ANIMAL PROXEMICS: A STUDY OF THE USE OF SPACE IN MACACA SILENUS AT THE ASSINIBOINE PARK ZOO

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Presented to

The Faculty of Graduate Studies

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by

Susan G. Hornshaw

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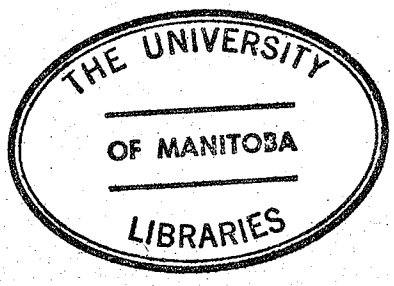

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Chapter I

INTRODUCTION

Almost all behavioral primatological studies to date have attempted to make statements regarding the social organization of nonhuman primate societies. The underlying assumption is that nonhuman primate groups and societies are organized and that the task of the primatologist is to identify the principles of this organization.

Until very recently investigators have tried to use unitary factors to explain intra-group cohesion and social organization among nonhuman primates. There are three such uni-factorial theories:

1. Sexual bond theory
2. Dominance theory
3. Environmental determinism

Sexual bond theory was first proposed by Zuckerman in 1932. Very simply, sexual bond theory states that sexual attraction explains why nonhuman primate groups persist through time. The underlying assumption in this theory is that nonhuman primates are sexually receptive all year round. This assumption was supported by data derived from captive groups. Data available up to 1965 were summarized by Lancaster and

Lee (1965) who concluded that constant sexual attraction could not be the sole basis for the persistent grouping of primates. Their conclusion was supported by more recent data demonstrating that year round sexual receptivity does not occur (Rowell, 1967; Sade, 1964).

Not only does year round sexual receptivity not occur, but, it appears that the predominant daily activity in primate groups is not copulation but feeding and peaceful grooming (e.g. Jay, 1965) and that Gartlan (1966) has demonstrated that the enduring social unit in a nonhuman primate group is not the consort-pair relationship but the mother-infant relationship. It cannot be stated, however, that the consort-pair relationship does not play a major function in nonhuman primate social organization. The critical point is that primatologists cannot use sexual bonding to explain completely social cohesion and organization.

The theory of social dominance, unlike the sexual bond theory, cannot be attributed to any single worker. However, several of the most important influences on the development of this theory have been the work of W. McDougall (1908), T. Schelderup-Ebbe (1931), A. H. Maslow (1963), and Gartlan (1972).

A concept of a simple linear hierarchy pervades both past and contemporary literature. This theory is so prevalent in the thinking of primatologists that its term-

inology is used time and again when the studies are not investigating "dominance", per se. Investigators, in their descriptions of a group, use terms like the "alpha-male" and "alpha-female", "beta-male" and "beta-female" - all of which, taken together, imply a single, simple linear hierarchy.

> Social dominance theory makes several implicit assumptions, including (1) that a continuum of rank-order criteria exists throughout groups, and (2) that dominance is a cluster of inter-related behaviour patterns. The former has been demonstrated not to occur, and in the later case behaviour patterns often used as indices of social dominance often show no inter-correlation. There is in addition, the problem of why intense selection for the associated morphological and behavioural phenomena does not occur if sexual behaviour is dependent on dominance characteristics. Evidence indicates that, on the contrary, learning plays a significant part in the assumption of social roles, and that genetic influences are minimal.
>
> Gartlan, 1972: 116

It became clear that a simple linear hierarchy was inadequate to deal with the observed social complexity in nonhuman primate groups. DeVore (1965) made an ad hoc revision of the dominance theory wherein he postulated a "central hierarchy". This modification of the theory stipulates that there is a central group of males and that this central group of males outranks individuals in the group, even though a young male outside the central group might be able to defeat any member of it separately. Not only did the field data not support the theory of social dominance, but the term "central hierarchy" is an oxymoron.

What DeVore is really describing, in the light of more recent evidence, is a clique (see Sade, for a discussion of cliques) and not a hierarchical organization. DeVore excludes all mention of the roles of females in the group even in this revised form of the dominance theory. The theory still reflects an overriding concern with the role of "male". This comment is particularly relevant in view of more recent research that documents the existence of a group of monkeys containing no "dominant" males (see Neville, 1968).

The behaviour patterns often used as indices of social dominance are:

1. Dramatic forms of aggression
2. Differential access to some desired object such as food or females (Bernstein, 1972)

One can derive an axiom from the first index of dominance: the individual who is the largest, the strongest and aggresses the most is defined as the most dominant animal.

Recent data on M. sylvanus (Burton, 1972) would indicate the converse; that is, the animal who has to expend the least amount of energy to effect a behaviour change in the individuals in the group is the most "respected" animal in the group.

There are numerous accounts in the literature of females copulating with subordinate, peripheral, and even extra-troop males. Those individuals who have been designated "dominant" do not necessarily exhibit differential access to females.

The recent data, cited above, in no way imply that the concept of dominance does not exist as an organizing principle of nonhuman primate social organization, but rather that the indices that have been employed heretofore are perhaps not accurate measures of dominance as it is expressed in a nonhuman primate group.

> One of the main functions of a hierarchy has generally been considered the reduction of aggression (c.f. (Scott, 1962). However, it seems to be a general rule in primates that hierarchies are both more pronounced and more rigid under captive conditions, and that correlated with this are levels of aggression much higher than normally found in the wild populations.
>
> Gartlan, 1972: 105

Given that hierarchies are more rigid in captive populations and given that aggression is more prevalent in captive populations, then one of four things might be happening.

1. That the function of a hierarchy is not to reduce aggression; that is, that hierarchical organization and aggression do not form a causative relationship.

2. That the function of a hierarchical organization becomes inoperative under captive conditions.
3. That the function of a hierarchical organization becomes transformed under captive conditions.
4. That the form of the expression of aggression becomes transformed under captive conditions. What might have been a subtle facial gesture in the wild becomes an exaggerated or dramatic form of aggression under captive conditions.

It would seem most probable that the form of aggression becomes transformed under captive conditions. The critical difference between the captive and free ranging conditions is that, in the free ranging condition, animals have the alternative of spacing themselves over a wider area. This alternative is denied in the captive condition. An individual who is being aggressed against and has nowhere to escape is left open to overt attack.

The use of environmental determinism is perhaps weak in its explanatory abilities.

> Jay (in press, pers comm.) in a comprehensive study of the distribution, ecology and behaviour of wild Macaca mullata noted differences in the size of groups, sex ratios, and behaviour according to the nature of the habitat in which they were found. Thus she was able to distinguish between forest, roadside and city rhesus which showed

> differences in social structure and behaviour, particularly an increasing gradient of aggression from forest to city. Southwick, Beg and Siddiqi (1965) also noted fewer individuals in rural habitats and forest areas compared with urban areas.
>
> Gartlan, 1972: 107

The results of studies like Jay's indicate that social structure in many widespread primate species is largely habitat-rather than species-specific. The implications of these findings are considerable for theories of primate social structure.

In the context of biofeedback systems, Wynne-Edwards (1962) defines society as an organization capable of providing conventional competition. While this is undoubtably one characteristic, to consider a society only in terms of a population regulatory system - as is the tendency when using the concept of social dominance in field studies-represents a gross oversimplification, especially in the persistent grouping of primates. A basic characteristic of society is that there is adaptive differentiation of function among group members (Gartlan 1972: 108). That is, social roles are adaptive to particular environmental pressures.

The idea of analyzing role behaviour is not new to other social sciences such as psychology and social psychology, but is relatively new to primatology. The main drawback of the sex-bond, social dominance and environmental determinism theories is found in their unifactorial approaches. Structure-function analysis is a systems

approach and is more powerful in its explanatory ability.

> The analysis of primate social structure in terms of social role differentiation permits the identification of environmental pressures important in moulding the society. Among pressures known to be important ... are population density, the type and availability of good resources and predation pressures. Analysis of this type follows logically from the proposition that social structure is determined multi-factorially and is appropriate to particular ecological conditions. Comparative studies, experimental alteration of the habitat and developmental studies will also indicate which social roles and patterns are species-specific and which are adaptive to particular environmental conditions. The identification of social roles thus permits comparison within and between species both objectively and quantitatively. From such studies, predictions about social structure in particular habitat conditions become possible.
>
> Gartlan, 1972: 113

It becomes clear, then, that there is a multi-factorial determination of social structure. It is perhaps impractical and unrealistic to analyze primate social structure in terms of variation in strength of a single unitary structuring mechanism. Structural-functional analysis considers sex-bonding, social dominance and the environment as well as the identification of roles to explain nonhuman primate social organization and cohesion.

METHODS OF ANALYSIS

Research heretofore can be divided into two areas:

1. Those studies that use description as their mode of analysis.
2. Those studies that use quantification as their mode of analysis.

There are advantages and disadvantages to both forms of analysis. The difference between the two is a qualitative-quantitative distinction. Description permits nominal and ordinal statements, quantification permits interval and ratio statements, the latter being the more precise. However, precision loses sight of qualitative distinctions. Individual values and characteristics are obscured by the averaging process. Those features which are not statistically significant may, nonetheless, be behaviourally or biologically significant.

The use of numerics and observational data in conjunction with each other can be very effective. Not only is the use of quantification the testing area for what has been observed but it is also able to yield data which are not apparent to the eye of the observer. At all times the investigator must keep in mind that statistical analysis is only a tool - a means to an end and not an end in itself.

This study utilizes both behavioural observational data and quantitative analysis.

CONTRIBUTIONS OF THIS THESIS

This study provides a testing area for a methodological approach that heretofore has not been applied to the study of nonhuman primates. It is an exercise to determine if proxemics as a methodology generates data that are comparable to the data that traditional approaches to primatology have generated. The study utilizes a numerical analysis of

behavioural input. This generates uncontestable data in the sense that the observational data serve as a check on the quantitative analysis and that the quantitative analysis provides verification and confirmation of the observational data.

The species selected as the subject of the study is little known in the literature. Only one study exists on M. silenus (Sugiyama, 1968) however, as it was not concerned with spatial behaviour, it yields no comparative data relevant to the thesis problem.

STATEMENT OF THE PROBLEM

The hypotheses around which this study is centered can be divided into two categories:

1. Those hypotheses that pertain to data arising from the observational process. (Type A hypotheses)
2. Those hypotheses that pertain to the numerical analysis of the spatial behaviour of a group of M. silenus. (Type B hypotheses)

Type A Hypotheses

Hypothesis I

> That there are preferred areas, that is, that certain individuals prefer to occupy certain areas in the enclosure and that some individuals demonstrate exclusive use of some areas.

Hypothesis 2

Because M. silenus is arboreal, there should be evidence of a preference for elevated loci, In connection with this there are two trees in the enclosure that are equidistant from the front extremity of the enclosure. It is hypothesized that both these trees should demonstrate equal usage. It is also hypothesized that there should be extensive use of the ledge not only because it is elevated but because it is associated with shelter during inclement conditions.

Hypothesis 3

Because of the way in which the enclosure is constructed, the sun is most intense in one area of the enclosure (specified in Chapter 3). It is hypothesized then that there would be high group use in this area if for no other reason than monkeys have been shown to express an affinity for the sun (Burton, 1972).

Hypothesis 4

Because this group of M. silenus is a captive group, it is hypothesized that there should be a high incidence of aggression and

that, connected with this, Goliath, the only mature adult male, would mediate any quarrels that might arise.

Type B Hypothesis

Certain kinds of relationships are characterized by low inter-individual distances.

Hypothesis 5

It is expected that there should be low inter-individual distances in the following relationships: Consort-pair, mother-infant, play-partner and associational partner.

In general, then, there are two major questions to which this research is addressed:

1. Is there such a phenomenon as personal space in this group of M. silenus?
2. How is this personal space maintained?

The numerical data consist of the mean distances (in centimeters) between every individual for the duration of the study. An analysis of these distances with their standard deviations and the corresponding observational data should yield responses to the questions and hypotheses stated above.

There are five principles that are hypothesized as governing the spacing of the individuals in this M. silenus group:

1. Age
2. Status
3. Role
4. Sex - (a) gender
   (b) sexuality or reproductive status
5. Tradition

The fifth principle accounts for qualities that are ineffable, that is, things that become apparent observationally but that cannot be demonstrated numerically, but are real nonetheless. Tradition includes such factors as group and individual history, "charisma" and "personality".

Chapter II

REVIEW OF THE LITERATURE

INTRODUCTION

Social co-ordination and adaptation cannot exist without communication. The modalities of communication are kinesic, tactile, olfactory, and auditory-vocal. Although not a modality, proxemics is a result of modalities - a social phenomenon, a nonverbal communication.

Research on the modalities of communication in nonhuman primates has been extensive (See Altmann, 1972; Marler, 1965; and Sebeok, 1971). There has been no research published to date on proxemic behaviour of nonhuman primates.

All literature on the genus Macaca is relevant insofar as the group presently under study belongs to it. Of particular significance are the studies on the species of macaque which fall within the geopolitical area of India, that is:

M. mulatta

M. radiata

M. silenus

The literature on M. mulatta is particularly voluminous because this species has been used by a variety of disciplines for many kinds of research, both in the laboratory and in the field. Research to date encompasses physiology, pathology, sensory behaviour and social behaviour.

Ideally, field and laboratory research should be mutually complementary (Jay, 1969). Each should draw on the other for evidence and hypotheses and thus provide the essential comparisons and corrections that will result in the most comprehensive understanding of the social organization and individual social behaviours of nonhuman primates (R. E. Miller, 1971).

GENERAL BEHAVIOURAL CHARACTERISTICS OF MACACA

> Groups of macaques ... have ranged in size from a single pair and young of *M. nemestrinus* to more than 150 individuals of a troop of common macaques in the Waterfall Gardens of Penang, Malaya. A typical undisturbed group of *Macaca assamensis* in Thailand consisted of two adult males, six adult females, two of which were carrying infants, and two juveniles. Another group had four adult males, ten adult females, four of which carried infants, and eight juveniles. The semi-domesticated rhesus monkey groups on Santiago Island, Puerto Rico, ranged in size from about 13 to 150 animals. On April 19, 1940, Group I, which I believe to be a rather typical grouping for this species, contained a total of seventy-three animals. These groupings are believed to characterize the range of groupings of *M. mulatta* of India.
>
> C. R. Carpenter, 1963

The number of females predominate over the number of males in every observed group of macaques and for all species except *Macaca nemestrina* which is little known. There is only one laboratory study on *M. nemestrina* (Jensen, Bobbitt and Gordon, 1969) and there is little opportunity to extract more information on this species

because it has been virtually exterminated (Bernstein, 1966).

Within organized groups, the males dominate all other individuals, but exclusive dominance like that described by Zuckerman for the baboon is not found, unless M. nemestrina proves to be an exception. M. nemestrina may very well be an exception but the paucity of data on this species does not allow one to make a conclusive statement of any kind.

Extra group males in the large genus of Macaca live both temporarily isolated, and also more frequently, in unisexual male groupings (Carpenter, 1963).

DOMINANCE

Dominance is one of the unifactorial theories proposed to explain nonhuman primate social organization. Much theorizing has been devoted to the concept of dominance. Investigators assume an underlying organization by dominance and even though they are not expressly dealing with dominance, they discuss it at length.

Kaufman (in Neville, 1969) stated that a rhesus troop's dominant male is characterized by his assurance, expressed in posture (such as the position of his tail, often erect when walking) and behaviour. The other males react cautiously to him and he is usually surrounded by a relatively large "social space". The dominant male is

more likely than other males to terminate fights, which he does by chasing or threatening some animal in the vicinity of the fight (Kaufman in Neville, 1969). The dominant male is also more successful in mating.

Neville (1969) working with M. mulatta in India, concludes that the factors involved in the assumption and maintenance of the dominant position are very complex. Physical strength and aggressiveness do not guarantee immediate accession to the position. "Aggression is evidently not a constant correlate of high status; ... it should no longer be considered either the most important aspect of a dominant individual's behaviour or the determinant of rank." (Chance and Jolly, 1972: 203-204).

In 1938, C. R. Carpenter took 400 M. mulatta from India to Cayo Santiago. The monkeys presently living on Cayo Santiago are descendants of these 400 monkeys.

Loy (in Sade, 1972) examined the relations among frequency of mating, dominance rank, age, rank of mate and age of mate among rhesus monkeys (M. mulatta) and concluded that dominance relations of the maturing young can be predicted to a greater or lesser degree by knowledge of the dominance relations among their mothers. His conclusions were supported by Kawamura, (1958); Kawai, (1958); Koford, (1963); Koyama, (1967); and Sade, (1966, 1967).

The regularity in rise in rank of younger over older sisters and unrelated adult females from low-ranking

genealogies suggests that two sets of mechanisms must exist. The first set includes those factors which initiate the rise in rank of the young female. The second set includes those factors which limit that rise in rank to the position just below her mother or to the position which her mother would have occupied (in the case of death) (Sade, 1965: 396).

A rhesus female and her offspring can continue to maintain a distinct relation into the offspring's physical maturity and the offspring often develops its strongest relations with monkeys of its own genealogy. The observer identifies relations by the consistent close spacing of individual monkeys, by incidents such as fights, and by the frequency of interactions such as grooming (Sade, 1965: I). This would mean, then, that an individual born to a high-ranking mother would associate or be in contact with other individuals of high rank because these would be the mother's associational partners. The converse would also be the case, that is, that an individual born to a low-ranking mother would be most in contact with other individuals of low rank. The relationship between infant and mother is assumed from the constant close spacing of the individuals. The inter-individual distances were achieved by "eyeballing" the subjects rather than actually calculating the distances. This would have been a perfect opportunity to employ the methodology of proxemics.

GROOMING

To this date, emphasis on the description of the daily activities of nonhuman primates has focused on agonistic encounters because of their dramatic nature. However, monkeys spend most of their day in peaceful grooming sessions.

Sade (1965) states that bouts of grooming may last only a few seconds or may last as long as an hour. In some sequences grooming seems to placate an aggressor, especially when the aggressor is a relative or frequent partner in peaceful inter-actions. After being cuffed or threatened, the victim making a display of submissive gestures, often approaches the aggressor and grooms with exaggerated movements and at a rapid rate. This kind of sequence is very frequently seen during the birth season when parents cuff and threaten older offspring who are trying to poke, tug, groom, or steal the newborn infant (Sade, 1965: 8).

Bouts of grooming may be terminated by either of the participants or by disturbances. The groomer may end the bout by soliciting grooming from the groomed. A pair may alternate for an hour or more. The groomer may simply stop grooming and leave to groom another monkey or to do something else, or to stay and go to sleep. The monkey being groomed may end the bout by getting up and leaving (Sade, 1965).

Simonds (1965) concluded that there is no significant difference between the amount that males and females groom in a Bonnet macaque (M. radiata) group; the female Bonnet macaque is not the major groomer either in number of interactions or in the time spent in grooming. Both sexes groom every age and either sex category in the group.

Grooming is a proximal or contact behaviour and, again, no measures of inter-individual distances were made in either the study by Sade or Simonds.

The general social behaviour of Bonnet macaques falls within the range of that reported for other macaques and baboons. Bonnet macaques live in highly organized groups, which include adult males, adult females, subadults, juveniles, and infants. They have a dominance hierarchy that is well marked in the males and rather less clear among the females. Their social communication is very elaborate, consisting of gestures and vocalizations (Simonds, 1965: 196).

Macaca silenus

The only study on Macaca silenus (Sugiyama) is a brief and rather uninformative account of two groups of M. silenus in Kerala State in India. In general appearance the lion-tailed macaque differs from other macaques (see plates 1 - 4). Group size is smaller (from sixteen to twenty-two individuals) and the sex ratio lower than in some other species of macaques. The social organization

and most of the behaviour patterns of lion-tailed macaque groups resemble other macaque societies (Sugiyama: 1968).

In general, M. silenus is more arboreal than other species of macaque (Sugiyama; Napier and Napier: 1967).

The data on M. silenus are, by and large, anecdotal and do not provide sufficient background data for comparison with the group presently under study.

CONTRIBUTIONS OF THE JAPANESE PRIMATOLOGISTS

Even though the habitat type of M. fuscata is not found in the Indian subcontinent, research with this species is of particular relevance because of the approach that the Japanese primatologists take and the valuable contributions that they have made to the primatological literature.

Imanishi (1963) describes the Japanese macaques as having a concentric social organization with the leader males in the core and the subleader males on the periphery.

Leaders look after females, mediate quarrels among them and guard against the entry of young males into the central part of the group. "Leaders never quarrel because of the dominance-subordination relationship which is settled among them." (Imanishi, 1963) Dominant females are situated near the central part, while the subordinates are found near the margin of the central part.

Itani (in Imanishi, 1963), reported that when the next birth season comes near, most leaders and subleaders

of the Takasakiyama group voluntarily take over the care of the babies from the mothers. He further states that this interesting behaviour has not been observed in any group except that of the Takasakiyama group and in no nonhuman society except that of Japanese monkeys. Recently, however, evidence of such behaviour was found by Deag and Crook (1970) working with M. sylvanus in Morocco and by Burton (1972) with M. sylvanus in Gibraltar.

Paternal care is a form of behaviour typical of leaders and subleaders. It is plain that paternal care itself is a sign of interest in the central part of the group, and the males that display it are trying to establish their social position indirectly through the medium of their activity in the central part. Paternal care can be thought of as a behaviour of this sort (Itani, 1963: 94). (See Mitchell and Brandt 1972 for an extensive review of the literature on paternal care in primates.)

Much attention has been paid to the concept of "acculturation" in the Japanese monkey. The concept of acculturation refers to the appearance of a new response such as potato-washing which has not yet been observed in other groups of nonhuman primates. Acculturation usually starts among infants whose behaviour is "free-floating" and not yet well-fixed.

> The propagation of subculture is apt to occur more readily along certain courses; e.g. paralleling the mother-infant relation or the relations between especially intimate individuals. The propagation depends entirely on the learning of the receiver, with no active behaviour on the side of the transmitter, although the inhibition directed by some individuals against the behaviour of others seems to work for the maintenance of subculture traits.
>
> Kawamura, 1963: 87

In their attitude toward a new food or a new behaviour trait, such as potato-washing, some groups are markedly open and other groups are conspicuously closed. These marked differences between groups will greatly influence the propagation of subculture constituents.

The great contribution that the Japanese primatologists make is found in the level of their explanations and theories. Western primatologists are only beginning to think about such concepts as personality and culture in terms of nonhuman primates.

The Japanese data is significant in that it demonstrates the adaptability and plasticity of a group of nonhuman primates: What happens behaviourally is both a function of the environment and of the group itself.

SPATIAL BEHAVIOUR AND PROXEMICS

Nearly all vertebrates have limited home ranges; far fewer can be seen to defend actively a portion of that range; excluding conspecifics. A large portion of the primatological research has been concerned with how nonhuman primates space themselves in their range or habitat.

The terminology associated with this research is very confused. The case in point here is the concept of "territoriality". Its popularization has been so confounded as to render it useless as a concept of any descriptive value. "Home range is the area normally occupied by an animal throughout its adult life" (Jolly, 1972: 102). What, in the past, was referred to as "territory" is defined by Burt (in Jolly, 1972: 103) as defended area. Kaufman's term "defended territory" (in Jolly, 1972: 103) becomes redundant in view of the preceding clarification. Defended area, then, refers to the whole region where an animal successively wins battles and drives away its neighbours (Jolly, 1972: 103). Exclusive area (Kaufman's original term was exclusive territory) is the area that intra-group neighbours never enter or enter only on a brief foray, perhaps chasing the "owners", but do not stop to feed. The concept of core area (Kaufman in Jolly, 1972: 103) is not much different from exclusive area: core area is that area where an animal habitually sleeps, feeds and so on. The area "that neighbours never enter" may very well coincide with that area where an animal habitually "sleeps, feeds and so on". Inter-individual distances may reflect individual core areas or individual exclusive areas.

All behaviour must occur in space, although species differ markedly in the kinds of environments they select

and the way they use the space within it. Some animals make more elaborate and subtle uses of space than do others. For the primates, strongly social creatures and heavily dependent on vision, spatial arrangements enter into almost every detail of every-day life. Spatial factors are intimately involved in feeding, resting, and sleeping; they play an important part in behaviour toward predators, and are prominent features of social relations both within and between groups (Mason, 1968: 200).

In nonhuman primates, free-living social groups are defined in part by spatial criteria, but the arrangement of individuals within those groups - the degree of dispersion, the presence of clusters and their composition - varies with the particular species and, indeed, varies with the particular group of a particular species. Spatial criteria also vary with the eco-habitat. Inter-species contrasts have been shown in the size of the group range, in the manner in which the range is utilized, and in the relation between the ranges of neighbouring groups (Mason 1968: 200).

Intra-group spatial relations (personal space) are technically more difficult to study quantitatively than inter-group spatial relations (group space). Personal space and group space are the two sub-areas of Proxemics, and, even though no primatologists to date have utilized a proxemic approach, the research heretofore can be divided

into 1, those studies concerned with intra-group relations or personal space (e.g. Goosen, 1973; Sade, 1972), and 2, those studies concerned with inter-group spatial relations or group space (e.g. Carpenter 1965; Devore and Hall 1968; Koford 1965; Mason 1968; Southwick, Beg and Siddiqi 1965).

As my paper is concerned with personal space and not group space, I shall not extensively review those studies concerned with group space.

C. Goosen's work with M. speciosa (1973) demonstrates the nature of the studies heretofore on personal space.

> Allogrooming reduces the probability of walking away in the groomer, and thus increases the time spent close to the other monkey; autogrooming seems to have a similar effect. The duration of autogrooming increased in a nonproportional manner by reduction of locomotion, but the duration of autogrooming seems to directly reduce the amount of locomotion. Up to a certain optimal value, the duration of autogrooming increases accordingly as the time spent close to the other monkey increases. The duration of allogrooming may be influenced in the same manner as the duration of autogrooming.
>
> C. Goosen, 1973: 531

The laboratory apparatus used in this study was an ideal one in that it permitted the possibility of detailed and accurate inter-individual measurements. The conclusions (above) are nothing more than ordinal statements. With detailed measurements valuable ratio statements could have been made from this laboratory study. As it stands, the results of this study are confused and confounded -

confounded in the sense that it is not clear whether it is grooming that reduces locomotion or locomotion that decreases the probability of grooming behaviour, and confused in the sense that I am not at all sure that locomotion and grooming are alternate behaviours of equal probability of occurrence.

It is interesting that as early as 1942, Carpenter stated that an important clue to social relations in primate societies is the observed spatial relations of individuals, sub-groups and organized groups.

> The observed strength of the attachment between two individuals may be judged, or actually measured, by observing for a period of time the average distance which separates the two individuals.
>
> C. R. Carpenter, 1942.

Carpenter went on to state that the total network or pattern of social relations in an organized primate society, undisturbed and living in its natural habitat, can be expressed in terms of spatial arrangements plus the quality of behavioural interactions. The character of the group scatter or spatial distribution varies from species to species and under different environmental conditions.

Therefore, even though the concept of proxemics is a relatively new one, the idea of analyzing the spatial relationships in groups of nonhuman primates is not.

Proxemics is largely a discipline of strict but simple methodology. E. T. Hall, an anthropologist, defined

proxemics as the study of man's perception and use of space or "out-of-awareness-distance-setting" (Hall, 1968: 2).

> By observing people over a long period of time as they use and react to space one can begin to discern definite patterns of proxemic behaviour. While photography is only a supplement to other forms of observation - an extension of the visual memory, as it were, - it is an indispensible aid in recording proxemic behaviours ... It freezes actions and allows the investigator to examine sequences over and over again. The difficulty is to photograph people without intruding or altering their behaviour.
>
> Hall, 1965: 88

Most of Hall's methodology is inapplicable to the proxemic analysis of nonhuman primate spatial behaviour. For example, there will never be any questionnaire data to examine, and there is no prose, poetry or art to analyze; but his use of photography and ratio measurement have boundless applications to the analysis of nonhuman primate spatial behaviour. O. M. Watson (1970), another anthropologist, further explicates Hall's work by reviewing the literature on the spatial behaviour of man and animals and putting it into Hall's framework.

Hall's only work on proxemics has been done with H. sapiens. Research on human personal space behaviour has been extensive (Sommer, 1969; Whyte, 1970). Research on animal personal space behaviour has been less well-developed. What research that has been done with animal

spatial behaviour has dealt with group space (Calhoun, 1962; Tinbergen,1953; Davies,1959), rather than personal space. Those studies that have been concerned with personal space or inter-individual distances have not subjected themselves to rigourous measurement. Sade (1972) was satisfied with producing a sociogram of a group of M. mulatta. The results were frequency distributions of the number of times each individual groomed every other individual.

> Hediger's unique work in zoology and animal behaviour is particularly important to proxemics. He has devoted himself to the study of what occurs when men and animals interact in the wild, in zoos, and in circuses as well as in experimental situations. His studies of the domestication process not only underline the necessity of thoroughly understanding the sensory symbolic world of a species (how it marks its "territory", for example, or the components that go to make up its biotope), but also stress the importance of knowing the specific way in which the species handles distance beyond strictly territorial (group space) considerations (Hediger 1950, 1955, 1961). Hediger distinguished between contact and non-contact species, and he was the first to describe in operational terms personal and social distances. He has demonstrated that critical distance is so precise that it can be measured in centimeters.
>
> Hall, 1968: 85

In general, animal studies indicate that individual distance is learned during the early years. At some stage early in his life the individual learns how far he must stay from species members. When he is deprived of contact

with his own kind, as in isolation studies (Harlow, 1971), he cannot learn proper spacing, which sets him as a failure in subsequent social inter-course; he comes too close and evokes threat displays or stays too far away to be considered a member of the group (Klopfer and Hailman, 1969: 29).

It is clear, then, how important an analysis of critical inter-individual distances is to the understanding of the social organization of nonhuman primates.

Chapter III

METHODOLOGY

INTRODUCTION

The general purpose of primatology is to describe and explain the principles of nonhuman primate social organization. This is also the general purpose of this research. The specific purpose of this study is to introduce ratio or precision measurement into behavioural primatological research.

Previous investigators have been content with "eyeballing" inter-individual distances rather than measuring or calculating them. The methods of analysis employed in this study enabled me to calculate (with the aid of a computer) the actual inter-individual distances in centimeters among all the individuals.

Inferences about inter-individual relationships can be made from the knowledge of inter-individual distances.

THE ENCLOSURE

The enclosure provided for the group of Macaca silenus group at the Assiniborne Park Zoo is hexagonal (See fig. 1, pg. 32 for a plan of the enclosure). The dimensions of the enclosure were measured along the exterior walls before recording any of the data. Each wall is 5.2 meters long. The diameter from point "x" to point "y" on the plan (pg. 32) is 10.3 meters. The height of the enclosure

LEGEND

Three-digit Cartesian Code

first digit - unit from west to east

second digit - level (ground, middle, upper)

third digit - unit from south to north

A ... Centre Pole

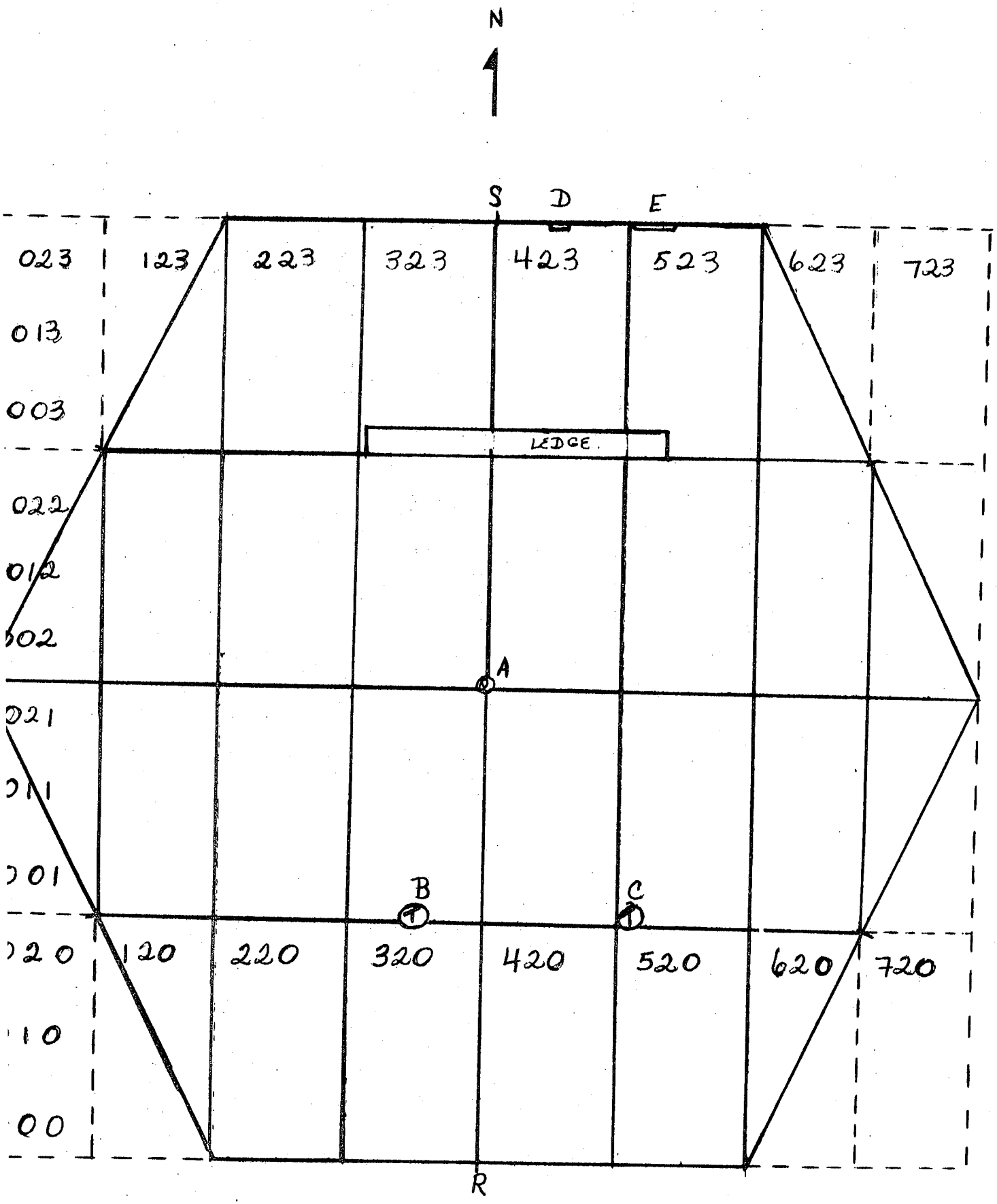
B ... Left Tree

C ... Right Tree

D ... Water Fountain

E ... Exit Way to the Interior Enclosure

- - - ... Extrapolated Line


N
S
D
E
023
123
223
323
423
523
623
723
013
003
LEDGE
022
012
002
A
021
011
001
B
C
020
120
220
320
420
520
620
720
010
000
R

is 3.6 meters, thus making the centre pole, N, 3.6 meters and the two trees "B" and "C", 3.0 meters in height. The roof of the enclosure sloped slightly downward. The distance RS on the plan is 4.9 meters. The plan has been drawn to scale: 5.1 centimeters equals 261.6 centimeters.

THE GROUP

The nucleus of the group, one sexually mature male and three productive females, has been imported from the Torino, Italy Zoo in 1964 and 1965.

At the commencement of the present study, there were twelve individuals. The genealogy provided by Clive Roots, Director, Assiniboine Park Zoo, follows:

TABLE I BIRTH RECORD

No.	Sex	Date & Location of Birth	Given Name	Date of Arrival	Departure
1.	M		Goliath	7/9/65 Torino, Italy	
2.	F		Old Lady	22/9/64 Torino, Italy	
3.	F		Little Lady	22/9/64 Torino, Italy	
4.	F		Granny II	7/10/65 Torino, Italy	Nursery
5.	F	1966 A.P.Z.	Thumper	4/5/66	
6.	F	1966 WPG	Little Girl	9/12/66 1X3	Nursery
7.	M	1968 WPG	Abe	24/12/68 1X3	Nursery 21/3/72*
8.	M	1969 WPG	Joe	31/1/69 1X2	
9.	F	1970 WPG	Betty	10/6/70 1X4	
10.	M	1970 WPG	Pat	7/12/70 1X5	

No.	Sex	Date & Location of Birth	Given Name	Date of Arrival	Departure
11.	M	1971 WPG	Erwin	3/1/71 1X2	
12.	F	1971 WPG	Harriot	3/3/71 1X3	
13.	M	1971 WPG		27/10/71 1X4	Died 8/11/71
14.	M	1972 WPG	1H1	29/4/72 1X2	
15.	M	1972 WPG	1H2	14/5/72 1X6	Nursery
16.	M	1972 WPG	1H3	15/7/72 1X5	
17.		1972 WPG	1H4	24/9/72 1X3	

The individuals signified "Nursery" are not a part of the group presently under study. They have been removed for a variety of reasons and housed in a separate enclosure which is not accessible to the public. The Zoo enforces a selective attrition policy. The two parameters subsumed under this policy are sexual maturity and behavioural "pathology" such that males who are attaining sexual maturity are removed from the group, as is any individual, male or female, that causes internal strife in the group. This policy served the function of reducing or eliminating two manifestations of aggression: The aggression associated with a male approaching sexual maturity which is expressed as ascendancy behaviour, and the aggression that is a result of an idiosyncrasy of a particular individual.

C. R. Carpenter (1965) has constructed an age classification of offspring as follows:

INFANT - ONE - from birth to 5 - 6 months

INFANT - TWO - from 5 - 6 months to 10 - 12 months

INFANT - THREE - from 10 - 12 months to 18 - 20 months

JUVENILE - ONE - from 20 - 30 months

JUVENILE - TWO - from 30 - 40 months

The typology developed by Carpenter is used because it was the first and most extensive of its type. Using this age - class breakdown, as of January 1, 1973, the group presently under study contained:

One - JUVENILE - Three - Betty

Three - JUVENILE - One's - Pat, Harriot, Erwin

Two - INFANT - Threes - IHI and IH3

One - INFANT - One IH4

Goliath was the only sexually mature propagating male in the group. Old Lady and Little Lady and their respective offspring formed an associational unit. Thumper and her offspring, Pat and IH3 formed an excluded associational unit. The other members of the group articulated little with Thumper and her offspring.

During the course of the study no changes were made in the group - no individuals were removed and no new individuals were added. No new births were recorded. This produced a constant population of individuals over time - a group whose numerical stability is reliably ascertained.

DAILY ROUTINE OF THE ANIMALS

The animals were fed once a day at approximately 6:30 p.m. They received a varied diet of fruit and vegetables depending on the season and including such items as apples, bananas, oranges, grapes, raisins, figs, dates, beets, onions, celery, carrots, Chinese cabbage, and peanuts. They were also given hard-boiled eggs, Purina Monkey Chow, alfalfa hay and browse during the summer months (Roots, 1973) At feeding time, the animals were taken indoors where they ate and passed the night. At this time they were closed off from the exterior enclosure. There were artesian water fountains both indoors and outdoors so that the monkeys had a constant supply of fresh water.

The outdoor enclosure was cleaned daily at approximately 9:00 a.m. The monkeys were still indoors at this time. The floor was hosed down and debris was picked up. Debris usually consisted of commercial food thrown into the enclosure by spectators. The monkeys were allowed to enter the exterior enclosure at approximately 9:30 a.m.

METHODOLOGICAL FEATURES

CAMERA

A single lens reflex Asahi Pentax Spotmatic 500 camera with a 55 mm. lens was used. The camera was fully automatic with a manual override so that exposure settings could be made both automatically and manually; however, the settings were manually adjusted.

FILM

The film used was Kodak Tri-x black and white print film (ASA 400). All the exposed film was processed into negatives and contact sheets.

DURATION OF THE STUDY

From January, 1973 to April, 1973 preliminary baseline data were collected while the monkeys were indoors. The purpose of the initial observation period was to familiarize myself with the operations of the zoo and to learn to identify the individuals in the group.

An attempt was made to secure photographic records of the monkeys while they were indoors but this was made virtually impossible by luminance problems; consequently, I relied on visual observation and manual recording. This consisted of identifying the individuals and marking their loci on a schematic sheet (see fig. 1, p. 32). There was insufficient data obtained from this initial

observation period to warrant quantitative analysis.

From May, 1973 to July 9, 1973 extensive daily observations were made excepting weekends and when the weather was inclement. Thus there were a total of 50 days of observation time.

Since the primary purpose of a zoo is exhibition, the zoo was not designed to accommodate research activities. At all times there were spectators who, by their very presence, made observations difficult. The number of spectators on the weekends made systematic observation totally impossible. In addition to simple photographic obstruction, many visitors harassed the animals by throwing foreign objects into the enclosure and by feeding the animals commercial products not intended for these animals. This upsets the diets of the monkeys and occurred in spite of easily visible signs that state:

PLEASE DO NOT FEED

Indoors the luminance in the cages was of a higher intensity than the luminance in the "viewing area". This created a considerable amount of glare. A similar problem occurred outside and was caused by the roof of the enclosure. The front half of the enclosure was in sunlight and the back half of the enclosure was shaded by the roof. Adjustments had to be made in order to overcome the effects of shooting from bright to dim conditions and were sufficiently successful.

PROCEDURE

The purpose of the methodology was to record the location of each individual in the enclosure through time. This recording of the locations of individuals at successive points in time produced photographic position fixes.

It often required from five to six frames to record every individual at one time. Care was taken to include one of the poles or features in the enclosure in each frame as well as recording the angle from which the shot was taken. This facilitated identification of individual monkeys on the contact sheets and negatives. The number of frames required for each group position fix was recorded and, when time permitted, the code names for the individuals were recorded in the space on the photographic record sheets corresponding to the frame number in which they appeared. A brief description of the on-going behaviour was also made on the photographic record sheets. This entire procedure was repeated every five minutes. This yielded a sequential rather than a continuous record of every individual's location in the enclosure through time. Continuous recording would have yielded a far more complete record of the behaviour within the enclosure. However, it was not feasible to mount a movie camera in the enclosure because the monkeys would have been easily able to knock the camera down and because this procedure would have been against zoo policy.

There were a total of thirty-four rolls of film exposed. However, seven of the rolls were ruined. The remaining twenty-seven rolls contained decipherable data. With thirty-six exposures per roll, the result was a total of 952 frames exposed containing analyzable position fix data.

As each roll of film was developed, it was labelled with a number and date that corresponded with the number and date on the notes taken on the same day so that the notes and negatives were cross-indexed.

THE PLAN

A plan was made of the enclosure and a cartesian co-ordinate grid was superimposed on the plan. Four hundred copies of the gridded plan were made and these served as transcription sheets. After the film was developed, the individuals were identified from the negatives and contact sheets and the code names were placed in the appropriate spot on the transcription sheets. Each transcription sheet represented one position fix locating all the individuals that were identifiable at a particular moment.

The intersecting lines that formed the grid created subdivisions was labelled a "unit". Each unit of the grid was assigned a numeric code (see schematic p. 32). After each individual was located on the grid, he or she was assigned the code number corresponding to that unit.

These code numbers were then recorded on IBM fortran coding sheets. IBM computer cards were punched and presented to the computer for analysis.

IDENTIFICATION PROBLEMS

It was not a difficult task to identify individual monkeys by sight, but, when I was viewing the photographic data, it was very difficult to identify the "juveniles". The distinguishing facial features of juveniles are not fully developed. Perhaps the modulation transfer function of the camera lens reduces frequencies crucial to making an accurate identification. A lens is more sensitive to some frequencies or wavelengths than others. It allows some wavelengths to pass through unaffected and reduces or distorts others. The distorted or reduced wavelengths may be the ones crucial to accurate identifications. Presumably this could be rectified by superimposing corrective filters on the camera lens to obviate the problem of frequency reduction. In this study the problem was off-set by referring to the notes on the photographic record sheets in order to "fix" the juveniles on the transcription sheets. This was not a fool-proof method and when there was doubt about who an individual was, he or she, was given the code 999 (defined as a non-fix). If there was an error, it was on the side of certainty. This reduced the number

of fixes to be analyzed but those fixes that were analyzed contained no doubt with respect to positive identification.

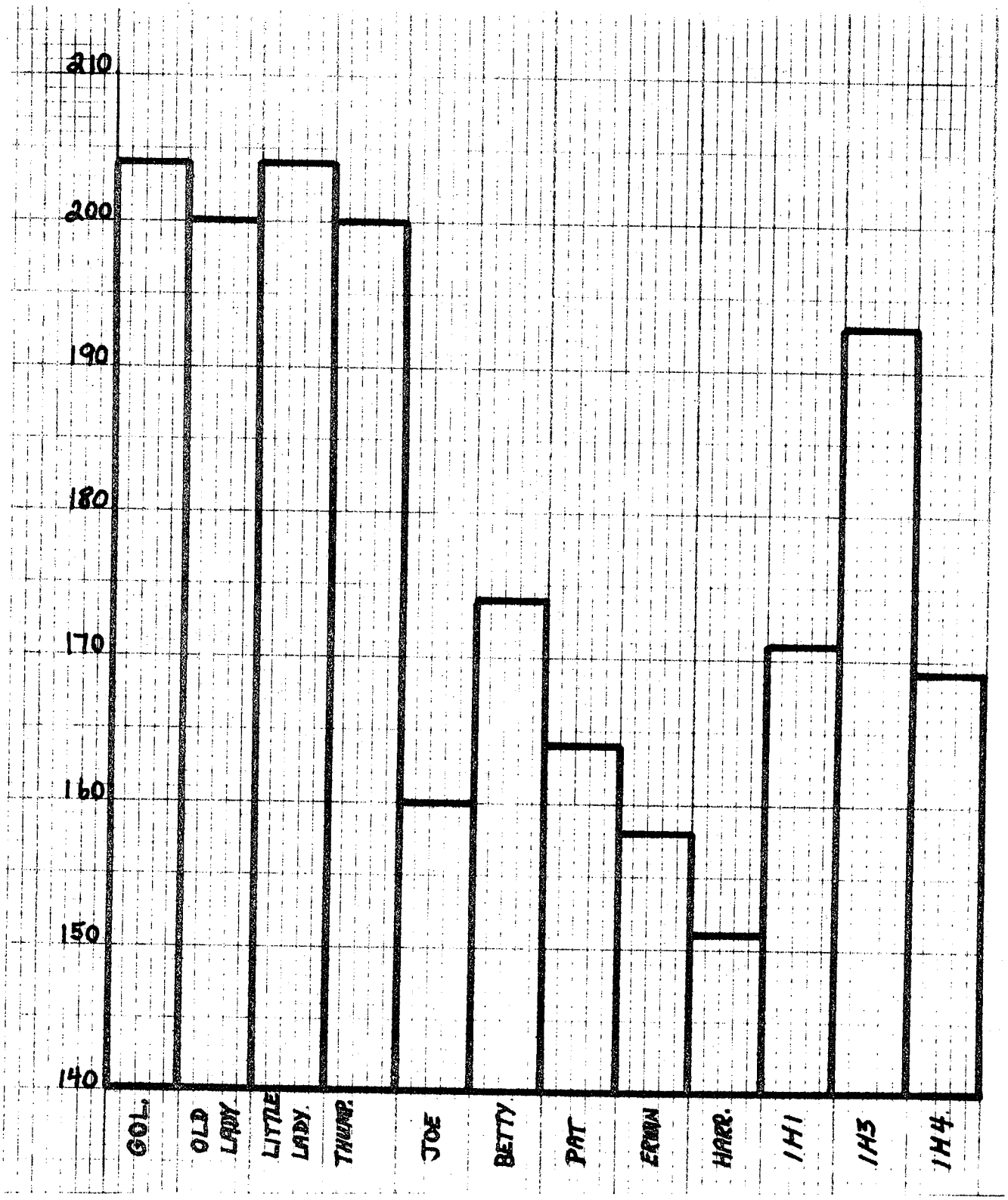
There were a total of 209 possible fixes; however, no individual was detected a total of 209 times. When an individual was not detected in a "fix", he or she was signified by a code 999 or a non-fix. See table 2 and the derived graphs, figures 2 and 3 for a breakdown of the position fixes.

2.

TABLE 2. EFFECTIVE FIXES AND NONFIXES

INDIVIDUAL	No. of Effective Fixes	No. of Nonfixes (Code 999)	Total
Goliath	204	5	209
Old Lady	200	9	209
Little Lady	204	5	209
Thumper	200	9	209
Joe	160	49	209
Betty	174	35	209
Pat	164	45	209
Erwin	158	51	209
Harriot	151	58	209
lH1	171	38	209
lH3	193	16	209
lH4	169	40	209

Figure 2. Effective Fixes



CHAPTER 4

RESULTS

In this particular study there are two aspects to the analysis of space. The first is the relationship of the monkeys to the enclosure - their environment. How do the monkeys use the space allocated to them? The observational data provide the answer to this question. The second is the relationship of individual monkeys to each other. The computer analysis of inter-individual distances provide answers to this aspect of the problem. The former is an ecological problem and the second is a social organization problem.

The first part of this chapter deals with the ecological space and the second part deals with the social space question.

PREFERRED AREAS

Not all areas in the enclosure were occupied equally. There were two main areas that the group as a whole used more than other areas in the enclosure. The two most important areas were the ledge (units 313, 413 and 513) and the sunning area (units 701 and 702).

The Ledge

The ledge was an elevated construction which the monkeys used more than any other area of the enclosure.

As a unit, they spent 29.19 per cent of the total number of effective fixes on the ledge engaged in huddling or grooming behaviour. The following table illustrates this statement.

Table 3

Individual	Number of times in Unit 313	Number of times in Unit 413	Number of times in Unit 513	% of each fixes
Goliath	29	27	31	42.65
Old Lady	57	22	3	41.00
Little Lady	45	12	20	37.75
Thumper	9	11	15	17.50
Joe	12	17	3	20.00
Betty	30	24	4	33.33
Pat	1	12	1	8.53
Erwin	12	17	3	20.25
Harriot	29	19	4	34.44
lHl	50	15	1	38.60
lH3	9	7	15	16.06
lH4	36	15	10	36.09
Total	319	198	110	
Composite Total		627		29.19

The Sunning Area

The sunning area (units 701 and 702) was defined both physically and behaviourally. The sun shone on this area more than any other area and the monkeys would go to this area because of the sun. The group as a whole spent 9.87 per cent of its observed time in the sunning area. The following table illustrates these statements.

Table 4 THE SUNNING AREA

Individual	Number of times in Unit 701	Number of times in Unit 702	Per Cent of each Individuals
Goliath	22	9	15.19
Old Lady	2	15	8.50
Little Lady	9	11	9.80
Thumper	4	6	5.00
Joe	5	7	7.50
Betty	6	18	13.79
Pat	8	2	6.09
Erwin	4	9	6.33
Harriot	7	15	14.57
1H1	5	15	11.70
1H3	5	6	5.70
1H4	7	15	13.02
Total	84	128	
Composite Total	212		9.87

AREAS OF INDIVIDUAL USE

Although the group as a whole used two areas of the enclosure more than any other single area or combination of units, the group was not always together as a unit. It is essential, then, that we examine the use of the enclosure units by each individual.

In the appendix to this chapter there is a table for each individual indicating three things:

1. the units occupied for at least one photographic fix.
2. The absolute number of times the individual occurred in each of these units.
3. the absolute number of occurrences were converted to a percentage of the total number of effective fixes.[1] All the percentages should total 100 per cent; however, in some cases this does not occur because of the "rounding off" procedure that was employed. Decimals were rounded off to the nearest one-one hundredth.

Because M. silenus is arboreal and because other investigators (e.g. F.D. Burton, 1972) have documented preferred use of a sunning area, it was hypothesized that Goliath would have spent most of his time in either 701-702 or 311 - 321 (either the sunning area or the left tree respectively) engaged in vigilation or siesta. However, this appeared not to be the case. He spent most of his time on the ledge grooming, being groomed, huddling or

---

[1] Both the absolute number of occurrences and the percentages are presented in descending order of frequency of occurrence.

sleeping. Combining all three sections of the ledge (units 313, 413, and 513), Goliath spent 42.64 per cent of his time on the ledge. He spent 15.19 per cent of his time in the sunning area, vigilating , sleeping or grooming and decreasing amounts of time in the other areas of the enclosure. He occupied the left tree a total of seven times and was never observed in the right tree. The left tree was not occupied as often as observation would have led me to believe. (See table 5, "Goliath", p. 59)

Because the ledge was shown to be a preferred area for the group (Table 3, p.46) it was hypothesized that Old Lady would spend most of her time on the ledge and this appeared to have been the case. She spent a total of 41.00 per cent of her time on the ledge, and 8.50 per cent of her time on the sunning area (units 701 and 702). In other words, virtually half of her time was spent in these two areas, the remainder of her time was distributed in decreasing proportions over other areas of the enclosure.

Old Lady was rarely found in units 513 or 701. In other words, she restricted herself to units 313 and 413 of the ledge and to unit 702 of the sunning area.

An unexpected finding was that Old Lady spent five per cent of her time in Unit 503 which had heretofore been thought of as Thumper's exclusive area. (See Table 6, "Old Lady", p. 60).

Little Lady was in estrus for part of the duration of the study. She spent most of her time on the ledge, primarily in unit 513, and in the sunning area, usually in unit 702. Like Old Lady, Little Lady also, unexpectedly, spent a fair amount of time in unit 503. (See table 7, "Little Lady", p. 61)

Thumper spent more time in any one single unit than did any other individual, with the exception of Thumper's two offspring. She spent 44.00 per cent of her time in unit 503. Surprisingly, she also spent a fair amount of time on the ledge (17.50 per cent), however, this usually occurred when no one else was there. She spent only five per cent of her time in the sunning area and, again, usually when no one else was there.

In this case, numerics corrected a possible experimenter bias. I thought that Thumper restricted herself almost totally to unit 503. (See table 8, "Thumper", p.62)

Joe was the oldest offspring of Old Lady. He spent most of his recorded time on the ledge (20.01 per cent) and 7.51 percent of his time in the sunning area (units 701 and 702); however, he was not detected a great deal of the time (see table 1, p 33). For the most part Joe was engaged in play of various types with Erwin. (See table 9,"Joe", p.63)

Betty was an offspring of Granny II who had been removed from the group prior to this study. She spent most of her time on the ledge (33.30 per cent) and in the sunning area (13.79 per cent). She also spent a fair amount of time with Thumper in unit 503 (6.32 per cent). The fact that Betty was the offspring of Granny II, Thumper's former cohort, may account for her affiliation with Thumper. Betty was a fully integrated member of the group in spite of this association with what appeared to be a peripheralized individual. (See table 10, "Betty" p. 64).

Pat was the older of Thumper's two offspring. He spent 22.56 per cent of his time in unit 503 with Thumper and 7.93 per cent in the adjacent unit 403. Pat was not detected a great deal of the time; this was probably because he was obscured by other individuals. He was, by and large, a "loner" that is, he play and cavorted by himself. (See Table 11, "Pat", p.65).

Erwin was Joe's younger brother and the second offspring of Old Lady. The high number of nonfixes recorded for Erwin (Table 12,p.66) was a result of the large amount of time he spent play-chasing with Joe. When Erwin was stationary long enough to be "fixed", he spent the majority of his time on the ledge (20-25 per cent), and in the sunning area (8.23 per cent). (See table 12, "Erwin", p. 66).

Harriot was the oldest remaining offspring of Little Lady. She spent a great deal of her time on the ledge (34.44 per cent) and in the sunning area (14.57 per cent). She often could be found in the same unit as Goliath but only when Little Lady, her mother, was there. (See table 13, "Harriot", p. 67)

In general the infants could be found where their respective mothers were, that is, they spent more time with their mothers than with any other individual. Little Lady's year old infant, 1H1, spent most of his time on the ledge (38.01 per cent) and in the sunning area (11.69 per cent). (See table 14, "1H1", p.68) These figures very closely resemble those for Old Lady. IH3, the most recent offspring of Thumper, spent virtually the same amount of time in unit 503 as did Thumper. In fact, all the percentages for both individuals are very similar indeed. (See table 15, "1H3", p.69)

Little Lady's most recent offspring, 1H4, spent most of her time with her mother on the ledge and in the sunning area. (See Table 16, "1H4", p.70)

PART II

The computer program was designed to calculate the average linear distance between every individual at every fix taken thoughout the course of the study. Table 17 (p. 54) is the computer summary of the data.

I have made an arbitrary classification of the distances, those distances from 1 to 100 cenimeters are labelled "short" mean linear distances; those distances from 101 to 250 centimeters are "medium" mean linear distances and those distances which include and exceed 251 centimeters are "long" mean linear distances.

The standard deviations which are designated in Table 17 (p.54) are measures of the variability of each distance. The factor, N, is the number of distances calculated between the two individuals. For example Goliath was, on the average, 273.85 cm. or 27.39 meters from Old Lady. There was, however, a great deal of variability in the inter-individual distances of Goliath and Old Lady - sometimes they were close to each other, and at other times they were very far away.

Goliath was, on the average, closer to Little Lady than to any other individual. Little Lady's condition of oestrus would at least partially account for the

Table 17. MEAN LINEAR DISTANCES BETWEEN INDIVIDUALS

* Standard deviation

	Gol.	O.L.	L.L.	Th.	Joe	Bet.	Pat	Erw.	Har.	IH1	IH3
O.L.	273.85 187.19 * N=195										
L.L.	194.32 201.87 N=199	207.19 205.92 N=197									
Th.	325.12 178.31 N=196	326.64 155.40 N=192	350.17 174.46 N=197								
Joe	323.77 192.97 N=156	288.97 203.73 N=153	315.42 188.91 N=157	337.19 165.11 N=153							
Bet.	333.88 191.13 N=172	233.35 209.37 N=169	293.92 191.77 N=172	266.36 172.81 N=170	264.28 205.94 N=134						
Pat	371.66 214.77 N=160	331.73 183.60 N=157	370.60 187.64 N=163	272.54 245.68 N=159	328.31 190.65 N=129	327.40 200.12 N=137					
Erw.	320.36 192.49 N=154	275.43 197.34 N=151	306.93 187.03 N=156	322.32 164.56 N=151	69.30 133.63 N=151	253.55 207.67 N=136	295.50 191.64 N=130				
Har.	307.98 191.26 N=149	179.80 204.34 N=149	243.22 190.91 N=149	321.76 160.86 N=146	238.08 204.88 N=121	132.35 198.74 N=146	312.81 191.76 N=116	248.48 209.63 N=121			
IH1	282.89 190.41 N=166	79.01 165.59 N=168	213.49 205.29 N=170	327.21 150.42 N=164	263.52 216.25 N=131	205.77 200.06 N=143	315.03 190.41 N=132	254.48 215.18 N=130	143.86 185.94 N=125		
IH3	338.68 172.52 N=189	330.01 160.49 N=185	356.22 176.51 N=190	25.55 80.00 N=192	336.51 168.46 N=148	266.81 169.74 N=164	254.92 238.07 N=154	321.32 166.65 N=147	319.65 165.19 N=141	323.57 154.44 N=158	
IH4	270.64 198.07 N=166	155.35 198.30 N=162	127.22 186.40 N=168	332.16 168.12 N=164	273.16 208.00 N=132	233.78 202.05 N=146	315.51 190.03 N=133	258.96 199.07 N=131	186.35 191.01 N=127	83.41 162.97 N=155	326.37 168.76 N=158

average close spacing. It is significant that Goliath was consistently furthest away from Pat, Thumper's older offspring. (See Table 18, "Goliath", p.71)

Old Lady was consistently closest to her own infant, 1H1. One would expect this because of the very nature of the traditional mother - infant relationship. She was also, on the average, closer to 1H4 than this infant was to its own mother, Little Lady. On several occasions, Old Lady baby tended 1H4 while Little Lady was with Goliath. Old Lady was furthest away from Thumper, Pat and 1H3. (See Table 19, "Old Lady", p.71).

Little Lady was consistently closest to her own infant, 1H4, but this distance was considerably greater than the other two mother -infant distances, i.e. Old Lady and 1H1 and Thumper and 1H3. Little Lady was furthest away from Thumper, Pat and 1H3 throughout the study. (see Table 20, "Little Lady", p. 71).

Of the three mother - infant pairs, Thumper and 1H3, her infant, had the smallest inter-individual distance. Thumper had a long mean linear distances from every other member of the group except Betty. Betty was the offspring of Granny II, who was Thumper's cohort in "terrorizing"

the rest of the group before Granny II's removal from the group. (See table 21, "Thumper", p.72)

Erwin was Joe's "play partner" - they were consistently found chasing each other or wrestling. Irwin was the only individual who was within a "short" linear distance of Joe. The other juvenile, Harriot was the only individual within the "medium" range of average linear distances. The distance between every other member of the group and Joe fell into the "long" classification. (See table 22, "Joe", p.72 and table 25, "Erwin" p. 73)

Betty occasinally sat with Thumper and IH3 in unit 002 and also with the core of the group on the ledge and in the sunning area. She was, however, closest to the other female juvenile, Harriot. (See table 23, "Betty" p. 72)

Pat, Thumper's older offspring tended to be a loner, off amusing himself with sticks or candies that visitors threw into the enclosure. He had no play partner. All his distances fell into the "medium" and "long" categories. (See table 24, "Pat", p. 73)

All Harriot's distances were medium and long distances. She was closest to the other female juvenile, Betty. Her next closest association was with Old Lady's infant lHl and then with Old Lady herself.

One would have expected that the infants would have been consistently closest to their respective mothers and this was indeed the case for two of the three infants.

Old Lady's infant, 1H1 had two short distances. He was closest to his own mother, Old Lady, and then to 1H4, Little Lady's most recent offspring. The short distance between 1H1 and 1H4 is due to the short inter-individual distances between their respective mothers. 1H1 and 1H4 were not "play partners"; only on a few occasions were they seen to play-wrestle with each other and, on one occasion, 1H1 mounted 1H4. 1H4 was closest to 1H1 rather than to his own mother, Little Lady because much of her time was spent with Goliath.

Thumper's infant, 1H3, had one short distance, with his mother. The next closest distance was to Pat, Thumper's older offspring and the rest of the distances fell into the "long" category.

Salient Results

In general, short average linear distances occurred in mother - infant dyads and play or associational partner dyads. Long distances were found between the tri-associational unit of Thumper, Pat and 1H3 and the other members of the group, and between the juveniles

and the other members of the group.

The sunning area was not as important as I thought it would have been. Other research (e.g. Burton, 1972) has indicated that monkeys demonstrate an affinity for sitting in the sun during siestas, but this was not borne out in this study.

The left tree was also not as important as I thought it would have been. I expected high use of both trees because M. silenus is arboreal. The right tree was used on only four occasions and this was by Old Lady.

Littly Lady was consistently closer to Goliath than either of the other two mature females, Old Lady and Thumper.

Joe and Erwin formed a same-sex sibling "play pair" which was reflected in their consistent close spacing.

APPENDIX

TABLE 5

GOLIATH

UNIT	NUMBER OF TIMES IN UNIT	PER CENT
513	31	15.20
313	29	14.20
413	27	13.24
701	22	10.78
503	13	5.88
702	9	4.41
203	9	4.41
200	7	3.43
600	7	3.43
601	6	2.94
400	6	2.94
321	5	2.45
521	5	2.45
500	4	1.96
502	4	1.96
511	3	1.47
300	3	1.47
301	2	0.98
311	2	0.98
501	2	0.98
100	2	0.98
602	1	0.49
401	1	0.49
602	1	0.49
303	1	0.49
Total	202	98.50

TABLE 6

OLD LADY

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	57	28.50
413	22	11.00
702	15	7.50
500	12	6.00
503	10	5.00
602	8	4.00
203	8	4.00
511	6	3.00
200	6	3.00
400	5	2.50
321	4	2.00
001	4	2.00
513	3	1.50
311	3	1.50
501	3	1.50
521	3	1.50
100	3	1.50
600	3	1.50
002	3	1.50
701	2	1.00
401	2	1.00
301	2	1.00
300	2	1.00
102	2	1.00
302	2	1.00
502	2	1.00
601	2	1.00
603	2	1.00
512	1	0.50
402	1	0.50
403	1	0.50
101	1	0.50
Total	200	100.00

TABLE 7

LITTLE LADY

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	45	22.06
513	20	9.80
413	12	5.88
702	11	5.39
503	11	5.39
600	10	4.90
701	9	4.41
203	9	4.41
500	7	3.43
200	7	3.43
300	6	2.94
511	6	2.94
501	5	2.45
400	5	2.45
601	4	1.96
502	4	1.96
602	3	1.47
302	3	1.47
521	3	1.47
100	3	1.47
301	3	1.47
321	3	1.47
401	2	0.98
001	2	0.98
603	2	0.98
002	2	0.98
402	2	0.98
202	1	0.49
311	1	0.49
301	1	0.49
103	1	0.49
101	1	0.49
TOTAL	204	99.97

TABLE 8

THUMPER

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
503	88	44.00
513	15	7.50
002	12	6.00
413	11	5.50
313	9	4.50
200	7	3.50
602	6	3.00
702	6	3.00
701	4	2.00
500	4	2.00
603	3	1.50
403	3	1.50
501	3	1.50
600	3	1.50
301	3	1.50
103	3	1.50
303	2	1.00
502	2	1.00
203	2	1.00
001	2	1.00
401	2	1.00
313	2	1.00
601	2	1.00
400	1	0.50
402	1	0.50
600	1	0.50
521	1	0.50
102	1	0.50
300	1	0.50

Thumper spent more time in one unit than did any other individual, with the exception of Thumper's two offspring.

Total	200	100.00

TABLE 9

JOE

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
413	17	10.63
313	12	7.50
300	12	7.50
702	7	4.38
411	7	4.38
511	6	3.75
521	6	3.75
501	6	3.75
600	6	3.75
421	6	3.75
701	5	3.13
200	5	3.13
001	5	3.13
012	5	3.13
002	4	2.50
500	4	2.50
503	4	2.50
403	4	2.50
512	3	1.88
311	3	1.88
302	3	1.88
400	3	1.88
310	3	1.88
321	3	1.88
513	3	1.88
401	2	1.25
203	2	1.25
101	2	1.25
721	2	1.25
402	1	0.63
502	1	0.63
301	1	0.63
022	1	0.63
103	1	0.63
601	1	0.63
602	1	0.63
123	1	0.63
510	1	0.63
412	1	0.63
TOTAL	160	100.12

TABLE 10

BETTY

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	30	17.24
413	24	13.79
702	18	10.34
503	11	6.32
203	7	4.02
002	7	4.02
501	7	4.02
701	6	3.45
300	6	3.45
200	6	3.45
302	5	2.87
513	4	2.30
511	4	2.30
102	4	2.30
500	4	2.30
303	4	2.30
400	3	1.72
103	3	1.72
600	3	1.72
301	2	1.15
403	2	1.15
603	2	1.15
001	2	1.15
602	2	1.15
601	2	1.15
100	1	0.57
401	1	0.57
521	1	0.57
101	1	0.57
311	1	0.57
411	1	0.57
TOTAL	174	99.95

TABLE 11

PAT

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
503	37	22.56
403	13	7.93
413	12	7.32
002	10	6.10
200	9	5.49
701	8	4.88
001	7	4.27
501	6	3.66
101	6	3.66
012	6	3.66
203	4	2.44
301	4	2.44
603	3	1.83
411	3	1.83
502	3	1.83
402	3	1.83
500	3	1.83
400	3	1.83
602	2	1.22
303	2	1.22
700	2	1.22
600	2	1.22
300	2	1.22
210	1	0.61
513	1	0.61
313	1	0.61
302	1	0.61
401	1	0.61
601	1	0.61
201	1	0.61
022	1	0.61
113	1	0.61
321	1	0.61
100	1	0.61
102	1	0.61
410	1	0.61
011	1	0.61
TOTAL	164	100.03

TABLE 12

ERWIN

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
413	17	10.76
313	12	7.59
702	9	5.70
300	8	5.06
311	7	4.43
511	6	3.80
503	6	3.80
500	6	3.80
400	6	3.80
521	5	3.16
001	5	3.16
302	5	3.16
701	4	2.53
403	4	2.53
002	4	2.53
501	4	2.53
600	4	2.53
513	3	1.90
421	3	1.90
301	3	1.90
200	3	1.90
411	3	1.90
402	2	1.27
203	2	1.27
101	2	1.27
012	2	1.27
321	2	1.27
401	2	1.27
310	2	1.27
401	1	0.63
502	1	0.63
602	1	0.63
303	1	0.63
022	1	0.63
220	1	0.63
103	1	0.63
601	1	0.63
221	1	0.63
223	1	0.63
210	1	0.63
512	1	0.63
123	1	0.63
510	1	0.63
412	1	0.63
200	1	0.63
612	1	0.63
TOTAL	158	99.97

TABLE 13

HARRIOT

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	29	19.21
413	19	12.58
702	15	9.93
400	8	5.30
200	8	5.30
203	7	4.64
701	7	4.64
503	7	4.64
300	6	3.97
500	5	3.31
600	4	2.65
303	4	2.65
513	4	2.65
521	3	1.99
001	3	1.99
602	3	1.99
311	2	1.32
601	2	1.32
402	2	1.32
301	2	1.32
511	2	1.32
512	1	0.66
103	1	0.66
403	1	0.66
101	1	0.66
002	1	0.66
100	1	0.66
102	1	0.66
502	1	0.66
501	1	0.66
TOTAL	151	99.98

TABLE 14

IHI

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	50	29.24
413	15	8.77
702	15	8.77
503	11	6.43
602	8	4.68
500	8	4.68
200	7	4.09
203	7	4.09
701	5	2.92
302	4	2.34
001	4	2.34
601	4	2.34
501	3	1.75
403	3	1.75
600	3	1.75
402	2	1.17
300	2	1.17
002	2	1.17
400	2	1.17
502	2	1.17
101	2	1.17
513	1	0.58
411	1	0.58
102	1	0.58
301	1	0.58
012	1	0.58
103	1	0.58
703	1	0.58
401	1	0.58
100	1	0.58
511	1	0.58
521	1	0.58
311	1	0.58
TOTAL	171	99.92

TABLE 15

IH3

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
503	85	44.04
513	15	7.77
002	11	5.70
313	9	4.66
403	8	4.15
413	7	3.63
200	6	3.11
702	6	3.11
701	5	2.59
602	4	2.07
603	4	2.07
301	4	2.07
203	3	1.55
501	3	1.55
600	2	1.55
300	2	1.04
502	2	1.04
001	2	1.04
401	2	1.04
601	2	1.04
500	2	1.04
103	2	1.04
402	1	0.52
012	1	0.52
511	1	0.52
100	1	0.52
102	1	0.52
113	1	0.52
400	1	0.52
TOTAL	193	100.54

TABLE 16

IH4

UNIT	NUMBER OF TIMES IN THE UNIT	PER CENT
313	36	21.30
413	15	8.88
702	15	8.88
503	15	8.88
513	10	5.92
203	9	5.33
701	7	4.14
500	7	4.14
200	7	4.14
300	5	2.96
601	4	2.37
600	4	2.37
602	3	1.78
302	3	1.78
001	3	1.78
403	3	1.78
401	3	1.78
402	2	1.18
002	2	1.18
301	2	1.18
603	2	1.18
101	2	1.18
400	2	1.18
502	2	1.18
501	1	0.59
100	1	0.59
411	1	0.59
012	1	0.59
103	1	0.59
303	1	0.59
321	1	0.59
TOTAL	169	100.60

TABLE 18

GOLIATH

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Little Lady	194.32
IH4	270.64
Old Lady	273.85
IHI	282.89
Harriot	307.98
Erwin	320.36
Joe	323.77
Thumper	325.12
Betty	333.88
IH3	338.68
Pat	371.66

TABLE 19

OLD LADY

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
IHI	79.01
IH4	155.35
Harriot	179.80
Little Lady	207.19
Betty	233.35
Goliath	273.85
Erwin	275.43
Joe	288.97
Thumper	326.64
IH3	330.01
Pat	331.73

TABLE 20

LITTLE LADY

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
IH4	127.22
Goliath	194.32
Old Lady	207.19
IHI	213.49
Harriot	243.22
Betty	293.92
Erwin	306.93
Joe	315.42
Thumper	350.17
IH3	356.22
Pat	370.60

TABLE 21

THUMPER

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
IH3	25.55
Betty	266.36
Pat	272.54
Harriot	321.76
Erwin	322.32
Goliath	325.12
Old Lady	326.64
IHI	327.21
IH4	332.16
Joe	337.19
Little Lady	350.17

TABLE 22

JOE

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Erwin	69.30
Harriot	238.08
IHI	263.52
Betty	264.28
IH4	273.16
Old Lady	288.97
Little Lady	315.42
Goliath	323.77
Pat	328.31
IH3	336.51
Thumper	337.19

TABLE 23

BETTY

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Harriot	132.35
IHI	205.77
OLd Lady	233.35
IH4	233.78
Erwin	253.55
Joe	264.28
Thumper	266.36
IH3	266.81
Little Lady	293.92
Pat	327.40
Goliath	333.88

TABLE 24

PAT

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
IH3	254.92
Thumper	272.54
Erwin	295.50
Harriot	312.81
IHI	315.03
IH4	315.51
Betty	327.40
Joe	328.31
Old Lady	331.73
Little Lady	370.60
Goliath	371.66

TABLE 25

ERWIN

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Joe	69.30
Harriot	248.48
Betty	253.55
IHI	254.48
IH4	258.96
Old Lady	275.43
Pat	295.50
Little Lady	306.93
Goliath	320.36
IH3	321.32
Thumper	322.32

TABLE 26

HARRIOT

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Betty	132.35
IHI	143.86
Old Lady	179.80
IH4	186.35
Joe	238.08
Little Lady	243.22
Erwin	248.48
Goliath	307.98
Pat	312.81
IH3	319.65
Thumper	321.76

TABLE 27

IHI

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Old Lady	79.01
IH4	83.41
Harriot	143.86
Betty	205.77
Little Lady	213.49
Erwin	254.48
Joe	263.52
Goliath	282.89
Pat	315.03
IH3	323.57
Thumper	327.21

TABLE 28

IH3

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
Thumper	25.55
Pat	254.92
Betty	266.81
Harriot	319.65
Erwin	321.32
IHI	323.57
IH4	326.37
Old Lady	330.01
Joe	336.51
Goliath	338.68
Little Lady	356.22

TABLE 29

IH4

DYADIC PARTNER	AVERAGE LINEAR DISTANCE
IHI	83.41
Little Lady	127.22
Old Lady	155.35
Harriot	186.35
Betty	233.78
Erwin	258.96
Goliath	270.64
Joe	273.16
Pat	315.51
IH3	326.37
Thumper	332.16

CHAPTER 5
DISCUSSION

One of the original questions that was addressed to this research was: Is there such a phenomenon as personal space in this group of M. silenus and, if so, what are its attributes in terms of size and shape? The answer to this question proceded in a slightly different fashion than was originally intended at the outset of the study. Because of the way in which the data were analyzed it was not possible to specify the actual shape and size of each individual's personal space. The data were analyzed in a linear fashion. This meant that I could demonstrate that there was personal space in this group of M. silenus but that I could not specify its parameters in terms of size and shape.

The "areas of most use" analysis permits one to see how frequently sub-areas or units of the enclosure were occupied and by whom. Statements proceeding from this analysis are nominal and ordinal statements in that they specify the units occupied and the frequency of occupation.

PREFERRED AREAS

Each individual spent a substantial proportion of his or her time on the ledge or in the sunning area. In other words, the two most important areas in the enclosure were the ledge and the sunning area. The group as a whole and on the average, spent 9.87 per cent of its time

in the sunning area (units 701 and 702) and 39.06 per cent of its time on the ledge (units 313, 413 and 513). (Tables 3-4 pp 46-47.)

At first it was thought that unit 503 was the exclusive area of Thumper and 1H3 (i.e. no one else entered this area); however, this was not the case. Other individuals did enter this unit. In fact, every individual entered unit 503 at one time or another. Occasionally this occured when Thumper was also in unit 503, but usually when she was not. This demonstrates quite clearly that use of numerics can confirm or, in this case, correct the investigators hypotheses. Thumper was not prevented from sitting on the ledge or in the sunning area (Tables 3-4,pp 46-47) but this only occurred when no other individual was in these units at the time. When the other members were in the preferred areas, Thumper and 1H3 did not approach these areas. In other words, Thumper and 1H3 did not approach the core of the group while they were in the preferred areas.

This might be explained by Thumper's past history. Before Granny II was removed from the group, she and Thumper used to "terrorize" the other members of the group (MacKendric, 1973). After Granny II's removal Thumper had no associational partner and has been maintained as a social isolate ever since. It would be inaccurate to state that Thumper was completely excluded from the group. In her position as a social isolate she was nevertheless a very functional member of the total group structure

or she would not have been able to mediate effectively the two quarrels she did without retaliation from the other members of the group. She was not totally shunned because other individuals did enter unit 503. On at least four occasions all the members of the group were in unit 503.

ARBOREALITY AND OCCUPATION OF ELEVATED LOCI

As stated earlier, the ledge was the most frequently occupied area of the enclosure. The ledge was an elevated platform approximately five feet long and one foot wide that was free-standing in the enclosure.

It had been hypothesized that both of the trees in the enclosure should have exhibited equal usage because there was nothing strikingly different between them. However, the right tree (units 511 and 521) was scarcely used at all and the left tree (units 311 and 321) was occupied not much more. Only Old Lady occupied the right tree although she did so infrequently. Goliath and Little Lady were the only individuals who occupied the left tree for any prolonged period of time.

The trees were closer to the public than the ledge, but this is probably not the overriding explanation for the

low frequency of occupation of the trees. The presence of the spectators did not appear to influence the monkeys' use of space since they occupied all parts of the enclosure even those close to the front. Perhaps the ledge served as a substitute for the trees. The ledge provided a greater seating capacity than the trees. Only two or three individuals could sit in either of the trees at one time; however, several individuals could sit on the ledge at the same time.

THE SUNNING AREA

Other investigators have demonstrated that monkeys show an affinity for the sun behaviourally expressed as "siestas" (e.g. Burton, 1972), so it was not surprising to see that the data supported this.

PROXIMAL RELATIONSHIPS

Certain roles and the behaviour patterns associated with those roles require consistent close spacing of at least two individuals. I have defined relationships of this type PROXIMAL RELATIONSHIPS. There are four such relationships that could be identified in this group of M. silenus: consort-pair relationships, mother-infant relationships, play-partner relationships and associational-partner relationships.

CONSORT-PAIR RELATIONSHIPS

Consort behaviour by its very nature is manifested by consistent close spacing. During the course of the study, both Little Lady and Old Lady showed visible signs of the oestrus condition. They were not in oestrus concurrently. Goliath was observed to mount both these individuals, although it appeared that Little Lady was Goliath's "preferred sex partner". Goliath was, on the average, closer to Little Lady than to Old Lady. Even when Little Lady was not visibly in oestrus and when Old Lady was visibly in oestrus, Goliath continued to seek out and mount Little Lady. Little Lady was the younger of the two individuals. Other investigators (e.g. Burton, 1972) have found evidence of such preference of the young individual for the consort partner.

The consistent close spacing of Goliath and Little Lady supports, in part, Zuckerman's opinion that the sex-bond is an important factor in the social organization and cohesion of the non-human primate groups. However, another type of proximal relationship consistently demonstrated smaller inter-individual distances than did the consort-pair relationships, and this was the mother-infant relationship.

MOTHER-INFANT RELATIONSHIPS

There were three mother-infant relationships; Old Lady and 1H1, Little Lady and 1H4, and Thumper and 1H3. The nature of the role "mother" necessitates close contact between the mother and her infant. Mothers feed, groom and cuddle their offspring. The infants in this group of M. silenus were rarely away from their mothers.

Thumper and 1H3 demonstrated the smallest average inter-individual distances; Little Lady and 1H4 demonstrated the largest average mother-infant inter-individual distances with Old Lady and 1H1 falling in the middle. The fact that not all mother-infant relationships were exactly alike was reflected by the variation in the inter-individual distances.

Except for the play-pair of Joe and Erwin, the mother-infant distances were the smallest distances generated by proximal relationships. This is positive support for Gartlan's idea about the importance of the mother-infant relationship in the structuring of non-human primate societies.

A role that arose from the mother-infant relationships was that of BABYTENDER. A babytender can be defined as a "temporary substitute mother", that is, the babytender performs the functions of a mother in the mother's temporary absence. A babytender is usually a mother herself in this group of M. silenus.

While Little Lady was consorting with Goliath, Old Lady babytended Little Lady's infant, 1H4. Old Lady was, on the average, 2.12 times as close to 1H4 as to 1H3, Thumper's infant. At no time was Thumper's infant babytended by any other member of the group.

Little Lady and Goliath were also observed to babytend. Towards the end of the study, Old Lady was visibly in oestrus and while she was in consort with Goliath, Little Lady babytended 1H1, but not to the extent that Old Lady babytended 1H4. Little Lady, as Goliath's preferred consort partner, spent more time away from her infant than did Old Lady and, as a result, 1H4 would have more need of a babytender than 1H1. One can see here that the same role can be filled by different individuals at different times or under different circumstances (as predicted by Gartlan, 1972).

Goliath babytended (played with) 1H1, 1H4, Joe and Erwin. This usually occurred in the evening just before feeding time. While Goliath was engaged in this activity, Old Lady and Little Lady were usually sitting in proximity to each other. Thumper was not observed to babytend anyone.

These data are further evidence for babytending behaviour in non-human primates. To date, three species of Macaca have been shown to exhibit this behaviour" M. fuscata (Itani in Imanishi, 1963) M. sylvanus, (Burton, 1972 a.b.; Deag and Crook, 1970) and now M. silenus

PLAY-PARTNER AND ASSOCIATIONAL-PARTNER RELATIONSHIPS

I witnessed only one juvenile male play-pair. Joe and Erwin played with each other consistently (average linear distance was 69.30 centimeters, sd. 133.63). This proximal relationship was also reflected in the high number of non-fixes (code 999) for both individuals. They were seldom observed sitting or stationary but rather play-chasing and play-wrestling.

There were no infant play groups observed. Even when Old Lady babytended 1H4, 1H1 and 1H4 just sat parallel to each other with little or no interaction. Apparently this is aberrant for Macaca (Burton, 1973). Towards the end of the study occasional play-type interactions occurred.

Play-groups have been found to be organized around a "same-sex" factor (Quiatt,1972). Even though Joe was two years older than Erwin, they formed a play pair. It must be pointed out, however, that Joe and Erwin were siblings as well as being the same sex and this relationship is probably the overriding factor in their consistent close spacing.

Old Lady and Little Lady were an associational unit, which was reflected in their average inter-individual distance. They were in proximity to each other when they were not with Goliath. This association can not be explained by similar age because Little Lady was the younger of the two. They were both the same sex and they were shipped from the Torino Zoo together, so that both these factors: same sex and individual history seem to be the accounting factors in this case.

Although Harriot and Betty were never observed to play, they were frequently found in proximity to each other. Betty was the offspring of Granny II and was, on several occasions, observed sitting with Thumper and 1H3. However, this articulation with the isolated member did not seem to affect her relationships with the other members of the group.

Pat, Thumper's older offspring, did not have a play-partner. He was most often alone and was seldom the recipient of any grooming. This was reflected in the condition of his hair which was matted and generally "scruffy-looking" By contrast all the other members had a grooming relationship including Thumper.

AGGRESSION

In the past studies on caged primates have emphasized aggressive episodes. Because this group of M. silenus was caged, it was hypothesized that there would be a high incidence rate of aggression. However, there were only four episodes of aggression recorded. On two of these occasions, Goliath, the mature male, mediated the "quarrel" and, on the other two occasions, Thumper, the isolated individual, mediated the quarrels.

Mediations consisted of walking up or toward the two individuals involved at which point they desisted. No overt aggression directed toward the quarrelers occurred.

The basis for Goliath's authority probably rests in his age, sex, and position in the group. The basis for Thumper's ability to mediate quarrels is a little more difficult to explain. Perhaps her past behaviour patterns (i.e. of aggressive acts directed towards the other members of the group) are still remembered by the other individuals.

VIGILATION

Vigilating behaviour usually occurs when an individual is situated in an elevated position surveying or watching the surroundings for unusual and potentially dangerous events. There have been many reports of vigilating behaviour in other primate groups (e.g. Burton, 1973). Vigilating behaviour was not as evident as I thought it would be . When Goliath was in the left tree (units 311 and 321)

and in the sunning area (units 701 and 702) he was very often engaged in vigilating behaviour, but he was only in these areas 16.66 per cent of his total time. Not all his time spent in these two areas was employed in vigilating behaviour. When he was vigilating he was not in association with any of the other members of the group. As stated earlier,Goliath spent most of his time on the ledge sleeping, grooming, being groomed or huddling. No other individual was observed vigilating. The necessity for vigilating behaviour in a zoo enclosure is minimal. There is no real threat from predators (the animals "ignore" spectators unless they have food) and no need to search for food.

OTHER SALIENT ROLES

Some roles are not necessarily reflected in the analysis of inter-individual distances but are behaviourally real nonetheless. These were the role of "juvenile" and the role of "infant". The infant role was by and large a recipient one and involved a provincial relationship with the mother.

Play behaviour appeared to be the major activity associated with the role of juvenile male play-pair observed.

MAINTENANCE OF PERSONAL SPACE

In this group of M. silenus no incident of aggression related to personal space was recorded in the entirety of the study. Even though Thumper was somehow "not allowed" on the ledge or in the sunning area when the other individuals were there, it was not as though she tried to enter these areas and was threatened away; she simply did not attempt to enter these areas when they were occupied. At no time was Thumper the object of any observable aggression.

Perhaps this can be explained by the concept introduced into primatology by Burton (1792): RESPECT. This concept does not assume overt forms of aggression. Such as chasing and biting in order to control interactions. Behaviour is, rather, controlled by the individual's awareness of his or her relationships to the other monkeys.

In conclusion, there appear to be principles that govern the spacing of individuals in the enclosure. Individuals do not space themselves in a random fashion. The principles are:

1. sex partner relationships, in general, are determined by gender and reproductive status. The preferred consort partner relationship, in this case, appeared to be determined by age (i.e. the younger individual was preferred) and possibly "personality".

2. not all mother-infant relationships were exactly alike. Some mother-infant distances were larger than others. The mother-infant relationship appeared to be modified by other factors. Because Little Lady was Goliath's preferred sex partner, she spent less time with her infant, 1H4, than Old Lady did with 1H1. It would appear that Thumper's past history caused a reduction of her proximity with other members and increased her proximity to her more recent offspring, 1H3. Thumper demonstrated distal relationships with the other members of the group.

3. the play-partner relationship appeared to be based on a same-sex sibling relationship rather than on age because Pat was excluded from it.

4. associational-partner relationships between adults, in this case, appeared to be based on the same sex factor and past history. Unfortunately there was no cross-sex associational unit to which one could compare the associational unit of Little Lady and Old Lady. It may be that the same sex factor is fortuitous. Thumper's past history generated her isolation from the rest of the group.

5. aggression was not the mechanism used to maintain personal space. Perhaps it was a more subtle device - Respect.

APPLICATION OF PROXEMICS TO OTHER SITUATIONS

In order to use photography as extensively as the methodology of proxemics requires, it is an absolute necessity that the animals be visible, unless one is able to make use of infra-red photography. Any situation that permits visibility of the animals is amenable to the use of proxemics. In situations that produce high rates

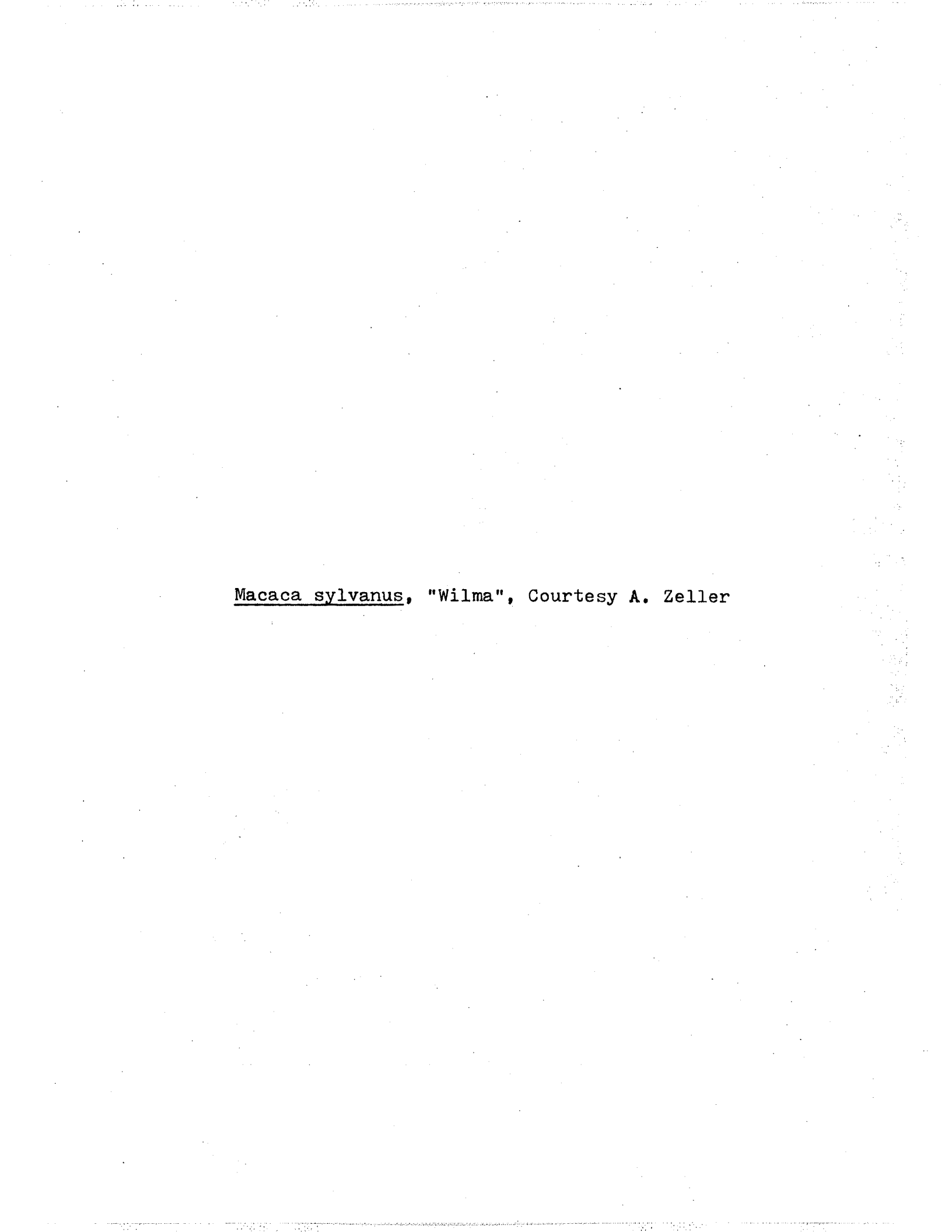
of invisibility such as tropical rain forests, it might be feasible to make use of telemetric techniques. In short, proxemics could be used in a great many situations.

The advantage of the proxemic methodology is that it permits ratio statements. Accurate measurements yield critical inter-individual distances that reflect inter-individual relationships.

The data generated by the proxemic methodology in concatenation with observational data has, in general, supported existing data in the primatological literature and generated new data concerning the relevance of associational units hitherto little considered.

LEAF BLANK TO CORRECT NUMBERING

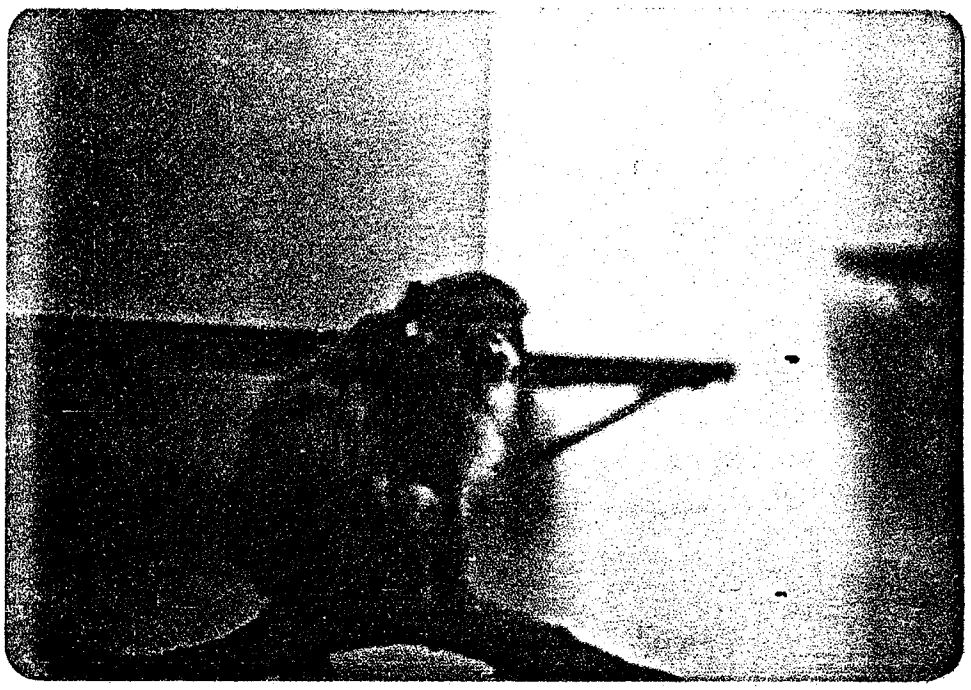
Macaca silenus, S.G. Hornshaw



Macaca sylvanus, "Wilma", Courtesy A. Zeller

TOP: Macaca mulatta, Courtesy A. Zeller

BOTTOM: Macaca fascicularis, Courtesy A. Zeller



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