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Social behavior in a group of captive bobcats : a study in the sociability of felids

Lon W. House
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AN ABSTRACT OF THE THESIS OF Lon W. House for the Master of Science in Biology presented October 31, 1978.

Title: Social Behavior in a Group of Captive Bobcats: A Study in the Sociability of Felids.

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Larry Crawshaw, Chairman

Richard Forbes

Hal Markowitz

Victor Stevens

Roger Jennings

A group of four captive bobcats (Felis rufus), two males and two females, was observed for 102.67 hours over the period of one year. A pilot study was conducted consisting of a minimum of three separate observations for each daylight hour. The remaining observations were concentrated during the early morning hours immediately after feeding,

the time of maximum activity and social interaction.

These bobcats were surprisingly social, spending up to one-third of the total time of this study resting or sleeping together, or grooming one another.

A loose hierarchy, based on greeting and presenting behavior, exists within this group, with one female dominating primarily over the other female. The males only occasionally exhibited these behaviors. The female exerted her dominance primarily at feeding time; at other times all the cats appeared on equal footing.

Grooming activity does not appear to be related to social status. Social grooming is primarily a mutual activity.

Scent marking does not appear to be related to ranking order.

The bobcats spend the major portion of their time resting or sleeping, with grooming being the other major activity.

SOCIAL BEHAVIOR IN A GROUP OF CAPTIVE BOBCATS:

A STUDY IN THE SOCIABILITY OF FELIDS

by

LON W. HOUSE

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE
in
BIOLOGY

Portland State University

1979

TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH;

The members of the Committee approve the thesis of Lon W. House
presented October 31, 1978.

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Special thanks to Ottis L. Dilworth, without whose financial help this thesis would never have been completed, and to Cleide Maia, for being there when I needed her.

To the Cat Family:

May there always be a world in which
you can run wide and free, and studies like
this are unnecessary.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	111
DEDICATION	iv
LIST OF TABLES	vii
LIST OF FIGURES	ix
CHAPTER	
I INTRODUCTION	1
Felid Morphology and Social Structure	3
Bobcats	7
Behaviors Related to Social Structure	10
This Study	12
II MATERIALS AND METHODS	14
Subjects	14
Procedure	17
Pilot Study	
Social Behavior Study	
III RESULTS	20
Pilot Study	20
Observational Hours	
Activity Patterns	
Scent Marking	

CHAPTER	PAGE
Social Behavior Study	26
Observational Hours	
Activity Patterns	
Grooming	
Association	
Vocalizations	
Scent Marking	
Social Interaction	
Correlation between Behaviors	
Social Structure	
IV DISCUSSION	41
Social Behaviors and Organization	41
Factors Favoring Increased Sociability in Felids .	45
Future Research Needs	47
V CONCLUSION	48
REFERENCES	49
APPENDIX	56

LIST OF TABLES

TABLE		PAGE
I	An Ethogram of Social and Nonsocial Behavior of Captive Bobcats	18
II	Pilot Study Results, Expressed as Percent, of Two-Minute Intervals Recording the Behavior	21
III	Social Behavior Results, Expressed as Percent, of Intervals Recording the Behavior	27
IV	Percentage Which Bobcats Licked Various Parts of Their Own Bodies, Expressed as Percent of Total Observed Grooming	31
V	Frequency with Which Bobcats Groomed Parts of Others' Bodies During Social Licking, Expressed as Percent of Total Observed Social Grooming	32
VI	Grooming Interactions, Expressed as Percent of Total Number of Two-minute Intervals Which Recorded the Behavior out of 2,202 Intervals Observed	32
VII	Percent of Two-minute Intervals Recording Associations among Bobcats During This Study out of 2,202 Intervals Recorded	34
VIII	Percent of Total Time Bobcats Were Associating That Various Pairs Were Together out of 1,123 Intervals Recording Association	34

TABLE

PAGE

IX	Vocalizations	35
X	Scent Marking Based on 73.4 Hours of Observation, Expressed as Percentage of Total Observed Scent-Marking Behavior	36
XI	Scent Marking When Presented with a Novel Object, Expressed as Percent of Observed Scent-marking Behavior	37
XII	Occurrence of Head Butting	38
XIII	Occurrence of Presenting	38
XIV	Product-movement Correlation Coefficients between Types of Behaviors	39

LIST OF FIGURES

FIGURE		PAGE
1.	Floor Plan of Bobcat Cage, Washington Park Zoo, Portland, Oregon	15
2.	Photograph of Bobcat Display Area, Washington Park Zoo	16
3.	Locomotion During Pilot Study	23
4.	Solitary Grooming During Pilot Study	24
5.	Social Grooming Sending During Pilot Study	24
6.	Degree of Association During Pilot Study	25
7.	Locomotion During Social Behavior Study	29
8.	Solitary Grooming During Social Behavior Study	30
9.	Social Grooming Sending During Social Behavior Study . .	30
10.	Association During Social Behavior Study	33
11.	Social Structure in Four Captive Bobcats	40

CHAPTER I

INTRODUCTION

The objective of the emerging discipline of sociobiology is to understand and explain the amazing diversity of social structure present among living species in light of modern evolutionary theory. The sociobiological approach is to analyze social behavior as evolved adaptations to ecological pressures (Jarman 1974; Brown 1975). The problem is not an easy one, as Crook (1970) observed:

. . . social structure is a dynamic system expressing the interactions of a number of factors within both the ecological and the social milieu that influences the social dispersion and grouping tendencies of the populations within a range of lability allowed by the behavioral tolerance of the species.

The goal of sociobiology is, knowing the proper variables, being able to predict the social organization of a species:

[T]he principal goal of a general theory of sociobiology should be an ability to predict the features of social organization from . . . information on the behavioral constraints imposed by the genetic constitution of the species (Wilson 1975).

One approach used in determining the lability in behavior of a species is to observe the social behavior in a variety of environments, the resultant range of behaviors being called the "behavioral scale." Different social structures are points on this scale, and the entire scale is assumed to be the "genetically based trait that has been fixed by natural selection" (Wilson 1975).

Studying animals in captivity is one approach used in determining extreme ends of the "behavioral scale." Rowell (1967) states:

[C]age environments can be regarded as an extreme of the range of environments which a species can survive and breed. In this sense the problem of the differences in behavior caused by captivity and that of the variability of behaviors in relation to ecology are only one aspect of the same problem . . .

In studies comparing the behaviors of wild and captive members of the same species some striking similarities emerge. Rowell (1967) observed the same units of social behavior in wild and caged baboons. Although the frequency of interactions was much higher in captivity no behavioral patterns were seen in one population and not in the other. Grant (1973) likewise noted that while the quantity of interactions was higher in a group of caged kangaroos, the quality was essentially the same.

The purpose of this research was to study the behavior and social organization of bobcats in a captive situation. Although the felids are one of the main attractions of zoos and circuses (Crandall 1964), virtually nothing has been published on their social structure and organization in captivity. Bobcats have been kept as pets (Blount 1941; Wolkenhauer 1949, 1950), but little has been recorded on their social structure or behavior. Hopefully this research will give some indication of one aspect of the evolution of sociability in the felids and some idea of the flexibility of social behavior in the group.

The felids, judging from their morphological characteristics, hunting style, and social organizations in the wild, have specialized evolutionarily as solitary hunters. The vast majority of them practice mutual avoidance of other adults of the same species. Animals as specialized for a solitary existence as the felids would not be expected to form stable, well-integrated social groups with conspecifics, for

they probably lack the behavioral repertoire to deal with other adults in a social setting.

FELID MORPHOLOGY AND SOCIAL STRUCTURE

The felids are marvelously adapted to a solitary carnivorous life. They have been called "predators par excellence" (Badino, 1975), and Ewer (1973) regards them as the most specialized of all the Carnivora. Their dentition is specialized for an exclusively meat diet; the carnassials are highly sectorial, the molars are reduced or absent, and the canines are large and well developed. Their body is built for catching prey and delivering one swift, powerful, killing bite. The jaws are short and powerful, the zygoma are strong and bowed out, providing large attachment area for the masseter muscles as well as space for the large temporalis fibres. These adaptations serve to increase the force of the bite. The skull architecture is arranged so "stresses applied to the carnassials are transmitted back along smoothly curving strengthened bony arches" (Ewer 1973). The high, wide braincase and strong sagittal crest provide generous attachment area for the neck muscles, which serve to transfer the shock of a bite or stab with the canines back through the skull to the body. The skeleton is adapted for leaping and short bursts of speed. The limbs are well-muscled and the claws are equipped with sharp, retractable claws.

The morphological specializations are reflected in the hunting style of the felids. The felids depend on secrecy and ambush for the success of their hunt, for they are not able to sustain long pursuits. The initial stages of the hunt consist of a cautious, stealthy approach

until the cat is close enough for a short dash or pounce. A cat's powerful forelimbs, long retractable claws, and short rostrum with long canines enable them to kill swiftly once they have made contact with their prey. Felids grab their prey with their forelimbs and aim their bite at the occipital region of the neck. Death occurs by severing the spinal cord by separating the cervical vertebrae with a canine, crushing the rear of the braincase, or crushing the cervical vertebrae (Leyhausen 1956). On large animals with elongated dorsal spines on the vertebrae, the bite is transferred to the ventral side of the neck. Death occurs in such cases through strangulation or by severing the large blood vessels of the neck. Thus the cats are very well adapted for killing prey by themselves, without any assistance. Kleiman and Eisenberg (1973) conclude that cats have apparently evolved as solitary hunters and feeders.

The basic social structure in felids is a solitary mode of existence. There are no known species in which pair bonding occurs between adults. A mother and her dependent young are the fundamental social unit. Usually the male and female do not associate beyond the breeding season, and the female has the sole responsibility for raising the young. In response to the need to provide sufficient food for the young, the felid society has developed mutually exclusive territories maintained by the females. Males are either nomadic or have large home ranges which encompass several females' smaller territories. The primary function of a territory is to ensure its owner an area sufficient to provide for its own or its family's needs (Ewer 1968). In felids, where the female alone must raise the family, reproductive success of

the species is largely female dependent. Females with small kittens utilize smaller areas than males, due to their limited mobility. Territoriality in felids is an adaptive measure to control a limited resource --prey--during a period crucial to the success of the species.

The critical factors determining the type of territoriality appear to be prey size, distribution, and mobility. The smaller felids prey on a wide variety of birds and small mammals, which are relatively uniformly distributed throughout the environment, sedentary, and too small for several adults to share. Their territorial system is composed of exclusive female ranges overlapped by male ranges (Ewer 1973). This system serves to ensure the females of a lack of conspecific competition for a limited food source.

The territorial system in the mountain lion (Felis concolor) is slightly different from the one described for the smaller felids. Males and females do establish territories, but the female territories overlap considerably. Females often share mutually overlapping territories, but maintain discrete temporal spacing. Seidsticker et al. (1973) explains this system in light of the characteristics of their principle prey species--deer (Odocoileus hemionus) and elk (Cervus canadensis). When these ungulates are disturbed by a mountain lion they leave the vicinity, generally going over the ridge to the next canyon (Hornocker 1970). If the females maintained mutually exclusive territories, the prey would leave her areas after each kill. The presence of several mountain lions in the same vicinity keeps the prey continually moving, increasing the possibility of female hunting success by countering the movement of prey away from her.

The tiger (Panthera tigris) exhibits another modification of the basic felid life style. Males and females appear to establish territories, but they often aggregate at large kills (Schaller 1967). Tigers regularly kill quite large prey (up to 900 kg) and several adults eat from the same carcass. Most of the other time, tigers appear to be solitary in their habits. It is interesting to note that this cat, which combines aspects of both communal and solitary life styles, has the largest repertoire of vocalizations known for any cat (Schaller 1967, 1972), including several used primarily to signify friendly greeting.

With the felid specialization as a solitary hunter depending on crypticity for hunting success, it is not surprising that the overwhelming majority of cats are found in areas with plenty of cover for stalking. Only two felids--the lion (Panthera leo) and the cheetah (Acinonyx jubatus)--are regularly found in open areas. Their social organization deviates from the typical felid form, for both species associate in larger groups. Lions' social unit is the pride, a closed society of related lionesses, their young, and two or more resident males. This is basically an extension of the mother family group. Prides apparently developed in response to the selective pressures experienced by a cat living in the open, as Schaller (1972) convincingly argues. Two lions hunting together had more than twice the success of a single lion. While a single lion is often driven from its kill by hyaenas or hunting dogs, several lions are never displaced. A pride will often appropriate the kills of other predators. During times of food stress, virtually the only lion cubs surviving are those raised by a pride.

In spite of their increased sociability, lions have maintained many of the behaviors of solitary cats. Although lions may hunt together, one lion usually makes the kill. There is not a high degree of interaction between the sexes, among group members, nor a clear definition of roles within the pride. There is no hierarchical organization maintained by status signals within the pride, lions seem to respect the fighting prowess of the others in the group, and stay out of each other's way (Schaller 1972). There remains a high degree of intragroup aggression that becomes obvious during feeding time and during times of food stress. There is no greeting ceremony nor a pre-hunt ceremony. Lion prides are apparently in response to a high local prey density. In areas which do not support a large biomass of ungulates (e.g., the Kalahari), lions form prides which are notably smaller or are solitary (Eloff 1973). These factors have led Kleiman and Eisenberg (1973) to conclude, ". . . the pride has evolved only recently as an adaptative form of social structure."

BOBCATS

The bobcat, Felis rufus,¹ is a medium-sized felid, from 76-100 cm long, standing 51-56 cm at the shoulder (Walker 1975). Average weight is from 6-23 kg (Hamilton 1940), although an occasional bobcat may exceed 30 kg (Young 1958). Their most distinguishing characteristics are

¹The systematics of the Felidae have long been the subject of controversy. The number of recognized genera of felids varies from eighteen (Ewer 1973) to six (Walker 1975) to three (IUCN 1977). For the purposes of this thesis, I will follow the arrangement proposed by Simpson (1945) which includes three genera--Panthera, Felis, and Acinonyx. The scientific name used here for the bobcat is Felis rufus. The most commonly used alternate name is Lynx rufus.

their tufted ears and their short (10-15 cm) tails (hence their common name, bobcat). Their range extends from Mexico to central Canada, and throughout the entire United States (Caras 1967).

Bobcats have typically been associated with the other major predators and thus much of the literature is concerned with their predatory habits. Bobcats have been known to eat everything from grasshoppers to deer, but they appear to be heavily dependent upon rodents and lagomorphs as a primary food source (Young 1958). Scat analysis from several different regions have shown a predominance of rodents and lagomorphs (up to 95 percent) in bobcat diets (Hamilton 1939; Rollings 1945; Pollack 1951; Progulske 1955; Gashwiler et al. 1960). Occasionally, when deep snow hampers their maneuverability, when fawns are young, or when there is a paucity of other food sources, bobcats may prey upon deer (Smith 1945; Marston 1942; Petraborg and Gusvalson 1965). The heavy dependence of their close taxonomic cousin, the lynx (Felis lynx),² on the lagomorph population is a well-known biological phenomenon (de Jong 1966; Nellis and Keith 1968; Nellis et al. 1972). Bobcat populations tend to follow a similar pattern; when there is a crash in the lagomorph population, few kittens reach maturity (Bailey 1974).

Bobcats are polyestrous, with a peak in breeding in the early spring (Grinell et al. 1937; Duke 1954; Young 1958; Gashwiler et al. 1961). Typical litter size is three (Crowe 1975). Bailey (1972) noted that older resident females appeared to have larger litters, presumably a selective advantage in reducing the mortality rate of kittens born to

² Commonly referred to as Lynx canadensis.

young, inexperienced mothers. Male bobcats do not contribute to the raising of the young.

Although bobcat food habits and their reproductive biology have been studied, only recently has their social structure been examined. Bobcats in the wild appear to follow the typical felid social structure. Marshall and Jenkins (1969) found that in South Carolina male bobcats tended to move through a large area, whereas females tended to concentrate their movements in certain exclusive areas. Bailey (1972, 1974), in a three-year study in Idaho using radio tracking, found that females had exclusive ranges, but male ranges overlapped each other as well as females' ranges. Female bobcats utilized their smaller home ranges more intensely than males. The size of home ranges appears to vary with regional concentrations of prey species. Provost et al. (1973), also using radio tracking, found smaller home ranges in the southeastern United States where there is a higher concentration of prey species year-round. The social structure in this area was the same as Bailey found in Idaho. Lynx appear to have a similar organizational system. In Alaska, resident female lynx had mutually exclusive areas and male ranges overlapped over males and several females (Berrie 1973).

Scent marking appears to be a significant mode of communication among bobcats. All the researchers noted that bobcats deposit feces in prominent locations throughout their ranges, use urine and anal sac fluid to mark rocks, trees, bushes, snow banks, and other objects, and scrape and scratch on trees and bushes.

Associations between adult bobcats were virtually nonexistent throughout these studies. Females and their kittens may associate with

each other for nearly a year, but adults appear to practice mutual avoidance. Aggressive interactions between adults and overt defense of their territories was determined to be minimal or nonexistent (Provost et al. 1973; Bailey 1974).

The land tenure system of bobcats is apparently based on prior right. Bailey (1974) noticed no bobcats settled in an area which was already occupied by a resident. The resident population within his study area remained constant for the three years he observed them, despite a 90 percent decline in the lagomorph population during one year. The young left the area when they matured; no bobcat stayed within its mother's range more than the first year. The exclusiveness of home ranges (particularly among the females), the failure of other bobcats to settle in occupied areas, and their scent-marking behavior led Bailey to conclude that the social organization of bobcats was a form of territoriality maintained primarily to assure the females of a lack of competition from conspecifics during the critical period of raising young.

BEHAVIORS RELATED TO SOCIAL STRUCTURE

Peaceful interactions among group members are often overlooked as indicators of group structure, although they may be very important.

Rosenson (1973) states:

The amount of time the various animals in a group spend in peaceful huddling or simply resting together is as important an indicator of social organization as are measures of more active encounters.

Grooming has been used as an indicator of social structure in a variety of studies (Sparks 1969; Bartlett and Meier 1971; Saayman 1971; Spigel

et al. 1972). The amount and directionality of grooming is important in reinforcing the relative positions of the animals within the group.

Scent marking frequency and location is related to high social status or dominance. Dominant animals mark more frequently and in more locations than those of lower social status (Johnson 1973; Thiessen and Rice 1976). Ralls (1971) concludes that animals "mark frequently in any situation where they are both intolerant of and dominant to other members of the same species."

Utilizing displays as indicators of social structure requires prior knowledge of the behavioral repertoire of the animals, for many of the displays are highly species specific. The greeting ceremony of the more social species (e.g., the African hunting dogs) serves to maintain social cohesion. To be used as indicators, the behaviors should be of routine or perfunctory manner. Cats greet by touching noses, or by rubbing against each other (Leyhausen 1956; Laundre 1977).

Nonsexual presentations and mountings have been recognized in many species as indicators of social rank (Richards 1974; Wilson 1975). Winslow (1938) found mountings played an important part in establishing dominance orders in cats. Presenting is important in maintaining social cohesion in groups of captive cats (Leyhausen 1956).

Most of the research on social behavior in felids has been done on domestic cats (Felis catus), using competitive food-getting situations. The feeding order and amount of food were used as indicators of dominance. In these studies (Winslow 1944a, 1944b; Baron et al. 1957; Cole and Shafer 1966), one dominant cat emerged, generally a male, and the remaining cats did not evidence any dominance behavior among themselves.

THIS STUDY

This study deals with the behavior and social structure of bobcats in captivity. Hediger (1950, 1955) noted animals in captivity tend to regard their cage or living space as their territory and maintain it with similar behaviors to those used in the wild. Animals which are normally territorial, when they are forced to live together in captivity shift to a primitive form of dominance hierarchy (Wilson 1975). Rowell (1967) and Grant (1973) noticed the principle difference between wild and captive members of the same species was the captives developed a social hierarchy not apparent in the wild group.

Behavioral studies which have relied on one or two behaviors have been criticized on their internal and external consistency (Syme 1974; Richards 1974). By including a wide range of behaviors the possibility that one behavior which is response specific or which one animal is particularly adept at will be given undue importance is minimized.

Felids, judging from their morphology, hunting style, and social organizations in the wild, have specialized as solitary predators. From such an evolutionary history we expect felids forced to live together in groups to retain a high degree of individuality in their interactions with others in the group. This study attempts to determine the social structure in a group of bobcats, using a variety of behaviors which have been associated with or used as determinants of social structure in other studies. We would not expect a strict linear hierarchy maintained by a range of behaviors as is found in some of the more social species (e.g., the canids and some of the primates). The behaviors recorded exhibit little or no correlation with each other, indicative of a very

loose social structure. If a correlation exists between behaviors the behaviors themselves will be considered dependent variables and dominance as the intervening variable (after Richards 1974).

CHAPTER II

MATERIALS AND METHODS

SUBJECTS

Four bobcats, two males and two females, were the subjects of this study. One female was donated to the zoo at the age of six months, after having been raised as a pet. Zoo records do not show where the other animals came from. The females at the time of this study were about ten years old. The males were about eight and eleven years old. These bobcats have been together as a group for the past six years, the last two years in the present cage.

Identification of individuals was based on notches in their ears, probably caused by fighting among themselves, pelage color, and body size. Individuals will be referred to throughout this thesis as M1 (for male 1), M2, F1, and F2.

The subjects were housed in an exhibit at Washington Park Zoo, Portland, Oregon (see Figures 1 and 2). The cage floor consisted of concrete and wood chips, with logs provided for the cats to climb and scratch. Near the east wall was a group of vine maples (Acer circinatum). Several small Douglas firs (Pseudotsuga menziesii) are planted in the cage.

Between 7:00 and 9:00 A.M. the bobcats were fed in the holding cages at the back of the cage. The females were fed in one cage, the males in another. At all other times the bobcats were together in the

Figure 1. Floor plan of bobcat cage, Washington Park Zoo, Portland, Oregon.

Figure 2. Photograph of bobcat display area, Washington Park Zoo.

display area. During feeding times the bobcats were locked in the feeding cages and the display was cleaned. Cleaning usually consisted of collecting fecal material, but occasionally the cage floor was hosed down.

Daily ration for each of these bobcats was approximately three-fourths pound of Zu-Preen, a commercial feline food, mixed with a liquid vitamin supplement. The bobcats were fed this mixture Tuesday through Saturday. Sunday they fasted, and Monday they were given fresh fish.

PROCEDURE

These bobcats were observed from February 1977 to April 1978. Observations were conducted from the public side of the moat around the cage. Some twenty hours of general observations were initially conducted to become familiar with the types of behavior and the individual animals. A data sheet for recording observations was developed, consisting of a series of squares in which the behaviors occurring during each two-minute interval were recorded. The behavior of all subjects was recorded simultaneously, using the ethogram in Table I. Every time a new behavior occurred during each two-minute interval the behavior and the animals involved was recorded in a checklist fashion. Additionally, the portion of the body licked during grooming activity and the areas of the cage marked during scent marking were recorded. No inter-observer reliability checks were taken. The behaviors recorded were so gross that individual observer interpretation was presumed to be negligible.

The zoo follows a fairly predictable routine, with the bobcats generally being let out between 9:15 and 9:30 A.M. For the purpose of

TABLE I

AN ETHOGRAM OF SOCIAL AND NONSOCIAL BEHAVIOR OF CAPTIVE BOBCATS

Behavior	Description
Association (peaceful proximity)	Two or more cats resting or sleeping in physical contact or separated by no more than 8 cm.
Grooming	Licking the body with the tongue. Individuals and portions of the body licked recorded.
Scent Marking	Deposition of a liquid from the anal region on a vertical surface. ^a
Head Butting	Contact of the forehead between cats, ears laid back. ^b
Rear Presentation	Placing the anal-genital region directly in front of another cat's nose with the presenter's tail uplifted. Often accompanied by curling the presenter's tail over the bridge of the other's nose. ^c
Vocalization	Issuance of sound from the mouth region.
Play	Stalking, chasing, or wrestling.
Aggressive Action	Growling: a deep, rumbling sound made with the mouth closed. Snarling: a higher pitched sound made with the mouth open and the teeth exposed. Swatting: a jab with the front paw.

^aThese bobcats bury their feces in the wood chips. Before wood chips were available, they would defecate into their pool. Defecation does not appear to be the "advertisement" that characterizes scent marking.

^bThese bobcats exhibited a rather peculiar greeting behavior. The bobcat initiating the approach would walk stiff-legged, with its head raised and its chin tucked. The approached cat could respond in several ways. The simplest would be to totally ignore the other, or lower its head, lay its ears back, and occasionally growl. Either of these responses would dissuade the approaching cat from further pressing the issue. If the approached cat wished to encourage the contact, it would raise its head, lay back its ears, and tuck its chin, whereupon the initiating cat would butt foreheads with the approached cat. Head butting was recorded only for actual contacts of the forehead.

^cOnly counted if the presenter's anus was or could have been in contact with the other's nose.

this study, 9:30 A.M. is assumed to be "0" hour--the hour the bobcats were released from the feeding area into the display.

Pilot Study

A pilot study was conducted, taking a minimum of three separate observations for each daylight hour (6:30 A.M.--7:30 P.M.). These observations were conducted from February 1977 to July 1977.

I originally intended to get twenty-four-hour observations but this proved unfeasible. The data sheet required positive identification of individual animals. The distinguishing characteristic used was ear shape. This worked during the daylight hours, but it proved impossible to identify individual cats during the night, even with the use of a red light.

Social Behavior Study

After completing the pilot study, observations were conducted during the early morning hours; the time, revealed by the pilot study, of greatest activity and social interaction. The bobcats were observed prior to, during, and after feeding. The feeding order and other behaviors was recorded.

CHAPTER III

RESULTS

PILOT STUDY

Observational Hours

A total of 29.27 hours was recorded on data sheets. Table II lists the behaviors recorded during this time period.* These observations were obtained from March 1977 through June 1977.

Activity Patterns

The activity patterns for these bobcats followed a fairly predictable pattern. The maximum activity and interaction was just after they have been returned to the display area following feeding. They roamed around the cage, climbed the logs, and occasionally wrestled and chased each other. After about an hour and a half, locomotion tapered off and grooming took over as the dominant activity (see Figures 3, 4, and 5). This progressed into resting and sleeping, which took up the rest of the day. The major portion of the day was spent resting or sleeping together (Figure 6).

Although these bobcats spent most of their time curled up along the east wall of the display in the sun, they utilized all of their available cage space. In the mornings the cats would climb and sit on

*Unless otherwise indicated, all values in this chapter reflect the number of two-minute intervals recording the behavior.

TABLE II--Continued

Behavior	Ani- mal	Time after Release from Feeding Area in Half-hour Increments															
		1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2
Rear Presenting	F2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Send	M1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	F1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Receive	F2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	M1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	F2	7	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	M1	7	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	F1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Associating	F2	0	16	18	9	55	46	40	49	67	100	64	67	44	82	77	75
	M1	16	0	0	22	56	73	69	67	44	95	82	89	82	56	67	60
	F1	16	16	9	15	38	46	67	82	100	100	69	80	75	82	71	73
	M2	0	0	11	11	38	46	64	26	44	84	51	55	29	49	38	47
Playing	F2	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
	M1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	F1	0	0	7	0	2	0	0	0	0	0	0	0	0	0	0	0
	M2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aggression	F2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	M1	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
	F1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M2	2	2	4	0	0	0	0	0	0	0	0	0	0	2	2	4

NOTE: The total number of two-minute intervals for each time period is forty-five except for the tenth hour, where the total number of intervals equals thirty-eight.

Figure 3. Locomotion during pilot study.

Figure 4. Solitary grooming during pilot study.

Figure 5. Social grooming sending during pilot study.

Figure 6. Degree of association during pilot study.

the tops of the logs, observing their surroundings or grooming themselves. One female, F1, seemed arthritic and was never observed to climb the logs.

The morning is also the time of maximum scent-marking behavior and social interaction.

Scent Marking

There were two distinct methods of marking. The less frequently observed one was urination. The animal would sniff the surface of the object, turn around, raise its tail, and expel a stream of urine. This was commonly directed to the walls of the display area and left a large stain. The animal would generally wander off after making this kind of mark. Often one would return and languorously rub the sides of its face in the mark. The other type of marking behavior involved lifting the tail until it came in contact with the object and forcefully expelling a few droplets of liquid. This was accompanied by vigorously jerking the tail back and forth. This behavior was often done almost nonchalantly. The animals would sometimes walk around the cage depositing droplets of scent without pausing or breaking stride.

SOCIAL BEHAVIOR STUDY

Observational Hours

A total of 73.4 hours were recorded following the pilot study, the results of which may be found in Table III. The bobcats were observed on six occasions prior to, during, and after feeding.

TABLE III

SOCIAL BEHAVIOR RESULTS, EXPRESSED AS PERCENT OF
INTERVALS RECORDING THE BEHAVIOR

Behavior	Animal	Time after Release from Feeding Area in Half-hour Increments, and Total Number of Intervals								
		1/2 347	1 351	1-1/2 348	2 252	2-1/2 245	3 246	3-1/2 144	4 105	4-1/2 -10 164
Locomotion	F2	97	77	59	9	10	7	11	6	5
	M1	82	42	44	15	16	10	8	6	6
	F1	69	64	59	17	5	7	6	4	4
	M2	64	63	45	42	24	11	9	3	5
Association	F2	2	10	21	54	78	81	85	68	67
	M1	4	20	15	58	74	60	60	63	50
	F1	5	10	20	84	86	88	88	84	82
	M2	1	6	13	40	55	61	63	42	36
Solitary Grooming	F2	6	18	11	5	4	4	1	6	6
	M1	13	20	9	12	8	10	5	4	5
	F1	5	10	3	5	2	2	1	2	1
	M2	7	15	10	5	5	7	2	2	5
Social Grooming	Send	F2	3	16	16	13	7	7	8	5
		M1	2	12	10	17	11	8	6	7
		F1	6	13	10	10	10	8	9	2
		M2	3	10	11	12	10	6	5	5
	Receive	F2	5	13	12	13	10	11	10	0
		M1	5	15	15	15	9	5	4	8
		F1	2	9	13	14	9	7	4	6
		M2	2	9	8	11	9	8	10	5
Head Butting	Send	F2	2	3	2	2	2	0	1	0
		M1	0	1	2	2	0	2	0	0
		F1	2	1	1	2	1	3	1	0
		M2	1	1	1	1	1	0	1	0
	Receive	F2	1	2	1	1	1	1	0	0
		M1	1	1	1	2	2	2	1	0
		F1	3	3	2	2	2	1	1	0
		M2	1	1	2	1	0	0	1	0
Rear Presenting	Send	F2	4	3	1	5	2	1	0	0
		M1	1	1	1	1	0	0	0	0
		F1	1	2	1	1	1	0	0	0
		M2	1	2	0	1	0	0	0	2
	Receive	F2	1	2	1	0	1	1	0	1
		M1	2	2	1	0	1	1	0	0
		F1	2	4	1	4	1	1	0	0
		M2	1	2	0	4	0	0	0	1

TABLE III--Continued

Behavior	Animal	Time after Release from Feeding Area in Half-hour Increments, and Total Number of Intervals								
		1/2	1	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2
		347	351	348	252	245	246	144	105	-10 164
Scent Marking	F2	6	3	1	0	0	0	0	0	0
	M1	8	2	2	0	0	0	0	0	0
	F1	5	6	1	0	0	0	0	1	1
	M2	3	3	3	2	0	0	1	1	0
Playing	F2	1	1	1	1	0	0	0	0	0
	M1	0	1	1	0	0	0	0	0	0
	F1	1	2	1	0	0	0	0	0	0
	M2	0	0	0	0	0	0	0	0	0
Aggression	F2	0	0	0	0	0	0	0	0	0
	M1	0	0	0	0	0	0	0	2	0
	F2	0	0	1	0	0	1	0	0	0
	M2	1	1	1	0	1	0	1	0	1

Activity Patterns

Activity followed very similar patterns to those observed during the pilot study, as Figure 7 shows. These bobcats are quite active immediately after their release from the feeding area back into the display. This activity tapers off rather rapidly, giving way to self-grooming (Figure 8), social grooming (Figure 9), and finally, resting or sleeping for the rest of the day.

Grooming

Next to sleeping or resting, grooming is the most common activity of these bobcats.

Table IV lists the frequency which bobcats licked the various parts of their bodies. All portions of the body receive a similar amount of attention, with the exception of the forepaws, which receive 36 percent of the total amount of grooming time. The forepaws are used

Figure 7. Locomotion during social behavior study.

Figure 8. Solitary grooming during social behavior study.

Figure 9. Social grooming sending during social behavior study.

TABLE IV

PERCENTAGE WHICH BOBCATS LICKED VARIOUS PARTS OF THEIR OWN BODIES,
EXPRESSED AS PERCENT OF TOTAL OBSERVED GROOMING

Part of Body	Percent of Total
Head/face	1
Shoulder/neck/chest	12
Back	4
Sides/abdomen	15
Groin/rump/thigh	11
Legs	14
Forepaw	36
Hindpaw	7
Percent of forepaw to face out of total forepaw licking: 65	

NOTE: Based on 679 intervals recording solitary grooming.

to groom the head and neck region which the animal cannot reach with its tongue. Thirty-five percent of the time spent grooming the forepaws is actually used for grooming that appendage, the rest being destined for the use on the facial region.

Poirer (1970) and Schaller (1972) have noted the areas concentrated on during social grooming are those areas which the animal itself cannot reach, a conclusion supported by Table V. The areas the animal itself can groom effectively (feet, legs, chest, groin) are virtually ignored during social grooming. The face, head, and ears make up 64 percent of the total social grooming time.

Table VI lists the frequency of grooming interactions between group members. Animal F1 licks F2 the most often; F1 licks M2 the least often.

TABLE V

FREQUENCY WITH WHICH BOBCATS GROOMED PARTS OF OTHERS' BODIES
DURING SOCIAL LICKING, EXPRESSED AS PERCENT OF
TOTAL OBSERVED SOCIAL GROOMING

Part of Body	Percent of Total
Face/head/ears	64
Neck	15
Chest	4
Back	16
Other	1

NOTE: Based on 743 intervals recording social grooming out of a total of 2,202 intervals observed.

TABLE VI

GROOMING INTERACTIONS, EXPRESSED AS PERCENT OF TOTAL NUMBER OF
TWO-MINUTE INTERVALS WHICH RECORDED THE BEHAVIOR
OUT OF 2,202 INTERVALS OBSERVED

		Licked				Total Times
		M1	F2	F1	M2	Licking
Licking	M1	--	9.56	8.08	8.75	196
	F2	9.96	--	8.88	6.46	188
	F1	8.75	11.17	--	5.25	187
	M2	<u>9.96</u>	<u>7.00</u>	<u>6.19</u>	<u>--</u>	172
Total Times						
Licked		213	206	172	152	

Association

Figure 10 graphs the degree of association during this study. Tables VII and VIII show the degree of association between members of this bobcat group. Table VII is the percent of two-minute intervals throughout this study that recorded associations between bobcats. Table VIII shows the percent of time various bobcats spent with each other out of the total time these bobcats associated with one another.

Figure 10. Association during social behavior study.

TABLE VII

PERCENT OF TWO-MINUTE INTERVALS RECORDING ASSOCIATIONS AMONG
BOBCATS DURING THIS STUDY OUT OF 2,202 INTERVALS RECORDED

Animal	Animal		
	M2	F1	F2
M1	14	25	36
M2	--	19	16
F1	--	--	45

TABLE VIII

PERCENT OF TOTAL TIME BOBCATS WERE ASSOCIATING THAT VARIOUS
PAIRS WERE TOGETHER OUT OF 1,123 INTERVALS
RECORDING ASSOCIATION

Animal	Animal		
	M2	F1	F2
M1	27	49	70
M2	--	37	31
F1	--	--	88

Vocalizations

Bobcats are silent animals compared to the other cats (Ulmer 1966). The most common vocalization observed was not a sound at all, but an open-mouthed silent "miaow" similar to what has been described for domestic cats (Corey 1977). It was made when the animal was walking around or lying down. I could not determine any eliciting behavior, nor any change in behavior after the call had been made.

M2 made a peculiar "barking" sound. It was a forceful expulsion of air which made a sound like "mar." He was the only cat that made this sound.

I did not find the variety of sounds described for bobcats by Young (1958). There was no caterwauling, howling, or purring.

It may be significant that these cats did not use a sound in their greeting behavior, such as the "prusten" in tigers (Schaller 1967). There was no sound made during mutual grooming sessions.

These bobcats seemed aware of the sounds made by the other cats. Although they would often awaken and seemingly listen to the roar of the lions or jaguar, they made no sound in response.

Table IX is a listing of the sounds made by the bobcats and the activities associated with the various sounds.

TABLE IX
VOCALIZATIONS

Type of Vocalization	Behavior Engaged in When Vocalizing
Silent "miaow"	Walking, resting
Bark "mar"	Walking, resting
Growl	Feeding, wrestling, when approached by another cat
Snarl	Feeding, wrestling

Scent Marking

Table X shows the frequency and location of observed marking behavior. Every vertical surface except the iron mesh at the front of the cage was marked at some point.

Scratching has also been regarded as scent-marking behavior (Ewer 1973). These bobcats used certain areas of the logs as scratching posts (visible as the light-colored patches on the logs in Figure 2). They would often sniff the log before and after they scratched.

In order to test scent-marking behavior further, on two separate occasions a small log (approximately 4 inches in diameter by 14 inches long) was placed along the west wall of the display while the bobcats

TABLE X

SCENT MARKING, BASED ON 73.4 HOURS OF OBSERVATION, EXPRESSED AS PERCENTAGE OF TOTAL OBSERVED SCENT-MARKING BEHAVIOR

Animal	Area of Display Marked								Total Times Scent Marked
	West Wall (B all)	West Tree (C-4)	Middle Tree (I-3)	East Tree (N-3)	Middle Log (H-4)	South Wall Hollow Log (9)	East Wall (R-U)	Upper Logs	
M1	4.24	6.67	6.06	2.42	1.21	0.00	5.45	1.82	46
F2	3.03	4.85	3.64	1.82	1.82	0.00	4.24	2.42	36
F1	4.85	6.67	3.64	2.42	3.03	0.00	6.67	0.00	45
M2	3.65	5.45	4.85	0.21	1.21	1.82	2.42	2.42	38

NOTE: Numbers in parentheses refer to coordinates in Figure 1.

were confined to the feeding dens; the resulting activity was video-taped. At first the cats seemed uncertain what to do with the new object. They clustered around it, sniffing it, but little scent-marking activity was directed toward it (see Table XI). A few scent marks were first casually deposited on it by F1 and M2 both times. The animal would walk by and squirt a few drops in the general direction of the log without pausing. The more the log was marked, the more marking behavior was directed toward it. The peak of activity occurred 20-30 minutes after the log was introduced into the display. After the log became saturated, the bobcats' interest in it declined. They still occasionally would come over and sniff the log, but did not direct marking behavior toward it. The next day several of the cats were observed rubbing the sides of their faces on the log, a behavior similar to what has been described for mountain lions and lynx when they were presented with a novel object (Glickman and Sroges 1966).

TABLE XI

SCENT MARKING WHEN PRESENTED WITH A NOVEL OBJECT, EXPRESSED AS
PERCENT OF OBSERVED SCENT-MARKING BEHAVIOR

Animal	Time in Minutes after Introduction of Log--Two Trials					Total Times Scent Marked
	0-10	11-20	21-30	31-45	46-75	
M1	0.00-2.63	7.14-2.63	10.71-5.26	3.57-5.26	0.00-2.63	6-7
F1	3.57-2.63	7.14-5.26	14.29-10.51	3.57-5.26	0.00-0.00	8-9
F2	3.57-5.26	10.71-7.89	10.71-13.16	3.57-10.53	0.00-2.63	8-15
M2	3.57-2.63	7.14-2.63	7.14-5.26	3.57-5.26	0.00-2.63	6-7

Social Interaction

During feeding time F1 was the first cat into the feeding dens. She was not intimidated by the other cats and was the most aggressive. M1 was the last cat in and appeared to be the most timid, backing down from encounters with the other cats. F2 sometimes did not come into the feeding dens at all. Since the cats were fed in different areas of the den, there was no direct competition among them for food; nevertheless, there was often growling, snarling, and swatting going on while they waited for their food.

Tables XII and XIII are tabulations of the occurrences of head butting and rear presenting among these bobcats. The two males in this group interacted with each other very little, the females doing most of this kind of behavior. F2 initiated head butting and rear presenting most often, with F1 being the recipient most often.

Correlation between Behaviors

Table XIV lists the product-moment correlation coefficients between the types of behaviors (see Appendix). There is a high correlation

TABLE XII
OCCURRENCE OF HEAD BUTTING

		Receiver of Head Butting				Total Times Initiated Head Butting
		M1	F2	F1	M2	
Initiator of Head Butting	M1	--	4.81	12.50	2.88	21
	F2	10.58	--	16.35	9.62	38
	F1	8.65	10.58	--	5.77	26
	M2	1.92	7.69	8.65	--	19
Total times received head butting		22	24	39	19	

NOTE: Expressed as percent of total number of two-minute intervals recording the behavior out of 2,202 intervals observed.

TABLE XIII
OCCURRENCE OF PRESENTING

		Receiver of Rear Presentation				Total Times Presenting
		M1	F2	F1	M2	
Rear Presenter	M1	--	3.16	7.57	2.16	13
	F2	14.74	--	20.00	12.63	45
	F1	4.21	11.58	--	6.32	21
	M2	2.11	6.32	8.42	--	16
Total times receiving		20	20	34	21	

NOTE: Expressed as percent of total number of intervals recording the behavior out of 2,202 intervals observed.

between grooming and being groomed, which indicates that grooming is primarily a mutual activity. The other significant correlations between behaviors is the highly positive correlation between head butting initiating and rear presenting, and between receiving head butting and receiving rear presentation. It appears that initiating head butting and

rear presentation are subordinate gestures, for an animal would often present immediately after initiating head butting, whereas the animal which was approached was never observed to present following forehead contact. Presenting is a subordinated behavior in other species. The low correlations between the respective dominant and subordinate gestures of both behaviors indicates that a hierarchy is operating. Animals which are often found in the subordinate are rarely found in the dominant position.

TABLE XIV

PRODUCT-MOMENT CORRELATION COEFFICIENTS BETWEEN TYPES OF BEHAVIORS

	Groomed	Head Butt Initiate	Head Butt Receive	Present Rear	Rear Recipient	Scent Marking	Associ- ation
Grooming	.89	.28	.25	.09	.02	.57	.56
Groomed		.47	-.12	.34	-.38	.19	.31
Head Butt Initiate			.20	.98*	-.04	-.50	.54
Head Butt Receive				.05	.96*	.47	.89
Present Rear					-.15	-.67	.38
Rear Re- cipient						.48	.72
Scent							.36

NOTE: d.f. = 2. two-tailed test.

*p < .05.

Social Structure

Figure 11 schematically depicts the social organization within this group, using the ranking order in head butting and rear presenting to assign the relative positions.

Figure 11. Social structure in four captive bobcats. The heavy dark line represents a strong relationship; dashed lines represent weak relationships. The top number of the pair is the percent of initiating head butting conducted by the animal in the nearest box. The bottom number is the percent of presenting by that animal.

CHAPTER IV

DISCUSSION

SOCIAL BEHAVIORS AND ORGANIZATION

These bobcats were surprisingly social, with individuals spending up to two-thirds of the total time of this study resting or sleeping together, or engaged in social grooming. They often appeared to actively seek out contact with another cat. When they rested or slept, rarely were they separated by more than one meter. This association may be an artifact of the display area. The portion of the display where they congregated (the northeast corner) was the driest and exposed to the sun for the longest period of the day. Nonetheless, this shows that bobcats do have the ability to group with conspecifics without continual fighting. The level of aggression during this study was very low.

As expected, a low correlation existed between most of the behaviors recorded. Bobcats apparently lack the ability to form well-integrated social groups. Grooming does not appear to be useful in determining the hierarchical position within this group. Grooming is a mutual activity; animals which groom a lot likewise show a high frequency of being groomed.

Scent marking likewise does not appear to be related to hierarchical position. All animals freely marked all areas of the display, with the exception of one male which preferentially marked his favorite resting area. Any novel object in the cage was intently sniffed and then

subjected to a flurry of scent-marking behavior by all the cats. After an object had been saturated, little attention was paid to it. An increase in scent-marking behavior was noticed after a heavy rain or after the cage had been hosed down.

Scent is important in establishing a group odor (Schaller 1972; Johnson 1973) and in recognition of other individuals (Ewer 1973). The bobcats marked various parts of the display they frequently visited, particularly concentrating on the westernmost fir tree. During their movements around the cage, they seemed to make a point to walk underneath this tree, rubbing their faces and backs on the lower branches. The odor that had been placed there by each of their individual scent marks was thus transferred to their fur, presumably giving them all a similar odor.

The social organization in this group of bobcats, based on a ranking order established by greeting and presenting behavior, was a relative hierarchy dominated by one female primarily over the other female. The dominant female was invariably the first cat into the feeding area. She was the most aggressive at this time and the other cats moved out of her way when she approached. At other times she did not exert her authority. No cat appeared to act restricted or inhibited by another cat's activity. All the cats freely approached one another, and all were observed to chase and wrestle with each other. A growl, snarl, or swat on the part of any one cat was sufficient to terminate any activity. The males, although they often slept with the group, only rarely interacted with each other.

When domestic cats meet, the dominant animal attempts to sniff the nose and anus of the subdominant animals (Leyhausen 1956). In these bobcats, the subdominant animal actively approached the dominant animal and initiated the greeting behavior of head butting and rear presentation. They occasionally insistently kept presenting until the dominant cat growled or swatted at them. Domestic cats threaten by a stiff-legged strut with the head up and the chin tucked, very similar behavior to the mannerisms of the bobcats prior to head butting. These bobcats may be acting similar to other species in which the subdominant animal initially gives a challenging gesture to the dominant animal and then immediately performs a subdominant behavior.

Leyhausen (1965) has made the distinction between a relative and an absolute hierarchy in his description of cat societies. An absolute hierarchy is one which the dominant animal is continually asserting itself, demanding subjugation of the subdominant members of the group. Such hierarchies are characterized by a range of definite subordinate and dominant behaviors. Cat groupings are characterized by a relative hierarchy. This type of hierarchy operates only at certain times and in certain places. The dominant animal has certain privileges, such as priority access to the feeding area, but, by and large, all the members of the group are on equal footing. While the superior animal may have preferential access to desired areas if another cat is already in position, it has the right-of-way, regardless of its ranking status, and the superior cat does not try to dislodge it. Different cats in captivity exhibit "temporal territoriality." They are active at different times of day, and during their preferred time they are superior to all others.

The spasmodic quality of dominant/subordinant relationships and the fact that cats do not exhibit a true submissive posture (Leyhausen 1956) led Leyhausen to categorize feline society as one in which a relative dominance is the norm.

A most important consideration in the study of social organization in a group is the stability of the relationships in the group under study. Richards (1974) maintains that a study of social organization can only be performed on a completely stable group in which the individuals have lived together for a long period of time without a member change, and without any animals undergoing any hormonal changes (such as puberty) or any signs of declining health. These bobcats have been together as a group for the past six years, the past two years in the same cage. The long period of association combined with the lack of restricted goals (the females are not known to have bred since 1973, the bobcats are fed separately in different areas, and the desired portion of the display is large enough to accommodate all the animals) is probably responsible for the surprisingly low level of aggression observed during this study.

It is important to consider how the results obtained from this study can be generalized to life in the wild. In captivity escape is not possible from other animals, so an animal cannot leave the vicinity as it could in the wild. This lack of escape is partially responsible for the increase in social interactions observed in captive studies. The development of a relative hierarchy may be these cats' way of dealing with the increased interactions. Strusaker (1967) says the "functional significance" of a hierarchy is to reduce physical aggression and

conserve energy. Collins (1953) states dominance orders replace continuous fighting and punishment and permit continual aggregation. There are natural situations which increase the pressure for felids to associate in groups, and presumably a similar hierarchy would be developed.

FACTORS FAVORING INCREASED SOCIABILITY IN FELIDS

Living in an open habitat with increased predation from other carnivores, or in an area which it would be advantageous for two cats to hunt, relying on large or highly localized prey would tend to increase the grouping tendencies of the felids.

Bobcat and lynx territorial systems are more flexible than has been discussed previously. Bailey (1974) noted a collapse of the territorial system one winter when heavy snows hampered bobcat maneuverability and there was a severe depression in the regional rabbit population. Two males and two females shared the same rock pile, preying on a local concentration of rabbits within 0.8 km of the rock pile. No aggressive actions were noticed between these bobcats, although they did maintain a personal space of approximately 3 m. Lynx have been noticed to concentrate in groups around a locally abundant rabbit population (Berrie 1973).

A combination of solitary and communal life styles in response to a localized food source has been observed by Laundre (1977) in domestic farm cats. The cats spend most of their time singly hunting mice and other small rodents, but they gather daily around the milking area to obtain their portion of milk. Laundre noted a loose female dominance hierarchy during aggregations at milking time (based on observation of

aggressive actions). The hierarchy reduced competition among the members for the localized food source. The females were the basis of the social organization, presumably because the milk supply reduced the importance of hunting for pregnant or lactating females.

Leyhausen (1965) reports on the surprising frequency of "social gatherings" in domestic cats. The cats will come to common areas adjacent to or on the fringes of their territories and "socialize," sometimes touching or grooming one another. These gatherings were quite common and often continued all night long.

It is apparent from my research and other observations that the felids have the capacity to successfully form social groups, and do so under certain conditions. The exact type and size of the group depends upon a number of variables: the openness of the habitat, the size and mobility of prey, and the competition from sympatric carnivores (Rosenzweig 1966).

We can expect, in light of the above research, the following to characterize sociability in felids:

- (1) The grouping tendency in felids is weak. The groups of felids, when formed, are relatively unstable, and will disperse readily.
- (2) The groups will exhibit a loose hierarchy. The dominant animal has limited privileges, but these depend on time and place. Individuals within the groups maintain a high degree of autonomy.
- (3) Scent-marking activity will be maintained by all individuals, not just the dominant ones.

- (4) Grooming behavior is a mutual activity dependent on proximity, not on ranking position.

FUTURE RESEARCH NEEDS

The effect of early socialization experiences on social organization has not been investigated in felids. It would be an interesting study to determine why types of social organizations develop within felids which were raised in a group with domestic cats compared with those which develop among adults captured in the wild. The type of group structure in different combinations of sexes, ages, and concentrations of felids has likewise not adequately been investigated.

To sufficiently test the thesis of prey size being one of the major determinants of territorial organization, it will be necessary to observe the same species in areas where they are dependent upon different size prey.

CHAPTER V

CONCLUSION

(1) This is a surprisingly social group of bobcats, spending up to one-third of the time in this study resting or sleeping together, or grooming one another.

(2) This group exhibited a relative hierarchy, based on ranking order in greeting and presenting behavior, with one female dominating primarily over the other female. The males only rarely engaged in these behaviors. The female asserted her dominance mainly at feeding time. At other times the cats appeared to be on equal footing.

(3) Grooming activity does not appear to be related to social status. It is primarily a mutual activity.

(4) Scent marking likewise does not appear to be related to ranking order.

(5) These bobcats spend the major portion of their time sleeping or resting, with grooming being the other major activity.

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APPENDIX

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The correlation coefficient is found by using the following formula (Mendenhall 1975):

$$r = \frac{n \sum_{i=1}^n x_i y_i - \left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right)}{\sqrt{\left[n \sum_{i=1}^n x_i^2 - \left(\sum_{i=1}^n x_i \right)^2 \right] \left[n \sum_{i=1}^n y_i^2 - \left(\sum_{i=1}^n y_i \right)^2 \right]}}$$

Where: x = the values for one type of behavior (e.g., grooming)
y = values for another type of grooming (e.g., rear presenting)

Animal	Social Grooming		Scent Mark	Head Butt		Rear		Associ- ation
	Send	Receive		Send	Receive	Present	Receive	
M1	196	213	46	21	22	13	20	850
F2	188	206	36	38	24	45	20	948
F1	187	172	45	26	39	21	34	1106
M2	172	152	38	19	19	16	21	643

NOTE: All values are out of 2,202 intervals observed.