PANEL 4: BEAR BEHAVIOR

Notes on the Behavioral Development of Two Female Black Bear Cubs: The First Eight Months

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INTRODUCTION

To understand the behavior of the black bear (*Ursus americanus*), field studies are naturally of primary importance. While substantial beginnings (e.g., Herrero, in press; Jonkel 1967) have been made, much of this information has been gathered coincidentally in projects dealing with more general ecological questions, such as numbers, movements, growth, age distribution and reproduction. This is especially true of our knowledge about cub behavior. There are good reasons for this: the size and potential danger of the mother hinders close proximity in observational and tracking studies, and the often rugged forested habitat makes observation from a more practical distance impossible.

Ethologists have been most distressed by the erroneous assumptions and conclusions concerning animal behavior put forth by those who have never seen or considered the animal's behavior outside of highly artificial and restrictive environments. In captivity, however, detailed observations on behavioral development can be made along with experiments impossible in the field, especially with a large and potentially dangerous species. One must, of course, always be aware of the possibility that captive conditions have produced abnormal behavior. However, even the abnormal behavioral aspects of an animal raised under deprived conditions can illuminate our knowledge about how the behaviors seen only in their highly adaptive settings in the natural environment function.

Our subjects, through tragedy, became dependent upon us suddenly, and the luxury of expertise had to be set aside for Ursine reasons.

There have been many studies on the comparative development of a variety of vertebrate species including mammals ranging from mice to primates. However, those studies most relevant in the present context have been performed with other members of the Carnivora, especially canids which belong to the same super family as the bear and about which a large body of knowledge is being accumulated (e.g., Kleiman 1967; Rabb, Woolpy, & Ginsburg 1967). Comparative work of a developmental nature on canids has been performed most systematically by Fox (1969, 1970).

Bears, because of their evolutionary position in the carnivore scene, merit the same type of treatment that has proved most valuable with other carnivores. Three unique aspects of bears add to the importance of such endeavors. (1) The bipedal habit which, aside from its behavioral interest, seems to be behind much of the anthropomorphic adoration, respect, and fear of bears by many cultures. (2) The bear's unique carnivore brain has unusual features which are remarkably similar to the primate brain (Papez 1929). These include the ursine lozenge, the slyvian fissure, and structures which in gross appearance resemble

the primate temporal lobe which is involved in complex sequences of behavior and memory. (3) Most bear species are the highest ranking members of the species community in areas where they are found. Their omnivorous and non-specialized feeding habits, along with size and strength creates direct competition with man, although bears have given way to humans in most parts of the world. Since man is also the highest ranking species in his environment and capable with his technology of destroying if not ruling all ecosystems on earth, insight into bear behavior may untimately shed some light on our own.

Black bears are often successfully raised in captivity (e.g. Crandall 1964). Unfortunately, only scattered information has reached the literature about the behavioral development of black bear cubs (Herrero 1970; Leslie 1971). An ethological study dealing with behavioral development by Leyhausen (1948) was based on observations of one black bear cub (Nelly) for a period of about ten months (about the fifth through fourteenth) and was performed under rather limited circumstances regarding equipment and facilities. Krott (1961, 1963) performed field observations on wild brown bears (*Ursus arctos*) in Europe and developmental observations on cubs. Kuckuk (1936) also observed brown bear cubs. While this work is most valuable, much remains unknown. Detailed comparisons with the literature will appear in forthcoming papers.

Two cubs, approximately one kilo each, weak and near death were found abandoned by their injured, probably killed, sow on April 18, 1970, in the Great Smoky Mountains National Park (GSMNP). They inflicted painful bites on the ranger's hand as he picked them up. Although the exact date of birth was unknown, we assume that it occurred at the beginning of February, leading to the conclusion that the cubs were two and one-half months old when they were found. The cubs were reared by Jack Collier in his cabin until May 1, when they came into our possession. During the interval, a large wooden variant of a covered playpen was constructed so that the larger, and by now healthy and active, bears would have better accomodations when they were not running free in our house or in the back yard. The bears remained in our house until June 18 at which time they were moved to a large converted shop in the Tremont Environmental Center, which is operated by Maryville College in the GSMNP. They remained here until the large 60 × 60 foot (18.3 × 18.3 meter) enclosure that was being built in a wooded area of the Park was completed in July.

Our aim was to familiarize ourselves with bear cubs and problems in their maintenance and rearing, while working out a rough classification and ontogenetic description of behaviors. The main method used was observation, mainly participant observation since unobtrusive observation was impossible. Only now, with construction of the enclosure and observation tower can we begin to approach relatively candid observation. Most of the observations were written; however, many 35 mm slides in addition to 8 mm and 16 mm movies were made, and vocalizations were recorded on tape. Only selected aspects of some behavior can be discussed here.

FEEDING AND DRINKING

From April 18-20 the cubs were fed whole warm cows' milk and honey every two hours. By the 20th they were fed only every four hours. This was reduced to four or five times daily on April 25 and to three or four feedings by May 10. Honey was eliminated shortly after we began taking care of the bears, but vitamin drops (0.6 cc Poly-Vi-Sol) were added to the milk once daily.

The sucking behavior of the bears would appear to be typical for a mammal. While holding the bottle, they would stretch out their claws and knead as if to facilitate the flow from their 'mother's' breasts. Often their eyes were closed and utter contentment would be the usual state. When the milk ran out, their noise level rapidly increased and changed to growls as they attacked each other. This was noticed the last week in April and was the first agonistic behavior seen between the cubs. It became noticable that Kate often did not suck the nipple normally when compared to Kit. Kate would turn her head to the side and chew the nipple with her molars. This hastened the milk flow, and she was frequently finished well ahead of Kit.

By the end of April both bears were receiving solid food, such as canned chopped-up peaches, applesauce, and strained fruit baby foods. Such items were lapped up with the tongue almost as a cat laps milk. By May 9 the bears were eating 'chewy' items, such as pieces of apple, leaves and grass brought in from the outside, and a Chop-Chop dog toy made of beef hide. They would use their claws to hold the item down, to turn it over, and to pick it up. This was only one of the many examples of precise manipulation that we were to see. At this time they would sometimes refuse milk in favor of fruit baby food. Raw meat was not eaten or even nibbled although they did begin eating vegetable and meat-flavored strained baby foods.

Beginning the first week in May, after drinking only a small amount of milk, Kate and/or Kit would often prefer to suck another object, such as an arm, a finger, etc. Even in April Kate often sucked Kit's ear until it was extremely soggy. Such behaviors were usually accompanied by the pulsating sound made when sucking milk. Perhaps the nipples were too free flowing. There is evidence that puppies have a certain 'need' to suck (Beach & Jaynes 1954). If they satisfy their hunger with minimal sucking from bottles with large holes in the nipples, the sucking behavior is directed to other objects. Consequently, we thought that if the nipples were made less free flowing and more sucking effort had to be expended, perhaps the sucking of 'inappropriate' objects would cease. Using smaller openings did appear to enhance their 'pleasure' at first, but then the bears could not get the milk fast enough, and this resulted in some frustration-induced aggression towards us and their sibling. Although both would suck on the human arm (Fig. 1), Kate would rather suck on Kit's ear. This usually took place when they were in the pen or when we were in the room but not paying particular attention to them. Although boredom or frustration might be involved in this behavior, its development as soon as the cubs recovered their health in April would seem to argue against this as the sole explanation. Kate could not be dissuaded from engaging in such activity. Slapping her snout repeatedly only caused her to back off for a few minutes and sneak back after a short interval. Repeatedly punishing her in this way would lead to her beginning to 'cry,' a response given by lowering the lips of the lower jaw accompanied by a low simpering. But no lasting result was accomplished. After moving the cubs out to the Park, the behavior continued (Fig. 2), and Ellis Bacon repeatedly attempted to eliminate the ear sucking by coating Kit's ear with distasteful substances. Unfortunately, Quinine, Vaseline, tabasco sauce, vinegar and salt, among others, did not succeed. Bear feces was more effective, but it was rather distasteful for Kit to have on her ear—not to mention for the person who had to apply it. Kit's right ear was, however, becoming more and more dilapidated. The fur was disappearing from the ear, and it was always wet and moist. In order to easily identify the cubs on still and movie films, a blue tag was placed on the favored sucking ear, but Kate soon grew adept at sucking around the tag. The sound of sucking whether taped or live often was the stimulus for this behavior. The sound of Kit sucking on the arm or leg of a person

Fig. 1 The two cubs sucking on the human arm (May).

Fig. 2 Kate sucking Kit's ear, although no longer being fed with a bottle (September).

would bring Kate over, and she would immediately engage in sucking on Kit's ear. Attempts to dissuade Kate by cuffing her snout or merely blocking access to Kit's ear led to clear examples of redirected aggression against Kit. Preventing Kit from engaging in sucking behavior with humans proved to be the most effective control of this behavior after the cubs were weaned.

On May 11 an intriguing and disconcerting behavior, which was also noted by Leyhausen (1948), began which involved the bears turning over their food dish with the paws and then lapping up the contents. They often pawed out the solid items first, but the presence of a liquid did seem to stimulate the turning response. The messes caused led us to purchase a weighted 'spill-proof' dog food container. The behavior, nonetheless, continued throughout the summer. We noted that it was very similar topographically to the way they turned over stones and pieces of wood when outside in the yard, leading to the hypothesis that it is a fixed action pattern associated with food finding.

Milk continued to be highly favored, although by the end of May the two began chewing frankfurters and Milk Bones, which certainly are neither fruity nor sweet, indicating further changes in food preferences were occurring. Their response to canned dog food was variable. Following Leyhausen, we began in early June to prepare an oatmeal mixture laced with honey, milk and the syrup from canned fruit. This proved to be a very useful way of giving the bears bulk and also of weaning them from milk. In fact, less than a week later the bears were down to only two bottle feedings a day. The total daily amount of milk drunk by each bear averaged over 4-day blocks (to reduce some of the variability) is shown in Table 1 for May 2 to June 18. While the total amount ingested decreased from a peak during the first week of June, Kit's decline was the more regular. Kate drank more milk than Kit on 30 of these 48 days, while

TABLE 1. MEAN DAILY AMOUNT OF MILK TAKEN BY EACH CUB IN FOUR-DAY BLOCKS (LITERS)

Date	Kate	Kit
May 2—5	0.52	0.46
May 6—9	0.97	0.83
May 10—13	1.01	1.16
May 14—17	1.21	1.07
May 18—21	1.20	0.92
May 22—25	1.26	1.50
May 26—29	1.38	1.29
May 30— June 2	1.28	1.26
June 3—6	1.65	1.53
June 7—10	1.26	1.48
June 11—14	1.19	1.09
June 15—18	1.39	1.02

Kit drank more on only 15. In June they began eating more fresh vegetables and fruit. Fresh berries were greatly relished. When first given blackberries on the vine, they daintly pulled the fruit from the prickly branches, although by now their resistance to aversive, normally painful stimuli had become very apparent.

By July the main diet was dry dog food (bite size, Wayne Feeds, Inc.) amply supplemented with fresh and canned fruit and fresh vegetables, particularly lettuce. At first applesauce had to be mixed with the dry dog food in order to entice them to eat it. Two liters or more of milk per day were drunk from bowls and, although gradually reduced, they did not seem to really miss it. Fresh ground beef was sometimes taken, and they began to enthusiastically chew cooked meat bones as described by Herrero (in press). It was not until their seventh and eighth months that meat and fish were taken in any quantity. Individual differences between the bears in food preferences were often striking but rather transient. The similarities were more important in our estimation.

In Fig. 3 is shown the weights of the two bears over the several months that we had them in captivity. Note that Kate remained heavier throughout. She consumed more and remained dominant in food competition. The large dip in Kit's weight occurred during the days shortly after they were moved to the large maintenance building in the National Park. Kit was always more sensitive to her surroundings, and her temporary period of minimal feeding seems consistent with this personality trait.

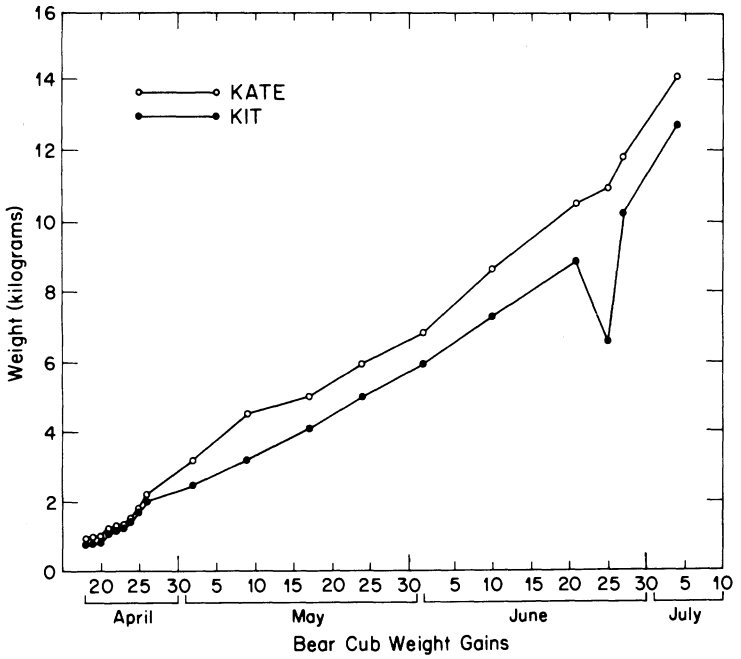

Fig. 3 Weight of the two cubs from April to July. By the end of September they were close to 25 kilograms each.

CLIMBING AND LOCOMOTION

The young cubs took to climbing trees from the end of April. As when on the ground, both bears tended to stay in very close proximity. They often would rest together in the fork of a tree or on the same limb. Kit climbed higher and actually was a little more dexterous in the tree which countered other evidence that Kate was the more inquisitive, the more bold and the more aggressive of the two bears. Bears use two basic means of climbing trees which parallels their terrestial locomotive patterns. One is a hopping behavior which involves the rear legs moving in unison. This is used for rapid movement. The second type involves a more leisurely walk. Both of these behaviors would be used in the trees. Usually when they ran towards trees, they would hop and start up the tree very quickly with this pattern. They then would slow down to the walk. In most cases, they used a reverse walk to descend, always rear end first, from the trees. The bears, even when very young, were agile in trees and were good judges of the strength of the limbs. Rarely were there any mishaps.

Usually the cubs would climb down the tree to us if we called them, gestured, brought out food, or merely disappeared from sight. From May 14 on they asserted more independence, remaining in the trees for hours, even during rain or darkness, despite our coaxing. Nonetheless, almost invariably when they were first taken out of the house, they were reluctant to stay in the yard. They would try to return to the house. After realizing that this was impossible (after bumping against the glass doors), they then would begin to scamper around, to play with objects and each other, and to climb trees.

DEFECATION AND URINATION

On the first day that we had the bears, we noted that Kate defecated within 15 minutes after drinking her ration of milk. A pattern was soon established whereby we would place them in their pen immediately after feeding. Both would defecate and often urinate within 5 to 10 minutes. This controlled almost all defecation in the house, even if the cubs were nor formally housebroken. Urination, on the other hand, was less predictible. Both females 'dribbled' when they urinated, usually down the tuft of fur below the tail. Male bear cubs reportedly squirt.

On May 8 the cubs were out in the yard, and we fed them milk. After finishing, Kate immediately came to the sliding glass door and scratched at it, indicating that she wanted to be let inside. After the door was opened for her, she ran in the house, up the stairs, and into the pen where she proceeded to defecate. Immediately afterwards she exited from the cage. This would indicate that an association with the newspaper covered floor of the pen had been established. About one month later the bears began urinating from the trees. Prior to this time, they had always returned to the ground to urinate.

RESPONSES TO WATER

At first the cubs were hesitant about going into water, particularly when it was descending from a faucet or showerhead. They would slowly explore around it and eventually walk right into the water. This was very apparent when they were placed in the shower room which has a large sunken tub-shower combination. When one of us took a shower with the bears free in the vicinity, they

would immediately show interest, come over to the person, walk down the several steps into the tub, and before long be romping under the water spray.

Groos (1898) reports observations which suggest that either a person or the cubs' natural mother is needed to guide cubs to a new locale, such as a bath. Kate would always venture in before Kit.

After we had the bears several weeks, we placed a plastic wading pool about two meters in diameter in the yard and filled it with about 12 cm of water. They soon discovered it and, without much coaxing, would play and wrestle with each other in the water.

EXPLORATION AND CURIOSITY

From the first day in our possession the bears preferred dark places. This was not just an escape reaction, but a true preference. For instance, they soon learned to open and climb inside the clothes dryer, kitchen cabinets and the clothes hamper. They would play or relax in these situations, which indicates a lack of fear. If frightened, however, they would run and hide in dark places.

Early in May the bears began to 'mouth' objects. By May 14 they were using their paws to drag out objects inaccessible or difficult for the jaws alone to procure. Teething on the wood cage bars and chair arms also began about this time. By May 19 Kit learned to open the sliding glass door leading to the outside if it was left unlocked and there was a small space in the door jam into which she could hook a claw. At about the same time Kate learned to open the cabinet doors in the kitchen by hooking her claws between the doors and the wall. By this time they could climb virtually anywhere in the house they desired. Often they would climb to the top of a chair, which, if it was a wooden straight chair, would begin to topple as their weight caused the center of gravity to shift. They would fall with a crash, give an immediate startled response, and then return for more. Outside they performed similar feats with small trees and shrubs. By June 13 they began carrying off objects like rolls of paper towels, purses, etc., from where they found them to somewhere else, e.g. behind a couch, where they would shred the paper or daintily remove each item from the purse to examine, chew a bit, and play with.

An extension of the upper lip often occurred when exploring strange or novel stimuli, each other, or when a strange sound or other 'distinct' stimulus occurred (Fig. 4). This lip extension was very pronounced when they were small and would often be done at a considerable distance from an object. This behavior may facilitate the detection and/or discrimination of odors. The bears would often approach and sniff and paw humans before proceeding with attempts to play more overtly with them. Strange humans were never really accepted over the few hours the bears were exposed to them. They were inclined to hide if inside the house or climb a tree if outside. Frequently however, they would ignore the stranger almost entirely and play with each other in front of him. Rarely would they play with the stranger or even offer play invitations (next section).

One indication of their response to other species was seen when a neighbor's part collie dog came running over to Lori who proceeded to pet it. Kit descended a tree 100 feet away and came within two feet of Lori and suddenly stopped, reared high upon her hind legs, and made a very monkey-like snuffling sound. After freezing for about 30 seconds, she ran to a tree and quickly climbed it, again making the same sound. This sound was subsequently made

Fig. 4 The upper lip extension, shown by Kit in September. When the cubs were younger, it was even more evident. Note also the straight back ear position, and the light markings on ear and muzzle.

in response to other dogs. The bears generally were frightened by small animals, as Leyhausen (1948) also noted with Nelly.

PLAY BEHAVIOR

Play behavior can be classified into several different kinds: self-play often involving inanimate objects, social play with humans, and social play with each other. Self-play was often associated with the exploration of objects. They would roll around on their backs in and on blankets and comforters, and inspect the contents of purses, paper bags and other containers. Once they were moved into the Park enclosure, a favorite pastime was to lie flat on their backs, stretch out their legs, and pull down branches, twigs, or leaves from low-growing shrubs with their paws and bring these into their mouth (Fig. 5). These they would alternately chew, rub, or even 'tickle' themselves with. Kit played alone much more readily and for longer periods than Kate.

Kate engaged in social play more than Kit did. Kit, however, often gave many play invitations to Kate which Kate would ignore in her endeavors to gain responses from people rather than from her sister. From the beginning we noted that play with each other and with people occurred most frequently shortly after feeding. After a play bout, a rest or sleep period would follow. Most play with each other was of a rough and tumble sort. In play-fighting silence was the rule. No growling or other sounds were heard. This can be contrasted with the 'serious' fighting that would break out over food or when one bear became annoyed. This distinguishing characteristic of true play was

Fig. 5 Resting self-play with branches and leaves (August).

virtually without exception. During the first week in May we noted that the ears were usually in the back position when the bears were inviting play and that they would move forward with the mouth open usually at a rear flank. By the last week of May the bears were noticeably more gentle when playing with us. That is, the teeth very rarely broke through the skin or caused pain. It was as if the bears were learning to distinguish playing with people versus playing with each other. This has been noted with the canids in developmental studies by Fox (1970).

By the end of May, bipedal wrestling and swatting out at each other with the front paws was occurring. This contrasts with Leyhausen who states this first happened at six and a half months. However, Leyhausen did note that this was later than had been recorded in other species of bears. On the basis of our observations, it would seem that the black bear engages in stand-up play closer to four months of age.

Rolling on the back seemed to signify submission in the cubs' play in a manner quite similar to puppies and other canids (Fox 1970). What we term the 'play invitation' seems derived from this response. A cub would come running toward her sister or to one of us and flip over onto her back in what is best described as an off-balance, head-first somersault (Fig. 6). If this did not elicit the desired response and the human or cub stayed near, the next stage was to sink her jaws into the foot or leg (if human) or the thigh or side (if bear).

Also involved in play behavior, particularly when it concerned people, were certain elements of threat towards the interloper. One bear (usually Kate) would freeze with her mouth open and ears back in a posture that inhibited further approach and appears very similar to the 'jaw-gape' described by Fox for canids. This became more common and fleeting as the bears aged. It eventually extended to a 'jealous' attitude by Kate, who would drive Kit away whenever the latter was receiving human attention.

Fig. 6 Play invitation by Kate (September).

COMMUNICATION

Unlike canids, bears do not possess a tail which can signify various meanings. Neither are black bears' faces very brightly marked. The main methods bears have of communicating are through sound, ear position, jaw position, body posture, and perhaps odors. Vocalizations cannot be adequately covered here and so will not be discussed. All these communication signals are presently under quantitative study, and only some will be touched on here.

Ear position seemed to be quite important; we can state roughly that four ear positions occur. The ears can be straight up, a normal alert posture; they can be moved forward with the opening rotated forward; moved straight back, as in the jaw-gape; or they can be moved up and out almost perpendicular to the side of the head. Both ears are almost always in the same position simultaneously. That these ear positions are important for communication is indicated by two morphological facts: (1) black bear ears are larger in proportion to face than those of most other bears including the polar, brown and grizzly; in cubs this is even more pronounced; (2) the ears themselves have a distinctive marking, at least in black bears of the Smoky Mountains which, unlike some variants, are in most respects almost jet black; however, there is some light-colored fur around the snout, above the eyes and, when our bears were young, inside and on the back of the ears. During June and July the interior of the ears was an almost luminous rusty even orange color. By fall, however, these markings had faded out although they were still evident. Perhaps these ear and face markings have a communication function during the summer of the first year when the bears are more playful and interact more extensively with each other than at any other time in their lives. The muzzle markings and the white spots above the eyes got progressively more distinctive as the bears got older (Fig. 7). Often the 'whites' of the eyes flashed during social interaction, and this too might be a social signal.

A highly developed greeting ceremony was not noted. However, if the two bears were separated for even a short time, they would run towards each other and very briefly and gently interlock jaws or pass their snouts close to each other, wrinkling them in their sibling's direction. Sometimes a play fight or a chasing bout would follow this brief greeting. Since the cubs were prevented from close contact with the human face, the greeting could not be detected in its 'normal' manifestation to humans. However, the attempts of the bears to nibble briefly on exposed parts of humans (hands or ankles) after approaching them would seem to be the greeting. Tentative or 'teasing' play with humans or each other was often marked by an ambivalent threat expression (Fig. 7).

Fig. 7 Kit in 'ambivalent threat' attitude towards a human (September). Note lower jaw, ear position and muzzle and eye markings.

Although the response to exposed human skin was usually a sucking (by Kit) or nibbling-chewing (by Kate), licking did occur at times. Usually it occurred when the hands obviously smelled or tasted of food. However, in September when the bears came down temporarily with some unknown illness which obviously discomforted them, they became remarkably more gentle and, in fact, would often explore and lick the human face with no attempts whatever to nibble, suck or bite (Fig. 4).

ADDITIONAL MAINTENANCE BEHAVIORS

The bears engaged in a variety of postures. They would frequently lie on their backs or sides. During the summer months when the temperature was around 80 degrees, they would respirate at 130-140 times a minute while resting in this fashion. Sitting was also common especially when eating or manipulating a novel object. While sleeping they often might lay on their backs. Scratching

behavior, usually the rear foot to the ear or side, was performed infrequently. Licking of the paws occurred from May on, but otherwise little grooming was noted. Only one observation of mutual grooming has been made up to the present time.

CONCLUDING COMMENTS

In this paper we have briefly given an interim report of some of our experiences and findings on two black bear cubs. Space precluded a more thorough presentation or discussion. Certainly, young bears, at least, have a wider range of predictable facial expressions than has been generally thought. Further studies of bears in the wild and captivity will help answer not only the broader questions concerning behavior in a group of unique carnivores but may also help to preserve and manage the living bears of the world and reduce the number of unfortunate incidents involving humans and bears—both physical damage and human injury (Stokes 1970).

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