CHARACTERISTICS.

Introduction.

The hypotheses listed in the previous section were generated to aid in determining how entire populations of beach users behave. However, describing aggregate behaviour does little to explain how differences between individuals influence observed patterns of behaviour.

In order to determine some of the factors influencing the spatial behaviour of individuals, I chose to administer a survey to randomly selected samples of beach users at a variety of different densities. The choice of survey instruments included tests designed to assess a broad range of environmental dispositions, mood variables and socio-economic and demographic characteristics. Besides interpersonal distance measures, I also chose to investigate how the personal attributes referred to above relate to the area circumscribed by an individual's or group's personal possessions (marked group area). These objectives were oriented toward gaining an understanding of psychological and socio-demographic characteristics as related to various aspects of beach user spacing and group behaviour.

The role of personality.

The literature relating to personality correlates of spacing behaviour is substantial. In general, however, the studies show little coherence, with lack of theoretical underpinnings being the most likely cause (Altman, 1975). Other than Hall's (1966) qualitative observations and cross-cultural comparisons few models exist which attempt to explain the role of personality in personal space preferences.

An early model by Argyle and Dean (1965) proposed an equilibrium hypothesis which suggested that behavioural shifts occur to maintain desired levels of intimacy and social interaction. Thus such behaviours as eye contact, body orientation, facial expressions, etc., operate to create desired interpersonal distances which they suggested are commensurate with the type of social interaction involved.

An additional attempt to develop a theoretical approach to spacing behaviour was proposed by Duke and Norwicki (1972). They suggested that appropriate distancing behaviours are related to social-learning models and that reinforcements act as the driving force for learning culturally defined spacing norms.

Altman (1975) suggests that spacing behaviour is, "one of a series of self/other boundary mechanisms that function in the service of desired levels of interaction." Central to Altman's hypothesis is the concept of privacy as a boundary control process. According to Altman, one of the ways in which people achieve desired levels of privacy is through the use of space.

Personality correlates.

Of the specific studies relating personality and spatial behaviour, only two areas maintain any degree of consistency. The first concerns the effect of anxiety on interpersonal distance. In general, measures indicating high levels of anxiety correlate with increased personal distance (Smith, 1953, 1954; Luft, 1966; Weinstein, 1968; Patterson, 1973; Karabenich and Meisels, 1972; and Bailey, Hartnett, and Gibson, 1972).

The second area of research where personality attributes have been related to spacing behaviour comes from studies of the introversion/extroversion complex. For the most part, subjects scoring highly on measures of extroversion are observed to maintain closer individual distances than those with elevated introversion profiles (Williams, 1971; Cook, 1970; Patterson and Holmes, 1966). In another study which related scores on "exhibitionism" and "impulsivity" scales, Sewell (1973) reported a significant negative correlation between the personality measures and distance. Contrary results, however, were obtained by Meisels and Canter (1970).

Finally, a study dealing with attitudes and perceptions of crowding on a public beach underscores the potential importance of personality characteristics of users of a recreational resource. This study, conducted by Meyer and Bryan (1974) at Long Beach, Vancouver Island, British Columbia attempted to correlate user responses relating perceived crowding to site density. They found that most respondents felt the number of people at their site was "about right". Since Long Beach is extensive with many sites available, Meyer and Bryan concluded that users may have selected the site which was consistent with personal crowding preferences.

Although not specifically tested by Meyer and Bryan, this explanation is central to questions relating to the present research. Implicit in the prediction that people select the density which is comensurate with spacing needs and preferences is the notion that site selection is mediated through various personality processes within the indivdual. In this way, a user by having previous knowledge of when a beach was less or more crowded could choose the time of day or day of the week most likely to fulfill basic internal needs. Similarly, once at the beach the user may choose a section which is more or less crowded and situate at a comfortable distance from neighbors.

The key question regarding the discussion above is: "What are the most likely characteristics of the user which influence such decisions?" Since the literature contained no guiding theory and few studies leading to such theory I chose to use scales derived principally from the field of environmental psychology. This decision was based on the argument that the ways in which people perceive and respond to the physical environment may offer valid insights into other behaviours relating to interpersonal functioning. For example, with reference to the present study, a person who manifests a positive orientation toward the high density urban environment should be more likely to be observed at the beach during high density periods or at shorter distances than someone who prefers the quiet and solitude of a more rural environment. Similarly, a person who affirms

a preference for highly stimulating environments or activities should be observed in closer proximity to others and at higher densities than a respondent who is typically fearful of such environments.

The main thrust of this component of the study was to determine whether a variety of personality and socio-economic characteristics of beach users are related to spacing preferences. Since I predicted earlier that due to the pressures associated with high density conditions, nearest neighbor distance would be constant at these times, the above preferences could only be effectively manifest at lower densities when choices are not inhibited by crowding influences. Thus the prediction is that at lower densities users may select a site based on preferences mediated by personality characteristics, whereas at high densities site selection is a function of adaptational processes directly related to gaining the minimum amount of space required for controlling social interation between neighboring groups.

The survey instruments.

The survey instruments which I chose were designed to measure a respondent's orientation toward various aspects of: 1) the physical and to a lesser extent social environment, 2) the recreational environment, and 3) his own internal "moods" within the setting. An additional section elicited background information designed to tap important socio-economic and demographic characteristics of the user. Two of these tests, the Environmental Response Inventory (ERI) and the Leisure Activities Blank (LAB) were developed by George McKechnie (1974). The mood scale was designed by Lorr, Daston and Smith (1967) and the background section was developed for the study by the author. A facsimile of the survey occurs in Appendix A.

The Environmental Response Inventory.

The ERI was specifically designed to assess what Craik (1966, 1969, 1970a, 1970b) has termed "environmental dispositions." Environmental dispositions are defined as relatively enduring psychological dimensions which are used by the individual to describe and evaluate various aspects of the physical environment. The ERI consists of 184 statements which tap a diversity of environmental themes, most of which relate to the non-human environment. The remainder relate to various aspects of the human social environment.

The inventory yields scores on eight scales plus one test reliability scale (termed communality) designed as a validity check for response bias. The nine scales and McKechnie's (1974) description of each are listed in Table 2. To facilitate the process of enumerating the hypotheses derived for the study I have also included in Table 2 a sign indicating the predicted direction of the correlation between each scale and the distance from a respondent and his or her nearest neighbor. In this way for example, a respondent scoring highly on the Urbanism scale is thus predicted to be found nearer than average to the closest neighboring group. This is based on the argument that people reporting a positive orientation to high density urban environments should tolerate or even seek out settings where crowds are likely to occur. Similar arguments can be generated for the other eight scales as well. A more specific discussion of the scales and response format occurs in the section on methods.

The Leisure Activities Blank.

The second part of the survey (Leisure Activities Blank, LAB) consisted of a comprehensive range of leisure and recreational activities which subjects responded to on the basis of past participation for each item. Through factor analysis McKechnie (1974) developed seven scales which he broadly classified as: Mechanics, Crafts, Intellectual, Slow Living, Neighborhood Sports, Glamour Sports, and Fast Living. Table 3 lists the activities and their factor loadings for each of the seven scales.

The choice of the LAB for the present study was based on the argument that the activities a person voluntarily chooses to participate

Table 2: Environmental Response Inventory Scales (adapted from McKechnie, 1973)

Scale and Major Themes:	High Scorers often Described as:	Low Scorers often Described as:
PASTORALISM. (+) Opposition to land development: concern about population growth: preservation of natural forces as shapers of human life: sensitivity to pure environmental experiences: self-sufficiency in the natural environment.	Aesthetic, affectionate, complicated, distractible, outspoken, progressive, rebellious, unconventional, unpredictable, selfish.	Apathetic, conscientious, conservative, conventional, deliberate, dependable, friendly, honest, practical, self-controlled.
URBANISM. (-) Enjoyment of high density living: appreciation of unusual and varied stimulus patterns of the city: interest in cultural life: enjoyment of interpersonal richness and diversity.	Critical, skeptical, responsive to urban aesthetics, high-brow, concerned with philosophical problems in life, valuing intellectual activity, managerial interests.	Conscientious, conventional, friendly, generous, non-verbal, opportunistic, robust, simple, unselfish.
ENVIRONMENTAL ADAPTATION. (+) Modification of the environment to satisfy needs and desires, and to provide comfort and leisure: opposition to government control over private land use: preference for highly designed or adapted environments: use of technology to solve environmental problems: preference for stylized environmental details.	Autocratic, condescending, conservative, efficient, interprising, extraverted, hard-headed, mannerly, methodical, power and money oriented, judgmental, aesthetically unresponsive.	Artistic, awkward, compassionate, curious, distractible, idealistic, introspective, moody, non-conforming, sensitive, sensuous, worrying, forthright.
STIMULUS SEEKING. (-) Interest in travel and exploration of unusual places: enjoyment of complex and intense physical sensations: breadth of interests.	Advonturous, disorderly, distractible, dreamy, easy-going, immature, impulsive, progressive, unconventional, undependable.	Conscientious, conservative, fastidious, practical, responsible, rigid, severe, stingy.

Table 2 (continued)

Scale and Major Themes:	High Scorers often Described as:	Low Scorers often Described as:
ENVIRONMENTAL TRUST. (-) General environmental openness, responsiveness, and trust, competence in finding one's way about the environment . vs Fear of potentially dangerous environments: security of home: fear of being alone and unprotected.	Capable, competent, diligent, efficient, helpful, ingenious, resourceful, stable, thorough, tolerant, well-adjusted.	Bitter, cold, coarse, dissatisfied, distrustful, intolerant, moody, prejudiced, spendthrift, unkind.
ANTIQUARIANISM. (-) Enjoyment of antiques and historical places: preference for traditional vs modern design: aesthetic sensitivity to manmade environments and to landscape: appreciation of cultural artifacts of earlier eras; tendency to collect objects for their emotional significance.	Affectionate, artistic, changeable, dependent, dreamy, emotional, forgiving, idealistic, introspective, aesthetically reactive, warm.	Coarse, cool, conservative, deliberate, mischievous, moralistic, practical, sky, stolid, unemotional.
NEED FOR PRIVACY. (+) Need for physical isolation from stimuli: enjoyment of solitude; dislike of neighboring; need for freedom from distraction.	Aloof, arrogant, autocratic, bitter, cold, formal, hardhearted, sulky, polished, resentful, stubborn.	Appreciative, cooperative, easy-going, friendly, seeking reassurance, warm, seeks acceptance, lacks confidence, introverted.
MECHANICAL ORIENTATION. (+) Interest in mechanics in its various forms: enjoyment in working with one's hands, interest in technological processes and basic principles of science: appreciation of the functional properties of objects.	Arrogant, conceited, egotistical, hard-hearted, masculine, self-seeking, inflexible, sociable, manipulative.	Affectionate, feminine, generous, sincere, understanding, submissive, sympathetic, warm.
COMMUNALITY. (+) A Validity scale, tapping honest, attentive, and careful test-taking attitude: response to items in statistically modal manner.	Calm, civilized, initiative, mannerly, patient, tactful, trusting, rule-following.	Hard-headed, flirtatious, good looking, immature, opportunistic, versatile, witty, independent-minded, psychologically complex.

Table 3: Seven LEISURE ACTIVITIES BLANK - Past Factors (adapted from McKechnie, 1974)

Factor 1: Mechanics

Loading*	#	Item
.327	2	Amateur radio
.353	6	Auto racing
.722	7	Auto repairing
.455	13	Billiards or pool
.516	18	Boxing
.311	19	Camping
.683	21	Carpentry
.488	37	Electronics
.405	41	Fishing (saltwater)
.484	42	Fishing (fresh)
.246	44	Flying (or gliding)
.423	60	Horseshoes
.575	61	Hunting
.682	72	Marksmanship
.829	73	Mechanics
.709	74	Metalwork
.469	75	Model building
.336	81	Playing poker
.524	111	Vol. fire fighting
.410	116	Weight lifting
.523	118	Wrestling
.622	121	Woodworking

Factor 2: Crafts

Loading*	#	Item
.440	22	Ceramics or pottery
.289	27	Collecting things
.521	29	Cooking and baking
.301	30	Crossword puzzles
.446	31	Dancing (ballet, mod)
.506	34	Designing clothes
.476	43	Flower arranging
.354	45	Folk dancing
.415	57	Home decorating
.455	63	Jewelry making
.412	64	Jig-saw puzzles
.539	69	Knitting-crocheting
.351	70	Leatherwork
.603	79	Needlework
.435	80	Painting and drawing
.351	91	Sculpture
.641	92	Sewing
.493	115	Weaving

Factor 3: Intellectual

Loading*	#	Item
.329	1	Acting (dramatics)
.631	4	Attending concerts
.344	8	Backpacking
.357	24	Chess
.442	26	Civic Organizations
.328	33	Darkroom work
.705	51	Going to plays
.424	56	Hiking or walking
.246	84	Musical instruments
.541	85	Political activities
.426	86	Reading: serious
.251	95	Singing
.353	107	Travel abroad
.548	108	Visiting museums
.428	119	Writing poetry, etc.
.494	28	Conservation-ecology

Factor 4: Slow Living

Loading*	#	Item
.413	32	Social dancing
.422	35	Dining out
.413	36	Driving
.323	39	Exercising
.430	49	Gardening
.497	50	Going to movies
.380	71	Listening to radio
.324	83	Playing records
.331	87	Reading: light
.329	94	Sightseeing
.476	98	Social drinking
.473	100	Sunbathing
.288	104	Taking pictures
.450	105	Talking on telephone
.472	109	Visiting friends
.340	112	Watch team sports
.453	113	Watch TV shows
.438	117	Window shopping
.347	120	Writing letters

*All factor loadings reported here are positive.

Table 3: continued

Factor 5: Neighborhood Sports

Loading*	#	Item
.407	9	Badminton
.628	10	Baseball
.644	11	Basketball
.355	12	Bicycling
.324	17	Bowling
.370	23	Checkers or Go
.506	46	Football
.402	65	Jogging
.338	68	Kite Flying
.226	93	Shuffleboard
.436	99	Squash or Handball
.389	103	Ping pong
.540	110	Volleyball

Factor 6: Glamour Sports

Loading*	#	Item
.356	3	Archery
.430	15	Boating (rowing)
.439	20	Canoeing
.339	59	Horseback riding
.275	62	Ice Skating
.498	76	Motor Boating
.372	77	Motorcycling
.376	78	Mountain climbing
.551	90	Sailing
.550	96	Skiing
.350	97	Skindiving
.455	101	Surfboarding
.410	102	Swimming
.381	106	Tennis
.583	114	Water skiing

Factor 7: Fast Living

.284	47	Fraternal organizations
.419	48	Gambling (casino)
.442	52	Going to Horseraces
.354	53	Going to Nightclubs

in during periods of leisure time may be related to other personal psychological characteristics. Evidence relating to this argument stems from McKechnie's (1974) study where he was able to correlate each LAB factor with various Environmental Response Inventory scales, socio-economic and environmental attitude variables. Based on these results he types high scores on each of the LAB factors in the following manner:

Mechanics: ". . . a rugged, mechanically-minded male, who enjoys the outdoors, working with his hands and getting away from home for periods of time."

Crafts: ". . . a woman who enjoys doing things at home: decorating the house, making clothing for the family, or engaging in other activities to make the home a cozy and emotionally satisfying place."

Intellectual: "A high scorer. . . is from an educationally and economically priviledged sector of society, enjoys the natural environment and desires to preserve it, and devotes his leisure time to pursuing this and other worthwhile community goals."

Slow Living: ". . . a person for whom the home is a refuge from commuting to and from a white collar job, who might relax by settling down on the patio and passively enjoying his periods of leisure."

Neighborhood Sports: ". . . a young, well educated male who enjoys the outdoors so long as some sort of playing field is nearby and a game is on."

Glamor Sports: "The person scoring high on Glamor Sports seems to like getting out in the environment and enjoying the intense stimulation that such activities as motorcycling, waterskiing, and sailing can afford. The high scorer on the factor is typically a young, well educated male; he is pro-conservation and enjoys sports equipment as a means of stimulating environmental experience."

Fast Living: * Not typed by McKechnie since the factor had but four item definers.

Although McKechnie does not relate the LAB factors to personality traits per se the typology which he derives does show how people differ according to their individual leisure activity patterns.

A study which did relate leisure activity patterns to personality traits was conducted by Lamphear (1970). He noted that subjects with "normal" MMPI (Minnesota Multiphasic Personality Inventory) scores

maintain recreation patterns which are significantly different from those with elevated profiles.

For the present study, predictions of spacing behaviour as it corresponds to scores on the LAB were made based on the extent to which activities within a factor were predominantly oriented toward solitary or individual pastimes versus group activities of a more gregarious nature. This criterion led to the following predicted correlations between LAB factor scores and respondent nearest neighbor distance: Mechanics, Crafts, Slow Living, and Glamour Sports - larger distance to nearest neighbor; Neighborhood Sports and Fast Living - smaller distance to nearest neighbor. A prediction of spacing and the Intellectual factor was not made since the activities seemed to be evenly split with respect to the selection criterion.

Mood Adjective Checklist.

The mood scale consists of sixty adjectives which, when subjected to factor analysis by Lorr, Daston & Smith (1967) produced eight identifiable mood factors (Table 4). These they termed: Cheerful, Energetic, Anger-hostility, Tense-anxious, Depressed, Inert-fatigued, Thoughtful, and Relaxed-composed. Since the other portions of the survey were included to assess more enduring psychological dimensions which might relate to spatial behaviour, the mood adjective checklist was inserted as a way of measuring more momentary and transient aspects of a subject's psychological profile. In this way I hoped to determine the extent to which a respondent's mood was influenced by the level of spatial press due to the proximity of others. One might expect, for example that a respondent who had chosen a site well away from more crowded portions of the beach and who had been subsequently intruded upon by another group would show elevated scores on the more "negative" mood variables. Although it was not possible to know when such a scenario occurred the correlation between the mood variables and distance measures would indicate, in a relative way, the extent that this and similar situations prevailed.

A final aspect of the survey related to the decision to make the mood checklist an optional feature of the questionaire package. Since the time required to complete the survey was lengthy (about 35 - 40 minutes), I reasoned that if a respondent was not enjoying the beach experience prior to filling out the survey then he would be less likely to

Table 4: Correlations of the Adjectives with Eight Mood Factors (Adapted from Lorr et al, 1967).

Factor 1: Cheerful			Factor 2: Energetic		
Loading	#	Item	Loading	#	Item
.70		*Elated	.62	1	Active
.69	35	On top of the world	.56	42	Energetic
.60	6	Excited	.54	38	Full of pep
.56	39	Light-hearted	.53	50	Alert
.56	49	Carefree	.51	24	Vigorous
.54	12	Gay	.50	55	Lively
.52	2	Cheerful	.44	47	Enthusiastic
.51	34	Happy-go-lucky			
.34	9	Pretty good			
.33	58	Optimistic			

Factor 3: Anger-Hostility			Factor 4: Tense-Anxious		
.68	27	Furious	.59	10	Nervous
.67	13	Annoyed	.53	51	Anxious
.65	5	Angry	.39	53	Shaky
.45	54	Spiteful	.36	59	Worried
.45	15	Resentful	.36	3	Jittery
.44	48	Ready to fight	.31	26	Tense
.41	7	Bad-tempered	.30	9	On edge
.33	52	Grouchy			

Factor 5: Thoughtful			Factor 6: Depressed		
.62	30	Introspective	.61	36	Hopeless
.58	33	Thoughtful	.59	16	Helpless
.56	22	Contemplative	.57	19	Worthless
.55	11	Pensive	.36	46	Unhappy
.40	14	Earnest	.32	44	Lonely
.35	25	Serious	.29	56	Blue
.32	32	Preoccupied	.28	20	Frightened
			.26	8	Apathetic

Factor 7: Inert-Fatigued			Factor 8: Relaxed-Composed		
.66	37	Weary	.59	21	Calm
.66	40	Tired	.52	45	At ease
.43	17	Sluggish	.44	43	Composed
.38	60	Lethargic	.44	41	Relaxed
.38	31	Lazy	.34	18	Serene
.25	57	Listless	.29	23	Nonchalant
.28	28	Languid			

*'Elated' deleted from present survey as it was mis-typed 'hated'.

complete the final segment if given a choice. Thus to the extent that crowding influences are related to a decrement in user satisfaction, I predicted that a respondent who chooses not to fill out the mood survey would be found at high densities and thus small nearest neighbor distances.

Socio-economic and demographic characteristics.

Questions relating to a respondent's socio-economic background were included to determine the extent to which such variables as age, sex, marital status, income, etc. were related to spatial and group behaviour as well as a way of describing the sample.

CHAPTER III

An Approach to the Study of Human Spatial Behaviour:

METHODS

AND

APPLICATIONS

The study areas.

Three beaches were chosen as suitable environments for the purposes of the study. The sites chosen were relatively distinctive thus ensuring as comprehensive a data base as possible. Two of these areas, English Bay beach and a grassy, sunning area near Kitsilano beach are located near the center of Vancouver, British Columbia (49° 17' No. Lat., 123° 8' Long.). The third site is located on Skaha Lake near the city of Pentiction, British Columbia (49° 27' No. Lat.,119° 36' Long.). Maps depicting the three areas are shown in figures 1 and 2.

English Bay is a gently curving, sand beach with the ocean along the western edge. The beach is characterized by two distinctive areas, one of which contains logs placed in parallel rows by the local parks board. Beach users utilize these logs as back supports and as a result, distributions of users in this area tends to be linear. This area runs parallel to the shoreline and is situated on the landward half of the beach. The other area nearer the ocean, has no logs and is thus free from such environmental influences. Since the research required a uniform environment it was this latter site which was chosen as the study area. The dimensions of this section of the beach are approximately 470 meters by 12 to 43 meters depending on the level of the tide. The average area as calculated from the aerial photographs was 1.20 hectares.

The site also contained a centrally located beach house/refreshment stand. Access to the beach was varied with some on street parking and a parking lot located near the south-east end.

The second study site, Kitsilano, is a complex area of ocean fronted beach containing "backrest" logs and two adjacent rectangular sunning areas covered with grass rather than sand. The southern-most sunning area was chosen because of its uniformity, wide range of density (over time) and basic rectangular shape. The area is 146 x 31 meters (.453 hectares)and is virtually free from physical obstructions such as back rest logs which might act to influence spacing behaviour. A small exception is a pathway slanting diagonally across the east end. Entrance is open except on the north and south where a seawall and a fence respectively limit direct access. A parking lot exists near the east end and a refreshment stand is situated on the west.

Figure 1. Map depicting Kitsilano and English Bay study areas.

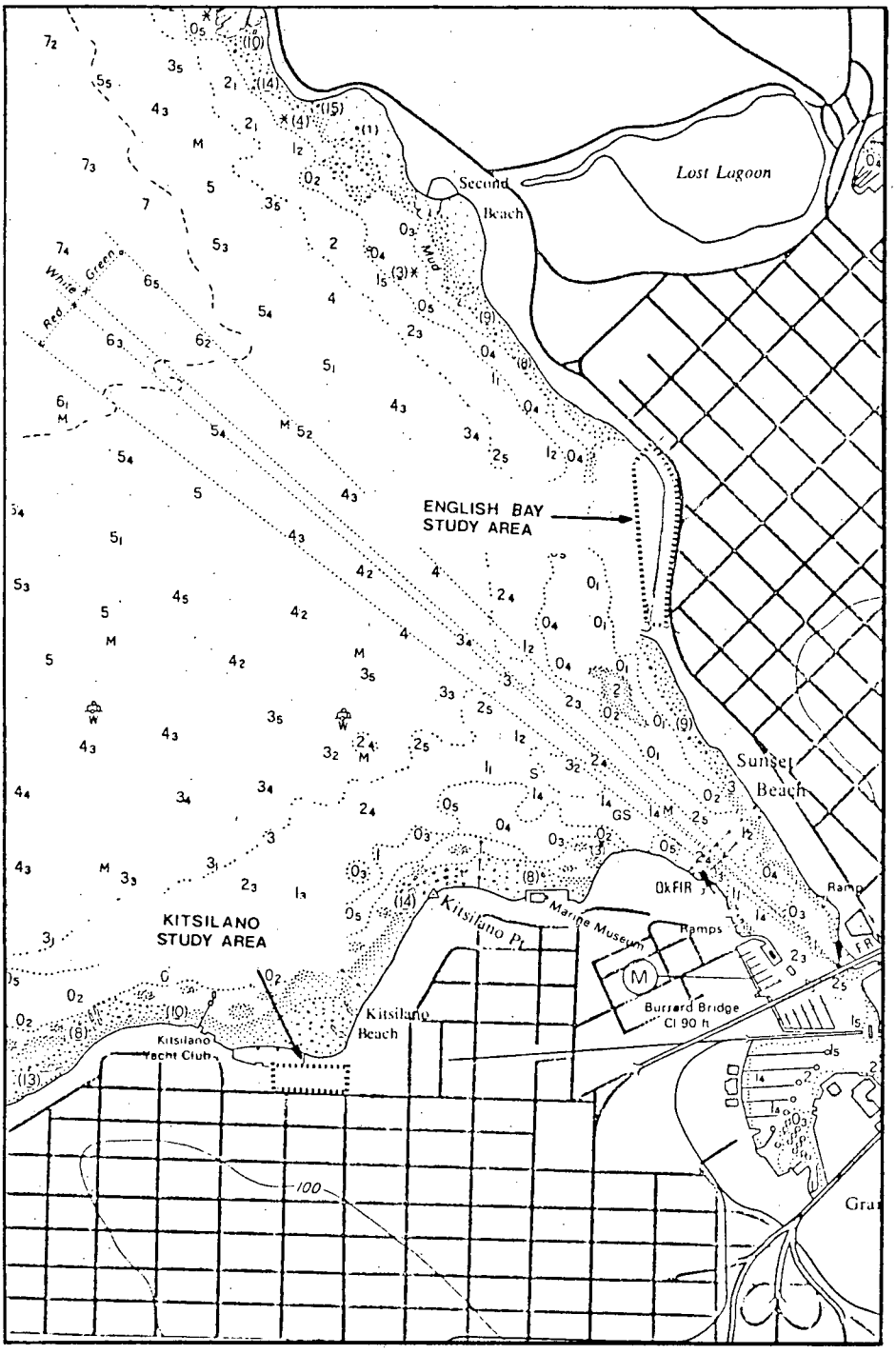
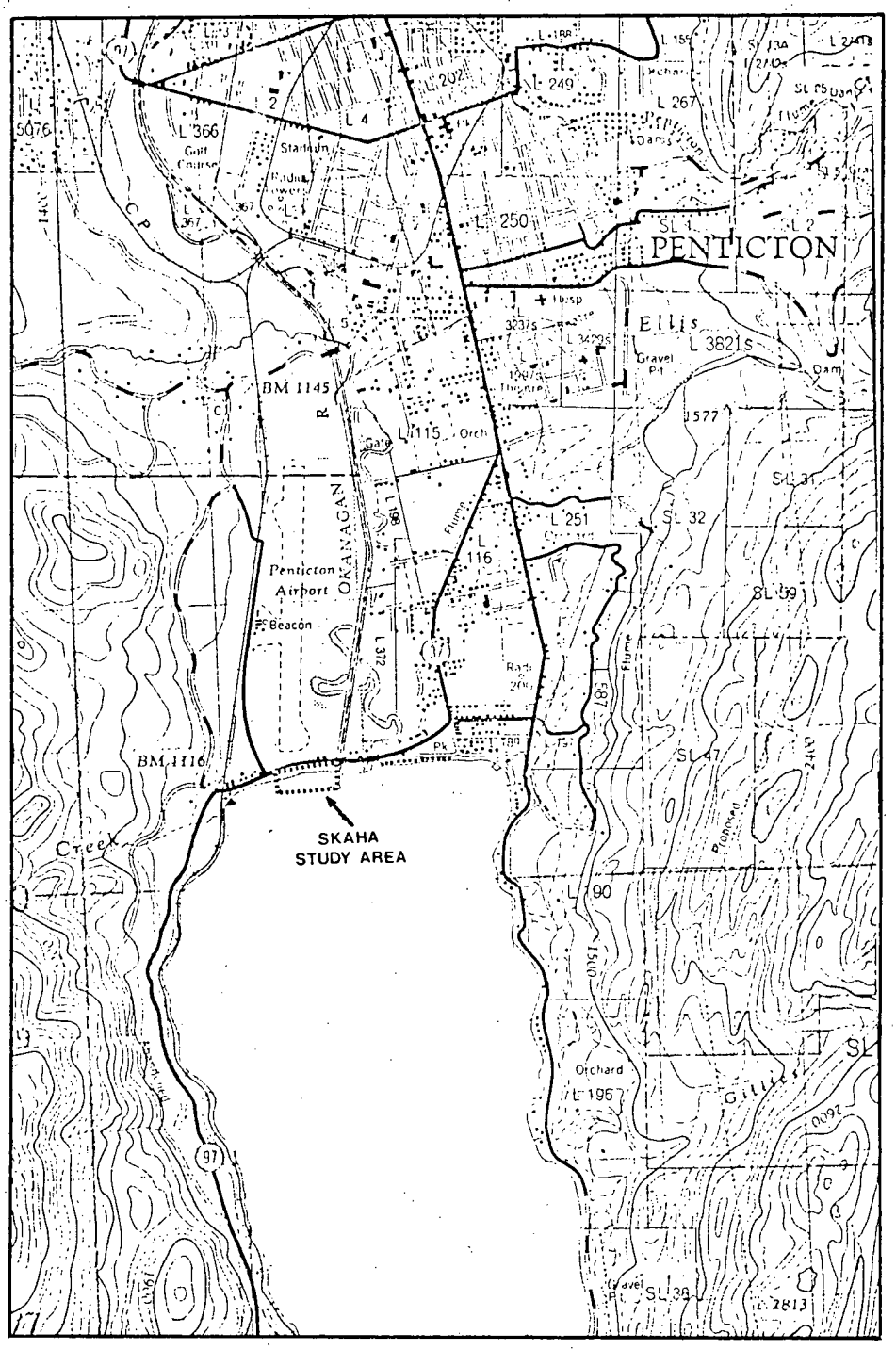


Figure 2. Map depicting Skaha study area.



The study site at Penticton (Skaha beach) is the middle of three beaches on the north shore of Skaha Lake. The study area dimensions are 260 x 25 meters (.54 hectares). A refreshment stand is located on the landward side near the mid-point and access is not limited.

Skaha was chosen because of its uniform character and because most users are vacationers and originate outside the immediate area. In fact the survey revealed that over 95% of all respondents did not reside in or near the city of Penticton.

In summary, the three sites were chosen for their essentially within beach uniform character, although certain aspects such as substrate type and refreshment stand location differed between beaches.

Aerial Photography.

Data concerning spatial behaviour and group phenomena were collected via aerial photography. This technique although complicated and prone to mechanical problems was chosen over others because of its ability to produce large quantities of date quickly as well as the relative ease with which the information can be digitized for computer analysis. Another important aspect was that data could be collected unobtrusively so that all behaviour is observed as 'natural' and thus uninfluenced by the observer.

Before outlining the methodology, three terms are operationally defined for purposes of clarity: 1) group - any set of interacting individuals situated in close proximity to one another so as to form an easily recognizable unit (for most purposes a lone individual is also labelled a group except where it is important to distinguish between single persons and larger numbers of people), 2) run - any aerial photographic pass over the study area which resulted in a complete record of the beach and its users, and 3) boundary - the geographical limits of the beach or sunning area except in the case of English Bay where only that portion of the beach between backrest logs and the water was used.

Although aerial photography is often a complex and rather costly undertaking, a method was devised which satisfied the requirements of the research and was at the same time only moderately expensive. Of the 27 runs finally used with the analysis, 23 were completed without the use of commercial aerial photographic techniques or equipment.

The method entailed the use of a light aircraft (Cessna 150)

converted for aerial photographic purposes by removing both doors. This practice provided the required visibility for both pilot and photographer where the key to a successful run was the maintenance of the proper flight path directly above the study area.

The camera, a 35 mm, motorized Nikon, equipped with a 135 mm lens was hand held and set to maintain a film transfer rate of 2.5 frames per second. At a flight altitude of 305 meters (1,000 feet), this equipment provided a good image of people and most of their beach articles. With an airspeed of 113-145 Km per hour (70-90 miles per hour) there was sufficient interframe overlap to ensure a complete record of the beach on any given run.

In order to scale the photographs for any given run three objects such as sidewalks, diving platforms, slides, etc, were chosen as environmental features easily visible within the photograph and permanent enough not to be moved during the duration of the study. Two of the objects were located at the respective ends of any given beach and a third was situated in the middle. A conversion factor was obtained for each of the three objects by dividing the known ground dimension of the object by its corresponding image dimension. In order to minimize errors due to altitude fluctuations the three conversion factors were averaged to obtain the final conversion value. These errors were minimal as the difference between the two most different values for any given run, was most often two to three percent and only once approached ten percent.

All film analyses were completed using a Vanguard motion analyzer and DEC II/45 computer. The motion analyzer is designed so that a single photographic frame is projected onto an opaque glass screen. Two thin wires running at right angles to each other act as cross-hairs and their movement is controlled by the rotation of two knobs on the console. By moving the cross-hairs over the screen to the desired point and by activating a switch, the X, Y co-ordinates of the point are transferred onto computer compatible paper punch tape. By digitizing around the perimeter of a group or individual as indicated by their physical belongings I was able to construct a representation of each group's spatial boundaries. This process was carried out for every group on the beach. The program designed for the project connects the points for any given group in such a way as to construct an irregular polygon. The area

subtended by each polygon was defined as the 'marked group area' for any given group. Since the motion analyzer was not infallible, all polygons (group areas) were plotted using a standard calcomplotter and as a result of this process large errors due to digitizer malfunctions could be detected by visual inspection of the completed maps.

Since it takes many frames to compose one beach image, it was necessary to subtract the overlap from each pair of frames. This was done by digitizing six recognizable points (objects on the beach surface) within each frame, three at the 'top' and three at the 'bottom'. Each set of three points was picked such that one was at the extreme left of the frame, one in the middle and one on the extreme right. After the analysis of that frame the 'lower' three points were found on the 'top' of the next frame and their positions placed on the tape. At this time the points were chosen and punched for the next frame at the 'bottom' of the frame currently being analyzed. The three distances between corresponding points on adjacent frames were then averaged. This average distance between corresponding points on adjacent frames was thus the amount of overlap for each frame. Averaging the distances of the widely separate points was done to minimize errors due to lens abberation and possible deviations resulting from the aircraft not maintaining its position directly above the study site. These errors were thought to be samll since a high quality lens was used and care was taken to maintain a flight path directly above the beach.

In addition to the digitizing process the number of people in each group was entered into the record. For this study it was generally easy to determine what did and what did not define a group, although one can visualize an area so crowded that group definitions by purely photographic means becomes difficult. Such densities were not observed and in most circumstances the placement of beach articles was sufficient to demarcate one group from another.

In order to determine the overall beach density during a run the area of each beach was required. This was obtained by digitizing around the perimeter of that portion of the study plot represented on one frame. These points were then taken as the vertices of a polygon and the area computed.

This process was completed for each frame with care taken to superimpose adjacent sides of each pair of contiguous polygons. Again these values are plotted to validate data transcription and the resulting polygons fitted together to represent the outline of the study area. This process was necessary once only for Skaha and Kitsilano. However, since English Bay is located directly on the ocean, a separate area computation for each run was required due to changes in the tide level.

Pattern Analysis.

The analysis of pattern originated with and has been developed primarily through work of ecologists and biometricians. Gleason (1920) was the first to develop a method describing pattern type using sample quadrats and the Poisson series. Criticism of techniques utilizing quadrat methods center around the influence of quadrat size on frequency data (Curtis and McIntosh, 1950; Skellam, 1952) and because of these criticisms, newer techniques were used for this study.

Another technique widely used by ecologists is the distance to nearest neighbor technique. This method of pattern analysis was originated by Dice (1952) and subsequently elaborated upon by Skellam (1952), Clark and Evans (1954), Morisita (1954) and Thompson (1956). This technique was used for the present study since it is the most accepted and widely used method of pattern analysis and since nearest neighbor distances were easily calculated from the aerial photographs.

The method as described by Clark and Evans (1954) consists of measuring the distance between an individual and his nearest neighbor, where individuals are chosen by some random process. An alternate method involves calculating the distance between individuals and their nearest neighbors for all members of the population. Of course, this variation only applies when the population is discrete and small enough that such measurement is feasible. Such was the case for this study, so that nearest neighbor distances for all groups on a beach for any given run were measured. Here a "run" refers to a photographic sequence of the entire length of a beach.

The pattern satistic 'R' is defined by Clark and Evans (1954) from the ratio of the observed to expected mean nearest neighbor distance

such that $R = \bar{r}_o / \bar{r}_e$, where $\bar{r}_o$ is equal to the mean observed nearest neighbor distance and $\bar{r}_e$ is equal to the mean expected nearest neighbor distance. The mean expected nearest neighbor distance ($\bar{r}_e$) is the mean distance which would be expected if the population in question were distributed at random. Clark and Evans show that $\bar{r}_e$ is equal to $1/2\sqrt{d}$, where d equals the density in individuals per unit area. The value of R is shown by Clark and Evans to exhibit a limited range with a lower limit of zero and an upper limit of 2.1491. Thus perfectly random, aggregated or regular patterns are described respectively, by R values of 1, 0, and 2.1491. Maximum aggregation occurs when all members of a population fall on the same locus and thus the mean distance to nearest neighbor is zero. Perfect uniformity exists when inter-individual distance is maximized. Under these conditions a hexagonal pattern is formed and each member of the population (except those at the periphery) will be equidistant from six other individuals.

A test of the significant departure of $\bar{r}_o$ from $\bar{r}_e$ is assesed by letting Z equal the standard variate of the normal curve such that $Z = (\bar{r}_o - \bar{r}_e) / \sigma \bar{r}_e$, where $\sigma \bar{r}_e$ equals the standard error of the mean distance to nearest neighbor in a randomly distributed population of the same density as the observed. The standard error ($\sigma \bar{r}_e$) as derived by Clark and Evans (1954) is expressed as:

$$\sigma \bar{r}_e = 0.26136 / \sqrt{nd} ,$$

where n equals the number of measurements and d is the density.

Another study of spacing behaviour of beach users has shown that the upper limit of R is influenced by linear environments such as beaches when densities are low (Brougham, 1968). This is based on the fact that under such conditions the primary assumptions associated with the nearest neighbor distance statistic are violated. The derivation of the formulae for $\bar{r}_e$ and also the upper limit of the R statistic, 2.1491, are based upon the assumptions of an infinite number of points and an unbounded surface. These assumptions are rarely, if ever met in practice. However, when the violation is extreme such as in Figures 3, 4, and 5 a hexagonal distribution does not maximize the spacing between points.

Figure 3. The distance between points is not maximized by a hexagonal pattern. (Adapted from Brougham, 1968)

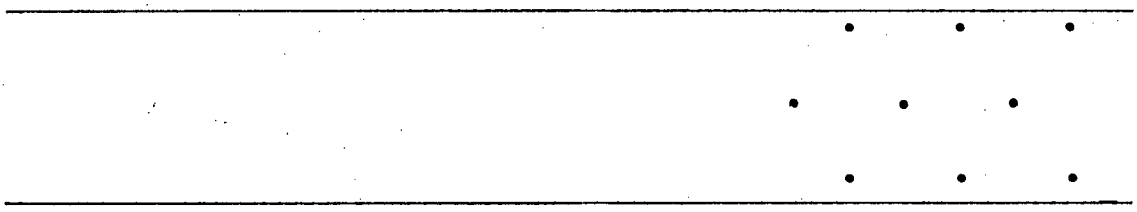


Figure 4. A pattern of equilateral triangles maximizes the inter-point distance.

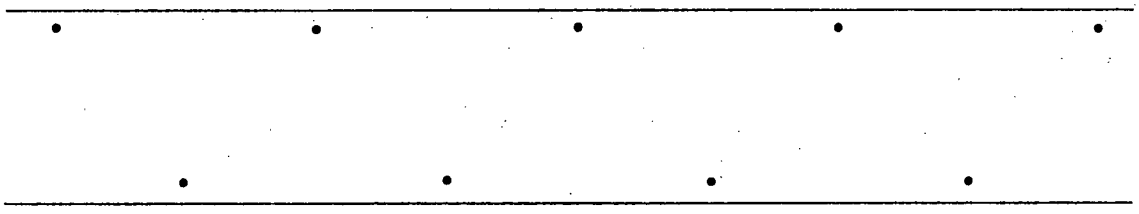
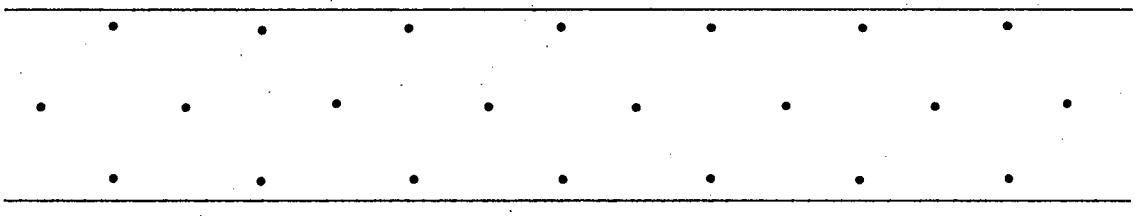


Figure 5. With more points in the same area, a pattern of squares maximizes the distance.



In a test of the effect of a linear, bounded surface with few points (81 points in an area 40" x 0.866") Brougham found that with a distribution similar to the one in Fig. 3, an R statistic of 3.0590 was obtained, a considerable deviation from the theoretical maximum value of 2.1491.

Since English Bay, Kitsilano and Skaha beaches reflect varying degrees of linearity and since much of the work depended upon an accurate assessment of pattern, the following procedure was developed: Because $\bar{r}_e$ must be an unbiased estimate of the mean distance between points scattered by some random process, a Monte Carlo simulation routine was used to place points across a rectangular representation of each beach. Although English Bay beach was not exactly rectangular, it was so considered for the purpose of the simulation. Errors introduced by this simplification seems small since the beach is a long, gently curving beach and is probably perceived as rectangular by users. For each run, the length and average width (with the same area as the actual beach in question was entered with the observed number of groups. For example, English Bay run number ten was observed to maintain an area of approximately 12,690 square meters (a length of 470 meters and an average width of 27 meters). For purposes of the simulation, the values used were the untransformed screen dimensions, i.e. the dimensions as taken from the projected image on the motion analyzer. The above values were: length = 152 cm., average width = 9 cm. and area = 1,368 square cm. The number of groups for run number ten as observed from the film was 76. Given the area dimensions and the number of groups the model was programmed to scatter these groups as points (centroids of polygons) in a random fashion over the available area. This process was iterated 100 times and for each iteration the average observed one to four nearest neighbor distances was calculated. This process was completed for all 27 runs and as a result of the iterative procedure each simulation produced a sampling distribution of means and therefore a reliable estimate of the true population mean nearest neighbor distance for each of the four orders. In addition, the process allows one to calculate the standard error of sample means ($\sigma \bar{r}_s$) to be used in place of the theoretical value as derived from the Clark and Evans method. The simulated mean nearest neighbor distance

for each run then becomes the expected value, $\bar{r}_e$, for that same run. The Clark and Evans model is therefore:

$$R = \bar{r}_o / \bar{r}_s$$

where $\bar{r}_s$ equals the mean of the simulated sampling distribution of the mean.

The results indicated a difference between the simulated and theoretical values especially at low densities and thus the method seems of worth for studies with similar physical constraints.

Since a large number of R values were calculated, an effort was made to simplify comparisons between runs by normalizing R according to the formula:

$$Z_R = (\bar{r}_o - \bar{r}_s) / \sigma \bar{r}_s$$

Using this formula any Z_R value between $\pm$ 1.96 indicates a random spatial pattern at the 0.05 probability level. Any value greater than 1.96 was considered a reflection of a regular pattern and any value less than -1.96 was considered clumped or aggregated.

Two strategies were employed to calculate the distance to nearest neighbor: (1) the centroid of each polygon was calculated and used as a point source for the 'R' statistic, and (2) 'nearest approach distance' calculated as the distance between the edges of any two nearest neighbor polygons. I predicted that the latter distance would be more responsive to any possible interactive effects due to psychological variables than the distance between group area centroids. This prediction was based upon reasoning which supposed that an individual or group probably decided where to 'settle' on the basis of distances between edges of groups rather than on center to center distances. The nearest approach distance was used as a dependent variable in that portion of the study designed to determine possible spatial group correlates of the various psychological indices; however, its use in the analysis of pattern was precluded for theoretical reasons. For example, in a recent paper Mohn and Stavem (1974) showed that for a Monte Carlo simulation of randomly spaced discs (red blood cells) in a haemocytometer, the poisson, binominal and hypergeometric models provided poor fits to the data. Although two of their models fitted the empirical results reasonably well, the fact that the sizes of the discs were relatively

uniform made their use in the present study difficult since the group areas were thought to be too variable to be applicable to their models.

Space-time study.

Since external features of the beaches such as bath houses, parking lots and refreshment stands seemed to exert a certain amount of influence over the general distribution patterns of beach users, an effort was made to determine the relative effects of these aspects of the beach environment. To maximize the range of observed densities the study took place at the Kitsilano site on a Saturday when crowds were expected to be large.

As mentioned previously, the Kitsilano study area extends in an east west direction with a parking lot near the east end and refreshment stand adjacent to the west end. Since these two features were at opposite ends of the beach, it was possible to determine their relative effects.

To determine the spatial distribution of users as the day progressed, hourly maps were made. To facilitate the mapping, the study site was divided into 20 quadrats 15.2 meters on a side with the outside corners marked with engineer tape. Maps were drawn to scale and at the appointed time the position and number of people in each group were placed on the sheet. The first census commenced at 1030 hours and a final count was made at 1530 hours, making a total of six separate enumerations. Plots of these data thus provided a time-series of the placement of each group over the study area. In this way effects due to environmental features such as the refreshment stand, parking lot and swimming pool could be ascertained.

Survey dissemination.

Two main factors influenced the choice of sampling methods for this phase of the research. First, since one of the primary goals of the study depended upon the coincident gathering of both overt and behavioural data relating to the distribution of beach users as well as subjective responses concerning various psychological variables, it was necessary to coordinate the aerial photography with the dispersal of the survey

booklets. This was accomplished by having the person distributing the surveys (surveyor), telephone the airport when the appropriate density was observed. At this time, the surveyor began distributing the booklets. When this was completed, a large brightly colored marker panel was situated in a predetermined spot thus signalling the aerial photographer to begin the photographic run over the study area. This method was found to work well except for low density situations. On most days the length of time which passed between low to medium density conditions was so short that a surveyor might begin handing out surveys at a low density, but by the time the aerial photographs were taken, enough new beach users had arrived as to make the density fall within the medium range. This problem was largely overcome by sampling on weekdays when the beach did not fill as fast.

The second aspect of the study areas which determined sampling procedures was the extreme length to width ratio of two of the three study sites. Because of this problem English Bay and Skaha were sampled in a slightly different manner than Kitsilano. The method developed for Kitsilano consisted of dividing the sunning area into six equally spaced 'lanes' which ran the length of the study site. Prior to distributing the booklets, the surveyor picked a number between one and six from a hat and used the corresponding imaginary line as the sampling transect. The surveyor then proceeded to distribute the booklets by pacing a prescribed number of paces. The person chosen was the closest individual in the closest group within the forward 180^{o} vision of the surveyor. If the person declined to complete the survey, the next closest group was chosen, and so on. After a subject had agreed to complete the questionaire, the surveyor returned to the transect and again paced the required number of steps before approaching the next potential respondent. This process was continued until ten surveys had been given out or, as happened occasionally at low densities, everyone had been asked. The number of paces between stops was determined by the length of the study area such that in most cases the complete length of the beach was surveyed.

This process was modified for English Bay and Skaha since they were so narrow that choosing 'lanes' was impractical. For these beaches the surveyor picked a midline path for the sampling transect and as with Kitsilano used the pacing technique to distribute the surveys evenly over the length of the beach.

The most important aspect of the dissemination of surveys was the need to assure that the respondents would be visually identifiable in the aerial photograph. This was accomplished with the aid of two foot square black and white marker panels, each with a distinctive pattern. After a potential respondent had been told of the purpose of the research, and had accepted the invitation to fill out the survey, the person distributing the surveys staked down the distinctive panel beside the individual or group and placed the corresponding marker panel symbol on the cover of the survey. Since the panel was visible in the aerial photograph, each subject's responses on the survey could be correlated with his or her spatial and group characteristics. Virtually no one questioned the significance of the panel, apparently believing it was necessary to guide the surveyor back to the spot when collecting the surveys.

The cover of the survey booklet contained a title 'Recreational Attitude Survey' as well as the purpose of the research and a short list of instructions. The planning aspects of the survey was implied by the label 'School of Community and Regional Planning, University of British Columbia.' The front cover also contained blanks for information which the surveyor obtained directly from the respondent. The light intensity on the beaches was characteristically high. To reduce eyestrain, the booklet was printed on blue paper.

Psychological and demographic information.

Briefly again, the survey of personal characteristics consisted of four parts: the Environmental Response Inventory (ERI), the Leisure Activities Blank (LAB), and a socio/demographic section and a mood adjective checklist (MACL). The ERI, LAB and socio/demographic profile were included to tap the more stable psychological dimensions, whereas the adjective checklist measured more transient mood states.

The Environmental Response Inventory.

The ERI consists of 184 statements or items which pertain to various aspects of designed and natural environments. To respond to these statements a subject circles the extent to which they agree or disagree with the item according to the following pattern: 1) SA = strongly agree, 2) A = agrees, 3) N = neutral, 4) D = disagree, and 5) SD = strongly disagree. On the basis of each subject's response pattern, a numerical score is obtained for the nine separate factors or dispositions. Documented on pages 21 and 22.

Leisure Activities Blank.

McKechnie's (1973) stated goal in producing the LAB was to present "a summary picture of a respondent's self-reported past recreation and leisure behaviours." This he accomplished by developing a list of 121 leisure activities which he felt comprehensively surveyed the currently popular recreation pastimes in the United States. The response format used in the present study is similar to the one developed by McKechnie except where he used a four point response scale, I used five. The response format which differed from McKechnie's was, " you occasionally participate in the activity at this time." The addition of this statement allowed for five response types and thus conformed with the ERI in this regard. The response format was developed as follows:

> Below is a list of leisure and recreational activities. For each activity indicate the extent of your participation using the following system:
>
> N - You have never engaged in the activity.
> T - You tried it once or a few times.
> U - You used to do it regularly, but not no longer do it regularly.
> O - You occasionally participate in the activity at this time.
> R - You currently participate regularly in the activity.
>
> Check the appropriate blank to indicate your participation in each of the following activities:

In addition to the 121 leisure activities space was provided for additional activities which the respondent participated in but which was not included in the list. In McKechnie's sample of 288 subjects and for the present study only a few additional activities were mentioned.

Socio-economic Variables.

In order to ascertain the degree of association between demographic and socio-economic variables with beach behaviour, a series of ten questions concerning the following categories were asked:

1. age
2. sex
3. marital status
4. number of children
5. number of siblings
6. education
7. number of years residing in six different sizes of urban centres (6 variables)
8. number of automobiles
9. occupation
10. household income

An additional question tapped the amount of leisure time spent in the urban environment, and in rural environments. This variable was included to test whether persons who spend a majority of their time in non-urban activities have a higher need for space than those participating in predominantly urban activities.

Mood Adjective Checklist.

The mood adjective checklist was developed by Lorr et al (1967). This survey consists of 60 adjectives which act as descriptors of various mood conditions. When these adjectives were factor analyzed by Lorr and his associates, eight factors emerged. Individual factors are listed on page 27. The survey used for the present research used only 59 adjectives rather than 60, since the adjective 'elated' was mis-typed as 'hated' and as a consequence was dropped from the analysis. A re-factoring of the

adjectives as used for the present study produced essentially the same factors as Lorr et al (1967) and as a result their factors were used to calculate respondent scores for the mood scale.

The checklist was made as an optional part of the survey, and each respondent chose whether he wished to complete this section. This final section was titled an 'Optional Word List Survey' and the response format was as follows:

> If you feel you have any extra time there is an optional survey below which consists of 60 words which describe how you may feel at this time. The survey takes about five minutes, and is designed to measure your personal feelings at this time. If you wish to complete the survey, for each word merely circle the number which best indicates how you feel at this moment according to the following scheme:
>
> 1. Not at all
> 2. A little
> 3. Moderately
> 4. Strongly
> 5. Extremely
>
> Work quickly -- first impressions are usually the most accurate.

Each adjective was followed by numbers from one to five and a respondent merely circled the number most nearly approximating his immediate feelings.

CHAPTER IV

SPACING BEHAVIOUR ON PUBLIC BEACHES: ANALYSIS OF RESULTS.

User distribution and external environmental features.

A primary assumption of this study was that a beach represents an isotropic environment free from artifactual constraints. However, initial observations suggested that users did respond to certain aspects of the beach environment, namely, bath houses, parking lots, and refreshment stands, especially at lower densities. In an attempt to quantify these observations I carried out a space-time study of the distributional pattern of users for the Kitsilano site for one complete day. (See methods)

The results of the census are represented by six separate plots (Figs. 6 -11), each the result of a single hourly census. A group's position is indicated by a dot and the diameter of the dot is proportional to the number of persons in the group. Only those groups which were actually present during any one census are represented by each figure.

Referring to the figures in succession, the first people to arrive tend to locate near the west end, close to the refreshment stand and densities continue to be higher in this area throughout the day. It also seems that larger sized groups tend to concentrate in this area as well.

Although these results tend to suggest that for Kitsilano there are behavioural effects due to certain physical structures surrounding the beach, later results indicate that the effect is slight since at no time did the pattern statistic (R) suggest an aggregated pattern was present for any of the three beaches studied. The most probable explanation is that environmental features such as refreshment stands exert a small attractive force but the repellent force of situating near other groups quickly becomes the dominant determinant in the site selection process of newly arriving groups.

Density and spatial pattern.

The testing of the first hypothesis and its corollary are the subject of this and the following section. To re-orient the reader they are restated below:

Figures 6 - 11. Spatial characteristics of beach users over time.

Figure 6. Time - 1030 hours, Density - 11 groups/hectare

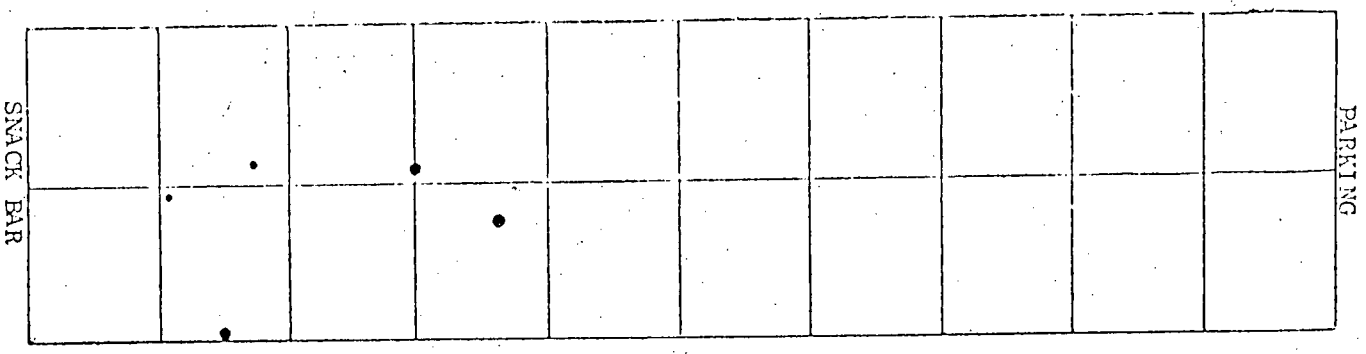


Figure 7. Time - 1130 hours, Density - 42 groups/hectare

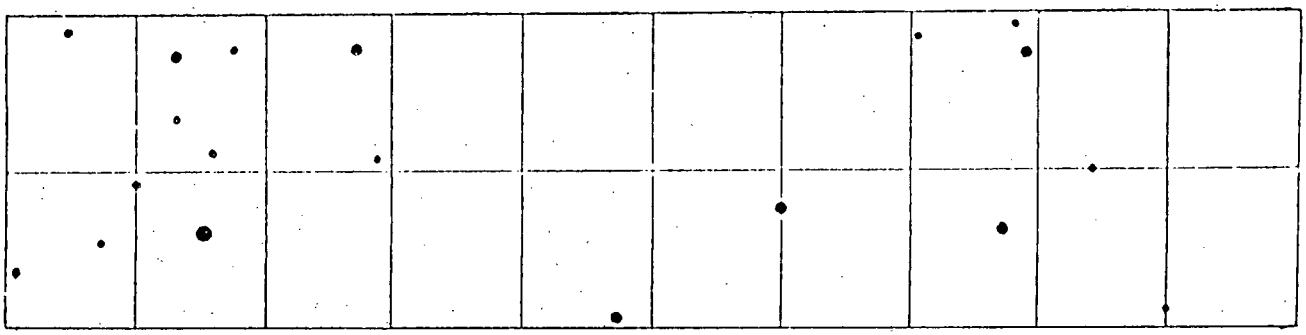


Figure 8. Time - 1230 hours, Density - 86 groups/hectare

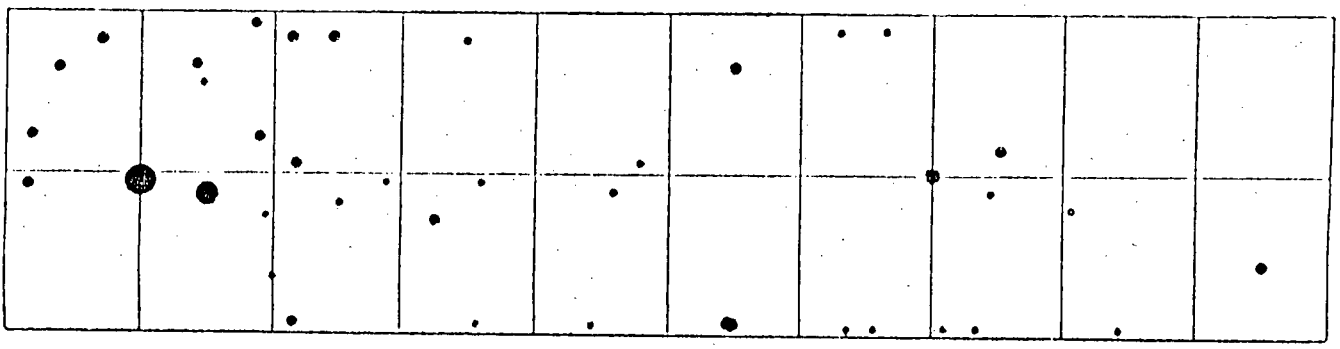


Figure 9. Time - 1330 hours, Density - 139 groups/hectare

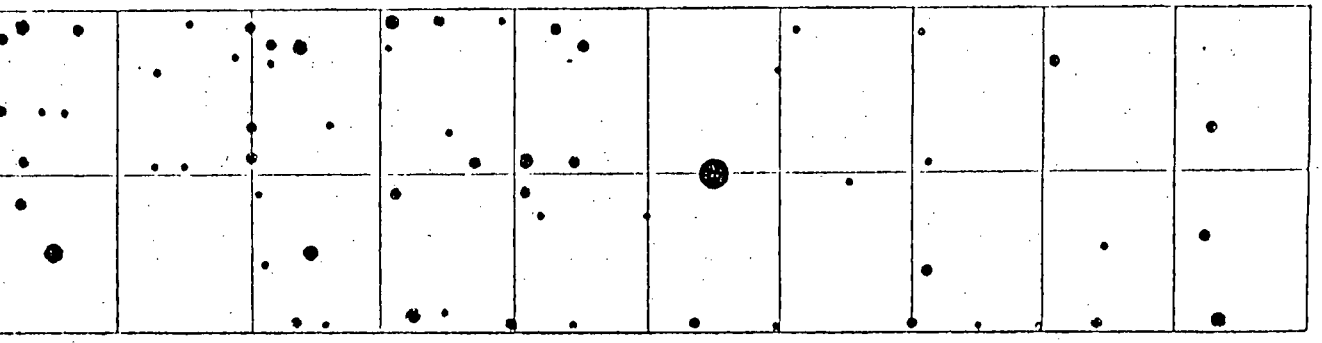


Figure 10. Time - 1430 hours, Density - 188 groups/hectare

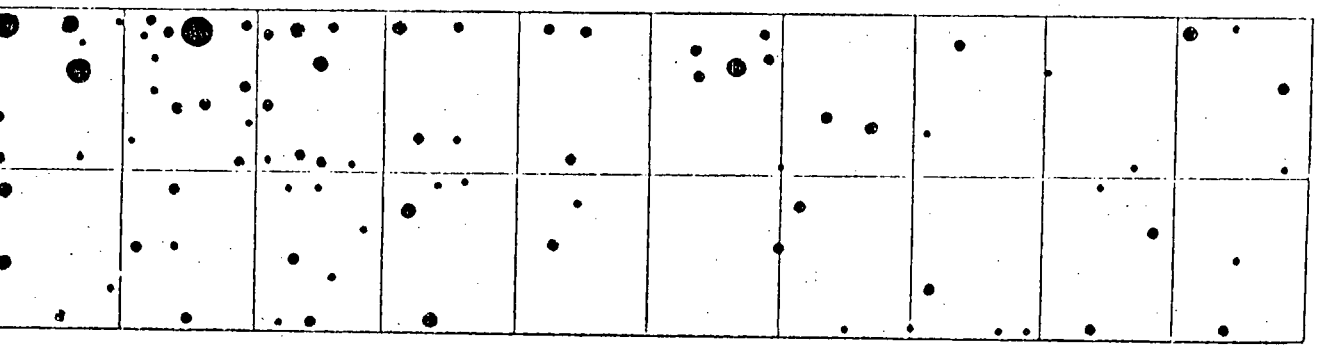
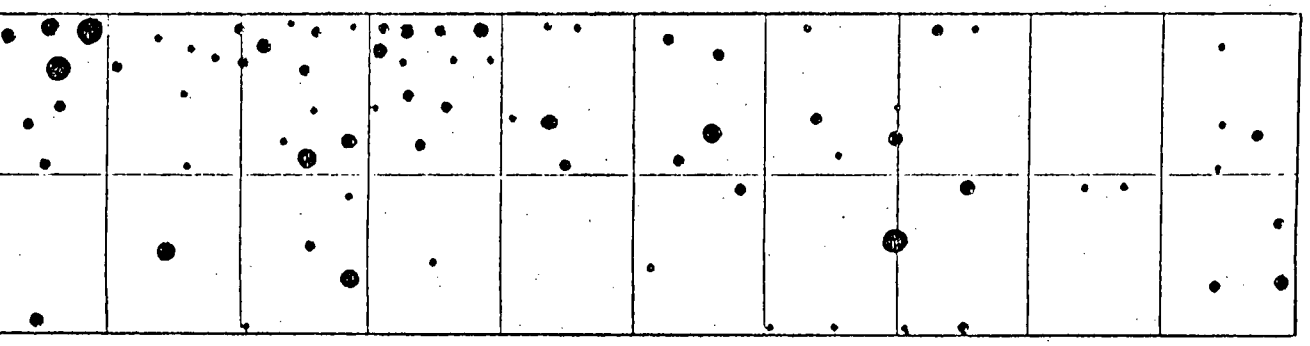


Figure 11. Time - 1530 hours, Density - 168 groups/hectare



Hypothesis: At low to moderate densities, distances to nearest neighbor will be greater than 3.7 meters, however, as space becomes limiting at higher densities, distances will approach a minimum value between 2.1 and 3.7 meters.

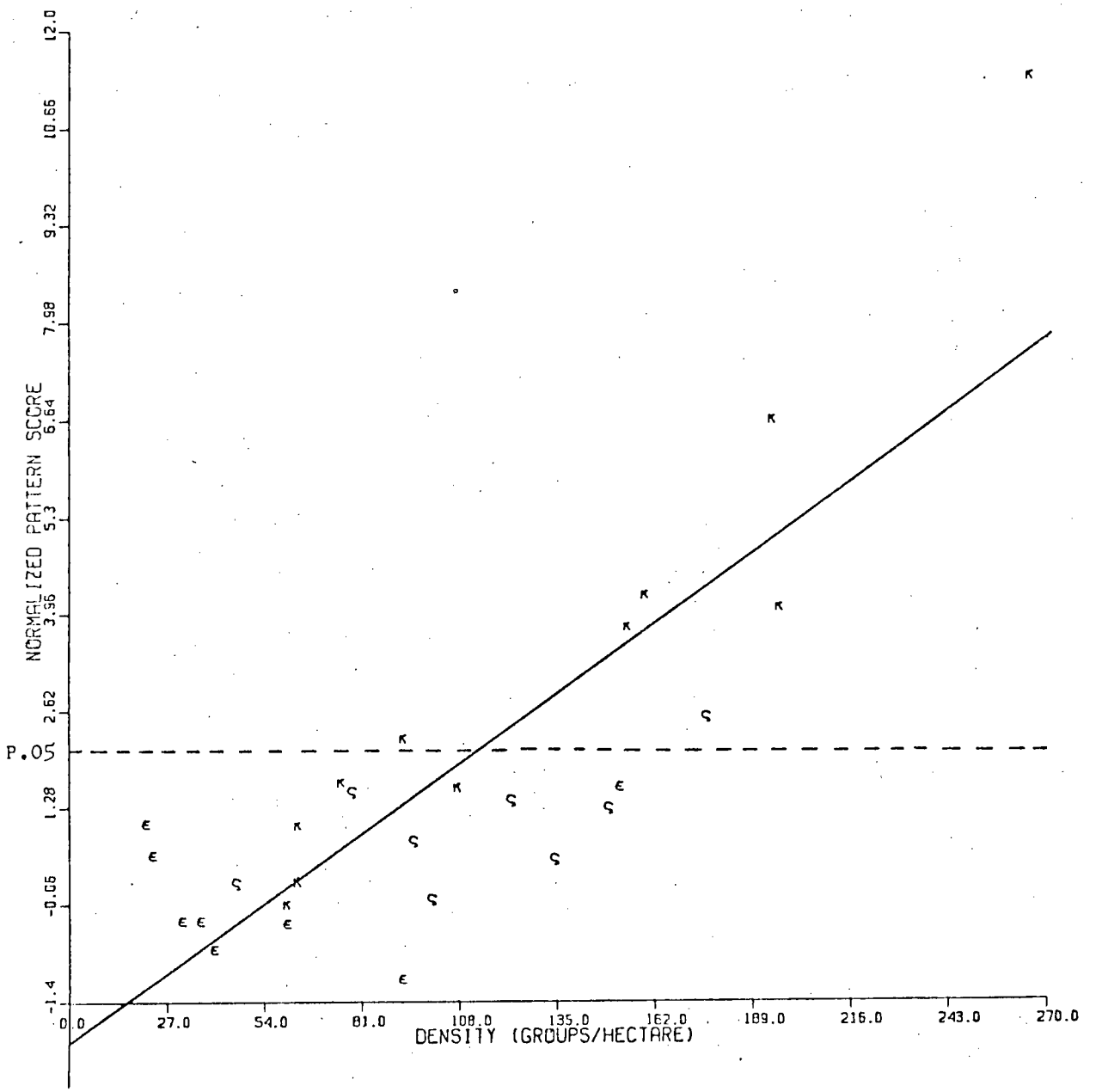
Corollary: The distribution of groups over the beach will approach a random pattern at low densities and as density increases the distribution of groups will exhibit an increasingly regular pattern.

The results relating to the corollary will be discussed first.

To test the relationship between density and pattern, the normalized R statistic (Z_R) was calculated from nearest neighbor distance data covering 1791 groups for 27 separate photographic runs. Inspection of Fig. 12 reveals a basically linear relationship between density and Z_R (points fitted by least squares regression). These data further indicate a continuous trend from a random pattern toward a regular distribution, that departs significantly from random ($p \leq .05$) at 110 groups/hectare. Although basically confirming the corollary relating density to pattern, I must point out that except for one case (Skaha), only Kitsilano regularly reached densities sufficiently high to exhibit a Z_R value greater than 1.96. This factor does not seriously detract from the validity of the results since the overall trend is basically linear and it seems justified to expect that if higher densities could be sampled from these other sites they would show the same trend as Kitsilano. (See Appendix D for photographs of typical spatial patterns of users as a result of different density conditions)

These results suggest several implications relating to site selection and the relative influence of other users on this behaviour. The results lend support to the argument that within a density range of 20 - 110 groups/hectare, beach users are able to select a site based on internal needs and preferences without reference to other groups. In addition, since an aggregated pattern was not observed, major characteristics of the physical environment do not exert a significant effect. Thus if one views available space on the beach as a resource, then the first group or individual to arrive at the beach has unlimited freedom to exploit this resource. As each new group arrives and chooses a site, the "degrees

Figure 12. Relationship between density and pattern.



Pattern is measured by the normalized 'R' statistic (Z_R). The dashed line represents the .05 probability level for a regular pattern. $r^2 = 0.67$, $Z_R = -1.88 + 0.03$ (d), where d equals the density in groups/hectare. K = Kitsilano, S = Skaha, and E = English Bay.

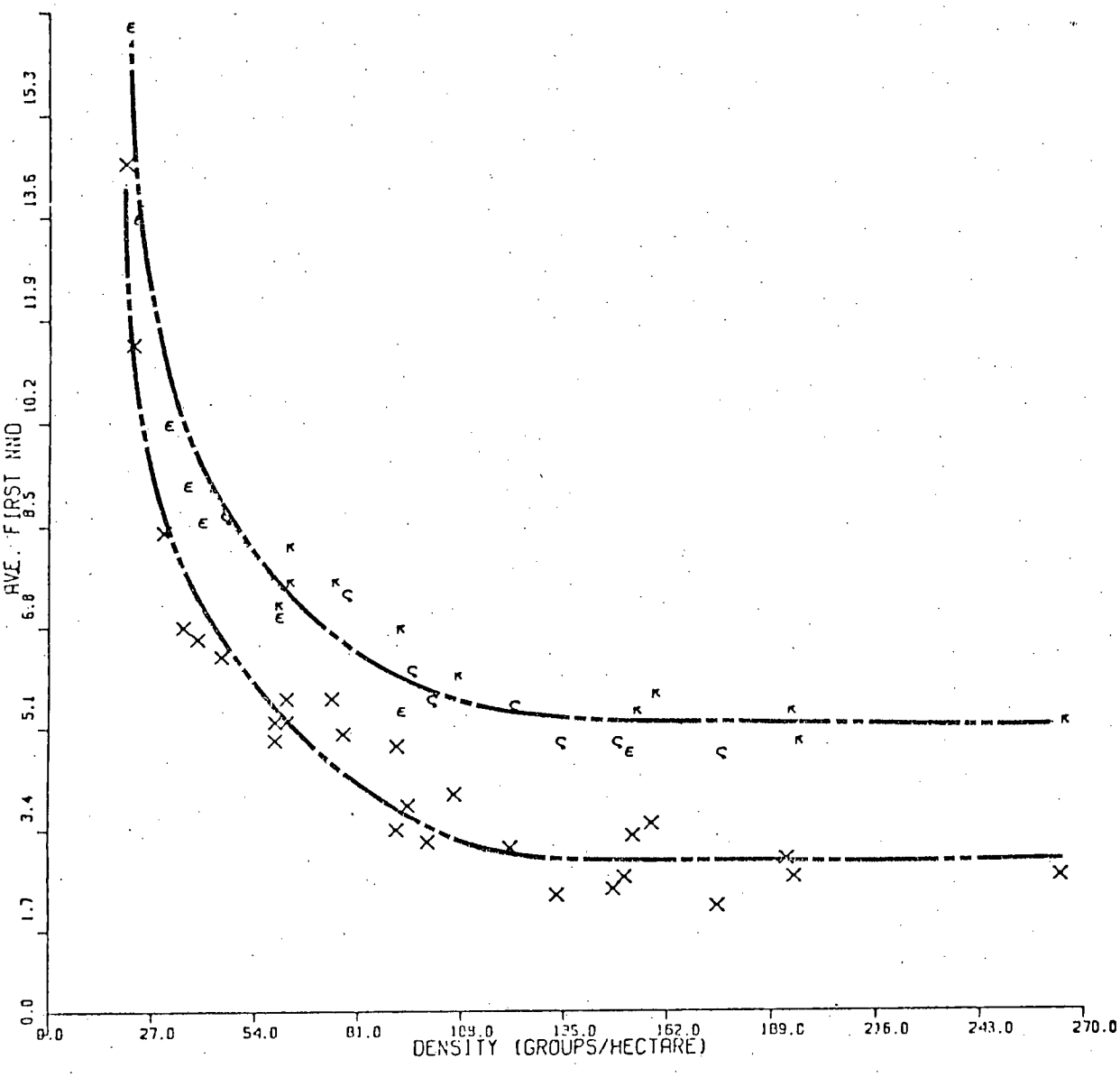
of freedom" for a subsequently arriving group have diminished, i.e. the physical space taken up by a group, plus as I will show in a later section, a certain amount of space surrounding the group, is not available for use by any other group. However, since the pattern is basically random for densities less than 110 groups/hectare, it seems evident that groups arriving within this density range have enough "degrees of freedom" or options available to them to select a site according to personal preferences, relatively uninfluenced by the social and psychological factors relating to space needs and preferences.

Further, as densities exceed 110 groups/hectare, there is a decreasing probability that any newly arriving group can locate solely on the basis of personal preferences without regard for their own spatial needs, i.e. other groups are the major influence with respect to site selection. The degree to which these spatial needs become primary is reflected in the extremely high Z_R values associated with higher densities. Since these values indicate an extremely low probability that the pattern regularity is due to chance, users arriving at the beach must choose to locate with reference to in situ groups such that distances between the chosen spot and near neighbors are maximized. This inter-neighbor distance and how it is influenced by density forms the basis of the following section.

Density and distance to nearest neighbor.

An analysis of the average distance to nearest neighbor (nnd) was carried out to test the hypothesis that spacing behaviour of beach users is related to density and that average nearest neighbor distance at a given density is related to cultural norms and proper social functioning. To make this test it was necessary to examine the relationship between the average nearest neighbor distance for all runs on all beaches and the density at which each run was completed. Figure 13 is a graphical representation of these data where the two curves shown are: 1) the average distances between polygon centroids of nearest neighbor groups, and 2) the average distances between the edges of nearest neighbor polygons. These measures are termed average centroid to centroid nearest neighbor distance (cc/nnd) and nearest approach nearest neighbor distance (na/nnd) respectively. (See page 39 for details of these distance measures).

Figure 13. Average distance between first nearest neighbors (NND) plotted against density for 27 runs.



The symbols E, K and S refer to the three study sites, English Bay, Kitsilano, and Skaha for the centroid to centroid NND. The points denoted by X refer to the measure nearest approach NND, whereas the letters E, K and S refer to centroid to centroid NND. Distances are in meters and the sample is based on 1791 groups.

The first aspect of Figure 13 to note is the existence of a constant relationship between the two measures of nnd such that the average difference between corresponding values of cc/nnd and na/nnd is 2.2 meters (S.D. = 0.23).

The relatively small standard deviation about the mean difference between cc/nnd and na/nnd is explained by two other results relating to group size and space characteristics. First, over 83% of all persons observed on the three sites were found in either one or two person groups and second, the average group area for one and two person groups as delineated by a group's possessions does not change appreciably over the observed density range.

Most important, Figure 13 shows that nnd becomes asymptotic to the x-axis (density) at about 110-120 grps/ha., i.e. within an observed density range of 110 - 264 grps/ha the average cc/nnd remains constant at 5.0 meters (S.D. = 0.36) and the average na/nnd is 2.7 meters (S.D. = 0.45). Thus within the 110-264 grps/ha density range, most groups maintain an edge to edge distance of about 2.7 meters which remains invariant despite density. Since the distribution, even though statistically regular, is patchy, newly arriving groups can "fit" into the remaining spaces or holes.

Figure 12 shows that the pattern of spacing becomes statistically regular ($Z_R \leq 1.96$) at about the same density as nnd becomes asymptotic i.e.,110 groups/hectare. This fact is important since it is possible to conceive of beach users exhibiting a regular spatial pattern while continuing to decrease the distance between nearest neighbors until the point is reached where groups' spatial boundaries touch their neighbors and average na/nnd is zero. However, this did not occur. At approximately 110 groups/hectare beach users have adapted to the influence of crowded conditions on the beach, and have done so by maximizing the distance between their near neighbors thus producing a regular distribution. The distance between neighbors remains constant above this density suggesting that there is a limit to the compressibility of any group's spatial preferences.

The limit to the compressibility of space preferences as demonstrated above was 2.7 meters. This value (na/nnd) is the average distance between the edges of two neighboring groups' marked space at densities greater than 110 grps/ha. and lies near the mid-point between the extremes of Hall's (1966) social distance zone (far phase). These results are thus consistent with the first hypothesis which stated that at higher densities distance to nearest neighbor would approach a minimum value and that this distance would fall within Hall's social distance zone (far phase).

These results suggest that individuals and groups adapt to increasing density by maintaining a minimum 'bubble' of space around themselves. This minimum distance between neighbors is likely related to the control of unwanted social interaction and may thus be a privacy regulation mechanism. This proposition is consistent with Hall's (1966) claim that, for North Americans, the social distance zone (far phase) is often used to screen or insulate one person or group from another.

In summary, the results relating to the effects of density on spatial pattern and distance to nearest neighbor indicates that for the three beaches studied, users respond to increasing numbers of others in characteristic ways. First, at low densities the observed spatial pattern is random and thus it is proposed that effects due to other groups (social effects) are minimal. Further, since the choice of a site seems not to be affected by other groups, users maintain more degrees of freedom in the process of selecting a site. Second, as density increases space becomes a limiting factor with respect to site choice. This is reflected in the existence of a statistically regular pattern as well as a constant average distance to nearest neighbor at densities greater than 110 grps/ha. Finally, a mechanism is proposed to explain these findings which relates inter-group distances to the control of social interaction.

CHAPTER V

GROUP CHARACTERISTICS

Marked group area and density.

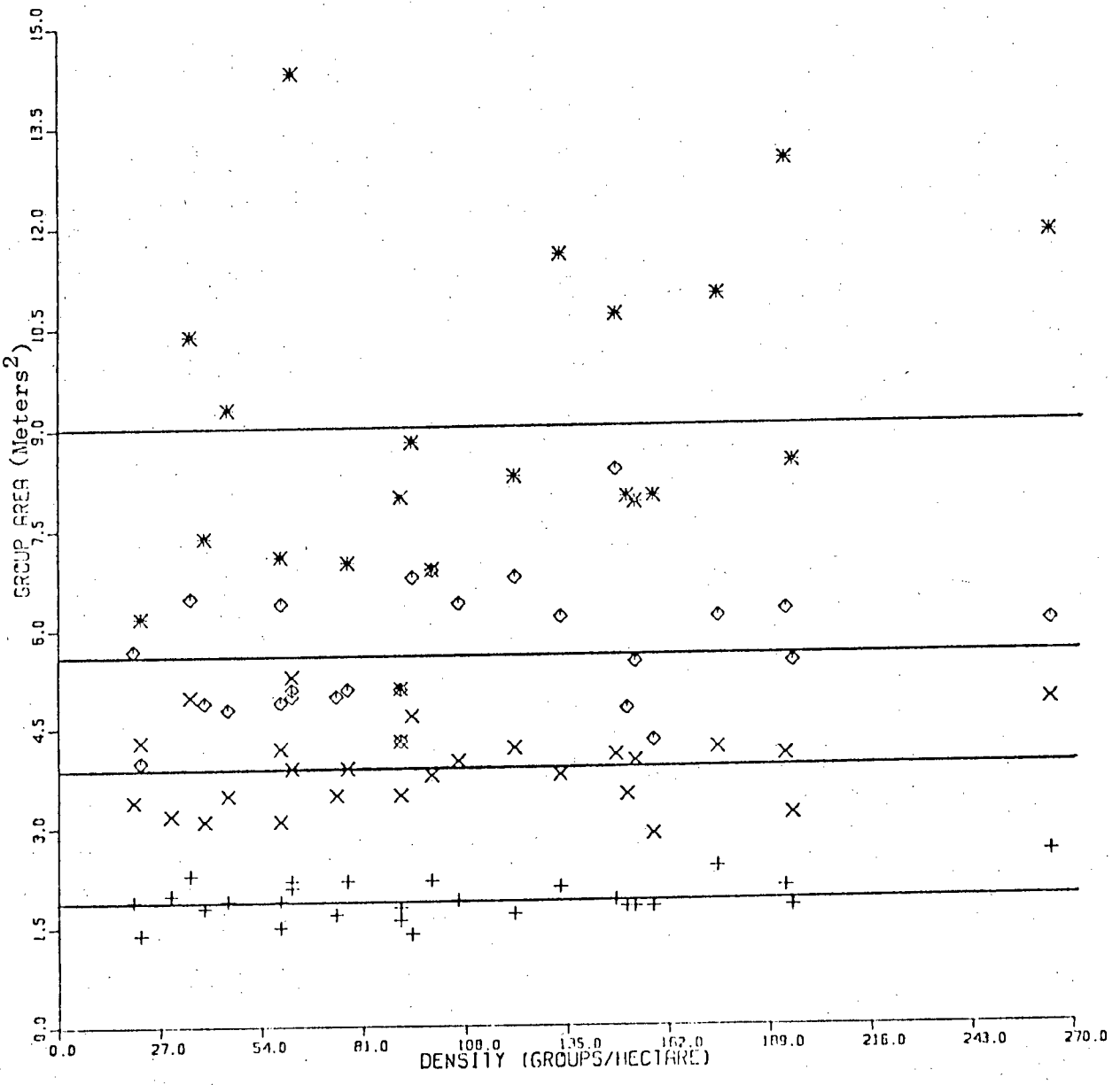
Although not tested as specific hypotheses, several aspects of the group size and group area of beach users are presented here since they are relevant to calculations in the following chapter on maximum beach population size.

A group's area was defined previously as the area circumscribed by the sides of a polygon, the vertices of which were beach paraphernalia, possessions owned or shared by a group, or in many cases the bodies of users themselves. Possessions used in this way have been termed spatial or "territorial" markers (Sommer and Becker, 1966; Becker, 1973) and for the present study, the area included within these objects has been operationally defined as a group's marked space.

Are the marked areas of groups influenced by density? Figure 14 indicates that for group sizes of from one to four persons, density had little or no effect on the marked area for a given size group. These results suggest that groups do not decrease the size of the marked space as a way of adapting to increasing density. These and other previous results suggest that tactical space-saving maneuvers may not be necessary on the part of in situ groups since new arrivals seem reluctant to situate within the 2.7 meter zone referred to earlier.

Another result expressed by Figure 14 is that the mean group area grows in linear proportion to the number of people for groups of one to three persons. Table 5 shows that for these group sizes (1 - 3), the space utilized increases by approximately two square meters for each group size. The next four group size classes (4 - 7) increase by amounts ranging from 2.6 to 3.4 square meters. These latter values must be viewed with caution however, since sample sizes are small and standard deviations substantial. These data may be explained in two ways. First, each person may bring to the beach a certain requirement for space which remains uninfluenced by the proximity of other individuals and groups. Such spatial needs if real would then be functionally related to the personal space construct of Hall (1966) and Sommer (1969). Second, since beach equipment such as towels and blankets are relatively uniform in size and shape, these articles may determine the spacing of individuals within a group. These may not necessarily be competing explanations since users

Figure 14. Density and group area.



Means for one to four person groups represented by solid lines. Lone individuals (+); Two person groups (X); Three person groups (◇); Four person groups (✳).

may choose towels, blankets, etc. which reflect personal space needs and preferences.

In a test of a possible relationship between marked space and the distance between neighboring groups (nearest approach nnd), analysis by simple correlation produced an r value of -0.07. This result suggests there is no clear relationship between the size of the marked space and the distance between the edges of neighboring groups' marked areas.

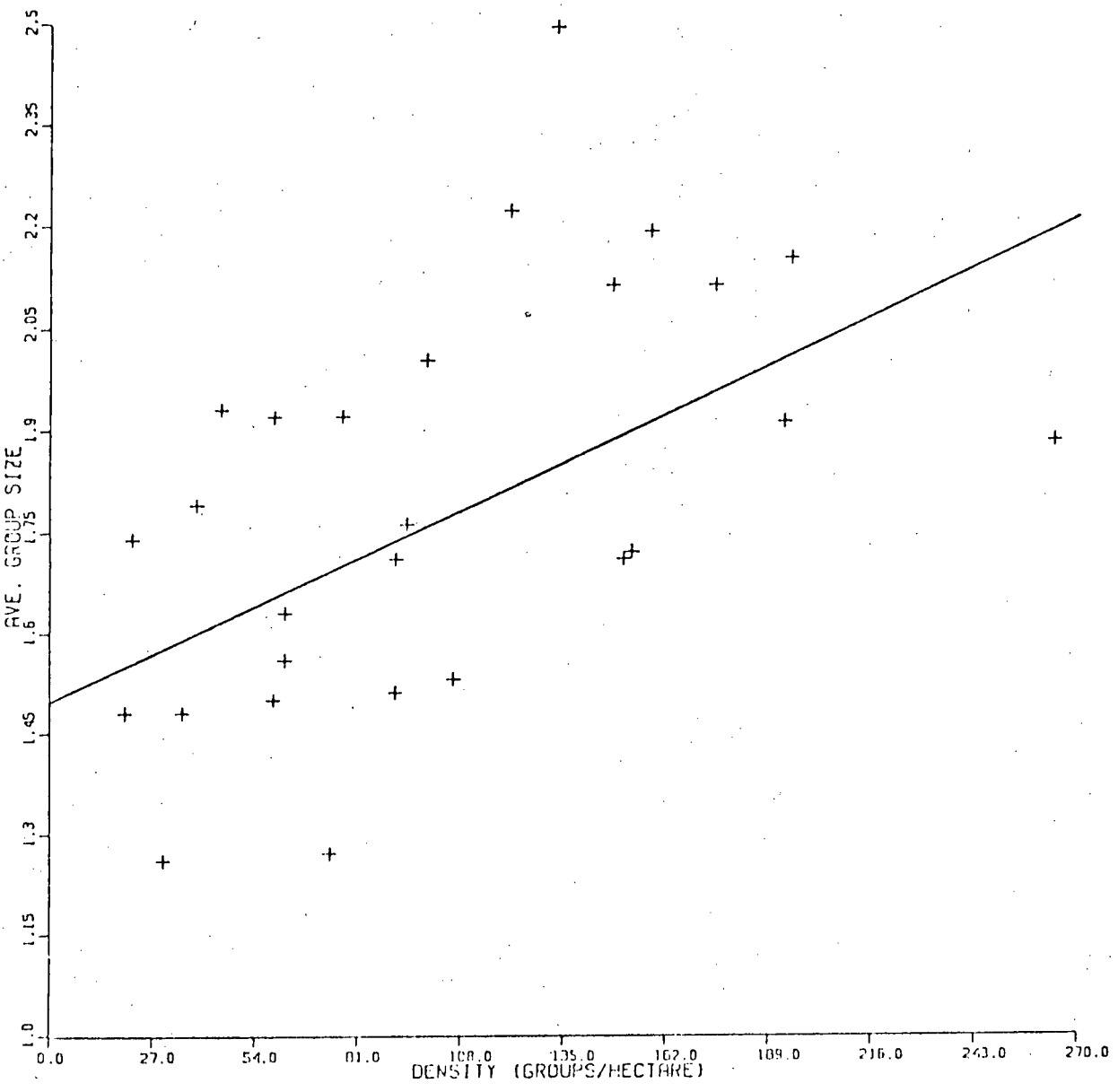
Table 5: Group Area Related to the Number of Individuals in a Group

Group Size Class	1	2	3	4	5	6	7	7	Total
Mean (meters^2)	1.9	3.9	5.7	9.0	12.1	14.7	18.1	11.1	3.8
S. D.	1.0	2.0	3.3	7.7	11.4	10.7	26.6	4.1	3.4
N	828	664	155	102	22	10	8	2	1791

Density and group size.

A final characteristic of beach user groups worthy of mention, concerns the relationship between density and the number of individuals in a group (group size). Analysis by simple linear regression indicates a moderate increase in group size as density rises ($r^2 = 0.29$, $p \leq 0.01$). Figure 15 shows this result graphically. This result leads one to speculate that individuals or groups come to the beach at low densities because of a high need for privacy or for the solitude which these times afford. Evidence from the survey results however, does not support this hypothesis. For example, the ERI scale 'need for privacy' only correlated -0.06 with nearest neighbor distance measures. Other possible causes of this relationship may be related to the temporal and structural dynamics of group formation, however this relationship was not tested and therefore remains hypothetical.

Figure 15. Density and group size.



n = 1791 groups for 27 runs over three beaches. (r^2 = 0.29, $p < 0.01$)

CHAPTER VI

CARRYING CAPACITIES AND THE BEACH EXPERIENCE

Introduction.

Previous results indicated most people on a public beach respond to increasing density by choosing sites with at least 2.7 meters between their own and neighboring groups' marked areas. From other research it seems likely that this distance is functionally related to the regulation of social interaction. Thus it should be possible to calculate the maximum population size which each beach could sustain and still allow users the benefit of this minimum space requirement.

Resource managers often refer to the carrying capacity of a site or geographical region. As the term applies to recreation, it generally refers to the number of persons (level of use) which a resource can support without a loss in user satisfaction and without a decrement in the quality of the physical environment. (For a review of the carrying capacity concept see Verburg & Rees, 1975) For the purpose of calculating maximum tolerable use rates for the present study, I have disregarded effects due to the user on the physical environment, since other than litter, the environment seems resilient to high intensity use rates. Of course for beaches with vegetated dunes, effects due to overuse could be severe.

Before proceeding with the results of these calculations several terms require clarification:

* Group size - the average number of individuals per group for all observations at each of the study sites.
* Marked group area - the average observed space subtended by (lying within) the personal possessions of user groups.
* Minimum group space - the calculated group space requirement (in addition to marked space) based on the average nearest neighbor distance values for densities $\geq$ 110 groups/hectare.
* Maximum carrying capacity estimate - the number of average size groups which each beach could sustain, based upon observed spatial behaviour.
* Load factor - a value representing the extent to which each site reached its maximum carrying capacity.

Carrying capacity and the response to density.

The calculation of the carrying capacities for each of the three sites requires knowledge of the average centroid to centroid nearest neighbor distance for densities exhibiting a constant nearest neighbor distance, i.e. densities $\geq$ 110 groups/hectare. Since capacity estimates required a constant representation of the average group areas, I chose a regular hexagon as a suitable geometric shape for this purpose. This shape approximates a circle (a study by Edney and Jordan-Edney, 1974 suggested the areas claimed by beach users approximated a circle), however in contrast to circular areas, hexagons leave no space unaccounted for.

For purposes of calculating the carrying capacity estimates, the distance between any two nearest neighbor group's marked space boundaries was considered to be shared evenly, i.e. each group maintained jurisdiction over one-half the intergroup space. In reality, this space is most likely perceived by users as common property with each group utilizing the space jointly. In any event, the equal space assumption above is merely utilized for calculation purposes and is not meant to convey the existence of such behaviour.

Figure 16 is a conceptual representation of the spatial configuration of any two average groups at or above 110 groups/hectare. The smaller of the two hexagons simulates the 'marked area', whereas the larger is a representation of the minimum spatial requirement of the group. To calculate the minimum spatial requirement of a group (large hexagon), one need only calculate the area of the triangle ADE and multiply by six. Referring to figure 16, the altitude of the triangle ADE is equivalent to one-half the centroid to centroid distance AA'. Knowledge of the altitude AC, allows one to calculate the area of the triangle ADE by the formula $Area = h^2 / \sqrt{3}$ where h equals the altitude AC. The maximum carrying capacity (# of groups) is therefore the area of the beach divided by the minimum space requirement (large hexagon).

Table 6 contains the results of these calculations as well as the maximum densities at each site which were observed during the study. By comparing the maximum theoretical population density for each beach with the highest observed density (load factor), it is readily apparent that at no time did any of the sites reach these limits. Kitsilano maintained the highest recorded density (264 grps/ha). During this

Figure 16. Hypothetical representation of two neighboring groups' "marked" and "minimum" space boundaries.

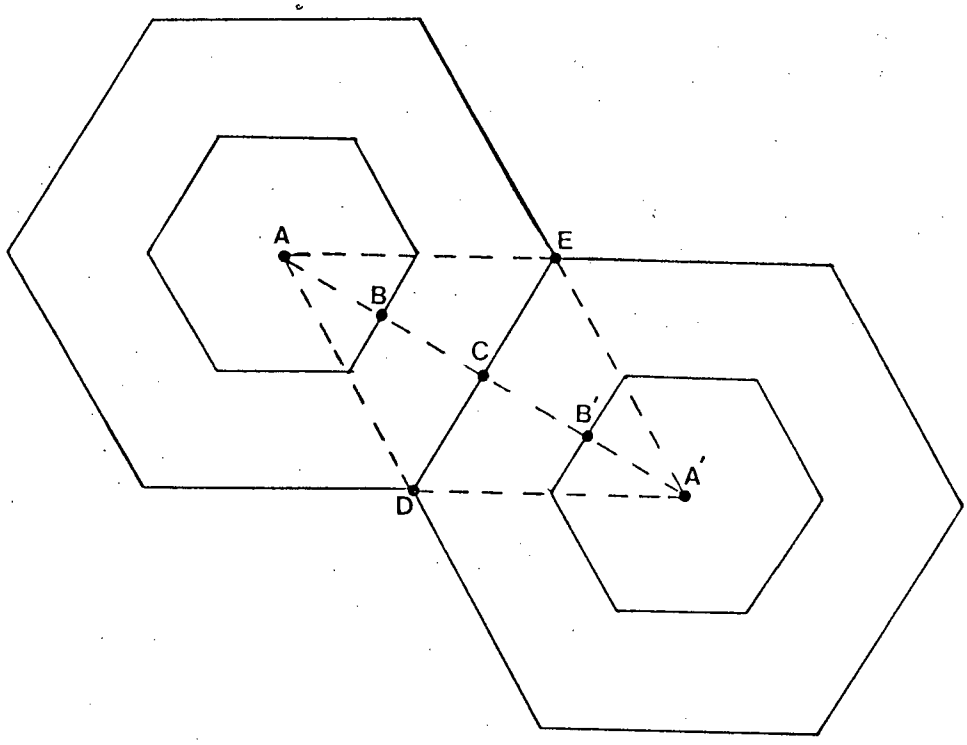


Table 6. Maximum beach population estimates.

	E. BAY	KITSILANO	SKAHA
Beach Area (meters^2)	11967	4522	6500
Group Size	1.6	1.8	2.1
Marked Group Area (meters^2)	3.0	3.9	4.5
Minimum Group Space*	21.7	21.7	21.7
Maximum Carrying Capacity of Beach (number of groups)	551	208	299
Maximum Carrying Capacity (groups/hectare)	461	461	461
Maximum Observed Density	151	264	175
Load Factor (observed/maximum)	33%	57%	38%

* Based on average nearest neighbor distance values across beaches for densities $\geq$ 110 groups/hectare.

period the beach was 57% of the estimated maximum carrying capacity. English Bay and Skaha beaches maintained densities which were only 33% and 38% respectively, of their estimates. These results suggest that even at the highest recorded densities newcomers were still able to locate in a spot which would allow them the minimum intergroup distance (nearest approach nearest neighbor distance) of 2.7 meters. This is an important point since it suggests that a density was never reached where all open space was utilized, thus forcing newcomers to locate within the spatial boundaries of others.

Note that if beach densities exceeded carrying capacity estimates derived above, the distances between neighboring groups would be reduced sharply. For example, if an 'average group' were to locate midway between neighboring groups at the maximum carrying capacity density, there would remain but 0.3 meters between the edges of any two of the three groups in question. Such distances fall within what Hall (1966) classifies as the 'intimate distance - far phase'. He characterizes this zone by stating that the use of such distances in public is not considered proper by most adult North Americans. He goes on to state however, that in many situations such as crowded elevators, trains, buses, etc., other tactics are used which serve to decrease visual and body contact. It seems probable that as such densities are approached, most users of a public beach facility would search for another site or return home, thus foregoing the experience rather than subjecting themselves to such close interpersonal distances. Of course beaches do exist where such high density conditions occassionally occur. It is likely that for these sites, users are highly motivated to participate either because no other sites are available or for reasons relating to costs involved in reaching the beach. Beaches where such levels of crowding occur would provide ideal environments for studying the range of tactics used by persons and groups in order to cope with personal space violations which occur at these extreme densities.

The above results are important since they demonstrate the effectiveness of using actual participant behaviour to arrive at carrying capacity estimates. What is apparent is that for the areas studied, users rarely select sites which violate prevailing social norms with respect to appropriate spacing behaviour. Since we assume that this behaviour serves

some basic social function, the manager or planner of such facilities may make policy decisions based on the needs and preferences of users themselves. In this way the decision maker can be reasonably well assured of adequately serving the interests of the greatest number of people without detracting seriously from the quality of the experience. Using this criterion, we may speak of optimal solutions to design and management problems. Of course, at such densities individual satisfaction may not be maximimal, however a satisfactory experience can be expected to be provided for the largest number of people. Such behaviourally based guidelines would surely serve as an improvement over more arbitrary techniques commonly used in the past.

CHAPTER VII

PREDICTORS OF SPATIAL BEHAVIOUR: ANALYSIS OF SURVEY RESPONSES

Predictors of spatial behaviour - all groups.

Results in a preceeding section indicated the existence of a minimum intergroup distance which was associated with high density conditions. This distance was in turn postulated as a mechanism by which people control social interaction. The purpose of the following section is to present evidence which demonstrates that certain psychological dispositions, mood states and socio-economic characteristics are related to spacing and group behaviour.

A total of 329 surveys were distributed (English Bay - 105, Kitsilano - 127, Skaha - 97) of which 23 were unuseable and 46 deleted due to camera malfunction or because the marker flag was not visible in the photograph. Of the 266 surveys remaining, 84 were from English Bay, and 99 from Kitsilano and 83 from Skaha.

The data were analyzed by a stepwise multiple regression program with an F probability to accept and reject potential independent variables of .05000 and .050001 respectively. Forty-eight independent variables (ERI - 8, LAB - 7, Mood - 9, Socio-economic - 24) were used as potential predictors of three dependent variables (two measures of nearest neighbor distance, and the area marked by a group).

Table 7 shows the partial correlations at the first step in the regression analysis as well as the final R^2 values for the dependent variables. Inspection shows few significant correlations and characteristically low predictability of target variables. Although discouraging, these results suggested an alternate approach which focussed attention on response patterns of solitary individuals not part of larger groups.

Lone Individuals - A second look at the data.

The analysis of survey data for lone individuals was based on the argument that solitary persons are probably more in control of where they locate, since in groups the decision may be made by someone other than the respondent, or may be a collective decision which does not exactly reflect the desires of the person completing the survey. Similarly, if only one individual in the group makes the decision as to site location, then as group size increases there exists a decreasing probability

Table 7. Initial partial correlations, F probabilities and final R^2 values for three dependent variables. (all group sizes considered - approximate degrees of freedom = 207)

VARIABLES	GROUP AREA		CENTROID TO CENTROID NND		NEAREST APPROACH NND	
ERI	Partial Corr.	F Prob.	Partial Corr.	F Prob.	Partial Corr.	F Prob.
PASTORALISM	0.322	< 0.001	0.022	0.748	0.008	0.875
URBANISM	0.060	0.396	0.059	0.406	0.078	0.265
ENVIRONMENTAL ADAPTATION	0.065	0.353	0.017	0.796	0.018	0.786
STIMULUS SEEKING	0.001	0.937	0.128	0.062	0.115	0.096
ENVIRONMENTAL TRUST	0.077	0.270	0.001	0.936	0.002	0.923
ANTIQUARIANISM	0.097	0.161	0.047	0.510	0.034	0.629
NEED FOR PRIVACY	0.107	0.122	0.036	0.609	0.047	0.512
MECHANICAL ORIENTATION	0.001	0.934	0.059	0.408	0.062	0.381
COMMUNALITY	0.036	0.616	0.013	0.834	0.011	0.852
LAB						
MECHANICS	0.050	0.479	0.133	0.053	0.153	0.026
CRAFTS	0.091	0.189	0.027	0.703	0.008	0.874
INTELLECTUAL	0.088	0.203	0.041	0.569	0.000	0.948
SLOW LIVING	0.016	0.805	0.139	0.043	0.140	0.042
NEIGHBORHOOD SPORTS	0.073	0.294	0.217	0.002	0.197	0.005
GLAMOUR SPORTS	0.031	0.661	0.096	0.166	0.058	0.416
FAST LIVING	0.089	0.198	0.182	0.009	0.171	0.013
MOOD						
CHEERFUL	0.093	0.179	0.063	0.375	0.036	0.616
ENERGETIC	0.038	0.594	0.062	0.376	0.048	0.497
ANGRY	0.050	0.485	0.064	0.364	0.124	0.071
TENSE-ANXIOUS	0.088	0.204	0.066	0.351	0.014	0.827
THOUGHTFUL	0.096	0.164	0.103	0.135	0.102	0.140
DEPRESSED	0.148	0.032	0.026	0.714	0.080	0.252
FATIGUED	0.092	0.185	0.042	0.557	0.020	0.765
RELAXED	0.029	0.683	0.011	0.845	0.021	0.760
MOOD	0.012	0.845	0.120	0.082	0.142	0.039

Table 7. (continued)

VARIABLES	GROUP AREA		CENTROID TO CENTROID NND		NEAREST APPROACH NND	
SOCIO/DEMOGRAPHIC	Partial Corr.	F Prob.	Partial Corr.	F Prob.	Partial Corr.	F Prob.
AGE	0.029	0.684	0.080	0.253	0.093	0.180
SEX	0.032	0.651	0.042	0.558	0.065	0.359
MARITAL STATUS	0.091	0.190	0.099	0.153	0.149	0.030
NO. OF CHILDREN	0.105	0.130	0.135	0.050	0.171	0.013
NO. OF SIBLINGS	0.092	0.184	0.050	0.479	0.046	0.517
EDUCATION	0.069	0.324	0.019	0.779	0.040	0.579
NO. OF YEARS LIVED IN CITIES WITH POPULATIONS OF:						
OVER ONE MILLION	0.098	0.155	0.005	0.898	0.019	0.779
100,000 - ONE MILLION	0.068	0.332	0.085	0.221	0.114	0.099
50,000 - 100,000	0.111	0.106	0.071	0.308	0.035	0.618
10,000 - 50,000	0.110	0.111	0.072	0.301	0.084	0.225
5,000 - 10,000	0.133	0.053	0.088	0.205	0.096	0.164
BELOW 5,000	0.067	0.342	0.174	0.012	0.177	0.010
NO. OF AUTOMOBILES	0.135	0.049	0.140	0.042	0.181	0.009
JOB CATEGORY	0.027	0.696	0.015	0.810	0.007	0.882
INCOME	0.075	0.286	0.089	0.198	0.106	0.123
% TIME RECREATING OUTSIDE URBAN ENVIRONMENT	0.015	0.814	0.127	0.066	0.134	0.051
DAY OF THE WEEK	0.117	0.089	0.044	0.538	0.024	0.726
TIME OF DAY	0.049	0.495	0.212	0.003	0.215	0.002
NO. OF CHILDREN IN GROUP	0.119	0.084	0.047	0.509	0.007	0.888
% OF GROUP WHO WERE MALES	0.071	0.312	0.025	0.716	0.029	0.679
% OF GROUP WHO WERE FEMALES	0.016	0.804	0.019	0.781	0.014	0.824
% OF GROUP WHO WERE CHILDREN	0.094	0.174	0.081	0.245	0.040	0.573
DISTANCE TO HOME CITY	0.065	0.353	0.010	0.862	0.082	0.240
POPULATION OF HOME CITY	0.026	0.709	0.096	0.167	0.219	0.002
R^2	0.18		0.22		0.19	

that the survey had been given to the person making the decision. In addition, I argued that with respect to the area which any size group marks as theirs, lone individuals will have more control over the size of the area than a single individual in a larger group.

Based on these arguments, the dependent variables cc/nnd, na/nnd, and group area, were analyzed for lone individuals only. Because of a sampling discrepancey associated with the nearest neighbor distance values (cc/nnd and na/nnd) for English Bay, these data were omitted from the analysis as well. (See Appendix C for a discussion of this problem)

To reiterate, on the basis of the above considerations, the dependent variables cc/nnd and na/nnd were analyzed for lone individuals at Kitsilano and Skaha beaches only, whereas the variable group area was analyzed for lone individuals at all beaches. Since the former two variables (cc/nnd and na/nnd) were based on response patterns and spatial data for lone individuals at two of the three sites the number of observations declined sharply (n = 64 with approximately 54 degrees of freedom). The results of this analysis must therefore be viewed with a certain degree of caution since the number of observations approach the number of independent variables used in the analysis.

Table 8 presents the R^2 values associated with the various analyses conducted for all beaches and group sizes, plus those completed for lone individuals only. These results indicate a comparatively large increase in the ability of the selected variables to account for the variance in the dependent variables when English Bay was dropped from the analysis and when groups containing two or more individuals were ommited.

Table 8: R^2 Values For Spatial And Group Dependent Variables.

	Group Area	cc/nnd	na/nnd
EKS (all/Si)	.18/.57	.22/.10	.19/.08
KS (all/Si)	.26/.66	.20/.46	.21/.47

E = English Bay; K = Kitsilano; S = Skaha; all = all group sizes; Si = single individuals.

Predictors of respondents' distance to nearest neighbor.

The two distance measures, nearest approach nnd and centroid to centroid nnd were predicted by identical independent variables and maintained very similar R^2 values for lone individuals. The only differences were the extent to which each independent variable contributed to the overall R^2. The independent variables accounting for a significant amount of the variance in the two distance measures are listed in Table 9.

These data indicate that people from small towns, those with high scores on 'pastoralism', 'environmental adaptation' and the mood variable 'relaxed' are all found at a greater than average distance from their nearest neighbor. Thus users who have spent much of their lives in rural environments, or who have a 'pastoral' disposition tend to choose a site with more intergroup space. The 'pastoralism' variable is defined by McKechnie with such phrases as, "concern about population growth and preservation of natural resources, including open space." These results would suggest that insofar as the 'pastoralism' scale measures a respondent's attitude and needs for space, the spatial behaviour of beach users tends to validate the scale.

The second best predictor of intergroup distance is the 'man over nature' variable (environmental adaptation). A person scoring highly on 'environmental adaptation' may be characterized as one who seeks to modify "the environment to satisfy needs and desires, and to provide comfort and leisure." This person is also "opposed to governmental control over private land use" and shows a "preference for highly designed or adapted environments." Adjective descriptors include, "autocratic, condescending, conservative, efficient, judgemental" etc. It seems likely that high scorers on 'environmental adaptation' have a basic need to control their environment and in an isotropic setting such as a beach dominating space is the most available way of maintaining this control.

The inclusion of the mood variable 'relaxed' is important since this indicates that respondents at larger distances tend to be less tense than those individuals situated nearer other groups.

Table 9: Significant independent variables contributing to the dependent variables, centroid to centroid and nearest approach nearest neighbor distances (cc/nnd and na/nnd).

VARIABLE	F PROBABILITY		NORMALIZED REGRESSION COEFFICIENT	
	CC/NND	NA/NND	CC/NND	NA/NND
1. Years lived in cities with populations between 5,000 - 10,000 people.	.0003	.0003	.4506	.4608
2. 'Urbanism'	.0010	.0021	-.4494	-.4128
3. 'Environmental Adaptation'	.0124	.0193	.3072	.2836
4. 'Pastoralism'	.0188	.0117	.2919	.3136
5. Number of children	.0104	.0050	-.2910	-.3217
6. 'Relaxed'	.0354	.0368	.2505	.2466

(Results based upon lone individuals at Kitsilano and Skaha beaches only)

The two variables negatively correlated with distance to nearest neighbors were the ERI scale 'urbanism' and 'the number of children a respondent claimed'. The scale 'urbanism' describes subjects who are oriented to high density urban environments and who maintain an interest in the unusual and varied aspects of city life. High scorers on 'urbanism' are thus those people who either enjoy the crowds a city affords or are those who are capable of adapting to such high density environments. Since our urban public beaches often reflect such environments, it is not surprising that this scale was a strong predictor of user spacing behaviours.

The correspondence of the second variable ' number of children' with smaller intergroup distances may be explained by the fact that a person who chooses to have a large family is probably more gregarious and enjoys being around larger groups of people. This latter statement, of course, is conjectural and awaits further testing.

Surprisingly, the Environmental Response Inventory scale, 'Need for Privacy' did not correlate significantly with the distance to nearest neighbor measures. In fact, the correlation was close to zero ($r = -.05$) for both nearest neighbor distance measures. One explanation for these results may be that the beaches chosen for the study are primarily urban public beaches which may only attract individuals with diminished privacy needs. These settings may thus convey the image of a crowded, high stimulus environment, even though the beaches exhibit lower densities for a portion of each day.

Predictors of 'group area'.

The R^2 value in Table 8 relating to the dependent variable 'group area' for single individuals at all sites was 0.57. The variables contributing to the regression equation are summarized in Table 10. (English Bay included). These data suggest that lone individuals who attain larger amounts of marked space may be characterized as having more automobiles than average, spend more recreational time away from the urban environment, have more children, have spent more of their lives in cities with populations between 50,000 to 100,000 and are more often at the beach on weekends when densities are highest. Similarly, individuals with

Table 10. Significant independent variables contributing to the dependent variable 'group area'.

VARIABLE	F PROBABILITY	NORMALIZED REGRESSION COEFFICIENT
1. Number of automobiles	< .0001	.4602
2. % recreation time spent outside the city	.0005	.3306
3. 'Environmental Trust'	.0006	-.2966
4. Number of children	.0002	.2797
5. Years lived in cities with fewer than 5,000 people	.0029	-.2696
6. Years lived in cities with population sizes between 50,000 - 100,000 people	.0179	.2207
7. Years lived in cities with population sizes between 10,000 - 50,000 people	.0209	-,1996
8. Day of the week	.0447	.1720

Values based upon lone individuals at English Bay, Kitsilano and Skaha Beaches. (n = 85)

smaller than average marked spaces tend to have a higher trust of potentially threatening environments (Environmental Trust) and have spent more of their lives in small towns and cities with populations between 10,000 and 50,000 people.

Five variables correlated positively with an individuals' marked space. Two of these, the number of children claimed by the respondent and the number of automobiles in the household may actually be artifacts attributable to the data collection technique utilized. For example, even though persons were visible in the photographs as lone individuals, a few may actually have been part of a larger family group. Children, for example, may have been playing elsewhere or other members of the family may have been strolling nearby. Since families could be expected to have a higher probability of owning more than one car and since such a family group would maintain larger marked areas on the beach, these variables would be selected as significant predictors of the dependent variable, group area. The data do not permit a test of this hypothesis and thus such an explanation remains conjectural.

The inclusion of 'percent time spent recreating outside the city' can be justified since it could be argued that each variable, large group area and high percentage of recreation time away from the city, are related to an increased need for open space. It is interesting to note that people who come to the beach on weekends also have larger marked spaces. This may reflect the need to buffer oneself from others by the use of space, since weekends offer the user the highest density conditions in which to recreate. The latter relationship is conjectural since earlier results on the effect of density on group area indicated little or no effect. It is also of interest that people who spend many years in small towns seem to maintain smaller marked areas. This result is in contrast to an earlier finding which suggested that persons from smaller cities tended to be at greater distances from their nearest neighbor. One explanation for these results may be that most people who came from small cities and towns were vacationers at Skaha beach and thus in order to save space on route may have brought fewer beach articles with them and thus had fewer materials to spread around. This argument may also

explain the finding that people living much of their lives in moderately large cities obtained larger amounts of marked space.

Beach users who scored highly on the ERI variable "Environmental Trust" tended to maintain smaller amounts of space which was marked. McKechnie's definition of this variable sheds light on this correlation:

> Environmental Trust: General environmental openness, responsiveness, and trust; competence in finding one's way about the environment. vs Fear of intentionally dangerour environments, security of house; fear of being alone and unprotected.

McKechnie also describes high scorers on this variable as:

> Capable, competent, diligent, efficient, helpful, ingenious, resourceful, stable, thorough, well adjusted.

and conversely low scorers as:

> Bitter, cold, coarse, disatisfied, distrustful, intolerant, moody, prejudiced, spendthrift, unkind.

The picture which emerges is that respondents categorized as capable, competent, well adjusted etc., have a greater ability to cope with smaller amounts of space whereas low scorers require larger individual marked areas as a buffer against a perceived, inhospitable environment.

In summary, the three dependent variables, group area and the two nearest neighbor distance variables were moderately well predicted with percentage variance accounted for ranging from 46 to 57 percent. In most cases the independent variable selected by the regression analysis were those that could be easily explained on the basis of their individual content and meaning. The independent variables of most interest were those relating to respondent's scores on various ERI scales and those relating to the number of years a subject had spent in high density urban centres versus those who had lived predomintly in smaller towns and villages. In general those respondents who maintain pastoral attitudes and who have spent a large proportion of their lives in small towns are more often found at greater distances from their closest neighbors than average and those who derive satisfaction from high density environments are most likely observed in close proximity to their near neighbors.

CHAPTER VIII

DISCUSSION AND SUMMARY OF RESULTS

Summary of results.

The two most important objectives of the study as set forth in the introduction were first, to determine if behavioural shifts occur in response to increasing density and second, to examine the extent to which individual personality characteristics are related to spatial behaviour differences. With respect to the first objective, evidence was presented which indicate shifts in behaviour did occur (analysis of the spatial pattern of users showed a gradual change from random at low densities to regular at high densities) and coinciding with these events users began to choose sites which were on the average 2.7 meters from their nearest neighbor. This distance fell within Hall's (1966) 'social distance zone' (far phase) which he claims is used by North Americans to effectively insulate themselves from unwanted social interaction. The results of the present study thus add strong empirical support for Hall's claim.

The second major objective was achieved by analyzing the spatial behaviour of beach users who chose to complete a questionaire designed for the study. The survey, composed of items dealing with environmentally based dispositions, participation in leisure activities, mood states and socio-demographic characteristics was analyzed by a stepwise multiple regression technique. The dependent variable in this analysis was the observed subject to nearest neighbor distance as obtained from the aerial photographs. The results indicated only a limited ability to predict the dependent variable when data for all group sizes were used. Based on the argument that lone individuals are more in control of the site selection process than groups of two or more, the data were reanalyzed for solitary respondents only. These results showed a substantial increase in the amount of variance accounted for by the selected independent variables. The most salient variables selected as significant predictors of distance to nearest neighbor measures were the Environmental Response Inventory variables: 'Urbanism', 'Pastoralism', and 'Environmental Adaptation'. In addition direct experiential measures of the number of years a respondent had lived in towns and cities of various sizes proved to be of importance. Other significant variables included the number of children a respondent claimed and the mood variable 'relaxed'.

In addition to the problems associated with sampling for groups containing two or more individuals, one other factor may explain why the selected independent variables were not capable of explaining a greater percentage of the total variance. Because of the dynamic quality of the beach environment, a user may have chosen a site under different conditions from those obtaining when he was selected as a respondent and subsequently photographed. This would decrease the predictive power of the independent variables since a user's spatial environment would have changed as more people arrived at the beach and filled in the area around him. A future research strategy might be devised which delineated the spatial characteristics of a beach user immediately upon his selecting a site. Of couurse, methods other than aerial photography would have to be used for obtaining data on the spacing behaviour of users in such a study.

Finally, based on the observed spatial behaviour of users mentioned above, the carrying capacity of each of the three study sites were calculated. Based on these calculations it was shown that at no time during the study did densities at the three sites surpass the estimated upper limits. These results indicated that on the average, conditions were never so crowded that new arrivals were forced to select a site within the 2.7 meter zone referred to above. The extent to which this situation prevailed as a result of new arrivals choosing not to participate in the beach experience is not known.

Methodology applications.

Webb et al. (1966), among others, have effectively demonstrated the advantages of using multi-method approaches to problem solving in the social sciences. In particular, Webb et al. argue persuasively for the expanded use of nonreactive techniques to assess human behaviour. The present study sought to utilize each of these research strategies. Firstly, the spacing and group behaviour of beach users were studied in a completely unobtrusive way through the use of aerial photography. This technique circumvented obvious sources of bias where the objective of the research is known or suspected by the subject. Such a procedure maximized the

probability that observed behaviour was typical and uninfluenced by the presence of the investigator or his equipment. Secondly, the study was undertaken in a 'natural' as opposed to a laboratory setting and as a result, conclusions reached offer 'real world' validity with little or no fear that results represent artifacts of experimental conditions. Finally, questionaire response patterns were correlated with each subject's spatial and group behaviour. Thus, both survey data and extant behaviour were jointly utilized to broadly describe how people in an isotropic environment respond to fluctuations in density conditions. This procedure offered some insight into individual personality differences and the extent to which they relate to beach user behaviour.

Implications for planning and design.

Although some caution must be applied when placing the results of the present study in a planning or design context, I should point out that most space standards have been based primarily on arbitrary decisions. For example, the California Outdoor Recreation Committee Report (1960) set the optimum space allotment for beaches at 100 square feet (9.3 meters^2) per person. This value was based on seasonal attendance records excluding the three most crowded days which fell on holidays. This report further stated that if attendance was higher than 70% of the density on the sixth most crowded day, then the area was considered over-used.

The present study represents a distinct improvement over such guidelines in that the behavioural characteristics of users have been used to arrive at social carrying capacity estimates. It is interesting to compare the California standard of 100 ft.^{2}/person, to results based on the present research. This comparison may be roughly made by dividing the average group size estimate (1.8 persons/group) into the minimum group space standard (21.7 meters^2). This value (12.1 meters^2) represents over a 20% increase over the 9.3 meter^2 estimate from the above report. We may conclude that, to the extent the two populations (California and western Canada) share similar spatial needs and preferences, the California beaches would be considered 'over-crowded' by the criterion suggested by the present study, at population densities considered 'optimal' by the C.O.R.C. report.

An important aspect of the results relevant to the planning and design professions concerns the carrying capacity estimates referred to above. To place these results in perspective it is necessary to examine the question of optimality which the carrying capacity concept implies. Depending upon ones frame of reference, the population estimates derived for the three beaches may reflect 'maxima' instead of 'optima'. I stress this point for two related reasons.

The first point concerns the extent to which people adapt to high density conditions and how such adaptation relates to user preferences and satisfactions. One might expect that users present during high density periods might possess skills which allow them to cope successfully with conditions relating to crowded environments. However, coping successfully does not necessarily imply maximum satisfaction. For example, users may tolerate such conditions at less than optimum satisfaction and participate in the activity even though they might prefer to experience the beach at lower density levels. Thus we might predict that a certain segment of society maintains skills which allow them to cope successfully with conditions relating to crowded environments and do so even though their preferences might dictate otherwise. Since I made no direct attempt to asses user preferences and satisfaction based on such factors as perceived crowding, it is not possible to know the extent to which this problem applies to the question of optimum vs maximum carrying capacities.

The second reason for emphasizing the optimality question is that the present results do not allow one to know the extent to which the sample of beach users is representative of the overall source population. Only those people actually at the beach were sampled and thus no data exist for those individuals who do not participate. For example, certain people may forego a trip to the beach because they perceive the area to be over crowded, too far away, or facilities not consistent with expectations. Such people are thus 'filtered out' and therefore not represented in any sampling procedure utilizing on site interviews or observations. Similarly, as the results have shown, personalities of users differ and certain differences seem to relate to spacing preferences. These differences, of course, only relate to the sample,

and given the sample was representative, of users at the three sites in general. Since it is difficult to know whether various selection processes mitigate against certain segments of the regional population it is doubtful that the personality indices are reflective of people in general. Without an understanding of the relative proportion of key personality variables of the source population it is also doubtful whether optimal carrying capacity estimates can be calculated. For example, in the present study respondents with elevated profiles on the pastoralism scale were observed to require more open space than those scoring highly on the urbanism scale. It seems probable that others not found in the sample would score more highly on the pastoralism scale and have even higher needs for space. Such people would rarely visit sites such as the three areas in the present study since their need for open space could not easily be satisfied in such environments.

The arguments above would suggest that to equitably manage recreational resources such as beaches, the manager should sample the source population to determine the relative proportion of individuals maintaining relevant personality characteristics. Armed with such data the designer or manager should be in a position to build or maintain facilities consistent with the needs of both actual and potential users. Such a strategy would eliminate the possibility of selecting against various segments of society.

Granting, that in many cases, the manager may not have sufficient resources to complete the requirements of such a study, an alternate strategy might consist of ensuring the presence of a range of facilities, each satisfying one segment of the range of user preferences. Such a tactic would provide valuable data on use rates for each facility and the manager could then infer the relative need for each class of facility. As mentioned in an earlier section, if such guidelines or procedures are not forthcoming, then the estimates derived from the present study would probabably serve to ensure adequate satisfaction for the largest number of people. At least using these estimates one can be relatively well assured of not seriously detracting from the spatial needs of users.

The discussion to this point has centered on space guidelines for public beaches; however, since the results were consistent with other more general work (Hall, 1966 for example), the findings may apply to other settings. The results seem especially applicable to environments where the type of social interaction (or lack of it) is consistent with behaviours characteristic of Hall's 'social and public distance zones'. For example, in settings where the maintenance of the integrity of the social group (including solitary indivduals) is important, the present research suggests designers should allow for at least 2.7 meters between the boundaries of any two design elements. A typical example of the type of design setting where these results could be applied, are airport, train and bus waiting areas. The present research suggests that for these areas, seating clusters should not be placed much closer than the 2.7 meter zone above. Other areas where these results might apply are, plazas, parks, restaurants, etc. Of course, in these settings the use of plants and other suitable perceptual barrier systems might be used to effectively decrease this space requirement

The most important point of the above discussion is that space itself communicates the need to be separate from others. By structuring space in this way, other more costly, behaviourally oriented space control mechanisms need not be called upon by the individual to maintain the social identity of the group. In an age where high density environments are often common features of our daily lives, the use of space standards based on behavioural criteria of actual and potential users seem crucial. Without such standards, it seems likely that many environments will continue to compromise user needs and as a result exacerbate the stress such high density settings undoubtedly offer.

Toward further research.

Many questions relating to the ways in which people structure and use space, expecially with respect to increasing density remain unanswered. The present research served as a source for many such questions, the most important of which are listed below:

1) What are the effects of various visual and auditory barriers on perceived density and spatial needs?
2) Does the experience of living in large urban environments provide people with coping strategies not available to rural inhabitants?
3) If these coping strategies exist what are their form and how do they function under varying density conditions?
4) What are the cultural traditions and behaviour patterns that increase or decrease the ability of individuals and groups to cope with close spatial proximity and high density conditions?
5) What are the forces of selection in determining who uses a particular environment and how do these forces relate to the observed population, i.e. who are the people who decided not to participate?

Answers to these questions might be best acquired by studying a population of beach users from a large metropolitan area such as New York, Los Angeles, or Hong Kong where beach densities reach levels in excess of the maximum derived from the present study. Of special interest would be the plot of average nearest neighbor distance versus density. For example one might predict a threshold effect such that as in the present study a similar asymptote would be observed until the maximum derived density was reached whereupon a new lower asymptote would appear. This would indicate a need for a basic amount of space but would differ in that users at the highest densities would be satisfied to obtain much less space in order to participate in the beach experience. This process if observed might be linked to prior expectations of how crowded the beach would be or to the perceived costs and benefits of the recreational experience.

Such high density beaches would also offer the opportunity to examine ways of limiting social interaction other than the regulation of space. Such mechanisms might include behaviours associated with minimizing

eye contact, such as controlling body orientation and gaze, lying face down, falling asleep, reading, etc. Similar behaviours have been shown to serve as powerful regulators of social interaction and sensory input (Chance 1962; Argyle and Dean, 1965; Grant, 1969; Goldberg, Kiesler and Collins, 1969; McGrew, 1972; Efran and Cheyne, 1974). Such a study would provide important data on how and when these behaviours are used and whether their occurrence and frequency are related to density considerations in a natural setting.

The answers to these questions and others would provide valuable information pertaining to issues and concepts relating to crowding, stimulus overload and the effects of selection in determining the composition of any given referent group. A public beach may be one of the most useful settings in which to conduct such research.

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APPENDIX A

THE SURVEY

School of Community & Regional Planning
University of British Columbia

Area_____

Date_____

Time_____

Group_____M_____F

Map No. _____

RECREATIONAL ATTITUDE SURVEY

As part of a study to determine how people view particular recreational environments, we have devised three surveys which are contained in this booklet. Your co-operation will provide a better understanding of how people perceive and behave with respect to each other as well as toward certain aspects of recreational settings.

The first section contains 184 statements concerning various aspects of the environment and your own attitudes. The second is a checklist of recreational and leisure activities which you may have participated in at one time or another. The third is a short list of questions concerning your own background which will help in understanding why people differ.

No name or other identification is required and your anonymity is ensured.

Work quickly -- first impressions are usually the most accurate. Most people finish in 20 - 25 minutes.

Each section is self-explanatory and contains its own set of instructions.

Thank you for your co-operation and time!
The first section begins on the next page.

- 2 -

ENVIRONMENTAL RESPONSE INVENTORY

Please read each statement and decide quickly whether you personally agree or disagree with it. To respond, simply circle the answer to the left of each statement according to these categories:

SA -- Strongly Agree
A -- Agree
N -- Neutral
D -- Disagree
SD -- Strongly Disagree

Again, work quickly. Do not be concerned if some items seem similar to ones you have seen earlier.

SA A N D SD 1. I like amusement parks.

SA A N D SD 2. I would enjoy the work of an architect

SA A N D SD 3. Machines increase man's freedom.

SA A N D SD 4. I prefer to live in an area where neighbours keep to themselves.

SA A N D SD 5. I would enjoy driving a racing car.

SA A N D SD 6. The idea of walking into the forest and "living off the land" for a week appeals to me.

SA A N D SD 7. Life in the city is more interesting than life on a farm.

SA A N D SD 8. I would enjoy building a radio.

SA A N D SD 9. Travelling isn't really worth the effort.

SA A N D SD 10. I have my best thoughts when I am alone.

SA A N D SD 11. I enjoy browsing in bookstores.

SA A N D SD 12. It would be fun to move around and live in different parts of the country.

SA A N D SD 13. It is boring to spend all day working with your hands.

SA A N D SD 14. It is exciting to go shopping in a large city.

SA A N D SD 15. There should be a law against skyscrapers.

SA A N D SD 16. I like to be by myself much of the time.

SA A N D SD 17. I enjoy browsing in antique shops.

SA A N D SD 18. I sometimes daydream of being stranded on a tropical island.

SA A N D SD 19. I like places that have the feeling of being old.

SA A N D SD 20. I shudder at the thought of finding a spider in my bed.

SA A N D SD 21. I would enjoy traveling around the world on a sailing ship.

SA A N D SD 22. Alleys are interesting places to explore.

SA A N D SD 23. I prefer a stick-shift car to one with an automatic transmission.

SA A N D SD 24. I like crystal chandeliers.

SA A N D SD 25. I like homes with stone floors.

SA A N D SD 26. I like the variety of stimulation one finds in the city.

SA A N D SD 27. I usually save spare nuts and bolts.

SA A N D SD 28. I get annoyed when my neighbours are noisy.

SA A N D SD 29. When buying clothes, I usually look more for comfort than for style.

SA A N D SD 30. I am quite skillful with my hands.

SA A N D SD 31. It's annoying to have to share an office or work space with someone.

SA A N D SD 32. I like to visit historic places.

SA A N D SD 33. Suburbs should replace the city as the centre of cultural life.

SA A N D SD 34. I would prefer working with precision power tools.

SA A N D SD 35. I have difficulty concentrating when things are noisy.

SA A N D SD 36. I would rather remodel an old house than build a new one.

SA A N D SD 37. We must move ahead and not worry about past failures.

SA A N D SD 38. Cities are too noisy and crowded for me.

SA A N D SD 39. I often feel uneasy in a large crowd of people.

SA A N D SD 40. I can repair just about anything around the house.

SA A N D SD 41. I often have trouble getting the privacy I want.

SA A N D SD 42. There should be a law against anyone owning more than a thousand acres of land.

SA A N D SD 43. I feel most secure when I am working around the house.

SA A N D SD 44. It is hopeless to try to save our cities.

SA A N D SD 45. It would be fun to own some old-fashioned costumes.

SA A N D SD 46. Motorcycles should be kept out of recreation areas.

SA A N D SD 47. I like modern furniture better than the more traditional styles.

SA A N D SD 48. I would like a job that involved a lot of traveling.

SA A N D SD 49. It is important for me to own top quality equipment.

SA A N D SD 50. As a child, I often watched when someone repaired things around the house.

SA A N D SD 51. I like the sounds of a city street.

SA A N D SD 52. Old sections of the city are more interesting than the new areas.

SA A N D SD 53. I often feel lonely when I am by myself.

SA A N D SD 54. As a child, I was taught respect for all living things.

SA A N D SD 55. It is good for man to submit to the forces of nature.

SA A N D SD 56. I prefer friends who are reliable and even-tempered.

SA A N D SD 57. I often think of settling down on a farm some day.

SA A N D SD 58. I don't like being completely alone.

SA A N D SD 59. I would like to live in a modern, planned community.

SA A N D SD 60. Zoning laws and other building controls are necessary to protect the rights of the public.

SA A N D SD 61. I like things that have precision moving parts.

SA A N D SD 62. I would enjoy entertaining famous people.

SA A N D SD 63. I often feel that I am a part of the space around me.

SA A N D SD 64. I can identify many of the local flowers and trees.

SA A N D SD 65. I would like to work with computers.

SA A N D SD 66. I have vivid memories of where I lived as a child.

SA A N D SD 67. Our national forests should be preserved in their natural state, with roads and buildings prohibited.

SA A N D SD 68. Flying in a small airplane would make me nervous.

SA A N D SD 69. As a child, I was afraid of being outside by myself.

SA A N D SD 70. It is better if people live out their lives in one place.

SA A N D SD 71. I would enjoy owning a fancy watch.

SA A N D SD 72. I would enjoy riding a motorcycle.

SA A N D SD 73. Making rain by artificially "seeded" clouds is a great technological advance.

SA A N D SD 74. I enjoy staying up all night.

SA A N D SD 75. I am happiest when I am alone.

SA A N D SD 76. No child should have to grow up in a rural area.

SA A N D SD 77. I get annoyed when people drop by my house without warning.

SA A N D SD 78. A fireplace adds a special feeling of coziness to a room.

SA A N D SD 79. It's interesting to learn about the history of the Place where you live.

SA A N D SD 80. It is fun to make scale models of things.

SA A N D SD 81. I would enjoy living the rest of my life in a large city.

SA A N D SD 82. Electricity fascinates me.

SA A N D SD 83. I like social gatherings where I can enjoy myself without worrying about other people.

SA A N D SD 84. I don't think that I would ever want to be hypnotized.

SA A N D SD 85. Small town life is too boring for me.

SA A N D SD 86. Fertilizers improve the quality of food.

SA A N D SD 87. I often get the feeling that I just must be alone.

SA A N D SD 88. A person has a right to modify the environment to suit his needs.

SA A N D SD 89. Sometimes I'm afraid of too much stimulation - from sounds, colours, odors, etc.

SA A N D SD 90. I understand the architectural idea that form follows function.

SA A N D SD 91. I enjoy working in a flower garden.

SA A N D SD 92. I enjoy owning a good piece of equipment, even if I don't get to use it much.

SA A N D SD 93. I pride myself on having a home which is always open to friends.

SA A N D SD 94. Fences make good neighbours.

SA A N D SD 95. I'd rather live in the suburbs than in the city.

SA A N D SD 96. A complex technological society cannot tolerate individuality.

SA A N D SD 97. I enjoy a change in the weather even when it turns bad.

SA A N D SD 98. It is unsafe to ride on buses these days.

SA A N D SD 99. Country people are more honest than city people.

SA A N D SD 100. Hiking is boring.

SA A N D SD 101. I'd be afraid to live in a place where there were no people nearby.

SA A N D SD 102. I find street noise very distracting.

SA A N D SD 103. I have always been somewhat of a daredevil.

SA A N D SD 104. I would enjoy riding in a crowded subway.

SA A N D SD 105. I am quite sensitive to the "character" of a building.

SA A N D SD 106. I like to ride on roller coasters.

SA A N D SD 107. I enjoy tinkering with mechanical things.

SA A N D SD 108. I do not like to loan things to neighbours.

SA A N D SD 109. I would enjoy living in a historic house.

SA A N D SD 110. Sometimes I wish I had power over the forces of nature.

SA A N D SD 111. I have no interest in ballet.

SA A N D SD 112. I like to read about the history of places.

SA A N D SD 113. Birth control practices should be accepted by everyone.

SA A N D SD 114. Jet air travel is one of the great advances of our society.

SA A N D SD 115. I have vivid memories of the neighbourhood where I grew up.

SA A N D SD 116. I would enjoy going to the opera.

SA A N D SD 117. Today people are too isolated from the forces of nature.

SA A N D SD 118. It is easy for me to work undistracted in most situations.

SA A N D SD 119. I like to dress in the latest fashions.

SA A N D SD 120. I seldom pay attention to what I eat.

SA A N D SD 121. It is dangerous to work around heavy machinery.

SA A N D SD 122. The wilderness is cruel and harsh.

SA A N D SD 123. Modern buildings are seldom as attractive as older ones.

SA A N D SD 124. I like experimental art.

SA A N D SD 125. I often wish for the seclusion of a weekend retreat.

SA A N D SD 126. I would like to own an expensive camera.

SA A N D SD 127. Building projects which disrupt the ecology should be abandoned and the land returned to its natural state.

SA A N D SD 128. The problems of the cities will never be solved.

SA A N D SD 129. I am easily distracted by people moving about.

SA A N D SD 130. I often have trouble finding my way around a new area.

SA A N D SD 131. In spite of all talk about pollution, the earth is still a safe place to live.

SA A N D SD 132. I need more variety in my life than other people seem to need.

SA A N D SD 133. I usually avoid public rest rooms.

SA A N D SD 134. I often have trouble figuring out how to use household appliances.

SA A N D SD 135. I usually enjoy having lots of people around.

SA A N D SD 136. I would enjoy watching movies made 15 or 20 years ago.

SA A N D SD 137. Natural resources must be preserved even if people must do without.

SA A N D SD 138. I like to get up early to see the sun rise.

SA A N D SD 139. I am afraid of driving in the city.

SA A N D SD 140. Trespassing laws should be more carefully enforced.

SA A N D SD 141. I am an adventurous person.

SA A N D SD 142. I often have strong emotional reactions to buildings.

SA A N D SD 143. There is too little emphasis on privacy in our society.

SA A N D SD 144. It is dangerous nowadays to live in a large city.

SA A N D SD 145. I seldom vary the route I take to everyday destinations.

SA A N D SD 146. It is important for me to feel that I am in harmony with the forces of nature.

SA A N D SD 147. When it comes to fixing things, I am hopeless.

SA A N D SD 148. Modern communities are plastic and ugly.

SA A N D SD 149. Science does as much harm as good.

SA A N D SD 150. I get upset if I must do too many things at once.

SA A N D SD 151. I would feel safer on the highway if speed limits were reduced.

SA A N D SD 152. I would like to take flying lessons.

SA A N D SD 153. Most jewellry is a waste of money.

SA A N D SD 154. I like to say hello to my neighbours.

SA A N D SD 155. I enjoy collecting things that most people would consider junk.

SA A N D SD 156. There are often times when I need complete silence.

SA A N D SD 157. I worry a lot about the rising crime rate.

SA A N D SD 158. The cultural life of a big city is very important to me.

SA A N D SD 159. I like to go to shopping centres where everything is in one place.

SA A N D SD 160. I am fond of oriental rugs.

SA A N D SD 161. I am afraid of heights.

SA A N D SD 162. People who try to repair appliances themselves usually end up breaking them.

SA A N D SD 163. I would like to live in a palace or a castle.

SA A N D SD 164. Sight-seeing is tedious and boring.

SA A N D SD 165. The cities contain the best aspects of modern life.

SA A N D SD 166. It's nice to buy a new car every year or so.

SA A N D SD 167. Bathtubs have become obsolete.

SA A N D SD 168. Places often play an important role in my dreams.

SA A N D SD 169. I would like to build a cabin in the woods.

SA A N D SD 170. I enjoy being in dangerous places.

SA A N D SD 171. Everyone should have the opportunity to live in a great city.

SA A N D SD 172. It's fun to walk in the rain even if you get wet.

SA A N D SD 173. Old buildings are usually depressing.

SA A N D SD 174. I would enjoy living on a houseboat.

SA A N D SD 175. Computers may someday take over the world.

SA A N D SD 176. I like to be on the move, not tied down to any one place.

SA A N D SD 177. Mental problems are more common in the city than in the country.

SA A N D SD 178. Odors often bring back distant memories.

SA A N D SD 179. I like to care for animals.

SA A N D SD 180. A man should spend his leisure time at home with his family.

SA A N D SD 181. If I had the money, I would enjoy owning an expensive stereo set.

SA A N D SD 182. I feel a great attraction to the sea.

SA A N D SD 183. I would rather sleep on the open ground than in a tent.

SA A N D SD 184. Given enough time, science will solve most human problems.

LEISURE ACTIVITIES BLANK

Below is a list of leisure and recreational activities. For each activity indicate the extent of your participation using the following system:

N - You have never engaged in the activity.
T - You tried it once or a few times.
U - You used to it regularly, but now no longer do it regularly.
O - You occasionally participate in the activity at this time.
R - You currently participate regularly in the activity.

Check the appropriate blank to indicate your participation in each of the following activities:

	N Never	T Tried it	U Used to	O Occasionally	R Regularly
1 Acting (dramatics					
2 Amateur radio					
3 Archery					
4 Attending concerts					
5 Attending auctions					
6 Auto racing					
7 Auto repairing					
8 Back packing					
9 Badminton					
10 Baseball or softball					
11 Basketball					
12 Bicycling					
13 Billiards or pool					
14 Bird watching					
15 Boating (rowing)					
16 Bookbinding					
17 Bowling					
18 Boxing					
19 Camping					
20 Canoeing					
21 Carpentry					
22 Ceramics or pottery					
23 Checkers or go					
24 Chess					
25 Child-related activities (e.g., scouts, PTA)					
26 Civic organizations					
27 Collecting (antiques, coins, etc.)					
28 Conservation or ecology organizations					
29 Cooking and baking					
30 Crossword puzzles					
31 Dancing ballet or modern					
32 Dancing (social)					
33 Darkroom work (photography)					
34 Designing clothes					
35 Dining out					
36 Driving (motoring)					
37 Electronics					
38 Encounter groups					
39 Exercising					
40 Fencing					
41 Fishing (deep-sea)					
42 Fishing (fresh water)					
43 Flower arranging					
44 Flying (or gliding)					
45 Folkdancing					
46 Football					
47 Fraternal organizations					
48 Gambling (casino)					
49 Gardening					
50 Going to movies					

LEISURE ACTIVITIES BLANK, p. 2.

	zNever	+Tried it	cUsed to	OOccasionally	RRegularly
51 Going to plays or lectures					
52 Going to horseraces					
53 Going to nightclubs					
54 Golf					
55 Gymnastics					
56 Hiking or walking					
57 Home decorating					
58 Homeowner organizations					
59 Horseback riding					
60 Horseshoes					
61 Hunting					
62 Ice skating					
63 Jewelry making					
64 Jig-saw puzzles					
65 Jogging					
66 Judo or karate					
67 Keeping pets					
68 Kite flying					
69 Knitting or crocheting					
70 Leatherworking					
71 Listening to the radio					
72 Marksmanship					
73 Mechanics					
74 Metalworking					
75 Model building					
76 Motorboating					
77 Motorcycling					
78 Mountain climbing					
79 Needlework					
80 Painting and drawing					
81 Playing poker					
82 Playing bridge					
83 Playing records (music)					
84 Playing a musical instrument					
85 Political activities					
86 Reading (books, plays, poetry)					
87 Reading (newspapers, magazines)					
88 Religious organizations					
89 Roller skating					
90 Sailing					
91 Sculpture					
92 Sewing					
93 Shuffleboard					
94 Sightseeing					
95 Singing					
96 Skiing					
97 Skin diving					
98 Social drinking					
99 Squash or handball					
100 Sunbathing					
101 Surfboarding					
102 Swimming					
103 Table tennis (ping pong)					
104 Taking pictures (photography)					
105 Talking on telephone					
106 Tennis					
107 Travelling abroad					
108 Visiting Museums					
109 Visiting friends					
110 Volleyball					
111 Volunteer fire fighting					
112 Watching team sports					
113 Watching TV shows					
114 Waterskiing					
115 Weaving					
116 Weightlifting					
117 Windowshopping					
118 Wrestling					
119 Writing poetry or stories					
120 Writing letters					
121 Woodworking and related crafts					

Others not listed (specify):

_____					
_____					
_____					
_____					

BACKGROUND INFORMATION

1. Age: _____

2. Sex: _____F____M

3. Marital Status:

a. Single _____ d. Divorced _____
b. Married ____ e. Separated _____
c. Widowed ____ f. Co-habiting _____

4. If you have any children, how many? _____

5. How many brothers and sisters do you have? _____

6. Check the highest level of education which you attained?

Elementary _____
Some High School _____
High School graduate _____
Some University or College _____
University Degree _____
Some graduate work _____
M.A. or equivalent _____
Ph.D., M.D., L.L.B., E.D.D., etc. _____

7. How many years have you lived in each of these urban centres:

over 1 million _____ 10,000 - 50,000 _____
100,000 - 1 million _____ 5,000 - 10,000 _____
50,000 - 100,000 _____ below 5,000 _____

8. How many automobiles are at your disposal in your household? _____

9. What is your occupation? Please be specific. _____

_____

10. What was your household income before taxes during the last tax year? _____

11. Of your total time spent in recreational and leisure activities, what percentage is spent away from the city as opposed to in the city?

Away from the city _____%, + in the city _____% = 100%

OPTIONAL WORD LIST SURVEY

If you feel you have any extra time there is an optional survey below which consists of 60 words which describe how you may feel at this time. The survey takes about 5 minutes and is designed to measure your personal feelings at this time. If you wish to complete the survey, for each word merely circle the number which best indicates how you feel at this moment according to the following scheme:

1. Not at all
2. A little
3. Moderately
4. Strongly
5. Extremely

Work quickly -- first impressions are usually the most accurate.

		1 Not at all	2 A little	3 Moderately	4 Strongly	5 Extremely			1 Not at all	2 A little	3 Moderately	4 Strongly	5 Extremely
1.	Active	1	2	3	4	5	31.	Lazy	1	2	3	4	5
2.	Cheerful	1	2	3	4	5	32.	Preoccupied	1	2	3	4	5
3.	Jittery	1	2	3	4	5	33.	Thoughtful	1	2	3	4	5
4.	Pretty good	1	2	3	4	5	34.	Happy-go-lucky	1	2	3	4	5
5.	Angry	1	2	3	4	5	35.	Top of the world	1	2	3	4	5
6.	Excited	1	2	3	4	5	36.	Hopeless	1	2	3	4	5
7.	Bad-tempered	1	2	3	4	5	37.	Weary	1	2	3	4	5
8.	Apathetic	1	2	3	4	5	38.	Full of pep	1	2	3	4	5
9.	On edge	1	2	3	4	5	39.	Light-hearted	1	2	3	4	5
10.	Nervous	1	2	3	4	5	40.	Tired	1	2	3	4	5
11.	Pensive	1	2	3	4	5	41.	Relaxed	1	2	3	4	5
12.	Gay	1	2	3	4	5	42.	Energetic	1	2	3	4	5
13.	Annoyed	1	2	3	4	5	43.	Composed	1	2	3	4	5
14.	Earnest	1	2	3	4	5	44.	Lonely	1	2	3	4	5
15.	Resentful	1	2	3	4	5	45.	At ease	1	2	3	4	5
16.	Helpless	1	2	3	4	5	46.	Unhappy	1	2	3	4	5
17.	Sluggish	1	2	3	4	5	47.	Enthusiastic	1	2	3	4	5
18.	Serene	1	2	3	4	5	48.	Ready to fight	1	2	3	4	5
19.	Worthless	1	2	3	4	5	49.	Carefree	1	2	3	4	5
20.	Frightened	1	2	3	4	5	50.	Alert	1	2	3	4	5
21.	Calm	1	2	3	4	5	51.	Anxious	1	2	3	4	5
22.	Contemplative	1	2	3	4	5	52.	Grouchy	1	2	3	4	5
23.	Nonchalant	1	2	3	4	5	53.	Shaky	1	2	3	4	5
24.	Vigorous	1	2	3	4	5	54.	Spiteful	1	2	3	4	5
25.	Serious	1	2	3	4	5	55.	Lively	1	2	3	4	5
26.	Tense	1	2	3	4	5	56.	Blue	1	2	3	4	5
27.	Furious	1	2	3	4	5	57.	Listless	1	2	3	4	5
28.	Languid	1	2	3	4	5	58.	Optimistic	1	2	3	4	5
29.	Hated	1	2	3	4	5	59.	Worried	1	2	3	4	5
30.	Introspective	1	2	3	4	5	60.	Lethargic	1	2	3	4	5

APPENDIX B

BEACH USER PROFILE: SURVEY DIMENSIONS

Environmental Response Inventory.

The means and standard deviations (by beach) for the first section of the survey (Environmental Response Inventory, ERI) are listed in Table 11. Comparison of these results with those of Hardwick & Collins (1973) (Vancouver Urban Futures Project) and McKechnie (1973) indicate overall congruence with samples from Vancouver, British Columbia, Marin County, California and a cross section of students from U. S. colleges and universities.

Leisure Activities Blank.

The second portion of the survey concerned the participation by respondents in 121 leisure activities (Leisure Activities Blank, LAB). The means and standard deviations are listed in Table 12. These results are not directly comparable to McKechnie's means since his survey used a four point response format, whereas I used five. By multiplying the means for the present study by 0.8, a rough comparison is possible. Table 13 lists the transformed means for the beach study, McKechnie's means.

The results of t tests (correlated means) indicated that the transformed means for the beach results differed from McKechnie's for the following scales: Mechanics, Slow Living, and Neighborhood Sports ($p < .01$). Of the three scales which differ, only "slow living" is easily explained. On McKechnie's LAB the activity "sunbathing" loads highly on the factor "slow living" and thus, persons on a beach engaged in this activity could be expected to maintain a higher score than those persons sampled from the population at large who were not engaged in similar activities at the time the survey was administered. The differences between the scales "mechanics" and "neighborhood sports" may be due to differing recreational preferences of Canadians and Americans, since McKechnie took his sample from Marin County, California.

Table 11. ERI variables: means and standard deviations for English Bay, Kitsilano, and Skaha Beaches. (n = 266)

VARIABLE	ENGLISH BAY		KITSILANO		SKAHA		GRAND MEAN
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
PASTORALISM	77.3	9.6	77.5	15.8	78.1	11.2	77.1
URBANISM	59.9	9.4	58.8	9.6	56.1	10.0	57.5
ENVIRONMENTAL ADAPTATION	68.9	9.4	67.1	9.2	69.0	10.7	69.1
STIMULUS SEEKING	67.6	11.0	70.1	10.4	71.0	12.4	68.9
ENVIRONMENTAL TRUST	61.9	9.3	63.0	8.1	63.4	8.5	62.6
ANTIQUARIANISM	67.2	10.2	69.7	9.7	66.9	9.8	66.9
NEED FOR PRIVACY	54.6	7.6	54.2	7.0	54.1	8.2	54.6
MECHANICAL ORIENTATION	63.6	9.3	62.0	8.9	64.5	9.1	63.5
COMMUNALITY	80.7	6.3	81.7	6.4	80.5	10.0	80.8

Table 12. LAB variables: means and standard deviations for English Bay, Kitsilano, and Skaha Beaches.

VARIABLE	ENGLISH BAY		KITSILANO		SKAHA		GRAND MEAN
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
MECHANICS	38.6	10.7	39.7	10.9	46.3	12.7	42.3
INTELLECTUAL	41.4	8.9	42.8	7.5	40.6	9.3	40.7
CRAFTS	41.6	12.1	40.8	10.1	37.8	10.3	39.5
SLOW LIVING	74.8	10.4	77.8	6.0	76.9	8.2	76.9
NEIGHBORHOOD SPORTS	33.9	8.7	37.2	8.0	37.9	7.6	36.6
GLAMOUR SPORTS	33.6	7.5	36.1	8.7	36.6	8.6	35.2
FAST LIVING	9.0	2.9	8.7	2.8	9.5	2.7	9.0

Table 13. McKechnie's (1973) LAB Results Compared With Those From The Present Study.

Scales	McKechnie	S.D.	Present Study	S.D.
Mechanics	38.4	11.3	33.8	12.8
Crafts	33.0	8.8	31.6	11.4
Intellectual	34.2	8.4	32.6	9.3
Slow Living	59.7	9.1	61.5	8.5
Neighbourhood Sports	26.0	5.6	29.3	8.4
Glamour Sports	27.0	6.9	28.2	8.9

(Note: McKechnie did not use the scale "fast living" in further analyses).

Socio-economic and demographic characteristics.

The results of the questions requesting background information (socio/demographic data) of beach respondents is included in Table 14. Before categorizing users for these dimensions, several items require clarification.

The first question (age of respondent) samples only those users 18 and over. Although the decision to exclude persons younger than 18 from the sample was to a certain extent arbirtary, I felt that the survey was more applicable to adults whose attitudes and opinions are probably more stable and less subject to change. The average age of the respondent (30.1) is thus biased upwards compared to that of the beach population for this study.

To ease mathematical computation, variable three (marital status) was reduced from six response possibilities to two. Thus, unmarried (1) included "single", widowed", "divorced", and "separated" whereas married (2) included the category "co-habiting". The results thus indicate that slightly over one half (58%) of all respondents were married.

Question six regarding education, was divided into eight response blanks where a respondent checked his level of education. Low numbers correspond to low education level attained and vice versa.

Question seven asked respondents the number of years they had lived in six different size urban centers. These data thus represent six independent variables and were asked in the following order:

1. Over one million
2. 100,000 - one million
3. 50,000 - 100,000
4. 10,000 - 50,000
5. 5,000 - 10,000
6. Below 5,000

Responses to question nine, "What is your occupation?" were categorized according to an occupation class scale (Blishen, 1958) which is a scheme whereby a respondent's job is ranked according to its relative prestige. In this case low numbers are associated with high status. There are a total of seven classes with the following four classifications

Table 14. Socio/demographic variables: means and standard deviations for English Bay, Kitsilano and Skaha beaches. (n=266)

VARIABLE	ENGLISH BAY		KITSILANO		SKAHA		GRAND MEAN
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
AGE	31.1	8.6	29.4	9.9	30.2	9.9	30.7
SEX	1.4	0.4	1.4	0.5	1.6	0.5	1.4
MARITAL STATUS	1.5	0.5	1.4	0.5	1.6	0.5	1.6
NO. OF CHILDREN	1.1	1.4	0.7	1.2	1.3	1.6	1.2
NO. OF SIBLINGS	3.6	2.4	2.9	3.1	2.8	2.3	3.1
EDUCATION	3.6	1.2	3.8	1.4	3.6	1.5	3.5
NO. OF YEARS LIVED IN CITIES WITH POPULATIONS OF:							
OVER ONE MILLION	8.6	9.8	6.6	10.0	5.2	8.3	5.6
100,000 - ONE MILLION	10.5	10.4	8.0	10.3	8.5	9.9	8.6
50,000 - 100,000	2.9	7.2	2.8	7.2	2.6	6.0	3.1
10,000 - 50,000	3.2	5.4	3.8	6.4	3.0	6.6	3.6
5,000 - 10,000	0.9	1.9	2.3	5.2	2.1	5.1	1.9
BELOW 5,000	1.6	3.2	4.6	6.6	7.2	10.3	5.8
NO. OF AUTOMOBILES	1.0	0.7	0.9	0.7	1.5	0.9	1.3
JOB CATEGORY	3.8	1.3	3.1	1.2	3.5	1.2	3.5
INCOME	8191	3534	10677	9301	12848	6893	11324
% TIME RECREATING OUTSIDE URBAN ENVIRONMENT	34	24	27	20	40	30	35
DISTANCE TO HOME	498	1136	221	835	331	664	360
POPULATION OF HOME CITY	1052500	552660	1084600	285680	676740	492880	824385

excluded from the analysis: 1) housewife, 2) retired, 3) unemployed, and 4) student.

Income (question ten) is expressed as total household income before taxes for the previous tax year.

A final question provided a description of the percentage of time a user spent in recreational and leisure activities outside the urban environment.

Additional information collected from the respondent by the surveyor included the following:

1) Total number of people in the group from which the respondent was selected.

2) Group composition according to sex.

3) The number of children in the group.

4) The straight line distance in miles from the city where the beach was located, to the city where the respondent resided. Note: This variable only applied to non-residents.

5) Population of the city of origin of the respondent. Note: This variable was collected for every respondent whether resident or non-resident.

The variables, day of the week and time of day were encoded so that a low number corresponded to low density conditions. For example, densities follow a generally increasing trend from Monday through the weedend, and from morning to afternoon. As a result, Monday was labelled as one, and time was encoded on a 24 hour clock basis, and morning hours were thus numerically smaller than afternoon times.

The average beach user who responded to the survey may be categorized by the socio/demographic variables in the following manner:

1) Approximately 31 years old (biased upwards because no users less than 17 were asked to complete the survey).

2) 45% were males.

3) 58% were married.

4) Number of children - 1.2.

5) Number of siblings - 3.1.

6) Level of education reached, equal to a point between high school graduate and some college.

7) Spent the most years in urban centers which were very large (50,000 - over 1 Million) and very small (less than 5,000).

8) Had at their disposal 1.3 automobiles.

9) Maintained occupations which were exactly midway between extremes on a prestige scale.

10) Had a household income before taxes of $11,324.

11) Spent a little over one-third of their recreational time away from the city.

12) Non-residents were, on the average, 360 straight line miles from home.

13) The average population of the city where the respondent resided was approximately 825,000 people.

Mood Adjective Checklist.

The analysis of the mood scale resulted in a profile much as one would expect given the context of the beach environment. Table 15 indicates that respondents scored most highly on the factors "cheerful", "energetic", "thoughtful", and "relaxed". As mentioned previously, these results are probably biased toward these more"positive" mood states, since the checklist was an optional feature of the survey. Of the 266 surveys finally included in the analysis, 68% elected to complete the mood checklist.

Table 15. Mood score means and standard deviations for English Bay, Kitsilano, and Skaha beaches.

VARIABLE	ENGLISH BAY		KITSILANO		SKAHA		GRAND MEAN
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
CHEERFUL	29.0	5.2	28.1	6.8	28.7	6.3	29.0
ENERGETIC	20.1	4.3	19.8	5.9	19.2	5.9	19.7
ANGER - HOSTILITY	10.7	2.9	11.7	4.1	9.5	2.2	10.6
TENSE - ANXIOUS	10.3	3.0	10.7	4.0	9.2	2.6	10.0
DEPRESSED	10.4	2.7	12.0	4.6	9.8	2.1	10.7
INERT - FATIGUED	10.7	2.7	11.8	3.2	11.9	3.3	11.7
THOUGHTFUL	18.1	3.8	18.2	4.6	17.6	4.2	17.6
RELAXED - COMPOSED	18.1	3.1	17.9	4.2	18.8	3.2	18.4
MOOD	1.6	0.5	1.8	0.4	1.7	0.4	1.7

APPENDIX C

SOURCES OF SAMPLING ERROR

Interviewer effects.

To test for possible interviewer effects a 3 X 3 (3 interviewers and 3 beaches) analysis of variance was conducted using two dependent variables: the percentage of respondents refusing to complete a survey and the percentage of partially completed surveys for any given interviewer (percentages were normalized by an arc-sine transformation). The use of these variables was based on the argument that any negative effects due to interviewer-respondent interactions would be reflected in the proportion of respondents who were unwilling to fill out a survey or not complete it once they had accepted the proposal.

Based upon these two variables, effects due to interviewer were not significant (survey unfinished, F probability > .27; survey proposal rejected, F probability >.32). Although this test may not have covered all sources of interviewer bias, it was considered sufficient for the purposes of the present research.

Sampling procedure.

The second test of sample bias utilized discriminant analysis and was concerned with determining whether the sample taken from the beach population was typical. For this test four spatial and group variables were compared for those individuals receiving surveys (n = 266) versus the total population sampled whether surveyed or not (n = 1791). The variables employed were: 1) total number of people in the group, 2) the area of a group as evidenced by personal markers, 3) centroid to centroid nearest neighbor distance, and 4) nearest approach nearest neighbor distance. The results of the analysis for the two conditions, 'surveyed' and 'not surveyed', indicated a significant difference between means ($p < .01$). Comparison of the means for surveyed and unsurveyed users for the three beaches indicated that surveyed subjects sampled on English Bay and Skaha were from larger groups with larger areas and respondents at English Bay tended to be on the average more distant from their nearest neighbors. The mean values for these variables and conditions are listed in Table 16.

Table 16. Comparison of means for the three sites for the two conditions: surveyed by questionaire (s), and surveyed + not surveyed (ns). E = English Bay, K = Kitsilano, Sk = Skaha. Areas are in meters^2 and distances are in meters.

	E/ns	E/s	K/ns	K/s	Sk/ns	Sk/s
Group size	1.63	2.48	1.81	1.92	2.08	2.33
Group area	2.95	3.64	3.81	4.10	4.43	4.89
cc/nnd	7.00	10.04	5.63	6.52	5.42	5.56
na/nnd	4.97	7.92	3.40	4.36	3.05	3.11

The results which indicate larger mean group sizes and areas for English Bay and Skaha survey respondents can be explained by the fact that group members at these two sites were often observed to be swimming, strolling, going to the refreshment stand, etc. and were thus not visible in the aerial photographs. Since a respondent indicated on the survey booklet the number of individuals in the group whether immediately present or not, these data would obviously be different from those obtained from the photographs. Kitsilano did not show this discrepancy as much as the other two sites since it was a much more compact area and most people tended to stay at their site. This may have been due to the fact that the area was grass covered and was not as hot as the other beaches which were sandy.

The second difference between surveyed and unsurveyed data mentioned previously was that surveyed respondents at English Bay tended to have greater nearest neighbor distances than the average. Thus respondents with greater than average nnd's were over-represented in the sample. These results are not explained easily since three different interviewers distributed surveys on that beach and thus it seems unlikely that interviewer bias was the source. Since no explanation was apparent the data for nearest neighbor distance for English Bay was not used in the regression analyses and thus the results for these two distance measures are based on data from Skaha and Kitsilano only.

APPENDIX D

REPRESENTATIVE DENSITY AND PATTERN CONFIGURATIONS

Figure 17. Random pattern characterictic of low densities. (Kitsilano - density = 66 groups/hectare).

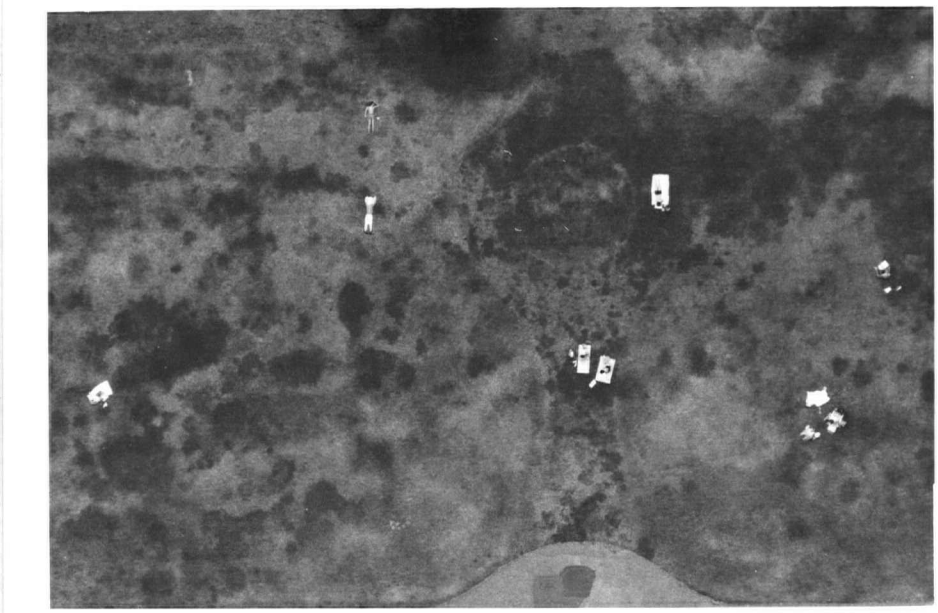

Figure 18. Transition from random to regular pattern. (Kitsilano - density = 106 groups/hectare).

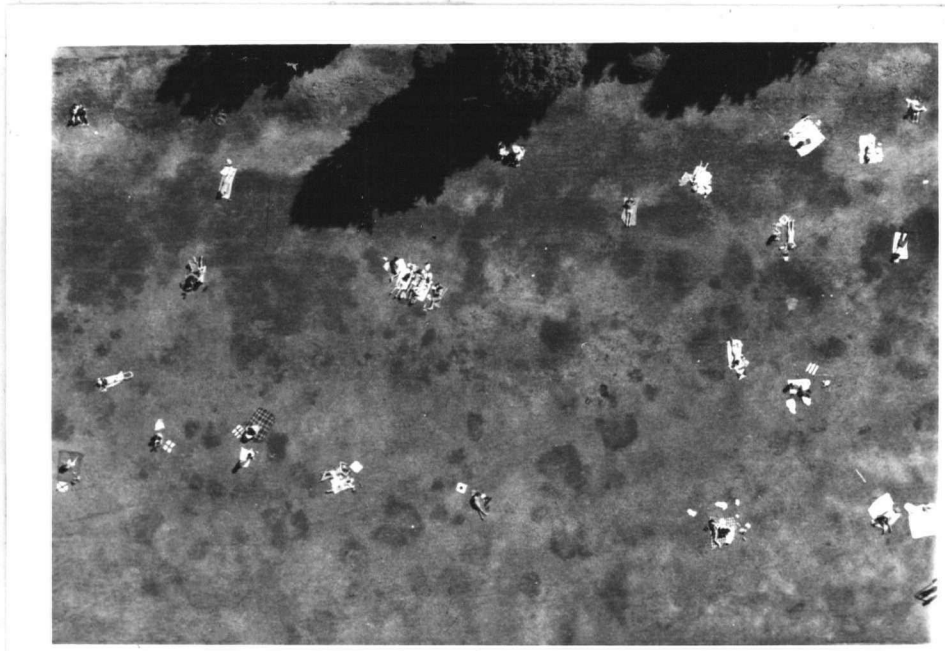

Figure 19. Regular pattern characteristic of high densities (Kitsilano - density = 264 groups/hectare).