

On the age of self-sufficiency in Scandinavian brown bears

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The young of brown bears *Ursus arctos* Linnaeus, 1758 are sometimes orphaned and found by humans. People and authorities often want to help these young survive by taking them into captivity. We report on the fate of five young-of-the-year brown bears in two litters that lost their mothers in May and September. We left food for one of the two cubs that were abandoned in May after the other one had died. He was shot four years later and had a normal weight at that time. The other three lost their mother in September, probably to illegal hunting. One was lighter than normal the following May and died that year. The two others are still alive at almost six years of age, and have shown normal growth and reproduction. We conclude that young-of-the-year brown bear cubs in Scandinavia can survive well on their own from the beginning of July, and recommend that they be left where they are found.

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Introduction

In many countries, female brown bears *Ursus arctos* Linnaeus, 1758 are protected from hunting while accompanied by dependent young. However, occasionally females are killed while with young. An often emotional question frequently arises about the fate of orphaned young-of-the-year; should they be left to themselves or should they be taken into captivity?

This question has been studied in detail in the American black bear *Ursus americanus* Pallas, 1780, with the conclusion that orphaned young can survive on their own, even from as early as five months of age (Erickson 1959, Payne 1975, Alt and Beecham 1984). However, black bears usually separate from their mothers in the spring as yearlings (Rogers 1987). The period of maternal care is often longer in brown bears; the young leave at ages varying from one to four years (Camarra 1989, McLellan 1994), which suggests that brown bear cubs may need their mothers for a longer time than black bear cubs.

Studies of brown bear cubs that have been in captivity before being released showed that the cubs were able to survive on their own from July and September (Jonkel *et al.* 1980, Pazhentov 1990 and pers. comm.). We have located four reports about completely wild brown bear cubs. Johnson and LeRoux (1973) marked, moved, and released a male cub that was orphaned in August in Alaska, USA. It was shot one year later 77 km away, but no weight was available. Russell *et al.* (1979) reported that 3 unmarked cubs that had lost their mother in late July were all still alive at least until the following July in Alberta, Canada. Palomero *et al.* (1992) followed 3 unmarked cubs that apparently lost their mother in July in Spain. They denned together and were observed together until May the following year. Craighead *et al.* (1995), however, found that, of 21 orphaned cubs in 9 litters in a population associated with garbage dumps in Yellowstone National Park, USA, 7 survived to at least one year of age, 7 died or were sent to zoos before becoming one year old, and 7 were unaccounted for. Only one of these orphans was known to survive beyond yearling age; it reached adult age. Thus, the literature suggests that brown bear cubs are self-sufficient from July in some, but not all, areas. Also, little is known about the condition or survival of orphaned cubs over a longer time period. Here we report the survival and growth of 5 brown bear cubs orphaned from two litters in northern Sweden, where about half of the young separate naturally as yearlings and the other half as two-year-olds, which is earlier than for North American brown bears.

Study area and methods

The study area was northwest of Jokkmokk in the southwestern part of Norrbotten, the northernmost county in Sweden (67°N, 18°E). The area is rolling with elevations below 300 m in the east, but is dominated by mountains that rise to over 2000 m in the west. Glaciated U-shaped valleys are common. The northern boreal forest is dominated by Scots pine *Pinus sylvestris* and Norway spruce *Picea abies*, but there are extensive subalpine forests dominated by birch *Betula* spp. (Björvall and Sandegren 1987).

Three yearling brown bears were captured in the spring by shooting them from a helicopter with darts containing immobilizing drugs. Two young-of-the-year cubs were captured at the den site after being abandoned, as described below. Captured bears were weighed on a spring scale to the nearest 1 kg and an identifying number was tattooed on the inner side of the lip. Bears received radio transmitters, mounted on a collar or attached to an ear (Björvall and Sandegren 1987) and they were located about once a week during their active period.

Young bears were captured each spring to change collars and obtain weights. We compared their spring weights with others of the same age and sex in the study area (Scandinavian Brown Bear Research Project, unpubl. data). We compared the weight of the male killed during the hunting season with those of other males of the same age killed during the hunting season in the two northernmost counties in Sweden (Västerbotten and Norrbotten). Ages were estimated from counting the annuli in the roots of a premolar tooth (Craighead *et al.* 1970). These weights and teeth were obtained from the mandatory reports on hunter-killed bears (Scandinavian Brown Bear Research Project, unpubl. data).

We also present the survival rates of radio-marked bears during 1985–1996, using the Kaplan-Meier technique (Kaplan and Meier 1958). We multiplied survival rates for each age class to obtain survival rates for periods longer than a year. When this was done, the sample size is given as

“bear-years”, ie the sum of the number of bears followed in each of the age classes in question. When calculating mortality rates, we considered a sudden stopping of a transmitter during the spring, when there was enough snow for snowmobile travel, or during the autumn moose *Alces alces* hunting season, to be an illegal mortality. No bears classified as “probably killed illegally” by this criterion have been recaptured subsequently nor killed in a subsequent hunting season in this area. Cub survival was based on observed, but unmarked, cubs accompanying radio-marked females. Cub survival is high (98%) in this area (Swenson *et al.* 1997).

Results

A radio-marked eight-year-old female brown bear (BD10) gave birth to two young in 1989, about 30 km from Jokkmokk. She was at the den on 19 April and 2 May. On 5 May, a set of tracks leaving the den area was observed from a helicopter, but no radio-telemetry equipment was in the helicopter at the time. On 6 May, radio-telemetry confirmed that she had left the den. On 9 May, she was observed from an airplane without young about 5 km from the den.

The den was visited on 20 May, and male and female cubs were found in the top of a 15-m Norway spruce. The female was caught and marked with a radio transmitter mounted on a neck collar. On 4 June, the female cub was found dead, probably due to starvation, and the male (BD26) was marked with an ear-mounted radio transmitter. At this time, we decided to give food to the surviving cub. Dog food («Frolic») was used primarily, but also slaughterhouse scraps, frozen berries, fish, honey, etc. were placed a few hundred meters from the den opening at regular intervals. The male cub was not seen again, but all the food disappeared and he stayed close to the den until around 19 June, when he moved 1 km away. He returned occasionally, but spent more and more time away. On 8 August, he lost his transmitter.

Local people observed a small bear in this area that summer and in following summers. From this, the local opinion was that the bear survived, but remained small. However, BD26 was shot legally on 10 September 1993 about 60 km from his place of birth. His live weight was calculated to be about 181 kg, based on a slaughter weight of 120 kg and the regression formula of Swenson *et al.* (1995). In comparison, the mean live weight of eight other four-year-old male brown bears killed in northernmost Sweden during the autumn was 173.6 ± 30.5 (SD) kg. Based on following radio-marked males and cubs of radio-marked females in this population, we have found that the probability of surviving from spring as a cub to autumn as a four-year-old for males is 0.46 ($n = 112$ bear-years).

In 1991, a radio-marked 14-year-old female (BD27) had three cubs. She disappeared suddenly during the hunting season in September 1991, with circumstances suggesting that she had been killed illegally. On 6 May 1992, three yearlings were observed together at their den site, about 3 km from where BD27 was last located and within her former home range. In our study, all cubs with radio-marked mothers have entered the den with their mothers and emerged with her as yearlings. However, in this case, the cubs had wintered without their

Table 1. Spring body weights (in kg), of three orphaned brown bears in northern Sweden, compared with the mean spring weights of radio-marked bears of the same age and sex in the same area (mean is given with standard deviation, sample size in parentheses).

Age, in years	Female BD37	Mean for females	Male BD38	Male BD39	Mean for males
1	25	23.7 ± 4.3 (22)	30	20	30.8 ± 9.6 (17)
2	45	44.1 ± 13.0 (17)	64	—	60.9 ± 16.2 (19)
3	83	72.7 ± 16.0 (12)	96	—	114.1 ± 44.9 (12)
4	98	89.4 ± 7.4 (9)	112	—	117.2 ± 30.0 (8)
5			169	—	145.6 ± 23.4 (5)

mother, because there were only three bed sites in the den. Thus, we conclude that they were BD27's orphans. They were all captured and radio-marked; one female (BD37) and two males (BD38 and BD39). The male (BD39) died in July 1992 of unknown causes. He was smaller than average for a yearling male in the spring, although within one standard deviation of the mean (Table 1). The survival of radio-marked yearling males in this population is 0.88 ($n = 17$). The other male (BD38) is still alive as of winter 1996/97. Based on radio-marked males in this population, we have found that the survival rate from spring as a yearling to autumn as a five-year-old is 0.31 ($n = 69$ bear-years). His growth has been similar to that of other radio-marked males in this population (Table 1).

The female (BD37) was still alive as of winter 1996/97 and her growth was similar to that of other females in the population (Table 1). In spring 1996, when BD37 was five years old, she was accompanied by three cubs and was therefore not captured for remarking. All the cubs survived the summer and entered the den with her in the autumn. In this population, the mean age of successful reproduction is 5.3 ± 0.5 years ($n = 9$), and 78% are first successful mothers at the age of five years. No births to four-year-old females have been observed ($n = 9$). The average litter size is 2.4 ± 0.8 ($n = 23$) (Scandinavian Brown Bear Research Project, unpub.). Based on radio-marked females in this population, the probability of surviving from spring as a yearling to autumn as a five-year-old is 0.73 ($n = 69$ bear-years).

Discussion

Although we have only followed five orphaned cubs from two litters, including the one that died at the den shortly after being abandoned, we are apparently the first to report growth rates of orphaned brown bear cubs and among the first to report their survival over several years. Our results showed that the cubs survived well without their mothers from about midsummer. Only one of the orphans did not reach the age of 4 years, and it is possible that becoming an orphan reduced

his survival, because yearling males have a relatively high survival rate in this population. He was unusually small in the spring of his yearling year. Among the three orphans that survived beyond their yearling year, we could not document that losing the mother had a negative effect on subsequent growth or survival. The other orphan was killed by a hunter and had reached the age of four years, in spite of a high mortality for males to that age.

This raises an important question of why some young stay with their mother until they are two years old when they obviously can survive well as yearlings, or even before. The mother provides learning, protection, and energetic advantages during denning in winter, all obvious benefits to the young. But, if the mother keeps them with her as two-year-olds, she must delay reproduction by one year. That some mothers keep their young for the extra year implies that there is a trade-off involved, and that the two-year-olds obtain an added advantage of staying with the mother. This was shown by Craighead *et al.* (1995), who found that young weaned as yearlings were five times more likely to die than those weaned later in Yellowstone National Park, where bears were concentrated at garbage dumps. Orphaned cubs and weaned yearlings may be especially vulnerable in such concentrations of bears. It is possible that orphaned cubs and weaned yearlings have a higher survival in our study population, which is increasing after an earlier reduction (Swenson *et al.* 1994) than would be the case at densities nearer carrying capacity. We are continuing our studies and hopefully will be able to answer this question for this population in the future.

Our results are important for the fate of lone cubs that are found in Scandinavia. Our results, and those of the literature, show that the chances of survival, normal growth, and reproduction of orphaned cubs are high enough that it is ethically responsible to leave the cubs to fend for themselves. We recommend that all cubs orphaned from the beginning of July be left where they are found. This applies to all of Scandinavia, because farther south in Sweden young usually leave their mothers as yearlings (Scandinavian Brown Bear Project, unpubl.). However, if the orphaned cubs are near human habitation, they should be moved away and released, because Alt and Beecham (1984) found that orphaned black bear cubs had a propensity to visit human habitation looking for food.

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