RESPONSE IN SKELETAL GROWTH AND BODY MASS OF JUVENILE AMERICAN BLACK BEARS TO PERIODS OF SEVERE FOOD SHORTAGE[1]

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SUMMARY OF FINDINGS

Across much of their range, American black bears (*Ursus americanus*) experience periodic and sometimes severe food shortages due to stochastic variation in wild fruit and nut production. Adult bears typically show little or no lasting effect from year-to-year fluctuations in food abundance, though females may sacrifice reproduction following years of particularly poor foods. However, young bears must maintain skeletal and muscular growth through unpredictable times, in addition to building fat reserves each year for hibernation; their ability to do so certainly affects their age of maturity (Noyce and Garshelis 1994) and may have longer-term repercussions. Hence, food conditions may have both short and long term effects on population growth and dynamics.

Captive studies have shown that young bears gain lean body mass in direct proportion to their protein intake, whereas they accumulate fat in proportion to total calories ingested (Felicetti et al. 2003). In north-central Minnesota, most protein-rich bear foods (e.g. emergent greens, insects, deer fawns) are reliably available every year, particularly in the spring and early summer. In contrast, high-calorie fruit and nuts are typically not available until mid-late summer and are notoriously inconsistent in production (Noyce and Coy 1990). We postulated that if growth in stature occurs mostly before mid-summer, then age-specific growth should be relatively consistent from year to year, independent of mast availability. In contrast, weight gain from fat accumulation should more closely reflect year-specific mast availability. If skeletal growth continues through the summer, however, it also should reflect mast abundance, as late summer protein-poor foods like berries can meet the dual requirements of growth and fattening only if consumed in large enough quantities.

We investigated the impact of 3 years of severe food shortage (1985, 1990, 1995) on growth and weight gain in juvenile black bears during a 2+-decade study of black bear population dynamics in north-central Minnesota. We trapped and radio-collared bears during May-July most years and handled radiocollared individuals in their winter dens in December and/or February-March each year. We measured total length, skull length, zygomatic girth, and length of humerus and ulna. We report results here for skull length, which appeared to be the most precise of the measurements and the one least affected by the fatness of the bear. We used a mixed model approach to derive population growth curves (Pinheiro et al. 2007), incorporating effects of sex, individual variation among bears and habitat (upland or lowland). We modeled separate growth curves for males and females living in upland habitats, where foods tended to be more abundant, and neighboring lowlands, where foods were typically less available. We documented abundance of natural foods via an annual survey of wildlife managers and other field personnel, in which they rated the productivity, relative to average, of 14 types of wild berries and nuts each year.

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Bone growth and weight gain were depressed in juvenile bears during 3 years of severe food shortage. Age-specific population means for body mass and skull length did not reflect this effect, due to large variation in age-specific size among juveniles. However, longitudinal data from individual bears showed that rates of bone growth and mass gain were both lower than expected during years of food shortage, when compared with sex-specific growth curves for the population. Weight gain was more profoundly affected; some bears gained almost no weight from one year to the next, despite modest growth in stature. Both size and weight rebounded the following year with average-to-good food abundance, compensating for temporary slowdown and returning bears to a normal growth trajectory. About half the growth observed in yearlings occurred during early summer and half during late summer; in 2-4-year-olds, more than half the growth observed occurred in early summer.

Modeled growth curves indicated that across the population, 95% of males reached full size (full skull length) by 7 years of age and 99% by 10 years, whereas 95% of females completed growth by 4 years of age and 99% by 7 years. Bears reached similar adult size in upland and lowland habitats, despite large differences in food availability, however, lowland bears grew slower and required more time to reach adult size.

In conclusion, despite temporary slowdown in growth, there was no difference in the adult size achieved by bears that experienced a severe food shortage during their growing years. Rebound was quick once food availability returned to normal. Instead, small size in adulthood appeared to stem from pre- and peri-natal nutrition related to maternal age and condition. Bears display a physiologic resiliency that enables them to withstand periodic famine with minimal lasting effect.

LITERATURE CITED

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