

# PRELIMINARY ANALYSIS OF FEMALE REPRODUCTIVE TRACTS FROM PENNSYLVANIA BLACK BEARS<sup>1</sup>

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**Abstract:** Reproductive tracts were collected from 87 female black bears (*Ursus americanus*) killed by hunters in northeastern and north-central Pennsylvania during November 1974 and 1975. Pregnant animals carried an average of 2.75 corpora lutea. Corpora lutea were significantly larger in tracts that had implantations than in tracts during the delay stage. The sources of ova were found to be equally divided between ovaries. Twelve blastocysts and 22 implanted embryos were examined. Variation in development stage among these samples indicated that implantation occurred late in November or early in December. An average of 2.88 placental scars were observed in animals bearing scars. Potential recruitment from first breeding (2.39 animals) was significantly less than from second or later breedings (3.23 animals). Minimum breeding age for female bears was 2.5 years, at which time 38 percent of the animals bred. The majority of females bred by the time they were 3.5 years old. A very low incidence of nonbreeding females was found.

Pennsylvania maintains one of the largest populations of black bears in the northeastern United States, but in recent years increasing concern for the status of the population has created a need for improved management information.

We extend our appreciation to J. Giles, J. Lambiase, and W. Shope for aid in examination of reproductive tracts and in age determination; to Pennsylvania Game Commission personnel, graduate students, and successful hunters for their efforts in collecting the tracts; and to R. Anthony, J. Lambiase, and G. Storm for their helpful suggestions for improving the manuscript.

## METHODS

Reproductive tracts and first premolar teeth were collected from 87 female bears harvested in northeastern and north-central Pennsylvania on 24 November 1974 ( $N = 35$ ) and 25 November 1975 ( $N = 52$ ). Most tracts were fixed in 10 percent formalin within several hours of death, although some were received frozen. All tracts were stored in 10 percent formalin until examined. Uterine cornus length was measured to the nearest mm from the point of bifurcation to the bursa-cornus junction. Outside diameter and inside circumference at the midpoint of each uterine horn were measured to the nearest mm. Horns were then opened to locate and count blastocysts, embryos, or placental scars. To simplify recording of blastocyst and implantation sites, cornu were divided into four regions. Region 1 was the quarter of each uterine horn nearest to the ovary, regions 2 and 3 were the next nearest quar-

ters, and region 4 was the quarter of each uterine horn closest to the bifurcation.

Ovaries were excised, cleaned of extraneous material, blotted dry, and weighed to the nearest 0.01 g. Each ovary was then divided along its long axis to count and measure any corpora lutea present.

The bears were assigned to age-classes by counting cemental annuli in prepared tooth sections (Willey 1974). Age distribution of the 87 animals is shown in Table 1.

**Table 1.** Age distribution and reproductive condition of 87 female bears harvested in Pennsylvania, 1974 and 1975.

Age	Sample size	Number pregnant	Number with placental scars	Number with no evidence of breeding
Cub	2	0	0	2
1.8	21	0	0	21
2.8	10	5	0	5
3.8	16	9	5	2
4.8	9	1	8	0
5.8	7	0	7	0
6.8	3	0	2	1
7.8	8	3	4	1 <sup>a</sup>
8.8	5	2	3	0
9.8	3	1	2	0
11.8	1	0	1	0
13.8	1	0	1	0
20.8	1	0	0	1 <sup>b</sup>
Total	87	21	33	33

<sup>a</sup>Less than half of tract available for examination.

<sup>b</sup>Cyst on antimetrial side of one horn.

## RESULTS

Size of reproductive tracts, as reflected by cornus measurements and ovarian weights, increased with age and with pregnancy. Heaviest ovaries were those bearing corpora lutea, with each corpus adding about 0.50-1.25 g to ovarian weight (Table 2, 3). The largest of the 44 corpora lutea examined measured  $18 \times 12 \times$

<sup>1</sup>Paper No. 210 of the Pennsylvania Cooperative Wildlife Research Unit; The Pennsylvania State University, Pennsylvania Game Commission, U.S. Fish and Wildlife Service, and the Wildlife Management Institute, cooperating.

Table 2. Cornus sizes of Pennsylvania bears, 1974 and 1975. SD = Standard Deviation.

Age	Length (mm)		Inside circumference (mm)		Outside diameter (mm)	
	Mean	SD	Mean	SD	Mean	SD
10 months	64.2	12.0	4.5	0.7	2.6	0.5
1 year, 10 months	82.8	16.9	7.1	1.4	3.3	0.6
2 years, 10 months	97.8	37.2	11.2	4.8	5.0	1.8
Never bred						
2 years, 10 months Pregnant	111.4	23.6	14.3	1.8	6.4	1.0
3 years, 10 months Bred previous year	117.8	14.2	11.4	3.0	5.2	0.6
3 years, 10 months Pregnant	140.8	15.0	15.6	2.3	7.0	0.9
≥4 years, 10 months Bred previous year	115.1	21.9	11.7	1.9	5.5	0.9
≥4 years, 10 months Pregnant	164.5	28.1	16.0	3.5	7.8	1.6

Table 3. Ovarian weights (g) by number of corpora lutea from Pennsylvania bears, 1974 and 1975. SD = Standard Deviation.

Age	Number of corpora lutea							
	0		1		2		3	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1 year, 10 months	1.24	0.49	-	-	-	-	-	-0-
2 years, 10 months	1.30	0.31	-	-	-	-	-	-
Never bred								
2 years, 10 months Pregnant	-	-	1.17	0.27	-	-	-	-
3 years, 10 months Bred previous year	1.95	0.62	-	-	-	-	-	-0-
3 years, 10 months Pregnant	-	-	1.92	0.63	2.47	0.81	3.70	-
≥4 years, 10 months Bred previous year	2.35	0.71	-	-	-	-	-	-0-
≥4 years, 10 months Pregnant	-	-	2.19	0.87	3.39	0.71	4.45	0.87

14 mm and was from a tract in which implantation had occurred. Mean maximum diameter of corpora lutea was 9.8 mm ( $N = 24$ ) in tracts that had not implanted and 12.3 mm ( $N = 20$ ) in implanted tracts, the difference being significant ( $P < 0.01$ ). Corpora lutea counts for 15 animals from which complete tracts were obtained yielded an average of 2.75 luteal bodies per animal.

Thirteen of the 15 bears mentioned above carried more than 1 corpus each. Erickson and Nellor (1964:29, 32) stated that "Multiple ovulations seem for the most part to be confined to one ovary, indicating that in most cases one ovary is more active than the other during the breeding season. . . ." Our observa-

tions, however, indicate that there is insufficient evidence for rejecting the hypothesis that both ovaries contribute equally to the total conceptus complement (Table 4).

Table 4. Distribution of corpora lutea in ovaries from 13 Pennsylvania bears having 2 or more corpora. For hypothesis of equal distribution between ovaries, chi-square = 3.44,  $P > 0.25$ .

Number of corpora lutea	Distribution between ovaries	Number of bears	
		Expected	Observed
2	0, 2	3.00	1
	1, 1	3.00	5
3	1, 2	2.25	2
	0, 3	0.75	1
4	0, 4	0.50	0
	1, 3	2.00	2
	2, 2	1.50	2

Twelve of 29 potentially recoverable blastocysts (based on corpora lutea counts) were located. Two were found in region 1 (the quarter of the cornus nearest the ovary), 6 in region 2, 3 in region 3, and 1 in region 4. All blastocysts were free-floating within the lumen or were unattached within the rugose folds of the uterus. The inner cell mass and trophoblast were evident in well-preserved specimens. All blastocysts were enclosed in a zona pellucida as described by Wimsatt (1963).

Twenty-two implantations occurred in 8 animals. Variation of multiple embryo development within animals was negligible, but variation among animals ranged from stages of recent implantation to well-developed embryos with limb buds and recognizable somites.

Implantation sites determined by placental scars and current implantations were equally divided among the three regions of the cornu closest to the bifurcation. Only 1 or 88 (1.1 percent) occurred in the region closest to the ovary. Scars were readily observed on the inner surface of the cornus but could not be seen by external examination of the tract. Changes in, and proliferation of, the endometrium of pregnant animals effectively obscured placental scars. These scars reappeared after parturition in at least some animals. In 2 tracts, scars could be categorized as faded or bright. Sixty-nine recent placental scars were counted on 29 complete tracts bearing scars, an average of 2.88 scars per tract.

Potential recruitment from first breeding averaged 2.39 animals ( $N = 23$ ,  $Sd = .066$ ) as derived from a sample formed by combining counts of corpora lutea from 2- and 3-year-old animals with recent scar

counts from 3- and 4-year-old animals. Potential recruitment from second and later breedings averaged 3.23 animals ( $N = 22$ ,  $SD = 0.75$ ). This estimate was determined from a sample formed by combining corpora lutea counts from animals older than 3 years with placental scar counts from animals older than 4 years. Second and later breedings had a significantly greater potential for recruitment than did first breedings ( $P < 0.01$ ).

Using the same technique to estimate the proportion of females breeding, we found that 38 percent of the females entered the breeding population at 2.5 years of age (Table 5). Our sample indicates that 88 percent of all females were bred by the time they reached 3.5 years of age.

Table 5. Proportion of sample of female bears in Pennsylvania showing evidence of breeding by age-class 1974-75.

Age	Number breeding/total	Percent
2.8	10/26	38
3.8	17/25	68
4.8	8/16	50
5.8	2/10	20
6.8	4/11	36
7.8	6/13	46
8.8	4/8	50
≥2.8	51/109	47

## DISCUSSION

Variability in conceptus development observed among bears harvested during the third week of November is sufficient evidence for placing time of implantation in Pennsylvania between mid-November and early December. Because of rapid growth immediately after implantation (Daniel 1974), we would expect embryos larger than those observed if implantation occurred much earlier. Had implantation occurred much later, it is doubtful that any well-developed embryos would have been found.

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High potential recruitment in Pennsylvania bears appears due to high ovulation rates, low intrauterine mortality, a low incidence of nonbreeders, and early sexual maturity. Corpora lutea and placental scar counts are considerably higher than those reported in Virginia (Stickley 1957), Michigan (Erickson and Nellor 1964), North Carolina (Collins 1974), and Montana (Jonkel and Cowan 1971). Our observations indicate that all females older than 2.5 years have the potential to produce approximately 2.5 cubs every other year.

Although reports of successful breeding by 2.5-year-old female bears are not unprecedented (Stickley 1957, Ammons 1974, Collins 1974), it was believed to occur only rarely (Collins 1974). The estimated 38 percent of Pennsylvania females breeding at 2.5 years of age significantly increases the reproductive potential of the population. The high reproductive potential may be explained, in part, by the large quantity and variety of foods provided in Pennsylvania's oak and transition forests.

Since only 1 of the bears examined was of known age, failure to determine accurately the age of the animals could be a source of bias in this study. Nevertheless, comparisons of our age assignments with those of other workers showed essential agreement in 36 of 38 tooth sections. The recorded increase in cornus size and in ovarian weight with increasing assigned ages provides added confidence in our age determinations. Although error might also occur through overestimation of the implantation rate through counting both old and recent placental scars and considering them one pregnancy, the probability of this occurrence appears minimal because of the obvious difference in brightness between old and new scars. Old scars also fade more rapidly than new ones when exposed to formalin, further lessening the chances of confusing old and new scars (Erickson and Nellor 1964).