

PANEL 1: THE ECOLOGY, POPULATION CHARACTERISTICS, MOVEMENTS AND NATURAL HISTORY OF BEARS

Black Bear Population Dynamics at Cold Lake, Alberta, 1968-70

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SUMMARY

A black bear (*Ursus americanus*) population study was initiated near Cold Lake, Alberta in 1968. In the three succeeding years, 108 individual bears have been captured 210 times. Mean estimates of population on the 80 square mile study area have been 78 in 1968, 79 in 1969, and 78 in 1970. Sex ratios of trapped subadults and in adults in 1968 and 1969 did not differ significantly from a theoretical 50:50. Significant differences in the adult cohort in 1970 were probably due to differences in mobility; the males ranging considerably more than females. The age composition of the black bear population did not differ significantly from other un hunted bear populations. A time-specific life-table analysis disclosed that mortality rates were 26.7% in cubs, 36.7% in yearlings, 37.5% in 2-year olds and 12.5% in adults.

INTRODUCTION

Our investigations of black bear population dynamics and ecology began near Cold Lake, Alberta, in May 1968. The purpose of this study is to determine the regulatory mechanisms acting on an un hunted black bear population. The initial phase of this study, in which we are presently involved, is designed to calculate estimates of population, determine rates of age-specific survival and mortality, and document the demographic parameters of the bear population. The second phase of our study is to evaluate the impact of environmental factors on bear population. This phase is directly concerned with population regulation.

We are presently capturing, marking and releasing bears on an eighty square-mile study area bordering the northwest shore of Cold Lake. Each animal is weighed, measured, individually color-marked for field identification and tattooed for permanent identification. In addition a tooth, either P_4 or P_1 is extracted for sectioning and subsequent age determination. During the period 1968-1970, 108 individual bears have been captured 210 times.

The present paper briefly presents our material on population phenomenon to date and presents a résumé of future project activities.

POPULATION ESTIMATES

In bear studies previously conducted, estimates of population have been based on a variety of methods, these ranging from Lincoln and Schnabel estimates, in at least two studies, to questionnaires, dump counts, casual observations,

numerous census techniques and in many cases to simple guess work (Bray & Barnes 1967).

A basic assumption in the use of marked/unmarked ratios to estimate total numbers is that either the initial marking or subsequent recapture or both be conducted in a random manner. Other prerequisite assumptions were considered fulfilled.

Homogeneity of trap response was tested by comparing the frequency distribution of capture (Table 1, column 2, 4 & 6) with an appropriate Poisson distribution (Table 1, column 3, 5 & 7) for the years 1968-1970. The mean (m) for the Poisson distribution was calculated by completing the O-capture category of the frequency distribution of captures using a 'maximum likelihood technique' described by Hartley (1958). The insignificant chi-square values (Table 1) indicate that we have achieved homogeneity of trap response and can hence utilize our capture data to calculate estimates of population based on Lincoln-index and Schnabel estimates (Table 2). Further, completion of the O-capture category as previously described, afforded us an additional independent estimate of population (Table 2). The Schnabel estimates (Table 2) were modified by calculating the mean estimate from the individual estimates only after the individual estimates had reached a plateau and levelled off.

The resulting mean estimates of population (Table 2) indicate a density of approximately 1 bear/square mile on our study area. This rather high density appears to be a function of diverse habitat types available on the study area. Certainly bears occupy different habitat types throughout the summer period and these appear to be adequately represented on the study area. The estimates also suggest a remarkable degree of stability in population numbers from 1968 to 1970. This stability would, however, be somewhat anticipated for a large carnivore such as the black bear.

TABLE 1. DISTRIBUTION OF TOTAL CAPTURES OF BEARS NEAR COLD LAKE, ALBERTA, Summers, 1968-1970

No. of captures for individual bears	1968		1969		1970	
	No. of bears	Poisson m=1.20	No. of bears	Poisson m=0.50	No. of bears	Poisson m=0.85
0	?		?		?	
1	24	24.0	32	32.8	34	34.2
2	13	14.4	8	8.2	15	12.8
3	5	5.8	2	1.4	4	4.4
4	2	2.1			1	1
5	1	1				
Totals	45	46.3	42	42.4	54	52.4
Chi-square	0.65		0.11		0.46	

TABLE 2. BLACK BEAR POPULATION ESTIMATES FOR 1968-1970

1968			1969			1970		
Mean date	Numbers estimated	Basis ¹	Mean date	Numbers estimated	Basis ¹	Mean date	Numbers estimated	Basis ¹
June 6	40	A	May 25	91	A	May 25	76	A
July 16	145	A	July 17	56	A	June 21	78	A
Aug. 23	79	A		108	B	July 28	76	A
	76	B		62	C		94	B
	62	C					64	C
Mean	78 ± 47			79 ± 40			78 ± 13	

¹) Numbers estimated based on:

- A. Lincoln index; retrapping of marked individuals.
- B. Completion of O-capture category using a 'maximum likelihood' technique.
- C. Modified Schnabel.

SEX RATIOS

There was no significant difference in sex ratios of trapped bears in 1968 and 1969 (Table 3). The 35:19 sex ratio in 1970 is, I feel, a function of mobility differences between males and females, particularly during the breeding season. Our movement data indicates that adult males are the most mobile cohort in the bear population, particularly during the breeding season. Likewise, females with cubs are very sedentary and are difficult to trap at different baited snare locations. The sex ratio of subadults does not differ significantly from the theoretical 50:50 and we can see no factor which would induce sex-specific mortality on adult females.

TABLE 3. SEX RATIOS BY AGE GROUPS FOR BLACK BEAR POPULATION 1968-1970

	1968		1969		1970		Total
	No. Males	No. Females	No. Males	No. Females	No. Males	No. Females	
Cubs	6	4	2	3	4	2	21
Yearlings	1	1	6	3	4	3	18
Older	18	17	16	12	27	14	104
Totals	25	22	24	18	35	19	143

AGE RATIOS

To make our data comparable to that of other workers, the age cohorts are indicated as cubs, yearlings and older animals (Table 3). This breakdown is convenient in that yearlings can be fairly accurately aged from weight alone. Tooth sectioning is not yet completed.

The age composition of our black bear population does not appear to be appreciably different from the age composition data published by Troyer & Hensel (1964) for Alaskan brown bear or Hornocker (1962) for a Yellowstone grizzly population.

MORTALITY RATES

A time-specific life-table analysis was used to compute mortality rates from population age composition data obtained from known-age animals (Table 4). A basic assumption in a life-table approach of this type is that the population is stationary and age stable with fixed rates of birth and death. Our population estimates and age composition data suggest that our bear population may indeed meet these assumptions. Pooling the data for 1968 and 1969 would further reduce any distortions from varying birth rates.

The life-table analysis discloses a mortality rate of 26.7% in cubs, 36.7% in yearlings and 37.5% in 2-year olds. Upon reaching maturity, this mortality

**TABLE 4. TIME SPECIFIC LIFE-TABLE ANALYSIS
OF AGE COMPOSITION DATA**

Age	Number alive l_x	Number dying d_x	Mortality q_x
c	15	4	26.7
1	11	3	36.7
2	8	3	37.5
3	5		
4	4		
5	5		
6	2		
7	7	5	12.5
8	6		
9	2		
10	1		
>10	8		
	74	15	

rate declines to 12.5%. The relatively high mortality in yearlings and 2-year-olds appears to coincide with the period beginning with self-sufficiency and before reaching maturity. Our movement data further demonstrates that subadults are only slightly less mobile than adult males. Hence this mortality is associated with dispersal of the subadults. Our hypothesis at this time is that this mortality is induced by adult members of the bear population and hence the bear population would be largely self-regulating.

PROPOSED PROGRAM

At this time we suspect that mature males are responsible for the high mortality of the subadult bears. To test our hypothesis we propose to eliminate as many adult males as possible, beginning in 1971 or 1972 at the latest. We will then monitor the population for a further two years to document changes in subadult survival and reproduction. Elimination of the adult males will also imitate the type of exploitation we wish to promote in a trophy-hunting situation. This program will then give us some indication of the proportion of adult males we can harvest without significantly reducing reproduction.

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