To the Graduate Council:

We are submitting herewith a dissertation written by Jane Tate entitled "A Profile of Panhandling Black Bears in the Great Smoky Mountains National Park." We have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Ecology.

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A PROFILE OF PANHANDLING BLACK BEARS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Jane Tate

June 1983

To Heather, with love

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ABSTRACT

A study of panhandling black bears (Ursus americanus), conducted in the Great Smoky Mountains National Park from 1976 through 1978, focused on establishing an ecological and behavioral profile of this segment of the population. Procedures included various photographic and written records.

The panhandling contingent showed a preponderance of older females and younger males. Of 392 panhandling sessions on 33 different bears, 43.9% involved aggression. Seven types of aggression were recorded and assigned numeric values based upon apparent severity. Blow vocalization and charge were the most likely to occur. Similarly, crowding by visitors was the most frequent precipitator of ursid aggression. Actual physical contact occurred in only 37 of the 624 aggressive acts recorded. The outcome of these interspecific interactions was dependent upon frequency of panhandling and individual differences among bears.

Multiple regression analyses of setting factors and visitor acts showed that duration of the session, number of feeding incidents, and visitor acts that resulted in invasion of the bear's individual space were the best predictors of ursid aggression. Furthermore, the level of aggression provided higher predictability than the mere number of aggressive acts.

An examination of panhandling strategies utilizing Judgment Analysis showed that family units had the most similar strategies and that members of the same sex tended to cluster together.

Feeding was the most common behavior exhibited by visitors. Sequential analysis of events surrounding aggressive acts revealed that total visitor actions peaked immediately preceding aggression and that afterward there was a decrease in interactional behaviors for both species.

Film analysis of 43 aggressive acts showed that the elements in the aggressive repertoire of black bears were not extensive but that there was much variation in the topography of different types of aggression.

Panhandling black bears were atypical of the species in food habits and activity patterns. Weight comparisons by sex-age class showed that panhandling bears were significantly heavier, possibly because unnatural foods supplemented the natural diet. The activity patterns of panhandlers were more diurnal than those of their backcountry counterparts, indicating a change in their normally crepuscular pattern.

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CHAPTER I

INTRODUCTION

Interactions between black bears (Ursus americanus) and humans occur frequently in many national parks in the United States. They do, in fact, seem but one more manifestation of the competition for space which characterizes modern life. The increasing human population and its demands upon the environment have far-reaching and multifaceted effects, including that which is of particular concern here--the modification of behavior of wildlife species as a result of infringement upon what was once their domain.

Black bears are generally shy, crepuscular animals, rarely seen by humans. Their original range included the forested areas of North America (Pelton 1982), but in the eastern United States they are now relegated to national parks and forests. It is to these same areas that millions of people come annually. Yet by their very numbers people have an impact upon the land, and through their littering and ignorance they often destroy what they have come to enjoy (Matthews 1975, Curry-Lindahl 1972). The inherent problems of human-wildlife interactions are compounded by the diverse and often paradoxical images held of the black bear. Figuring prominently in folklore, these animals have been regarded as gentle teddy bears or wild marauding beasts. Perhaps the most common attitude reflected by park visitors is to treat these wild animals as household pets (Tate 1981). This manifestation of the "teddy bear syndrome" which pervades our

society is deeply rooted. From childhood we are exposed to stuffed bears, Goldilocks, Smokey the Bear, Yogi and Boo-Boo, Gentle Ben, and Paddington. Indeed many aspects of the physical appearance and behavior of bears readily lead to anthropomorphism. It is not surprising that these images prevail when visitors encounter bears in national parks.

As a result of this influx of visitors, some bears exhibit atypical behavior. They have learned to associate people as well as their camping equipment and vehicles with food, a process which is accelerated and reinforced by many persons offering them handouts. These bears, euphemistically known as panhandlers, regularly interact with park visitors. They beg for food along roadsides, raid picnic tables, break into coolers, and rip open backpacks. Panhandling behavior is not limited to bears alone; however, their size and strength coupled with the general naivete of many visitors creates a potentially hazardous situation. Such interactions have caused perennial problems of property damage and personal injury. They have also posed questions--both practical and ethical--about our responsibility to maintain the behavioral integrity of wildlife species. To understand why such atypical behavior may have developed and why it continues despite inherent risks to both species it is necessary to: 1) examine the evolutionary history, ecology, and behavior of bears, and 2) analyze attitudes toward wildlife prevalent today in American society.

Sociobiological Bases for Panhandling in Bears

During the early Miocene (about 25 million years ago) bears diverged from the Miacidae, a family of small, carnivorous, arboreal mammals (Colbert 1955). Like their ancestors, these early bears were also forest-dwellers although their diets probably changed to include more vegetation. Pruitt (1974) suggested that this transition in food habits occurred because of stability in their environment. While brown bears (U. arctos) evolved to use the more open peri-glacial habitat, black bears remained more anatomically and behaviorally adapted to the forests (Hererro 1972, 1978). Modern black bears became essentially opportunistic omnivores with relatively unspecialized digestive tracts. Their diet consists primarily of vegetation, with most protein coming from insects or carrion (Beeman and Pelton 1980, Eagle 1979). They do, in fact, appear to have a protein-deficient diet and exhibit preferences for foods high in proteins and carbohydrates (Bacon 1973). Because of their rather ubiquitous eating habits, they will apparently consume any palatable food item which they may encounter.

Another relevant point is the plasticity that they exhibit in their sociality with conspecifics. Bears have traditionally been regarded as solitary animals except for mother-cub relationships and consort pairs during breeding. However, as Cloudsley-Thompson (1965) pointed out, many animals are perhaps erroneously considered solitary either because scientific studies on them are lacking or because they can be killed only one at a time. Leyhausen (1965)

suggested a dichotomy of social hierarchy, with many animals being able to shift from a basically solitary life to group-living, dependent upon the circumstances. There does appear to be support for his hypothesis as varying social systems have been reported for closely related species, e.g., African lion (Panthera leo) (Bertram 1973, Rudnai 1973, Smuts et al. 1978), wolves (Canis spp.) (Mech 1970, Murie 1944, Schenkel 1947), hyenas (Crocuta crocuta, Hyaena hyaena, H. brunea) (Mills 1978), foxes (Bassariscus astutus, Urocyon cinereoargenteus) (Trapp 1978).

Earlier studies have reported territoriality in bears (Meehan 1961, Meyer-Holzapfel 1957), but this was denied by Krott and Krott (1963) who described them as being socially indifferent. Ewer (1973) stated that bears exhibit an intermediate form of territoriality, utilizing the same areas on occasion but nonetheless respecting rights of ownership to home ranges. Indeed more recent investigations have shown that brown bears aggregate seasonally along streams to feed upon migrating salmon (Egbert and Stokes 1976, Luque and Stokes 1976, Stonorov and Stokes 1972). Brown, black, and polar (U. maritimus) bears have all been reported eating together at garbage dumps (Craighead and Craighead 1971, Herrero 1978, Hornocker 1962, Rogers 1977), and black bears have been observed panhandling together along roadsides (Tate Eagar and Pelton 1979). Bears appear to be flexible in social structure, their degree of association with conspecifics being dependent upon spatial and temporal distribution of resources. This plasticity is also evident in their tolerance of human presence (Alt 1977, Ford 1981, Herrero unpublished

manuscript, Jonkel 1978). Indeed Jonkel (1978) stated that in interspecific interactions bears seem to defer to humans as "super bears."

The sociality of any species reflects both ecological opportunity and genetic make-up. Hemmer (1978) proposed that social behavior in carnivores is a function of brain size and environment, with many species being capable of great plasticity. The degree of sociality necessarily affects the sophistication of communicative signals that a species evolves. Jonkel and Cowan (1971), in their study of black bears in Montana, concluded that these animals utilize both visual and vocal displays as warnings. Their findings contradicted an earlier postulation by Lorenz (1953) that bears are unpredictable, giving no vocal or visual warning before attack. Pruitt (1974) suggested that the position of ears, mouth, head, and body may be indicative of aggression in bears and that these may interact to form a Gestalt possessing communicative value. The fact that researchers have independently cataloged the same facial and ear positions consistently in specific contexts lends support to the thesis that bears do indeed possess a communication system (Henry and Herrero 1974, Pruitt 1974, this study).

Finally, bears possess both a genetic and learned ability to deal with environmental change and utilize whatever resources become available (Burghardt and Burghardt 1972, Jonkel 1978). They have a high degree of cephalization and are presumably quite intelligent (Hemmer 1978). Krushinsky (1974) proposed that a direct relationship exists between the rate of cephalization and the ability for

intellectual activities and, moreover, between the development of intellectual ability and the complexity of intragroup social relationships. In his review of the evolution of the brain, Jerison (1973:316) stated that diversity in relative brain size implies a diversity in behavioral adaptations and is influenced by selection pressures and niches occupied. Bipedalism and manual dexterity (both of which are well developed in black bears) tend to be indicative of enlarged brains (Jerison 1973:402-405, Washburn 1965). Papez (1929) reported that the brain of bears is unique among carnivores, being remarkably similar to that of primates. It includes the ursine lozenge, sylvian fissure, and structures similar in appearance to the primate temporal lobe, which is involved in complex sequences of behavior and memory. Their sensory abilities are also quite keen. They have excellent form discrimination as well as color vision (Bacon 1973, Bacon and Burghardt 1976a). Furthermore, Bacon (1973, 1980) showed that bears learn tasks rapidly, have excellent retention, and exhibit high levels of curiosity. Burghardt and Burghardt (1972) also attested to the great curiosity and learning ability of black bears in their ontogenetic description of two female cubs reared in their home. Wormer (1966) stated that black bears recognize National Park Service (NPS) vehicles, something that was observed during this study.

In summary, the natural history and ecology of black bears has provided them with a propensity for panhandling.

1) Being opportunistic omnivores, bears can exploit any new food source that may become available to them.

2) The plasticity in their sociality with conspecifics appears to transfer to an adaptability for contact with humans.

3) Because of their intelligence, they quickly associate people with food and subsequently learn how to beg for handouts along roadsides or how to procure unnatural food for themselves.

Black bears are remarkably adaptable animals. Unlike other carnivores such as wolves and cougars (Felis concolor), they appear to be capable of co-existing with humans and have maintained viable and stable populations in the eastern forests of this country. They are usually the highest ranking non-human members of the communities in which they are found, and their ecological niche can be viewed as closely related to that of humans. It seems likely that from an ursid perspective, panhandling bears are reacting to human infringement in an advantageous manner.

The Human Element in Panhandling

While their food habits, flexible sociality, and intelligence may predispose black bears to becoming panhandlers, people play an important and undeniable role in their acquisition of the habit. Basically these human behaviors fall into two categories: passive neglect and active enticement. Passive neglect encompasses many aspects of improper disposal of food items and containers in wild areas. It includes not only littering of manmade materials but less obvious practices as well. For example, tossing fruit cores or melon rinds to the edge of a campsite or disposing of used paper plates in a campfire can produce odors which attract wildlife.

There were, in fact, fewer bear incidents in Glacier National Park at campgrounds allowing only self-contained stoves rather than open fires (Merrill 1978). Such problems are compounded by the very design of national parks. For aesthetic and/or practical reasons people congregate in the same areas (e.g., roadside overlooks, campgrounds, picnic areas), thereby increasing litter and the likelihood of attracting bears. Even when all garbage is properly discarded, the attractant odors remain. Furthermore, "bear-proof" garbage containers, while a definite improvement over standard models, are frequently robbed by these strong, adaptable animals.

The more obvious avenue through which people share responsibility for panhandling is active enticement--the actual feeding of animals. Feeding bears in national parks is a common occurrence and can be considered a principal component of human-bear interactions (Tate Eagar and Pelton 1979) (Figure 1). It occurs despite road signs, brochures, and interpretive programs attesting to the illegality of such activities (Figure 2). Indeed Bryan and Jansson (1973), in a survey conducted in Canada, reported that many respondents said that they would feed bears regardless of regulations. In a survey of visitors in the Great Smoky Mountains National Park, the most frequently given response as to why people were injured by bears was that they fed them (Burghardt et al. 1972). Similarly, most respondents in Shenandoah National Park knew that visitor carelessness caused most bear problems (Baptiste et al. 1979). These authors also reported that while most visitors were eager to

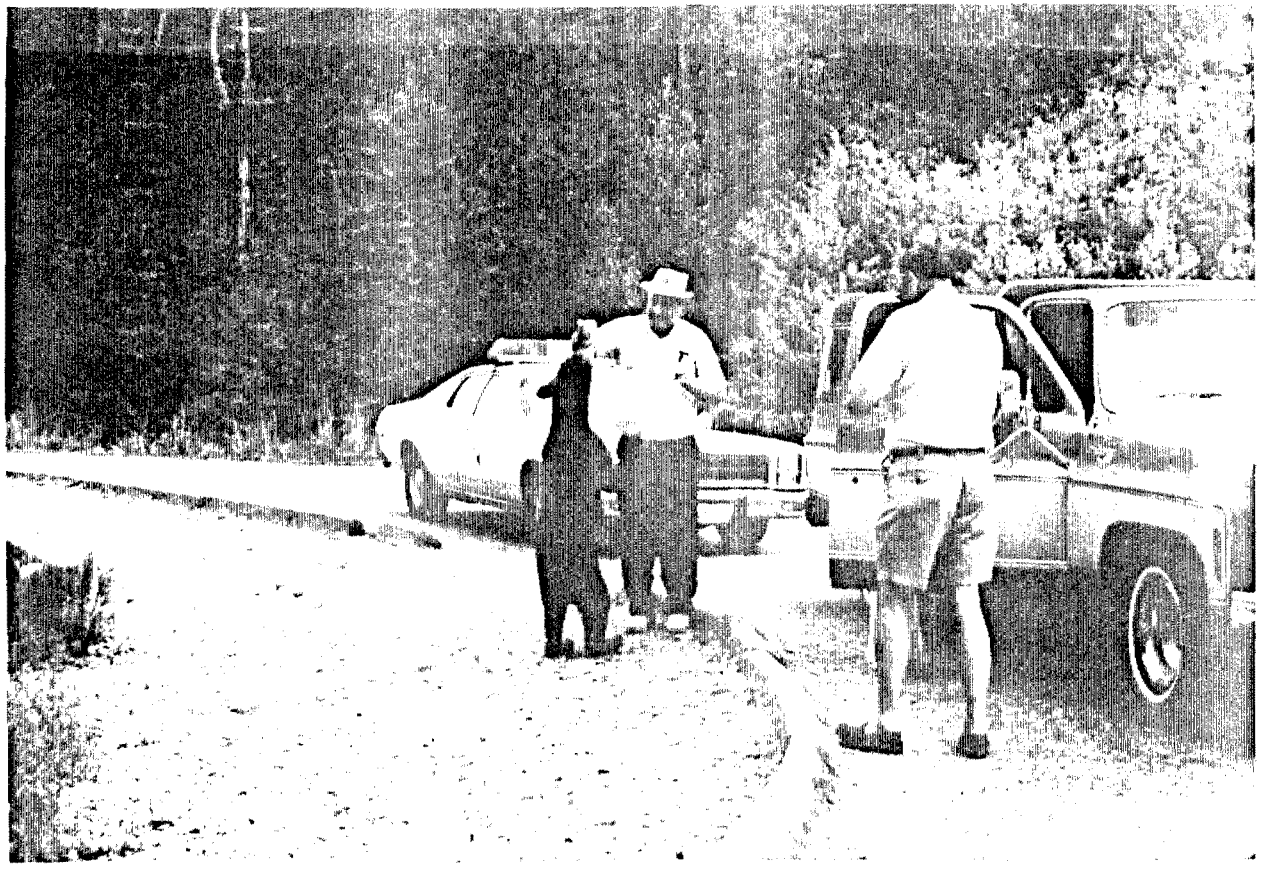


Figure 1. Visitor feeding a panhandling bear, apparently oblivious to the arrival of a Park Ranger, GSMNP.

Figure 2. Panhandler resting near sign stating that feeding of bears in national parks is prohibited.

see bears, they were unwilling to risk property damage or injury to do so. Furthermore, Pelton et al. (1976) found that persons who had been involved in bear incidents had a more realistic view of these animals. Overall, people tend to be quite naive in their interactions with bears, regarding them more as household pets than as wild animals capable of inflicting injury.

Focal Point: Great Smoky Mountains National Park

The Great Smoky Mountains National Park (GSMNP), where this study was conducted, has high visitor use, a high population density of black bears, and a history of problems with human-bear interactions. Visitor use has increased tremendously, averaging 7% per year between 1953 and 1973 (USDI, NPS, 1976). Visitation reached 9,173,600 in 1977 before dropping off to 8,695,500 in 1978 (NPS records, GSMNP). There is an estimated average population density of 1 bear per 2.7 km^2 (Eagar 1977, Pelton and Marcum 1975). Beeman and Pelton (1976) estimated that panhandlers comprised only 5% of the black bear population; however, these animals are of particular significance because they are responsible for the incidents of property damage and personal injury. Singer and Bratton (1977) reported 107 incidents of personal injury and 715 of property damage from 1964 through 1976; NPS records listed property damage at 83 incidents in 1977 and 189 in 1978, with injuries totalling 8 and 16 for those years, respectively.

CHAPTER II

RESEARCH OBJECTIVES

While many studies have focused on the biological and ecological parameters of black bear populations (Beeman 1981, Eagle and Pelton 1978, Eiler 1981, Garshelis and Pelton 1980, Herrero 1972, Jonkel 1967, Quigley 1982, Villarubia 1982), ethological information is minimal. Studies of captive animals (Bacon 1973, Henry and Herrero 1974, Jonkel 1970, Jordan 1979, Ludlow 1974, Pruitt 1974) have provided a foundation for investigating the behavior of free-ranging animals. A study of panhandling bears conducted in Yellowstone National Park by Barnes and Bray (1967) emphasized parameters such as activity cycles, home ranges, length of stay on the roadside, preferred terrain, and movement patterns.

Hastings (1982) studied human-bear interactions in backcountry areas of Yosemite National Park. He classified behaviors of both species into four categories: 1) fear/avoidance, 2) neutrality, 3) approach, and 4) aggression. Both bears and people were more likely to exhibit neutral responses to each other. Less than 2% of all bear responses were in the aggressive category. However, he reported that bear behavior was greatly altered by possession of unnatural foods.

The present study, which was conducted in the GSMNP from 1976 through 1978, focused on developing a behavioral and ecological profile of panhandling bears as well as analyzing the nature of

their interactions with visitors. The goals of the study were:

1) To develop a behavioral profile of panhandling bears;

2) To determine whether differences occur between panhandling sessions containing agonistic behavior by bears and those that do not;

3) To determine whether aspects of the setting within which the interactions occur are related to the occurrence of aggression;

4) To assess differences in individual bears regarding the nature of their interactions with visitors;

5) To evaluate the effects of panhandling on the normal behavior patterns of black bears, especially on activity cycles and food habits.

CHAPTER III

STUDY SITES AND METHODS

Study Sites

Observations were recorded primarily along the transmountain road (US 441 between Gatlinburg, Tennessee, and Cherokee, North Carolina); supportive data were also collected in picnic areas (Chimney Tops and Collins Creek) and campgrounds (Elkmont, Smokemont, Cades Cove, and Cosby) (Figure 3). Cooperation of NPS personnel and monitoring visitor conversations on a Citizens Band radio aided in locating panhandling bears.

Methods

A pilot study to determine proper techniques and gain familiarity with the interactions of bears and humans was conducted in 1976; actual data collection occurred from June through September of 1977 and 1978. Periods of data collection were concentrated in the daylight hours since these represented times when bears were most likely to interact with visitors. To ascertain peak periods of panhandling, sufficient variation was incorporated into the work schedule to monitor all daylight hours. In addition, the research team on several occasions remained throughout the night in those areas frequented by panhandlers to determine the activities--or lack thereof--of these bears. During the 1978 field season bears were active more frequently after sunset than in the previous year; the work schedule was then expanded, usually terminating between 2200-2400 hours.

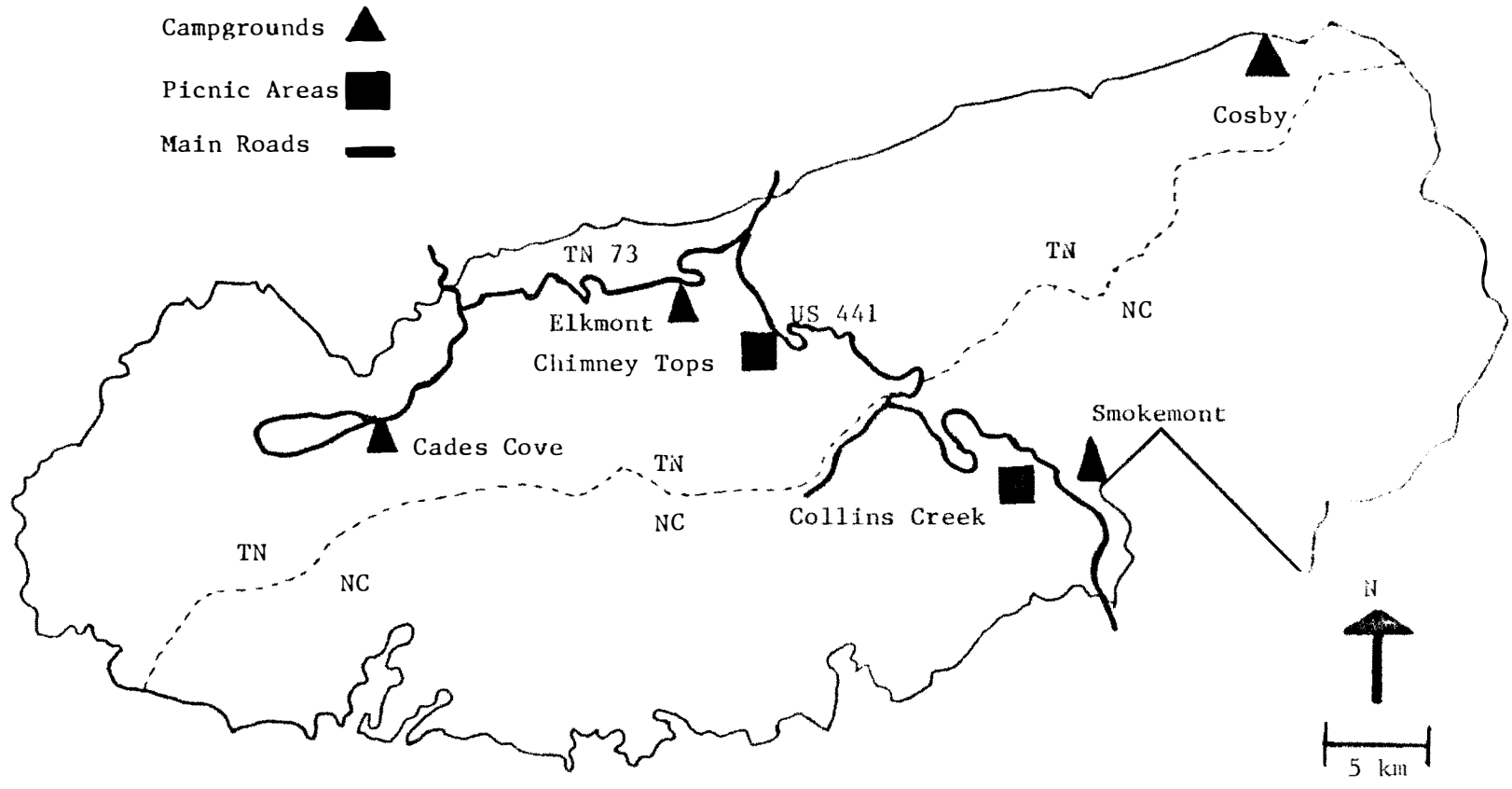


Figure 3. Great Smoky Mountains National Park, showing campgrounds, picnic areas, and roads that were sites of panhandling by black bears.

Efforts were made to concentrate data collection on those bears who panhandled regularly but also to record sessions on infrequent panhandlers whenever possible. This allowed us to become very familiar with the behavioral patterns of a few individuals but to observe a sufficient number of animals so that any idiosyncracies of the first group would be more evident. It also elucidated the changes in behavior as bears interacted more often with people.

While minimal interference with the behavior of both bears and people is imperative in a study of this nature, the impracticality of being unseen by either bears or visitors coupled with the requirement of being sufficiently close to accurately observe and record what transpired necessitated the use of an obtrusive approach. Bears quickly habituated to the presence of the research team and exhibited no begging behavior unless visitors were present. This attested to their excellent cognitive ability which was reported in earlier studies (Bacon 1973, Kuckuk 1937, Wormer 1966). Likewise visitors expressed little concern over our presence and only rarely asked if we were NPS employees with authority to reprimand them for their actions.

In order to obtain as complete a record as possible, data collection incorporated both written and photographic records.

Data sheets. A Panhandling Bear Observation Data sheet (Figure 32, Appendix A) was completed for each panhandling session and focused on the setting and aggressive actions. Setting data

included: date; location; individual bear; time of initiation, cessation, and duration of session; temperature; weather conditions; maximum distance from cover; time that the first visitor stopped; and apparent precipitating factor for the end of the session. For aggressive acts the following information was recorded: type of aggression, time of occurrence, latency from the beginning of the session, apparent precipitating factor (handfeeding, photographing, crowding, petting, etc.), and whether actual physical contact was made.

A Visitor Information sheet (Figure 33, Appendix A) was also completed for every panhandling session. It consisted of the total number of different feeding incidents as well as the total number of people present, counts being made in concurrent five-minute intervals. A feeding incident was operationally defined as one person feeding the bear within a five-minute interval, regardless of the amount of food offered. However, if the same person fed the bear in two separate intervals, that was scored as two feeding incidents.

Panhandling Bear Activity Data were collected daily. Information included: date, individual bear (if that could be ascertained), time, location, and source of information (NPS personnel, CB radio, observation, etc.).

NPS Observation Cards (Figure 34, Appendix A) were distributed to NPS personnel upon which to record sightings of bears. Relying upon this system greatly increased the personnel available for recording activity of the bears since more than one bear might be active at a particular time. It also allowed for monitoring activity over longer time spans.

Field notes. A symbolic shorthand system was devised for continuously recording in 15-second intervals the most commonly occurring actions in panhandling sessions. Forty-seven symbols (Table 30, Appendix A) were utilized, covering seven different categories:

1) forms of ambulation--running, randomly moving, climbing, approaching;

2) body postures--sitting, standing, lying;

3) feeding--toss feeding, handfeeding, cessation of feeding, eating, begging;

4) other visitor activities--photographing, petting, harassing;

5) vocalizations--grunt, jaw popping, cub crying;

6) miscellaneous--sniffing, grooming, yawning; and

7) types of aggressive acts.

If an activity occurred only once in a 15-second interval, the appropriate symbol was entered only once. However, if that activity was interrupted by another then resumed, the symbol occurred twice. For example, if the bear spent the entire interval in random movement, only one symbol was entered; if it ceased random movement, oriented toward an object, then resumed moving, the notes indicated random movement, orientation, random movement. The system was flexible in that rarely occurring but possibly relevant actions could be incorporated into the sequence by descriptive acronyms or phrases and (when necessary) a more detailed explanation written upon completion of the session. This symbolic system of continuously recording actions in the sessions was employed only in 1977.

Photography. Various photographic methods were employed to: 1) provide a verifiable record of the identity of individual bears, and 2) record segments of panhandling behavior. Equipment included a 35mm camera (Canon AE-1) with standard and telephoto (200mm) lenses, a super-8mm movie camera (Yashica Model 25) with 12-30mm zoom lens, a videotape recording unit (Sony Model 2400), a Eumig 8mm projector (Model Mark 610D), and a Lafayette Film Analyzer. Records were maintained so that filmed sequences could be matched to the appropriate sessions.

The celerity with which some actions, particularly aggressive ones, occurred prohibited the documentation of all elements by simple observation. Frame analysis of the filmed sequences allowed for detailed cataloging of what transpired.

Scat collection. Throughout the summer scats were collected from areas frequented by panhandlers, both along roadsides and in campgrounds and picnic areas. They were placed in plastic bags, labelled, and frozen until time of analysis.

CHAPTER IV

SEX-AGE DISTRIBUTION

Determining the sex-age structure of panhandling bears can provide insight into the dynamics of that segment of the population and could also have management implications. Earlier studies (Beeman and Pelton 1976, Erickson 1964, Harger 1967, Sauer et al. 1969, Wasem 1968) had reported a strong sexual bias with most panhandlers being male; however, many of these studies were based on composition of relocated animals and not the population as a whole. By examining the sex-age structure, factors such as recruitment and level of panhandling can be considered. Since females are responsible for the education of their offspring, the number of reproductive females influences recruitment. Young males on their emigrations may be only transient panhandlers whereas young females are more likely to remain near their mothers' home ranges (Rogers 1977).

Classification of Groups

Many of these bears were not tranquilized, and thus aging by the cementum annuli technique (Willey 1974) was not possible. The determination of age was based primarily on two factors: 1) comparison with known-age bears, and 2) reproductive status. Cubs were easily identified, but the demarcation between subadult and adult was more tenuous. Females in estrus were classified as adults although in some cases they were only 2.5 years old. The degree of development of the external genitalia was also used as a criterion

for estimating age of males. Many authors have arbitrarily established 4.5 years as classification for adults. Because of the discrepancies in the literature and a lack of specific ages on many of the subjects, the system utilized appeared to be the most viable alternative. The age classes used in the study were: 1) cubs--animals born the previous winter; 2) subadults--animals greater than one year old but not yet of reproductive status; and 3) adults --animals capable of reproducing.

Results

During the 2-year study, 301 panhandling sessions were recorded on 33 different bears. There were 76 sessions on 14 bears in 1977, and 225 sessions on 23 bears in 1978. (Because more than 1 animal was sometimes present during a session, there were a total of 392 data observations on individuals.) Examination of the sex-age distribution showed equal numbers of males and females (7) panhandling in 1977 (Table 1). During 1978 there were 11 males, 9 females, and 3 cubs of undetermined sex. (Positive sexing was prohibited by an inability to get sufficiently close and their habit of entering the picnic area at night.) The overall sex ratio was 52.9% male and 47.1% female; however, from a total of 20 adults, 14 (70.0%) were female while only 6 (30.0%) were male.

Discussion

There existed a preponderance of older females and younger males in the population of panhandling bears observed in this study in the GSMNP, with the overall sex ratio being nearly equal. This

Table 1. Sex-age distribution of individual panhandling bears, GSMNP, 1977-1978.

Sex	Age: Cub	Subadult	Adult	Totals
		1977		
Male	1	5	1	7
Female	0	1	6	7
Unknown	0	0	0	0
Totals	1	6	7	14
		1978		
Male	2	4	5	11
Female	1	0	8	9
Unknown	3	0	0	3
Totals	6	4	13	23
		Combined		
Male	3	9	6	18
Female	1	1	14	16
Unknown	3	0	0	3
Totals	7	10	20	37[a]

[a]Total number of different bears over the two-year period is 33. The apparent discrepancy results from four bears being included in both 1977 and 1978.

contradicted earlier reports (Beeman and Pelton 1976, Erickson 1964, Harger 1967, Sauer et al. 1969, Wasem 1968) in which "nuisance" bears were from 71% to 87% male. The figures from Beeman and Pelton (1976), which were for GSMNP, were based on NPS records of relocated bears and not upon the composition of the population as a whole. This discrepancy has two possible explanations. First, the task of relocating a female with cubs is more formidable than that of moving a single male. Therefore, fewer females may have been captured, lowering their numbers in the records. Secondly, males may be more likely to be involved in incidents of personal injury and property damage, leading to a greater likelihood of their being relocated and inflating the sex-ratio figures.

Social structure and home range may also influence the disparity in numbers of adult animals. Rogers (1977) proposed that females are territorial and actively defend at least a central area. Through radiotracking known family groups, he also learned that whereas young males emigrate, daughters remain in the same area and often incorporate a portion of the mother's home range into their own. Two instances of this were recorded in the present study with known mother-daughter groups. In one case, the daughter panhandled in the same area as her mother for a while (at 2.5 years of age) before moving to a nearby overlook. In the second case, the daughter assumed possession of her mother's panhandling site when the older female disappeared.

Another possible factor relates to the different sizes of the home ranges of males and females. While much variation exists in regions inhabited by black bears, the size and utilization of home

ranges purportedly are dependent upon food quality, availability, and distribution (Herrero 1978, Jonkel and Cowan 1971). Garshelis (1978) reported that in GSMNP the entire home range of adult females averages 15 km^2 and that of adult males 40 km^2. Since the number of prime panhandling sites is limited, a mother and her female progeny could eventually gain possession of most of these sites. Because they require smaller territories, the number of females utilizing such areas could be larger. Not only were adult females observed chasing young males from panhandling sites, but several of the young males appeared to be emigrating. They quite often travelled from one area to another. If their mothers had been panhandlers, it seems likely that they would visit other panhandling sites as they began their emigration; however, if these sites were already occupied, the young males would be unable to remain.

Pruitt's (1974) claim that bears are more tolerant of those known to them was also documented by the present study. After the dissolution of the family unit, siblings and/or bears panhandling together were more likely to interact with each other without exhibiting intraspecific aggression which characterized encounters between unfamiliar bears. In one case, a yearling male frequently associated with a female from an earlier litter who had occasionally been present during panhandling sessions when he was a cub. Bachelor groups of several species have been documented by many authors (e.g., cheetahs, Acinonyx jubatus, Eaton 1974; wildebeest, Connochaetes taurinus, Estes 1966; impala, Aepyceros melampus, Klingel 1967; vicuna, Vicuna vicuna, Koford 1957; African lions, Panthera leo, Schaller 1970 and Schenkel 1966; Grant's gazelle, Gazella granti,

Walther 1965). They were also observed in panhandling black bears. Young males frequently travelled together. In one case, they were known brothers, and in two other instances the great similarities in physical appearance indicated that they were likely related. It does, in fact, seem logical that following the break-up of the family unit, siblings who had been together for 1.5 years would at least for a time still associate with each other. Kleiman and Eisenberg (1973) suggested that male bachelor groups in canids and felids were littermates. While the nature of these male associations in black bears and the length of their duration were beyond the scope of this study, they warrant further investigation.

CHAPTER V

SESSIONS ON INDIVIDUAL BEARS

In studying panhandlers it was imperative to identify the specific bear(s) involved in a session. This information provided the basis for: 1) evaluating behavioral changes from the initiation of the habit through its development; 2) assessing individual differences in the way bears interacted with visitors; and 3) analyzing differences in intraspecific social behavior of family and non-family groups panhandling together.

Classification of Groups

For analysis, bears were divided into two groups: frequent and infrequent panhandlers. Group I was composed of those bears with more than 15 recorded sessions, and Group II of those having fewer than 15. The number of sessions recorded on individuals reflected to some degree the amount of panhandling activity engaged in by these animals. However, a caveat should be interjected here. Observations were concentrated along the transmountain road, and bears utilizing those areas would be more likely to account for greater numbers of sessions than would those frequenting picnic areas and campgrounds. While the group dichotomy has relative and functional merit, it should not be construed as reflecting precisely the different levels of panhandling of particular animals.

Results

Tabulation of the number of sessions by individuals showed that the 10 bears composing Group I accounted for 81.1% of all

sessions (Table 2). The number of panhandling sessions for bears in Group II declined rapidly. Eight of these animals had only one session each, and most had five or fewer. No Group II bears were observed in both 1977 and 1978.

The apparent discrepancy in the number of sessions reported earlier and the total when summing the number by individual was due to more than one bear being present during some of the sessions. There were 67 sessions recorded with multiple bears present. Of these 53 had 2 bears present, 9 had 3, and 5 had 5. Approximately half (50.7%) were family groups. Sex and age composition of bears observed panhandling together other than family groups is presented in Table 31, Appendix B.

Discussion

Not all bears panhandled in the same manner. Some interacted with visitors on a regular basis while others had limited human contact. They might panhandle for several hours a day, several days a week, or from year to year. Some panhandled intensively for brief time periods and then apparently discontinued the habit; I did not observe them later at any of the study sites not did I receive sighting reports from NPS personnel. The differences were reflected not only in the frequency of their interactions but also by the manner in which these encounters were manifested. Human-bear interactions along roadsides were substantively different from those occurring in campgrounds and picnic areas. Roadside bears were "beggars," and bears in campgrounds and picnic areas were "raiders." The latter

Table 2. Number of panhandling sessions by individual bear and year, GSMNP, 1977-1978.

Bear Code Name	Total Sessions	1978 Sessions	1977 Sessions
	Group I		
Tyler	54	39	15
Tippecanoe	53	38	15
Patchouli	40	40	0
Adelaide	37	37	0
Yuri Van Gogh	29	29	0
Phoenix	27	1	26
Tahini	27	21	6
Jeremiah	17	17	0
Sydney	17	0	17
Bjorn-Bearg	17	17	0
	Group II		
Arlo	9	9	0
Rousseau	7	7	0
Roden	6	6	0
Melbourne	5	0	5
Jane	5	5	0
Justin	5	5	0
Alan	5	5	0
Jasper	5	5	0
Chris	5	5	0
Naomi	3	3	0
Lady Fuschia	3	0	3
Lady Bilbo	2	0	2
Bismarck	2	2	0
Trudeau	2	2	0
Zuma	2	2	0
Wisteria	1	1	0
Jasmine	1	1	0
Spyder	1	0	1
Galileo	1	0	1
Obi-wan	1	0	1
Joni	1	0	1
Alfie	1	0	1
Hunkalichen	1	0	1

group had no need to beg for food since it was readily available in these areas; bears could procure it for themselves. Some entered campgrounds or picnic areas only at night (when likelihood of encountering visitors was reduced) and fed on refuse left around grills or tables or robbed "bear-proof" garbage cans. Group I bears were all roadside panhandlers whereas Group II was comprised of animals from both settings (11 roadside, 12 campground/picnic area).

Since bears are known to feed together at salmon streams (Luque and Stokes 1976, Stonorov and Stokes 1972), berry patches, and mast-producing trees (Garshelis and Pelton 1980), it is not surprising that they would transfer this plasticity in conspecific association to unnatural food sources as well. Herrero (unpublished manuscript), Hornocker (1962), and Rogers (1977) reported the establishment of dominance hierarchies in bears at garbage dumps. This was not observed in the present study but was likely due to the transitory nature of panhandling sessions. What did occur when non-family groups were panhandling together was a partitioning of sites, with bears repeatedly using the same section of the overlook.

CHAPTER VI

AGGRESSIVE BEHAVIOR

Aggressive behavior is characteristic of situations with approach-avoidance conflicts; it is not surprising, therefore, that human-bear interactions often result in ursid aggression. This is an area of concern to park managers because it affects the safety of visitors. It is also important from a scientific perspective because the analysis of behaviors of both species provides insight into the level of habituation of a wildlife species to the presence of humans (Hastings 1982). Data were collected on the types of aggression exhibited by bears and the human behaviors that apparently precipitated them. These were examined by individual bears, whether actual physical contact was made, and in terms of the duration of the panhandling session.

Classification of Aggressive Behavior

Pruitt (1974), in a study of captive black bears, classified various types of interspecific aggression. Her system was modified slightly to include additional types of aggression observed in this study. To facilitate data analysis, these types of aggression were ranked by the apparent severity or intensity of the act. This system was of necessity somewhat arbitrary and dependent upon human perception of what constituted increasing levels of aggression. However, to combat this difficulty somewhat the rankings of four different people who were familiar with human-bear interactions were used in determining the final scheme (Table 3).

Table 3. Description and ranking by apparent intensity of seven types of aggression recorded for panhandling black bears, GSMNP, 1977-1978.

Type of Aggression	Description	Rank by Increasing Severity	Numeric value[a]
Low moan vocalization		1	1
Blow vocalization	Coupled with lip extension and head oriented downward	2	2
Running toward crowd	Differs from charge in that head is held in same plane as body and ears not flattened	3	3
Bipedal swat	Slapping of front paw toward object or person while in bipedal stance	4.5	4
Quadripedal swat	Swatting of the front paw, oriented toward a person or the ground, while the body is in a quadripedal position	4.5	4
Charge	Oriented toward person, shoulders and head lowered, neck outstretched, and ears flattened	6	5
Bite-snap	Snapping or biting at a person	7	6

[a]If actual physical contact was made with a person, two points were added to this value.

Ranking the intensity of aggressive acts seems justified; some have greater energy costs and/or are more potentially endangering to the performer. Riechert (1978) used a cost-benefit system and game theory to rank different behaviors of the spider Agelenopsis aperta in intraspecific contests. Similarly, Rand and Rand (1976) rated agonistic displays of gravid female iguanas (Iguana iguana) according to energy levels required for their performance.

Classification of Precipitating Factors

Aggressive behavior in bears was usually precipitated by the actions of visitors (e.g., handfeeding, crowding, petting). In some instances where more than one factor may have contributed, both were recorded, e.g., one visitor was handfeeding while several others were crowding. NPS personnel were included as a distinct category. Bears recognized their uniforms and vehicles, possibly because the bears were frequently chased away by park rangers. During sessions when more than one bear was panhandling, intraspecific aggression occasionally occurred; this was categorized under "Another Bear."

Results

Overall 624 aggressive acts by bears were recorded during 392 observations; 172 (43.9%) contained at least 1 aggressive act. Ten of the 33 bears were never observed engaging in any aggressive behavior. All of these, which included three adults, three subadults, and four cubs, were infrequent panhandlers.

Types of aggressive behavior and precipitating factors. Frequency tabulations for types of aggressive behavior (Table 4) and their apparent precipitating factors (Table 5) showed the predominance of a few categories. The blow vocalization and charge, with frequencies of 257 and 234, respectively, were the most likely types of aggression. Conversely, the bipedal swat, running toward a crowd, and the low moan vocalization together accounted for less than 6% of the total. Crowding by visitors was by far the most common precipitator of ursid aggression, accounting for nearly 40% of all acts (Figure 4). If all double precipitating factors of which crowding was a component were included, 64% of ursid aggression could be attributed wholly or partially to visitors approaching too closely. It was interesting to note that toss feeding or photographing from a distance rarely led to aggression.

The next step was to determine if certain precipitating factors were more likely to result in particular types of aggression (Table 6). A G-test, based on a contingency table of observed versus expected frequencies of individual aggressive acts resultant from different precipitating factors, was significant at $P<0.0005$ ($G=292.57$, $df=114$). While the bipedal swat occurred only 22 times, petting and harassing were its most frequent causes. Petting alone and in combination with crowding most often resulted in bite-snap aggression; these also figured highly in quadripedal and bipedal swats. Photographing while kneeling led to agonistic behavior only 11 times yet in 9 of these cases the result was a charge (Figure 5). Twenty-nine instances of aggression toward NPS personnel were recorded, with the blow vocalization being the most likely form.

Table 4. Frequencies of types of aggressive behavior exhibited by panhandling black bears, GSMNP, 1977-1978.

Rank by Increasing Severity	Description	Percentage of Total (N=624)
1	Low moan vocalization	1.1
2	Blow vocalization	41.2
3	Running toward crowd	1.3
4.5	Bipedal swat	3.5
4.5	Quadripedal swat	7.2
6	Charge	37.5
7	Bite-snap	8.2

Table 5. Frequencies of precipitating factors for aggressive behavior of panhandling black bears, GSMNP, 1977-1978.

Precipitating Factor	Percentage of Total (N=624)
Crowding	39.1
Photographing-Crowding	10.9
Miscellaneous[a]	7.9
Another bear	6.4
Harassing-Crowding	4.8
NPS personnel	4.6
Petting	4.3
Photograph kneeling-Crowding	3.7
Petting-Crowding	3.0
Harassing	2.6
No apparent reason	2.6
Combination of three factors[b]	2.2
Handfeeding-Crowding	2.1
Handfeeding	1.8
Photograph kneeling	1.8
Photographing	1.0
Cessation of feeding	0.5
Toss feeding	0.5
Toss feeding-Crowding	0.3

[a]All factors which were considered peculiar to a certain session (e.g., feet dangling over the wall, motorcycle engine revving) and not likely to occur in other sessions were included in this category.

[b]Since combinations of three factors were fairly infrequent, they were all included in one category.

Figure 4. Panhandling bear reacting aggressively to crowding by visitors.

Table 6. Apparent precipitating factors by individual types of aggression for panhandling black bears, GSMNP, 1977-1978.

Precipitating Factors	Types of Aggression							
	Low moan	Blow	Bipedal swat	Charge	Quadri-pedal swat	Bite-snap	Running toward	Totals
Crowding	4	96	1	102	19	15	7	244
Photographing-Crowding		17		42	4	4	1	67
Miscellaneous	2	29	1	15	1	1		49
Another bear		35		4	1			40
Harassing-Crowding		8	1	15	3	3		30
NPS personnel	1	25		3				29
Petting		3	6	4	6	8		27
Photograph kneeling-Crowding		8		11	4			23
Petting-Crowding		3		3		13		19
Harassing		8	5	2	1			16
No apparent reason		8		7	1			16
Combination of three factors		2	3	5	2	2		14
Handfeeding-Crowding		6	1	2	1	3		13
Handfeeding		4	2	3	1	1		11
Photograph kneeling		1	1	9				11
Photographing		2		3		1		6
Cessation of feeding		1	1	1				3
Toss feeding		1		2				3
Toss feeding-Crowding				1	1			2
Totals	7	257	22	234	45	51	8	624

Figure 5. Panhandling bear charging a man who is kneeling to photograph him.

The next analysis dealt only with those incidents in which bears actually made physical contact with visitors. Contact should not, however, necessarily be equated with injury. In most cases, bears merely touched visitors with their paws or teeth without inflicting physical damage. Of 624 aggressive acts recorded during panhandling sessions, 37 (5.9%) resulted in contact; of the latter number, 10 (1.6% of all aggression and 27.0% of contact aggression) involved injury in the form of scratches or puncture wounds. Three types of aggression were involved: the bipedal swat (N=4), the quadripedal swat (N=8), and the bite-snap (N=25). The latter not only accounted for the highest percentage of contacts (67.7%) but was also more likely to end in contact than any other type (49.0%).

When assessing visitor actions which were most likely to precipitate contact, the results were clear cut (Table 7). Crowding, petting, or a combination thereof accounted for 78.4% of all contact. Crowding alone led to contact 10 times; however, it resulted in aggression with no contact 234 times. Conversely, when petting elicited aggression, contact was made in more than 37% of the instances; likewise more than 47% of the petting-crowding led to contact.

Responses of individual bears. Since bears react differently to panhandling situations, it was desirable to analyze the data for individual animals exhibiting agonistic behavior (Table 8). Four bears showed aggression in all of their sessions; however, the total number of sessions was quite low, ranging from one to three. For Group I bears, those on whom more than 15 sessions were recorded,

Table 7. Precipitating factors for aggressive acts resulting in physical contact by panhandling black bears, GSMNP, 1977-1978.

Precipitating Factor	Total Frequency (N=433)	Contact Frequency (N=37)	Percentage Resulting in Contact	Percentage of all Contacts
Crowding	244	10	4.1	27.0
Petting	27	10	37.0	27.0
Petting-Crowding	19	9	47.4	24.3
Harassing-Crowding	30	2	6.7	5.4
Photographing	6	1	16.7	2.7
Handfeeding	11	1	9.1	2.7
Photographing-Crowding	67	1	1.5	2.7
Three factors	14	1	7.1	2.7
Handfeeding-Crowding	13	1	7.7	2.7
Toss feeding-Crowding	2	1	50.0	2.7

Table 8. Basic profile of aggressive behavior exhibited by individual panhandling black bears, GSMNP, 1977-1978.

Bear Code Name	Sex	Age	Number of Sessions with Aggression (%)	Total Number of Aggressive Acts (%)	Aggression Index[a]
			Group I		
Tyler	M	C-S	14 (25.9)	37 (5.9)	0.69
Tippecanoe	F	A	28 (52.8)	73 (11.7)	1.38
Patchouli	F	A	22 (55.0)	80 (12.8)	2.05
Adelaide	F	A	6 (16.2)	9 (1.4)	0.24
Yuri Van Gogh	M	A	20 (69.0)	95 (15.2)	3.28
Phoenix	F	A	12 (44.4)	31 (5.0)	1.15
Tahini	F	A	10 (37.0)	42 (6.7)	1.56
Jeremiah	M	A	12 (70.6)	60 (9.6)	3.53
Sydney	M	S	13 (76.5)	53 (8.5)	3.12
Bjorn-Bearg	M	S	5 (29.4)	28 (4.5)	1.65
			Group II		
Arlo	M	A	8 (88.9)	34 (5.5)	3.78
Rousseau	M	A	3 (42.9)	9 (1.4)	1.50
Roden	M	S	4 (66.7)	26 (4.2)	4.33
Jane	F	A	3 (60.0)	3 (0.5)	0.60
Justin	M	C	1 (20.0)	7 (1.1)	1.40
Naomi	F	A	1 (33.3)	4 (0.6)	1.33
Lady Fuschia	F	A	3 (100.0)	11 (1.8)	3.67
Lady Bilbo	F	A	2 (100.0)	9 (1.4)	4.50
Bismarck	M	C	1 (50.0)	1 (0.2)	0.50
Trudeau	M	A	1 (50.0)	5 (0.8)	2.50
Zuma	M	S	1 (50.0)	3 (0.5)	1.50
Spyder	F	A	1 (100.0)	1 (0.2)	1.00
Joni	F	A	1 (100.0)	3 (0.5)	3.00

[a]Mean number of aggressive acts per session.

the range in percentage of sessions containing aggressive behavior was 16.2% to 76.5% ($\bar{X}$=47.7, s.d.=20.6). As expected, Group I bears accounted for a greater proportion (81.4%) of all aggression. The aggression indices (mean number of aggressive acts per session) for Group I bears ranged from 0.24 to 3.53 ($\bar{X}$=1.86) and for Group II from 0.50 to 4.33 ($\bar{X}$=2.28). While Group II had higher aggression indices, the difference was not significant (Mann Whitney U test, U=57, $p>0.20$). In evaluating sex differences, the mean number of aggressive acts per session for males was 2.32 and for females 1.86. For Group I alone the difference was even greater: 2.66 for males and 1.28 for females. However, neither difference was significant (Mann Whitney U test, $p>0.20$).

For those bears on whom sessions both with and without aggressive acts were recorded, the mean duration in each category was calculated (Table 9). When comparisons were made by individual bears, the overall mean length for sessions with aggression (47.6 minutes) was significantly greater than that for sessions without aggression (23.2 minutes) (Wilcoxon Signed Rank, Matched Pairs, $p<0.001$). The mean latency--the time from the initiation of the panhandling session to the performance of the first aggressive act--was significantly greater for Group I bears (15.8 minutes for Group I compared to 9.6 for Group II) (Mann Whitney U test, U=29, $p<0.05$).

Frequency tabulations of the different types of aggressive behavior for individual bears (Table 10) showed that the blow vocalization was the most common for 11 bears; it was the only type recorded for 2 animals. The charge ranked second and was most frequent for eight bears. Only two other types occurred most often

Table 9. Comparisons of sessions with and without aggression for individual bears in terms of duration and mean latency to the performance of the first aggressive act, GSMNP, 1977-1978.

Bear Code Name	Mean Duration (min) of Sessions with Aggression	Mean Duration (min) of Sessions without Aggression	Mean Latency (min) to Performance of First Aggressive Act
		Group I	
Tyler	51.1	33.4	21.0
Tippecanoe	37.6	26.4	15.0
Patchouli	52.2	26.5	21.6
Adelaide	59.2	31.6	35.5
Yuri Van Gogh	38.9	16.6	11.4
Phoenix	42.3	20.6	12.8
Tahini	35.9	28.3	11.2
Jeremiah	47.4	34.8	9.9
Sydney	26.8	8.0	10.3
Bjorn-Bearg	34.2	13.0	9.2
		Group II	
Arlo	31.5	27.0	5.0
Rousseau	49.0	19.0	17.3
Roden	32.0	25.0	5.5
Jane	58.0	12.5	37.3
Justin	60.0	34.8	20.0
Naomi	41.0	none	7.0
Lady Fuschia	30.3	none	8.3
Lady Bilbo	20.5	none	1.0
Trudeau	118.0	25.0	1.0
Spyder	22.0	none	12.0
Joni	33.0	none	2.0
Zuma	42.0	11.0	7.0

Table 10. Frequency tabulations of types of aggressive behavior exhibited by individual panhandling black bears, GSMNP, 1977-1978.

Bear Code Name	Types of Aggression						
	Low moan	Blow	Bipedal swat	Charge	Quadri-pedal swat	Bite-snap	Running toward
			Group I				
Tyler		26		10	1		
Tippecanoe		33	3	28	3	2	4
Patchouli		30	1	40	2	7	
Adelaide		1		2	2	4	
Yuri Van Gogh		44	3	23	2	21	2
Phoenix		4	2	14	2	9	
Tahini		31	2	4	2	3	
Jeremiah		12		37	10	1	
Sydney		6	1	35	11		
Bjorn-Bearg	4	11		9		4	
			Group II				
Arlo	3	24		4	3		
Rousseau		6		1	2		
Roden		6		15	3		2
Jane		3					
Justin		6			1		
Naomi		2	2				
Lady Fuschia		7	2	2			
Lady Bilbo			3	6			
Bismarck		1					
Trudeau		2	3				
Zuma		1		1	1		
Spyder				1			
Joni		1		2			

for any animal: bite-snap for Adelaide and bipedal swat for Trudeau.

Crowding was the most common precipitating factor for all except three bears in Group I (Table 11). Group II bears were excluded from this analysis since the frequencies were too sparse in any category to make definitive statements. For Tyler and Tahini the presence of another bear most often led to agonistic behavior, and for Adelaide it was petting.

Eleven bears, 10 of whom were in Group I, performed aggressive acts resulting in contact (Table 12). Yuri Van Gogh (an adult male) accounted for the greatest number (12), all of which were bite-snap. The most common precipitating factors for him were petting and crowding alone or in combination. Phoenix (an adult female) was responsible for six aggressive acts which resulted in contact, five of which were also bite-snap. Again petting and crowding were primarily responsible.

Discussion

Panhandling by black bears is learned behavior. Regular interactions with people are not a part of their normal behavioral repertoire. Indeed what transpires in such encounters can be considered the result of mutual conditioning, with each species influencing the behavior of the other. People primarily utilize positive reinforcement (food) while bears rely on punishment (aggression). Yet problems develop because they have different perceptions of the situation (Figure 6). By panhandling, bears are merely exploiting a new food resource and not seeking

Table 11. Frequency tabulations of precipitators of aggressive behavior for panhandling black bears (Group I), GSMNP, 1977-1978.

Precipitating Factors	Bear Code Name									
	Tyler	Tippecanoe	Patchouli	Adelaide	Yuri Van Gogh	Phoenix	Tahini	Jeremiah	Sydney	Bjorn-Bearg
Crowding	8	31	31	1	36	7	10	33	30	15
Photographing-Crowding	5	6	12		10	3	3	9	4	1
Miscellaneous	7	5	7		6		1	4	5	5
Another bear	9	1	3				22			4
Harassing-Crowding		7	12		3			2	3	
NPS personnel	2	3	1		7		1			
Petting		1	2	3	8	4	2	1	2	
Photograph kneeling-Crowding		5	2		1	1	1	6		1
Petting-Crowding					11	6				2
Harassing		5	2	2	1		2			
No apparent reason	2	2	3	1		1		1	1	
Combination of three factors			2	2	5	1		2	1	
Handfeeding-Crowding	1	2			7	1		2		
Handfeeding		1	2						4	
Photograph kneeling		1	1			1			3	
Photographing	1	1				4				
Cessation of feeding		1								
Toss feeding		1				1				
Toss feeding-Crowding	2									

Table 12. Types and precipitating factors for contact aggression by individual panhandling black bears, GSMNP, 1977-1978.

Bear Code Name	Type of Aggression	Precipitating Factor	Frequency
Yuri Van Gogh	Bite-snap	Crowding	3
	Bite-snap	Petting	3
	Bite-snap	Photographing-Crowding	1
	Bite-snap	Three factors	1
	Bite-snap	Petting-Crowding	4
Phoenix	Quad. swat	Crowding	1
	Bite-snap	Crowding	1
	Bite-snap	Photographing	1
	Bite-snap	Petting-Crowding	3
Bjorn-Bearg	Bite-snap	Crowding	2
	Bite-snap	Petting-Crowding	2
Tippecanoe	Biped. swat	Petting	1
	Bite-snap	Handfeeding-Crowding	1
	Bite-snap	Harassing-Crowding	1
Sydney	Quad. swat	Crowding	2
	Quad. swat	Petting	1
Trudeau	Biped. swat	Petting	3
Jeremiah	Quad. swat	Petting	1
	Quad. swat	Harassing-Crowding	1
Patchouli	Bite-snap	Handfeeding	1
Adelaide	Bite-snap	Petting	1
Tahini	Quad. swat	Crowding	1
Tyler	Quad. swat	Toss feeding-Crowding	1

Figure 6. Panhandling bear approaching visitor in search of more food.

domestication. For visitors, feeding is an avenue through which they can gain closer contact with wild animals (Figure 7). Steinhart (1980), describing how feeding has historically had symbolic meanings among humans, suggested that by offering food to wild animals today people may be trying to capture some of their spirit, a notion which is increasingly romanticised by an urban existence. The general naivete, lack of knowledge, and misconceptions which characterize human behavior in these encounters only serve to increase the likelihood of ursid aggression.

The concepts of frustration, conflict, and stress are integral to some classical psychological theories of motivation (Cofer and Appley 1967:412-465). Applying these theories to human-bear interactions can lend insight into the different reactions of ursids. There is for bears an approach-avoidance conflict inherent in panhandling. Their attraction to food is countered by historic avoidance of humans, and they frequently vacillate between approaching the crowd and retreating toward cover. Such behavior is especially pronounced in infrequent panhandlers and during the initial stages of acquiring the habit. Food provides strong positive reinforcement, and bears endure many inappropriate behaviors by visitors to obtain it. However, the invasion of their individual space, which is so prevalent in panhandling sessions, often results in aggression. A threshold is reached where the negative aspects of the situation outweigh the positive. At this point the bear either becomes aggressive or ceases the interaction, behaviors which are consistent with the "fight or flight" theories of animal spacing (McBride 1971). Aggression is,

Figure 7. Typical human-bear interaction during panhandling session.

in fact, one of the principal reaction patterns to an approach-avoidance conflict (Cofer and Appley 1967:429). Moreover, this threshold is quite variable in a manner reminiscent of Huxley's (1934) "elastic disc." It is dependent upon the psychological and physiological states of the animal (Archer 1976, Leyhausen 1971) as well as what transpires in the panhandling session.

Perhaps the most important point to emerge from this analysis is that bears appear to be using their entire aggressive repertoire primarily as threats--as a means of communicating that visitors are behaving inappropriately. While the number of aggressive acts appears high, the percentage resulting in contact is quite small. Analysis of cine films indicated that bears can make contact whenever they choose. They possess remarkable agility and quickness. Moreover, the celerity with which aggressive acts are performed leaves most visitors temporarily immobile, followed by rapid retreat. Frame analysis of films further illustrated this point. One bear merely rested clenched teeth against a girl's bare leg rather than biting. Another, with his paw raised into swatting position, slowly lowered it to the ground rather than scratching a man's arm. While this is consistent with the accepted ideas that animals avoid fighting and rely upon threat whenever possible (Barash 1977, Ewer 1968), it is the extent to which bears exhibit such behavior that merits attention. Kummer (1971) stated that at close range social stimuli become so powerful communication becomes compulsive and that crowding carries a constant provocation to react. Perhaps it is the frequent crowding of bears by visitors which has resulted in so many aggressive acts.

Since exhibiting aggression was effective (at least temporarily) in regaining the bear's individual space, such behavior was reinforced.

Although there is some variation, bears generally exhibit the same types of agonistic behavior with similar relative frequencies and respond to the same precipitating factors. However, the aggression indices are quite different. One aspect of these differences can be interpreted on the basis of how experienced bears are at panhandling. After they become accustomed to interacting with people, they tolerate more to obtain food. The approach-avoidance syndrome, while still present, is less pronounced. They are less likely to either retreat or respond aggressively. The 10 bears for whom no aggressive behavior was recorded were all infrequent panhandlers; they responded by fleeing. Group II bears who did exhibit aggression had higher aggression indices and shorter temporal latencies to performance of these acts than did Group I, indicating a greater readiness to respond with aggression. Though Group I bears had higher thresholds, they too were likely to become aggressive if interactions continued for longer time periods. The average duration of all sessions with aggression was twice that of those with none.

Yet even among Group I bears, who were experienced panhandlers, there were pronounced behavioral differences. This indicated that some animals were simply more aggressive than others and concurred with Herrero's (unpublished manuscript) statement that bears in Jasper National Park exhibited distinct differences in aggressive tendencies. The lowest index (0.24) was for Adelaide, an adult female. She often panhandled with two other bears (Patchouli and

Jeremiah), both of whom had higher indices. These differences indicated that more than the conditions of the panhandling session was reflected in aggressive tendencies. Furthermore, when she did exhibit aggression, she responded with acts of higher intensity (charge, quadripedal swat, and bite-snap). Tyler, a young male born in the winter of 1977, had the second lowest index (0.69). He was always accompanied by his mother until the onset of her estrus in 1978, after which he panhandled alone. It was not unexpected that a cub might be less aggressive; however, during 1977 no instances of aggressive behavior were recorded for him while aggression was noted for other cubs. As a yearling, he still was fairly docile when compared to other Group I bears in that age class (Sydney--3.12 and Bjorn-Bearg--1.65). It was, in fact, the presence of another bear that for him most commonly precipitated aggression; in his interactions with visitors he was not very aggressive.

Archer (1976), in his review of aggression and fear in vertebrates, stated that the same situation can evoke either response. The outcome is dependent upon both internal and external variables. A major factor is the discrepancy between expected and observed events and the strength of motivation associated with the expected. Some of the situations which he delineated as being likely to produce these responses are relevant to panhandling bears: 1) individual distance intrusion (crowding by visitors), 2) unfamiliar situation (interactions with humans), 3) frustrative non-reward (no feeding), 4) low reinforcement schedule (little feeding), and 5) thwarting as a result of a physical barrier or competition (presence of NPS personnel or another bear). He further suggested that all these situations can summate to a certain point (increasing the likelihood and

intensity of aggression) but that above that point fear and/or avoidance occur.

But what of the people? What motivates them to continue these interactions even after witnessing ursid aggression or injury? Perhaps some of the answers lie in understanding how the general public views wildlife. Debates on the inherent values of other animals are not new; they have surfaced many time throughout history from Aristotle to Descartes to Schweitzer. Petulla (1980) stated that historically the dominant cultural value of wildlife in this country has been exploitative, and Matthews (1975) contended that television and the tourist trade are two of the greatest debasers of human attitudes toward wildlife today. Other authors have recently tried to evaluate and categorize feelings which are prevalent in our society (Burghardt and Herzog 1980, Curry-Lindahl 1972, Dasmann 1981, Hendee and Schoenfield 1973). Perhaps the most extensive study was provided by Kellert (1980), in which he listed the attitudes toward wildlife as follows: naturalistic, ecologistic, humanistic, moralistic, scientistic, aesthetic, utilitarian, dominionistic, negativistic, and neutralistic. Certain of these attitudes were observed in the ways in which people interacted with bears. The most obvious was the humanistic category, defined by Kellert as ". . . strong affection for individual animals, principally pets. Regarding wildlife, focus in on large, attractive animals with strong anthropomorphic associations." A principal mode of interactions with bears was to regard them as pets. Visitors pictured themselves as temporary caretakers, frequently pursuing this role through one of its most basic avenues--feeding. Parents

encouraged children to pose for photographs standing next to bears (Figure 8). They also expressed affection by attempting to touch bears (Figure 9). At times the seemingly harmless appearance and behavior of panhandlers made it difficult for visitors to think of them as wild animals.

The naturalistic and aesthetic attitudes, though difficult to distinguish between, were also present in human-bear interactions. Kellert stated that ". . . observation and personal involvement with wildlife are the keys to the naturalistic interest in the outdoors . . ." and described the aesthetic attitude as being concerned with the ". . . artistic merit and beauty of animals or their allegorical appeal as emblematic of particular meanings." Besides those people who fed the bears or treated them as pets, there were others present during panhandling sessions who merely watched quietly or photographed from a distance. They seemed to realize that these bears were not pets but wild animals. To many people, black bears have become the symbol of the eastern wilderness (Pelton and Burghardt 1976); they are a reminder of the lifestyle of an earlier era and an avenue through which people can temporarily and/or symbolically experience some of its charm.

The dominionistic attitude was most often reflected by visitors harassing bears. Kellert said that embodied ". . . satisfactions derived from the mastery and control of animals . . . the human ability to confront wildness and render it submissive . . . ." Abuse of the animal--either physical or psychological--was the unifying element of harassment as defined in this study. It took many forms: holding food just out of reach and tantalizing the animal, attempting

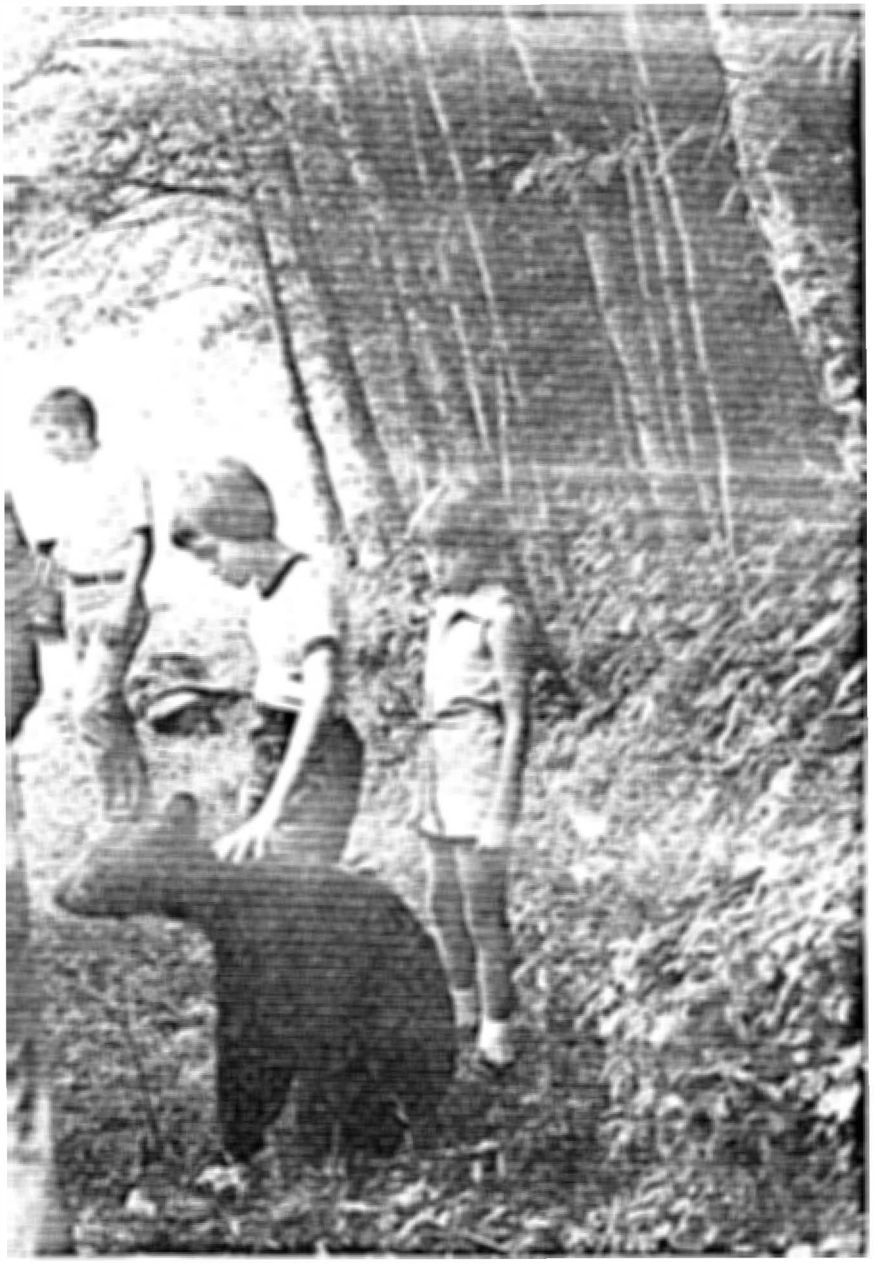


Figure 8. Children posing next to panhandling bear while father takes photograph.

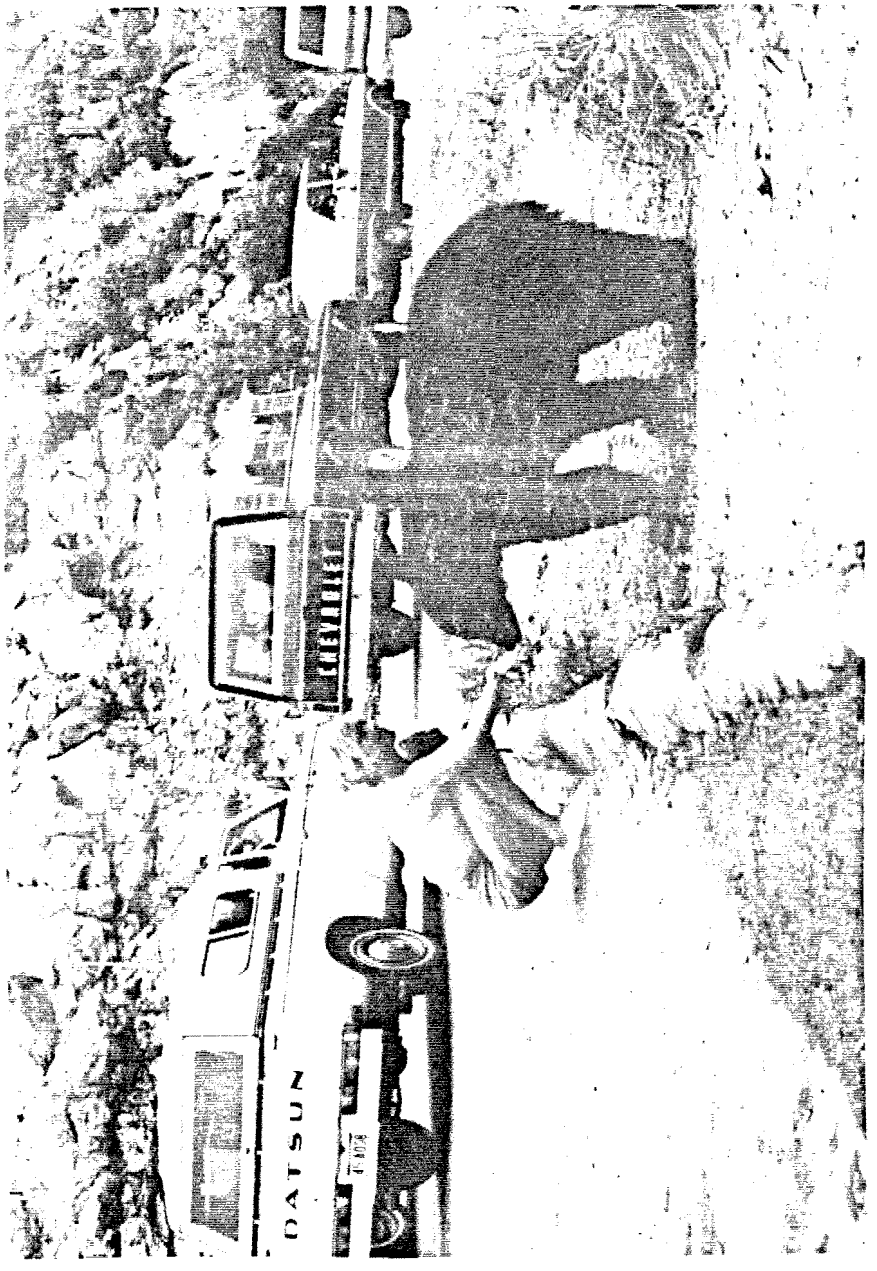


Figure 9. Visitor attempting to pet panhandling bear.

to feed non-food items such as Polaroid backings or empty bags, tossing sticks or stones, pouring drinks on a bear's head, or even trying to lasso a bear. People exhibiting such behaviors were obviously seeking to establish their dominance over bears and thereby enhance their images among other visitors.

CHAPTER VII

THE INFLUENCE OF SETTING FACTORS AND VISITOR ACTS

Besides the human behaviors which served as the immediate precipitating factors, it is probable that the setting (used here as total context, not just environmental variables) within which the interactions occurred affected the likelihood of ursid aggression. It was impossible under field conditions to measure physiological and psychological parameters that may have influenced the nature of the session; however, general variables such as temperature, number of visitors, amount of feeding, and frequencies of different visitor acts were recorded and analyzed to determine which were the best predictors of aggression.

By altering both independent and dependent variables, two different questions are addressed here.

1) Does the inclusion of visitor acts as independent variables substantially increase the predictability over that obtained when setting factors alone are used?

2) Does the mere number of aggressive acts when utilized as the dependent variable provide the same degree of predictability as the level of aggression, which is based on different intensities of individual acts?

Analysis

Using all panhandling sessions from 1977-1978, a stepwise multiple regression analysis with maximum R^2 improvement (SAS, Barr et al. 1976; Harris 1975) was used to determine relative strengths

of relationships between the setting factors (independent variables) and the level of aggression (dependent variable). Setting factors used in the analysis were: date, time of day, duration of the session, maximum distance from cover, temperature, weather conditions, number of visitors, number of feeding incidents, and sex and age of the individual bear. It should be emphasized that while independent variables may be used to predict the outcome of the dependent variable, no causality can be directly imputed. In conjunction with this analysis, a correlation matrix was computed to aid in interpretation.

Examination of these setting factors and the interactional behaviors of visitors was the subject of a second multiple regression analysis, based only on sessions in 1977. Field notes, which were not recorded in 1978, were used to tabulate frequencies of different visitor acts. These frequencies were combined with the independent variables delineated above; again the dependent variable was level of aggression. By comparing the levels of predictability from these two regression analyses, the relative importance of setting factors and interactional behaviors by visitors can be examined.

Two additional multiple regression analyses on sessions in 1977 used the same independent variables (frequencies of visitor acts) but altered the dependent variable. The objective was to determine whether the number of aggressive acts or the level of aggression provided greater predictability.

Results

Simple statistics for selected setting variables and visitor acts are presented in Table 13. Examination of the correlations

Table 13. Simple statistics for selected setting factors recorded during panhandling sessions, 1977-1978 (N=392), and for setting factors and visitor acts, 1977 (N=67), GSMNP.

Variable	Mean	Standard Deviation	Range
	1977-1978		
Duration	34.0 min	24.9	1-127
Distance	10.1 m	7.8	0- 40
Temperature	23.3 C	3.0	15- 34
Number of visitors	16.7	10.7	0- 58
Number of feeding incidents	5.8	7.3	0- 36
Level of aggression	6.0	11.3	0- 77
	1977		
Duration	30.2 min	20.5	3- 96
Distance	11.0 m	7.1	3- 40
Temperature	24.6 C	3.8	15- 34
Number of visitors	20.2	11.5	2- 58
Number of feeding incidents	5.6	6.8	0- 35
Level of aggression	7.9	12.7	0- 74
Total visitor acts	20.0	21.0	0- 91
Toss feeding	11.3	13.2	0- 56
Handfeeding	2.0	4.6	0- 20
Photographing	2.7	3.6	0- 17
Photograph kneeling	1.7	2.9	0- 16
Petting	0.2	0.9	0- 5
Harassing	1.6	3.6	0- 22
High noise level	0.3	0.9	0- 6

among frequencies of different visitor acts (Figure 10; Table 32, Appendix B) showed that the strongest associations were between toss feeding and petting, harassing, and handfeeding. The level of aggression and duration were not only strongly correlated with each other but also with many of the visitor acts (Figure 11; Table 32, Appendix B). Similarly, analysis of level of aggression and selected setting variables for all 392 panhandling sessions showed highest correlations with duration, feeding incidents, and number of visitors (Figure 12; Table 33, Appendix B). The distance which bears came from cover was negatively associated with number of visitors and age; furthermore, males were likely to have greater distances than females. Sex and age were highly negatively correlated, indicating that younger panhandlers tended to be male and older ones female. Older bears also exhibited higher levels of aggression than younger animals.

Results of the regression analysis for setting factors alone showed that the total amount of variability accounted for by all these factors was only 25.1% (Table 14). Significant independent variables are listed in the equation in the order of entry, and only those that showed a sizeable increase in the R^2 value are included in the equation. However, the R^2 value for the entire model is also included for comparative purposes. The same format is used for all regression analyses in this chapter.

Duration of the session and number of feeding incidents were the first two factors to be entered in this stepwise analysis, producing R^2 values of 0.178 and 0.206, respectively. The regression analysis utilizing both setting factors and visitor acts had a final R^2 value of 0.605, indicating that inclusion of interactional

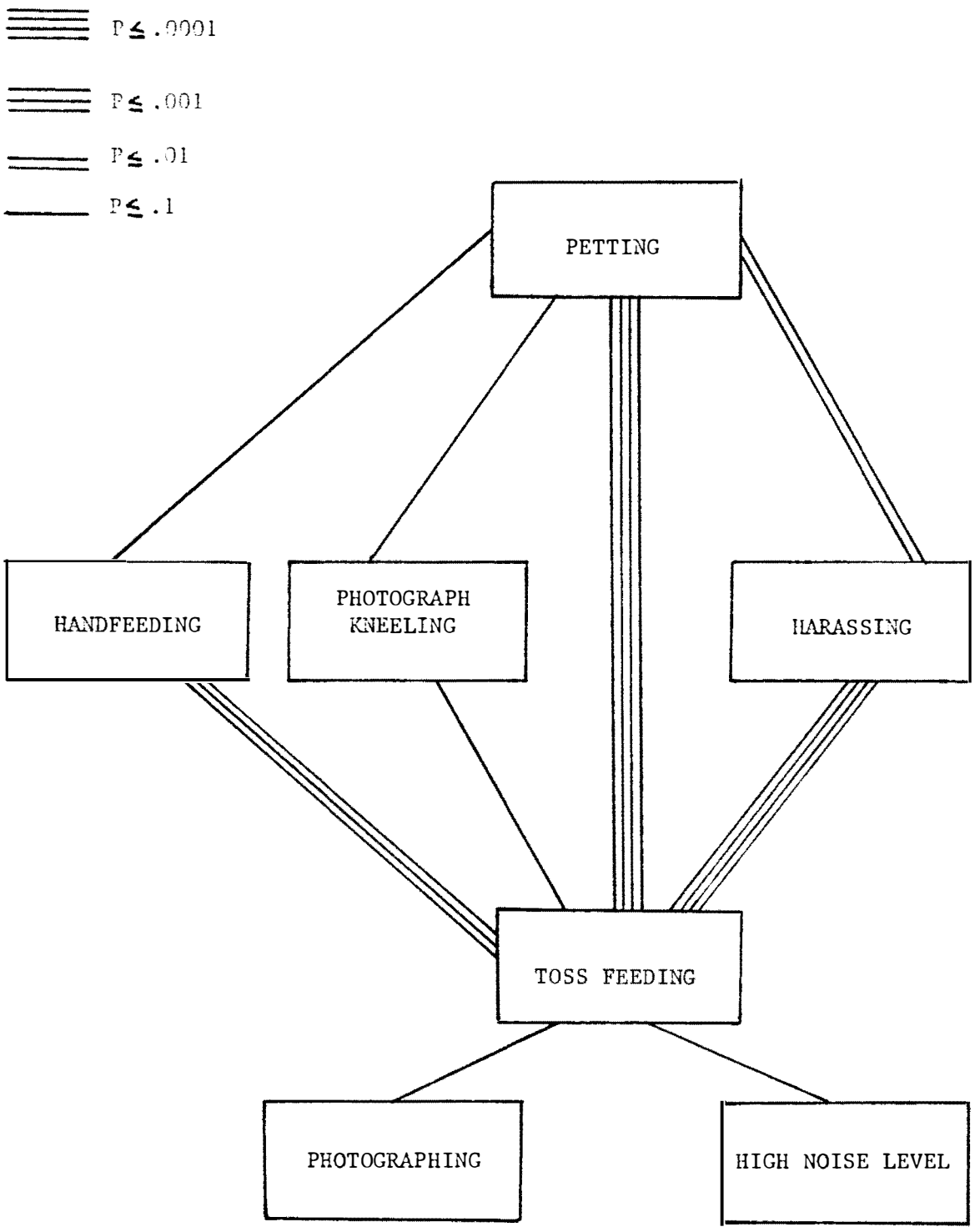


Figure 10. Association diagram of frequencies of visitor acts during panhandling sessions, GSMNP, 1977, based on probability values of a correlation matrix (N=67).

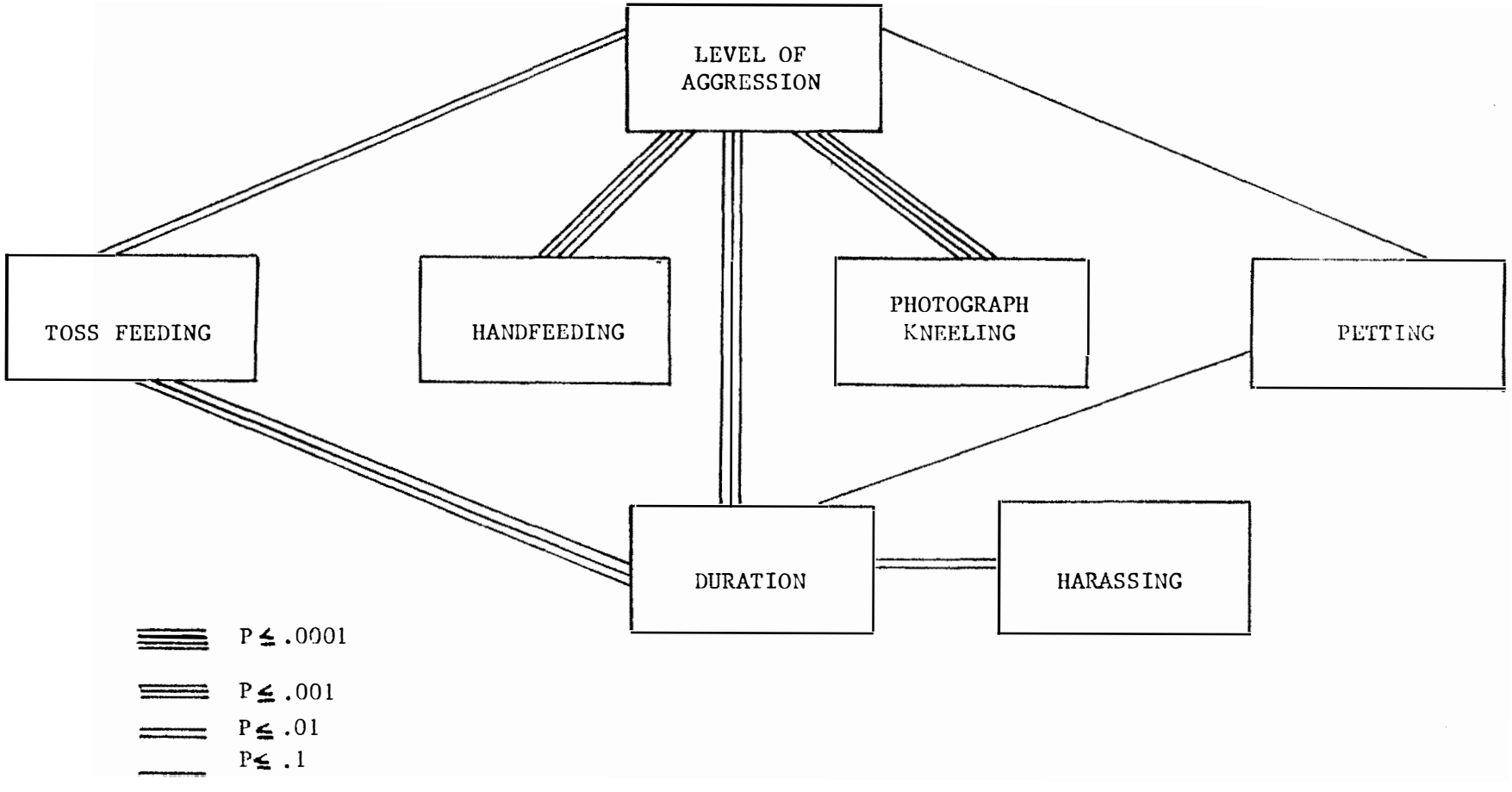


Figure 11. Association diagram of level of aggression and duration of the session with frequencies of visitor acts during panhandling sessions, GSMNP, 1977, based on probability values of a correlation matrix (N=67).

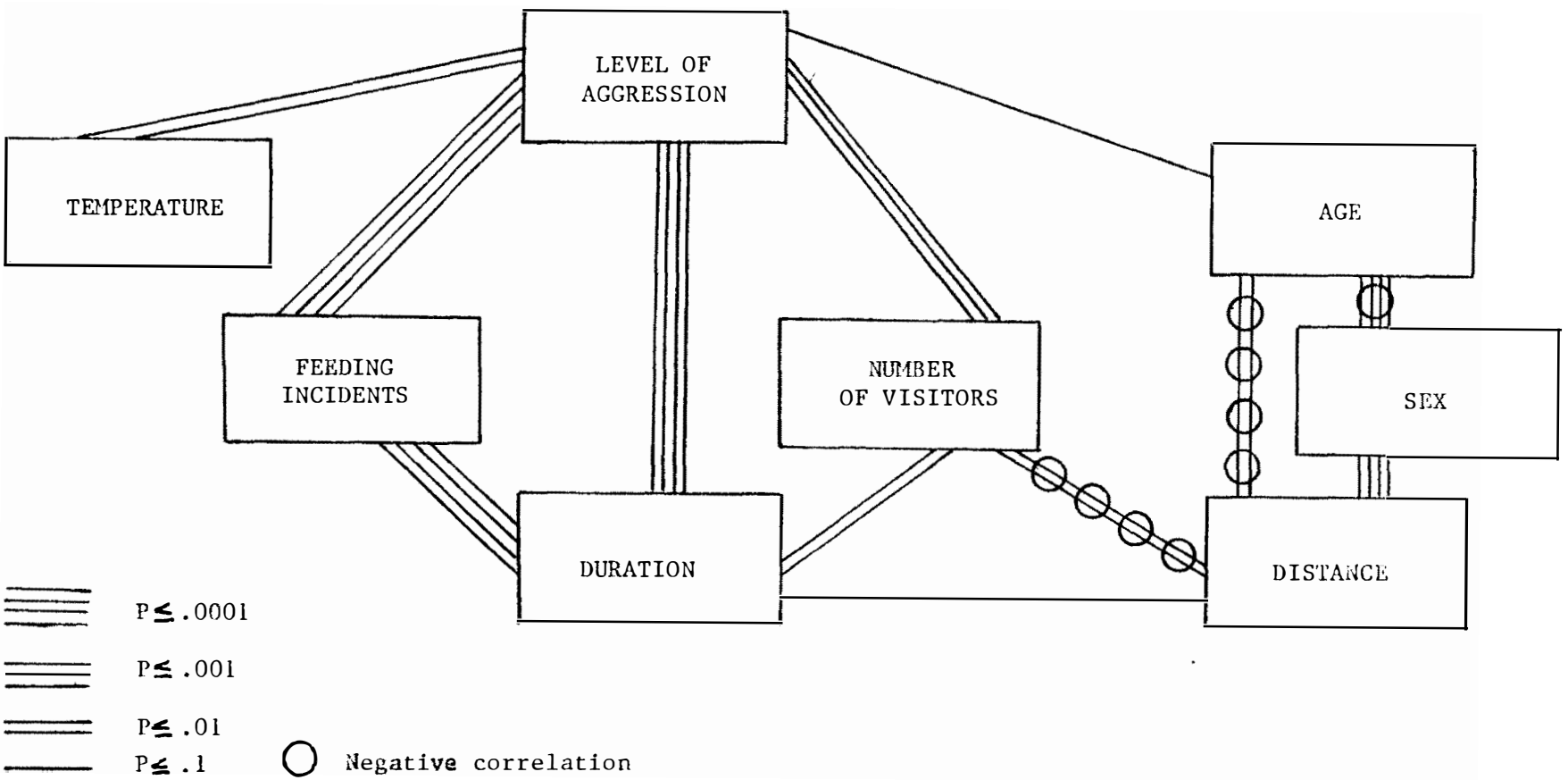


Figure 12. Association diagram of selected setting variables for panhandling sessions, GSMNP, 1977-1978, based on probability values of a correlation matrix (N=392).

Table 14. Multiple regression analyses of setting factors and visitor acts during panhandling sessions, GSMNP, 1977-1978.

Analysis	Equation[a]	R^2 of Partial Model	R^2 of Entire Model
	Changes in Independent Variables		
Setting Factors	LA=-25.10+0.13DUR+0.30FI+0.37TEMP+3.95AGE+4.10SEX	.245	.251
Setting Factors plus Visitor Acts	LA=10.42+0.17FI+1.66PN+0.19DUR-5.05AGE+0.59HF	.547	.605
	Changes in Dependent Variable		
Number of Aggressive Acts	NOAA=0.90+0.34PN+0.20HF+0.08H	.250	.262
Level of Aggression	LA=2.12+1.74PN+0.84HF+0.11TF	.396	.410

[a]LA=level of aggression, FI=feeding incidents, PN=photograph kneeling, DUR=duration, AGE=age of bear, HF=handfeeding, NOAA=number of aggressive acts, H=harassing, TF=toss feeding, SEX=sex of bear, TEMP=temperature.

behaviors accounted for more variability (Table 14).

Results of the second set of multiple regression analyses showed that the highest R^2 value (i.e., the most variability accounted for by visitor acts) was 0.410 for the model utilizing level of aggression as the dependent variable and 0.262 for the model with the number of aggressive acts (Table 14). The first two factors to be entered (photographing while kneeling and handfeeding) were the same for both models. After Step 4, very little increase in predictability was seen in either. Correlations of level of aggression and number of aggressive acts followed a similar pattern except for petting, which was much more highly correlated with level of aggression (Table 32, Appendix B).

Discussion

The duration of the session and the number of feeding incidents were the setting factors which were the best predictors of aggression. Not only were they the first variables entered in the analysis using setting factors alone but also contributed significantly to the R^2 value when visitor acts were included. Since the duration of the session was highly correlated with the number of feeding incidents, satiation might have become a factor. As bears consumed more food, the value of the positive reinforcement might have diminished while the negative aspects of the situation became more pronounced. The nature of the progression of a typical panhandling session might have also contributed to the likelihood of aggression. Initially most people maintained an appropriate distance; however, the longer the session lasted, the more likely people were to engage in interactional

behaviors in closer proximity to the bear. Photographing while kneeling and handfeeding, which contributed significantly to the level of aggression, both involved an invasion of the individual space of the animal. Thus it was not only the duration of the session per se but the nature of the interaction as well that contributed to an increased likelihood of aggression.

Two environmental variables--temperature and weather conditions --also had an effect, with temperature being more important. Levels of aggression increased with rises in temperature and as cloud cover increased or precipitation began. Garshelis and Pelton (1980) reported a substantial decrease in activity of backcountry bears during periods of precipitation or when temperatures were greater than 25°C.

The sex and age of bears had discernible effects upon the nature of interactions. Males were more likely to venture farther from cover than females. Their larger size and more aggressive nature suggested that they would be less intimidated by humans. Hazlett (1968) and Slater (1981) stated that behavior is influenced by the size relationships of the participants. A similar pattern was evident in the correlation between age and level of aggression. Older bears, who were presumably larger and more experienced, were more aggressive. Carr (1962) reported that young African lions at first retreated from superior animals. As they grew older, they became bolder and finally succeeded in driving away adults. If humans are perceived as "super bears" (Jonkel 1978), then bears would be expected to become more aggressive toward them with increase in age.

Moreover, the number of visitors was inversely related to the distance from cover. As mentioned earlier, the increase in crowd size was accompanied by more frequent invasion of the bear's individual space. Under such conditions bears remained closer to cover, which afforded them an escape route. The most common interspecific message is a socially negative one, designed to prevent closer approach (Ewer 1968:24). At intermediate levels of crowding, aggression would be expected. However, as these escalated, the best strategy would be to conserve time and energy, lessen the risk of injury, and retreat to await more favorable conditions (Barash 1977:217).

The fact that the level of aggression provided greater predictability than the mere number of aggressive acts indicated that differences in the intensities of the acts were perceived by both species. It seems intuitively correct that aggressive vocalizations by bears would not have the same effect upon interactions as a bite-snap. Aggressive acts of higher intensity not only increased the likelihood of injury to humans but to bears as well. This was further substantiated by the fact that so few aggressive acts resulted in actual physical contact.

The panhandling situation was one of great variability. While statistical examination of these setting factors and visitor acts was helpful in determining their relative importance, there were too many compounding variables (e.g., the physiological and psychological states of bears) to achieve a high level of predictability.

CHAPTER VIII

PANHANDLING STRATEGIES

Much of the behavior of intelligent animals such as black bears is apparently learned through a gradual parental teaching process or imitation. Comparisons of the panhandling strategies of individual bears were used to: 1) assess the importance of the family unit in the development of this habit, 2) determine if presumably unrelated bears panhandling together exhibit similarities in behavior, and 3) ascertain sexual differences. The term "strategies" is used here in the statistical sense of "policy capturing." (For a more detailed discussion of this usage of the term, the reader is referred to Zedeck and Kafry 1977.)

Analysis

An adaptation of Judgment Analysis (JAN) was used to further examine which setting factors had the strongest relationship to aggression (Christal 1963, Dudycha and Naylor 1966, Naylor and Wherry 1965, Tavlor and Wilstead 1974). This multivariate statistical technique, developed by the U.S. Air Force to "capture the policy" of raters, was subsequently used in psychological (Zedeck and Kafry 1977) and ecological (Propst 1980) studies. It was employed here to ascertain panhandling "strategies" of individual bears and to examine how consistently they relied on these setting cues. JAN is a three-phase analysis. JAN I consists of performing a multiple regression analysis on each bear; setting factors are the independent variables and the level of aggression serves as the dependent

variable. In conjunction with this, a correlation matrix is computed for each individual. In JAN II, a cluster analysis using a single linkage algorithm (Johnson 1967), the regression weights and correlation coefficients for individuals are used as input. These are used to cluster the bears into composite groups based on similarity in their reliance upon certain cues. The final step, following the format of JAN I, derives a linear model for each of the groups and evaluates the change in efficiency of predictability in going from individual to group strategies.

Results

Both the level of predictability (R^2) and the ranking by importance of the setting factors (JAN I) exhibited much variation when compared for individual bears (Table 15; Table 34, Appendix B). However, the duration of the panhandling session was the most important factor for 10 of 15 subjects used in the analysis. Another salient point to emerge was the similarity in rankings of Phoenix and Sydney, an adult female and her yearling son. Except for the factors in the seventh and eighth positions (which were reversed), the rankings of setting variables were identical for these bears. Generally there was a trend for animals panhandling more frequently to have lower R^2 values and lower aggression indices (Table 34, Appendix B; Table 8, p. 41) while infrequent panhandlers relied upon fewer setting factors.

JAN II showed that family groups composed the closest clusters (Figures 13 and 14). This analysis involved not only the relative rankings of setting factors but also the level of aggression

Table 15. Summary of rankings of setting variables for individual bears as indicated by JAN I.

Variables	Rankings							
	1	2	3	4	5	6	7	8
Duration	10/15[a]	1/15	-	2/15	-	1/15	-	-
Number of visitors	1/15	4/15	1/15	3/15	-	4/15	1/15	-
Date	2/15	2/15	4/15	2/15	1/15	1/15	1/15	1/15
Distance	-	1/15	3/15	3/15	2/15	-	2/15	-
Weather	-	1/15	-	-	5/15	3/15	2/15	1/15
Temperature	-	3/15	3/15	3/15	1/15	1/15	2/15	2/15
Feeding incidents	1/15	-	2/15	-	3/15	1/15	3/15	2/15
Time	1/15	3/15	2/15	2/15	1/15	1/15	-	4/15

[a]Numerator of fraction represents the number of bears who had the variables ranked in the position indicated; 15 bears were included in the analysis.

Figure 13. Cluster analysis for panhandling strategies of black bears as indicated by JAN II. For sex and age of individual bears, refer to Table 8, page 41.

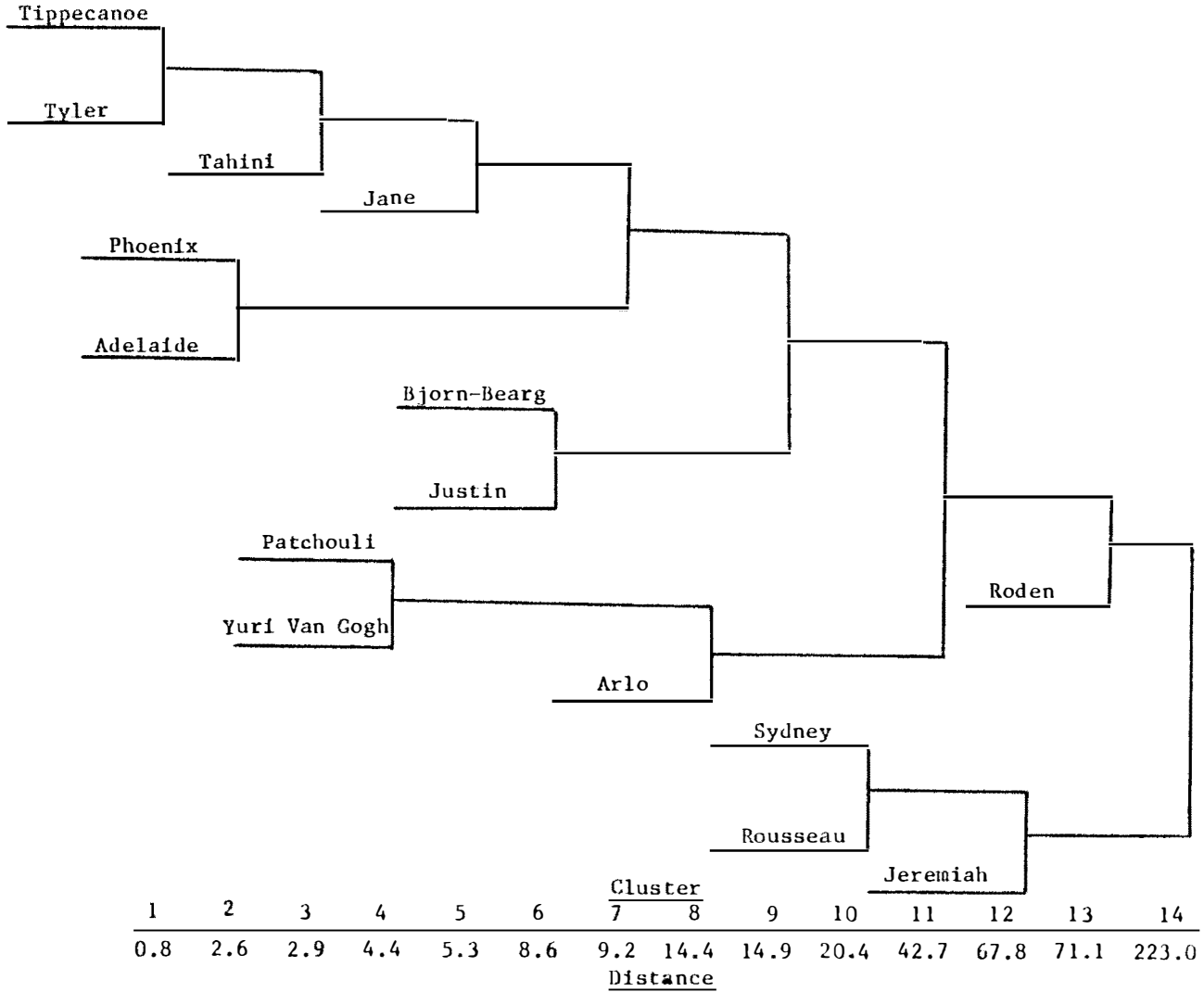

Tippecanoe
Tyler
Tahini
Jane
Phoenix
Adelaide
Bjorn-Bearg
Justin
Patchouli
Yuri Van Gogh
Arlo
Roden
Sydney
Rousseau
Jeremiah
Cluster
1 2 3 4 5 6 7 8 9 10 11 12 13 14
0.8 2.6 2.9 4.4 5.3 8.6 9.2 14.4 14.9 20.4 42.7 67.8 71.1 223.0
Distance

Figure 13

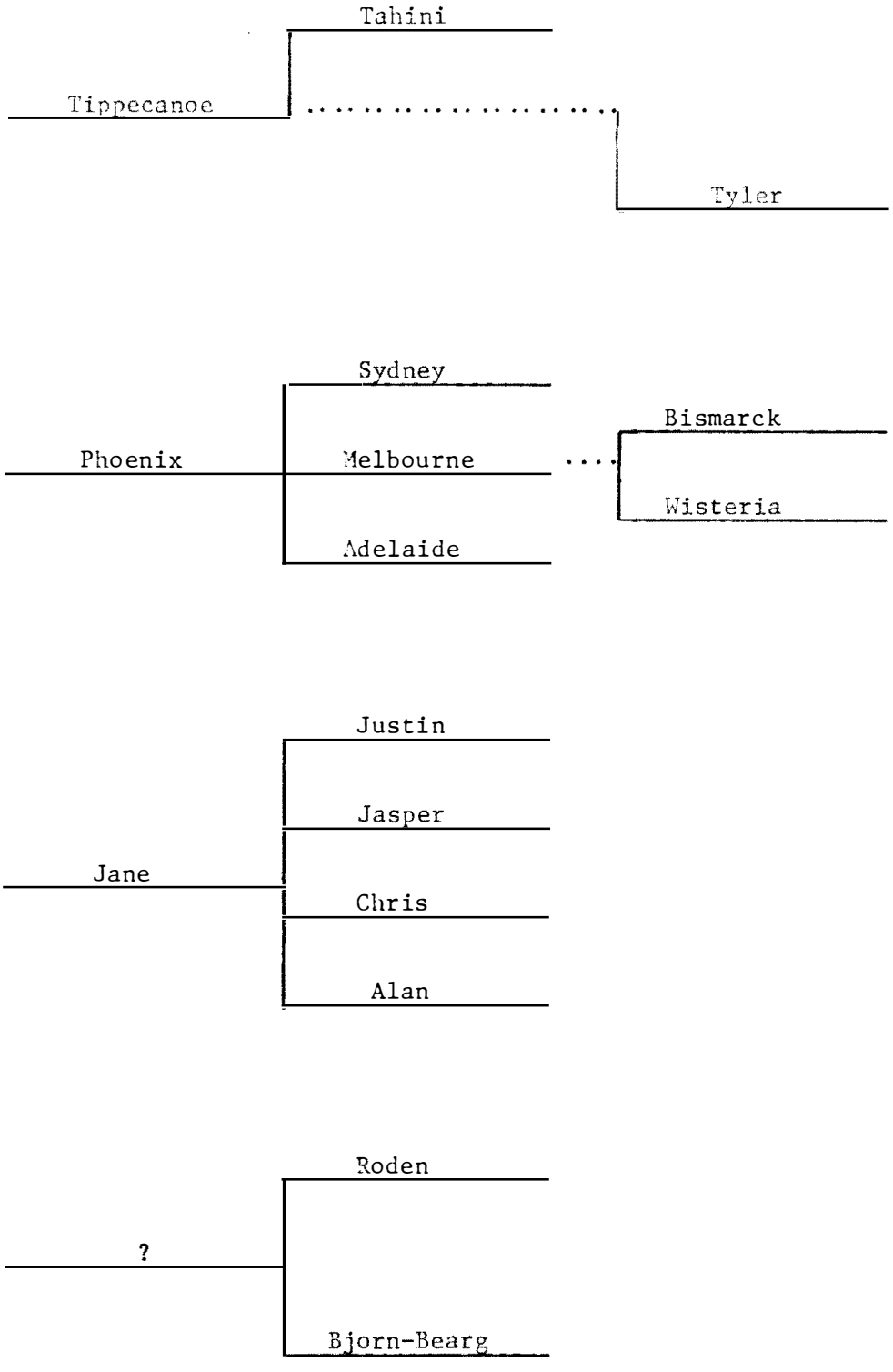


Figure 14. Genealogy chart of known family groups of panhandling black bears, GSMNP, 1977-1978. Dotted lines indicate different litters.

exhibited in response to them. Tippecanoe and her son Tyler were most similar in strategy, having a maximum cluster distance of 0.75. When Tahini, a daughter from a previous litter, was added to the cluster, the maximum distance increased to 2.93, but this was still the third most tightly clustered group. In second position with a distance of 2.63 was another family unit, Phoenix and her daughter Adelaide. With the exception of Patchouli and Yuri Van Gogh, members of the same sex tended to cluster together, with females exhibiting more similarity in their strategies. Further substantiation of this trend was provided by separating those sessions after the dissolution of the Tippecanoe-Tyler family unit. Tyler's position then moved away from his mother and nearer to the clusters of single male bears.

JAN III provided the rankings of setting factors and reliability for the different clusters of bears (Table 16). As with individuals, there was much variability, except for the preponderance of duration in the first position. However, for groups of young males with high aggression indices the number of feeding incidents was in first position. Generally, the smaller the cluster, the greater was the predictability. The notable exception was the family group of Tippecanoe, Tyler, and Tahini, all of whom were experienced panhandlers.

Discussion

Influences of environmental parameters in the selection of behavioral responses of the same or related species have been studied by many researchers (e.g., marmots, Barash 1977; primates, Crook

Table 16. Rankings of setting variables and level of predictability for clusters of bears as indicated by JAN III.

Cluster No.	Setting Variables								R^2
	Date	Time	Duration	Distance	Temperature	Weather	No. of Visitors	Feeding Incidents	
1	2	5	1	3	6	8	7	4	.182
2	2	8	1	3	4	7	6	5	.469
3	5	3	1	8	7	6	2	4	.595
4	2	7	1	6	3	8	4	5	.786
5	7	4	5	3	2	8	6	1	.840
6	3	6	1	2	7	8	5	4	.107
7	7	2	1	5	6	4	3	8	.472
8	5	8	4	7	3	2	6	1	.570
9	2	8	1	7	5	4	6	3	.070
10	4	6	1	5	8	3	2	7	.134
11	6	5	1	8	3	4	2	7	.130
12	4	6	1	5	8	7	2	3	.227
13	3	6	1	5	7	8	2	4	.208
14	7	6	1	8	3	4	5	2	.236

and Gartlan 1966, Eisenberg et al. 1972: mountain sheep, Geist 1971; antelopes, Jarman 1974: blackbirds, Orians 1961: sandpipers, Pitelka et al. 1974). Therefore, the use of setting factors in an assessment of strategies of panhandling bears seems justified. Individuals do not develop in a void, and their behavior is constantly being influenced by their surroundings--whether animate or inanimate. Likewise the behavioral variable that provides the most information about the composite motivational state of the bear toward its interactions with humans is the level of aggression. Hence it was used in this analysis as the bear's "rating" of the situation. Use of the term "strategy" does not necessarily impute conscious thought processes or teleological motives; it simply refers to various patterns that have evolved.

The close similarity in strategies of family groups substantiated the importance of education of offspring. As in many K-selected species where parental investment is quite large, the mother's responsibility extends beyond initial caring of the altricial young; she must teach them how to survive. Just as many carnivores apparently teach their young to hunt and kill (Carr 1962, Eaton 1974, Kruuk and Turner 1967, Schaller 1967, Schenkel 1966), some female black bears apparently show their cubs how to panhandle (Figure 15). Indeed this atypical behavior appears to be incorporated into the entire educational process and is a principal mode for perpetuation of the panhandling habit (Tate Eagar and Pelton 1979). The transference of panhandling from one bear to another can be considered a form of cultural transmission, reminiscent of the familiar account of

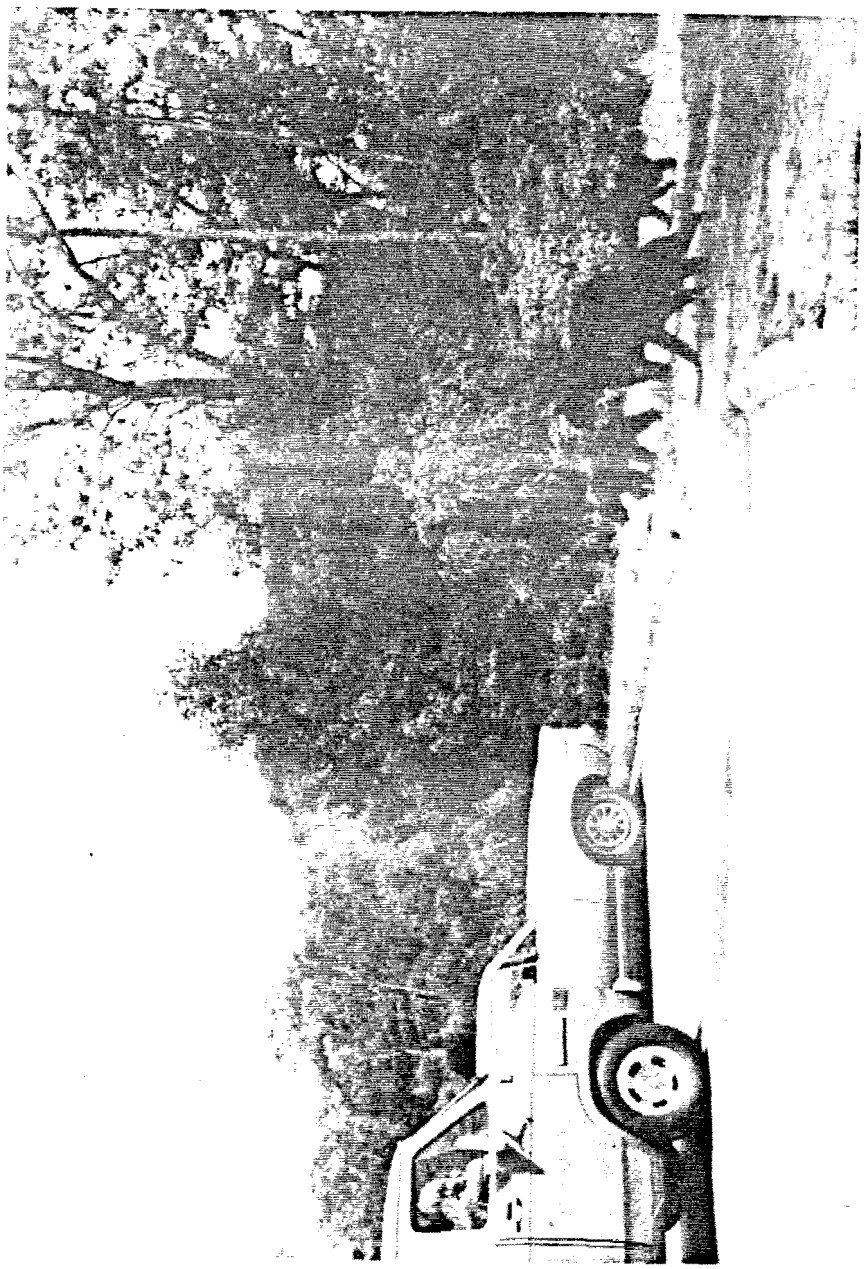


Figure 15. Adult female introducing her cubs to panhandling.

potato-washing behavior which spread through a troop of macaques (Macaca fuscata) (Kawai 1965, Mainardi 1980). Moreover, the concept goes further than the mere exploitation of a new food resource to the adoption of particular behaviors for doing so. One family unit, Tippecanoe and her offspring Tahini and Tyler (who were from different litters), all used a very distinctive begging posture that was not observed in other animals (Figure 16). Tippecanoe was the first to utilize it, and later her offspring followed. This penchant for panhandling, once ingrained, is difficult to dissuade, even in bears who acquire the habit as adults. For those who grow up interacting with people, panhandling can become an integral part of their lives.

Discounting family units members of the same sex tended to cluster together, with females being more closely aligned than males. Such was not surprising because of the sex-age distribution of the panhandling population and the social structure of the species. The older females were more experienced at panhandling, more adaptive and labile in their behaviors, and more secure because they were operating within an established home range. Males were generally young bears, some of whom had just left the family unit and were dispersing. The emigration of young animals has been documented for many species. Reduction in inbreeding and competition among kin make it a successful strategy for increasing inclusive fitness. Rogers (1977) found that yearling male bears often establish a temporary home range near their mothers, possibly including a portion of her own. However, they engage in extensive wanderings until they eventually find a permanent home range at three to four

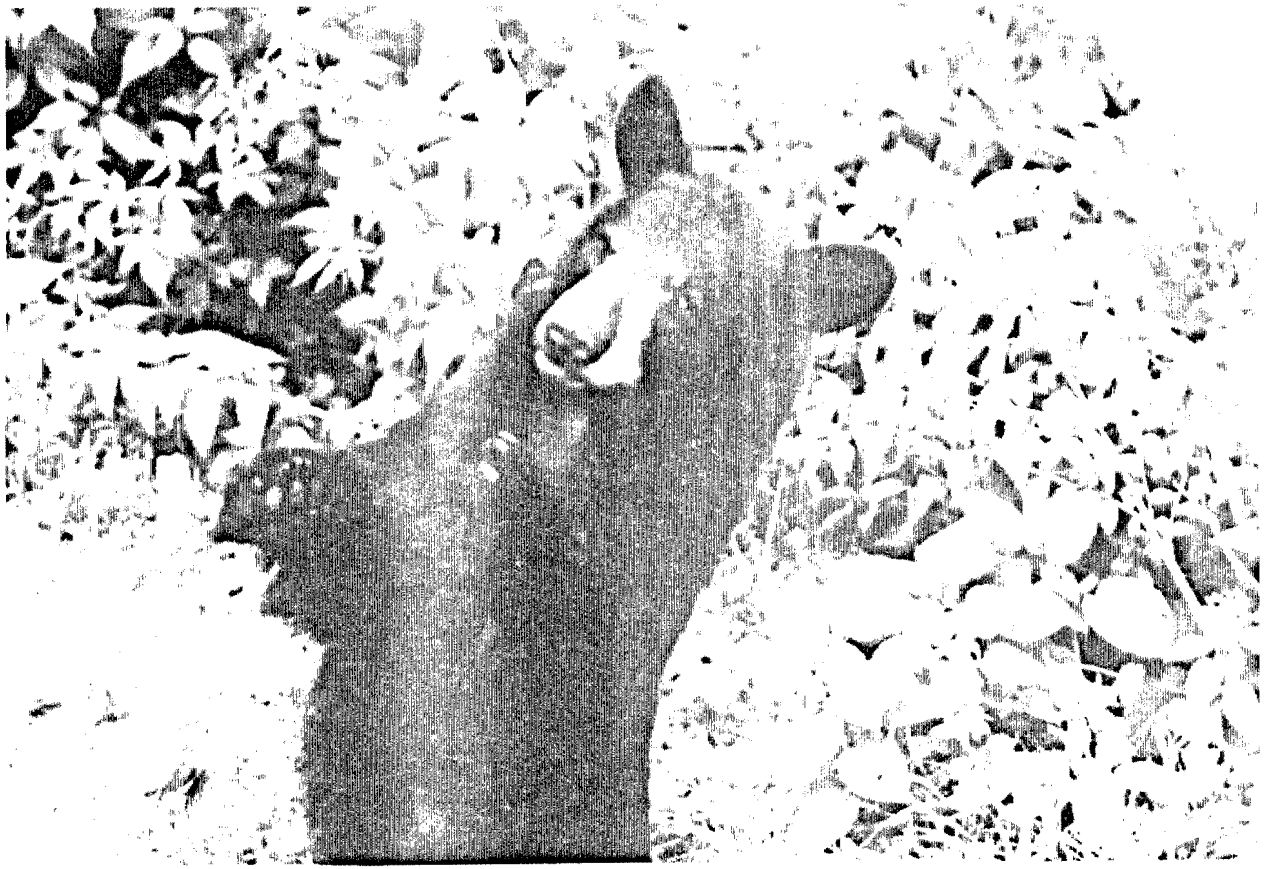


Figure 16. Panhandling bear exhibiting begging posture.

years of age. The lack of a permanent home range undoubtedly affects their behavior. These areas not only provide resources and protection (Alcock 1975:307) but also serve a psychic function (Beeman and Pelton 1976, Griffo 1961). This is supported by the fact that translocated bears frequently travel great distances to return to their original home ranges even though their physical needs could be provided equally well or better in other areas (Beeman and Pelton 1976, Erickson 1964, Harger 1967, Sauer et al. 1969, Tate Eagar and Pelton 1979, Wasem 1968). Without the benefits of a home range, these animals are certainly more vulnerable. Jonkel and Cowan (1971) reported increased mortality of young bears after dissolution of the family unit, and Rogers (1977) attributed the death of most yearlings in his study to starvation.

Whether threat of predation by adult males is a substantial factor in population control of black bears is subject of debate (Stringham 1981). Instances of conspecific predation have been documented for lions (Schaller 1972) and langurs (Presbytis entellus) (Eisenberg et al. 1972, Munhot 1971) and have been reported in captive (Baker 1904) and trapped black bears (Black 1958, Erickson 1957, Jonkel and Cowan 1971). Even if threat of death is a negligible factor, resident males do--either actively or passively--discourage transient males from settling within their domain (Rogers 1977). The combination of these factors likely contributes to the more aggressive nature of young panhandling males.

The older female bears, who are generally more experienced at panhandling, tend to evaluate situations before reacting. Their behavior is less predictable from a human perspective although

they tend to follow more closely aligned "policies." Young males are more predictable, being likely to react aggressively to a variety of situations.

The anomalous grouping of Patchouli, an adult female, and Yuri Van Gogh, an adult male, was possibly related to the "roles" they assumed. Both panhandled frequently with other bears--Patchouli with Adelaide and Yuri Van Gogh with Rousseau. In these panhandling partnerships, one bear seemed to adopt a "hawk" strategy while the other tended to be a "dove" (Maynard Smith 1974, Maynard Smith and Price 1973). Patchouli and Yuri Van Gogh were both hawks, having much higher aggression indices. This pattern was also displayed in a sibling pair, Sydney and Melbourne; however, Melbourne was not included in this analysis because no aggressive acts were recorded for him. Slater (1981) proposed that differences in behavior may occur because selection favors the adoption of different strategies by different individuals. Variation may exist because a particular behavior makes little difference from the perspective of selection or because the best strategy cannot be determined in an unpredictable environment. As was discussed earlier, some bears are simply more aggressive than others. If Patchouli and Yuri Van Gogh had greater predispositions toward aggressive behavior, their partners would also benefit from the subsequent increased distance between the crowd of visitors and the bears which usually followed ursid aggression.

CHAPTER IX

FIELD NOTES: FOCUS ON INTERACTIONS

Field notes were used to maintain a continuous record of the behaviors of both bears and people. Various non-sequential analyses allowed the comparisons of sessions as a whole. These assessments were based upon frequency of interactional behaviors of visitors, the number of aggressive acts as well as the level of aggression for bears, and duration of the panhandling session. Sequential analysis of segments of the field notes provided a more detailed view of the behaviors of both species immediately preceding and following aggressive acts. By utilizing both types of analysis it was possible to consider in a general way all that happened during the session and to focus in detail on instances of aggression.

Analyses

Non-sequential. For each panhandling session, tabulations were made of frequency of occurrence of the following activities by visitors: toss feeding, handfeeding, photographing, photographing while kneeling, petting, harassing, high noise level, and the sum of all visitor acts. The total number of visitor acts was divided by the duration of the session to obtain an interactional index corrected for time. The number of aggressive acts performed by bears and the level of aggression were recorded. In addition an aggression unit corrected for time was computed by dividing the level of aggression by the duration. For comparison of sessions by duration, they were

divided into 10-minute intervals based on total length (e.g., Category I--1-10 minutes, Category II--11-20 minutes, . . . Category VII--over 60 minutes).

Discriminant function analysis was used to compare sessions with and without aggression. Variables included were: sex and age of the bear, time of day, duration of session, distance from cover, temperature, weather conditions, number of visitors, number of feeding incidents, total visitor acts, and frequencies of all visitor acts delineated above. A stepwise method based on Wilks' lambda was utilized, and prior probabilities were assumed to be equal. In this stepwise analysis, independent variables are selected for entry on the basis of their discriminating power in conjunction with those already selected: therefore, the sequence in which variables are entered is not necessarily the same as their relative importance as discriminators. The relative contribution of the variables is represented by their standardized canonical discriminant function coefficients, the sign of which indicates whether that variable is making a positive or negative contribution. Univariate F-ratios based on a one-way analysis of variance test for equality of group means on a single discriminating variable were also calculated.

Sequential. Examination of the patterns of behavior utilized the combined principles of lag sequential analysis (Bakeman 1978) and the pre-post-state-histogram (PPSH) (Douglas and Tweed 1979). The aggressive act served as the criterion, and 10 behaviors occurring prior to and subsequent to this criterion were recorded. Only the

order of behaviors was considered and not their duration; no event could immediately precede itself. The behaviors recorded at each "event slot" (or "lag") could be those exhibited by either bears or visitors since the aim was to determine whether there were particular patterns of behavior for either species before and after ursid aggression. The total frequency of behavioral events was then calculated for each of the 20 lags.

Results

Continuous field notes were recorded for 67 panhandling sessions, of which 38 (56.7%) contained at least 1 aggressive act. The total number of interactional behaviors by visitors was 1,332; most of these (69.7%) were recorded in sessions containing agonistic behavior (Table 17). Toss feeding was the most likely of all visitor acts to occur, accounting for 56.7% of the total. Examination of the percentage of occurrence of different human behaviors in aggressive sessions revealed that harassing (86.2%), handfeeding (84.3%), and petting (70.6%) ranked highest. Furthermore, all five instances of petting recorded in the non-aggressive category occurred in the same session and were directed toward Melbourne, a yearling male for whom no aggression was recorded during the entire study. All human behaviors except high noise level occurred more frequently in aggressive sessions. Analysis of frequencies of visitor acts observed versus those expected (probabilities being based on total time of aggressive versus non-aggressive sessions) showed that some behaviors deviated significantly (G-test, $G=45.58$, $df=6$, $P<0.001$). Those showing the greatest discrepancy in expected versus observed

Table 17. Frequency tabulations of visitor acts in panhandling sessions with and without aggression, GSMNP, 1977.

Visitor Acts	Total Frequency N=1,332	Percentage of Total Visitor Acts	Frequency in Aggressive Sessions (%) N=928	Frequency in Non-aggressive Sessions (%) N=404
Toss feeding	755	56.7	513 (67.9)	242 (32.1)
Photographing	183	13.7	114 (62.3)	69 (37.7)
Handfeeding	134	10.1	113 (84.3)[a]	21 (15.7)
Photograph kneeling	113	8.4	75 (66.4)	38 (33.6)
Harassing	109	8.2	94 (86.2)[a]	15 (13.8)
High noise level	21	1.6	7 (33.3)	14 (66.7)[b]
Petting	17	1.3	12 (70.6)	5 (29.4)

[a] $P<0.001$, based on Interaction G-test.

[b] $P<0.005$, based on Interaction G-test.

were handfeeding, harassing (higher in aggressive sessions), and high noise level (lower in aggressive sessions).

Durational analysis. Examination of the seven categories of panhandling sessions showed a general trend of increase in the mean number of total visitor acts as well as in the individual categories (Table 18). The durational category which most often differed from this trend was that of 51-60 minutes. However, if these activities occurred at a regular rate, increases in the means would be expected simply because the sessions lasted longer. To correct for this, all mean values for visitor activities were converted to indices (Visitor Interaction Index) by dividing these means by the mean length of the sessions in each durational category. The results of this transformation showed much variation in human behavior (Table 19). However, with the exception of Category VI (51-60 minutes), there was a steady increase in the percentage of panhandling sessions containing ursid aggression: I--22.2%, II--47.4%, III--57.1%, IV--71.4%, V--80.0%, VI--70.0%, VII--100.0%.

Discriminant analysis. Overall classification success was 76.1%; 7 of 30 (23.3%) non-aggressive sessions were misclassified and 9 of 37 (24.3%) aggressive sessions (Figure 17). The group centroid for non-aggressive sessions was -0.87 and for aggressive sessions was 0.71. All except one of the improperly classified sessions were recorded along the roadside and involved members of two family groups, all of whom were frequent panhandlers. Phoenix, an adult female, accounted for half of them. One session from

Table 18. Mean number of visitor acts for each of the seven durational categories of panhandling sessions, GSMNP, 1977.

Durational Category (min)	Means of Visitor Acts							
	Toss Feeding	Handfeeding	Photographing	Photograph Kneeling	Petting	Harassing	High Noise Level	Total Visitor Acts
I (1-10)	2.4	0.1	1.1	0.2	-	-	0.1	4.0
II (11-20)	6.3	0.6	2.2	1.7	0.1	0.5	0.2	11.6
III (21-30)	8.9	1.5	2.3	1.9	0.5	1.1	0.5	16.7
IV (31-40)	13.4	4.6	6.9	2.7	-	1.9	0.1	29.6
V (41-50)	20.4	9.0	2.6	3.2	-	1.6	0.4	40.5
VI (51-60)	17.9	0.5	2.4	-	0.6	5.4	0.6	27.1
VII (>60)	37.7	6.0	5.0	5.7	1.7	2.7	0.3	59.0

Table 19. Visitor interaction indices for each of the seven durational categories of panhandling sessions, GSMNP, 1977.

Durational Category (min)	Visitor Interaction Indices[a]							
	Toss Feeding	Handfeeding	Photographing	Photograph Kneeling	Petting	Harassing	High Noise Level	Total Visitor Acts
I (1-10)	0.34	0.02	0.15	0.03	-	-	0.02	0.55
II (11-20)	0.41	0.04	0.14	0.11	0.02	0.03	0.01	0.75
III (21-30)	0.33	0.06	0.09	0.07	0.02	0.04	0.02	0.62
IV (31-40)	0.38	0.13	0.19	0.08	-	0.05	0.00	0.83
V (41-50)	0.48	0.21	0.06	0.07	-	0.04	0.01	0.95
VI (51-60)	0.30	0.01	0.04	-	0.01	0.09	0.01	0.46
VII (> 60)	0.46	0.07	0.06	0.07	0.02	0.03	0.00	0.72

[a]See text for explanation of computation.

O = Properly Classified Sessions

X = Misclassified Sessions

* = Group Centroids

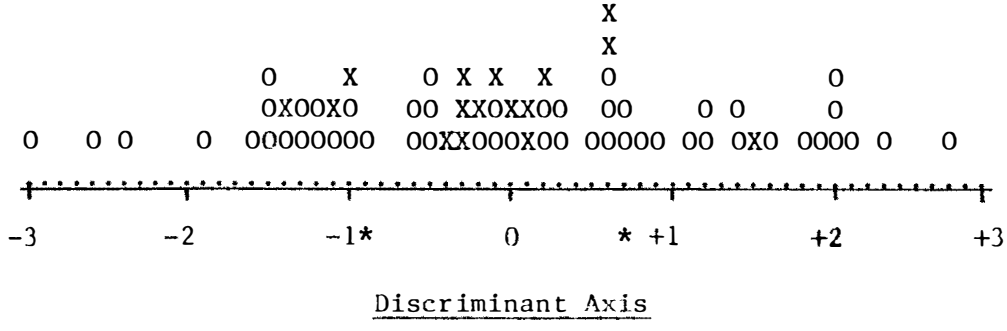


Figure 17. Territorial map of individual cases in discriminant analysis of aggressive and non-aggressive sessions, GSMNP, 1977.

Chimneys Picnic Area was misclassified and was the only session recorded for that bear.

Comparisons of means showed higher values in aggressive sessions for all variables except high noise level (Table 20). Results of the stepwise variable selection, based on minimizing Wilks' lambda, are presented in Table 21. The equivalent F-ratios and significance levels between groups are also included. The first variable to be entered was duration, and the greatest significance level was attained after Step 4. Thereafter the decreases in Wilks' lambda became less, the final value being 0.61. After all variables were entered, however, the significance level was still less than 0.05. Univariate F-ratios, their significance levels, and the standardized canonical discriminant function coefficients are presented in Table 22. The eigenvalue for the discriminant function was 0.637; the X^2 for testing its significance was 27.86 ($df=17$, $p<0.05$). Based on F-ratios and standardized canonical discriminant function coefficients, the variables best at discriminating between aggressive and non-aggressive sessions were duration, total visitor acts, number of visitors, feeding incidents, toss feeding, handfeeding, and harassing.

Sequential analysis. Ninety-four aggressive acts were recorded in the field notes and subjected to sequential analysis to ascertain whether distinct patterns existed in human-bear interactions. Compilation of frequencies of all behavioral acts was used to determine those which showed the greatest change when comparisons were made of the 10 precedent (P) and subsequent (S) behaviors

Table 20. Comparisons of means and standard deviations of variables in field note analysis for panhandling sessions with and without aggression, GSMNP, 1977.

	Non-aggressive Sessions		Aggressive Sessions	
Variable	Mean	S.D.	Mean	S.D.
Duration	22.4	15.3	36.6	22.0
Distance	10.8	5.5	11.2	8.2
Temperature	24.0	3.7	25.1	3.9
Number of visitors	17.1	10.1	22.6	12.2
Feeding incidents	3.5	4.0	7.2	8.1
Total visitor acts	13.5	13.5	25.3	24.7
Toss feeding	8.1	9.3	13.9	15.4
Handfeeding	0.7	2.0	3.1	5.8
Photographing	2.3	4.0	3.1	5.8
Photograph kneeling	1.3	2.2	2.0	3.4
Petting	0.2	0.9	0.3	0.9
Harassing	0.5	1.0	2.5	4.5
High noise level	0.5	1.3	0.2	0.5

Table 21. Stepwise variable analysis for discriminating between aggressive and non-aggressive panhandling sessions, GSMNP, 1977.

Step	Variable Entered	Wilks' Lambda	Equivalent F-Value (d.f.)	Significance Between Groups
1	Duration	0.88	8.93 (1,65)	.004
2	Number of visitors	0.82	6.88 (2,64)	.002
3	High noise level	0.78	5.82 (3,63)	.001
4	Harassing	0.75	5.14 (4,62)	.001
5	Age	0.73	4.42 (5,61)	.002
6	Sex	0.72	3.89 (6,60)	.002
7	Handfeeding	0.70	3.54 (7,59)	.003
8	Toss feeding	0.69	3.30 (8,58)	.004
9	Distance	0.67	3.05 (9,57)	.005
10	Weather	0.67	2.78(10,56)	.007
11	Petting	0.66	2.58(11,55)	.01
12	Temperature	0.65	2.39(12,54)	.01
13	Time	0.63	2.39(13,53)	.01
14	Photographing	0.63	2.19(14,52)	.02
15	Total visitor acts	0.62	2.07(15,51)	.03
16	Photograph kneeling	0.61	1.98(16,50)	.03
17	Feeding incidents	0.61	1.83(17,49)	.05

Table 22. Standardized canonical discriminant function coefficients and F-ratios of individual variables in discriminant analysis of panhandling sessions, GSMNP, 1977.

Variable	Standardized Discriminant Function Coefficient	F-Ratio	Level of Significance
Sex	-0.49	0.07	.786
Age	-0.85	1.57	.215
Time	-0.41	0.02	.884
Duration	0.61	8.98	.004[a]
Distance	0.14	0.06	.801
Temperature	0.56	1.24	.270
Weather	0.61	0.06	.812
Number of visitors	0.34	3.87	.053[a]
Feeding incidents	0.19	5.41	.023[a]
Total visitor acts	-5.79	5.55	.022[a]
Toss feeding	3.20	3.29	.074[a]
Handfeeding	1.81	4.53	.037[a]
Photographing	1.25	0.67	.417
Photograph kneeling	0.63	0.95	.334
Petting	-0.16	0.53	.468
Harassing	1.68	5.82	.019[a]
High noise level	-0.08	1.50	.224

[a]$P<0.10$.

(Tables 35 and 36, Appendix B). All visitor actions were examined individually and collectively for their position relative to performance of ursid aggression. Results were tabulated for different types of agonistic behavior as well as for all forms combined.

The most obvious pattern to emerge was the disparity between frequencies of all visitor acts prior to and subsequent to aggression (Figures 18-24). There was, in fact, a temporary subsiding of interactional behaviors for both species. Bears were more likely to approach people prior to aggression and afterward were likely to retreat: human activities tended to increase again in the later S lags, but they did not reach the peaks recorded preceding aggression. Of all visitor actions, feeding showed less change in total frequency between P and S events. Conversely, petting occurred 10 times before aggression but was never recorded in the S lags.

Closer examination of individual types of aggression revealed events peculiar to them. Visitor interactions tended to be more evenly divided for the blow vocalization (Figure 20). However, the frequency of harassing was higher in the P lags for this type of aggression than for any of the others. The change in frequency of all visitor acts showed a marked decrease after charges (P=57, S=30) (Figure 19). When all aggressive behaviors involving the bite-snap (either singly or as a part of a combination) were summed, there were nine visitor acts before compared to only three afterward, none of which occurred prior to the S-5 lag (Figures 23 and 24). Aggressive acts of higher intensity tended to show greater differences in the mean number of visitor acts in the P and S categories.

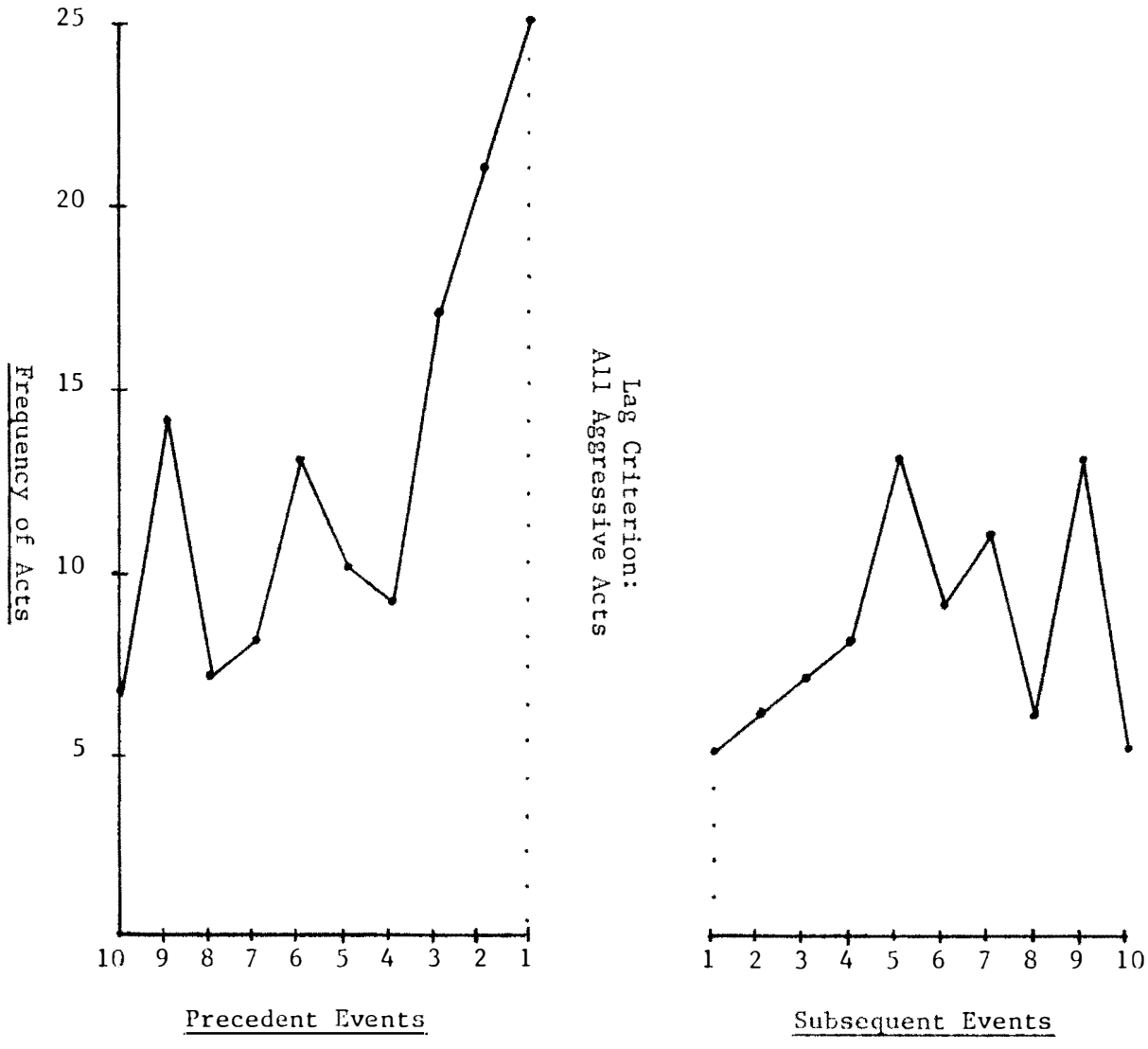


Figure 18. Frequencies of total visitor acts in precedent and subsequent lags for all types of aggression combined, GSMNP, 1977.

Figure 19. Frequencies of total visitor acts in precedent and subsequent lags for the charge, GSMNP, 1977.

Figure 20. Frequencies of total visitor acts in precedent and subsequent lags for the blow vocalization, GSMNP, 1977.

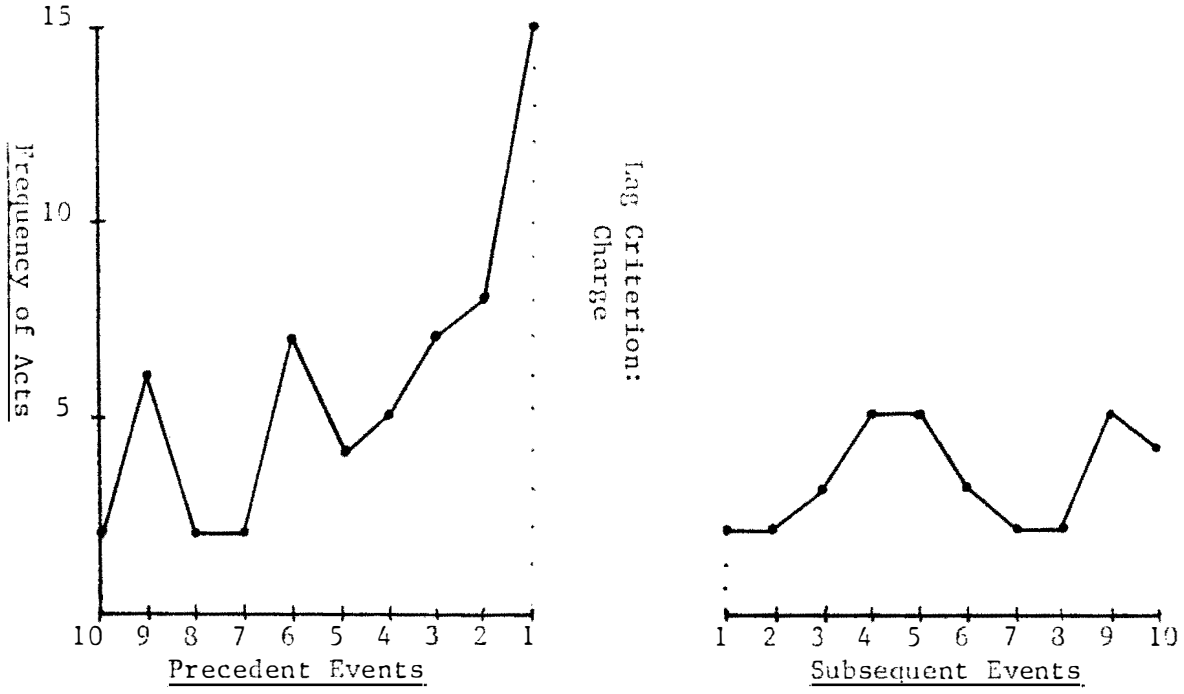


Figure 19

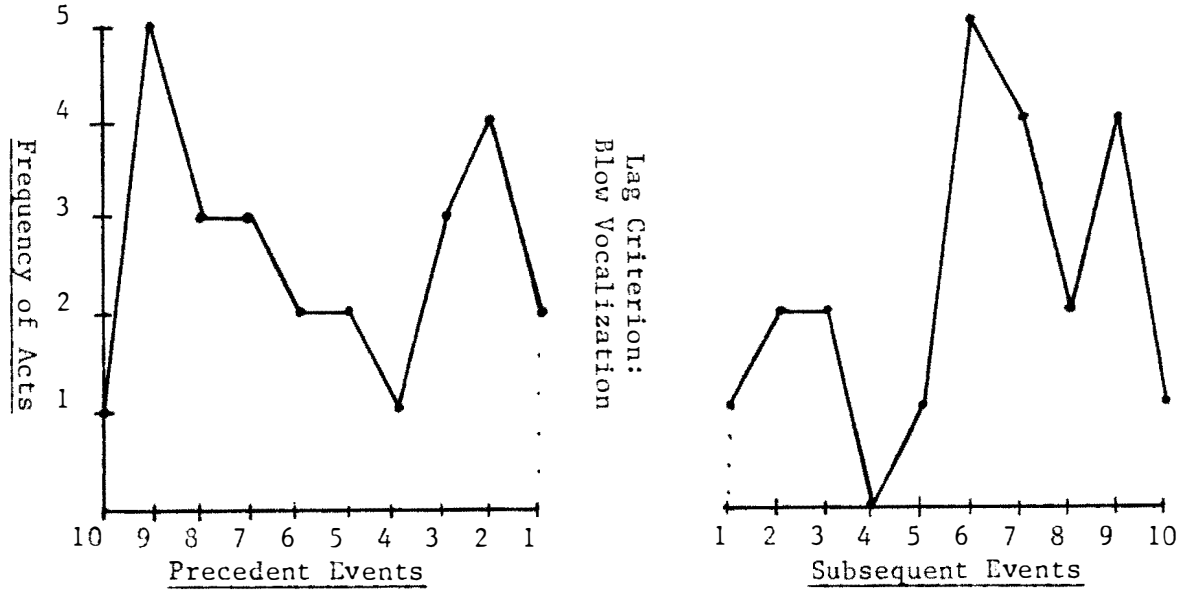


Figure 20

total visitor acts in precedent and
s for the bipedal swat, GSMNP, 1977.

total visitor acts in precedent and
s for the quadripedal swat, GSMNP,

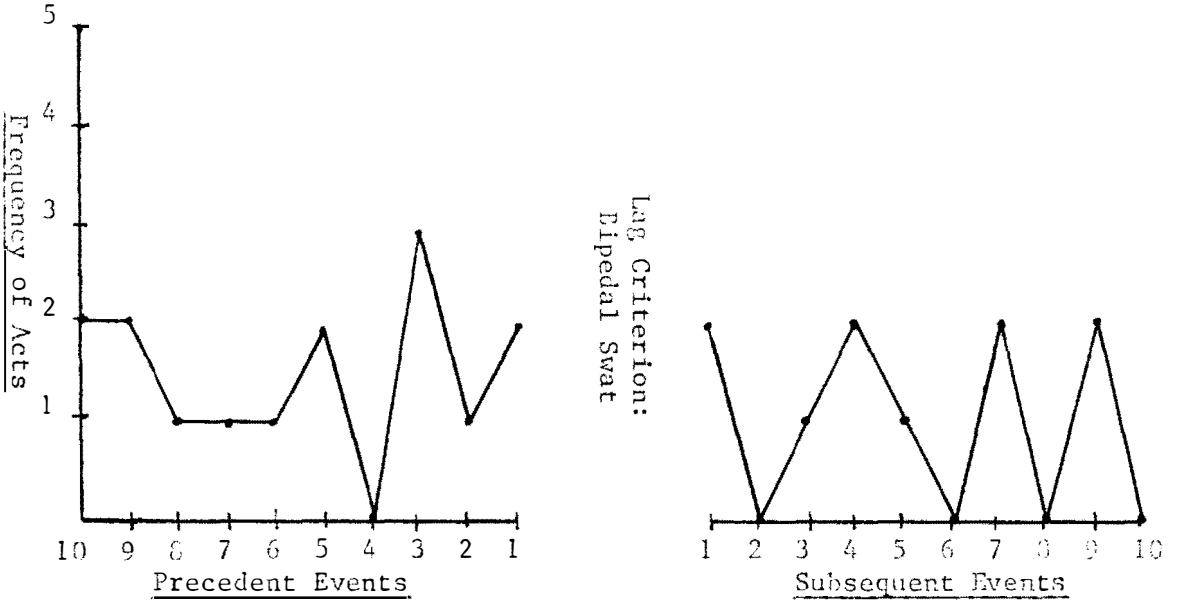


Figure 21

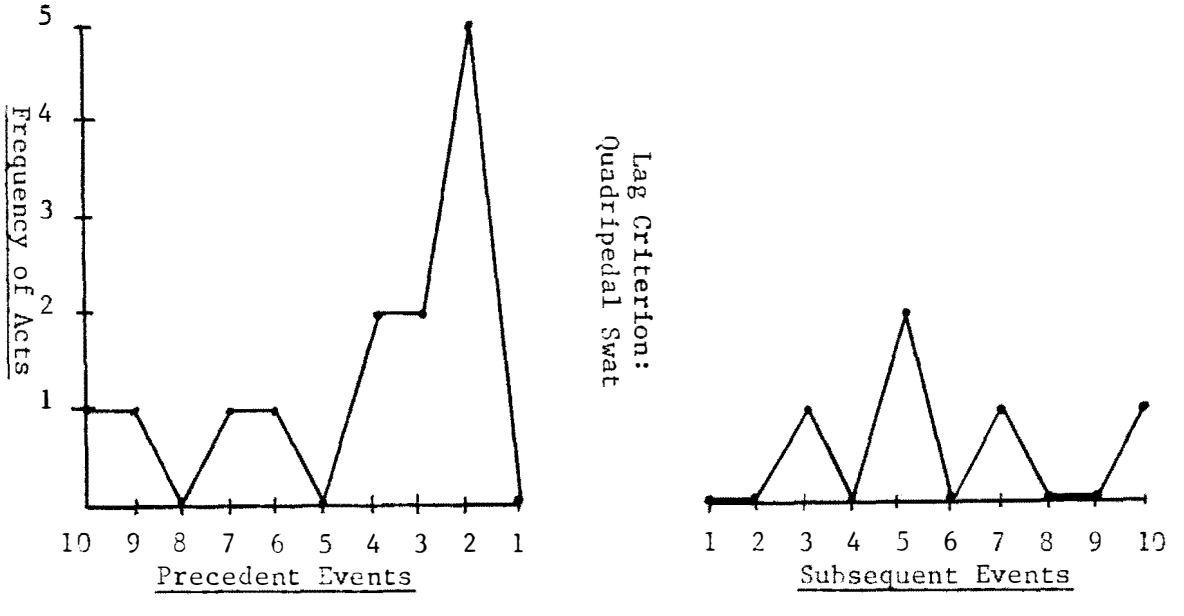


Figure 22

Figure 23. Frequencies of total visitor acts in precedent and subsequent lags for the bite-snap, GSMNP, 1977.

Figure 24. Frequencies of total visitor acts in precedent and subsequent lags for the combinations of different aggressive acts, GSMNP, 1977.

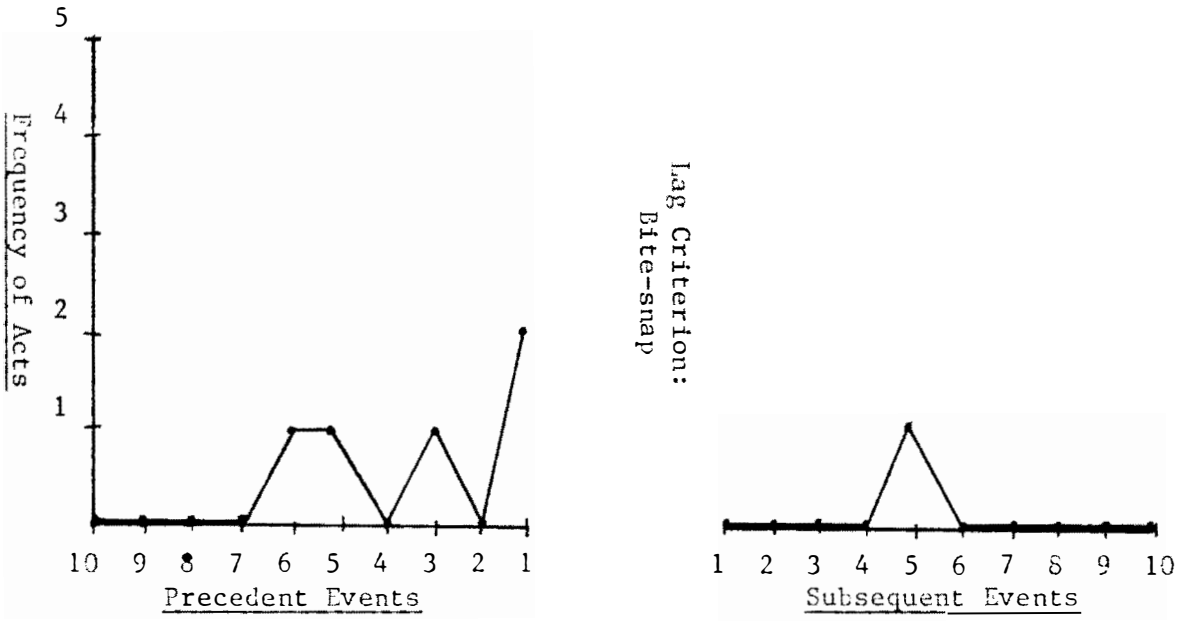


Figure 23

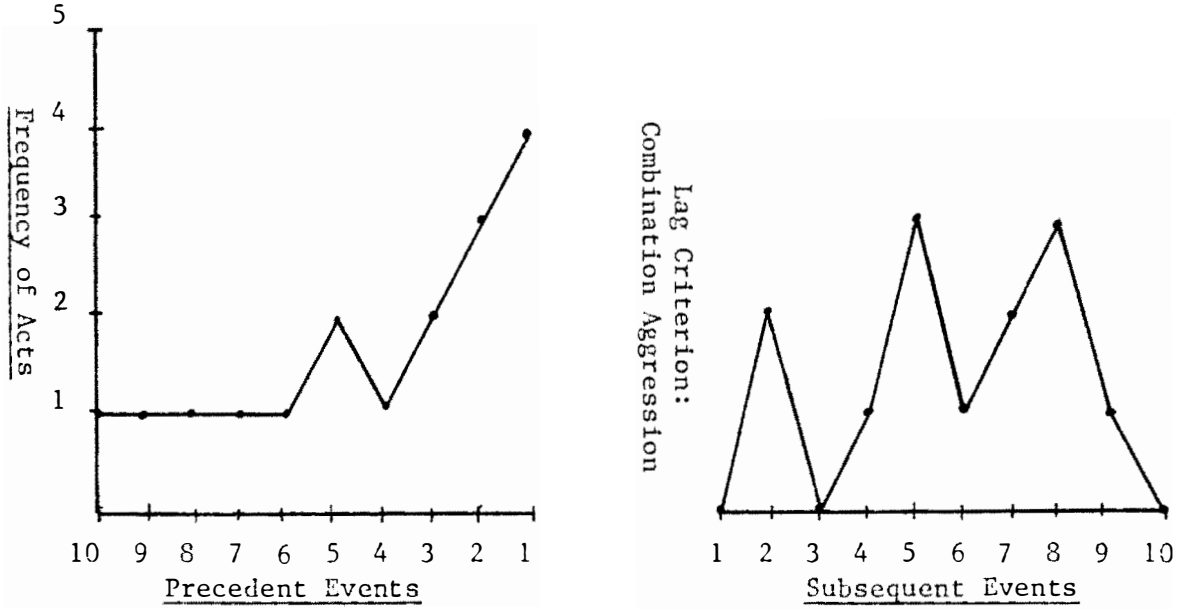


Figure 24

Discussion

Examination of the interactions of humans and bears as indicated by both sequential and non-sequential analyses of field notes can be summarized in a few salient points.

1) The behaviors of visitors appear to occur at a fairly random rate throughout the course of a panhandling session, regardless of its duration.

2) As panhandling sessions increase in duration, the percentage of those containing ursid aggression increases.

3) Human behaviors performed in close proximity to bears are more likely to result in aggressive actions.

4) There is an increase in overall frequency of human behaviors prior to ursid aggression and temporary subsiding of interactional behaviors for both species subsequent to the aggressive act.

5) Most panhandling sessions were properly classified into aggressive and non-aggressive categories, indicating that there were discernible differences in the two.

Turnover in visitors during panhandling sessions was undoubtedly a factor in the random rate of their interactional behaviors. While there was variation in their length of stay, most remained only a few minutes. New arrivals usually exhibited the same types of behavior as their predecessors, but the frequencies of the acts varied as did the size of the crowd. Moreover, there were differences in frequencies of human behaviors in aggressive and non-aggressive sessions. Handfeeding and harassing were higher than expected in those containing aggression. The fact that high noise level was more common to non-aggressive sessions suggested that bears were

more likely to retreat (ceasing the interaction) rather than behaving aggressively.

The relatively high classification success obtained from the discriminant analysis suggested that there were tangible and measurable differences in aggressive and non-aggressive sessions. Closer examination of the misclassified sessions revealed extenuating circumstances that may have influenced the outcome of some of them. The session in Chimneys Picnic Area involved a young female whose behavior indicated that she was unaccustomed to interacting with people. This was, in fact, the only session recorded on her. When she was surrounded by a crowd of visitors, she reacted aggressively. As mentioned earlier, all other misclassified sessions involved two family groups. Two of the sessions contained only intraspecific aggression between Tippecanoe and her subadult daughter Tahini. One misclassified non-aggressive session was for Tyler during his first summer; no aggressive acts were recorded for him as a cub. Another non-aggressive session occurred when it was raining and most visitors remained in their cars, thereby not intruding into the bear's individual space. A third lasted only seven minutes; while the frequency of visitor acts and other setting variables might have been more closely aligned with aggressive sessions, this one was very brief and the threshold for aggression was not reached. Three sessions involved either no or very little feeding. Aggression in these sessions could possibly be explained by the discrepancy between observed and expected situations. Additionally, several authors have related increased aggression to scarcity of food (e.g., in brown bears, Egbert and Stokes 1976; in various canids and felids,

Kleiman and Eisenberg 1973: and in the African lion, Schaller 1972). Reactions of bears to different panhandling situations were most certainly dependent upon variables other than those evaluated here. Nonetheless, the setting factors and frequencies of visitor acts provided a fairly reliable measure for distinguishing between aggressive and non-aggressive sessions.

The effects of duration of the session and invasion of individual distance upon the behaviors of bears were evident in analyses of previous data sets. However, they warrant further elaboration here. The longer the session lasted, the more numerous were instances of intrusion into the bear's space. This in conjunction with the satiation factor altered the weights of the approach-avoidance vectors, lowering the threshold for aggression. McBride (1971) stated that aggression is the most common behavior for controlling space, and Leyhausen (1971) related space to a status symbol. He said that the size of the area around animals which they can keep free of intruders as well as how far they dare penetrate into the sphere of others is indicative of the social status of individuals (Figure 25). Herrero (unpublished manuscript), in his observations of bears at garbage dumps in Canadian national parks, reported that although these animals were tolerant of each other's presence, individual distance among aggregations of bears was of great importance and that invasions resulted in aggression.

Sequential analysis of field notes illustrated the importance of distance relationships, the level of human interactional behaviors, and the differences in intensity of various aggressive acts. The

Figure 25. Young male panhandler swatting visitor who approached too closely.

number of human behaviors increased just prior to ursid aggression and then dropped substantially afterward as bears retreated. The differences in interactive behaviors were more pronounced in acts of higher intensity, suggesting that people perceived differences in meaning and function in types of aggression. Similarly, the fact that the level of aggression showed higher correlations with visitor actions and greater predictability in the regression analyses than did the mere number of aggressive acts (Table 14, p. 66) indicated that bears distinguished a hierarchy in their aggressive acts.

The subsiding of interactions and the retreat of bears following aggression corresponded to what was reported by Herrero (unpublished manuscript). It was also consistent with theories of aggressive behavior (Barash 1977:209-246, Ewer 1968:154-185, Geist 1974, Hinde 1981, Maynard Smith and Price 1973, Moynihan 1955). Performance of such acts has inherent risks. While animals may benefit by reclaiming individual space and causing a cessation of human behaviors which are inappropriate, they also risk injury and/or retaliation. By retreating, bears are also providing themselves with a more readily available escape route should they need it. The pattern of retreat has been reported in conspecific agonistic interactions for many species, including black bears (Henry and Herrero 1974, Herrero unpublished manuscript, Jordan 1979) and brown bears (Egbert and Stokes 1976).

Examination of particular human behaviors showed that toss feeding was almost as likely to occur after an aggressive act as before (P=40, S=36) (Tables 35 and 36, Appendix B). However, this

was somewhat misleading. Precedent toss feeding usually involved leading the bear closer. Conversely, after ursid aggression, people often tossed the remaining food in a different direction as if to redirect the bear's attention. Petting, which connotes the greatest intrusion into individual space, never occurred in the 10 event lags after an aggressive act. Bears responded with high-intensity aggression and were apparently effective in communicating their message.

By considering the distribution of visitor acts surrounding aggressive acts, it was evident that aggressive behavior affected the probability of some human behaviors and, hence, the nature of the interaction. Since these displays were effective in accomplishing the desire results, their value as signals was reinforced and the likelihood of their continued use in similar situations was increased. Burghardt (1970), in his review of the problems surrounding the concept of "communication," concluded that the central criterion is intent and that there must be an advantage (either real or perceived) to the signaler in getting the message across. Certainly the aggressive displays used by panhandling black bears in their interactions with humans were a form of interspecific communication.

CHAPTER X

FILM ANALYSIS: AGGRESSION IN DETAIL

Frame analysis of cine films was utilized to develop profiles of the behavioral topography of different types of aggression. Positions of the head, body, ears, and mouth were recorded at different, specified stages in the course of an aggressive act. These profiles were then examined to determine the amount of variability that existed.

Analysis

Forty-three aggressive acts were recorded on cine film and subjected to analysis. During the course of the aggressive act, footage was analyzed frame-by-frame, and the following data recorded:

1) movement--approaching person/crowd, stationary, or retreating;

2) body position--bipedal, quadripedal, or forepaw raised;

3) head position--in the same plane as the body, raised, or lowered;

4) ear position--frontal (pinnas erect on head and facing forward), lateral (pinnas facing lateral position, halfway between being erect and flat on the neck), or flattened (pinnas flattened on the neck, disappearing from view);

5) mouth position--open, closed, or occurrence of bite-snap;

6) piloerection--presence or absence.

Frequency tabulations were made of the positions of head, ears, and mouth at different stages of the performance of the aggressive act: 1) at the initiation of the approach, 2) at the initial

resumption of a stationary position, 3) during the aggressive act proper (i.e., at the time of the swat or bite-snap), and 4) at the initiation of the retreat. Not all stages were present for all types of aggressive behavior; therefore, calculations were made only for those which were applicable. From these data, probabilities of different postures were calculated for each type of act and for all combined. In addition, the mean duration of each act was calculated.

To assess the variability of types of aggression, coefficients of variation were computed for those elements which showed the greatest probability of association with aggression. These were based on the duration of head lowered, ears flattened, aggressive act proper, and time from initiation of approach to resumption of stationarity or retreat. Duration was measured in number of frames. Again only pertinent categories were used in the calculations. The coefficient of variation is the standard deviation expressed as a percentage of the mean (Bekoff 1977, Colgan 1978):

$$CV = S.D. \times 100 \div \bar{X}.$$

The conditions under which filming took place occasionally precluded recording the entire sequence; however, those segments filmed were included in analyses not requiring the act in totality. While earlier studies (Henry and Herrero 1974, Pruitt 1974) have differentiated more positions of the ears and facial expressions, these more subtle gradations could not be seen with consistent reliability here and were not included.

Results

The 43 aggressive acts used in film analysis involved 8 bears and 5 different categories of aggression (Table 23). The mean duration of all aggressive acts is presented in Table 24; the average for all combined was 2.3 seconds, attesting to how rapidly they were performed.

Tabulations of the positions of head, ears, and mouth were converted into probabilities for each aggressive category and for all combined (Figure 26; Table 37, Appendix B). In considering aggression overall, at the initiation of the approach, the head was likely to be lowered, the ears flattened, and the mouth closed. At the resumption of stationarity, the head was likely to be in the same plane as the body, the ears were somewhat more likely to be in a lateral position than flattened (though never in a frontal position), and the mouth was closed. At the initiation of retreat, the head was held in the same plane, the ears flattened, and the mouth closed. During the actual swat, the ears were more likely to be flattened than at any other time throughout the sequence of that act. This was even more pronounced during the bite-snap, occurring in 100% of the observations. The position of the head during the bite-snap was dependent upon the area of orientation for that act; probabilities were equally divided between lowered and raised for the combination of charge and bite-snap and higher for the raised position in bite-snap alone. The phase which exhibited the most variation was initiation of retreat.

The coefficients of variability were quite high for all the parameters investigated (Table 25). The computation of this statistic

Table 23. Number of aggressive acts subjected to film analysis by individual bear and type of aggressive behavior.

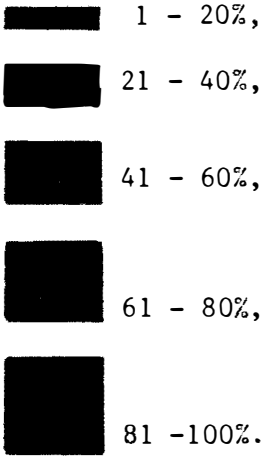
	Types of Aggressive Acts					
Bear Code Name	Charge	Charge-Quadripedal swat	Quadripedal swat	Charge-Bite-snap	Bite-snap	Total
Yuri Van Gogh	1	1	1	1	2	6
Jeremiah	7	4	-	-	-	11
Adelaide	1	-	-	-	1	2
Patchouli	2	-	1	-	-	3
Sydney	2	6	3	-	-	11
Tyler	3	-	-	-	-	3
Tippecanoe	3	2	1	-	-	6
Tahini	-	-	-	1	-	1
Total	19	13	6	2	3	43

Table 24. Mean duration of different aggressive acts by panhandling black bears, GSMNP, 1977-1978.

Type of Aggression	Duration	
	Number of Frames	Seconds
Charge	50.9	2.8
Charge plus Quadripedal swat	30.7	1.7
Quadripedal swat	30.0	1.7
Charge plus Bite-snap	58.0	3.2
Bite-snap	38.0	2.1

Figure 26. Postural probabilities of body positions at different stages of aggressive acts.

Probability categories are as follows:



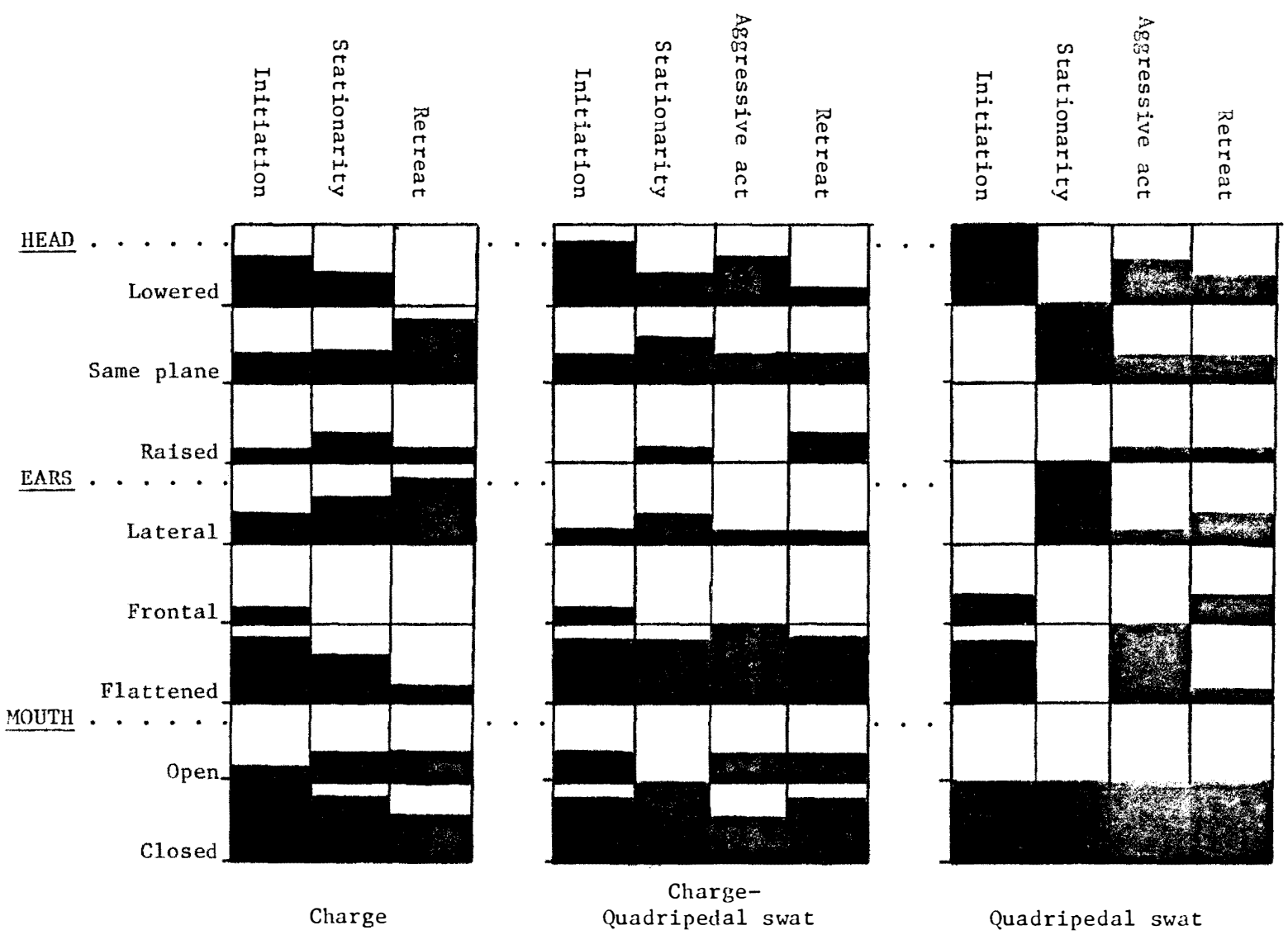

Initiation
Stationarity
Retreat
Initiation
Stationarity
Aggressive act
Retreat
Initiation
Stationarity
Aggressive act
Retreat
HEAD
Lowered
Same plane
Raised
EARS
Lateral
Frontal
Flattened
MOUTH
Open
Closed
Charge
Charge-
Quadripedal swat
Quadripedal swat

Figure 26

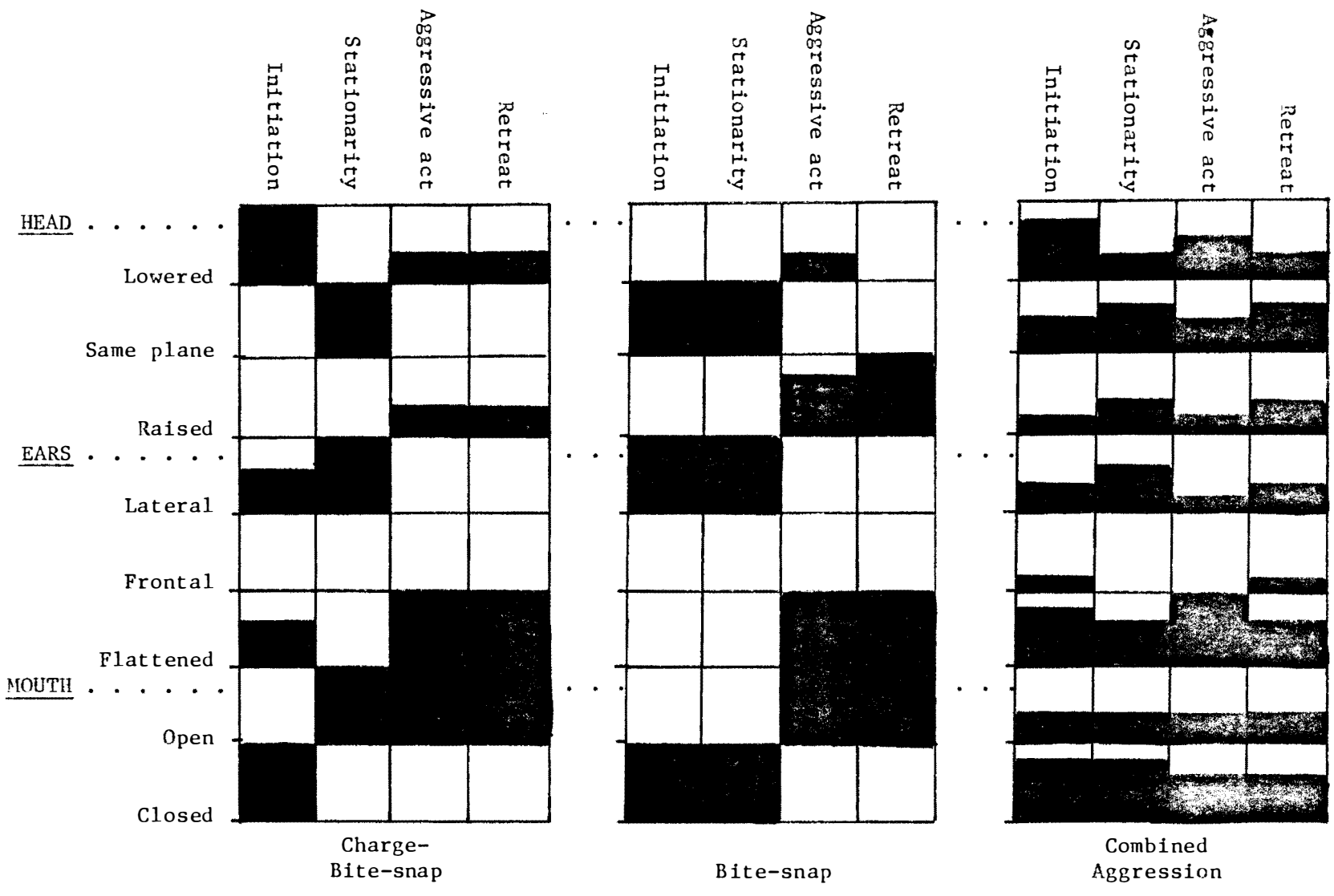


Figure 26 (continued)

Table 25. Coefficients of variability for the duration of selected postures and movements of panhandling black bears during aggressive acts, GSMNP, 1977-1978.

Element of Behavior	Types of Aggressive Acts			
	Charge	Charge-Quadripedal swat	Quadripedal swat	Charge-Bite-snap and Bite-snap
Duration (from approach to stationarity or retreat)	55.10	69.29	-	-
Ears flattened	58.83	79.59	43.73	32.54
Head lowered	66.21	67.53	55.53	58.43
Aggressive act proper	-	36.75	31.69	53.82

was based on the duration of the elements and not on their presence. While the probabilities of occurrence of some postures were quite high (Figure 26), the length of time the positions or movements were maintained exhibited much variation. The aggressive act proper of the quadripedal swat (either alone or in combination with a charge) and the flattening of the ears during the bite-snap were the least variable. Though the categories of aggressive acts on individual bears were too sparse to provide valid results, coefficients of variability were calculated for some individuals where specific acts were higher (e.g., charge for Jeremiah and charge-swat for Sydney) (Table 29). Variability remained high even in these calculations, suggesting that the duration of components of aggression were not stereotyped in individual bears.

While not the principal focus, piloerection and intraspecific aggression should be mentioned. Piloerection was occasionally observed during human-bear interactions and filmed on four occasions. It was recorded on three different bears (Sydney, Jeremiah, and Patchouli) during the performance of the charge, quadripedal swat, and their combination. Four instances of intraspecific aggression, all of which were charges, were also recorded. They followed the same general pattern as when directed toward humans. The mean duration of intraspecific charges was 51.0, compared to 50.9 for interspecific ones. During the charge the head was lowered in all instances, and the ears were flattened in three of four cases. The mouth was closed in one intraspecific charge, open in two, and not visible in one. These mouth positions were maintained throughout the aggressive act.

At the resumption of stationarity, the head was raised in three of four cases, and the ears were lateral in all four. Considering the variation exhibited in interspecific aggression, there were no detectable differences in duration or body positions.

Discussion

Situations which simultaneously evoke attacking and fleeing have been of particular interest to ethologists. The behaviors resulting from these conflicting tendencies often take the form of highly ritualized and much-studied displays (Andrew 1956, Archer 1976, Baerends 1975, Bastock et al. 1953, Darwin 1872, Hinde 1981, Huxley 1914, Rasa 1976, Smith 1977, Tinbergen 1952). Various functions have been attributed to these behaviors. They were summarized by Tinbergen (1952) as threat and intimidation, stimulating and attracting the opposite sex, strengthening the pair bond, keeping the partner on the nest, and serving as diversions. However, the common element of all functions is that displays serve as social releasers, stimuli to which others react; thus they have become a primary element of communication in many species.

The specific function of threat displays is to produce an appropriate response in the recipient, i.e., deter the opponent (Ewer 1968:154). Three basic principles are involved in accomplishing this end: 1) displaying the weapons used in attack, 2) displaying maximal apparent size, and 3) sudden changes in the sensory input received (Ewer 1973, Leyhausen 1967). The first often entails opening the mouth and/or baring the teeth. Piloerection and turning broadside are commonly used to make the animal appear larger, the

epitome of this being exhibited in the "Halloween cat" posture. The third mode is evidenced in accompanying vocalizations or dramatic changes in contour of the visual image such as laying back the ears. While threat displays are considered "ritualized" (Huxley 1923), scientists have recently begun to study the variability which exists therein, both intra- and inter-individually.

When compared with the felids and canids, the agonistic displays of black bears are considered less spectacular and less understood (Herrero unpublished manuscript, Pruitt 1974). Perhaps this is because bears have been less studied in this respect and we have been less adept at "breaking" their communication code. Bears do use body postures, facial expressions, and body movements as social signals (Burghardt and Burghardt 1972, Henry and Herrero 1974, Jordan 1976, Pruitt and Burghardt 1977). Indeed many of the elements of threat display reported for other carnivores are utilized by bears: piloerection, raised forepaw, stamping forepaw, flattened ears, lowered head, blowing, charging, and accompanying vocalizations.

While the probabilities of different body postures were such as to allow the development of profiles of different aggressive acts in panhandling bears, the variability with which they were performed was quite high. This was not unexpected since the situations within which they occurred and their precipitating factors were also quite variable. Bekoff (1977) reported great variability in the components of agonistic behavior and social play in coyotes (Canis latrans). He stated that the context appears to be an important factor in determining the form of a particular act. Indeed studies using

coefficients of variation have produced a great range in the values of this statistic for a myriad of behaviors in many species (Goldeneye duck, Bucephala clangula, Dane and van der Klott 1964, Dane et al. 1959; domestic chicks, Dawkins and Dawkins 1973; black-throated sparrow, Melospya melodia, Heckenlively 1970; fiddler crabs, Uca spp., Salmon 1967, Salmon and Atsaides 1968; Anolis aeneus, Stamps and Barlow 1973; sage grouse, Centrocercus uropasianus, Wiley 1973). Display behaviors which were seemingly quite stereotyped have, upon closer examination, been different in their manifestation.

However, Schleidt (1982) proposed that even complex behavior patterns can be characterized by a few salient feature variables which are sufficient to represent the entire pattern. He analyzed 204 feature variables of the "wet-my-lips" call of the male migratory quail (Coturnix coturnix coturnix L.) and found that the most stereotyped features ($CV < 0.015$) were those constituting the rhythm of the call. It is certainly possible that there may be stereotyped features within the aggressive acts of bears. However, the conditions within which filming occurred in this study allowed calculations of variability only on the more generalized components of aggressive acts.

Statistical tests should not, however, be allowed to distort the fact that there are recognizable, species-typical threat displays and that some elements of these signals may appear cross-specifically. Jordan (1976) reported that threat behavior in black bears occurs in a stereotyped manner in reliable sequences. Similarly, Herrero (unpublished manuscript) considered agonistic behavior in black bears

to be ritualized because the species possesses a limited set of actions and reactions.

Lowering the head and flattening the ears produces an alteration in visual contours, which is one of the basic principles of threat displays (Leyhausen 1967). These postures were not only characteristic of agonistic behavior in human-bear interactions documented in this study but were also reported in black bears by Henry and Herrero (1974) and Pruitt (1974). Furthermore, the occurrence of one or both of these elements is wide-spread in carnivores. A representative list would include: brown bear (Egbert and Stokes 1976), cheetah (Eaton 1974), domestic cat (Felis catus) (Leyhausen 1967), golden jackal (Canis aureus) (Golani and Keller 1975), red fox (Vulpes vulpes) (Scott and Fuller 1965, Kleiman 1966, Fox 1974), coati (Nasua narica) (Kaufmann 1962), and raccoon (Procyon lotor) (Barash 1974). Thus they are quite common and likely to be of conservative origin.

Ewer (1968:157) stated that the open-mouth display--with or without exaggerated baring of teeth--is the most elementary form of threat because it displays the weapons frequently used in attack. With the obvious exception of bite-snap, black bears usually exhibited a closed mouth during aggressive behavior. The changes in dentition resultant from a more omnivorous diet (Herrero 1972) were probably associated with the essential absence of this display. However, a slow opening and closing of the mouth (usually accompanied by intermittent tongue extension) was observed frequently in panhandling bears. It was usually seen during times when the panhandling session was judged to be stressful to the bear and frequently preceded

aggressive acts. The same behavior was mentioned by Egbert and Stokes (1976) as a part of an intraspecific threat display in brown bears. This behavior was reminiscent of the Flehman response exhibited by many felids and was closely akin in form (though not speed or intensity) to jaw-popping in black bears (Henry and Herrero 1974, Jordan 1976). Wysocki (1980), in his review of the vomeronasal organ, stated that there is evidence of its existence in most mammalian species although he did not discuss bears individually. However, there are inconsistencies in the literature regarding its level of development in carnivores. Age appears to be an important factor; the possibility exists that the vomeronasal organ may be well-developed in embryonic and infant states but that the accessory olfactory bulb becomes diffuse during development. If the vomeronasal organ is active in bears, this response could be a behavior for gaining sensory input via airborne chemical molecules.

Bears have a dual weapon system--sharp, strong claws as well as teeth. It is not unexpected that they should use paw swats in aggressive displays. This behavior is also exhibited by lions (Rudnai 1973), cheetahs (Eaton 1974), red foxes (Kleiman 1966), and domestic dogs (Canis familiaris) (Scott and Fuller 1965). The swat, besides being capable of inflicting injury and maintaining individual distance, probably has the function of startling the recipient. It is possible that it originated from an intention movement of charging and was subsequently ritualized into a display.

Herrero (unpublished manuscript), Jonkel (1978), and Jordan (1976) reported that black bears used the same aggressive reactions to humans as to conspecifics. Numerous observations and limited

film analysis during this study supported that statement. Research is insufficient to determine how widely distributed this similarity of intra- and interspecific responses is among carnivores, but Eaton (1974) noticed differences in the reactions of cheetahs to humans and to conspecifics.

In summary, the elements of the aggressive repertoire of black bears are not particularly extensive, and many of the these are also observed in other carnivores. The lack of a large tail, which is an integral part of the communicative system of many species, further restricts their communicative ability. While there is much variation in the behavioral topography of their aggressive acts, they are not completely unpredictable as Lorenz (1953) conjectured. They are extremely adaptable animals, quite capable of assessing situations and responding accordingly.

CHAPTER XI

FOOD HABITS

One objective of the present study was to ascertain the effects of panhandling upon the normal diet of black bears. The possibility existed that feeding upon unnatural foods was altering their dietary regime. Scats were analyzed to determine the food habits of panhandling black bears and to assess the importance of unnatural foods in their diet. Two different analyses were performed. The first, utilizing scats collected in 1977, involved categorizing the remains to obtain a general picture of their dietary habits. The second facet entailed a comparison of weight loss between panhandler and backcountry scats collected in 1978. Since many unnatural foods are highly processed, thereby leaving no identifiable remains, it was hoped that the percentage utilization of such foods could be determined by comparing dry weights before and after washing the scats.

Analysis I

These scats were analyzed following the techniques of Tisch (1961). Immediately prior to analysis, scats were thawed. They were then placed on a series of sieves (U.S. Standard sizes 10, 20, and 35) and washed with a spray of tap water. What remained on the sieves was spread out on aluminum foil and either air dried or placed in a drying oven. The food items were divided into five categories: 1) fruits and berries, 2) grasses and other herbaceous materials, 3) animal matter, 4) debris, and 5) unnatural foods.

A reference collection of seeds was used for identification. Presence of unnatural food, which left very few identifiable remains, was assessed by indicators such as paper, aluminum foil, plastic wrapping, egg shells, etc. Furthermore, large bird bones (i.e., chicken), peach pits, apple and pear seeds were classified as unnatural foods.

Following the method of Beeman (1971), food items were placed by estimates into 5 volumetric categories: 1) trace, <1%, 2) 1-25%, 3) 26-50%, 4) 51-75%, and 5) 76-100%. An index was assigned to each category: 0, 1, 2, 3, and 4, respectively. The following formula was then used to calculate the volume index percent (V.I.P.):

$$V.I.P. = \frac{\text{Index value for individual food item}}{\Sigma \text{ of index values for all food items}} \times 100.$$

Beeman (1971) summarized the reasons for not taking exact volumetric measurements: 1) feces could not be collected in their entirety; 2) weather conditions and differential exposure greatly affected the volume prior to collection; 3) other animals feeding on scats affected the volume; 4) relative amounts of food items in scats might not be indicative of the food originally consumed; and 5) the time required to separate food items in scats was impractical.

The volume index percent and frequency of occurrence of food items were calculated for three time periods. The first was 1 June to 30 June, a period prior to the first major holiday. The second coincided with the peak period of visitor use, 1 July to 4 September. The final period was from 5 September through the end of the field season.

Analysis II

The scats were thawed and weighed on an Ohaus triple beam balance (wet weight) before being placed in a drying oven. After drying, they were weighed a second time (first dry weight) then washed through a series of sieves (U.S. Standard sizes 10, 20, and 35). Materials remaining on the sieves were returned to the oven for drying again. When completed, the scats were weighed a third time (second dry weight). Comparing the first dry weight to the second allowed the determination of the percentage of scats washed through the sieves. Scats were then divided into the five food categories as described in Analysis I.

Results

Analysis I. Sixty-eight scats were analyzed. Grasses and herbaceous materials showed the highest frequency of occurrence, being present in 93% of the scats from Period I, 98% from Period II, and 86% from Period III (Table 26). Overall frequency was 96%. The volume index, which was 42% overall, showed a general decline throughout the summer: 59% for Period I, 42% for Period II, and 11% for Period III (Table 27, Figure 27). While many of the earlier scats were virtually all grasses, there were only three in which no grasses or other herbaceous materials were present.

The food category second in importance was fruits and berries, with an overall frequency of occurrence of 91% and an overall volume index of 33% (Tables 26 and 27, Figure 27). This category exhibited an inverse relationship to grasses, becoming more important

Table 26. Frequency of occurrence of food categories from scat analysis of panhandling black bears, GSMNP, 1977.

Food Category	Frequency of Occurrence (%)			
	Period I 1 June-30 June (N=14)	Period II 1 July-4 Sept. (N=47)	Period III After 4 Sept. (N=7)	Overall
Fruits and berries	79	94	100	91
Grasses and herbaceous materials	93	98	86	96
Animal matter	79	79	86	79
Debris	71	57	86	63
Unnatural food	36	38	29	37

Table 27. Volume index percent for food categories from scat analysis of panhandling black bears, GSMNP, 1977.

Food Category	Volume Index Percent			
	Period I 1 June-30 June (N=14)	Period II 1 July-4 Sept. (N=47)	Period III After 4 Sept. (N=7)	Overall
Fruits and berries	10	35	58	33
Grasses and herbaceous materials	59	42	11	42
Animal matter	13	9	8	10
Debris	12	9	21	11
Unnatural food	1	4	3	4

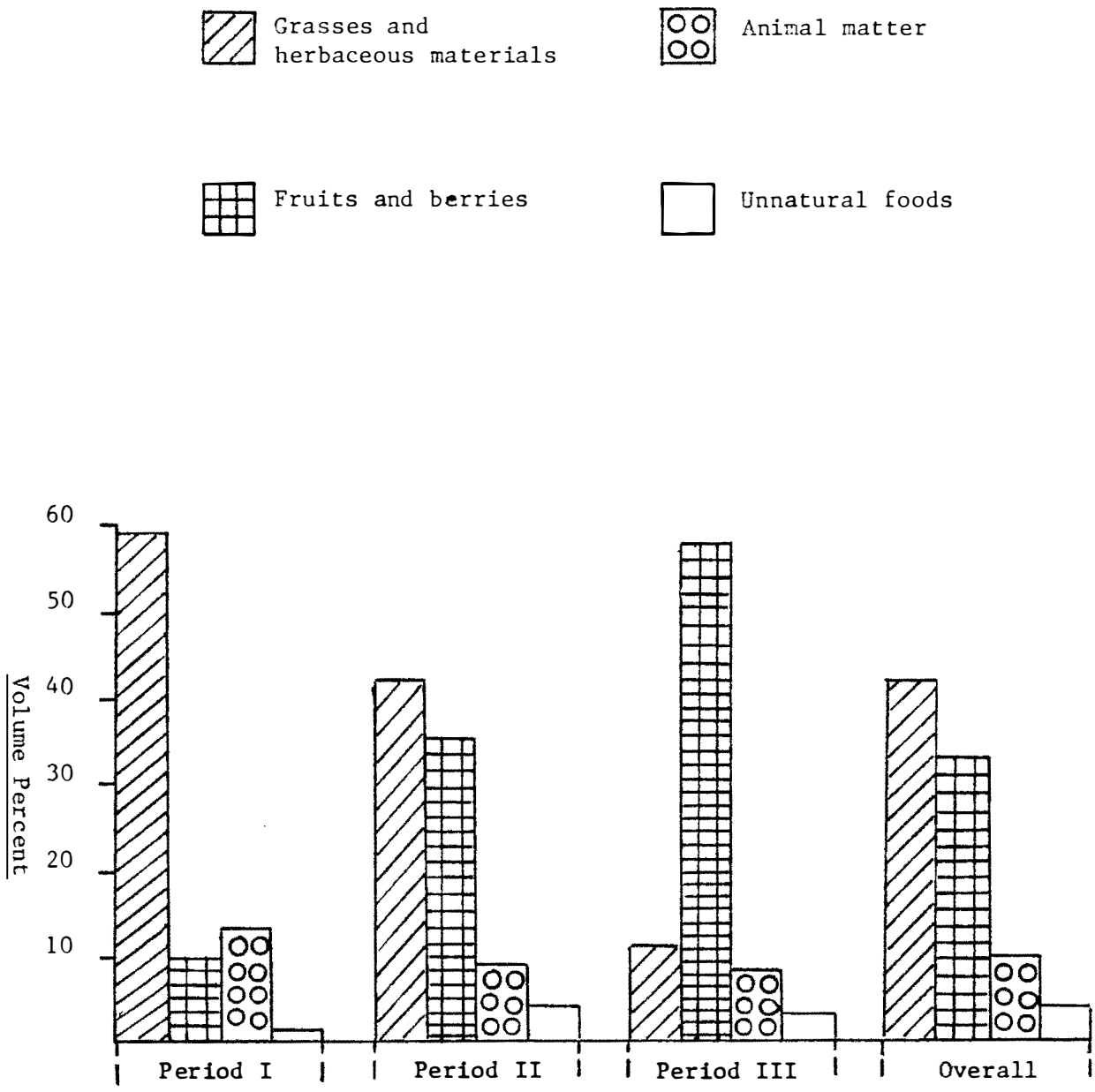


Figure 27. Seasonal food items of panhandling black bears (by volume percent), GSMNP, 1977.

as the season progressed. Seventy-nine percent of the scats from Period I contained seeds from fruits and/or berries, 94% from Period II, and 100% from Period III. Many of the scats collected late in the season were essentially all fruit and berry seeds.

Animal matter, while having an overall volume index of only 10%, was present in 79% of the scats analyzed (Tables 26 and 27, Figure 27). Frequency of occurrence and volume index remained fairly constant throughout the three periods. These animal foods consisted primarily of insects but a few mammal hairs and small bones were found.

Evidence of unnatural foods was found in 37% of the scats; however, the overall volume index was only 4%. This likely resulted from the system of using aluminum foil, plastic, etc., as indicators. The volume of such items was probably much less than the food itself. Unnatural foods exhibited their greatest importance during Period II, that of greatest visitor use. Data from scat analysis of backcountry bears are summarized in Figure 28 (Beeman and Pelton 1980). Comparisons of food habits of panhandlers and backcountry bears based on the increasing or decreasing importance of food categories throughout the season showed remarkable similarities (Table 28). The only difference was recorded in the volume index percent for animal matter, which showed a decrease for panhandlers over the summer and an increase for backcountry bears.

Analysis II. Results of the comparisons of 10 panhandler and 10 backcountry scats are presented in Table 29. Panhandler scats had a percentage weight loss of 24.5 and backcountry scats of 33.2. The difference was not significant (Mann Whitney U test, $U=68$, $p>0.20$).

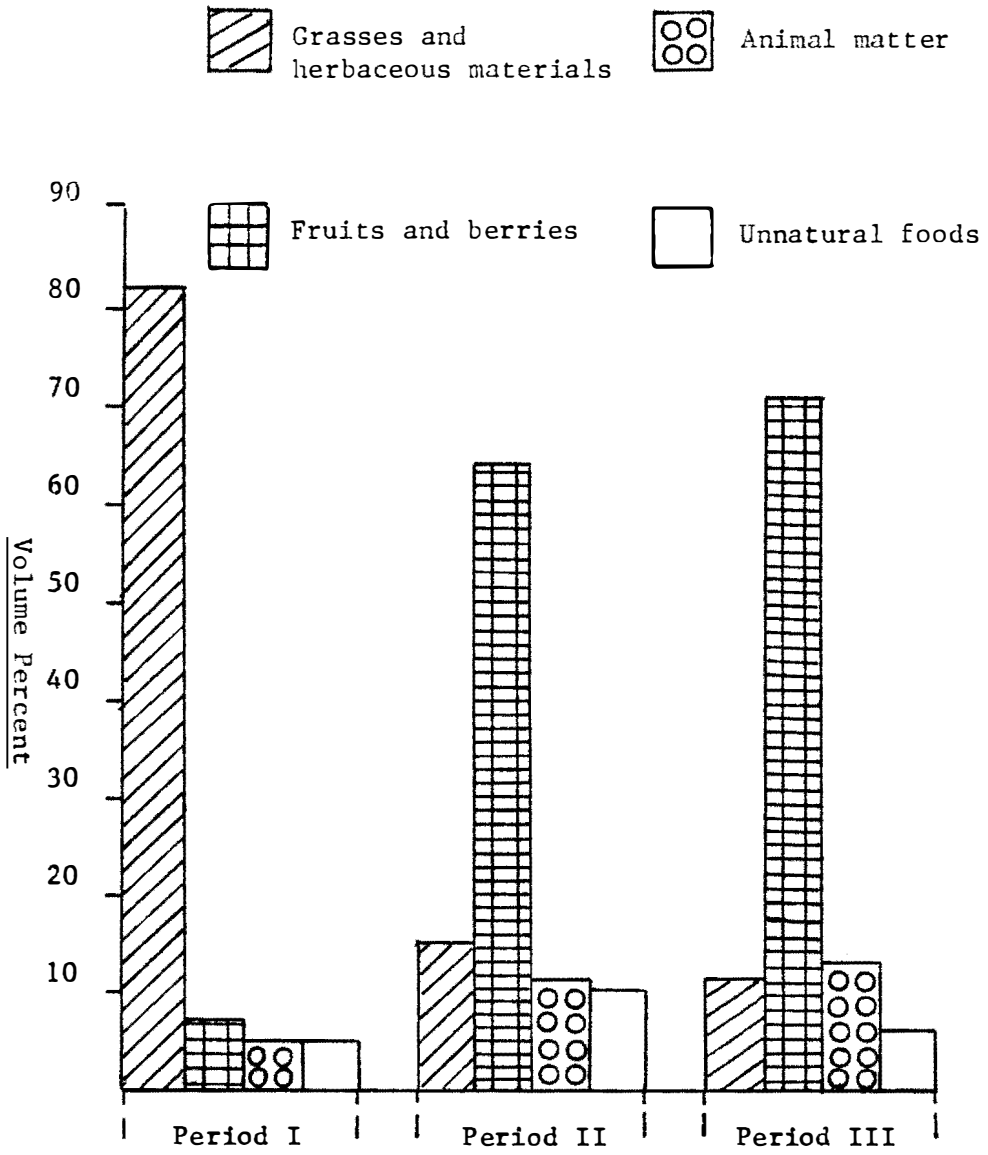


Figure 28. Seasonal food items of backcountry black bears (by volume percent), GSMNP, from Beeman and Pelton (1980). Reprinted with permission of the authors.

Table 28. Comparison of food habits of panhandlers and backcountry bears, based on increasing (+) or decreasing (-) seasonal importance of food categories, GSMNP.

Food Category	Period I to Period II		Period II to Period III	
	Panhandler	Backcountry	Panhandler	Backcountry
Grasses and herbaceous materials	-	-	-	-
Fruits and berries	+	+	+	+
Animal matter	-	+	-	+
Unnatural food	+	+	-	-

Table 29. Comparison of 10 panhandler and 10 backcountry scats, GSMNP, 1978, based on percentage weight loss.

Date Collected	Wet Weight (g)	First Dry Weight (g)	Second Dry Weight (g)	Percent Loss
		Panhandler Scats		
6 July 1978	322.0	105.0	90.8	13.5
13 July 1978	95.3	45.3	29.4	35.1
18 July 1978	225.4	75.6	62.2	17.7
24 July 1978	357.5	112.1	88.7	20.9
26 July 1978	240.5	75.0	57.7	23.1
28 July 1978	262.5	81.4	75.2	7.6
31 July 1978	151.8	56.8	45.6	19.7
2 August 1978	322.2	131.8	116.4	11.7
3 August 1978	153.5	58.2	44.6	23.4
15 August 1978	265.1	71.8	20.1	72.0
		Backcountry Scats		
26 July 1978	66.3	22.3	18.1	18.8
27 July 1978	101.7	33.3	27.6	17.1
28 July 1978	134.7	57.0	21.3	62.6
31 July 1978	224.3	65.4	41.2	37.0
12 August 1978	93.7	25.2	18.2	27.8
12 August 1978	123.4	37.0	16.6	55.1
17 August 1978	107.5	21.7	13.4	38.2
20 August 1978	380.0	110.5	86.9	21.4
20 August 1978	274.5	81.2	70.9	12.7
25 August 1978	83.9	28.8	16.8	41.7

However, nine of the frontcountry scats analyzed were composed of essentially all squawroot. The one having evidence of unnatural food showed the highest weight loss of any of the scats sampled (72%).

Discussion

The normal diet of black bears is high in sugars and carbohydrates. It consists primarily of vegetation (fruits, berries, nuts, and herbaceous materials) with animal matter comprising only a small percentage of their total intake (Beeman 1971, Eagle 1979). They do, in fact, have a protein-deficient diet, most of it being supplied by colonial insects (Bacon 1973, Beeman and Pelton 1980, Jonkel 1967). Bacon (1973) found that captive black bears given a choice of food items exhibited a measurable preference for those rich in proteins and carbohydrates. A preference for high-carbohydrate foods is unusual among carnivores. However, even the more strictly carnivorous felids can become quite omnivorous if introduced to such foods when young (Ewer 1968:29). With their relatively unspecialized guts, black bears seem to prefer foods which are easily digested and high in energy and nutrients (Herrero 1978). The low level of protein consumption seems to be an artifact of food availability and the lack of predatory behavior in the species.

There were many problems inherent in these attempts to determine the degree of dependence upon unnatural foods for panhandling bears. Foremost was the lack of identifiable remains. Bacon and Burghardt (1976b) reported that bears are very clean and delicate eaters who ingest very little debris. Whereas the normal diet left much residue (seeds, undigested herbaceous materials, and portions of insects),

this was not the case with most of the highly processed foods obtained from panhandling. The only direct evidence of most unnatural foods was their packaging, which was a poor indicator of the amount of such foods consumed. Bears begging along roadsides were usually given snack foods without any wrapping. Even on occasions when panhandlers were offered individually wrapped candies, they frequently used their mouth and forepaws to meticulously unwrap them before ingesting the food. For bears rummaging through garbage in picnic areas or campgrounds where visitors were more likely to dispose of leftover food in bags or foil wrapping, these indicators might provide a closer approximation of the amount of feeding on such items if not of the quantities consumed.

Barnes and Bray (1967) reported that for panhandlers in Yellowstone National Park, 44.4% of the scats examined contained greater than 50% garbage, with the number increasing from June through August and decreasing thereafter. However, their methods of analysis were unclear, and they did not specify what they identified as garbage.

In an attempt to combat the problem of identifying unnatural food, the weight loss comparison was made between frontcountry and backcountry scats (Table 29). Yet the results here were inconclusive. While it was thought that the semiliquid portions of the scats which were washed through the sieves would be greater for panhandlers, this was not so. Panhandling bears were observed eating great quantities of unnatural foods; however, the techniques available for analysis of this portion of their diet were insufficient. Snack foods were composed primarily of sugars and carbohydrates which were readily

digestible and easily absorbed by the intestines (Mealey 1975), leaving no evidence of their ingestion.

However, the results from Analysis I, which focused on determining the relative importance of different food categories, were more conclusive. The natural diet of panhandling bears in GSMNP was very similar to that reported for backcountry animals (Beeman and Pelton 1980) (Table 28). Grasses and herbaceous materials accounted for a high percentage of the diet in spring and early summer, showing a gradual decrease in importance in late summer and early fall. Conversely, fruits and berries exhibited an increase as the season progressed. Animal matter, while comprising nearly the same overall percent volume for frontcountry (10%) and backcountry (11%) scats, increased in importance for backcountry bears in the fall and decreased for panhandlers then. However, these changes were slight. Evidence of unnatural food appeared in 37% of the panhandler scats in this study compared to only 7% for Beeman and Pelton (1980). Panhandler scats were essentially indistinguishable from backcountry scats except for the presence of unnatural food.

Since frontcountry bears consumed the same natural foods as did backcountry bears, the foods obtained by panhandling appeared to be purely supplemental. Ewer (1968:29) stated that most mammals can learn to accept foods not normally encountered in natural conditions. These bears were not altering their normal food habits per se, merely exploiting a new food resource; they were not dependent upon panhandling for their survival.

CHAPTER XII

WEIGHT COMPARISONS

Since panhandling bears were merely supplementing their normal diets with unnatural foods, a comparison of weights by sex and age class was made between panhandling and backcountry bears captured from 1969 through 1978. These figures were obtained from both NPS records and wildlife research files at the University of Tennessee, Knoxville.

Previous studies (Burghardt and Burghardt 1972, Pruitt 1974, Rogers 1977) have reported more rapid development in black bears fed nutritionally rich diets. The objective was to determine if the addition of unnatural foods to their diets resulted in more rapid weight gain by panhandlers.

Analysis

Certain criteria were established for inclusion of these data:

1) animals whose weight or age was estimated were deleted (only those who were actually weighed and whose ages were determined by the cementum annuli technique were included);

2) individuals captured more than once during a season were included in the data only one time, with the weight at first capture being utilized;

3) bears were divided into one-year age classes (i.e., 0.5, 1.5, 2.5, etc.) and only those age classes for which both panhandling and backcountry bears were captured were used in calculations.

Results

Weights of 266 bears were included in the computations. Of these 204 were backcountry animals (65 females, 139 males) and 62 were panhandlers (17 females, 45 males). For males all age classes from 0.5 to 10.5 were represented; for females the age classes used were 0.5, 2.5, 3.5, 5.5, 6.5, 7.5, and 8.5. No females meeting the criteria delineated above were found for the 1.5 and 4.5 age classes of panhandling bears.

Panhandlers of both sexes weighed significantly more than backcountry animals (females--$t=3.20$, $df=6$, $p<0.02$; males--$t=3.54$, $df=10$, $p<0.01$). In only 1 of the 18 categories was the mean weight for backcountry animals higher--males of 0.5 years (12.7 kg versus 10.4 kg).

Discussion

Within genetic limitations, the body weights attained by bears are reflective of the productivity of their environment (Herrero 1978). The greater weight of panhandling bears when compared with their backcountry counterparts suggests that their diet is of higher quality and that unnatural foods are only supplemental to their normal dietary regime. The results are consistent with Rogers' (1977) statement that captive black bears receiving nutritionally rich diets develop more rapidly, weigh more, and reach sexual maturity earlier. Burghardt and Burghardt (1972) also reported rapid weight gain by two female cubs reared in their home and fed a variety of human and pet foods. After these bears were moved to

a semi-naturalistic enclosure, they continued to show steady weight gain, reaching about 90 kg by 22 months of age (Pruitt 1974). The additional sugars and carbohydrates in the diet of panhandlers are readily converted to body fat. Furthermore, many of the prepared foods today are vitamin-enriched. Although their nutritional requirements have not been completely documented, it seems a safe assumption that bears consuming these foods would benefit from the additives. Psychological studies have shown that deficiencies of certain nutrients result in compensatory changes in diet. Animals tend to select from available foods those which meet their nutritional needs (Cofer and Appley 1967:230-236, Young 1949:101-104). Such findings have particular relevance for panhandling. Some black bears, with their protein-deficient diet and preference for such foods, have found another source. Fried chicken, hamburgers, hot dogs, and sandwich meats--picnic staples for park visitors--have provided a substantial increase in protein for panhandling bears.

From an ecological and behavioral viewpoint, panhandling bears are exploiting a new food resource. From a physiological perspective they are enhancing their overall condition by increasing their intake of sugars and carbohydrates, obtaining vitamins from enriched foods, and adding more protein to a diet in which it is generally deficient. Teleological motives should not necessarily be implied; such actions can result from learned behavior and biological drives. From an evolutionary standpoint, panhandling bears have an advantage. Some females in this study experienced estrus and mated at 2.5 years of age, and litters of 3 to 4 cubs were not uncommon. Their reproductive

advantage is, however, accompanied by greater risks from poaching and death from automobiles.

CHAPTER XIII

ACTIVITY PATTERNS

Data for activity patterns of panhandling bears were compiled from observations by NPS personnel and researchers. These represented times when bears were sighted along roadsides, in picnic areas, or in campgrounds; they should not be interpreted in the more traditional sense as being the only times bears were active. Though these bears were occasionally seen resting, foraging for natural foods, or wandering through areas outside their panhandling domains, usually their activities other than panhandling were not known.

Black bears are generally crepuscular animals, with peaks in activity at 0800 and 1800 (Garshelis and Pelton 1980). Comparisons between the activity patterns of panhandling bears and their backcountry counterparts may provide insight into whether interactions with humans have altered the normal behavior patterns of some bears.

Analysis

All observations (sightings by both NPS personnel and researchers as well as recorded panhandling sessions) were divided into two categories: 1) roadside, or 2) campground/picnic area. These were then tabulated on an hourly basis, e.g., 0900-0959, 1000-1059, etc. If the session or sighting spanned two temporal categories, the bear was counted as being active during both.

Results

There were 980 observations of panhandling bears along roadsides during 1977-1978. The distribution remained quite high from 0900 (N=53) to 2000 (N=46) and peaked at 1400 (N=106) (Figure 29). No roadside bear observations were recorded before 0800 or after 2200.

While there were fewer observations in campgrounds and picnic areas (N=115), a definite pattern emerged (Figure 30). There were a few sightings during the day; however, bears frequenting these areas were more likely to do so in the evenings, with the peak of activity being from 2000 to 2059.

Discussion

The activity patterns for panhandlers in the GSMNP closely corresponded to that reported by Barnes and Bray (1967), who stated that peaks of roadside panhandling occurred between 1000-1200 and 1400-1800. They further reported that bears were sighted more often between 2000 and 0400 in campgrounds which had bear-proof containers. Of the campgrounds monitored in this study, three (Cosby, Cades Cove, and Smokemont) were outfitted with bear-proof cans as were both picnic areas. The other campground (Elkmont) had all bear-proof containers by the conclusion of the study in 1978. While bears occasionally entered campgrounds during the daylight hours, such activities were concentrated during the night. The fact that NPS personnel and researchers worked primarily from 0600-2400 introduced a bias into the data. However, on numerous occasions when the research team monitored panhandling sites for 24-hour periods, bears were rarely

Figure 29. Activity patterns of panhandling black bears along roadsides, GSMNP, 1977-1978.

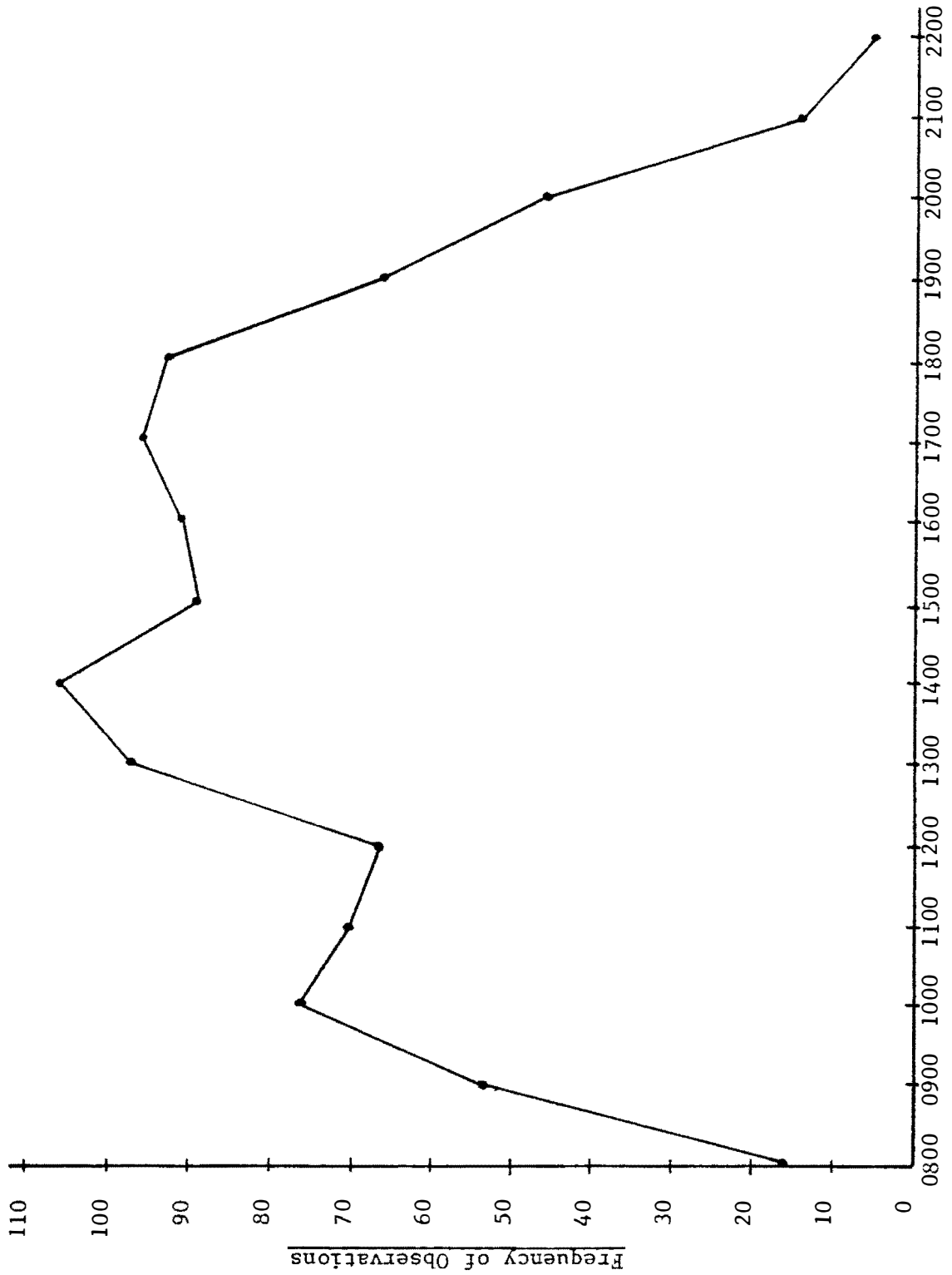

Frequency of Observations
0
10
20
30
40
50
60
70
80
90
100
110
0800
0900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
Time

Figure 29

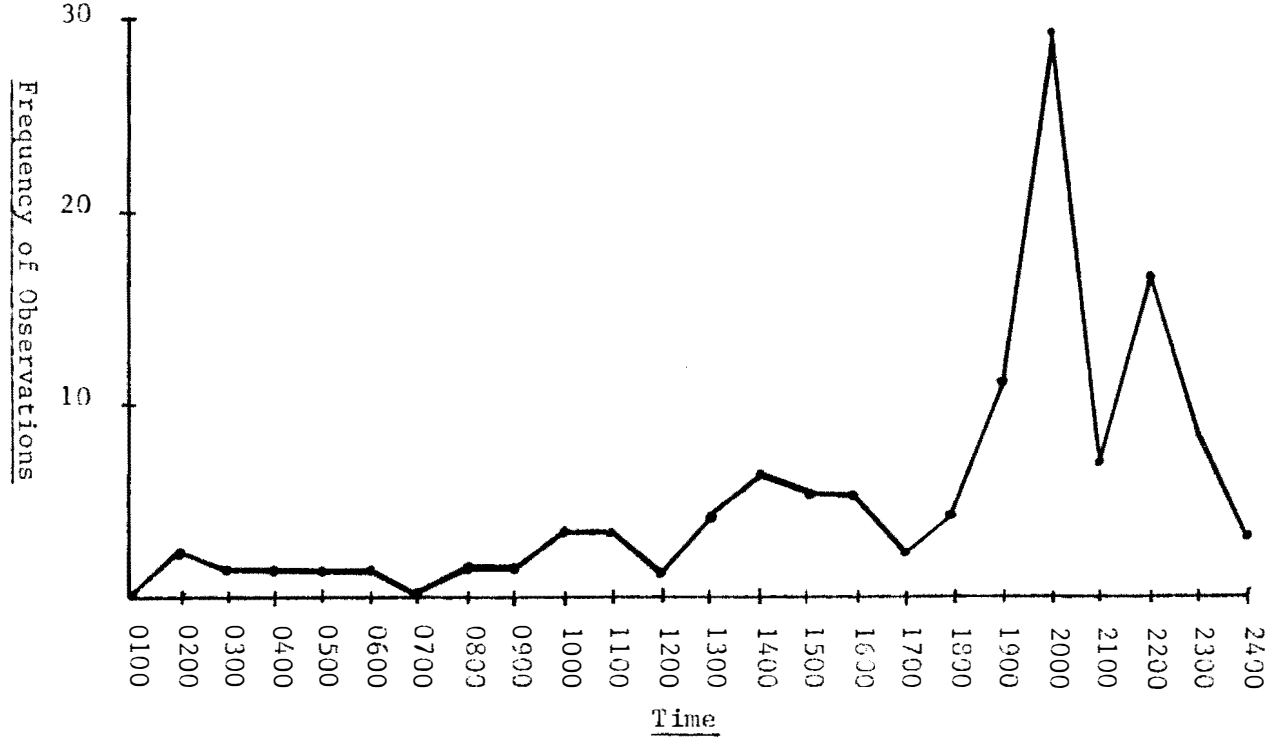


Figure 30. Activity patterns of panhandling black bears in campgrounds and picnic areas, GSMNP, 1977-1978.

observed at hours other than those reported here.

Garshelis and Pelton (1980) reported an essentially crepuscular pattern for the "wild" black bear population in the Smokies, with peaks at 0800 and 1800. However, this pattern was altered by several factors: season, mating activities, the abundance of food, temperature, and precipitation. During the summer when berries were plentiful, bears were more likely to be diurnal; on the other hand, more nocturnal activity was recorded in the fall. This, the authors speculated, could result from extensive foraging in the pre-denning period. These seasonal changes in activity agreed with patterns reported for black bears in other parts of their range (Alt et al. 1976, Amstrup and Beecham 1976, Lindzey and Meslow 1977).

The panhandling activities of roadside bears exhibited a pattern quite different from that of the backcountry animals. Panhandling bears were more active during the daylight hours. Yet, as mentioned earlier, no direct comparison can be made between these data since other activities engaged in by these bears were generally not known. Perhaps panhandlers, too, were foraging for natural foods during the crepuscular time periods.

If food availability altered the activity patterns of backcountry bears, could it not be possible that panhandlers would also change their activities to exploit their new food resource? Bears were more likely to obtain unnatural foods during the day since the number of visitors who travelled the road at that time far exceeded those who did so at night.

Jordan (1972) found that the olfactory, visual, and auditory stimuli produced by actions of people affected the activity levels of captive bears. He classified ursid activities into four levels based on energy expenditure required for their performance. Bears maintained in an environment rich in unusual stimuli (i.e., frequent presence of visitors, construction work, farm animals, and trains) seemed to have habituated to activities outside their enclosure. Similarly, some black bears habituated rapidly to the novel stimuli of panhandling sessions and to interactions with people. The opportunity to exploit a new food resource coupled with the bear's adaptability to human presence was certainly a factor in the alteration of activity patterns of panhandlers.

With some exceptions, bears visiting picnic areas and campgrounds did not engage in begging activities per se but rather raided trash cans, grills, or coolers (Figure 31). They procured food on their own. Those bears which entered campgrounds after darkness fed primarily upon garbage or visitors' food supplies: direct interactions with humans were minimal when compared to roadside bears. This segment of the panhandling population maintained activity patterns more closely aligned with those of backcountry bears.

Roadside bears exhibited a change in their daily activity patterns. While little definitive could be stated about their activities otherwise, the fact that they were panhandling during periods when backcountry bears were usually inactive illustrated a change in behavior. They modified their daily routines in response

Figure 31. Panhandling bear approaching picnic table while visitor takes photograph.

to humans. To ascertain whether there were any detrimental effects resulting from this change was beyond the scope of the present study.

CHAPTER XIV

SUMMARY AND CONCLUSIONS

1. Interactions between black bears and visitors are commonplace in many national parks and create perennial problems of property damage and personal injury. Given the present policies and manpower of the National Park Service and the tremendous influx of people into such areas, it is unlikely that a total separation of the two species can be attained.

2. There existed a preponderance of older females and younger males in the panhandling segment of the population. The sex ratio was nearly equal at 16 males to 14 females (with 3 cubs being of undetermined sex); however, from a total of 20 adults, 14 (70.0%) were females.

3. There were 392 data observations on 33 different bears; 172 (43.9%) involved at least 1 aggressive act. Ten bears, all of whom were infrequent panhandlers, were never observed exhibiting aggressive behavior. Of 624 aggressive acts recorded, 37 involved actual physical contact, and 10 resulted in injuries.

4. Seven categories of aggressive behavior were recorded. Frequency tabulations showed that the blow vocalization and charge were the most likely types to occur.

5. Rarely was an aggressive act directed toward visitors that was not apparently attributable to their inappropriate behavior. Frequency tabulations showed that crowding was the most common precipitator or ursid aggression, accounting for nearly 40% of

all acts. If double factors of which crowding was a component were included, 64% of all aggression could be attributed to visitors approaching too closely. Moreover, certain visitor acts were likely to result in particular ursid responses.

6. Less than 6% of all aggression resulted in physical contact. Three types of aggression (bipedal swat, quadripedal swat, and bite-snap) led to such contact, primarily when humans crowded and/or petted.

7. Group I bears (frequent panhandlers) accounted for 81.4% of all aggression; however, Group II bears (infrequent panhandlers) had higher aggression indices.

8. Multiple regression analyses showed that the model utilizing frequencies of visitor acts as well as setting factors as independent variables increased the level of predictability. Likewise, the level of aggression when used as the dependent variable provided higher predictability than did the mere number of aggressive acts.

9. Examination of panhandling strategies based on setting factors showed that family units were most closely related. There was a tendency for members of the same sex to cluster together, with females being more closely aligned than males.

10. Analysis of field notes showed that feeding was the most likely of all visitor behaviors to occur and that the rate of all human actions appeared to be random. However, bears were more likely to become aggressive the longer the session lasted. After the performance of an aggressive act, there was a subsiding of interactional behaviors for both species.

11. Frame analysis of cine films revealed that although the number of elements in the aggressive repertoire of black bears was not extensive, there was much variability in the behavioral topography of individual acts.

12. Panhandling black bears had a dietary regime of natural foods that was very similar to that of backcountry bears; they appeared to merely be exploiting a new food resource by consuming handouts from visitors.

13. Weight comparisons by sex-age class showed that panhandlers were significantly heavier than their backcountry counterparts.

14. Panhandling bears altered their activity patterns, becoming more diurnal than backcountry bears.

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APPENDICES

APPENDIX A

Figure 32. Panhandling bear observation sheet used for collecting data on setting factors and aggressive acts during sessions.

PANHANDLING BEAR OBSERVATION DATA

Date _____ Location _____

Bear _____ Observation No. _____

Temperature _____ Weather Conditions _____

Time Appeared _____ Time Left _____ Duration _____

FVS _____ Latency _____ Maximum Distance from Cover _____

Retreat: Motorcycle _____ Harassment _____
NPS Personnel/Vehicle _____ NAR _____
Other _____

AGGRESSIVE ACTIONS

				Precipitating Factors								
Time	Type	Contact	Latency	TF	HF	CF	H	PT	PH	PF	PN	OTHER

Comments _____

_____

_____

Figure 32

Figure 33. Visitor information sheet used for collecting data on numbers of visitors present and numbers of feeding incidents during sessions.

VISITOR INFORMATION

No. People Feeding _____

Observation No.	# People	Time	Comments

Figure 33

BEAR OBSERVATION DATA
GSMNP

Date_____ Time_____ Sighted By_____

Where sighted: Picnic Area ___ Size of Bear Cub _____
Campground ____ Medium _____
Roadside ____ Large _____

Exact Location_____

Other Comments_____

_____

Return to: Mike Myers
Park Headquarters

Figure 34. Observation card distributed to NPS personnel for recording sightings of panhandling bears.

Table 30. Symbols used for taking continuous field notes of panhandling sessions, GSMNP, 1977.

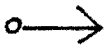
Symbol	Interpretation
	Ambulation
	Movement toward an apparent goal
	Random movement
	Running
	Pacing
rtrv	Retreat, visible
rtrnv	Retreat, not visible
ap	Appear
	Ascend
	Descend
	Body Postures
	Standing quadripedally
	Standing bipedally
	Sitting up
	Lying with stomach on ground
rest	Resting in tree
	Orientation toward a specific object
	Feeding Activities
	Begging posture
tf	Toss feeding
hf	Handfeeding
cf	Cessation of feeding

Table 30 (continued)

Symbol	Interpretation
lf	Leading toward visitors with food
e	Eating
fg	Foraging on natural food
dk	Drinking
	Other Visitor Actions
ph	Photographing
pf	Photographing with flash
pn	Photograph kneeling
pt	Petting or attempting to pet
h	Harassment
avl	All visitors leave
n	High noise level
	Vocalizations
grt	Grunt
jp	Jaw popping
cc	Cub crying
	Aggressive Acts
(1)	Low moan vocalization
(2)	Blow vocalization
(3)	Bipedal swat
(4)	Charge
(5)	Quadripedal swat

Table 30 (continued)

Symbol	Interpretation
(6)	Bite-snap
(7)	Running toward crowd
	Miscellaneous
∧	Sniffing
scr	Grooming or scratching
∪	Yawning
moc	Mouth-open-close
te	Tongue extension
t	Tree
w	Wall

APPENDIX B

Table 31. Sex-age distribution of black bears panhandling together (non-family groups), GSMNP, 1977-1978.

Sex-Age Class	Number of Sessions
Two Bears Present	
2 adult females	14[a]
2 adult males	2
1 adult female, 1 adult male	6
2 subadult males	4
1 adult male, 1 subadult male	3
1 adult female, 1 subadult male	2
Three Bears Present	
2 adult females, 1 adult male	1
2 adult males, 1 adult female	1
2 adult males, 1 subadult male	2
1 adult female, 1 adult male, 1 subadult male	1
Total sessions	36

[a]The cub of one of these females was present during 4 of the 14 sessions.

Table 32. Correlation matrix of variables in field note analysis of panhandling sessions, GSMNP, 1977.[a]

	DUR	LA	NOAA	TVA	TF	HF	PH	PN	PT	H	N
DUR	1.00	0.43[b]	0.44[b]	0.52[b]	0.56[b]	0.19	0.19	0.06	0.22[b]	0.39[b]	0.13
LA		1.00	0.90[b]	0.46[b]	0.32[b]	0.49[b]	0.16	0.53[b]	0.27[b]	0.17	-0.05
NOAA			1.00	0.35[b]	0.22[b]	0.40[b]	0.11	0.41[b]	0.18	0.16	-0.05
TVA				1.00	0.61[b]	0.38[b]	0.40[b]	0.35[b]	0.37[b]	0.65[b]	0.23[b]
TF					1.00	0.39[b]	0.25[b]	0.21[b]	0.49[b]	0.61[b]	0.26[b]
HF						1.00	0.00	0.34[b]	0.26[b]	0.16	0.07
PH							1.00	0.33[b]	0.06	0.13	-0.01
PN								1.00	0.22[b]	0.09	-0.01
PT									1.00	0.35[b]	0.01
H										1.00	0.10
N											1.00

[a]DUR=duration, LA=level of aggression, NOAA=number of aggressive acts, TVA=total visitor acts, TF=toss feeding, HF=handfeeding, PH=photographing, PN=photograph kneeling, PT=petting, H=harassing, N=high noise level.

[b]Significant at P<0.10.

Table 33. Correlation matrix of setting variables of panhandling sessions, GSMNP, 1977-1978.[a]

	SEX	AGE	DATE	TIME	DUR	DIST	TEMP	WEA	NOV	FI	LA
SEX	1.00	-0.69[b]	0.10[b]	0.23[b]	0.02	0.22[b]	0.02	-0.09[b]	0.14[b]	-0.03	0.05
AGE		1.00	0.18[b]	-0.05	0.02	-0.15[b]	-0.01	0.14[b]	-0.06	0.08	0.11[b]
DATE			1.00	0.44[b]	0.11[b]	-0.03	-0.21[b]	0.19[b]	-0.13[b]	0.05	0.00
TIME				1.00	-0.05	0.30[b]	-0.13[b]	0.18[b]	-0.20[b]	-0.11[b]	-0.05
DUR					1.00	0.10[b]	0.03	-0.03	0.14[b]	0.64[b]	0.42[b]
DIST						1.00	-0.04	-0.04	-0.15[b]	-0.02	-0.01
TEMP							1.00	-0.43[b]	0.23[b]	0.10[b]	0.13[b]
WEA								1.00	-0.02	0.00	0.01
NOV									1.00	0.31[b]	0.18[b]
FI										1.00	0.40[b]
LA											1.00

[a] SEX=sex of bear, AGE=age of bear, DUR=duration, DIST=distance from cover, TEMP=temperature, WEA=weather conditions, NOV=number of visitors present, FI=number of feeding incidents, LA=level of aggression.

[b] Significant at P<0.10.

Table 34. Rankings of setting variables and level of predictability for individual bears as indicated by JAN I.

	Setting Variables								
Bear Code Name	Date	Time	Duration	Distance	Temper-ature	Weather	No. of Visitors	Feeding Incidents	R^2
Tippecanoe	6	2	1	5	7	8	4	3	.281
Tyler	2	5	1	4	3	6	7	8	.277
Tahini	2	8	6	3	4	7	1	5	.477
Phoenix	8	4	1	3	2	5	6	7	.693
Sydney	7	4	1	3	2	5	6	8	.857
Adelaide	3	8	1	2	6	5	4	7	.396
Patchouli	5	3	1	4	8	7	2	6	.551
Jeremiah	3	6	4	7	5	2	-	1	.577
Roden	1	2	-	-	4	-	3	5	1.000
Bjorn-Bearg	4	8	1	7	3	6	2	5	.813
Arlo	1	3	2	4	8	5	6	7	1.000
Jane	3	-	1	-	2	-	4	-	1.000
Justin	-	1	4	-	3	-	2	-	1.000
Rousseau	3	2	1	-	4	5	6	-	1.000
Yuri Van Gogh	4	8	1	5	7	6	2	3	.735

Table 35. Frequency tabulations of all behaviors in 10 precedent and 10 subsequent event lags to aggressive acts, based on field notes of panhandling sessions, GSMNP, 1977.

	Precedent Events										Subsequent Events									
Behaviors	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10
Standing	20	11	22	17	20	12	30	16	17	7	33	22	26	17	22	13	23	14	23	19
Random movement	10	11	8	10	12	15	9	16	7	9	21	10	10	13	10	10	10	11	8	9
Sitting	11	6	14	3	8	7	14	4	7	7	4	11	10	6	10	7	9	10	7	3
Lying	4	4	1	5	1	3	–	1	2	2	1	–	1	1	4	2	6	4	5	5
Orienting	12	11	7	12	12	12	7	13	10	9	2	18	11	14	10	13	8	14	8	16
Approaching	4	4	4	6	4	3	3	2	5	10	4	2	3	4	2	6	1	6	–	3
Retreat visible	–	5	–	–	–	2	–	1	1	–	13	2	2	2	2	2	2	2	2	1
Retreat not visible	1	–	1	1	–	–	1	–	–	–	2	2	1	1	2	–	1	–	–	1
Climb up	–	2	–	1	–	1	–	1	–	2	2	–	–	1	–	–	–	–	–	1
Climb down	–	–	2	–	1	–	1	–	–	1	1	1	–	–	–	–	–	–	–	1
Scratching	3	5	4	4	1	7	5	5	6	3	–	2	6	9	4	12	4	7	3	7
Eating	8	9	12	8	11	11	6	7	8	6	–	5	7	7	4	5	9	8	13	8
Sniffing	5	4	4	3	1	2	–	3	1	3	–	2	3	2	2	6	2	3	4	6
Standing bipedally	3	3	2	1	5	4	4	4	2	9	4	3	2	2	1	2	1	1	2	1
Aggressive acts	3	1	1	2	1	1	3	2	4	–	–	3	2	4	1	1	2	1	1	3
Yawning	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Drinking	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Foraging	–	–	–	1	–	–	1	1	–	–	–	1	–	–	1	–	–	–	–	–
Begging posture	–	–	1	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Running	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–
Appear	–	1	–	–	2	–	–	–	1	–	–	1	–	–	1	1	1	–	–	–

Table 35 (continued)

Behaviors	Precedent Events										Subsequent Events									
	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10
Photographing kneeling	–	1	–	2	1	1	1	2	2	6	–	–	1	1	1	1	–	1	1	2
Photographing	–	3	–	–	2	2	1	2	2	8	–	1	–	2	–	1	–	–	4	–
Toss feeding	6	4	4	2	8	2	4	7	2	1	3	2	3	2	8	3	5	3	4	3
Handfeeding	1	4	1	3	1	2	2	1	5	1	1	1	3	1	2	2	4	1	2	–
Crowding	–	1	1	–	–	–	–	1	2	3	–	2	–	1	–	1	–	–	–	–
Harassing	–	1	1	1	–	1	1	2	6	3	1	–	–	1	2	1	2	1	2	–
Petting	–	–	–	–	1	2	–	2	2	3	–	–	–	–	–	–	–	–	–	–
High noise level	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–

Table 36. Total frequencies of all behaviors precedent to and subsequent to aggressive acts, based on field notes of panhandling sessions, GSMNP, 1977.

Behavior	Precedent Events	Subsequent Events	Total
Standing	172	212	384
Random movement	107	112	219
Orienting	105	114	219
Sitting	81	77	158
Eating	86	66	152
Scratching	43	54	97
Approaching	45	31	76
Toss feeding	40	36	76
Sniffing	26	30	76
Standing bipedally	37	19	56
Lying	23	29	52
Retreat visible	9	30	39
Handfeeding	21	17	38
Aggressive acts	16	16	32
Photographing	20	8	28
Harassing	16	10	26
Photograph kneeling	16	8	24
Retreat not visible	4	10	14
Crowding	8	4	12
Climbing up	7	4	11
Petting	10	0	10
Climbing down	5	3	8
Appearing	4	4	8
Foraging	3	2	5
Yawning	3	0	3
Running	3	0	3
Drinking	2	0	2
Begging posture	2	0	2
High noise level	0	1	1
Total	914	897	1811

Table 37. Probabilities of postural positions of head, mouth, and ears at different stages of aggressive acts, based on film analysis of panhandling sessions, GSMNP, 1977-1978.

	Types of Aggressive Acts					
Posture	Charge	Charge-Quadripedal swat	Quadripedal swat	Charge-Bite-snap	Bite-snap	Combined
			Initiation of Approach			
Head						
Lowered	57.9	69.2	100.0	100.0	0.0	65.8
Same plane	31.6	30.8	0.0	0.0	100.0	28.9
Raised	10.5	0.0	0.0	0.0	0.0	5.3
Ears						
Lateral	26.3	15.4	0.0	50.0	100.0	23.7
Frontal	10.5	15.4	33.3	0.0	0.0	13.1
Flattened	63.2	69.2	66.7	50.0	0.0	63.2
Mouth						
Open	17.6	36.4	0.0	0.0	0.0	21.2
Closed	82.4	63.6	100.0	100.0	100.0	78.8
			Resumption of Stationarity			
Head						
Lowered	28.6	33.3	0.0	0.0	0.0	25.0
Same plane	35.7	50.0	100.0	100.0	100.0	50.0
Raised	35.7	16.7	0.0	0.0	0.0	25.0

Table 37 (continued)

Posture	Types of Aggressive Acts: Charge	Charge-Quadripedal swat	Quadripedal swat	Charge-Bite-snap	Bite-snap	Combined
Ears						
Lateral	57.1	33.3	100.0	100.0	100.0	58.3
Frontal	0.0	0.0	0.0	0.0	0.0	0.0
Flattened	42.9	66.7	0.0	0.0	0.0	41.7
Mouth						
Open	33.3	0.0	0.0	100.0	0.0	23.8
Closed	66.7	100.0	100.0	0.0	100.0	76.2
During Aggressive Act Proper						
Head						
Lowered	N/A	61.5	50.0	50.0	33.3	54.2
Same plane		38.5	33.3	0.0	0.0	29.2
Raised		0.0	16.7	50.0	66.7	16.7
Ears						
Lateral		7.7	16.7	0.0	0.0	8.3
Frontal		0.0	0.0	0.0	0.0	0.0
Flattened		92.3	83.3	100.0	100.0	91.7

Table 37 (continued)

Posture	Types of Aggressive Acts: Charge	Charge-Quadripedal swat	Quadripedal swat	Charge-Bite-snap	Bite-snap	Combined
Mouth						
Open		27.3	0.0	100.0	100.0	40.0
Closed		73.7	100.0	0.0	0.0	60.0
Initiation of Retreat						
Head						
Lowered	0.0	20.0	40.0	50.0	0.0	21.7
Same plane	80.0	40.0	40.0	0.0	0.0	43.5
Raised	20.0	40.0	20.0	50.0	100.0	34.8
Ears						
Lateral	80.0	20.0	40.0	0.0	0.0	34.8
Frontal	0.0	0.0	40.0	0.0	0.0	8.7
Flattened	20.0	80.0	20.0	100.0	100.0	56.5
Mouth						
Open	40.0	33.3	0.0	100.0	100.0	40.0
Closed	60.0	66.7	100.0	0.0	0.0	60.0

VITA

Jane Tate was born 2 May 1947 in South Pittsburg, Tennessee. She attended elementary school there and graduated as valedictorian from South Pittsburg High School in June, 1965. She entered The University of Thnnessee, Knoxville, in the fall of 1965 and graduated summa cum laude in June, 1969, with a major in Psychology.

After travelling extensively throughout the United States and working as a writer/account executive in advertising, Ms. Tate was accepted to the Graduate Program in Ecology at The University of Tennessee, Knoxville. She began working toward a Master of Science degree in September, 1976: her status was subsequently changed to a doctoral program. Ms. Tate received a Doctor of Philosophy degree in Ecology in June, 1983.