Conservation and Management of Isolated Black Bear Populations in the Southeastern Coastal Plain of the United States

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Abstract: Developing black bear (*Ursus americanus*) conservation strategies for the southeastern United States is critical because of increasing habitat fragmentation. Ecological and demographic data collected from a black bear population in Great Dismal Swamp has provided insight into development of these strategies. One strategy is maintaining large, contiguous forest tracts with minimal human disturbance. Identification, maintenance, and enhancement of key habitat patches, such as pocosins and mesic islands, also are important. Remote sensing data can identify corridors among relatively disjunct bear populations that should be targeted for conservation. Population data also suggest the role of Great Dismal Swamp and other large tracts of occupied bear range in this region as reservoirs for black bear reproduction and dispersal into smaller, more fragmented habitats. Research on dispersal and gene flow is essential to determine the true degree of isolation among coastal populations. We consider determining female survival rates and maintaining contiguous forest blocks as the most critical conservation needs.

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The range of the North American black bear is becoming increasingly fragmented by habitat loss and habitat disturbance. This problem is particularly evident in the southeastern United States, where perhaps as many as 30 relatively disjunct populations occur in 13 southeastern states (Pelton 1990) with differing degrees of isolation and vulnerability to extirpation. Most of these populations reside in the Atlantic and Gulf Coastal Plains from Virginia to Louisiana.

Conservation concerns regarding 2 putative subspecies, *U. a. luteolus* and

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U. a. floridanus, has resulted in accelerated research activity oriented at developing management strategies to conserve bears in this region. At least 12 coastal populations in 7 states are currently under study. Few published data on population dynamics are available (Smith 1985, Hellgren and Vaughan 1989) to aid in developing black bear conservation strategies. Additionally, little is known about the long-term security of isolated populations. Conversely, several authors (Landers et al. 1979, Mykytka and Pelton 1990, Weaver et al. 1990, Hellgren et al. 1991) have discussed habitat management strategies that are conducive to black bears in the Coastal Plain.

Great Dismal Swamp, an 850 km^2 forested wetland that borders Virginia and North Carolina, is primarily public-owned, and contains the most northerly population of black bears in the Coastal Plain. In the early 1980s, this population was isolated from other populations by 40–60 km and was assumed to be virtually demographically closed (Hellgren and Vaughan 1989). The study area (555 km^2) population also appeared to be at least stationary (Hellgren 1988). These insular and demographic characteristics make GDS a useful case study for addressing fragmentation, population isolation, and the future of black bears in this region. In this paper, we will synthesize present thought concerning management strategies and tactics for conservation of isolated black bear populations in the Southeastern Coastal Plain of the United States. We will draw upon our work in GDS, as well as research in other areas of the Coastal Plain.

Forest Contiguity

Several authors have argued that maintenance and enhancement of habitat contiguity is a critical strategy for conservation of black bears in the Coastal Plain. For example, Mykytka and Pelton (1990) recommended restoration of large, interconnected swamp systems and upland buffers in northern Florida. Estimates of areas required for viable populations range from 320–500 km^2 (Zeveloff 1983, Rudis and Tansey 1995). Habitat loss from agricultural, residential, urban, and recreational development has been the major fragmentation force on Coastal Plain black bear populations. Rudis and Tansey (1995) showed a strong relationship between permanently occupied bear habitat and counties with at least 34% and >160 km^2 of the county characterized as remote forest land. Areas of smaller, more fragmented forests did not contain black bear populations. In Florida, the presence of black bears varied in a positive manner with public preserve area (Hellgren and Maehr 1992). Thus, a likely strategy to keep viable bear populations is to maintain large, contiguous forest tracts.

The Great Dismal Swamp exhibits several characteristics of a contiguous forest block that are advantageous for black bear conservation (Williamson et al. 1981). These include a protected area exceeding 500 km^2 (unhunted national wildlife refuge and state park managed by the U.S. Fish and Wildlife Service and the state of North Carolina, respectively) and a low edge-to-area ratio, a consequence of the generally rectangular shape of the Swamp. The large size provides secluded habitat and the low ratio reduces the probability of bears encountering the swamp boundary where vulnerability to human-induced mortality factors (hunting, depredation-related harvest, or vehicular collision) is increased.

Restriction of human use and access is another essential management strategy in the Coastal Plain. McLellan (1990), reviewing effects of industrial roads and activities on grizzly bears (*Ursus arctos*), concluded that roads without restricted access negatively influence bears in 5 ways: vehicular harassment of bears, displacement of bears from quality habitat, reduction of bear use of altered habitats, social disruption of bears away from roads, and elevation of human-related mortality. Mattson (1990) suggested that selective elimination of bears that are habituated to and forage near humans can lead to decreases in ecological carrying capacity of an area because habitat within the sphere of human influence becomes unused and unavailable. In GDS, dense understory vegetation and restricted access contribute to minimal human disturbance of bears, in turn leading to bears using productive roadside habitats (Hellgren and Vaughan 1988, Hellgren et al. 1991). Similar habitat and access conditions in other areas of the Southeast Coastal Plain populations have contributed to survival of isolated black bear populations (Smith 1985, Weaver et al. 1990, Pelton 1990). Mykytka and Pelton (1990) recommended closure of existing roads and limited construction of new roads in bear habitat in northern Florida.

Key Habitats

Identifying, maintaining, and enhancing key patches within the occupied habitat of isolated bear populations is another critical conservation strategy. The goal of such a strategy should be to improve habitat quality and ultimately increase ecological carrying capacity for black bears in remaining fragments. In the Southeast Coastal Plain, several important habitat types have been identified, including Carolina bays (Landers et al. 1979), cypress-gum (*Taxodium-Nyssa*) and mixed bay swamps (Mykytka and Pelton 1990), pocosins (Hellgren et al. 1991), bottomland hardwoods (Weaver et al. 1990), and mesic stands of oak (*Quercus* spp.; Landers et al. 1979, Smith 1985, Weaver et al. 1990, Hellgren et al. 1991). Individual habitat stands, such as a single 600-ha pocosin that was heavily used for foraging and denning cover by female bears (Hellgren and Vaughan 1988), can be key areas to identify and maintain.

Maintaining and enhancing these key habitats has been proposed through timber management, surface water manipulation, prescribed burning, and mechanical manipulations (Smith 1985, Hellgren and Vaughan 1988, Weaver et al. 1990, Hellgren et al. 1991). Rudis and Tansey (1995) recommended promoting forest regeneration in and along river systems and managing forests for remote conditions. Preventing succession to red maple (*Acer rubrum*) forest types, which are avoided by black bear, also has been suggested (Hellgren et al. 1991). Empirical data from monitoring vegetation trends and describing bear population dynamics in managed areas are necessary to determine if these strategies are of conservation value.

Corridors and Dispersal

Maintaining large, contiguous forested areas, even as large as GDS, is difficult to impossible, especially in areas with human densities as high as the southeastern United States. Therefore, development of habitat corridors between fragmented forests is a consideration for black bear conservation in this region. Harris (1988) discussed the need for corridors to connect major islands of habitat to maintain areas large enough to support viable populations of black bears in Florida.

Desired parameters of habitat corridors have not been defined for black bears. Usable corridors may range in width from a few meters (Weaver et al. 1990) to bottomland hardwood drainages several kilometers in width (Harris 1988). Remote sensing and Geographic Information Systems (GIS) technology can identify natural corridors between and among disjunct populations (e.g., riverine strips) that should be conserved or protected. For example, rivers draining the eastern and southern regions of GDS provide natural corridors to smaller blocks of habitat near the Atlantic Coast (Fig. 1). The Chowan River, 40 km southwest of GDS, may act as a corridor for bear movement between GDS and large bear populations in Bertie, Washington, and Tyrrell counties, North Carolina.

Corridor use does not imply corridor success. In developing and main-

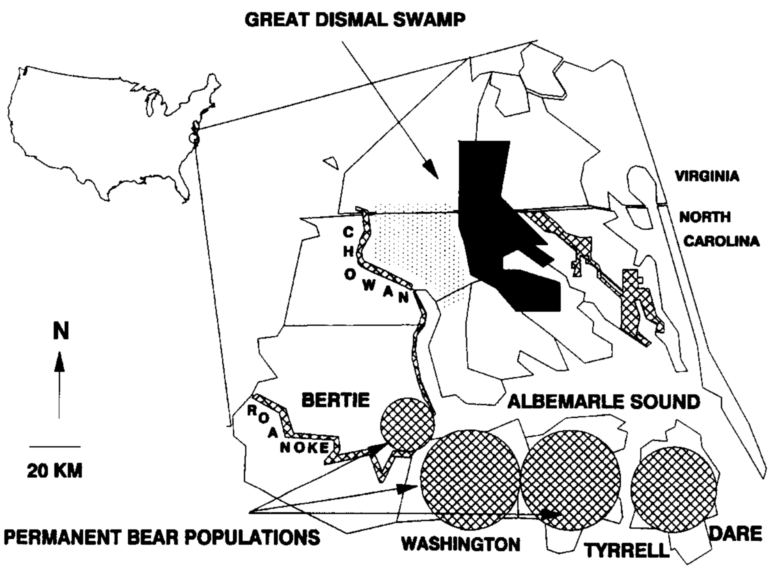

Figure 1. Schematic map of Great Dismal Swamp (solid) in Virginia and North Carolina, with corridors to other potential and occupied bear habitat (hatched). Stippled area represents occupied bear range between Great Dismal Swamp and Chowan River bottomland.

taining corridors, an operational definition of a successful corridor should include some comparative measure of mortality of dispersers using the corridor to reach another isolated population versus mortality of dispersers not using the corridor. Or, alternatively, immigration/emigration rates among similarly isolated populations with and without corridors should be determined. As far as we are aware, there are few empirical data on this subject for large mammals.

It is possible that abilities of black bears to disperse can mitigate some deleterious effects of habitat fragmentation and isolation. Previous studies on black bear dispersal indicate that subadult male bears disperse between 13 and 219 km (Rogers 1987, Elowe and Dodge 1989), with mean and median distances of 61 and 49 km, respectively (Rogers 1987). Additionally, several accounts of black bears moving long distances either following translocation (McArthur 1981, Rogers 1986, Fies et al. 1987) or capture (Maehr et al. 1988, Wooding et al. 1992) have been reported. For example, at least 11 (15%) of 73 translocated bears recrossed Shenandoah Valley in Virginia, a 40-km wide, populated region of agricultural land and small woodlots, without an obvious corridor (Fies et al. 1987). Though natural dispersal (i.e., bears that have not been previously translocated) may not occur at such high rates, bear dispersal abilities are striking. Maehr et al. (1988) have argued that corridors may be unnecessary to connect disjunct bear populations, if the level of human disturbance and habitation in the intervening areas does not hinder dispersing individuals. Research on rates and success of bear dispersal is needed to address questions on gene flow (see below), habitat connectivity, and metapopulation dynamics.

Demographic Considerations

Two life-history characteristics of black bears increase their vulnerability to local extinction: low densities and low intrinsic rates of increase (Laurance 1991, Hellgren and Maehr 1992). Additionally, ability of black bears to tolerate edge conditions and modified habitats may increase risks of bear mortality in fragmented situations. Because small populations can become extinct due to demographic stochasticity (Gilpin and Soule 1986) and because bear population growth rates are most sensitive to changes in adult female survival rates (Taylor et al. 1987, Eberhardt 1990, Miller 1990), determining female survival rates for isolated populations is critical. However, few published data are available on survival rates of female black bears in Southeastern Coastal Plain populations.

Refugia need to be large enough to maintain rates of female survival above the minimum required to sustain the population. They also should minimize contact of adult females with man-related mortality factors. Such an idea is not new—the genesis of the black bear sanctuary system in North Carolina and other southeastern states developed in the 1970s (Sanders et al. 1978) was based on similar thought.

Available estimates of female survival range from 0.84–0.95 for isolated Coastal Plain populations (Smith 1985, Hellgren and Vaughan 1989, K. M.

Weaver, unpubl. data) and, given known reproductive data, are probably at sustainable levels (Eberhardt 1990). The GDS and White River National Wildlife Refuge in Arkansas (Smith 1985) contained apparently stable bear populations in isolated areas of 555 and 457 km^2, respectively, and these values can be used as starting points in discussions about minimum preserve size. As demographic data accumulate for other smaller and isolated Coastal Plain bear populations, perhaps this figure can be reduced.

Mortality data from GDS provide interesting information on mortality patterns of isolated populations and the role of large, protected areas to serve as reservoirs or sources for bear dispersal into smaller, more fragmented habitats. Female mortality within protected areas can be low, but male mortality, even for large (>500 km^2) protected areas, may be high. It is noteworthy that although the annual survival rate of male bears was estimated at 0.59 in GDS, all mortality occurred on the periphery of the Swamp (Hellgren 1988). If mortality outside the boundary of the GDS National Wildlife Refuge is ignored, then male and female bear survival rates within the Refuge were 1.00 and 0.93, respectively (Hellgren and Vaughan 1989, unpubl. data). A protected population of black bears in Shenandoah National Park in Virginia had similar mortality patterns to GDS (Carney 1985), with male and female survival rates of 0.59 and 0.93, respectively. Though the population was protected, the male survival rate was indicative of an exploited population. Carney (1985) believed that the long, narrow shape of the Park, and the larger home ranges and extensive movements of male black bears led to increased vulnerability to hunting and lowered male survival. Conversely, female ranges were small enough to remain within the protected Park and female survival was high.

Smith (1985) reported a combined survival rate of males and females of 0.95 in an isolated, protected population in Arkansas (refuge area size = 457 km^2). Although this population was isolated from other bear habitats by intensive agriculture similar to the GDS population, male mortality was much lower. Bears in the Arkansas population did not feed on agricultural crops (Smith 1985:88–104) as much as they did in GDS (Hellgren and Vaughan 1988), a difference that partially may account for the mortality rate difference. Eastern Arkansas is heavily cultivated for cotton, rice, and soybeans, while the GDS area is farmed for corn and peanuts. Male bears feeding in and around agricultural fields would be more susceptible to mortality by shooting or vehicular collision. Perhaps planting crops (e.g., cotton, rice) that black bears will not use would act as a buffer around isolated bear populations.

Mortality data from GDS also allows for some discussion of the role of the Swamp (and other large, isolated tracts) as a source of bears for smaller, more fragmented forests. As mentioned above, most mortality, including all male deaths, occurred on the periphery on the Swamp. For example, at least 8 bears (6 M, 2 F) were killed on the heavily-travelled major highways surrounding the Swamp during 1984–1986 (Hellgren and Vaughan 1989). We suggest that many of these mortalities were a direct result of movements out of an insular population into more marginal habitats.

Between 1984 and 1994, bears occupied fragmented forests between GDS and the Chowan River bottomland (G. S. Warburton and D. Rowe, N.C. Wildl. Resour. Comm., pers. commun.). This range expansion is evidence that large tracts can act as sources for less contiguous habitats. However, it is apparent that high rates of mortality, such as those experienced around the periphery of GDS, are not conducive to maintaining populations in fragmented areas. Such sink populations would continually need to be augmented by dispersers from a source population (e.g., GDS), or would disappear (Pulliam 1988). The source-sink phenomenon also points out the importance of determining demographic characteristics for both fragmented and contiguous habitats. Those responsible for managing southeastern black bear populations must seek to place bear mortality, which is >95% human-caused in populations studied thus far (Hellgren and Vaughan 1989), under direct management control. Additionally, female black bear philopatry and extremely low rates of dispersal (Elowe 1987, Rogers 1987, Schwartz and Franzmann 1992) impede colonization of adjacent habitats. On the positive side, if only a small proportion of dispersers spilling out of these populations reach other permanent bear populations, then perhaps problems associated with genetic variation and isolated populations can be eased.

Genetic Considerations

The fragmented nature of black bear populations in the Southeast Coastal Plain may render them susceptible to a deleterious loss of gene variation (Soule 1980, Allendorf and Leary 1986, Gilpin and Soule 1986). However, data on black bears are inadequate to determine if gene variation is being compromised in insular populations. Existing data indicate a low level of protein variation among black bear populations (Manlove et al. 1980, Wathen et al. 1985, Pelton 1989). Intraspecific variation in mitochondrial DNA (mtDNA) among several North American black bear populations suggested both considerable polymorphism and gene flow during the evolutionary history of the species (Cronin et al. 1991). However, ability to maintain gene flow among populations has been reduced concomitantly with isolation of populations. Rudis and Tansey (1995) hypothesized 5 black bear provinces in the southeastern United States that lack among-province linkages. They proposed that gene flow among these provinces is constrained.

Using DNA fingerprinting to compare genetic structure among southeastern U.S. black bears would shed light on the question of genetic variability within disjunct populations. Fingerprinting and mtDNA studies examining taxonomic and genetic relationships within and among 31 black bear populations, primarily in the southeastern United States, are ongoing (Kasbohm et al. 1994). Hellgren and Maehr (1992) argued that though problems related to loss of genetic variation can be expected in isolated populations, they may be less significant than rate and variability in population growth.

Dispersal abilities of bears probably can overcome most geographic barriers to provide gene flow among isolated populations in the Southeastern Coastal

Plain, within geographic limits (perhaps 100–200 km) of male bear dispersal (Elowe 1987, Rogers 1987). Interfragment movement promotes population survival by genetic and demographic contributions of immigrants (Laurance 1991). Given the high mobility of black bears and population models suggesting that limited dispersal (on the order of 1 successful migrant per generation between populations) may be sufficient to prevent losses in genetic variation (Ralls et al. 1985), disjunct populations may not be as effectively isolated as previously believed. More research on subadult male dispersal is needed to determine if disjunct populations are actually and effectively isolated from each other.

We have not discussed effective population size and population viability analysis (PVA), and leave that for other workers. Effective population size for 2 Coastal Plain populations, White River in Arkansas (53–92; Smith 1985) and GDS (56; Hellgren and Vaughan 1989), have been estimated from demographic data. As more genetic data become available, it will be possible to conduct separate PVA using genetic and demographic data, as in Kinnaird and O'Brien (1991).

Conclusions

In this paper, we have reviewed and synthesized current thought on management and conservation of isolated black bear populations in the Southeastern Coastal Plain of the United States. We have drawn upon data collected from 1 of these populations, bears in Great Dismal Swamp, to restate important considerations in black bear conservation in this region. Because of the adaptability of bears to a wide range of habitats, we believe that the most critical conservation needs are large contiguous forests and "managed" female survival rates, rather than habitat quality per se.

Literature Cited

Allendorf, F. W. and R. F. Leary. 1986. Heterozygosity and fitness in natural populations of animals. Pages 57–76 *in* M. E. Soule, ed. Conservation biology—the science of scarcity and diversity. Sinauer Assoc., Sunderland, Mass.

Carney, D. W. 1985. Population dynamics and denning ecology of black bears in Shenandoah National Park, Virginia. M.S. Thesis, Va. Polytechnic Inst. and State Univ., Blacksburg. 84pp.

Cronin, M. A., S. C. Amstrup, G. W. Garner, and E. R. Vyse. 1991. Interspecific and intraspecific mitochondrial DNA variation in North American bears (*Ursus*). Can. J. Zool. 69:2985–2292.

Eberhardt, L. L. 1990. Survival rates required to sustain bear populations. J. Wildl. Manage. 54:587–590.

Elowe, K. D. 1987. Factors affecting black bear reproductive success and cub survival in Massachusetts. Ph.D. Thesis, Univ. Mass., Amherst. 82pp.

——— and W. E. Dodge. 1989. Factors affecting black bear reproductive success and cub survival. J. Wildl. Manage. 54:962–968.

Fies, M. L., D. D. Martin, and G. T. Blank, Jr. 1987. Movements and rate of return of translocated black bears in Virginia. Internatl. Conf. Bear Res. and Manage. 7:369–372.

Gilpin, M. E. and M. E. Soule. 1986. Minimum viable populations: processes of species extinction. Pages 19–34 *in* M. E. Soule, ed. Conservation biology—the science of scarcity and diversity. Sinauer Assoc., Sunderland, Mass.

Harris, L. D. 1988. Landscape linkages: the dispersal corridor approach to wildlife conservation. Trans. North Am. Wildl. and Nat. Resour. Conf. 53:595–607.

Hellgren, E. C. 1988. Ecology and physiology of a black bear (*Ursus americanus*) population in Great Dismal Swamp and reproductive physiology in the captive female black bear. Ph.D. Diss., Va. Polytechnic Inst. and State Univ., Blacksburg. 231pp.

——— and D. S. Maehr. 1992. Habitat fragmentation and black bears in the eastern United States. East. Workshop Black Bear Res. and Manage. 11:154–165.

——— and M. R. Vaughan. 1988. Seasonal food habits of black bears in Great Dismal Swamp, Virginia-North Carolina. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 42:295–305.

——— and ———. 1989. Demographic analysis of a black bear population in the Great Dismal Swamp. J. Wildl. Manage. 53:969–977.

———, ———, and D. F. Stauffer. 1991. Macrohabitat use by black bears in a southeastern wetland. J. Wildl. Manage. 55:442–448.

Kasbohm, J. W., D. A. Miller, and M. R. Vaughan. 1994. Taxonomy of black bears in the southeastern United States. Annu. Rep., U.S. Fish and Wildl. Serv. 24pp.

Kinnaird, M. F. and T. G. O'Brien. 1991. Viable populations for an endangered forest primate, the Tana River Crested Mangabey (*Cercocebus galeritus galeritus*). Conserv. Biol. 5:203–213.

Landers, J. L., R. J. Hamilton, A. S. Johnson, and R. L. Marchinton. 1979. Foods and habitat of black bears in southeastern North Carolina. J. Wildl. Manage. 43:143–153.

Laurance, W. F. 1991. Ecological correlates of extinction proneness in Australian tropical rain forest mammals. Conserv. Biol. 5:79–89.

Maehr, D. S., J. N. Layne, E. D. Land, J. W. McCowan, and J. C. Roof. 1988. Long distance movements of a Florida black bear. Fla. Field Nat. 16:1–6.

Manlove, R. M., R. Baccus, M. R. Pelton, M. H. Smith, and D. Graber. 1980. Biochemical variation in the black bear. Int. Conf. Bear Res. and Manage. 3:37–41.

Mattson, D. M. 1990. Human impacts on bear habitat use. Internatl. Conf. Bear Res. and Manage. 8:33–56.

McArthur, K. L. 1981. Factors contributing to effectiveness of black bear transplants. J. Wildl. Manage. 45:102–110.

McLellan, B. D. 1990. Relationships between human industrial activity and grizzly bears. Internatl. Conf. Bear Res. and Manage. 8:57–64.

Miller, S. D. 1990. Impacts of increased hunting pressure on the density, structure, and dynamics of brown bear populations in Alaska's Game Management Unit 13. F.A. Proj. W-23-2 Prog. Rep. 54pp.

Mykytka, J. M. and M. R. Pelton. 1990. Management strategies for Florida black bears based on home range habitat composition. Internatl. Conf. Bear Res. and Manage. 8:161–167.

Pelton, M. R. 1989. The Louisiana black bear: status and future. U.S. Fish and Wildl. Serv., Spec. Rep. 22pp.

———. 1990. Black bears in the Southeast: To list or not to list. East. Workshop Black Bear Res. and Manage. 10:155–161.

Pulliam, H. R. 1988. Sources, sinks, and population regulation. Am. Nat. 132:652–661.
Ralls, K., P. H. Harvey, and A. M. Lyles. 1985. Inbreeding in natural populations of birds and mammals. Pages 35–56 *in* M. E. Soule, ed. Conservation biology. The science of scarcity and diversity. Sinauer Assoc., Sunderland, Mass.
Rogers, L. L. 1986. Effect of translocation distance on frequency of return by adult black bears. Wildl. Soc. Bul. 14:76–80.
———. 1987. Effects of food supply and kinship on social behavior, movements, and population dynamics of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72pp.
Rudis, V. A. and J. B. Tansey. 1995. Regional assessment of remote forests and black bear habitat from forest resource surveys. J. Wildl. Manage. 59:170–180.
Sanders, O. T., K. Johnson, and J. Rieffenberger. 1978. An evaluation of black bear sanctuaries. East. Workshop Black Bear Res. and Manage. 4:278–287.
Schwartz, C. C. and A. W. Franzmann. 1992. Dispersal and survival of subadult black bears from the Kenai Peninsula, Alaska. J. Wildl. Manage. 56:426–431.
Smith, T. R. 1985. Ecology of black bears in a bottomland hardwood forest in Arkansas. Ph.D. Diss., Univ. Tenn. Knoxville. 209pp.
Soule, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. Pages 151–169 *in* M. E. Soule and B. A. Wilcox, eds. Conservation biology: an evolutionary-ecological perspective. Sinauer Assoc., Sunderland, Mass.
Taylor, M. K., D. P. DeMaster, F. L. Bunnell, and R. E. Schweinsburg. 1987. Modeling the sustainable harvest of female polar bears. J. Wildl. Manage. 51:811–820.
Wathen, W. G., G. F. McCracken, and M. R. Pelton. 1985. Genetic variation in black bears from Great Smoky Mountains National Park. J. Mammal. 66:564–567.
Weaver, K. M., D. K. Tabberer, L. U. Moore, Jr., G. A. Chandler, J. C. Posey, and M. R. Pelton. 1990. Bottomland hardwood forest management for black bears in Louisiana. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 44:342–350.
Williamson, J. F., Jr., A. R. Tipton, R. M. Keel, Jr., and J. B. Whelan. 1981. Assessment of black bear habitat suitability in the Great Dismal Swamp. Trans. Northeast Sect. The Wildl. Soc. 38:120–132.
Wooding, J. B., S. M. Shea, M. L. Richardson, and D. Y. Dowling. 1992. Movements of a female black bear in northwestern Florida. Fla. Field Nat. 20:46–48.
Zeveloff, S. I. 1983. Island biogeographic considerations for pocosin wildlife conservation. J. Elisha Mitchell Sci. Soc. 99:69–77.