Winter Movements and Denning of Black Bears in Northwest Florida

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Abstract: Information on winter movements and denning of Florida black bears (*Ursus americanus floridanus*) is important to develop habitat management programs. I studied denning characteristics and winter movements of 13 radio-collared bears (9M, 4F) in the Apalachicola National Forest and surrounding timberlands of northwest Florida from 1990–91 to 1992–93. All monitored bears denned during the study. Pregnant females entered dens earlier ($P < 0.02$), emerged later ($P < 0.02$), and denned longer (142 ± 5 [SE] vs. 52 ± 7 days) than other bears. Denning periods for pregnant females were similar to those reported from other Southeastern black bear populations. Males denned for short periods ($\bar{x}$ = 51 ± 8 days, $N = 8$). One male bear, which denned during winter 1991–92, remained active during winter 1992–93, using a range of 37 km^2. All males, even when they denned, ranged widely during winter ($\bar{x}$ = 18 ± 7 km^2). Short denning periods and extensive winter movements are likely related to food availability, mild climate, and possibly habitat quality.

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Black bear denning behavior has been studied extensively in northern climates (e.g., Kolenosky and Strathearn 1987, Rogers 1987, Schwartz et al. 1987); however, less is known about denning in Southeastern coastal plain bear populations. Studies by Hamilton and Marchinton (1980), Smith (1985), Hellgren and Vaughan (1987, 1989), Wooding and Hardisky (1992), Lombardo (1993), and Weaver and Pelton (1994) show much variation in winter activity, denning chronology, and den types used throughout the Southeast. Some of the variation may be from local environmental conditions. Winter-active bears have been reported from many studies (Alt et al. 1976; Hamilton and Marchinton 1980; Smith 1986; Hellgren and Vaughan 1987, 1989; Graber 1990; Wooding and Hardisky 1992; Lombardo 1993; Weaver and Pelton 1994). Graber (1990) mentioned bears roaming over a few square kilometers during winter, but only Hell-

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gren and Vaughan (1987) described winter range size and movement. Information on winter movements and denning of bears is important to develop habitat management programs.

Previous research in north central Florida (Wooding and Hardisky 1992), showed that some bears were active throughout winter, others denned for short periods, and pregnant females denned for periods of time similar to other Southeastern bear populations. This paper describes winter activity and denning ecology of black bears in northwest Florida.

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Methods

Study Area

Field work was conducted on the Apalachicola National Forest (2,261 km^2) and adjacent industrial timberlands in the Florida panhandle (collectively referred to as ANF). The entire area was 3,002 km^2. Major plant communities in ANF were pine (*Pinus* sp.) flatwoods interspersed with hardwood swamps and ericaceous shrub swamps dominated by titi (*Cliftonia monophylla*). Extensively drained, boggy pine flatwoods characterize the private timberlands. Average high and low temperatures (°C), respectively, for winter are: December (19, 5), January (19, 5), February (20, 6), and March (23, 9) (Winsberg 1990). Rainfall from December to March averages 10–12 cm/month (Natl. Oceanic and Atmos. Admin. 1976).

Data Collection and Analysis

Black bears were captured with Aldrich foot snares (Johnson and Pelton 1980*a*), immobilized, fitted with breakaway radio collars (Seibert and Wooding 1994), and released. The first premolar was extracted for aging by cementum annuli analysis (Willey 1974). Bears 1–2 years old and 3-year-old females that had not reproduced were classified as subadults. All other bears ≥3 years old were considered adults. Bears were located 2 to 3 times per week from December 1990 to April 1993. Winter ranges (December 10–March 31) were calculated using ground triangulations (N = 131) and aerial telemetry (N = 195). Mean bearing error was 5.8°, and the standard deviation of error associated with hand-held equipment was 5.2° (N = 25). Minimum convex polygon (100% of locations) ranges (Hayne 1949) were constructed with TELEM88 (Coleman and Jones 1988).

I radio-tracked bears to dens in winter and defined entry dates as the mid-

point between the last recorded movement and the first of a series of stationary signals (O'Pezio et al. 1983). Date of den emergence was defined as the midpoint between the last denning location and the first radio location away from the den (O'Pezio et al. 1983). I used the Mann-Whitney *U*-Test (Siegel 1956) to analyze differences in den period.

I did not approach bears at their den sites in order to prevent den abandonment (Smith 1986, Hellgren and Vaughan 1989, Wooding and Hardisky 1992, Lombardo 1993). Den sites of pregnant females were examined for evidence of cub production after emergence in mid-April. General cover type of all den sites was classified by aerial observation.

I compared proximity of bear den sites and random points to roads on the study area to assess the effect of roads on bear den sites. Distances from roads were grouped into 3 categories: ≤150, 151–630, and >630 m. Chi-square and Bonferroni *Z*-statistics (Neu et al. 1974, Byers et al. 1981) were used to compare the distribution of den sites and random distances from roads at $P = 0.05$.

Results

Thirteen bears (9M, 4F) were monitored during winter 1990–91 through winter 1992–93. All bears denned at least once during the study period; including 1 male which denned in one year and was active the next year. One yearling male (M-13) was included as a female with yearlings because yearlings normally den with their mothers (Rogers 1987).

Winter Activity

Winter ranges were constructed for male and non-pregnant female bears; however, small sample size precluded comparisons between sexes. Winter ranges of males ($\bar{x} = 18 \pm 7$ km^2, range 0.3–60 km^2, $N = 8$) varied, while non-pregnant female ranges ($\bar{x} = 6.6 \pm 2$ km^2, $N = 3$) were less variable. Winter movements by pregnant females ($N = 3$) were practically nonexistent, although 1 female shifted her den site twice during December.

One adult male remained active during an entire winter using a range of 37 km^2. The previous winter, as a subadult, he used a winter range of 25 km^2 and denned for 46 days. Two other males remained active for most of a winter using ranges of 11 and 60 km^2, and denned for only 13 and 23 days, respectively.

Denning Ecology

Denning periods varied from 13 to 150 days (Table 1). Pregnant females ($N = 3$) denned longer (142 ± 5 days, $P < 0.02$) than other bears (51 ± 7 days). Denning began 50 days earlier (1 Dec ± 2 days, $P < 0.02$) than other bears ($N = 11$, 20 Jan ± 7 days) and they emerged 40 days later (20 Apr ± 3 days, $P < 0.02$) than other bears (11 Mar ± 4 days). Male bears ($N = 8$) denned for an average of 51 ± 8 days (Table 2). One female monitored for 2 winters denned during both winters, but for different lengths of time due to her reproductive

Table 1. Denning chronology of black bears in northwest Florida, during the winters of 1990–91 through 1992–93.

		Denning chronology					
		Entry date		Emergence date		Denning period	
Age/sex group	*N*	$\bar{x}$ (range)	SE (days)	$\bar{x}$ (range)	SE (days)	$\bar{x}$ (range)	SE (days)
Pregnant female	3	1 Dec (27 Nov–4 Dec)	2	20 Apr (15 Apr–25 Apr)	3	142 (134–150)	5
Solitary female/or with yearlings	3	3 Jan (24 Dec–13 Jan)	6	26 Feb (12 Feb–6 Mar)	7	55 (31–72)	12
Adult male	6	19 Jan (31 Dec–18 Feb)	7	17 Mar (8 Mar–2 Apr)	4	58 (23–75)	8
Subadult male	2	10 Feb (21 Jan–1 Mar)	20	10 Mar (6 Mar–13 Mar)	4	30 (13–46)	17

Table 2. Black bear denning dates and duration in northwest Florida during the winters of 1990–91 through 1992–93

Bear ID	Age	Entry date	Emergence date	Estimated *N* days	
M-01	2	1 Mar 91 ± 1 day	13 Mar 91 ± 1 day	13	
M-15	3	18 Feb 93 ± 2 days	12 Mar 93 ± 3 days	23	
F-08	7	13 Jan 93 ± 1 day	12 Feb 93 ± 2 days	31	
M-12	2	21 Jan 92 ± 1 day	6 Mar 92 ± 3 days	46	
M-07	5	19 Jan 92 ± 6 days	8 Mar 92 ± 4 days	50	
M-04	4	24 Jan 92 ± 3 days	15 Feb 92 ± 3 days	23	
		15 Feb 92 ± 3 days	25 Mar 92 ± 2 days	39	62[a]
M-13[b]	1	4 Jan 92 ± 4 days	6 Mar 92 ± 3 days	63	
M-214	8	6 Jan 93 ± 6 days	12 Mar 93 ± 3 days	66	
F-26	6	24 Dec 92 ± 6 days	16 Jan 93 ± 2 days	24	
		16 Jan 93 ± 2 days	5 Mar 93 ± 2 days	48	72[a]
M-92	7	31 Dec 92 ± 3 days	12 Mar 93 ± 3 days	72	
M-02	3	19 Jan 92 ± 2 days	2 Apr 92 ± 6 days	75	
F-08	6	4 Dec 91 ± 7 days	15 Apr 92 ± 7 days	134	
F-18	7	1 Dec 92 ± 7 days	22 Apr 93 ± 1 day	143	
F-27	8	27 Nov 92 ± 3 days	12 Dec 92 ± 2 days	15	
		12 Dec 92 ± 2 days	24 Dec 92 ± 6 days	12	
		24 Dec 92 ± 6 days	25 Apr 93 ± 2 days	123	150[a]

[a]Represents total denning days for bears that used multiple den sites.
[b]Presumed to be denned with his mother.

status. She gave birth to cubs during winter 1991–92 and denned for 134 days. During winter 1992–93 she denned with 2 yearlings for 31 days (Table 2).

Forested stands containing den sites ranged from 1,382 ha to small, narrow strands (<100 m width) of extremely dense vegetation. General cover types of den sites included pine flatwoods ($N = 7$), shrub swamp (titi) ($N = 5$), hardwood swamp/titi strand in pine flatwoods ($N = 3$), and hardwood swamp ($N = 3$). I examined 2 maternal den sites after emergence in mid-April. Both were ground dens located on densely vegetated hammocks in wetlands. The den of female F-28 was a cypress stump in a narrow strand of hardwood swamp/titi in the pine flatwoods. The stump was cut 76 cm above the ground and was enclosed on all sides with the "roof" being a thick layer of shrubs. The den of F-18 was an excavated ground cavity dug under the root system of a complex of sweetbay (*Magnolia virginiana*) trees in an inundated hardwood swamp. Both maternal dens had minimal amounts of leaves lining the dens.

Den sites were located an average of 568 ± 215 m (range = 70–3,400 m, $N = 18$) from roads. Two males denned within 140 m of busy 2-lane highways. Chi-square analysis indicated there was no effect of roads on den site selection. All distance categories were used in proportion to availability. Three bears moved to different den sites during winter: one female moved twice before giving birth to cubs and 2 other bears were displaced by flooding.

Denning bears were not displaced by prescribed fire. A compartment within 200 m of a female with neonatal cubs was burned but did not cause

den abandonment. Additionally, an adult male which had not denned remained inside a forest compartment while it burned, presumably seeking shelter in a titi thicket.

Discussion

Winter movements were extensive even for male bears who eventually denned. One adult male denned for 57 days, but still used a winter range of 26 km^2. However, only 1 bear, an adult male, remained active an entire winter. Hellgren and Vaughan (1987) described the movements of 4 winter-active bears in Great Dismal Swamp (GDS) Virginia-North Carolina, but their ranges were small (0.4–4.5 km^2) compared to winter ranges in ANF (0.3–60 km^2, $N = 11$). Winter movements in ANF may result from available foods existing for a longer time than in GDS, relatively poor habitat quality, warmer weather, or a combination of factors. Average annual home ranges for adult bears in ANF (male = 209 km^2, female = 65 km^2, Seibert 1993) were larger than those reported for most black bear populations. Size of adult female ranges may reflect habitat quality (Alt et al. 1976, Amstrup and Beecham 1976) with small ranges indicating better quality habitat. The large adult female annual ranges and large male winter ranges may suggest poor habitat quality in ANF.

Wooding and Hardisky (1992) suggested that pregnant females are obligated to den for 3–4 months to care for newborn cubs. This denning period appears consistent for pregnant female bears throughout the Southeast (Hamilton and Marchinton 1980, Johnson and Pelton 1980*b*, Smith 1985, Hellgren and Vaughan 1989, Wooding and Hardisky 1992, Weaver and Pelton 1994, this study) and may represent the minimum time denned females need to care for newborn cubs. Pregnant females den for longer periods (5–8 months) in northern areas where food shortages and severe winter weather are limiting factors (Jonkel and Cowan 1971, Kolenosky and Strathearn 1987, Rogers 1987). Pregnant females in ANF entered dens 21 days earlier (1 Dec) than pregnant females in north central Florida (22 Dec) (Wooding and Hardisky 1988).

Male and non-pregnant female bears displayed much variation in denning period (Table 2). Non-pregnant females denned for 55 days in ANF compared to 71, 81, and 82 days in the Tensas River Basin in Louisiana (Weaver and Pelton 1994), White River Basin in Arkansas (Smith 1985), and GDS (Hellgren and Vaughan 1989), respectively. Males in Arkansas (Smith 1985) and GDS (Hellgren and Vaughan 1989) denned for longer periods, 76 and 82 days, respectively, than males in ANF (51 days). ANF males denned for periods similar to Louisiana males (43 days) (Weaver and Pelton 1994). The denning period for males in ANF was longer than those from north central Florida, who commonly denned for $\leq$17 days (Wooding and Hardisky 1992). The denning period for males in ANF was more similar to populations in other Southeastern states than to bears in north central Florida. Wooding and Hardisky (1992) attributed the short duration of denning in northcentral Florida to existence of abundant

food sources (e.g., acorns) throughout early winter. Such quality food sources are less abundant in ANF, although low quality foods such as bitter gallberry (*Ilex glabra*) and greenbriar (*Smilax* spp.) berries persist throughout winter. Additionally, northwest Florida is more severely affected by cold air masses from the interior of the continent than is peninsular Florida where the Atlantic Ocean and Gulf of Mexico cause moderate temperatures (Winsberg 1990). Thus, different climatological effects and lack of quality winter foods likely contributed to ANF bears entering dens earlier and denning longer than bears in northcentral Florida.

Aerial observation indicated all den sites were located in dense vegetation. Den sites located in pine flatwoods ($N = 7$) were all located on privately-owned, industrial timberlands. These stands typically are lacking prescribed fire, which results in a dense shrub understory and security cover for denning bears. The security afforded bears by this dense cover likely contributed to the variability of den site selection in relation to stand size and distance to roads. ANF bears can select den sites close to roads in extremely dense vegetation because this impenetrable vegetation provides secure denning cover.

Management Implications

Prescribed fire in pine flatwoods, such as ANF, is a common forest management practice for manipulating habitat conditions. The frequency and seasonality of fire influences the woody understory and herbaceous component of the forest. Prescribed fires in ANF have typically occurred during winter. These fires usually do not penetrate titi thickets and bayheads more than a few meters, and likely do not affect denned black bears. However, bears have abandoned den sites because of excessive smoke from prescribed fires (Lombardo 1993). The chances of winter fires displacing denned bears will likely decrease as more growing season burns are implemented on ANF.

Den sites do not appear to be limited by the vegetation on ANF. The habitat mosaic of pine flatwoods interspersed with hardwood swamps and ericaceous shrub swamps provide protection from disturbance and an abundance of secure denning sites.

Black bears were hunted during a 12-day season in ANF during this study. Hunting season began on the Monday following the Thanksgiving holiday to protect females. Results from this study indicate that pregnant females were entering dens at the time the hunting season started and were receiving the intended protection from a late bear hunting season.

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