

LONG-TERM SURVIVAL OF ADOPTED BLACK BEAR CUBS IN SUBOPTIMAL HABITAT

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Bears (*Ursus* spp.) readily adopt cubs in dens and, under some conditions, after spring emergence from dens (Hornocker 1962, Erickson and Miller 1963, Bledsoe 1975, Jonkel et al. 1980, Clarke et al. 1980, Alt 1984, Alt and Beecham 1984). Thus, adoption is a possible method for aiding survival in the wild of orphans of threatened and endangered species (Jonkel et al. 1980). Most reported adoptions have taken place in Pennsylvania (Alt 1984), where natural foods and foods provided by humans are abundant and black bears (*U. americanus*) show the highest growth and reproductive rates reported for the species (Alt 1980, 1982). There and elsewhere, litters with adopted cubs have shown high survival in their first year (Bledsoe 1975, Clarke et al. 1980, Jonkel et al. 1980, Alt 1984, Alt and Beecham 1984), but subsequent survival has been reported only for Pennsylvania (Alt and Beecham 1984). Long-term survival might be lower where food is less abundant (Alt and Beecham 1984). I studied long-term survival of adopted cubs and effects of adoptions on foster families in suboptimal habitat.

STUDY AREA, STUDY ANIMALS, AND METHODS

The study was conducted in the Superior National Forest in northeastern Minnesota. Food was less abundant than in the Pennsylvania study area of Alt and Beecham (1984), and black bears showed growth and reproductive rates less than half those in Pennsylvania (Rogers 1986).

On 11 April 1978, 3 orphaned female black bear cubs, about 3 months old, were introduced singly to 3 undrugged, radio-collared mothers. Two of the orphans were tossed into dens and were observed as they touched noses with the mothers, crawled underneath them, and joined the mothers' natural litters of 1 and 2 cubs. A third orphan was introduced to a mother and 3 cubs that had recently emerged from the den. The mother moved away when researchers ap-

proached, and the orphan was placed in her bed among the other cubs. The researchers immediately left, and the mother returned within 30 min according to telemetry signals.

All 3 mothers were in good condition because of unusually abundant fruits and nuts the previous year. However, fruits and nuts were scarce in 1978. Cub survival was first assessed in mid-May 1978 by flying over the families and counting the cubs. Survival was next assessed by examining the families in their dens in late winter 1979 when the cubs were 13-14 months old. Individuals surviving at that time were weighed and radio-collared for studies of survival and reproductive success during the next 2-5 years. Capture, handling, and tracking of bears followed Rogers (1986).

RESULTS AND DISCUSSION

All 9 cubs were with their mothers when the families were observed in May 1978, 34-38 days after the adoptions. Eight were present in February and March 1979, but only 5 were present after 2 May 1979. All cubs died in the litter of 4. The sequence of deaths in this litter is uncertain because all 4 cubs lost their ear tags. The last 3 deaths occurred at distances of 20, 500, and 2,400 m from the winter den, with the lightest of the 3 dead yearlings closest and the heaviest farthest from the den. Bone marrow in all 3 yearlings was nearly devoid of fat, indicating starvation. None of the carcasses was dismembered, which indicates that predation was not a cause of death. All 5 members of the 2 smaller litters survived until ≥ 2.5 years of age.

Ear tag loss in the 3 litters was greater (75%, 12 of 16 tags lost) than for similarly tagged cubs in previous years (2.6%, 2 of 77 tags lost) ($P < 0.0001$, $\chi^2 = 54$). High ear tag loss may have resulted from fighting over nipples and food because of disrupted cub social hierarchies caused by the introductions. Litter disruption also may have been exacerbated by malnutrition. However, malnourished cubs did

not show high ear tag loss in previous years (without adopted cubs).

In the litters of 2, 3, and 4, average weights were 11.6, 7.4, and 7.0 kg, respectively, at 13-14 months of age. Although the litter of 3 survived, they were the lightest yearlings to survive of 38 studied (Rogers 1983, this study).

The 2 adopted bears that survived were radio-tracked until 5 years old. Each established a territory adjacent to her foster mother's territory, as is usual for natural daughters (Rogers 1986). Neither approached people or visited areas of human habitation, despite feeding and handling by people for a week before adoption. One cub returned to the researcher at the time of introduction, but any affinity for people apparently disappeared.

The 3 foster mothers produced litters of 2, 2, and 3 cubs in 1980, and all of the cubs survived >15 months. This suggests that subsequent reproduction in black bears is not diminished by raising orphaned cubs.

My findings on cub growth and survival differ little from findings for natural litters (Miller 1963, Rogers 1976). In both studies, larger litters showed reduced growth and/or survival. In Saskatchewan, body weights of cubs in litters of 1, 2, 3, and 4 averaged 7.7, 5.9, 4.1, and 2.5 kg, respectively, during a 1-week period in spring (Miller 1963). In Minnesota, survival rates to 1.5 years were 100% (n = 2), 88% (n = 16), 82% (n = 66), and 50% (n = 12) for litters of 1, 2, 3, and 4, respectively (Rogers 1976). Thus, females with 4 cubs raised fewer to independence than females with 3.

Growth and survival of bears is enhanced in areas with supplemental food (Rogers et al. 1976, Alt 1980, Alt and Beecham 1984). This suggests that survival of enlarged litters can be increased by supplementing food in territories of foster mothers in suboptimal habitats. Providing food not subsequently associated with people should be considered when adoption is used with threatened or endangered species or in areas where survival of orphans

might be important to the viability of low populations. An alternative might be replacing natural male cubs with orphaned female cubs in foster families (C. Jonkel, Univ. Montana, and G. Alt, Pa. Game Comm., pers. commun.).

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