

Observations of Conspecific Predation by Brown Bears, *Ursus arctos*, in Alaska

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A naturally occurring concentration of Brown Bears at McNeil River has been closely monitored by Alaska Department of Fish and Game personnel for the last 19 summers. During that time, observers witnessed the killing of four cubs or young bears by adult Brown Bears of known sex and age. Adult females were the perpetrators in three of these incidents, while an adult male killed a cub in the fourth. These events add new information about infanticide among bears.

Key Words: Brown Bear, *Ursus arctos*, mortality, infanticide, McNeil River, Alaska.

Some authors have speculated that conspecific killing of unrelated immature individuals by adult males may increase male fitness if females that lose their offspring are subsequently impregnated by the male doing the killing (Hausfater and Hrdy 1984). Conspecific killing of juvenile Brown Bears (*Ursus arctos*) has been used to advance the hypothesis that subadult Brown Bear survival has a negative density-dependent relationship with adult male abundance (Stringham 1980, 1983; McCullough 1981, 1986; Young and Ruff 1982). Since bear hunters typically select for male bears over female bears (Bunnell and Tait 1980, 1981; Fraser et al. 1982), these observations and hypotheses have led to a common perception that increased hunting may be compensated by enhanced recruitment. The hypothetical and inconclusive nature of this relationship was discussed by Miller (1990), who urged biologists not to rely on such density-dependent mechanisms in developing their management strategies for hunted bear populations. These conclusions were strengthened in comparison studies by Wielgus (1993).

Although conspecific killings by bears are seldom observed, they have been reported for Brown Bear (*Ursus arctos*) (Troyer and Hensel 1962; Glenn et al. 1976; Murie 1981; Dean et al. 1986; Olsen 1993; Pearson 1975) as well as for Black and Polar bears (*U. americanus* and *U. maritimus*) (Rogers 1983; Taylor et al. 1985; LeCount 1987; Tietje et al. 1986; Elowe and Dodge 1989; Amstrup, personal communication). These observations include accounts of conspecific killing of other adults and killings of juveniles by both male and female adult bears. In some of these accounts, the sex of the bear doing the killing was unknown; in other cases the sex of the bear doing the killing was inferred based on size of the bear or size of the tracks which are often unreliable indicators of sex in bears. We report on three

instances where young Brown Bears were killed by conspecific adult females and one where a cub was killed by an adult male.

Study Area

Our observations were made at McNeil River State Game Sanctuary (MRS GS). This sanctuary is located 133 km west of Homer, Alaska, on the Alaska Peninsula (59°08'30"N, 154°11'30"W). MRS GS is adjacent to Katmai National Park and Preserve. Glenn et al. (1976) previously provided a map of the 33 832 ha sanctuary which is managed by the Alaska Department of Fish and Game (ADFG). Habitat of MRS GS is low shrubs, primarily alders (*Alnus crispa* and *A. sinuata*) and open tundra (Bledsoe 1987). Topography consists primarily of low, rolling hills which are cut by McNeil River and Mikfik Creek. Both watersheds drain into a tidal lagoon which is protected from the open sea by a 0.5 km long gravel spit.

The sanctuary was created in 1967 to protect habitat and the Brown Bears which concentrate at McNeil River falls to feed on migrating Chum Salmon (*Oncorhynchus keta*) (Egbert and Stokes 1976; Bledsoe 1987). Because of this concentration of bears, the area is popular with viewers and photographers who compete for a limited number of visitor permits each year (Aumiller and Matt *in press*; Faro and Eide 1974). Bears in the area are wild, but many have become habituated to a strictly controlled human presence.

Observations

Based on markings, size, coloration, sex, and behavior, we identified more than 200 individual bears frequenting MRS GS since 1976. Individuals were sexed based on presence of offspring, observations of genitals, or of urination. The term "cub"

refers to a cub of the year (<1 year-old). We gave these individuals anthropocentric names to facilitate recognition and to provide data continuity on individuals between years. These names are used here.

Our first observation was a killing of a yearling male ("WC") by an adult female accompanied by two cubs. For unknown reasons, WC separated from his family (a female and two siblings) 40 days before he was killed on 17 August 1985. We saw WC with his own family the previous year and in June 1985. After his separation from his family, we did not observe WC associating with other bears. However, from 0800-0830 h the day he was killed, we observed WC following within 40 m of a newly arrived and previously unknown female ("Idi"), accompanied by two cubs.

At midday (1230 h), Idi was on the mud at the water's edge, on the south side of the gravel spit. One cub was about 6 m behind her and the second cub about 4 m behind the first one. WC was about 2 m behind the second cub. All three bears approached Idi. The first cub ran to Idi, and they touched noses. Idi turned away from the cub to look at the lagoon, and the cub moved about 8 m back toward the other cub. WC stopped briefly when 5 m away from Idi and then slowly approached her. She was still facing the lagoon at this time. When WC was about 1 m from Idi and between her and her nearest cub, she turned slightly toward him, then swung her head around and swatted at him with a forepaw. WC turned and ran with Idi in pursuit. When WC slipped on a muddy area within 15 m of where he had first turned to run, Idi caught him by the neck and threw him onto the mud. WC struggled to rise, but Idi kept him pinned. She bit his head at least five times and shook him by the neck. At 1238 h, Idi tore at his right hind leg, and WC made his last effort to rise. At this time, Idi bit him several more times around the head. She then moved back to the leg from which she ate a small amount. She also opened WC's visceral cavity.

When Idi first pursued WC, her two cubs ran away briefly and then sat down within 10 m of where Idi killed WC. Both cubs began bawling within two minutes of the start of the altercation. Apart from raising her head several times, Idi did not appear to respond to these vocalizations. Idi stayed on or near the carcass and appeared to be eating occasionally until 1430 h, when the tide began to rise and cover the carcass. Idi and her cubs left, and we did not see them in the area again in 1985.

Examination of WC's carcass revealed that the neck was not broken, and the trachea was not damaged. The cranium had been punctured by at least two bites. WC weighed approximately 70 kg and was less than 10% consumed. Both femurs and part of the pelvic girdle were exposed. Most of the meat consumed was from the hindquarters and thighs.

Although WC had been living on his own for over a month, he appeared to be in good condition. His stomach was filled with fish, fish roe, and cow parsnip (*Heracleum lanatum*) seeds. Although the visceral cavity was opened, nothing in it had been consumed.

We pulled WC's carcass to the outside of the gravel spit, but within 24 hours a subadult bear had dragged it back inside the spit. During the next week the carcass was scavenged to bones by gulls and ravens. Another female bear accompanied by a single cub was observed briefly feeding on the carcass several times.

This killing was most likely caused by WC's proximity to Idi and her cubs. Idi had not acted aggressively toward WC during earlier approaches when he was seen as close as 15 m from Idi. He was killed when he was positioned between the female and her closest cub. WC may have escaped had he not slipped on the mud. Because of this slip, he was unable to outrun Idi, or to stop, turn, and assume a submissive posture which normally defuses aggression (Egbert and Stokes 1976; Bledsoe 1987; Aumiller and Matt *in press*).

Our second observation was a killing of two cubs (accompanied by their mother), by an adult female with cubs of her own on 21 July 1986 at 1410 h. Our attention first was drawn to this interaction by loud growling and roaring that resulted from a fight between an adult female ("McBride") and another adult female ("Fossey") in the water at the mouth of Mikfik Creek.

During the fight, Fossey was accompanied by two cubs, whereas McBride's three cubs were on a bench above the lagoon, about 1 km from the fight. Fossey's cubs tried to stay close to her as she fought with McBride. McBride picked up one of Fossey's cubs by its neck, shook it, and dropped it, still alive, into the water as Fossey pressed the fight. When McBride and Fossey reached the shore, McBride ran after Fossey's cubs and caught one as they ran back toward their mother. McBride, with this cub in her mouth, disappeared from our sight behind a gravel bar for about 1 min. Once we saw this cub's body as it was tossed into the air, its hide partially separated from its body. Fossey went to the other cub and looked back at McBride (who was 30 m away). McBride ran toward her and caught the second cub. Fossey made a brief attempt to interfere, but after less than 1 min she went to the carcass of the first cub (still out of sight behind the gravel bar), lowered her head as though to sniff it, and then moved away, favoring one of her hind feet. She bedded down facing McBride and the cubs' carcasses, about 100 m away. Meanwhile, McBride fed on the second cub for less than 2 min. Both cubs were dead within 7 min of the time that we first heard roaring.

After feeding on the second cub, McBride began giving a low grunt of the type we have commonly heard from females separated from their cubs. After lifting her head from the carcass and sniffing the air several times, she left the second cub's body, now afloat on the rising tide, and started to swim across the mouth of Mikfik Creek to her cubs. At this time we saw a small unknown bear (estimated to be 2.5 years old) walking about 100 m away from McBride. McBride's three cubs followed this bear at a distance of about 5 m. When McBride was halfway to her cubs, this lone bear ran off and McBride went to her cubs.

Later on the same day (approximately 2205 h), we heard roars from the mudflats near the MRS GS campground. We saw Fossey within 3 m of McBride and her three cubs. Several times McBride and her cubs ran away a short distance; then McBride turned in an apparent effort to block Fossey from her cubs. Fossey did not make contact with the cubs, and the McBride family group eventually moved to the base of a bluff. McBride and her cubs climbed the bluff to a ledge near the top. With her cubs behind her, McBride turned to face Fossey, still at the base of the bluff. At one point, Fossey climbed a short distance up the bluff towards McBride. This apparent standoff continued for nearly an hour, after which McBride and her cubs moved over the top of the bluff into the brush. Fossey climbed to the ledge where McBride and her cubs had been, sniffed around and returned to the beach. Later she tried to climb the bluff by a different route. Our observations on this day were curtailed by darkness. The following day, Fossey again tried unsuccessfully to reach McBride's cubs while the bears were at McNeil River falls, approximately 1.5 km from the lagoon. However, we did not observe any physical contact between these bears.

We examined the carcass of the first cub killed, a male. The head had a large puncture mid-sagittally and the body had two other major wounds, both dorsal. The pancreas was exposed and the backbone was severed. A second wound was just anterior to the tail. The intestines extruded through the visceral cavity and some muscle tissue was eaten from the anterior parts of the hind legs.

We found a partial skeleton, probably belonging to the second cub, several days later on a gravel bar in the lagoon. There were not enough remains to allow us to gather any information about actual cause of death of this cub.

We do not know what precipitated the fight between McBride and Fossey, as we did not observe its initial stages. It is possible that McBride was responding to a distress call from Fossey's cubs. We have occasionally seen females with cubs responding to distress calls from cubs that belong to another family group. It is also possible that Fossey and her

cubs passed too closely to the McBride group. We estimated Fossey's age at 6-7 y. This was the first litter we had observed with her. Her inexperience may have contributed to the death of her cubs. This also was the first litter we had seen with McBride. McBride was an older bear (8-9 y) and weighed approximately 50-70 kg more than Fossey. Based on our observations of other interactions of these bears with other bears in the area, McBride was generally more dominant than Fossey. We suspect that Fossey was still trying to recover "her" cubs during her subsequent interactions with McBride.

A year later, McBride, accompanied by her three yearlings, killed another cub. On 26 July 1987 at about 1030 h, a female ("Melody") with two cubs ("Cub A" and "Cub B") crossed the gravel spit in the lagoon. She began fishing on the landward side of the spit, making forays into the water up to 100 m from where her cubs were sitting on the gravel spit. She returned to her cubs and they moved nearby to a large pile of driftwood. The cubs remained here while Melody moved onto the mud flats seaward of the gravel spit. At this time, McBride and her yearlings came across the spit near Melody's cubs. Melody returned to her cubs, and all seven bears were out of view briefly. What happened next was reported to us by a group of MRS GS visitors who were present on the gravel spit.

These visitors heard growling and roaring; initially they could not see fighting. They saw Cub A run eastward down the seaward beach and out of sight. In the next 10 min, McBride's family group moved to the mud flats seaward of the spit. Cub B's location was unknown. Melody moved briefly east along the spit, sniffing the ground, apparently searching for her missing cub. Within 1 min, she ran toward McBride's group and had a brief fight with McBride. After this, she ran west, crossed the mouth of McNeil River and climbed a bluff, still apparently searching for her cub.

At about 1330 h, we inspected the fight scene. There were many scuffle marks, and we found the carcass of Cub B, a male, by the water's edge. The neck was bitten severely and appeared broken. A small amount of fur and flesh was missing from one rear leg and there were many puncture wounds over the body. We moved the carcass above the tideline and placed several logs over it.

Meanwhile, Melody continued to search the area for Cub A. At about 1440 h, she returned to the carcass of Cub B, dragged it to the top of the gravel spit, and consumed a small part of it. When examined later, the carcass was missing some meat around the pelvic girdle; some of the viscera were exposed.

Throughout the afternoon, Melody continued searching for Cub A, grunting repeatedly and walking rapidly. At about 1830 h, Cub A appeared on the beach near camp, about 0.75 km from where it was

ast seen. Melody, behind camp and about 0.25 km from the cub, apparently heard the cub vocalizing, and moved to it. She nursed the cub for at least 5 min, then both lay down.

We saw Melody occasionally for the next week, during which time she lost Cub A, last seen alive on 31 July. We did not see this loss, but on 17 August we found the carcass of a similarly-sized and colored male cub near the McNeil River Falls. He was found in a stand of alders Melody frequented after losing Cub A. The cub appeared to have been dead for several days. Very little meat was consumed. The carcass had only one large wound, on the right flank. We speculate that the cub received this wound from a bear at the falls and died a day or two later.

In contrast to the above three instances of conspecific killings by adult females, on 20 July 1991 we observed an adult male kill and eventually eat a cub at McNeil River Falls. At approximately 1525 h on the west side of McNeil River and opposite from the viewing pad, an 8-9 year old female ("Molly") was fishing. Her two cubs stayed in the grass along the bank when she followed another adult, which had a salmon. She was approximately 30 m from her cubs when an adult male approximately 10 years old ("PB") noticed the two cubs and approached them. They attempted to flee, but he caught one by the hindquarters and held it for several seconds before letting it drop from his mouth. The cub tried to run away again, but PB caught it before it had gone more than 6 m. He picked it up by the neck and shook it violently. The cub immediately went limp and appeared to be dead. PB carried the cub 10 m to the water's edge and put it down. He sniffed and gently pawed at the cub for a minute without opening the carcass and then left.

Molly became aware of the missing cubs while PB was still sniffing this carcass. She approached within 15 m of PB, searching for her cubs. However, she did not seem to notice the dead cub and did not approach PB or the dead cub any closer. She continued to search for the cubs, moving away from PB.

After leaving the carcass, PB moved downstream 50 m and fished cursorily for less than one minute. At 1534 h, he then returned to the carcass and opened the visceral cavity. PB alternately ate small amounts from the carcass and lay nearby until 1605 h, when he again wandered downstream. He returned again at 1615 h, continued to eat small amounts, and at 1626 h again left the carcass, this time perhaps due to pressure from other nearby bears. One of these bears, another adult male, approached the carcass, which was still more than half intact, and sniffed it. He wandered away at 1628 h without eating any of the carcass. At 1651 h, PB returned to the carcass and continued to eat everything but the head and paws. He left the carcass for the final time at 1656 h and returned to fishing.

At 1645 h, we observed Molly looking and sniffing at the area where the initial attack occurred. For the next 65 min, she searched for her cubs in several areas on both sides of the river. She was last seen within 6 m of the remains of the carcass, but did not stop to investigate closely. Molly was not seen the rest of the day.

Within 30 sec of PB's attack on the cub, Molly's second cub was seen in the mouth of another adult bear of unknown sex. This bear was approximately 80 m upstream of the initial incident and was moving away. Neither it nor the cub were seen again.

Molly was observed every day following the incident for two weeks. The day after this incident she showed no sign of searching for the cubs. On 24 July, she was followed at a distance of 100 m by an adult male, not PB. Apparently she was in estrous or false estrous. After this date, no males showed interest in her.

Discussion

The exceptionally high bear density at MRS GS may be a contributing factor in any or all bear interactions we have described here. In 1989, a minimum of 84 individual adult and subadult Brown Bears and 42 offspring in family groups (including cubs, yearlings, and 2.5 year olds) were observed using the area within 4 km of McNeil River Falls, including Mikfik Creek, McNeil Lagoon, and the surrounding grass flats and bluffs where the killings occurred (Aumiller and Matt *in press*). A small rise in the number of human visitors to the area may have slightly increased our opportunities for observing these interactions, since we spend proportionally more time travelling to bear-viewing areas and supervising the visitors remaining in camp.

Alaska Department of Fish and Game personnel have monitored bear and human activity at MRS GS for 21 years. During this period, only the four incidents reported here resulted in mortalities in which the sex of the bear that did the killing was known. However, during this same period, two cubs were killed in separate instances by bears of unknown sex, classified as adults based on size. In studies carried out by ADFG at McNeil River in the early 1960s, the loss of three cubs from unknown causes was documented (Glenn et al. 1976). In 1989, an adult male attacked and wounded a cub that was separated from its family group. This cub's mother intervened, and the cub survived the incident. In over 7000 hours of observation in 18 years of monitoring by the authors at MRS GS, this and the incident involving PB are the only documented occurrences of a known adult male attacking a cub.

We do not imply that the incidents reported here indicate that adult female brown bears are more likely than males to kill conspecific juveniles. However, our observations added to Murie's (1981) demon-

stration that killing of unrelated offspring by adult female Brown Bears does occur. The circumstances of these kills, as well as the small amount of tissue consumed by the bears doing the killing in three of the four instances, and the lack of defense of the carcasses, indicate that sustenance needs were not primary motives for these attacks. Our observations support the contention of Miller (1990) that biologists should be cautious about assuming density-dependent relationships between subadult recruitment and number of adult males in populations of Brown Bears. Conspecific predation of subadults by unrelated female bears may, in fact, increase female fitness if it makes more resources available to a female's own offspring (LeCount 1987). However, this may be less of a factor in a food-rich environment like MRS GS.

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Premières

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