Sources and Patterns of Black Bear Mortality in Louisiana

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Abstract: Louisiana black bears *(Ursus americanus luteolus)* are protected under the Endangered Species Act and live in 3 isolated geographic areas thought to encompass nearly all breeding individuals for that subspecies. Management strategies to recover these bears continue to evolve without knowledge of any differences in demographic patterns among these populations. We summarized data on Louisiana black bear deaths to see if any evidence existed for differences in mortality patterns among the 3 subpopulations. Since June 1992, 34 of 75 (45±6 [SE]%) verified losses (72 deaths plus 3 live removals) were caused by vehicular collisions, including road kills (27), farm equipment (5), and train (2), which was the most common cause of death. Although this bear subspecies has been protected under the Endangered Species Act since 1992, at least 12 (16±4%) have been illegally shot. Nearly two-thirds of verified deaths have come from the coastal population, which is not believed to be as abundant as the population in northeast Louisiana. Also, mortalities in the coastal population were predominantly adult females, whereas subadult males dominated mortalities in northeast Louisiana. Given the frequency with which adult females have been lost from the coastal population, the geographic limits of suitable bear habitat, and increasing development, long-term viability of this population is precarious. Patterns of observed mortalities alone suggest that conservation agencies must develop area-specific management strategies for these 3 isolated populations.

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In the Coastal Plain of the southeastern United States, several relatively isolated black bear populations exist which differ by geographic extent and availability of

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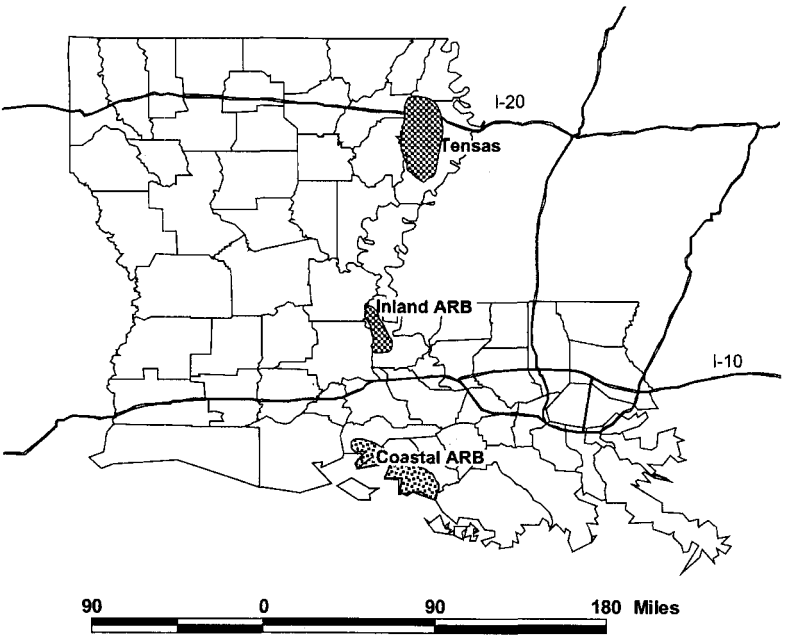

Figure 1. Louisiana black bear populations study areas designated for the analysis of mortality patterns.

habitat and are imperiled in the region primarily because of habitat loss (Wooding et al. 1994). Therefore, habitat enhancement and protection actions should dominate recovery or maintenance strategies offered for regional and state-wide bear populations. However, demographic patterns may affect short-term stability of local populations. Reproductive outputs vary within and among black bear populations, but this variability is generally thought to be a consequence of food availability and habitat quality (Pelton 1982, Bunnell and Tait 1981). Even if reproduction, which is generally difficult to monitor in unharvested bear populations, could be quickly enhanced through management, increased reproductive output does not always produce recruitment (Garshelis 1994). Conversely, differing mortality patterns may be a useful short-term indicator that new management emphases may benefit a local bear population. Evaluations of mortality patterns, in particular road kills, have been published for other coastal southeastern coastal plain bears, including North Carolina (Warburton et al. 1993), Florida (Wooding and Brady 1987) and the Great Dismal Swamp in Virginia (Hellgren and Vaughan 1989). We examined mortality sources and patterns for 3 relatively isolated black bear populations in Louisiana to determine if differences emerged among these populations or with other published reports that suggested differing management emphases were warranted.

Because all of Louisiana lies within the historic range of *U. a. luteolus* (Hall 1981), all Louisiana bears are protected by similarity of appearance and listed as threatened under the Endangered Species Act of 1973 (Fed. Reg. 57[4]:588:595).

Three relatively isolated geographic areas encompass all the known black bear breeding populations in Louisiana (Fig. 1). Probably the most numerous bear population located is in northeast Louisiana and is composed of 2 subpopulations with minimum interchange due to their separation by U.S. Interstate 20 (Pace et al. in press). The Inland Atchafalaya River population is considerably smaller than the other 2 populations (Pace et al. in press). All 3 populations have been subjects of continuous capture and tagging efforts since 1992 (Pace et al. in press) and researchers, together with the various responsible wildlife managment agencies, have placed a high priority on investigating and reporting bear deaths. However, no attempt had been made to summarize these data and assess their usefulness for setting management strategies.

We are grateful to many biologists, agents, mangers, technicians, and students who spent many field hours helping acquire these data. Research efforts have been supported by a wide array of public and private funding arrangements including considerable support from the U.S. Fish and Wildlife Service and the Louisiana Department of Wildlife and Fisheries. We are also grateful to an increasingly knowledgeable and responsive public in Louisiana who reported many of the otherwise unverifiable bear deaths or who otherwise aided our agencies' efforts. We thank D. Hightower, M. Vaughan, R. Wagner, and an anonymous referee for their reviews of our manuscript.

Methods

The 3 areas in Louisiana with occupied bear range are: 1) the Tensas River Basin (Tensas) on lands within, surrounding, and north of Tensas River National Wildlife Refuge (TRNWR), 2) the upper Atchafalaya River Basin (Inland ARB), especially the northwestern two-thirds of Point Coupee Parish, and 3) the coastal area west of the Atchafalaya River Delta (Coastal ARB), primarily south of U.S. Hwy. 90 in St. Mary and Iberia parishes. Considered part of the Tensas bear population, but north of and separated from TRNWR by U.S. Interstate 20 (I–20), are a number of bears living in small fragmented forest tracts owned by Deltic Timber Corporation. Tensas bears south of I-20 rarely encounter high-to-moderate traffic roads, whereas those north of I–20 are often forced to cross such roads to move among fragmented forest patches (Anderson 1997, Marchinton 1995). Road distribution and traffic volumes relative to bear habitat may be roughly comparable between Tensas north of I-20 and Inland ARB. In contrast, bear habitat in Coastal ARB is dissected by more well-traveled, paved, 2-lane roads. Row-crop agriculture is a common land use in all 3 geographic areas, but sugarcane farming is commonly practiced in Coastal ARB, occurs on the fringe of Inland ARB, and is absent in Tensas.

We pooled information from data bases held by 3 agencies to construct a list of verified bear mortalities. Verified mortalities were distinguished among reported mortalities by having filed reports demonstrating that agency personnel or bear researchers had examined the carcass. Dead bears were identified to study area, sex, age class (adult [>3], subadult, and cub of the year [<1]), whether or not the bear was tagged (ear tag and/or radio collar), probable cause of death, and date of death.

Dates of deaths varied in precision due to decomposition states of carcasses and were recorded as the first of the month if only month was reported.

We graphically explored data for patterns in timing of death (by year or month). We used loglinear models (Fienberg 1977) to examine associations between counts of deaths and sex, age (adult or subadult [included cubs of the year]), and area. Using a subset that excluded management and research-related losses, pooling among types of vehicular deaths and pooling other deaths, we used Fisher's exact test to examine if mortality counts by type (open situation vs. secluded situation) was independent of whether or not bears were tagged. This later test was performed to address whether or not inclusion of bears without radios would bias frequency of mortality causes toward vehicular deaths.

Results

Between 1 June 1992 and 31 May 2000, at least 75 bear (72) deaths plus live removals (3) occurred in Tensas (18), Inland ARB (8), and Coastal ARB (49) (Table 1). These 75 losses were attributed to road kills (27), unknown causes (15), shootings (12), management takes (8), sugarcane harvesting equipment (5), natural (4), research takes (2), and trains (2). Losses resulting from management actions included takes of 7 nuisance bears and 1 orphaned cub. Two management actions were live removals of nuisance bears from the population and their placement in zoos. The orphaned cub was moved from Coastal ARB to a rehabilitation center and later released at Tensas on 12 December 1997. It was radio-tagged at release and known to have left Tensas; its whereabouts are at present unknown. Management takes represented losses only to Coastal ARB (7) and Inland ARB (1). The 2 research takes were from deaths related to trapping efforts. Only 8 losses were observed for the Inland ARB population, and 4 of these were from illegal shooting. Mortalities were distributed somewhat uniformly among years (Fig. 2), but unevenly among months (Fig. 3). Relatively few deaths were

Table 1. Verified Louisiana black bear deaths (72) and live removals (3) from 3 areas arranged by probable source summed over years for the period 1 June 1992–31 May 2000.

Source	Coastal ARB	Inland ARB	Tensas	Total
Road kill	17		10	27
Poaching	6	4	2	12
Unknown	10	1	4	15
Management take[a]	7	1		8
Cane harvester	5		5	
Natural	2		2	4
Train	1	1		2
Research take	1	1		2
Totals	49	8	18	75

a. Includes 3 live removals. Two animals were placed in zoos. The third was moved from Coastal ARB to a rehabilitation center and later released at Tensas on 12 December 1997. It was radio tagged at release and known to have left Tensas; its whereabouts are at present unknown.

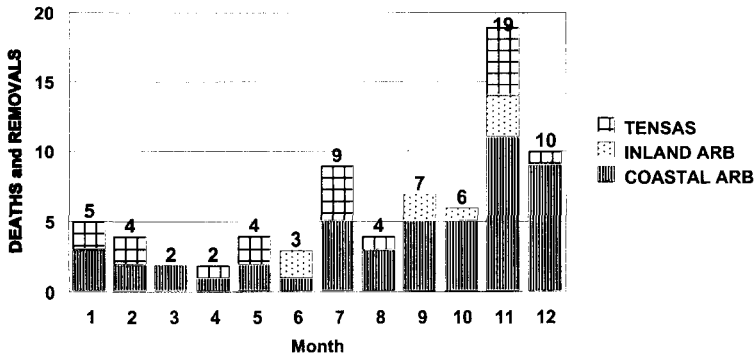

Figure 2. Verified bear deaths (72) and live removals (3) by year for the period 1 June 1992–31 May 2000 combined for 3 areas of Louisiana.

observed in the months of March through June (12±4%), whereas 25±5% occurred in November (Fig. 3). Road kills of males were nearly equal between January–June vs. July–December (6 vs. 8), whereas all 13 road kills of female bears occurred July–December (Fisher's exact test $P=0.016$). Mortality counts by source were nearly identical between sexes (all areas pooled) except for management takes (6M: 2F).

Despite small sample sizes, we had statistical evidence that mortalities ($N=65$), excluding research and management takes, were distributed disproportionately across areas by sex and age class (subadult and adult) ($\chi^2=9.18$, df=3, $P=0.03$). Adult female bears (42%) comprised the majority of deaths in Coastal ARB, whereas 9 of 18 Tensas bear deaths were subadult males (Table 2). During 8 years of observation, 8.5 times as many adult female bear deaths were recorded from Coastal ARB than Tensas. We observed 7 deaths of cubs of the year, all of which occurred in Coastal ARB.

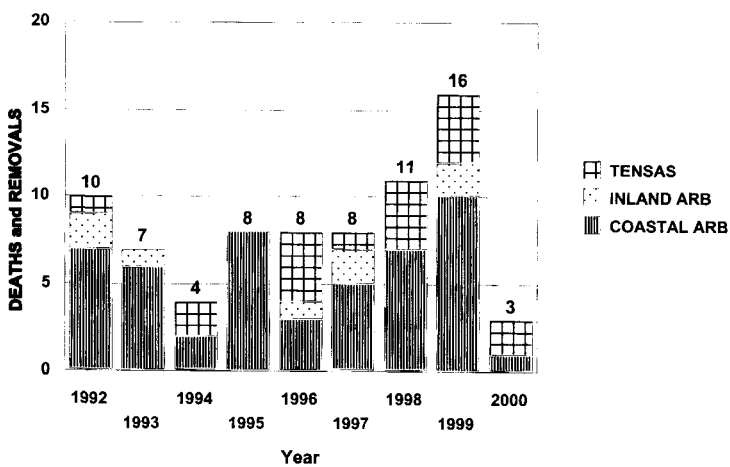

Figure 3. Verified bear deaths (72) and live removals (3) by month combined over the period 1 June 1992–31 May 2000 and over 3 areas of Louisiana.

Table 2. Verified bear deaths (72) plus live removals (3) arranged by sex, age, and area, and summed over years for the period 1 June–31 May 2000.

	Male		Female		
Area	Subadult	Adult	Subadult	Adult	Total
Coastal ARB	11	10	7	17	49[a]
Tensas	9	5	2	2	18
Inland ARB	2	1	1	3	8[b]
Totals	22	16	10	22	75

a. Total includes 4 bears of unknown sex and/or age.

b. Total includes 1 bear of unknown age.

Over all, 35% of dead bears (excluding research and management takes) were wearing radio collars and the proportion was the same for Tensas and Coastal ARB. We had no statistical evidence to suggest that the proportion of bears wearing radio collars differed between deaths in relatively open settings (road kills, sugarcane harvesting equipment, and trains) and deaths in relatively secluded settings (shootings, natural, and unknown) (Fisher's exact test $P=0.426$). Neither did proportions differ for open-setting deaths among radio tagged, ear tagged only, and untagged bears (Fisher's exact test $P=0.294$). These results suggest that including unmarked bears did not strongly bias the observed distribution of deaths among causes of mortality.

Discussion

Based upon habitat availability, trapping success, and associated observations during 1988–1998, the expert opinions of biologists have remained constant and place the combined or statewide bear population at 200–300 animals (excluding cubs of the year), with the population distributed according to Tensas > Coastal ARB >> Inland ARB. At such low population abundance, moderate levels of anthropogenic mortality will depress bear population growth rates, especially if adult females constitute many of the deaths. Hence, the larger number of deaths observed and the high proportion of adult females lost from Coastal ARB and Inland ARB were especially disconcerting. An analysis of mark-recapture data gathered during 1992–2000 (R. M. Pace, La. Coop. Fish and Wildl. Unit, Baton Rouge, La., unpubl. data) provided evidence for lower adult female survival in Coastal ARB (75.8±8.6%) than in Inland ARB (94.0±8.2%) which was more indicative of an unexploited bear population (Bunnell and Tait 1981).

Road kills are a common source of non-hunting mortality in bear populations (Pelton 1982). Evaluations of road kills have been published for other coastal southeastern coastal plain bears, including North Carolina (Warburton et al. 1993), Florida (Wooding and Brady 1987), and the Great Dismal Swamp in Virginia (Hellgren and Vaughan 1989). In general, young males are the most common group of bears in road kill statistics (Wooding and Brady 1987, Warburton et al., 1993), especially during

summer. As in North Carolina and Florida, road kills of female bears were more common in fall, which is at least partly explained by female home range and habitat use shifts in fall (Hellgren and Vaughan 1989, Nyland 1995, Wagner 1995). In Coastal ARB, many bears use sugar cane fields in fall (Nyland 1995), which places them near roads more often during summer than winter.

We continue to be amazed by the number of illegal shootings of bears in Louisiana. Some of these undoubtedly occurred as the result of nuisance situations in rural settings. Some were linked to perpetrators ostensibly engaged in legal hunting, and for whatever reason decided to shoot a bear. Although agencies and non-governmental groups have been engaged in a public information campaign and nuisance abatement program for several years, these takes do not seem to have slowed.

We are somewhat surprised by our lack of evidence that the proportion of bears wearing radio collars was different among mortality causes. Because of the relatively dense understory and forbidding terrain of areas occupied by bears in Louisiana, it would be extremely difficult to locate bears that died from poaching, unknown, or natural causes without a radio tag on or near the carcass. We believe that our considerable ongoing efforts to trap, tag, and monitor bears coupled with aid from landowners interested in our work, led us to many dead but uncollared bears. Concomitantly, radio tags probably allowed us to find some bears that were struck by vehicles and wandered away from the road (open setting mortality) to secluded sites. The net result is that we believe our tabulation of mortality sources is less biased than a study without any radio-tagged animals, but may be somewhat biased relative to a study based solely on radio-tagged animals.

Management Recommendations

Antropogenic causes of mortality are taking a relatively large toll on the Coastal ARB population, both in terms of absolute numbers and because adult females represent a high proportion of the take. Similarly, female losses in Inland ARB are unacceptably high if that small population is to recover. Conversely, the mortality pattern observed in Tensas was predictable from life history and behavioral knowledge of black bears: young male bears tend to disperse and face greater hazards (Wooding and Maddrey 1994). The Coastal ARB population represents a challenge if management goals include the long term maintenance or enhancement of this population. Wildlife conservation agencies can do little to slow increasing human population growth and development in the area. The U.S. Fish and Wildlife Service has begun acquisition of land for a refuge featuring bears within Coastal ARB. Agencies have already joined with academic and non-governmental groups to work toward Louisiana black bear restoration (Bullock 1992), but the education and public awareness efforts need to be increased. Because poaching appears to be a relatively substantial cause of mortality in Coastal ARB and possibly Inland ARB, any increase in enforcement activities should be directed to those areas.

Management plans include repatriation of native bears to suitable vacant habitat within the historic range of Louisiana black bears (U.S. Fish and Wildl. Serv. 1995).

An effective method for repatriation appears to be winter translocation of female bears with their cubs of the year. Repatriation actions require selections of source populations from which adult females would be taken. Our mortality data represent the first comparative demographic information upon which to base a selection of a source population. In an analysis of mark recapture data spanning the same 8 years for Coastal ARB and Inland ARB, Pace (La. Coop. Fish and Wildl. Unit, Baton Rouge, unpubl. data) estimated annual survival of adult females at 75.8±8.6% and 94.0±8.2%, respectively. The already relatively low apparent survival and the disturbingly disproportionate number of mortalities of adult females in Coastal ARB seem to disqualify Coastal ARB as a potential source population until a more complete analysis of the impact of these removals on the long-term viability of this population can be completed.

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