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# PREDATORY BEHAVIOR OF GRIZZLY BEARS FEEDING ON ELK CALVES IN YELLOWSTONE NATIONAL PARK, 1986-88

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*Abstract:* Grizzly bears (*Ursus arctos horribilis*) were observed preying on elk calves (*Cervus elaphus*) on 60 occasions in Yellowstone National Park, with 29 confirmed kills. Some bears were deliberate predators and effectively preyed on elk calves for short periods each spring, killing up to 1 calf daily. Primary hunting techniques were searching and chasing although some bears used a variety of techniques during a single hunt. They hunted both day and night and preyed on calves in the open and in the woods. Excess killing occurred when circumstances permitted. One bear caught 5 calves in a 15-minute interval. Elk used a variety of antipredator defenses and occasionally attacked predacious bears. The current level of this feeding behavior appears to be greater than previously reported. This is probably related to the increased availability of calves providing a greater opportunity for learning, and the adaptation of a more predatory behavior by some grizzly bears in Yellowstone.

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Earlier investigators mentioned that grizzly bears in the Yellowstone area preyed on newborn elk calves but reported only briefly on this behavior. Murie (1944) stated that during the calving period bears would occasionally seize a calf while it was bedded. Johnson (1951) noted that grizzlies were associated with elk calving grounds but did not report any episodes of predation by them. Craighead and Sumner (1982) reported that during the 1960's some grizzlies followed elk to their calving grounds or returned to these areas each spring. They noted bears appeared to locate calves by scent but gave no further details. Cole (1972) reported that grizzlies preyed on some newborn elk calves but noted his study did not adequately sample the calving period.

During a study of grizzly bear behavior that began in the Yellowstone ecosystem in 1983, several episodes of elk calf predation were observed. It appeared to be more common and complex than previously reported, so an investigation of this predatory activity was added to the ongoing behavior study. This paper discusses the predatory behavior of bears feeding on newborn elk calves based upon field observations in Yellowstone National Park from 1986-1988.

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## STUDY AREA

Hayden Valley and the Mt. Washburn massif and its associated drainages were the primary study areas. Inci-

dental observations of predatory behavior in other parts of the park were also included.

Hayden Valley is located in the central portion of the park and encompasses approximately 40,000 ha. It has an average elevation of 2,400 m, range 2,365-2,445 m. Its open rolling meadows are dominated by the silver sagebrush/Idaho fescue (*Artemisia cana/Festuca idahoensis*) vegetation community with isolated pockets of graminoid wetlands. Hayden Valley has 4 active geothermal regions and is surrounded by plateaus covered with lodgepole pine (*Pinus contorta*) forests. Large herds of elk and bison (*Bison bison*) are common in the spring with fewer mule deer (*Odocoileus hemionus*) and moose (*Alces alces*). Elk use this valley for calving grounds each spring. Grizzlies are active here during the spring, feeding on carrion, root caches made by pocket gophers (*Thomomys thalpoides*) and voles (*Microtus* spp.), various graminoids and forbs, and newborn elk calves. Courting pairs and adult males are frequently seen here during the breeding season.

Mt. Washburn is located in the north-central portion of the park, and the area where most observations were made encompasses approximately 1,000 ha. In contrast to Hayden Valley, this area is characterized by complex topography and high relief. Elevations range from 2,194 m to 3,109 m. The forested higher elevations contain extensive whitebark pine (*Pinus albicaulis*) zones along the ridges and steep slopes with interspersed meadows. The adjacent lower valleys contain large open meadows with similar vegetation communities found in Hayden Valley. Elk are the predominant herbivores in this area with fewer bison, moose, mule deer, bighorn sheep (*Ovis canadensis*), and pronghorn antelope (*Antilocapra americana*). Elk use the lower meadows for calving each spring and a mineral lick in the lower meadows appears to influence their daily movements. Grizzlies are active in the Mt. Washburn area during the spring, feeding on

whitebark pine nuts, biscuitroot (*Lomatium cous*), various graminoids and forbs, and newborn elk calves. Courting pairs and adult males are also frequently seen in this area during the breeding season.

The park's loop road passes through both study areas, but off-road human travel is minimal during the spring. The Mt. Washburn area has been closed to human activity from May to November since 1982, except for a hiking trail along its northeastern border and foot travel on the Chittenden Road up to the Mt. Washburn fire lookout. Hayden Valley is open to the public but has only a few marked foot trails along its northern boundary. These trails receive human traffic primarily in July and August.

## METHODS

Data were collected by recording the activities of all grizzly bears observed in the study areas from April to November each year. Observations were made non-intrusively from distant vantage points using binoculars and spotting scopes. Some bears were filmed with a 16-mm motion picture camera and a telephoto lens. Distances bears traveled were measured by plotting their movements on U.S. Geological Survey (USGS) topographic maps. Behavior was further analyzed by review of the film record.

Prey behavior was defined as any bear or bear group (sow with cubs, bonded siblings, courting pairs) that stalked or chased elk, or searched for bedded calves. The activities of a bear exhibiting prey behavior were recorded as long as possible each time it was observed. Some bears were identified by their distinctive physical features and radio-instrumented bears were identified and tracked on the ground with a Telonics receiver and a hand-held Yagi antenna.

A night vision device (Dark Invader) attached to a telephoto lens was used to observe predatory behavior at night beginning in 1988. Nocturnal movements of radio-instrumented bears were monitored using the portable telemetry unit.

## RESULTS

Grizzly bears were observed preying on elk calves on 60 occasions. The duration of each observation ranged from 2 minutes to 13 hours. Observations of this feeding behavior were limited to a brief period after calves were born (Fig. 1) and were observed from 27 May to 28 June 1986 (30 days), 27 May to 30 June 1987 (34 days), and 26 May to 3 June 1988 (26 days). Twenty-six of these observations were single adult grizzly bears, 17 were family groups, 4 were paired subadults, and 13 were single subadults.

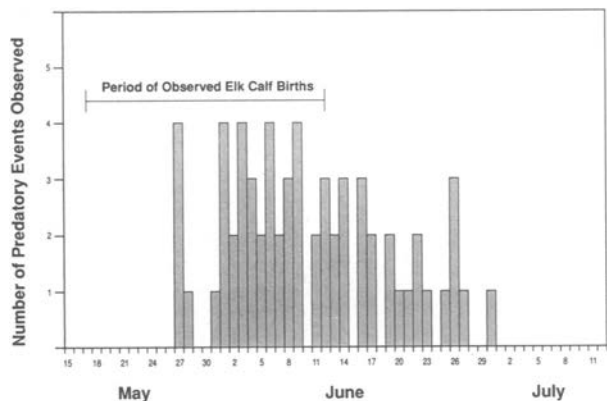


Fig. 1. Total number of observed predatory events and period of observed elk calf births during 1986-88.

## Hunting Techniques

Grizzlies preyed on elk calves primarily by searching or chasing, but there were several variations of both techniques. Bears that were observed on multiple occasions used a variety of techniques and sometimes used different ones during a single hunt.

The most common hunting technique was searching for bedded calves. Searching was used in 75% (45) of all hunts observed. There were 2 general categories of this technique. The most common search pattern was a "blind" search that occurred in areas where no elk were visible. Thirty blind searches were observed and 8 were successful. These hunts lasted from 2 to 123 minutes, with bears covering distances of approximately 50-3,100 m.

The second type of search occurred in areas where elk were visible. Bears searched either the immediate area where an elk herd was standing or the surrounding area. On 12 occasions bears searched the immediate area of elk herds. They slowly approached or loped towards the herds, but instead of chasing, stopped and searched for bedded calves where the elk herd had been standing. These hunts were typically brief and lasted from 3 to 20 minutes. Some of these hunts may have been aborted chases, but 5 of the 12 were successful. On 7 occasions, bears searched only in areas within 50-200 m of a herd. They periodically looked towards the elk but never chased or approached them. These hunts lasted from 2 to 95 minutes and 2 were successful.

When hunting for bedded calves, bears looked, listened, and smelled. They walked through an area frequently lowering their noses to the ground and periodically looked up while moving their ears and sniffing the

air with their noses held high. They investigated potential bedding sites by holding their heads down near them for several seconds. Occasionally bears stood erect and looked around and sniffed the air. Periodically they began a rapid search of an area, zigzagging back and forth. Occasionally they circled or passed within 2 m of bedded calves without finding them, or spent several minutes searching within a small area before locating a calf.

Another major hunting technique was the chase. Grizzlies chased elk in slightly more than 1/3 (21) of all hunts observed. Most chases had some element of surprise or ambush. On 12 occasions, bears charged into an elk herd from cover less than 100 m away; calves were caught 8 times. In 4 of these ambushes, the bear was observed stalking the herd for more than 100 m concealed within the forest edge before charging out into the meadow; 3 were successful.

Bears also preyed on calves in the woods. Twice bears appeared to wait just within the woods and ambushed the elk when they entered. One was successful while the outcome of the other was unknown. One bear entered the woods and encountered a calf at close range and caught it after a prolonged chase back out into the meadow. Another bear came out of the woods, crossed a meadow and charged into a herd just after it had entered the woods on the opposite side.

Two episodes were observed where bears slowly approached a herd in the open while the elk were alert to their presence. In both cases the bear began a charge from about 100 m, but the outcomes were not observed.

Two other chases occurred in an open meadow. In one, a calf jumped up and ran in front of a bear that had been searching for bedded calves, and was quickly caught. In the other, a bedded calf stood up, unaware that a bear was foraging about 100 m away. The bear gave chase but the calf escaped.

When a bear charged into a herd, it looked around for a potential calf to chase. If none were selected, it swung around and made another pass through the herd. Some bears made several charges (up to 7) before catching a calf or leaving the area. Calves that became visually isolated from the herd were typically the ones selected for pursuit. These calves were not always the slowest ones or the ones that were closest to the bear. The pursuit was initiated with a sudden burst of speed by the bear. If the calf was fleeing obliquely or in an arc, the bear often accelerated in a straight line to cut it off. However, once the bear was running at full speed it had difficulty turning quickly and was frequently outmaneuvered if the calf turned sharply. Occasionally calves were fast enough

initially to avoid capture, but were overtaken in long chases.

### Antipredatory Behavior

The earliest date the birth of a calf was observed in the study areas was 17 May and the latest date was 12 June. However, most were born in the last week of May and the first week of June each year. An elk calf's best defense during its first few days of life is concealment because it lacks the agility, speed, and endurance to flee effectively. Its spotted coat gives it some natural camouflage and it generally beds near objects that provide cover. Calves appear to emit little scent and tend to lie perfectly still in the presence of danger. Additional protection is provided when an alert cow detracts a bear's attention. Twice we observed cows approaching to within 5 m of bears that were rapidly searching a bedding area. Both times the bears chased the elk and did not return to the original locations to search, and the cows became less concerned.

After a calf is several days old, it joins the herd. Calves benefit from the collective vigilance of the herd but still must rely on their ability to flee. However, we observed some calves drop to the ground when a bear approached the herd or after a bear began chasing another calf in the herd.

We were able to differentiate at least 3 distinct maneuvers adult elk used to protect a calf once a bear began chasing it. The first was directed towards the bear. They ran alongside the bear and hazed it, often in pairs attacking from both sides to within a meter. Although this maneuver was frequently used during chases, it never appeared to deter or interfere with the bear's pursuit.

The second defense maneuver was directed towards the calf. During 13 chases we observed 1 or more cows run alongside and/or directly in front of the pursued calf. This appeared to benefit the fleeing calf in 2 ways. First, the presence of adult companions appeared to quicken the calf's pace, and second, the cow (or cows) selected the path of flight. This maneuver allowed the calf to escape in all but 1 chase that continued for almost 1 km.

The third defensive maneuver appeared to confuse the bear by momentarily obscuring the visual lock it had on the calf it was chasing. During 7 chases, we observed 1 or more adult elk run between the bear and the calf. They either crossed obliquely or continued running in front of the charging bear. This caused the bear to slow down and allowed the calf to escape each time.

Cows occasionally defended a calf after it was caught. They harassed the bear by repeatedly darting toward it or following it as it carried the calf into the woods. On 5

occasions we observed cows using their forelegs to kick at the bear, and twice this technique allowed the calf to escape, apparently unharmed.

### Capture

We observed how bears caught calves 15 times. They typically knocked them to the ground and then held them down with their paws. Nine times, they did this by striking them on the rump or flank with their paws, 3 times they butted them down using their muzzles. One bear simply picked the calf up by its back while it was running and 2 catches occurred when the calves fell down and the bears lunged on top of them.

Bears' initial actions after a catch were observed 21 times. On 12 of these occasions they began feeding on the abdominal contents immediately while holding the calves down with their front paws. Five times, bears picked up calves by their upper back and carried them in their mouths to the woods. Twice bears fed on the calf for less than 5 minutes, then left the area. One returned 7 hours later, fed briefly, then carried the carcass back into the woods. Twice bears were observed biting into the upper back and neck region and shaking the calf vigorously for several seconds immediately after the capture. Neither time was the calf killed by this maneuver, but 1 calf appeared to be paralyzed in its hindquarters.

Bears were never observed killing calves before feeding on them, but calves generally stopped moving and appeared dead shortly after their abdomens had been opened. Also, we never observed a bear using its paw to slap at a calf's head or neck.

### Consumption

There was no uniform method of consumption. In 3 episodes, calves were fed upon continuously for 85, 110, and 120 minutes, respectively. Five calves were fed on briefly after the catch, then buried and fed on intermittently throughout the day. Twice bears fed briefly after the catch, left the carcass unburied, and returned later to carry the carcass into the woods. A cow, presumably the mother, generally stayed near the calf while it was being consumed, sometimes within 20 m, and stayed with the carcass for about 2 days before returning to the herd.

### Individual Bears

Use of elk calves varied among individual bears. Some were never observed preying on calves. Others preyed on calves periodically but were observed foraging for other foods most of the time. Some bears appeared to feed almost exclusively on calves and rarely foraged for other foods.

This latter category provided information about the number and frequency of calves killed by some bears. A female with 2 cubs-of-the-year was seen hunting calves 6 times and killed 4 calves in a 5-day period. A subadult was observed hunting each of the 5 times it was seen in 7 days and killed 3 calves in a 24-hour period. An adult grizzly was observed killing 4 calves over a 25-day period and was always hunting on the 7 days it was seen.

Bears observed preying on calves on multiple occasions did not use a single hunting technique. Each used a variety of techniques and some even used different ones during a single hunt. There was no apparent preference of hunting techniques used by the various age and sex classes. However, adult males observed in the study areas were primarily involved with breeding, and their predatory behavior was limited to brief incidental searches. They were observed either courting females or making extended walks, probably in search of females. On 6 occasions they interrupted their walks to search briefly in the immediate area, and twice a bedded calf was found.

### Competition

We also observed black bears (*Ursus americanus*), coyotes (*Canis latrans*), and golden eagles (*Aquila chrysaetos*) prey on elk calves during this study. These predators along with grizzly bears, bald eagles (*Haliaeetus leucocephalus*), ravens (*Corvus corax*), and numerous unidentified small birds were the primary scavengers of unattended calf carcasses. Three grizzly bears were displaced from their calf kills by other grizzlies and all 3 were observed to resume their search for other calves.

### Excess Killing

We documented 2 cases of excess killing when bears killed more calves than they were immediately able to consume. In the first, a bear caught 5 calves within a 15-minute period. Two calves escaped, apparently unharmed, due to the constant intervention by 12 cows. This bear fed briefly on each of the 3 remaining calves before burying their remains. Nine hours later, it was displaced by a grizzly sow and her yearling who claimed all 3 carcasses.

In the second episode, we observed a bear find a bedded calf and feed on it for 95 minutes. It then traveled approximately 200 m through a stand of trees and encountered a cow/calf herd. It charged into the herd and after several attempts caught a calf. It fed for 2 minutes then disappeared into the adjacent woods. It returned to the calf carcass 7 hours later, fed briefly, then carried it back into the woods.

### Night Predation

We observed the predatory behavior of 3 bears hunting elk calves at night. A sow and her yearling cub conducted a blind search for bedded calves in an open meadow shortly after dark. After hunting unsuccessfully for 20 minutes, they traveled approximately 1.4 km and approached a cow/calf herd downwind to within 50 m. They searched the immediate area for 30 minutes and disappeared into the woods without a calf.

A radio-instrumented 5-year-old female was monitored and intermittently observed during a 48-hour period. She remained inactive and out of sight in the woods during the day, but when it became dark, she began a search for bedded calves. The first night she searched for 2 1/2 hours across an open meadow and traveled approximately 3.1 km. The second night she searched within a small meadow adjacent to trees for more than an hour before she disappeared.

Another radio-instrumented bear, a 16-year-old female, and 2 cubs-of-the-year, were monitored for a 24-hour period. They remained inactive during the day and became active just after dark. They crossed a meadow and approached a large cow/calf herd. The sow chased intermittently for about 10 minutes before catching a calf and carrying it into the woods.

There was evidence that other grizzlies also preyed on calves at night. Five times, bears either searched for bedded calves or chased them at dusk and were subsequently observed feeding on a calf in the same area the following morning.

### DISCUSSION

This is the first published study of the predatory behavior of grizzly bears feeding on elk calves, and despite its qualitative nature, it nonetheless demonstrates that elk calves are an important and predictable annual food for some grizzly bears in the Yellowstone ecosystem. Grizzly bears have been described as opportunistic predators (Herrero 1985), but in this study, some were deliberate predators and effectively preyed on newborn elk calves for short periods each spring. During the field work of this study, we were biased visually to predatory events that occurred in open areas and during the daytime, but we also documented similar events that occurred in wooded areas and at night. Because of this bias and the fact that some bears varied their hunting technique or used different ones during a single hunt, caution should be used in applying these data to develop predation success rates for location, time, or hunting technique.

We also made incidental observations of this feeding

behavior in a few calving grounds outside the primary study areas, both within the park and in the adjacent national forests. We assume this feeding activity occurs at all calving grounds within the Yellowstone ecosystem but are unable to compare the level of activity in these locations with that observed in the primary study areas.

Bears used a combination of sight, sound, and smell as their primary senses when preying on elk calves and it was sometimes difficult to determine which sense was the most important during a specific episode. They occasionally located elk by hearing either the sound of a bleating calf or the general noise of a herd. The use of hearing was not as obvious as was sight or smell and appeared to play a lesser role in predation once they located the general area of calves.

Sight was vital in all aspects of their hunts. They used it to initiate a stalk and, when searching for bedded calves, they constantly scanned the area. Sight also appeared to be the key sense used to initiate a chase and during the pursuit. This was evident by their selection of calves that became visually isolated from the herd. A successful defense used by adult elk broke this visual link between a bear and the calf it was pursuing by running between the two. Bears also have adequate night vision that allows them to chase calves in the dark. Future work on nighttime predatory behavior may reveal more information about their night vision as well as to better understand the balance between predator and prey at night.

Smell is considered to be the fundamental and most important sense a bear has (Herrero 1985), and yet the role of olfaction in elk calf predation remains an enigma. Reported evidence that newborn elk calves emit a scent is varied. Johnson (1951) concluded that newborn calves were odorless, while Murie (1951) felt it was probably justified to assume that a newborn calf emits less scent than the adult. Herrero (1985) described newborn calves as being "almost odor-free" but observed that bears could sometimes detect their scent. He further stated that once they smell a calf it will soon be located and killed.

During this study we noted that bears consistently used their noses while searching for calves and appeared to readily locate the general area of bedded calves. They usually found a calf quickly in such an area, but sometimes they searched for several minutes before finding a calf or they circled or passed within 2 m of bedded calves without finding them. Apparently, bears could easily detect the general area that calves were bedded, but had difficulty in finding the exact location of a calf by its scent. While their ability to locate a calf by its scent varied, there was evidence they could sometimes discriminate among scents. We observed several episodes

where a bear charged into a standing cow/calf herd, began a search of the area, and soon found a remaining bedded calf. With a bear's acute sense of smell, it may seem logical to assume that its olfactory receptors would have been overwhelmed in these instances, and yet sometimes they appeared to discriminate among scents by successfully locating a calf.

Newborn calves are probably not odorless, but rather emit a small amount of scent that increases with age. Also the direction of the wind, proximity or preoccupation of the bear, or other unknown parameters may play a role in the ability of a bear to detect the scent of a particular calf. Mother elk frequently lick their calf's anus after it defecates and perhaps this behavior serves to reduce her calf's scent. If newborn calves emit only a small amount of scent, then under certain conditions this may require a bear to get within a close range before the scent could be detected. This would be facilitated by their rapid and sometimes repeated zig-zag search pattern. This hunting technique may also serve to increase its chance of seeing a bedded calf or making the calf flush and expose itself.

Surplus killing as described by Kruuk (1972) has been documented in Yellowstone by grizzlies preying on species that have little or no ability to defend themselves. Knight and Judd (1980) reported that 2 grizzlies killed more than 30 domestic sheep in a single night. During this study we observed a bear kill more than 100 spawning cutthroat trout (*Salmo clarkii*) and leave about half uneaten (French and French, unpubl. data). Unlike domestic sheep and cutthroat trout, elk have several effective prey defenses that prevent surplus killing except in rare instances. Bears will take advantage of an easy opportunity and kill more than 1 calf, even if they are satiated from a previous kill, and will bury the remains or stay close by to defend them. Therefore these episodes of multiple calf kills lie outside the definition of surplus killing and is better described as excess killing.

Despite extensive field work by previous researchers, predation on elk calves in Yellowstone by grizzly bears was only briefly mentioned. Craighead and Sumner's (1982) field work began each year in early June, while Cole's (1972) field work occurred in late winter and early spring, and did not extend through the calving season. Therefore these studies may not have adequately sampled the calving season. In contrast, Murie (1944, 1951) and Johnson (1951) both observed grizzly feeding activities during the calving season but only recorded occasional instances of calf predation with scant details. Mealey (1975) conducted a study of the natural food habits of grizzly bears in Yellowstone National Park in 1973-1974, but did not identify elk calf remains in the 615 bear

scats he analyzed.

These previous studies did not concentrate on the predatory behavior of grizzly bears so it is difficult to say how much predation was actually taking place. However, the lack of any comprehensive documentation in the past leads us to believe that Yellowstone grizzlies are currently preying on elk calves more. The apparent increase in this feeding behavior is probably related to the increased availability of elk calves, combined with the adaptation of a more predatory behavior by some grizzly bears. Since the end of the park's annual elk herd reduction program in 1968, the elk population has significantly increased (Servheen et al. 1986). More prey has created a greater opportunity for learning. In this study, almost a third (17 of 60) of the predatory events we documented involved sows with young. Although bears can probably learn to prey effectively on calves without previous experience, the acquisition of predatory skills is probably facilitated when cubs are raised and taught by predacious mothers.

Competition by scavengers and displacement from calf kills by other bears forced some grizzlies to make additional kills. This has also been described for bears feeding on adult elk (Cole 1972). Some bears fed on their kills immediately or buried the remains, presumably to reduce the attraction to other scavengers, while other bears carried their kills to the security of nearby woods. There was not a uniform use of elk calves among the various age/sex classes since adult males were typically preoccupied with courting and mating during the elk calving season. However some bears had their kills taken away by more dominant bears. Some bears may have also been excluded entirely from the calving grounds by dominant bears. The social structure of the current Yellowstone grizzly population needs to be defined to understand the possible exclusion of subordinate bears from this important seasonal food.

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