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BLACK BEAR MOVEMENTS AND HABITAT USE RELATIVE TO ROADS IN OCALA NATIONAL FOREST: PRELIMINARY FINDINGS

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Abstract: Since 1976, the Ocala National Forest and surrounding areas have accounted for over 50 percent of all black bear roadkill in Florida. To better understand the dynamics involved with this source of mortality, the Florida Fish and Wildlife Conservation Commission, in partnership with the Florida Department of Transportation and the United States Forest Service, began investigating the movements, habitat use, and home range dynamics of black bears relative to roads in Ocala National Forest. This paper presents the preliminary findings from the first two years of the study and focuses on the characteristics of bear crossings of State Road 40. We captured 94 bears (36F, 58M) and collected more than 3,400 locations from 77 radio-collared individuals. Radio-collared bears crossed State Road 40 a total of 324 times, with both sexes crossing at similar frequencies. Concomitant with telemetry locations, we documented 752 sets of bear tracks along a 17.7-kilometer disced transect adjacent to State Road 40. Bears crossed State Road 40 most frequently during the fall, with other peaks in spring and summer. We compared crossing sites to the available habitat adjacent to State Road 40 and documented road mortality sustained by bears since 1976. Bears crossed in young to medium aged stands of sand/pine scrub at higher frequencies than would be expected by chance. Bears crossed in mature sand/pine scrub and scrub oak stands at lower frequencies than would be expected by chance. The sites at which bears were most often struck by vehicles did not coincide with locations where bears most frequently crossed the road. There seem to be highway design features that may contribute to this phenomenon.

Introduction

Currently, Florida is home to over 15 million people, and habitat loss due to residential, commercial, agricultural, and transportation needs of humans is recognized as the most important cause in the decline of many of the state's wildlife populations (Kautz et al. 1993). The goal of the Florida Fish and Wildlife Conservation Commission (FWC) is to perpetuate the black bear (*Ursus americanus floridanus*) in Florida. However, management of bears to assure their future in Florida increasingly depends upon accurate biological information.

The Florida black bear once occurred throughout the Florida mainland. Unregulated hunting prior to 1950 and rapid conversion from native range to agricultural and urban landscapes in this century, however, has resulted in several geographically isolated sub-populations of bears and has contributed to its listing as a threatened species by the State of Florida throughout most of its range. Currently, the largest bear populations are concentrated in and around Ocala National Forest, Osceola National Forest, Apalachicola National Forest, the Big Cypress region, and Eglin Air Force Base.

Because bears in Florida have large home ranges and make extensive movements in response to reproductive activities and nutritional needs (Maehr and Brady 1984, Wooding and Hardisky 1994, Roof and Wooding 1996, Roof 1997), their behavior often puts them in conflict with the state's human population. Wooding and Brady (1987) noted that bear/vehicle collisions had occurred in 27 of Florida's 67 counties. More recent studies have identified collisions with vehicles as the leading cause of mortality among some bear populations in Florida (Wooding and Hardisky 1994, Land et al. 1994, Roof and Wooding 1996). Efforts to address highway mortality have been successful for panthers (Foster and Humphrey 1993) and bears (Roof and Wooding 1996) when based upon intensive home range, habitat use, and movement studies.

The Ocala National Forest is one of the largest and most important habitats for bears remaining in the state, but is located near the heavily populated central Florida area, which continues to develop at a rapid pace.

Since the FWC began documenting the numbers of bears killed by vehicles in 1976, the Ocala population has had the highest number of roadkills (381 of 880, or 43.3 percent of the statewide total) of any area in the state. Furthermore, more than half of 15 chronic roadkill problem areas in Florida identified by Gilbert and Wooding (1996) were in Lake and Marion counties. Since State Road 40 divides the Ocala National Forest, it provides a unique opportunity to assess bear movements relative to a major state road surrounded by prime bear habitat. The findings presented in this paper represent only the road crossing characteristics portion of the overall study and are preliminary in that they only address the first two years of a multi-year study. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation. This manuscript was prepared in cooperation with the State of Florida Department of Transportation.

Study Area

Snedaker and Lugo (1972) describe the vegetative communities and soils of ONF. Soil types on ONF are predominately old dune sands. The 169,290 ha forest has four major vegetative types: 1) swamps and marshes along the Oklawaha and St Johns rivers; 2) pine flatwoods between the rivers and the central ridge; 3) mixed hardwood swamps; and 4) dune-like interior ridges of sand pine (*Pinus clausa*) and scrub oaks (*Quercus spp.*) interspersed with numerous lakes and ponds (Ayedelott et al. 1975). Within ONF the study area used for the majority of this study is comprised overwhelmingly of the sand pine/scrub oak community. The core study area is centered on State Road 40 and extends south to Forest Road 573, north to State Roads 19 and 314, east to State Road 19, and west to Forest Road 579 (figure 1). This area encompasses approximately 335 km^2 (130 mi^2) and covers the central portion of Ocala National Forest.

Methods

We opportunistically captured bears throughout the designated study area. We trapped intermittently from mid May to mid December each year and concentrated trapping along the State Road 40 corridor. We captured bears by use of Aldrich spring-activated foot snares and immobilized them by injection of a 1:1 mixture of Tiletamine hydrochloride and Zolazepam hydrochloride (Telazol®) following standard procedures (Johnson and Pelton 1980). This mixture was administered at 4.5 mg/kg of estimated bear weight via a remote injection gun. We measured, weighed, ear-tagged and lip-tattooed all immobilized bears. Additionally, we collected hair and blood samples for genetic analyses, extracted a premolar tooth for aging purposes, and fitted selected individuals with radio collars for remote tracking. After work-up, bears were released at the capture site, or moved to a nearby area if safety during recovery was a concern.

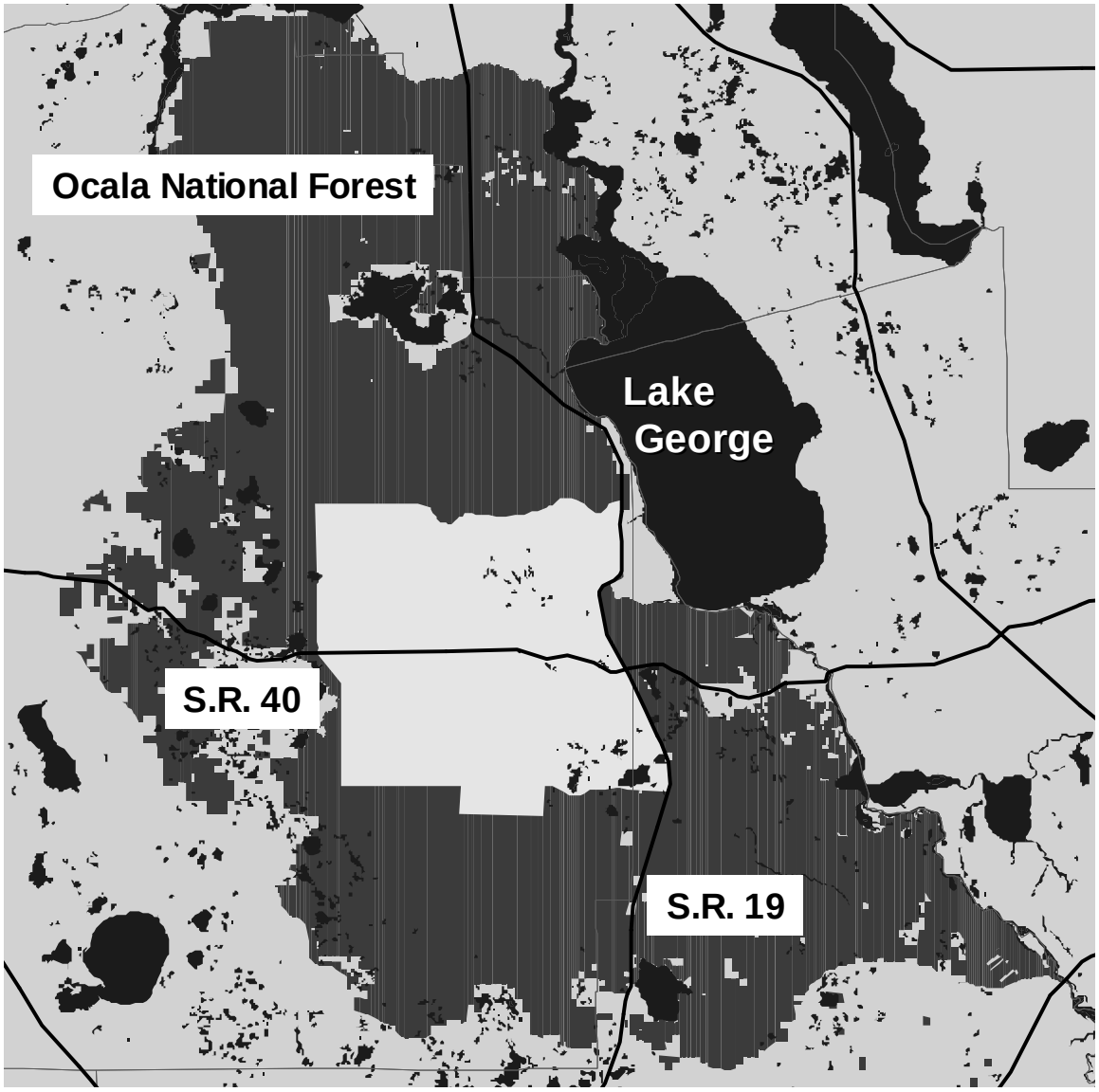

Fig. 1. Location of black bear study area (yellow area) within Ocala National Forest in central Florida.

We selected individuals to be fitted with radio collars based on several criteria, including: 1) ensuring bears were of adequate size (at least 100 lbs.) to prevent collar injuries due to growth, 2) preferentially sampling bears adjacent to State Road 40, and 3) maintaining as balanced a sex ratio as possible. Because more males were captured than females, we fitted a higher percentage of females with collars than we did males. We attempted to locate each collared bear two to three times weekly; due to inclement weather and scheduling conflicts; however, we located them less often. Generally, we acquired at least one location per week on most bears. We collected locations through the use of ground triangulation and aerial plotting. We used program Locate II to calculate error polygons for ground triangulations and assessed aerial telemetry error through the location of collars placed at known sites. We excluded all ground triangulations with excessively large error polygons from analyses and used all aerial locations because of the small error associated with their location. We documented mortality events for all collared bears by ground checking mortality signals, and we performed necropsies on dead bears to verify their cause of death.

We documented road crossings by bears with two techniques. Because of the overlap in the two techniques (radio-collared bear crossings could have been counted in the track transect), we analyzed and interpreted results from each technique separately. The first technique consisted of connecting consecutive telemetry locations that fell on opposite sides of State Road 40. From this technique we could identify individual bear

crossing tendencies. We used this technique to document and compare crossing rates between individuals, sexes, and seasons. We defined seasons so as to correspond with important yearly biological events for bears: winter (denning) = January – April, spring (pre-breeding) = May – June, summer (breeding) = July – September, and fall (hyperphagia) = October – December.

The second technique involved monitoring of a disk transect along State Road 40. The transect started at Forest Road 579 on the western side of the study area, traveled approximately 18 km eastward, and ended at S.R. 19. The disk transect alternated from the south to north side of S.R. 40 at roughly 2-km intervals to discourage use by off-road vehicles and avoid patches of endangered plant life. Each month we monitored the transect once a week for three weeks and further monitored it daily for one week, totaling approximately 10 monitoring trips each month. This schedule allowed us to document daily and weekly use rates for subsets of data as well as overall use rates for all of the data. Also, we analyzed the frequency of crossings in different forest cover types and compared them to expected frequencies based on percent coverage of each forest type (Neu et al. 1974).

Results

Forty-four of 63 radio-collared bears with more than 10 locations crossed State Road 40 a total of 324 times (average = 7.4, range = 1 – 40). Sixteen females crossed a total of 108 times (average = 6.8, range 1 – 30) and 28 males crossed a total of 216 times (average = 7.8, range 1 – 40). Crossing rates of males and females did not vary significantly (p=0.7438). Crossings were lowest in winter and spring, increased in the summer, and peaked in the fall (figure 2).

We documented 752 bear track crossings of S.R. 40 at 707 locations along the disk transect (figure 3). The number of tracks per location varied from one to four. Weekly crossings averaged 8.1 (range 0 - 67) and daily crossings averaged 2.2 (range 0 - 13). Frequencies of crossings increased in the spring and fall and decreased in the winter and summer (Figure 4). Locations of historic road mortalities were heavily skewed toward the eastern half of S.R. 40 within the study area, even though crossings occurred throughout the length of the track transect (figure 3). Crossings occurred at young- to medium-aged stands of sand pine at frequencies greater than would be expected by chance (table 1). Conversely, crossings occurred at mature-aged stands of sand pine and oak pine scrub at frequencies less than would be expected by chance (table 1). Seven marked bears (4 radio-collared and 3 tagged) were hit and killed by vehicles on State Road 40.

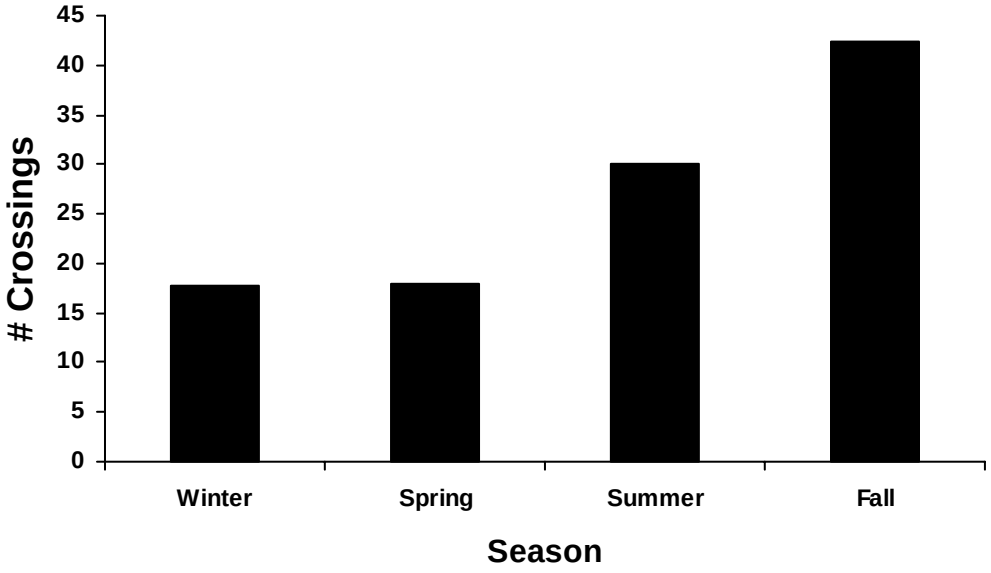

Fig. 2. Mean monthly crossings of SR 40 by radio-collared black bears in Ocala National Forest, May 1999 – May 2001.

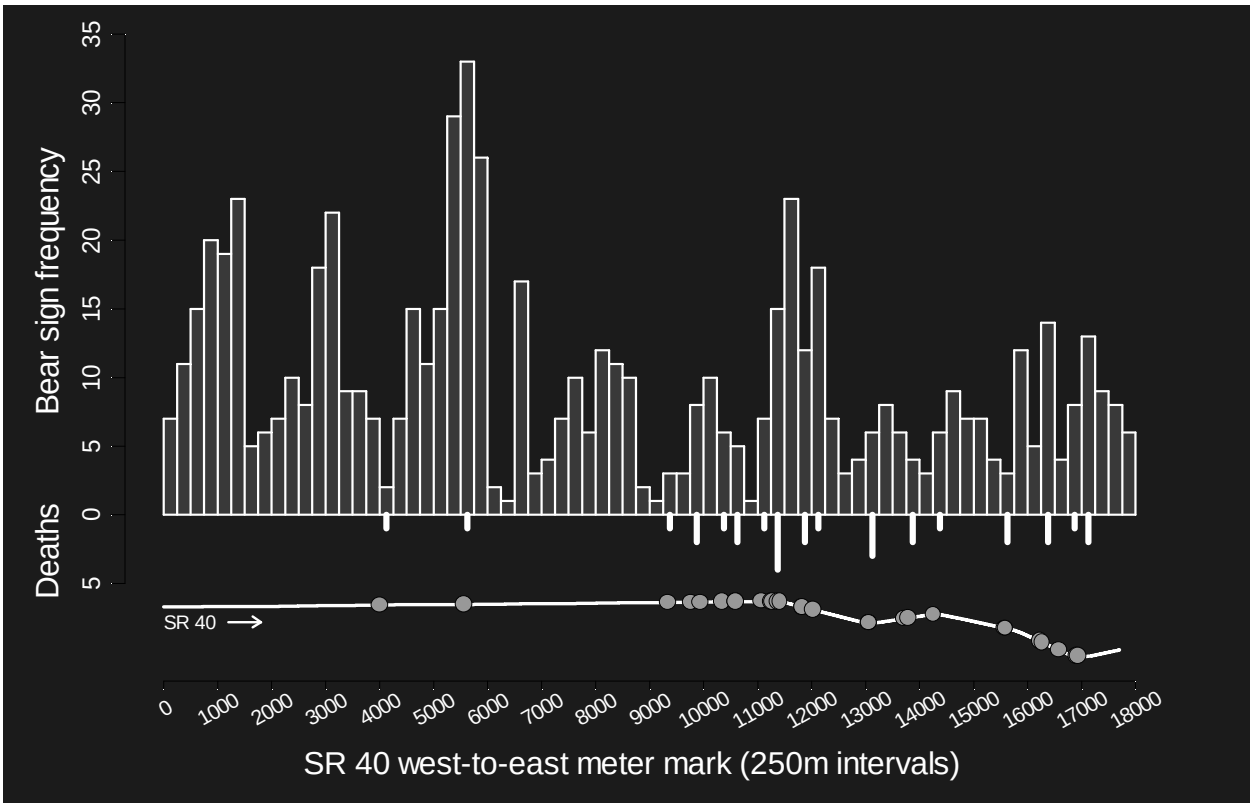

Fig. 3. Frequency of black bear crossings (1999-2001) and roadkill (1976-2000) along 250 m intervals of State Road 40 in Ocala National Forest.

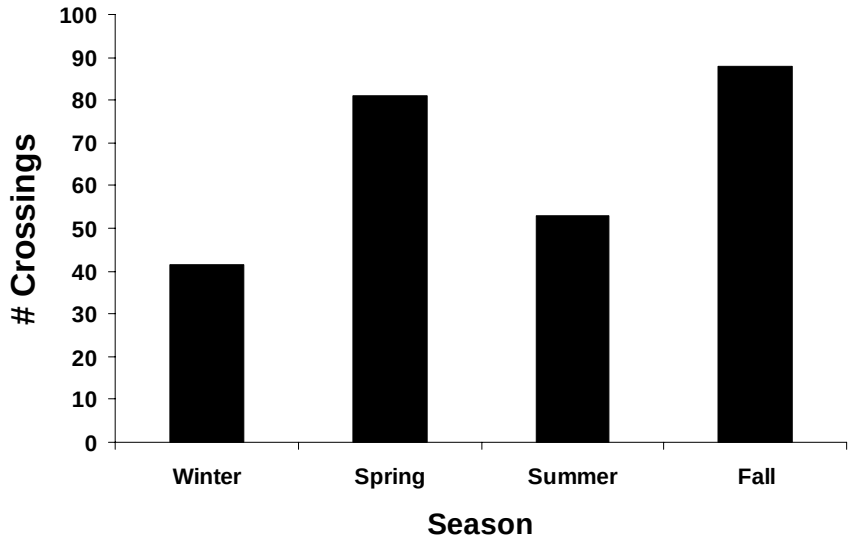

Fig. 4. Mean monthly crossings of State Road 40 as documented b y black bear track counts in Ocala National Forest, December 1999 – May 2001.

Table 1
Comparison of black bear use versus availability of forest cover types at crossing sites along State Road 40 in Ocala National Forest

Cover Type	Observed Frequency	Expected Frequency	Significant Difference?
Mixed Pine	45	46.2	No
Prairie	0	13.3	--NA--
Sand Pine 0-7 yrs.	71	46.0	+++++
Sand Pine 8-24 yrs.	292	228.8	+++++
Sand Pine 25+ yrs.	288	334.7	- - - - -
Scrub Oak	4	11.3	- - - - -
Upland Hardwood	7	10.7	No
Wet Hardwood	0	15.9	--NA--

+++++ indicates significant greater proportion
----- indicates significant lesser proportion
--NA-- indicates no test possible because of 0 sample size

Discussion

The two techniques that we used to document black bear road crossings complemented each other well, but revealed slightly different crossings patterns. Both techniques showed that bears crossed at high rates that peaked in the fall. However, the telemetry data showed a second, smaller peak in summer, whereas the track data showed an equally large peak in the spring. We believe that two factors contributed substantially to this result. The first factor was the biased sample of bears that we radio-collared in this study. Because of our study objectives and logistic constraints, we did not radio-collar juveniles and sub-adults in proportion to their occurrence; instead, we concentrated our telemetry efforts on adult males and females. Consequently, our telemetry results did not account for the movements of younger bears, which most likely increased in the spring as these subdominant bears searched for the meager food sources available after denning. The second factor was the increased frequency and amount of rain that fell in the summer months. This rainfall obliterated tracks that had been left by bears and prevented us from documenting many crossings during the summer months.

The large number of road crossings documented in this study was unusual for black bears. Previous studies had consistently shown that black bears not only crossed at low rates, but that they tended to avoid habitats adjacent to major roads (Beringer et al. 1990, Brody and Pelton 1989, Carr and Pelton 1984, Kasworm and Manley 1990, and Wooding and Maddrey 1994). We found no evidence to support these findings in Ocala National Forest. Additionally, even though more males crossed than females, we found no difference in the frequency of crossings between males and females that did cross at least once. The higher number of males that crossed was explained by their larger home ranges that brought them into contact with roads more often than females. The fact that many females crossed frequently indicates that State Road 40 was not a major barrier to the bear population in Ocala National Forest. Additionally, the relatively few number of roadkill as compared to the number of captures (7 out of 94, or 7.5 percent) indicated that the mortality rate was sustainable.

Because black bears tend to move within heavy cover, especially when approaching areas of possible danger or vulnerability, we expected bears to cross State Road 40 at areas of dense vegetation. Medium-aged stands of sand pine were the most dense, followed by mature stands, and lastly by young-aged stands. Therefore, we were surprised to find that bears in Ocala National Forest crossed more often then would be expected by chance at open, young-aged stands of sand pine and less often then would be expected by chance at relatively dense mature stands. One possible explanation is that bears may have been influenced by vegetative characteristics on the opposite side of the road or that our grouping of age classes did not reflect the intended

structural characteristics of the young stands. Alternatively, assuming that most crossings occurred at night (as supported by field observations), cover may not be vital to crossing attempts. More research is needed to tease out the underlying factors behind this phenomenon. In this regard, we hope to initiate an intensive diehl study of individual bear movements in the near future.

The results of this study indicate that State Road 40 currently does not act as a significant barrier to black bear movements in Ocala National Forest. Moreover, current roadkill levels do not seem to be negatively impacting the bear population. Even so, although we believe that the data presented here are robust and meaningful, caution must be exercised in extrapolating these results to other bear populations or other situations. The two years of this study fell in the middle of Florida's worst drought in over 50 years. Without doubt, the drought conditions affected bear movements and behavior through food availability and other mechanisms we may not understand. Additionally, bears are long-lived, wide-ranging mammals with complicated life history traits. The two years of study conducted merely provide a snapshot, frozen in time, of bear dynamics in the Ocala National Forest; as time passes and conditions change, so too will the bear population. The conditions documented in this study reflect the dynamics of a two-lane road with moderate traffic levels (6,000 – 12,000 vehicle trips per day) in a distinct habitat type that does not occur in large acreages anywhere else in Florida. Expansion of State Road 40 to increase traffic capacity could have profound impacts on the population if critical tolerance or mortality thresholds are surpassed. Additional research will be needed to better understand the intricacies surrounding black bears and roads in Florida. The continuing studies in Ocala National Forest hopefully will continue to provide new insights into these dynamics.

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Biographical Sketch: Thomas Eason is a wildlife biologist who has spent most of his career studying the American black bear. Thomas has completed his B.S. and M.S. in wildlife science and his Ph.D. in ecology. He began research on black bears during the summer of 1992 and has continuously studied various aspects of bear ecology since that time. Thomas has conducted fieldwork throughout the Southeast including study sites in: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, and Virginia and has handled several hundred bears during this work. Today, Thomas continues his nine years of research and management of bears as the leader of the Bear Management Section for the Florida Fish and Wildlife Conservation Commission. Current projects include studying the effects of roads on bear movements and habitat use in Ocala National Forest, initiating a statewide bear monitoring program, and organizing a statewide black bear working group.

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