

FOOD COMPETITION AND GROUPING BEHAVIOR OF ORPHANED BROWN BEAR CUBS IN RUSSIA

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Abstract: During spring–fall 1985–95, 5 groups of orphaned brown bear cubs (*Ursus arctos*) were captive-raised in the Central-Forest Biosphere Reserve in Russia. The groups of 2–12 individuals were raised to be released in the wild. We documented the onset of aggressive behavior between cubs. When cubs were 3 to 40–45 days old they were not aggressive toward one another. Low intensity aggressive behavior developed between 45–55 days. After 60 days of age, aggressive reactions were observed near food, including milk bottles, food cups, or natural foods. At age 5–7 months some cubs stayed in the wild surroundings of the station, did not return to their artificial den, and fed on ant (*Formica* spp.) brood pupae and larvae. Individual success in getting ants was inversely proportional to the level of social activity and aggression in the group. Individual success was highest in small groups (2–3 animals) where the number of aggressive contacts and the degree of dominant behavior was lower than in groups of 6–12 individuals. Subordinate members of large groups were very irritable and stayed immobile for long periods. They also revealed the pathological habit of paw sucking and their growth rate was retarded. After the age of 6 months when bears cubs stayed in the woods, these large groups spontaneously separated into smaller groups of 2–3 cubs. We suggest that aggressive behavior in cubs regulates group size, and the age of onset and level of aggression are adaptive features for brown bear survival. Aggression begins when ants are most abundant (Jun–Jul) and when lactation declines in free-ranging female bears. The more aggressive individual would likely be the most fit under these circumstances. We provide evidence that size of the brown bear family is an optimal solution of maintaining the population within the constraints of (1) the resource base, (2) the level of aggression among family members, and (3) the physiological traits of nursing by females. Based on these factors, we consider 3 cubs to be the optimal litter size. Larger litters would probably have difficulty in getting enough protein-rich food, while smaller litters could lead to population decline.

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Key words: aggression, behavioral development, brown bear, captive rearing, cubs, Russia, *Ursus arctos*.

The hunting of female bears in the forest provinces of the western Russian plain results in orphaned cubs. Based on our research on the population biology, ecology, and behavior of the brown bear from 1972–85 (Pajetnov 1993), we developed a method of raising orphaned bear cubs for release back into the wild. Bear cubs from about 3–30 days of age were sent by local game conservation departments or private correspondents to our biological station in the Clear Forest, part of the Central-Forest Biosphere Reserve in Russia. Because most of the orphaned cubs we received were destined to be released back into the population from which they came, we purchased only animals which originated from Tver Oblast, to prevent genetic dilution of our population from other sources. We report on our technique of raising the cubs and their behavior toward each other.

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STUDY AREA

Our investigation took place at the Clear Forest Biological Station in the Central-Forest Biosphere Reserve. The reserve is located in the southwestern Valday Hills, 400 km west of Moscow. This region is characterized as the European subzone of southern taiga. Conifers and broad-leaved trees are the dominant forest cover types. Approximately 70% of the region is forested. Species composition varies and depends largely on relief type, soil type, degree of soil, moisture, and human activity. Intensive logging occurred during the 1970s, and successive changes of biocenosis followed it. Most of the forests in the river valleys were undeveloped. These areas are covered with dense vegetation and thus are suitable as brown bear feeding habitat. The vegetation food resources for brown bear are dispersed along this area uniformly. The local climate is continental, with temperatures ranging from -6 to 30 C and summer temperatures between 9 and 25 C. Brown bear population density is 8–10 animals/100 km², and hunting removes approximately 8–10% of the bear population annually (Pajetnov 1993).

METHODS

Bear cubs younger than 45 days were kept in a warmed laboratory room (Pajetnov 1990). During this early developmental period, cubs were fed milk through a rubber nipple. Before cubs opened their eyes (age 28–32 days), they were held in our arms while being fed. After their eyes opened, cubs were left in a box during the feeding. Cubs remained in boxes (2 cubs/box) until they reached the age of 70 days. Then they were transferred to a small windowless hut that imitated the low light conditions of a bear den. The hut was 400 m from human habitation in the forest. Only 1–2 persons fed animals, giving them cow's milk flavored with oil, vitamins, and honey. People always wore dark-colored clothes and were silent during feeding sessions.

Near the end of March, the door of the hut was left open for periods so that animals could go out. We made excursions with the bear cubs as soon as most snow began to melt. Our first walks were of several hours duration, but soon the walks became excursions in the woods that lasted several days and enabled animals to experience the environment. In 1996 we improved the cub-rearing routine by leaving the hut doors open permanently beginning in April so that animals were free to explore the environment at will, and we did not accompany the cubs on their excursions into the wild. This change allowed the cubs to investigate the area around the Biological Station without humans present. Concurrently, they were given food (boiled grain with milk powder that was left near the hut) daily until the end of summer.

We recorded the behavior of cubs throughout their rearing, including bouts of aggression and group associations. Beginning 28 May 1993, we quantified the number of aggressive contacts between pairs of cubs while in groups of 2–7 individuals to investigate the effect of group size on aggression.

Thirty-two orphan bear cubs were raised during our work at the Biological Station (3 cubs in 1990, 9 in 1993, 2 in 1994, 12 in 1995, and 6 in 1996). All but 6 animals were released into the wild. Of these, 3 were killed by an adult male bear during the breeding season (1990), 1 died after eating a poisonous plant (1993), and 2 were killed by stray dogs (1995). One of the 26 released bears was returned to the Biological Station a short time after being released. He had developed very slowly and his body weight was abnormally low. This bear went to sleep in the artificial den and died from hypothermia.

During our years of observation, occasional contacts between released bears in the wild and humans were recorded. In summer 1996 we tracked released animals with telemetry equipment.

RESULTS

Aggressive Behavior

No signs of aggressive behavior were noted before cubs were 40 days old. After 40 days, aggressive interactions between cubs occurred during feeding when 1 cub pushed another from the milk bottle. Between 45–55 days of age this behavior became very well developed, although no signs of direct attacks were noticed. After the age of 60 days this pushing was frequently followed by fighting in which cubs embraced one another with their paws and bit. At the age of 2 months, aggressive contacts in front of the food cup were common. The position of assigned food cups in the feeding area was permanent. If only 2–3 animals were fed simultaneously, they quickly approached their respective food cup and ate. In these small groups, aggressive interactions were infrequent. Special efforts were required to induce animals to stay near their own food cup when 4–6 cubs were fed at once; otherwise, intense fights could start. Cubs learned their assigned positions, and the number of aggressive contacts declined. Such aggressive interactions were rare after the age of 3.5 months.

In addition, through this period more robust bear cubs usually finished their meals earlier than others, then attacked weaker individuals and consumed their food. The weaker cubs tried to resist but were usually unsuccessful. This behavior was more intense in larger groups. We observed that large groups stratified according to physical vigor of group members, even before animals started to feed on vegetation. As soon as vegetation was available, the bear cubs started to consume many plant species (Pajetnov 1990). The agonistic contacts in April–May that resulted in the stronger (dominant) bear cubs obtaining food from the weaker (subordinate) bear cubs were not noted when bears fed on vegetation. These contacts were seen only in front of food cups with food from humans.

In contrast to the lack of aggressive encounters over plant foods, the behavior changed when cubs started to feed on ant broods (larvae and pupae of *Formica* spp.) during June–July. This period coincided with the maximal reproductive rate in ant colonies (Dloussky 1967). As soon as bear cubs began to search for food in ant hills, their behavior toward one another acquired new aspects. The strongest cubs asserted dominant control of the most productive ant hills. The weaker animals searched for food in less productive ant hills while staying in visual contact with other group members. If the group included 2–4 animals, there was ample food for all.

In 1993 we observed 136 aggressive contacts between pairs of bear cubs in 134 hours of observation time. For groups of 2–4 animals, the mean frequency of aggressive contacts was low and ranged from 0.08–0.30 encounters/pair/hour of observation. For larger groups (5–7 animals) there was a mean of 0.23–1.33 aggressive contacts/pair/hour of observation. This increased aggression resulted in weaker individuals being displaced from food and receiving less food than was necessary for normal development. Displaced cubs developed more slowly, with their body weight lower and size smaller, than stronger individuals.

These displaced cubs developed the pathological habit of sucking their paws or the ear of a nearby cub. They devoted so much time to paw sucking while their group mates were feeding that they consumed less plant food than other cubs. We suggest that such intense sucking temporarily reduced their hunger, which inhibited them from consuming plants which were not in limited supply. Bear cubs which adopted this behavior became easily irritated, were hyper-reactive, and stayed motionless for long periods.

Grouping Behavior

When orphaned bear cubs began spending longer periods in the natural environment, they tended to move around together even when groups included 4–7 individuals. Animals revealed this affiliation by maintaining visual contact with other members of the group. When visual contact was lost, the “separated” individual emitted loud vocalizations. Due to this grouping behavior, the forest feeding area used by any bear cub group was generally $\leq 100 \text{ m}^2$. When a bear cub group dispersed while searching for food, animals still tended to be within sight of each other. We defined these affiliative bonds in bear cub groups as intrafamilial bonds.

During long excursions we made with cubs in the wild, all animals stayed close to their human leader regardless of the group size. When they later were free to explore the territory on their own (Jun–Jul), their social behavior changed. Larger groups of 6–12 individuals separated spontaneously into small groups of 2–3 animals, which remained stable during long periods. Cubs who were siblings did not remain in the same subgroup, but belonged to different ones.

DISCUSSION

The timing of onset of aggressive behavior between orphaned bear cubs and its context regarding ant food and group size may help explain why wild brown bear

families are rarely larger than a female with 3 cubs. We discuss this from 2 perspectives: the physiology of female bears and the parallels between the aggressive behavior we observed and what wild cubs experience.

Physiology and Litter Size

The structure of brown bear mammary glands combined with the onset of aggressive behavior in cubs may not permit females to successfully raise >4 cubs. Mammary gland morphology of female brown bears is similar to that of pigs and dogs (ungulates and carnivores); they regenerate from the connective tissue before the onset of lactation (Azimov et al. 1978). The milk is ejected into the nipples of the female bear reflexively. This occurs for all nipples at once; no milk is found in nipples between nursing sessions (Azimov et al. 1978).

Brown bear cubs in zoological parks have been observed constantly using a specific nipple when nursing from their mother. Cubs initiated agonistic behavior with siblings to search for food in adjacent nipples only when there had not been enough milk in its own nipple (R. Chizpiakov, Kazan Zoo-Botanical Garden, Kazan, Tatarstan, Russia, pers. commun., 1995). In our study this agonistic behavior appeared at the age of 50 days and was expressed by pushing a group member from the milk bottle, the analog of a mother's nipple.

Captive versus Wild Behavior

The shift in diet from milk to naturally-occurring foods occurred at the same time for both captive and wild populations of brown bears in western Russia. The same dietary pattern of feeding on a variety of plant species as they become available also occurs for brown bear families in the wild (Pajetnov 1990). The shift in feeding preferences in our bear cubs to include ant broods occurred in the same period when lactation abruptly declines in the wild. Female bears with litters which were killed at the end of July and in August had mammary glands with no milk and showed histological evidence of reduced size (Bromley 1965, our observations). This means the protein needed for normal growth and development must be obtained from a source other than mother's milk. The protein which wild brown bears get from ant broods in this part of Russia is indispensable for their survival. Aside from occasional live prey, ants are the major source of animal protein for bears in western Russia during this period. Due to regular supplemental feeding, protein need could not be the only cause of the aggression which appeared in these animals when they started feeding on ant broods. Thus the elevation of aggression in orphaned bear cubs could be determined at least partly by a spe-

cies-specific innate pattern of behavioral development (Pajetnov 1990).

The behavioral tendency for bonding and aggression both may serve as proximal mechanisms to help control group size. Bonding keeps brown bear families together, female to progeny. Our data show that this bond is very strong and effective in orphan bear cub groups which had no previous contact with one another. These behavioral mechanisms keep animals close to each other. However, despite the cub's inborn tendency to stay together (intrafamilial bond), large groups of these young animals were unstable. We believe that the higher aggression levels in large groups, particularly when feeding on ants, and the spontaneous division of these groups into smaller ones where aggressive interactions were less frequent are evidence of the same mechanisms that may contribute to the natural brown bear litter size of 2–4 cubs.

Smaller groups of bear cubs (2–3 animals) usually did not suffer the deficit of ant food and got enough of these nutrients while within the limits of their feeding area (~100 m²). Almost no agonistic behavior was noticed among these animals. Our observations indicate these behavior patterns could reflect adaptations which stabi-

lize litter sizes of brown bears. Three progeny are usually successfully nursed and raised by the brown bear female (Pajetnov 1990). After lactation declines and litters separate from their mother, litters of 3 cubs maintain recruitment in the population and allow each cub sufficient protein while exploiting feeding areas of restricted size.

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