To the Graduate Council:

I am submitting herewith a thesis written by Donald R. Anderson entitled "Corridor Use, Feeding Ecology, and Habitat Relationships of Black Bears in a Fragmented Landscape in Louisiana." I have examined the final copy of this thesis for form and content and recommend that is be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

Michael R. Pelton

Michael R. Pelton, Major Professor

We have read this thesis
and recommend its acceptance:

David A. Buehler

Accepted for the Council:

Associate Vice Chancellor
and Dean of The Graduate School

CORRIDOR USE, FEEDING ECOLOGY, AND HABITAT RELATIONSHIPS OF BLACK BEARS IN A FRAGMENTED LANDSCAPE IN LOUISIANA

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Donald R. Anderson

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ABSTRACT

Twenty Louisiana black bears (*Ursus americanus luteolus*) were captured 23 times on a privately-owned study area (350 km^2) in the Tensas River Basin in northeast Louisiana. The area consisted of 4 major isolated bottomland hardwood fragments totaling < 35 km^2, surrounded by extensive agricultural fields. Radio-telemetry, geographic information systems (GIS), and habitat sampling were used to determine corridor use, feeding ecology, and habitat relationships.

A total of 2,417 telemetry locations were obtained from 19 radio-collared bears (13 female, 6 male). Mean annual home-range estimates were 41.6 km^2 and 13.2 km^2 for males and females, respectively. Seasonal home ranges were largest in summer, with males having larger home ranges than females in all seasons.

Radio-collared bears were located in corridors and forested tracts more than expected in proportion to occurrence, whereas there were fewer locations than expected in agricultural fields ($P < 0.001$). Locations in corridors were farther from forested tracts ($\bar{x}$ = 1,443 m, S.D. = 913 m) than locations in fields ($\bar{x}$ = 290 m, S.D. = 292 m) ($P < 0.001$). Bears were radio-located in corridors most often during the summer months; of 115 corridor locations, 64 were in June and July. Bear sign along corridors indicated that most activity occurred in May and June.

I documented radio-collared bears moving from 1 forested tract to another on 47 occasions. All males ($n = 6$) moved to another tract other than the tract of capture, whereas only 3 of 13 females moved to another tract other than the tract of capture. Males do not seem to be affected as much as females by the level of fragmentation on the

Deltic study area. Of the 33 male tract-to-tract movements, 52% were from tracts linked with a corridor, whereas, of the 14 female tract-to-tract movements, 100% were from tracts linked with a corridor.

Seasonal and annual diets of bears on the Deltic study area were determined from analysis of 249 scats. Agricultural crops (corn, wheat, oats) comprised 49% of the annual diet by volume. Natural foods in the annual diet were dominated volumetrically by unknown vegetation, paw paw *(Asimina triloba)*, and oak (*Quercus* spp.) mast, accounting for 12%, 11%, and 7% of the diet, respectively.

An index based on 11 habitat variables was developed to determine relative habitat quality between 4 habitat fragments. The results indicated that Blue Cat contained the best bear habitat, followed by Wade Bayou, Panther Lake, and Brownie. Two indices of bear activity between the 4 habitat fragments supported the results of the habitat index.

All radio-collared bears denned in bottomland hardwood habitat. Of the 9 radio-collard bears (8 females, 1 males) monitored the winter of 1994-1995, 2 females denned in hollow trees and the remainder used ground dens. Of the 8 radio-collared bears (5 females, 3 males) monitored the winter of 1995-1996, one female denned in a hollow tree and the remaining females used ground dens. Mean litter size was 1.8 and ranged from 1 to 3 ($n = 4$). I documented no cub mortality.

Two mortalities of radio-collared bears occurred during the study. One subadult female was killed in a vehicle collision, and the other was a suspected vehicle collision. No instances of bear poaching have been reported on the study area, nor in the Tensas River Basin since 1991.

Prior to October 1996, there was some speculation that this bear population may be isolated. There had been no documentation of bear immigration or emigration nor of a bear crossing Interstate 20 (I-20), which bisects the Deltic bear population from the Tensas River National Wildlife Refuge (TRNWR) population. In October 1996, a subadult male bear tagged on the Deltic study area in May 1995 was captured on the TRNWR. This was the first documentation of a bear crossing I-20 within the Tensas River Basin.

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INTRODUCTION

LOUISIANA BLACK BEAR

The historic distribution of the American black bear (*Ursus americanus*) covered most of the forested habitats in North America. Habitat loss and fragmentation by human disturbance has greatly diminished the range of the black bear (Pelton and van Manen, in press) (Fig. 1). The Louisiana black bear (*Ursus americanus luteolus*) is one of 16 subspecies of the American black bear found in North America (Hall 1981). The Louisiana black bear was once abundant within its historic range of eastern Texas, southern Mississippi, and all of Louisiana (Hall 1981). Extensive habitat loss, primarily land clearing for agriculture, had reduced available habitat for the Louisiana black bear to < 20% by 1980 (Neal 1990). The present known occupied habitat within the historic range of the Louisiana black bear includes the Tensas River Basin (TRB) in northeastern Louisiana, the Atchafalaya River Basin (ARB) in southeastern Louisiana, and small scattered populations in Mississippi (Shropshire 1991). Although no formal population estimate is available, trapping results and observations suggest a population of approximately 300 animals for Louisiana (Weaver 1990), with approximately 100-125 animals in the TRB (T. Edwards, USFWS, pers. commun.)

The Louisiana black bear was first described as a separate species (*U. lutelous*) by Griffith (1821). The subspecies *U. a. luteolus* , "the yellow bear of Louisiana" ,was

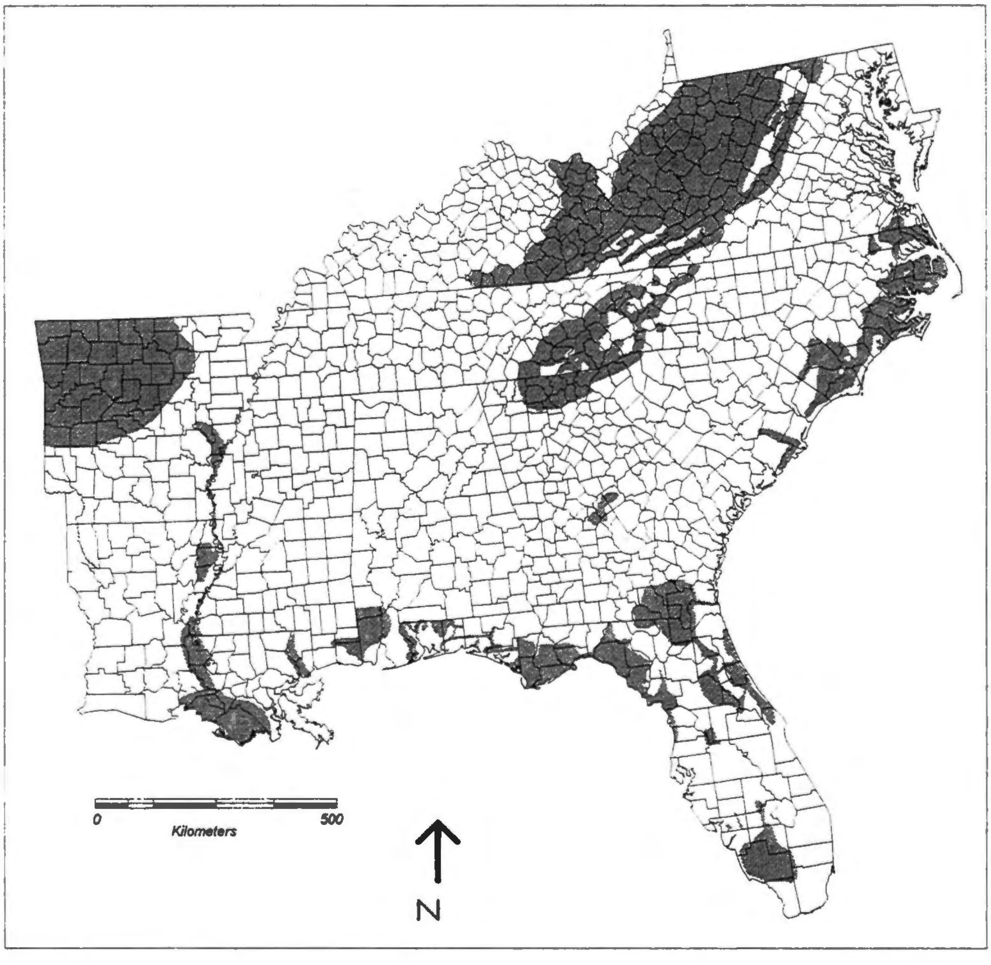

Figure 1. Present distribution of the American black bear in the southeastern United States. Modified from Pelton and van Manen (in press).

described by Merriam (1893) based on skull measurements from 5 specimens taken in Morehouse parish in northeast Louisiana. Further morphometric analyses (Nowak 1986, Kennedy 1989) as well as genetic analyses (Miller 1995) have been performed and support the subspecific status.

Historically, the black bear has been a game animal in Louisiana. Native Americans and early settlers reported the black bear as common, particularly in the bottomland hardwood forests of the lower Mississippi River Valley (MRV) (Taylor 1971). Prior to 1930, the season bag limit in Louisiana was 5 bears, and later reduced to 1 bear per season (Taylor 1971). From 1964-1974, the bear hunting season was closed, but it was reopened from 1975-1987 in the ARB (Hammond 1989). Since 1987, the bear season has remained closed in Louisiana.

From 1964-1967, the Louisiana Department of Wildlife and Fisheries recognized that bear numbers were low and initiated a bear restocking program in Louisiana. Approximately 160 black bears (*U. a. americanus*) were translocated from Cook County Minnesota in an effort to bolster the declining population (Taylor 1971, Lowery 1974). Thirty-one bears were released in Madison/Tensas Parishes in the TRB, and the remainder in Point Coupee Parish in the ARB (Taylor 1971). The possibility of genetic mixing of *U.a. americanus* and *U. a. luteolus* has caused much controversy over the status of the Louisiana black bear (Nowak 1986, Pelton 1990). It is unknown if the released Minnesota bears had any impact on the native population, as records of released bears were not conclusive regarding the success of the translocation (Taylor 1971). Evidence suggests that the translocated bears may have immediately dispersed from the release sites due to the number of recorded mortalities of released bears in the surrounding areas (T. Williams, USFWS, pers. commun.). Nowak (1986) also expressed doubt of any impact of the translocated bears to the native population, while Pelton (1990) suggested some interbreeding could have occurred.

Miller (1995) assessed the genetic effect that may have been caused by the translocation of bears from Minnesota to Louisiana. It was determined that any genetic impacts as a result of the translocation were not statistically significant. These findings provide further evidence for the subspecific status and are in agreement with previous morphological and genetic studies on the Louisiana black bear (Miller 1995).

In January 1992, the United States Fish and Wildlife Service (USFWS) designated the Louisiana black bear as threatened under the authority of the Endangered Species Act of 1973 (Federal Register, 1992, pp. 588-595). Habitat loss and illegal take were cited as the primary determining factors in the listing decision (Neal 1992). Presently the USFWS considers all wild black bears found within the historic range of the Louisiana black bear to be *U. a. luteolus* (Neal 1992). As part of the listing process, the USFWS proposed designating critical habitat for the subspecies, which included the TRB and ARB (Neal 1993).

FRAGMENTATION AND CORRIDORS

Fragmentation associated with habitat loss and human encroachment has become an important issue regarding wildlife populations. The black bear may be particularly vulnerable to habitat loss and fragmentation (Spencer 1981, Nowak 1986, Mykytka and

Pelton 1989, Weaver et al. 1990*b*). In the Southeast, bears occupy only 5-10% of their original range (Pelton 1982, Maehr 1984) and there are at least 30 relatively isolated bear populations in 13 states (Pelton 1990). Habitat fragmentation has many potential biological impacts which include effects on genetic diversity, demographics, range dynamics, and dispersal (Hellgren and Maehr 1992).

Saunders et al. (1991*b*) defined a landscape as fragmented when the habitat is transformed into smaller patches of a total smaller area that are surrounded by different vegetation and land uses than the original habitat. MacArthur and Wilson (1967) developed the theory of island biogeography and describe isolated habitat patches as habitat islands. In the lower MRV, 21% of the original bottomland hardwood habitat remained in 1980 (MacDonald et al. 1980). Within the TRB, >85% of the bottomland hardwood habitat has been cleared and converted to farmland (Burdick et al. 1989) and <450 km^2 of BLH habitat remained in the TRB (Weaver et al. 1990*a*). Black bear habitat in the TRB has been reduced to relatively small isolated "islands" of BLH tracts surrounded by large expanses of agricultural lands. Approximately 80% (318 km^2) of the contiguous BLH habitat in the TRB is in public ownership, comprised of the Tensas River National Wildlife Refuge (TRNWR) and the adjacent Big Lake Wildlife Management Area (BLWMA) (Weaver et al. 1990*b*).

The issues of connectivity and the usefulness of corridors have also gained recent scientific attention (Harris 1985, Pelton 1989, Hobbs et al. 1990, Hellgren et al. 1991, Saunders et al. 1991*a*). Corridors have been considered to provide potential benefits such as maintenance of genetic diversity, dispersal, recolonization, and cover for concealed travel (Simberloff and Cox 1987). However, there is a paucity of empirical data demonstrating the biological importance of corridors, especially to wide-ranging mammals (Simberloff and Cox 1987, Nicholls and Margules 1991, Saunders and Hobbs 1991*a*).

In this study, I defined a corridor as a linear strip of forested habitat ($\geq$10 m wide) that passed through open agricultural habitat and linked forested tracts. Generally, the corridors were along waterways, linked forested tracts, and provided sufficient cover to conceal bear movements. It is not known if the isolated BLH tracts within the TRB are replenished by immigration. Until recently, there had been no documentation of bear movements across I-20, which bisects the northern portion of the TRB (T. Edwards, USFWS, pers. commun.). After completion of this study, a subadult male bear initially tagged on Blue Cat in May 1995 was captured in October 1996, approximately 30 km southeast of the initial capture site on the TRNWR (T. Edwards, USFWS, pers. commun.). This bear had to cross I-20 to reach the TRNWR. Included in the recovery plan for the Louisiana black bear is an attempt to link the Deltic study area to the TRNWR with a travel corridor (U.S. Fish and Wildlife Service 1995).

The TRB once consisted almost completely of BLH forest (Lyttle and Sturgis 1939). The loss of forested habitat and the resulting fragmentation has been associated with the extirpation and decline of a number of area-sensitive species within the TRB. Burdick et al. (1989) stated that red wolves (*Canis rufus*) and Florida panthers (*Felis concolor coryi*) were found in the TRB up into the 1970's, but now are extirpated. The TRB contained one of the last ivory-billed woodpecker (*Campephilus principalis*) populations in the 1930's (Tanner 1966). Bachman's warbler (*Vermivora bachmanii*) was thought to be extinct, but was heard in the TRB in 1988 (Burdick et al. 1989). Burdick et al. (1989) statistically demonstrated a correlation between the decline in forest bird populations with the decline in the amount of BLH habitat. The black bear is another species of concern within the TRB because of the extensive habitat loss and fragmentation (Mykytka and Pelton 1989, Weaver et al. 1990*b*).

PREVIOUS RESEARCH

Little information is available on the effects of forest fragmentation on bears. Mollohan and LeCount (1989) conducted research on the effects of fragmentation on black bears in Arizona. They found that bears had larger home ranges and higher mortality in fragmented habitats. Marchinton (1995) investigated the movement ecology of black bears in the same study area as this study. Marchinton (1995) found that home range shape was influenced by habitat configuration and that males moved between habitat patches more often than females. The majority of studies on the effects of fragmentation have dealt with birds, with few studies conducted on large mammals (Rosenfield et al. 1992).

Most black bear research has focused on the Appalachian region, Great Lakes states, Canada, and mountainous regions in the western United States. Until recently, relatively few studies on black bears have been conducted in the southeastern coastal plain, and even fewer in BLH habitats. Smith (1985) studied black bear ecology in a BLH habitat in Arkansas (White River NWR). In the coastal plains of North Carolina, researchers have investigated habitat relationships, population characteristics, effects of roads, and feeding ecology (Hardy 1974, Hamilton 1978, Lombardo 1993, Maddrey 1995, Jones 1996, Brandenburg 1996). Maehr and Wooding (1992) summarized the research conducted on black bears in Florida. In the coastal plain of Virginia and North Carolina, Hellgren (1988) and Hellgren et al. (1991) conducted research on black bear ecology.

There have been a number of black bear studies in Louisiana. Taylor (1971) radio-monitored 6 black bears, 4 of which were translocated Minnesota bears. Hammond (1989) described the history and status of the black bear in Louisiana. Weaver et al. (1990*b*) provided a forest management plan for bears in Louisiana. Weaver et al. (1990*b*) and T. Edwards (USFWS, pers. commun.) collected data on black bears to assist the USFWS in assessing the taxonomic status of the Louisiana black bear. Weaver and Pelton (1995) detailed the denning ecology of black bears in the TRB. Habitat relationships and movement patterns of black bears were investigated in the ARB (Wagner 1995, Nyland 1995). Marchinton (1995) reported on movement ecology on the Deltic study area, within the TRB.

OBJECTIVES

This study was an effort to better understand how black bears use the small isolated forested tracts on the Deltic study area. Ojectives for this study were:

(1) to determine whether forested corridors facilitated travel further away from forested tracts than agricultural fields,

(2) to determine the season of greatest use of forested corridors,

(3) to determine whether movements between corridor-linked forested tracts were more frequent than between forested tracts that were not linked by corridors,

(4) to determine the amount of agricultural crops and natural foods that made up the seasonal and annual diets of bears,

(5) to determine relative habitat quality of the 4 forested tracts, and

(6) to determine differences in habitat characteristics and use of the 4 tracts by bears.

CHAPTER II

STUDY AREA

LOCATION

The 350 km^2 Deltic study area was located in the northern portion of the TRB in northeast Louisiana (Fig. 2). The majority of the study area was in Madison parish, with a portion in East Carroll, West Carroll, and Richland parishes. Approximate boundaries were Louisiana state highway 17 (west), Louisiana state highway 80 (south), Louisiana state highway 580 (north), and Bear Lake (east). The towns of Delhi and Tallulah are to the southwest and southeast of the study area, respectively. There are several small communities and private residences within the study area. The study area is north of Interstate 20 (I-20), with the TRNWR south of I-20. Other roads within the study area include Louisiana state highways 577 (~330 vehicles/day), 579 (~320 vehicles/day), 877 (~260 vehicles/day), gravel roads, and unimproved farm roads (Louisiana Department of Transportation 1994).

Major waterways within the study area include Bayou Macon, Joes Bayou, Tensas River, and Bear Lake/Roundaway Bayou, all of which generally flow south. Also located within the study area were several small ponds, cypress sloughs, and lakes.

Principal black bear habitat consisted of isolated BLH surrounded by large expanses of agricultural land (Fig. 3). Within the study area, > 85% of the land was in intensively farmed agricultural fields. The forested areas comprised < 35km^2.

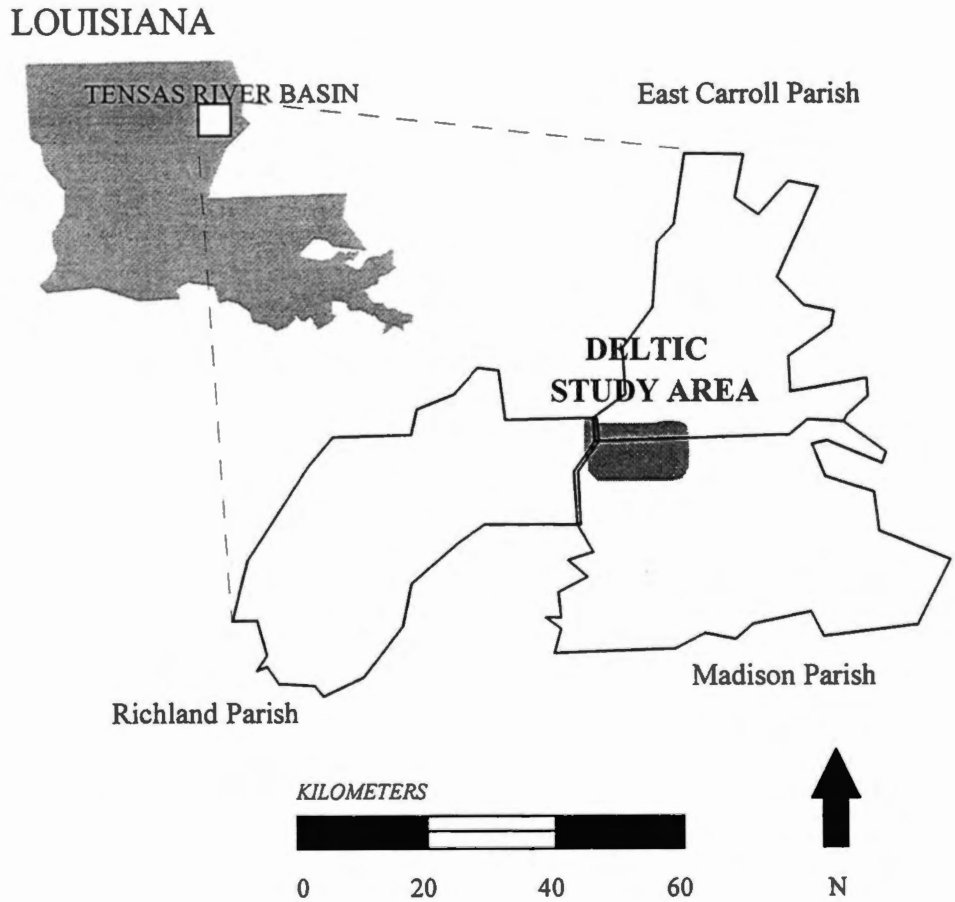

Figure 2. Geographic location of Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

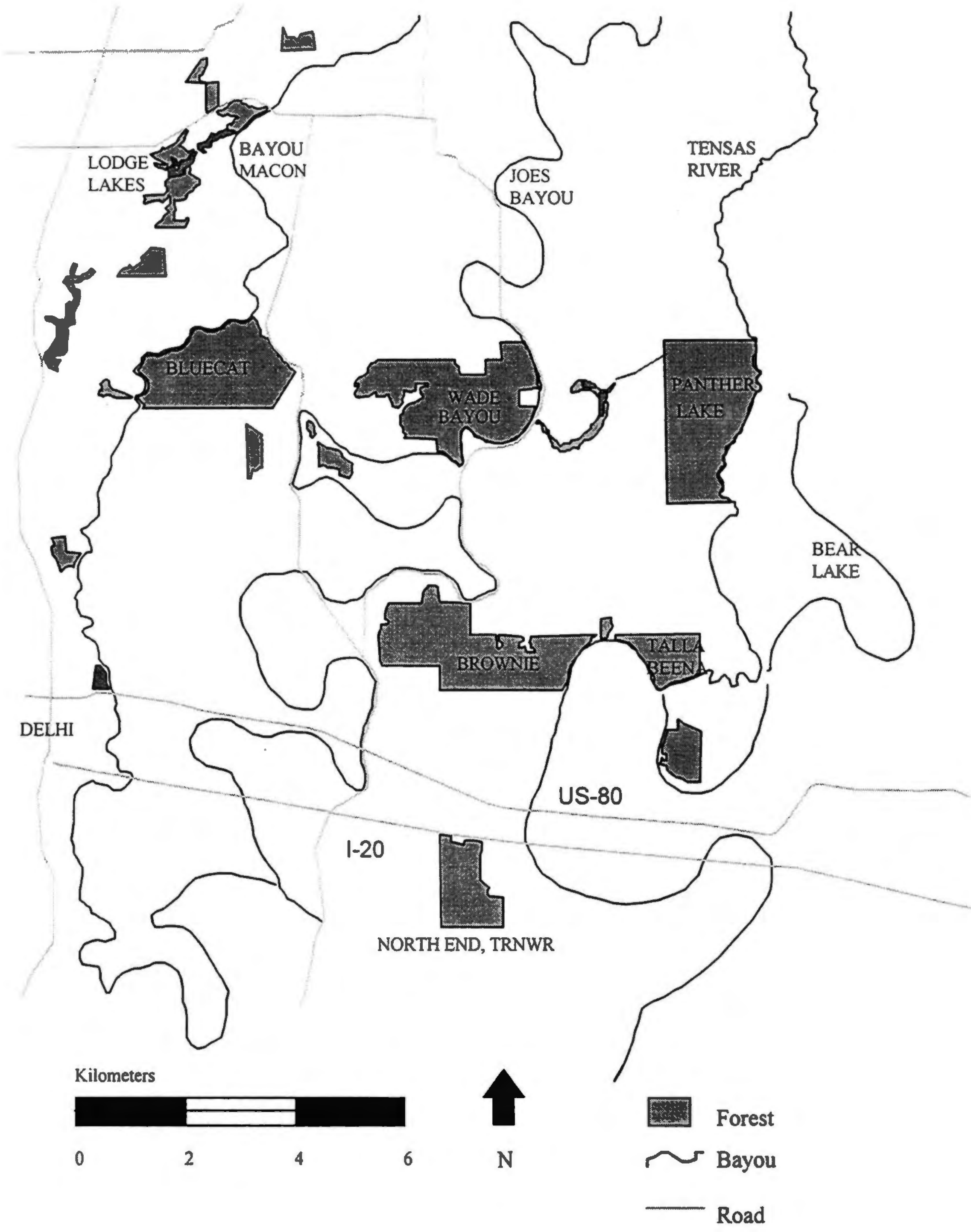

Figure 3. Location of Deltic study area and distribution of bottomland hardwood habitat tracts, Tensas River Basin, Louisiana, 1994-1995.

Four BLH tracts comprise the majority of the forested habitat within the study area. The largest forested tract was Brownie (10.4 km^2); included in this tract is a 2.0 km^2 tract east of Brownie owned by Talla Bena Plantation. The 3 remaining tracts are Panther Lake (7.6 km^2), Wade Bayou (6.9 km^2), and Blue Cat (6.4 km^2). Numerous small tracts (<0.8 km^2) were located throughout the study area. Notable tracts included Carson Woods (0.4 km^2), located south of Blue Cat; Lodge Lakes Woods (2.0 km^2), a complex of small forested tracts north of Blue Cat; Poverty Point South Woods (0.8 km^2), located southwest of Blue Cat; and Talla Bena South Woods (1.1 km^2), south of Talla Bena Plantation. All of the 4 major forested tracts and much of the agricultural land is privately owned by Deltic Farm and Timber Co., Inc.

Major forest overstory components included hackberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), elm (*Ulmus* spp.), bald cypress (*Taxodium distichum*), and numerous species of oak (*Quercus* spp.), including willow oak (*Q. phellos*), water oak (*Q. nigra*), nuttall oak (*Q. nuttallii*), and overcup oak (*Q. lyrata*). Principal understory species included palmetto (*Sabal minor*), switchcane (*Arundanaria gigantea*), poison ivy (*Rhus radicans*), and honeysuckle (*Lonicera japonica*).

PHYSIOGRAPHY, GEOLOGY, AND SOILS

The study area was located in the Mississippi River alluvial plain. Prior to construction of the levees, this area was subject to floodwaters of the Mississippi River. The Tensas River represents a historical channel of the Mississippi River that formed about 1,000 years ago (Weems et al. 1982). Bayou Macon and Joes Bayou were historic channels of the Arkansas River made about 5,000 years ago (Weems et al. 1982). These shifting river channels have created a ridge and swale topography with elevations from 18-29m

Soils were formed by alluvial deposits of the Mississippi River and the original forests were BLH. Most of the soils had high fertility and are well suited for croplands. The major soils of the area were in the Sharkey, Dundee-Sharkee, and Tensas-Sharkey association. These soils are typically level or undulating, poorly drained, and clayey or loamy (Weems et al. 1982). The texture ranges from fine sand to clay with about 65% being clayey soils. Seasonal and annual inundation was common in lower areas of the study area.

CLIMATE

The Deltic study area was in a subtropical transitional climatic region, that is largely affected by cold, dry air out of the north, and by warm, moist air out of the south (Weems et al. 1982). Summers are hot and humid and winters are cool with occasional subfreezing temperatures. For 1994, the monthly mean temperature was lowest in January (5.3 C) and highest in July (27.0 C), with 155.0 cm of precipitation. For 1995, the monthly mean temperature was lowest in December (8.0 C) and highest in August (28.8 C), with 125.6 cm of precipitation (La. Office of State Climatology 1995).

FAUNA AND FLORA

The fertile habitat of the TRB supports a diversity of plant and animal species. In Madison parish, the flora checklist includes 717 species representing 389 genera and 114 families (Rich and Thomas 1981). Within the TRB, 227 bird, 78 fish, 40 mammal, 45 reptile, and 19 amphibian species are found. Common game animals include white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), cottontail rabbit (*Sylvilagus floridanus*), swamp rabbit (*Sylvilagus aquaticus*), raccoon (*Procyon lotor*), eastern wild turkey (*Meleagris gallopavo*), American woodcock (*Philohela minor*), and many species of waterfowl.

CORRIDORS

Rivers, bayous, and ditches were generally bordered by wooded strips 5-75m wide. These wooded corridors typically linked wooded tracts. Four major wooded corridors were located on the study area (Fig. 4). These corridors included Panther Lake corridor (5.6 km long), Tensas corridor (7.7 km long), Macon north corridor (6.9 km long), and Macon South corridor (4.5 km long). The average width of vegetation along each side of these corridors was 50, 63, 78, and 73 m, respectively. These corridors were characterized by gently sloping to steep banks with thick vegetative cover. The height and thickness of this vegetative cover was enough to conceal bear movements.

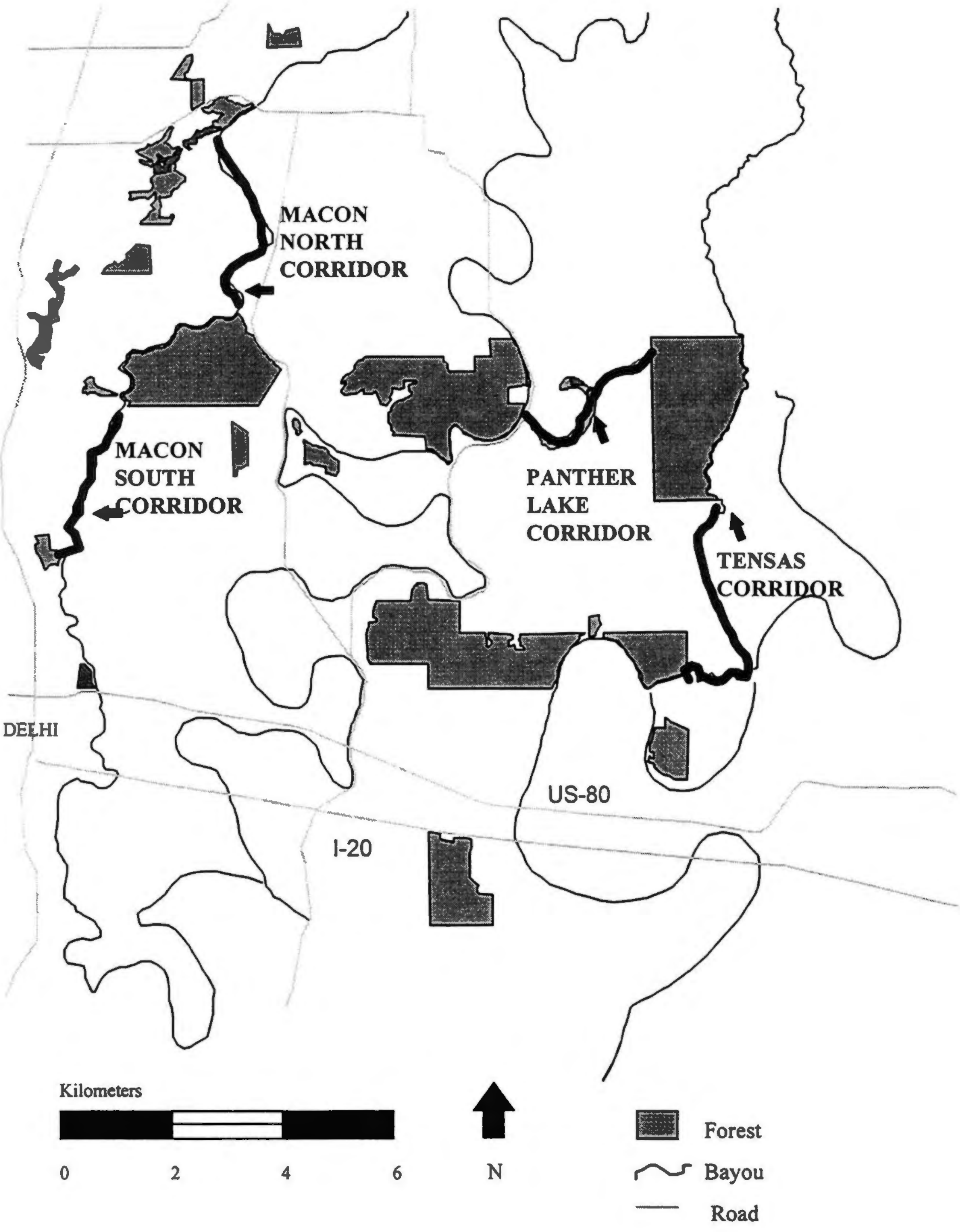

Figure 4. Location of wooded corridors, Deltic study area, Tensas River Basin, Louisiana. 1994-1995.

LAND USE

With the highly fertile soils, agriculture is the primary land use in this area. Agriculture is generally more profitable than silviculture in this area of the Mississippi Delta (MacDonald et al. 1979). Common crops include corn, soybeans, cotton, and rice, with lesser amounts of wheat, milo, and oats. The majority of the study area was owned by Deltic Farm and Timber Co., Inc. and is farmed by Deltic employees or leased to local farmers. Agricultural practices include fertilizer and pesticide application, irrigation, and ditching. Small area select timber cuts have occurred on all 4 tracts in the past. In 1995, a timber harvest plan was developed to thin a portion of each of the 4 forested tracts annually over the next 8-10 years.

OTHER ACTIVITIES

With the exception of hunting season (October to February), there was little human activity within the forested tracts. Hunting (deer, squirrel, and duck) was a common activity within the study area. All-terrain vehicles (ATV's) were used by hunters and baiting for deer with corn was legal, but was only commonly practiced in the Brownie tract. The Blue Cat, Wade Bayou, and Panther Lake tracts were hunted by Deltic Farm and Timber employees and had 7, 8, and 15 members, respectively. The Brownie tract was leased to a private hunt club that had approximately 40 members (B. Lambert, Deltic Farm and Timber, pers. commun.).

CHAPTER III

METHODS AND MATERIALS

TRAPPING

Black bears were captured from June to August 1994 and from May to September 1995 using Aldrich spring-activated foot snares (Aldrich Animal Trap Co., Clallam Bay, WA) (Johnson and Pelton 1980*a*). Both trees and mobile home anchors (122 cm long) were used to secure the snares. Artificial raspberry flavoring (Medallion International Inc., North Haledon, N.J.) was used to lure bears to the trapsite and bakery products (e.g. donuts, cakes) or meat scraps were used to lure the bears into the snare.

Trapsites were primarily established in areas with recent bear sign or in areas that would potentially attract bears. All 4 major tracts and a wooded corridor (Panther Lake corridor) were trapped with 3-10 traps per trap line. Trap lines often were placed near ATV trails or along farm roads to efficiently set and check traps. Traps were checked by 0830 hr and again in the afternoon to minimize the time a bear was confined in a trap and to reset and rebait the trap. When temperatures were unusually high, traps were deactivated during the day.

Captured bears were immobilized with a mixture of ketamine hydrochloride (Ketaset, Bristol Lab., Syracuse NY), xylazine hydrochloride (Rompun, Haver-Lockhart, Inc., Shawnee, KS), and mepivicaine hydrochloride (Carbocaine, Winthrop Lab., New York, NY) at a 200/100/20 mg/ml concentration, respectively. The drug was administered with a jabstick or blowgun at a dosage of ~ 1cc/25kg. Upon initial captures, the first upper premolar was extracted for age estimation (Willey 1974, Eagle and Pelton 1978). Bears were weighed to the nearest 0.45kg using portable hanging scales. Bears were observed until recovery from immobilization at the capture site.

Bears were marked with a numbered metal tag in each ear. A corresponding number was tattooed on the inside of the upper lip. All bears $\geq$ 25 kg were fitted with motion-sensitive radio-collars (Telonics, Inc., Mesa, Ariz.). This type of radio-collar emits a steady pulse rate when it is motionless and switches pulse rates when in motion. A leather or cotton breakaway insert was fitted to the collar to allow collar retrieval (Hellgren et al. 1988). Morphological characteristics and descriptive information related to the condition of the animal were recorded.

RADIO-TELEMETRY

Radio-collared bears were monitored using a receiver (TR-2 and TR-4, Telonics Inc., Mesa, Ariz.) and a vehicle mounted 5-element antennae (Wildlife Materials, Carbondale, Ill.). Bears were primarily located from roads, but occasionally were located from the air. An attempt was made to locate each radio-collared bear 2-4 times weekly at random times of the day and night.

The "loudest signal method" (Springer 1979) was used to obtain azimuths on radio-collared bears. Azimuths were taken from telemetry stations that could be accurately located on 1:24,000 scale United States Geological Service (USGS) maps. Universal transverse mercator (UTM) coordinates were measured to the nearest 10 m from the USGS maps for each telemetry station. The computer program TELEM88 (Coleman and Jones 1988) was used to triangulate the location using the UTM of the telemetry station and the recorded azimuth. Triangulations were determined using ≥ 2 azimuths for each location. Aerial locations gave approximate locations, which were followed up with a ground triangulation.

Triangulation Error

Thirty radio-collars were placed 1 m off the ground at locations throughout the study area that could be identified on a USGS 1:24,000 scale map. Various locations such as forest edges, forest interior, corridors, and fields were used to simulate actual bear locations. In addition, simulated locations were taken at random times of the day, by all researchers, and in various climatic conditions. The distances from the estimated locations and the true locations were measured on the map to the nearest 10 m to estimate triangulation error.

Independence of Locations

White and Garrott (1990) stated that no telemetry location is completely independent of another because an animal's movements are not truly random. However, longer intervals between locations reduce the dependence of locations. In this study, successive locations were considered independent if recorded ≥ 12 hours apart. Twelve hours was sufficient time for a bear on the Deltic study area to traverse its home range.

HOME RANGE ANALYSIS

The adaptive kernel (AK) (Worton 1989), harmonic mean (HM) (Dixon and Chapman 1980), and minimum convex polygon (MCP) (Ackerman et al. 1990) methods were used to estimate seasonal and overall home range sizes. The AK and HM methods are nonparametric methods that estimate probability of use. Data sets of ≥ 50 locations were analyzed using the AK, HM, and MCP methods (Ackerman et al. 1990). Most seasonal data sets contained < 50 locations, and were analyzed using the MCP method only.

The program CALHOME (J. Kie, U.S. Dep. Ag. For. Serv. Pacific Southwest For. Exp. Stat., Fresno, Calif.) was used to estimate home range sizes. Home range estimates are generally more conservative using CALHOME than other home range programs (Larkin and Halkin 1994). For each home range estimation, 95%, 75%, and 50% contours were used. The 95% contour excluded outliers (MacDonald et al. 1980), whereas the 50% contour delineated core use areas. All independent locations were used for bears monitored for ≥ 8 months to estimate overall home ranges instead of annual home ranges. Successive telemetry azimuths taken ≥ 15 minutes apart and at angles < 30° were omitted from analysis (Coleman and Jones 1988, Shmutz and White 1990, White and Garrott 1990).

A Wilcoxson Rank Sum Test (Ott 1993) was used to compare overall home range estimates by sex. A Bonferonni t-test (SAS Institute 1990) was used to compare MCP seasonal home ranges. Seasons were defined by climatic conditions and bear food availability. Winter was defined as 15 December to 15 March, spring - 16 March to 15 June , summer - 16 June to 15 September, and fall - 16 September to 15 December.

CORRIDOR ANALYSIS

General

For corridor analyses, telemetry locations ≥ 100 m from a forested block and ≤ 100 m from a wooded corridor were classified as corridor locations. Locations outside a forested block ≥ 100 m from a wooded corridor were classified as field locations. A distance of 100 m was used based on the average telemetry error of 109.5 m. Because of the openness of the agricultural lands and the locations of telemetry stations, it is unlikely that the locations were classified incorrectly.

Corridor Preference

I tested the hypothesis that bears prefer forested corridors over agricultural fields when outside of a forested tract. To test this hypothesis, I compared the observed frequency of corridor, field, forested tract locations to the proportion of available corridor, field, and forested tract habitat with the overall home ranges with a chi-square goodness-of-fit test. For this analysis, 95% AK home range polygons were overlayed on a GIS habitat coverage. The available corridor, field, and forested habitat area (ha) was determined using individual home range polygons and for all bears using a composite home range polygon (95% AK).

Distances From Forested Tracts

I tested the hypothesis that forested corridors allow for bears to move farther away from a forested tract than agricultural fields. For this analysis, all locations outside a forested tract were classified as field or corridor locations and the distance to the nearest forested tract was measured to the nearest 10 m. All independent telemetry locations outside a forested tract (males and females) were pooled and the distances were compared for field versus corridor locations with a *t*-test. Additionally, distances for corridor and field locations were compared between sexes with a *t*-test.

Seasonal Corridor Use

I used 2 methods to determine seasonal use of corridors: the frequency of corridor telemetry locations in each season, and the amount of bear sign found in searches along the corridors. From June 1994 to December 1995, each radio-collared bear was monitored and locations were determined at random times of day and night. To compare seasonal use of corridors, the frequency of corridor locations was determined for each month. The second method to determine seasonal use of corridors was based on searches along 3 corridors (Macon North, Panther Lake, and Tensas corridors). Macon South corridor was excluded due to logistical constraints. ATV's were slowly ridden along the edges of both sides of the corridors and bear sign (tracks, scats, and foraging activity) was recorded. These searches were conducted monthly from March to November 1995. The frequency of observed bear sign was compared among seasons.

Movements between forested tracts

I hypothesized that movements between forested tracts would be greater between tracts that were linked with a forested corridor. To test this hypothesis, when a radio-collared bear moved from one forested tract to another, I recorded whether there was a corridor linking the two tracts. The number of movements between corridor-linked tracts was compared with the number of movements between unlinked tracts.

FEEDING ECOLOGY

Food habits were determined from analysis of scats (Martin et al. 1946, Korschgen 1980). Scats were incidentally collected during field research and frozen for later analysis. Samples were thawed and washed through a series of sieves with openings 5.6, 2.3, and 0.25mm to separate individual food items. Items were identified to lowest possible taxon. An ocular estimation of percent volume and frequency of occurrence was determined for each food item (Martin 1946). Items of < 1% were considered trace amounts. Seeds and fruits from known and potential bear foods were collected to aid in identification of samples. Unknown samples were identified with the use of identification keys (Stains 1958, Mohlenbrock 1985).

HABITAT RELATIONSHIPS

Forested Track Use Indices

Habitat within the study area was delineated into 6 habitat types based on classification of satellite imagery data (Landsat TM Imagery) from 1992. These habitat types were: bottomland hardwood, agricultural fields, cypress/willow, cut/thin, wet bottomland hardwood, and lake/pond (Table 1). The area (ha) of each habitat type was determined for each of the 4 forested tracts.

I used 2 methods to compare relative bear use among the 4 main forested tracts. Each of the forested tracts were trapped based on observed sign so trap nights/ known visits was used as an index of use among the 4 tracts. The first method was the number of trap nights/ known bear visits to the trap site. A known bear visit was sign that a bear had visited the trap site (i.e. captures, track, scats, hair, or disturbance to the site). Bear visits could have been underestimated as it was not always possible to identify the animal that visited the trap.

The second method to determine relative bear use among the 4 forested tracts was the amount of bear sign along transects. Transects were walked once (June 1995) in each of the 4 forested tracts. Transects were established at 0.5 km intervals and observed bear sign (i.e. scat, track, marked trees, day beds, bear observations, or foraging activity) was recorded within each 1.0 km transect. A Chi-square approximation of the Kruskal-Wallis test (Ott 1993) was used for both methods to determine differences in use among the 4 forested tracts.

Table 1 . Description of habitat types as revealed by analysis of satellite imagery data of the Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Habitat Types	Description
1. Bottomland Hardwood	Hardwood stands with a diversity of species in all canopy layers. Typically not inundated seasonally or annually. Often thick understory of palmetto/switchcane. Overstory primarily oaks, hickory, ash, sweetgum, maple.
2. Wet Bottomland Hardwood	Hardwood stands located in "lower" portions of the forest that are typically flooded seasonally or annually. Generally very little understory. Species include oaks, ash, hackberry.
3. Cypress/Willow	Areas typically inundated throughout the year. Dominant vegetation includes cypress, willow, buttonbush, and other flood tolerant taxa.
4. Cut/Thin	Hardwood stands that have been disturbed by forestry practices. Typically areas that have been select cut or small area clear cut. Understory is generally dense with shrubs, vines, and saplings.
5. Lake/Pond/River	Lakes, ponds, reservoirs, and wide rivers that hold water annually.
6. Agriculture	Areas that are in cropland or pasture. This habitat type includes roads, residences, and other non-forested areas.

Home Range Habitat Characteristics

For each radio-collared bear, habitat types were determined within the home range. Overall home range polygons (95% AK) were overlayed on a GIS coverage of habitat types. The proportion of agricultural habitat within each bear's home range was compared between sexes with a *t*-test. Additionally, the proportion of the home range in forested habitats was calculated for each radio-collared bear.

Relative Habitat Differences Between Tracts

Traditional use-availability methods (Neu et al. 1974, Johnson 1980) were not used because of the lack of large homogenous habitat stands, which lower the rate of habitat misclassification due to telemetry error (Nams 1989). Therefore, I investigated habitat trends within the small forested tracts on the Deltic study area to determine the relative habitat quality between tracts (i.e., which tract has the best bear habitat).

Eleven habitat variables were identified as potentially important to bears on the Deltic study area (Table 2). These variables were determined from bear habitat models (van Manen 1991, Rogers and Allen 1987), review of bear literature, and food habits analysis (see Feeding Ecology). These variables were classified into 4 major habitat components (food, cover, den sites, and human disturbance). Each of the 11 habitat variables were measured on the 4 forested tracts.

Table 2. Description of habitat variables for each habitat component and description of data collection method, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Habitat Variable	Description
FOOD COMPONENT	
V1. Soft mast	Soft mast is an important food item beginning in late spring and into fall. This variable was determined from vegetation sampling (Appendix A). A 1% inventory was performed and all plant species were tallied inside a 0.04 ha plot. This variable is expressed as the average number of soft mast plants/ha.
V2. Hard mast	Hard mast, particularly oak species, provide important fall nutrition. This is important in adding fat prior to the winter denning period. This variable was determined from a timber cruise performed by Deltic Farm and Timber Co. in 1993. This variable was expressed in the percent volume(beard feet) of oak species.
V3. Corn	Corn is a high quality, agricultural food available to bears. Corn made up 33 % of the annual volume in scats on this study area. This variable was determined by measuring the percentage of the perimeter of a forested block planted in corn. It was expressed in a percentage averaged over a two year period (1994-1995).
V4. Wheat	Wheat is an important spring food item. The succulent early growth is used at den emergence. Once the seed head matures, it is used extensively by bears. This variable is expressed as the percentage of the perimeter of a forested tract planted in wheat. It is expressed as a two year average (1994-1995).
V5. Paw Paw	Paw paw was commonly used as an early fall food in this study. This variable was determined from the vegetation inventory and is expressed in the average number of paw paw plants/ha.
COVER COMPONENT	
V6. Cut/Thin	The cut/thin habitat type generally has large areas of impenetrable thickets as a result of logging activities. These thickets are important for escape and bedding cover. This variable was determined through GIS analysis of satellite imagery and is expressed in percentage of cut/thin habitat type.

Table 2. (cont.)

Habitat Variable	Description
V7. Palmetto	Palmetto is the dominant species found in the understory in this area. It is an important species for concealing bear movements and often forms dense thickets. This variable was determined from vegetation sampling and is expressed as the average number of palmetto plants/ha.
V8. Switchcane	Switchcane is an important species because it can form dense thickets that are important for escape and bedding cover. This variable was determined from vegetation sampling and is expressed as the average number of switchcane stems/ha.
DEN COMPONENT	
V9. Cypress	Cypress trees are important for den sites. Larger trees are often hollow and can provide excellent protection for the denning period. This variable was determined from GIS analysis of satellite imagery and it represents the percentage of the area in cypress habitat.
V10. Old Growth	Trees >40" DBH could potentially be hollow and be used as den sites. Additionally, bears during this study denned at the bases of large trees so they could be climbed to safety. This variable was determined from a timber cruise from Deltic Farm and Timber Co. in 1993. It is expressed as the average number of trees > 40" DBH/ha.
HUMAN COMPONENT	
V11. Human	In this study, human disturbance inside the forested tracts was uncommon outside of the hunting season. This variable was determined from the land manager at Deltic Farm and Timber Co. and is expressed as the number of hunters/ha in the 1995 hunting season.

Habitat Suitability Index (HSI) models typically are used to assess habitat quality for a particular species. These type of models are developed for a specific region or study area. HSI models apply an index value to each habitat variable and to the overall habitat suitability of an area, that are determined in a subjective manner. A suitability index value is generated from 0 to 1, with 0 being "unsuitable" habitat and 1 being "optimum" habitat.

In this model, each habitat variable was measured in all 4 of the forested tracts and then a score of 0 to 1 was determined (Individual Value). One was considered the highest (i.e. "best") and 0 the lowest. On the Y-axis was a scale from 0 to 1 and on the X-axis was the lowest to highest score for each habitat variable (see Appendix B). This was a relative score between the tracts determined on a straight linear scale, and is not an HSI. A Relative Score (RS) for each habitat component (food, cover, den, and human disturbance) was determined as the arithmetic mean of the Individual Value (IV) for each of the component's habitat variables. The food component was considered the most important component (van Manen 1991) and was multiplied by 2. The overall Relative Habitat Index (RHI) was determined for each of the 4 forested tracts using the formula:

$$RHI = \frac{(RS_{Food} \times 2) + RS_{Cover} + RS_{Den} + RS_{Human}}{5}$$

My goal was to objectively assess the relative differences in habitat quality among the 4 forested tracts. There seemed to be a disproportionate use of the forested tracts by bears, so this method was chosen to assess relative habitat quality. Each tract was treated as its own "study area" and all 11 habitat variables were measured on each tract. The score for each habitat variable in each of the 4 forested tracts was entered into the formula and an overall Relative Habitat Index was determined.

DENNING

Denning chronology and site selection were determined from radio-collared bears. When a bear's signal was repeatedly located in the same area, researchers walked in on the signal to determine if the bear had denned. Den site characteristics were recorded on all denning bears. The median date between the first denned location and the previous location was used as the date of den entry. The date of den emergence was determined when the radio-collared bear moved out of the den area.

CHAPTER IV

RESULTS

TRAPPING

From 2 June 1994 to 24 October 1995, 20 bears were captured 23 times (Table 3). Twelve bears were unmarked and 8 were recaptures from previous years. A total of 488 trap-nights were accumulated with an average of 21 trap-nights per capture.

The 1994 trapping season was from 2 June to 12 August, with 12 bears captured 13 times. Of these, 6 were recaptures from previous years. Six bears were captured in Blue Cat, 3 in Wade Bayou, 2 in Panther Lake, and 1 in Panther Lake corridor. In 1994, a total of 281 trap-nights were accumulated for an average of 22 trap-nights per capture. Bear M202, a cub of the year, and F200 were not radio-collared. Bear M190 was radio-collared, but immediately dropped the collar.

The 1995 trapping season was from 18 May to 24 October with 9 bears captured 10 times. Of these, 3 were recaptures from previous years. Seven were captured in Blue Cat and 1 in Brownie. Twenty-one trap-nights per capture were achieved in 207 trap-nights. All captured bears were radio-collared in 1995.

TELEMETRY

Number of Locations

A total of 2,417 telemetry locations were obtained from 19 bears from June 1994 to December 1995. Of those, 2,014 met the criteria for analysis ($\leq$ 15 minutes

Table 3. Capture summary of black bears on the Deltic study area, Tensas River Basin, Louisiana, 1994 - 1995.

Date	ID#	Sex	Trap Location	Last Capture	Weight(kg)	Age
04 Jun 94	190	M	West Wade Bayou	New	56.7[a]	3
09 Jun 94	192	F	West Wade Bayou	New	36.3	3
15 Jun 94	194	F	NE Wade Bayou	New	24.5	2
22 Jun 94	124	F	NE Bluecat	20 Jul 93	63.5	8
23 Jun 94	126	F	SW Bluecat	11 Jun 89	59.0	A[b]
26 Jun 94	156	F	NE Bluecat	06 Aug 93	53.1	5 ± 1
27 Jun 94	196	F	SW Bluecat	New	46.3	4
01 Jul 94	128	F	South Bluecat	21 Jul 93	68.0	12
02 Jul 94	108	F	NE Bluecat	29 Sep 90	55.3	7 ± 1
15 Jul 94	182	M	Panther Lake Drain	11 May 93	70.1	3
17 Jul 94	200	F	West Panther Lake	New	27.2	2
20 Jul 94	202	M	West Panther Lake	New	11.3[a]	<1
21 Jul 94	194	F	Panther Lake Drain	15 Jun 94	28.6	2
01 May 95	208	F	West Bluecat	New	54.4	4
02 May 95	184	F	East Bluecat	14 Jul 93	38.5	3
10 May 95	162	F	East Bluecat	05 May 93	40.8	3
11 May 95	210	M	South Bluecat	New	24.9	1
16 May 95	200	F	East Brownie	17 Jul 94	43.1	3
20 Jun 95	212	M	SW Bluecat	New	145.1	8 ± 1

Table 3. (cont.)

Date	ID#	Sex	Trap Location	Last Capture	Weight(kg)	Age
26 Jun 95	226	M	NE Bluecat	New	72.6	3
09 Sep 95	210	M	South Bluecat	11 May 95	38.5	1
13 Sep 95	228	M	South Bluecat	New	49.9	1
24 Oct 95	230	M	South Bluecat	New	49.9	1

[a] estimated
[b] Adult (exact age not determined).

apart and angles $\geq 30^{\circ}$). Of these, 1,561 were considered independent and were used in the home range and corridor use analyses (Table 4).

Telemetry Error

For the 30 test collars, the mean error was 109.5 m (S.D. = 91.8 m, range = 10 to 300 m). Ninety-five percent of the test locations were within 300 m of the actual location and 50 % were within 90 m. I attributed telemetry error to researcher differences, weather conditions, and to the habitat configuration. In some instances, signal "bounce" was noted when the transmitter was near the forest edge or a wooded corridor. Results should not be affected by this level of telemetry error .

HOME RANGE

Size

The average estimate (95% AK) for overall home ranges was 41.6 km^2 and 13.2 km^2 for males and females, respectively (Table 5). Seasonal home ranges were largest in summer, with males having larger seasonal ranges than females in all seasons (Table 6).

Shape and Overlap

The available forested habitat and the configuration of the forested tracts appeared to influence the shape and size of home ranges. All males ($n = 6$) were located in more than 1 of the 4 forested tracts, whereas only 3 of the females ($n = 13$) were located in a tract other than the tract of capture. Females generally remained in the tract of capture

Table 4. Number of telemetry locations of radio-collared black bears, Deltic study area, Tensas River Basin, Louisiana, 1994 - 1995.

ID#	Sex	Dates Monitored	Valid Locations	Independent Locations
108	F	Jul 94 - Aug 94	24	10
124	F	Jun 94 - Nov 95	169	119
126	F	Jun 94 - Dec 95	186	139
128	F	Jun 94 - Aug 95	152	107
156	F	Jun 94 - Dec 95	182	152
162	F	May 95 - Dec 95	63	59
180	F	Jun 94 - Mar 95	105	78
182	M	Jul 94 - Sep 95	155	130
184	F	Jun 94 - Dec 95	194	147
192	F	Jun 94 - Aug 95	157	102
194	F	Jun 94 - July 94	21	17
196	F	Jun 94 - Oct 95	173	126
200	F	May 95 - Dec 95	79	76
208	F	May 95 - Nov 95	113	94
210	M	May 95 - Dec 95	75	69
212	M	Jun 95 - Oct 95	69	61
226	M	Jun 95 - Oct 95	39	29
228	M	Sep 95 - Dec 95	35	30
230	M	Oct 95 - Dec 95	23	16
Total			**2014**	**1561**

Table 5. Comparison of overall home range estimates for bears monitored ≥8 months by calculation method and contour level, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

		FEMALES				MALES				
		n	x	SD	Range	*n*	x	SD	Range	*P*
AK	95%	11	13.20	10.63	3.98-30.51	2	41.55	34.22	17.35-65.75	.138
	75%	11	4.41	2.80	1.60-9.27	2	16.17	9.52	9.43-22.90	.029
	50%	11	2.12	1.45	0.61-4.87	2	6.62	5.88	2.46-10.78	.167
HM	95%	11	11.61	9.56	2.49-28.52	2	43.32	30.14	22.01-64.63	.114
	75%	11	3.57	2.03	1.17-7.25	2	14.04	10.63	6.52-21.56	.076
	50%	11	2.19	2.36	0.46-8.58	2	5.45	5.23	1.75-9.15	.114
MCP	95%	11	8.87	6.51	2.32-21.66	2	38.70	27.12	19.52-57.88	.048
	75%	11	4.47	3.01	1.36-11.06	2	24.52	17.01	12.5-36.54	.030
	50%	11	2.15	1.55	0.38-4.59	2	6.34	2.10	4.85-7.82	.030

Table 6. Comparison of mean estimates of seasonal home range sizes (km^2) between sexes by use of Minimum Convex Polygon, Deltic Study area, Tensas River Basin, Louisiana, 1994-1995.

		Summer 94	Fall 94	Spring 95	Summer 95	Fall 95
n	M	1	1	1	4	4
	F	10	8	7	10	7
95%	M	43.18 a[1]	6.70 a	3.19 a	41.05 a	14.27 a
	F	3.46 b	5.92 a	2.67 a	5.12 b	1.81 b
75%	M	9.67 a	3.91 a	1.65 a	18.73 a	7.80 a
	F	1.99 b	3.02 a	0.97 a	3.52 b	1.02 b
50%	M	5.57 a	2.74 a	0.58 a	9.15 a	4.90 a
	F	0.79 b	1.74 a	0.38 a	1.76 b	0.49b

[1] different letters indicate a significant difference ($p<0.05$) between sexes for a season.

with their home range centered on that tract. Among Blue Cat females, telemetry locations were often in close proximity, making home range overlap evident. Overlap of male home ranges was also extensive because they all used several tracts.

Dispersal

Bears M210, M228, and M230, all yearling males captured in Blue Cat in 1995, dispersed from Blue Cat in late October and early November 1995 (Fig. 5). All telemetry locations prior to the dispersal were located in Blue Cat. Bear M210 left Blue Cat in October and spent the winter in Wade Bayou and was located in Brownie in May 1996. Bear M228 left Blue Cat and was located in Talla Bena throughout the winter and was located back in Blue Cat in spring 1996. Bear M230 left Blue Cat in October and spent the winter in Wade Bayou. All 3 bears settled in the Brownie/Talla Bena area in spring and summer of 1996.

CORRIDOR USE

Corridor Preference

Radio-collared bears were located in corridors and in forested tracts more than expected in proportion to occurrence, whereas there were fewer locations than expected in agricultural fields (X^2 = 1582.33, df = 2, P < 0.001) (Table 7). The Bonferonni-Z

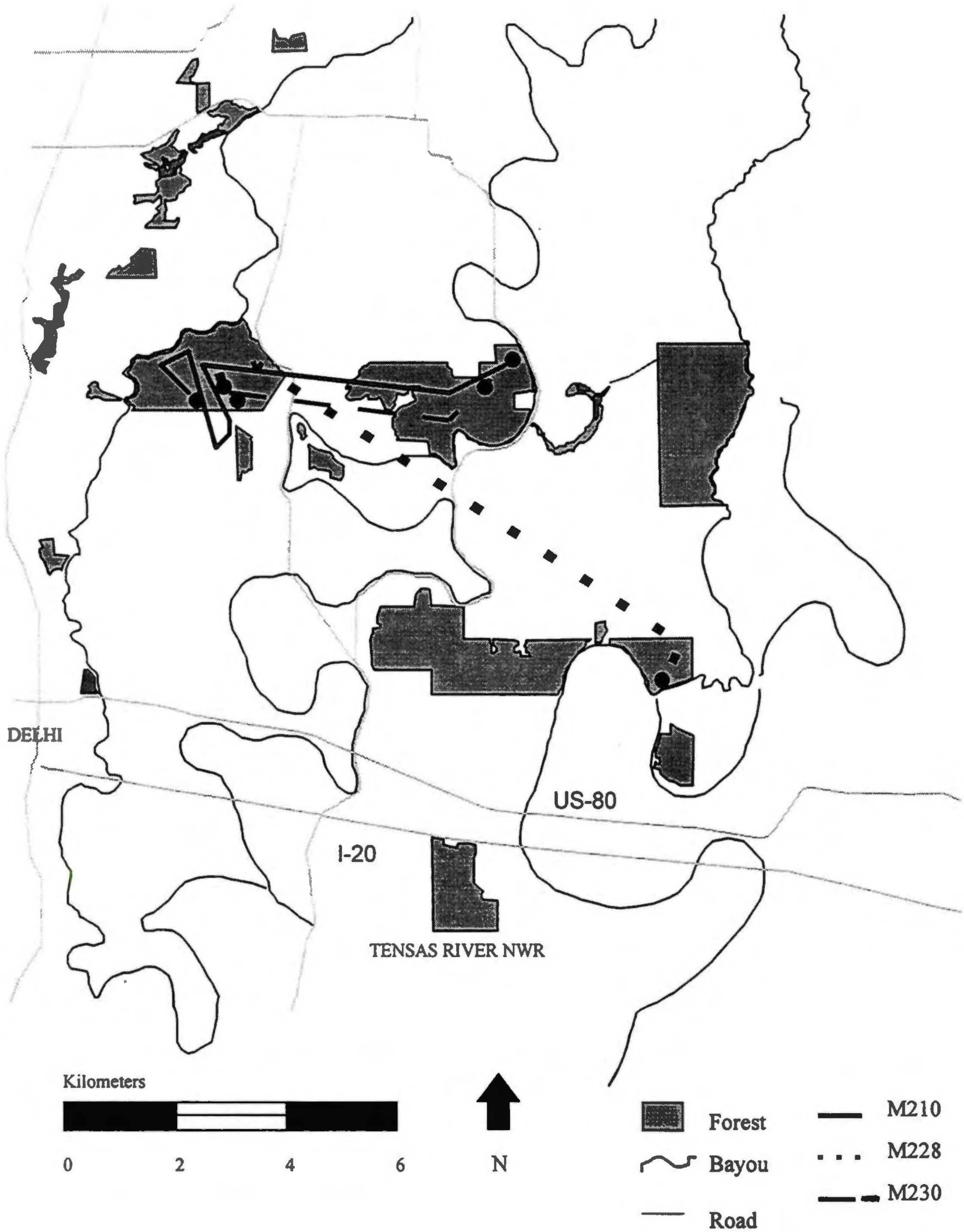

Figure 5. Monthly centers of activity showing dispersal patterns of yearling black bears M210, M228, M230, Deltic study area, Tensas River Basin, Louisiana, 1994 - 1995.

Table 7. Used and available habitats for all radio-collared bears on the Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Habitat Type	Ha	Ha %	Observed %	Observed Frequency	Expected Frequency	95% CI	+, -[b]
Agricultural Fields[a]	4285.296	0.539	0.044	69	842	0.032-0.056	-
Forested Tracts[a]	3470.102	0.437	0.882	1377	682	0.863-0.901	+
Corridors[a]	186.589	0.024	0.074	115	37	0.059-0.089	+

[a] Significant difference between use and availability.
[b] (+ Preference) (- Avoidance)

statistic indicated a preference for corridors and forested tracts, and an avoidance of agricultural fields. Of the radio-collared bears (n = 19), all showed an avoidance of agricultural fields. Forty-two percent showed a preference for corridors, and 95% showed a preference for forested tracts (Table A-1).

Distance from Forested Tracts

For telemetry locations outside of a forested tract, 115 were classified as corridor locations and 69 were classified as field locations (Figs. 6 and 7). Corridor locations (pooled male and female) were farther from forested tracts than field locations ($P <$ 0.001) (Table A-2). Corridor locations averaged 1443 m (S.D. = 913) from the nearest forested tract and field locations averaged 290 m (S.D. = 292) from the nearest forested tract.

For corridor locations, females were located at greater distances from forested tracts than males ($P < 0.001$). I attributed this difference to 1 female (F208) that had many locations a long distance in Macon South corridor, south of Blue Cat. Excluding F208, there was no difference in the corridor distances between males and females ($P =$ 0.0625). Additionally, there was no difference between males and females in the field distances from the nearest forested tract ($P = 0.3388$).

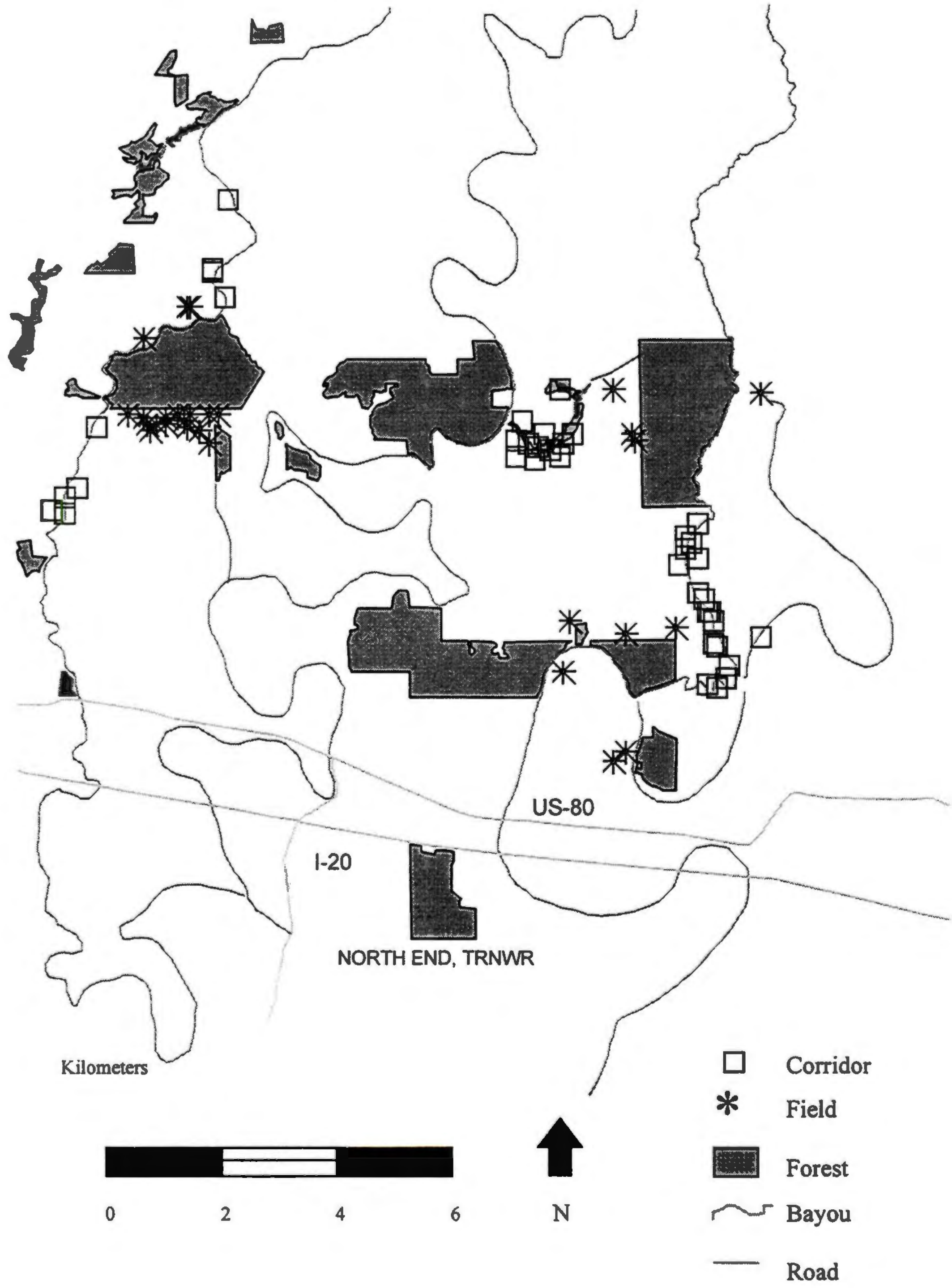

Figure 6. Telemetry locations outside of the forested tracts for male radio-collared bears, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

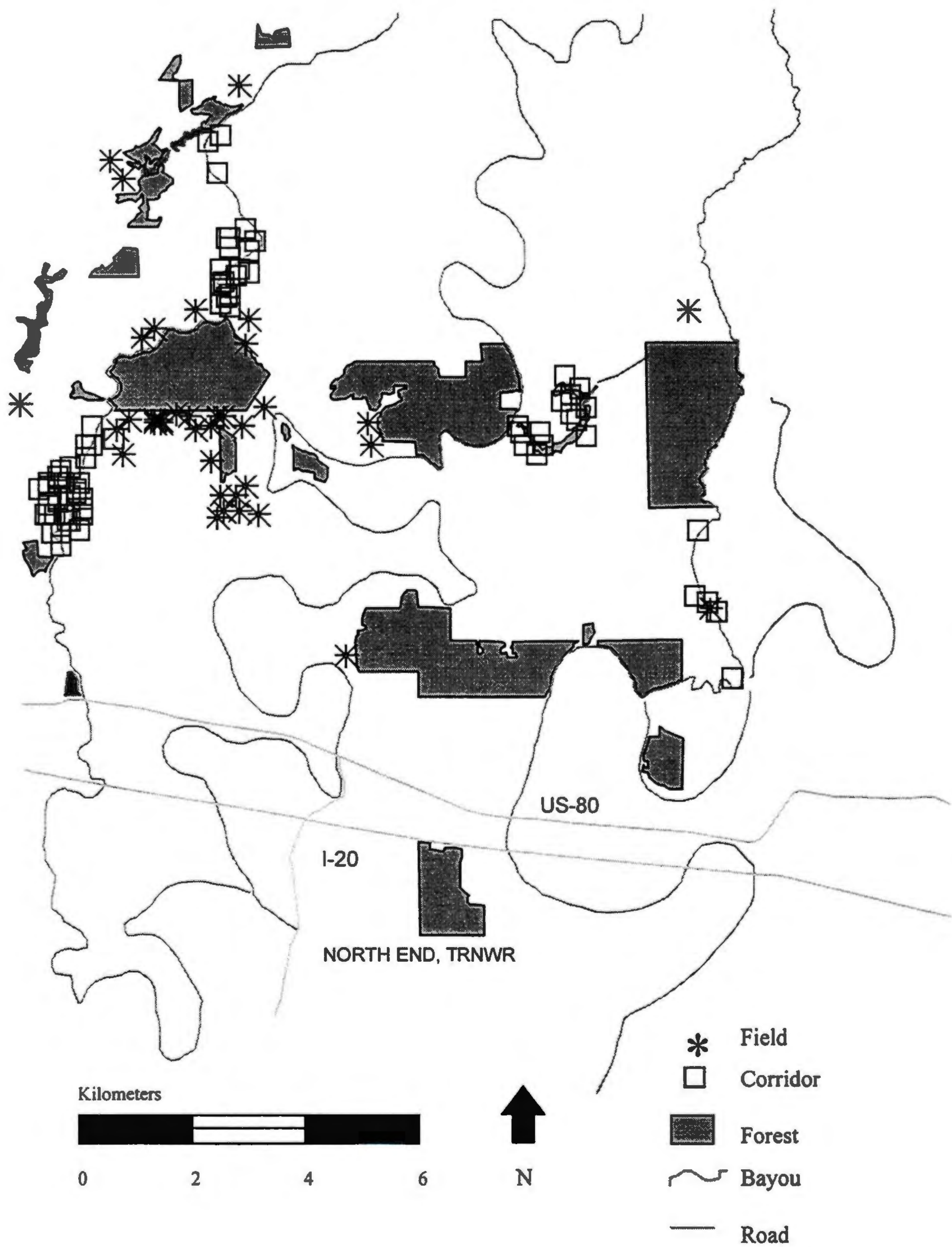

Figure 7. Telemetry locations outside of the forested tracts for female radio-collared bears, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Seasonal Use

Of the 115 corridor telemetry locations (male and female), 69.6% occurred in summer, followed by fall (20.0%), and spring and winter (5.2%) (Table 8). June and July had the most corridor locations with 21.7% and 33.9%, respectively. Macon South corridor had the most telemetry locations (36.5%).

The searches for bear sign along the 3 corridors indicated most bear activity in May, June, and July with 23.9%, 43.7%, and 12.7%, respectively (Table 9). Panther Lake corridor had the most sign (47.9%).

Agricultural Field Excursions

Of the 69 documented field locations, 69.6% occurred in corn fields that provided sufficient cover (May 15-Aug 15), 14.5% occurred at night, and 15.9% in open fields during daylight hours. Bears that were observed during daylight hours were generally $\leq$ 100 m from some type of protective cover.

Movements Between Forested Tracts

There were 47 documented instances of radio-collared bears moving from 1 forested tract to another (Table 10). All males ($n = 6$) moved to another tract other than the tract of capture. Of the 33 documented male tract-to-tract movements, 17 (51.5%) were from tracts linked with a forested corridor, and 16 (48.5%) were from tracts that were unlinked.

Table 8. Number of corridor telemetry locations from radio-collared bears by month and corridor, Deltic Study area, Tensas River Basin, Louisiana, 1994 - 1995.

Corridor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Panther Lake	1	0	0	0	0	0	17	3	1	1	2	0	**25**
Macon North	0	0	0	0	1	3	2	2	3	6	7	1	**25**
Macon South	0	0	0	0	5	18	15	4	0	0	0	0	**42**
Tensas	2	0	1	0	0	4	5	4	3	0	1	3	**23**
Total	**3**	**0**	**1**	**0**	**6**	**25**	**39**	**13**	**7**	**7**	**10**	**4**	**115**

Table 9. Amount of bear sign observed on all-terrain vehicle (ATV) searches along corridors for bear activity by month and corridor, Deltic Study area, Tensas River Basin, Louisiana, 1994 - 1995.

Corridor	May	June	July	August	September	October	November	Total
Panther Lake	17	9	3	1	1	2	1	**34**
Macon North	0	21	6	2	3	1	0	**33**
Tensas	0	1	0	2	1	0	0	**4**
Total	**17**	**31**	**9**	**5**	**5**	**3**	**1**	**71**

Table 10. Characteristics of movements between forested tracts for radio-collared bears, Deltic Study area, Tensas River Basin, Louisiana, 1994 - 1995.

ID#	Movements between Forested Tracts	Date	Corridor Connected?
M182	Wade Bayou to Panther Lake	8 Jul 1994	Y
	Panther Lake to Brownie	19 Jul 1994	Y
	Brownie to Wade Bayou	20 Jul 1994	N
	Wade Bayou to Brownie	21 July 1994	N
	Brownie to Wade Bayou	23 July 1994	N
	Wade Bayou to Panther Lake	26 Jul 1994	Y
	Panther Lake to Brownie	28 Jul 1994	Y
	Brownie to Wade Bayou	28 Jul 1994	N
	Wade Bayou to Panther Lake	30 Jul 1994	Y
	Panther Lake to Wade Bayou	03 Aug 1994	Y
	Wade Bayou to Panther Lake	05 Aug 1994	Y
	Panther Lake to Brownie	12 Sep 1994	Y
	Brownie to Panther Lake	17 Jan 1995	Y
	Panther Lake to Brownie	20 Jan 1995	Y
M210	Blue Cat to Wade Bayou	28 Oct 1995	N
M212	Blue Cat to Wade Bayou	30 Jul 1995	N
	Wade Bayou to Panther Lake	01 Aug 1995	Y
	Panther Lake to Wade Bayou	06 Aug 1995	Y
	Wade Bayou to Blue Cat	07 Aug 1995	N
	Blue Cat to Wade Bayou	09 Aug 1995	N
	Wade Bayou to Panther Lake	11 Aug 1995	Y
	Panther Lake to Brownie	14 Aug 1995	Y
M226	Blue Cat to Wade Bayou	27 Jun 1995	N
	Wade Bayou to Blue Cat	30 Jun 1995	N
	Blue Cat to Wade Bayou	21 Jul 1995	N
	Wade Bayou to Panther Lake	22 Jul 1995	Y
	Panther Lake to Wade Bayou	01 Aug 1995	Y
	Wade Bayou to Blue Cat	11 Aug 1995	N
	Blue Cat to Wade Bayou	15 Sep 1995	N
	Wade Bayou to Blue Cat	09 Oct 1995	N
M228	Blue Cat to Wade Bayou	27 Oct 1995	N
	Wade Bayou to Panther Lake	03 Nov 1995	Y
M230	Blue Cat to Wade Bayou	27 Oct 1995	N
F108	None		
F124	None		
F126	None		
F128	None		

Table 10. (cont.)

ID#	Movements between Forested Tracts	Date	Corridor Connected?
F156	None		
F162	None		
F180	Panther Lake to Wade Bayou	27 Sep 1994	Y
	Wade Bayou to Panther Lake	05 Oct 1994	Y
	Panther Lake to Wade Bayou	04 Nov 1994	Y
	Wade Bayou to Panther Lake	10 Nov 1994	Y
F184	None		
F192	None		
F194	None		
F196	Blue Cat to Lodge Lakes	05 Jul 1994	Y
	Lodge Lakes to Blue Cat	8 Jul 1994	Y
	Blue Cat to Lodge Lakes	14 Jul 1994	Y
	Lodge Lakes to Blue Cat	23 Jul 1994	Y
	Blue Cat to Lodge Lakes	26 July 1994	Y
	Lodge Lakes to Blue Cat	02 Apr 1995	Y
	Blue Cat to Lodge Lakes	10 Apr 1995	Y
	Lodge Lakes to Blue Cat	19 Jul 1995	Y
	Blue Cat to Lodge Lakes	22 Jul 1995	Y
F200	Panther Lake to Brownie	Unknown	Y
F208	None		

Only 3 of 13 (23.1%) radio-collared females moved to a tract other than the tract of capture. Of the 14 documented female tract-to-tract movements, 100% were from tracts that were linked with a corridor.

FEEDING ECOLOGY

From May 1994 to December 1995, 249 scats were collected and analyzed to determine food items in the diets of bears on the Deltic study area. Seventy-three percent (183) of the scats were found in or near Blue Cat, followed by 12 % (29) in Wade Bayou, 8% (19) in Panther Lake, and 7% (18) in Brownie. Thirty-four separate food items were identified in the scats (Table 11). Ninety six percent of the diet was of plant origin. Agricultural crops (corn, wheat, and oats) made up 49% of the annual diet by volume.

Spring diets were dominated by wheat and oats, which accounted for 62% of the volume (Fig. 8). Succulent vegetation (unidentified grasses and leaves) accounted for 31% of the volume. Beetles (Coleoptera) were found in 11% of the spring scats, but only accounted for 2% of the volume.

The summer diet was volumetrically dominated by corn . Corn accounted for 56% of the volume, and was found in 59% of the summer scats. Paw paw (*Asimina triloba*) and muscadine grapes (*Vitis* spp.) each accounted for 13% of the volume in the summer diet. Other soft mast species accounted for much of the summer diet.

Table 11. Frequency of occurrence (%) and volume percent of items identified in 249 black bear scats, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

	% Frequency of Occurrence (F), % Volume (V)				
Food Item	**Spring (*n*=87) F[1] V[2]**	**Summer (*n*=94) F V**	**Fall (*n*=58) F V**	**Winter (*n*=10) F V**	**Annual (*n*=249) F V**
Crops					
Zea mays	1 / T[3]	59 / 56	40 / 19	40 / 23	33 / 27
Triticum aestivum	39 / 39	2 / 2			15 / 14
Avena sativa	22 / 23				8 / 8
Tree Fruit					
Asimina triloba		15 / 13	38 / 28		15 / 11
Quercus spp.	1 / 1		28 / 23	40 / 20	9 / 7
Malus pumila		1 / T	2 / T		T / T
Nyssa sylvatica			1 / 2		T / T
Prunus serotina		1 / 1			T / T
Diospyros virgiana			5 / 1		1 / T
Morus rubra	2 / 3				T / T
Carya aquatica			1 / T		T / T
Shrub/Vine Fruit					
Aralia spinosa		1 / T	10 / 5		3 / 1
Vitis spp.		18 / 13	12 / 5		10 / 6
Phytolacca americana		13 / 3	26 / 6		11 / 2
Sabal minor			17 / 5		4 / 2
Callicarpa americana			3 / 1		T / T
Ampelopsis arborea		2 / 2	7 / 2		2 / 1
Berchemia scandens			1 / T		T / T
Rubus spp.		5 / 4			2 / 1
Prunus angustifolia		1 / T			T / T
Sambucus canadensis		1 / 1	2 / T		1 / T

Table 11. (cont.)

	% Frequency of Occurrence (F), % Volume (V)				
Food Item	**Spring (n=87) F[1] V[2]**	**Summer (n=94) F V**	**Fall (n=58) F V**	**Winter (n=10) F V**	**Annual (n=249) F V**
Animal					
Rodentia		2 / T	5 / T		2 / T
Dasypus novemcinctus			1 / T		T / T
Didelphis virginiana		3 / T	3 / T		2 / T
Ursus americanus	1 / T	2 / T			1 / T
Sylvaligus floridanus			1 / T		T / T
Chelydridae		1 / T			T / T
Aves	1 / T	1 / T			T / T
Coleoptera	11 / 2	7 / T	14 / 1		13 / 1
Acrididae		1 / T	12 / 5		3 / 1
Cyprinidae			1 / T		T / T
Astacidae	1 / T				T / T
Vegetation	34 / 31	9 / 1	10 / 1	80 / 57	21 / 12
Debris	1 / T	1 / T	7 / T		4 / T

[1] = Frequency of occurrence
[2] = Volume percent
[3] = Trace amount (<1%)

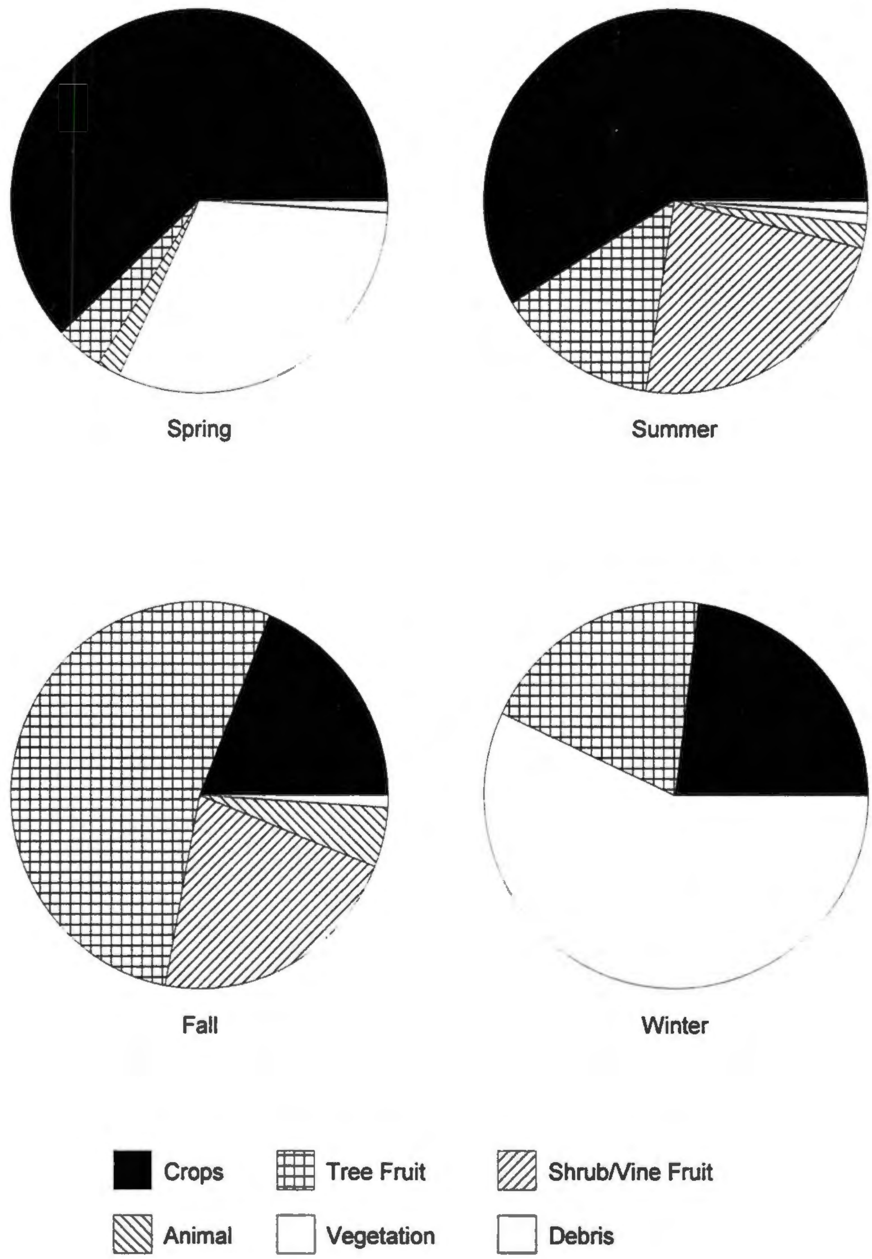

Figure 8. Seasonal diets (% volume) of black bears as revealed by analysis of 249 scats, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

The fall diet was dominated by paw paw. Paw paw accounted for 28% of the fall diet by volume and occurred in 38% of the scats. Corn occurred in 40% of the fall scats and accounted for 19% of the volume. Oak mast (*Quercus* spp.) accounted for 23% of the volume and occurred in 28% of the scats. Grasshoppers (Acrididae) accounted for 5% of the fall diet by volume. Beetles were found in 14% of the fall scats, but only accounted for 1% of the diet by volume.

Only 3 items were identified in winter scats ($n = 10$). Vegetation accounted for 57% of the volume, corn accounted for 23% of the volume, and oak mast accounted for 20% of the winter diet by volume.

The annual volume of food items consumed by bears on the Deltic study area was dominated by agricultural crops (49%) (Fig. 9). Corn, wheat, and oats accounted for 27%, 14%, and 8% of the annual diet, respectively. Shrub and vine fruits accounted for 15% of the volume in the annual diets, while tree fruit accounted for 20% of the volume. Vegetation accounted for 12% of the volume in the annual diet. Animal matter was a small but consistent part of the diet, accounting for 3% of the volume in the annual diet.

Natural foods (discounting agricultural crops) in the annual diet were dominated volumetrically by unidentified vegetation, paw paw, and oak mast, accounting for 12, 11, and 7% of the annual diet, respectively.

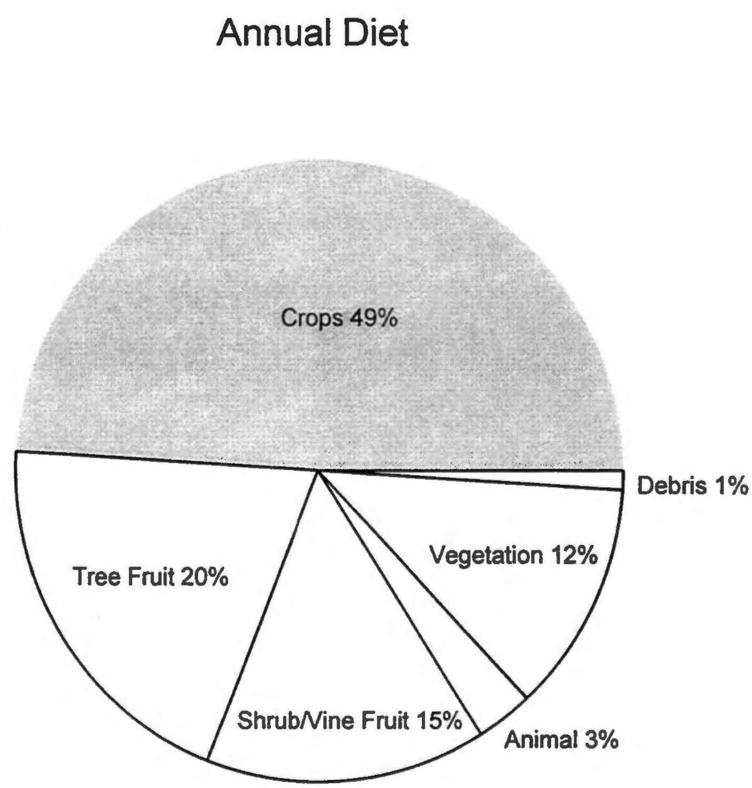

Figure 9. Annual diet of black bears as revealed by analysis of 249 scats, Deltic study area, Tensas River Basin, Louisiana. 1994-1995.

HABITAT RELATIONSHIPS

Habitat Types Within Forested Tracts

The amount of each habitat type was calculated for the 4 forested tracts (Table 12). Blue Cat had the highest percentage, and Brownie had the lowest percentage of BLH; BLH generally contained the most cover, soft mast, and hard mast. Brownie had the highest percentage, and Blue Cat had the lowest percentage of wet BLH; this type generally had sparse understory that provided cover and soft mast. Blue Cat had the highest percentage, and Brownie had the lowest percentage of cut/thin habitat type; this habitat type was associated with impenetrable thickets and high volumes of soft mast.

Forested Tract Use Indices

The known visits/trap night showed a difference between the forested tracts (P = 0.015). Blue Cat had the most activity, followed by Wade Bayou, Panther Lake, and Brownie (Table 13). The amount of sign along transects also showed a difference between the forested tracts (P = 0.003). Blue Cat had the most sign, followed by Wade Bayou, Panther Lake, and Brownie (Table 14).

Agricultural Habitat Within Home Ranges

Agricultural habitat types made up an average of 42.9% of all home ranges, yet only 4.9% of the telemetry locations were in agricultural fields (Table A-3). I attributed this to the configuration of the forested habitat and to the method used to

Table 12. Amounts (ha) and percentages (%) of each habitat type within the 4 major forested tracks, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Tract	Bottomland Hardwood (ha)	Bottomland Hardwood (%)	Wet Bottomland Hardwood (ha)	Wet Bottomland Hardwood (%)	Cypress/ Willow (ha)	Cypress/ Willow (%)	Cut/Thin (ha)	Cut/Thin (%)	Lake/Pond/ River (ha)	Lake/Pond/ River (%)
Blue Cat	373.6	58.5	71.2	11.2	35.1	5.5	160.3	25.2	2.9	0.5
Brownie	332.1	31.9	533.6	51.3	55.9	5.4	88.3	8.5	33.1	3.2
Panther Lake	415.8	55.0	192.3	25.4	33.1	4.4	90.0	11.9	27.9	3.7
Wade Bayou	386.2	55.8	112.4	16.2	57.9	8.4	118.5	17.1	55.0	7.9

Table 13. Use index for known bear visits/trap night for each of the forested tracts, Deltic study area, Tensas, River Basin, Louisiana, 1994-1995.

Tract	# of Trap Sites	Trap Nights	Bear Visits	Visits/Trap Nights
Blue Cat	22	157	28	0.178
Brownie	9	60	3	0.050
Panther Lake	14	63	4	0.063
Wade Bayou	12	132	9	0.068

Kruskal - Wallis Test (X^2 Approximation)
$X^2 = 10.488$ df = 3 Prob. > $X^2 = 0.01484$

Table 14. Use index for the amount of sign found along transects for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995

Tract	# of Transects	#of Plots	Amount of Sign	Sign/Plot
Blue Cat	17	149	55	.369
Brownie	27	195	16	.101
Panther Lake	20	180	24	.133
Wade Bayou	20	140	26	.186

Kruskal - Wallis Test (X^2 Approximation)
$X^2 = 16.386$ df = 3 Prob. > $X^2 = 0.0263$

calculate the home ranges (AK). Males had a larger proportion of their home range in agricultural habitats than females ($P = 0.046$). Forested habitat accounted for an average of 46.3% and 59.3% of home range for males and females, respectively.

Relative Habitat Index

The food component included the habitat variables soft mast, hard mast, corn, wheat, and paw paw. Soft mast was highest in Blue Cat and lowest in Wade Bayou (Fig. B-1). Hard mast was highest in Brownie and lowest in Panther Lake (Fig. B-2). Both corn and wheat were high in Blue Cat, whereas the other 3 tracts scored near 0 (Figs. B-3 and B-4). Paw paw was highest in Blue Cat, with Wade Bayou next, and Brownie and Panther Lake near zero (Fig. B-5). The Relative Score (RS) for the food component was highest in Blue Cat (0.89), followed by Brownie (0.29), Wade Bayou (0.22), and Panther Lake (0.07) (Table 15).

The cover component included cut/thin habitat, palmetto, and switchcane. The cut/thin habitat was highest in Blue Cat and lowest in Brownie (Fig. B-6). Palmetto was highest in Wade Bayou and lowest in Blue Cat (Fig. B-7). Switchcane was highest in Brownie and Panther Lake, and low in Blue Cat and Wade Bayou (Fig. B-8). The RS for the cover component was highest in Brownie (0.55), followed by Wade Bayou (0.5), Panther Lake (0.41), and Blue Cat (0.34).

The den component included cypress and other trees ≥ 40" diameter at breast height (DBH). Cypress habitat was highest in Wade Bayou and lowest in Panther Lake (Fig. B-9). The trees ≥40" DBH variable was highest in Wade Bayou and lowest in

Table 15. Individual values, relative scores within components, and overall relative habitat index for each of the forested tracts, Deltic study area, Tensas River Basin, 1994-1995.

	BLUE CAT	WADE BAYOU	PANTHER LAKE	BROWNIE
FOOD COMPONENT				
Soft Mast	1.00	0.01	0.33	0.05
Hard Mast	0.45	0.43	0.00	1.00
Corn	1.00	0.18	0.00	0.20
Wheat	1.00	0.00	0.01	0.17
Paw paw	1.00	0.50	0.00	0.01
RELATIVE SCORE	**0.89**	**0.22**	**0.07**	**0.29**
COVER COMPONENT				
Cut/thin	1.00	0.52	0.17	0.00
Palmetto	0.00	1.0	0.65	0.20
Switchcane	0.02	0.00	0.85	1.00
RELATIVE SCORE	**0.34**	**0.50**	**0.41**	**0.55**
DEN COMPONENT				
Cypress	0.30	1.00	0.00	0.22
Trees > 40" DBH	0.25	1.00	0.11	0.00
RELATIVE SCORE	**0.28**	**1.00**	**0.06**	**0.12**
HUMAN COMPONENT				
Human Disturbance	0.95	1.0	0.65	0.00
OVERALL RHI	**0.67**	**0.59**	**0.20**	**0.25**

Brownie (Fig. B-10). The RS for the den component was highest in Wade Bayou (1.00), followed by Blue Cat (0.28), Brownie (0.12), and Panther Lake (0.06).

The human component included the numbers of hunters (Fig. B-11). The RS for the hunter variable was highest in Wade Bayou (1.00), followed by Blue Cat (0.95), Panther Lake (0.65), and Brownie (0.00).

The overall Relative Habitat Index (RHI) score for each of the 4 forested tracts was highest in Blue Cat (0.67), followed by Wade Bayou (0.59), Brownie (0.25), and Panther Lake (0.20). These RHI scores are consistent with the forested tract use indices (see Forested Block Habitat Indices). The use indices showed the highest bear activity in Blue Cat and Wade Bayou, and low bear activity in Brownie and Panther Lake.

DENNING AND REPRODUCTION

Denning Chronology

Mean denning period for the 9 radio-collared bears during winter 1994-1995 was 89.0 (S.D. = 53.1 days, range = 37 to 135 days) (Table 16). Eight females denned for an average of 95.4 days (S.D. = 39.8 days, range = 37 to 135 days). One subadult male (M182) was collared during winter 1994-1995 and denned for 38 days.

Den Sites

All radio-collared bears used BLH habitat for den sites. Two bears (M182 and F128) denned on wooded river corridors. Of the 9 radio-collared bears for the winter of 1994-1995, 2 females denned in hollow trees and the remainder used ground dens

Table 16. Den sites and chronology for 9 radio-collared bears, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

Bear ID	Den Type	Den Period	# Days Denned	# Cubs/Yrl.[a]
F124	Ground	29 Nov - 12 Apr	135	1 cub
F126	Ground	21 Nov - 5 Mar	90	2 yrl.
F128	Ground	5 Dec - 19 Mar	105	3 yrl.
F156	Ground	29 Nov - 26 Feb	90	
F180	Ground	17 Jan - 22 Feb	37	3 yrl.
M182	Ground	25 Jan - 3 Mar	38	
F184	Ground	17 Dec - 20 Feb	66	
F192	Tree	30 Nov - 25 Mar	117	
F196	Tree	2 Dec - 20 Mar	108	
			Mean = 89.0	

[a] yearlings (1 year old)

(Appendix C). Ground dens consisted of open nests, brushpiles, or cane thickets. Of the 8 radio-collared bears during winter 1995-1996, 1 female denned in a hollow tree and the remainder used ground dens.

Natality and Survival

During winter of 1994-1995, 2 females (F124 and F180) had cubs with litter sizes 1 and 3, respectively. During that same winter, 2 females (F126 and F126) were observed with yearling cubs with litter sizes 2 and 3, respectively. During the winter of 1995-1996, 2 radio-collared females (F184 and F156) had cubs with litter sizes of 1 and 2, respectively. There was no known mortalities of cubs of radio-collared females.

MORTALITY

Two mortalities of radio-collared bears occurred during the study. Bear F194 was killed by a vehicle on Louisiana state highway 579 east of Wade Bayou in July 1994. Bear F108 was found dead in Blue Cat in August 1994. The cause of death was a suspected vehicle collision, because she was found within 200 m of Louisiana state highway 577. The fate of her cub was unknown. Also in 1994, a bear was reported killed on highway 577, but this incident was never confirmed. No incidences of bear poaching have been reported on the study area, nor the TRB, since 1991 (T. Edwards, USFWS, pers. commun.).

CHAPTER V

DISCUSSION

FOREST FRAGMENTATION

The geographic range of the black bear in Louisiana has been greatly reduced and fragmented. The result of extensive habitat loss has been extirpations and isolated bear populations. The potential effects of forest fragmentation on bear population dynamics and ecology include changes in genetic diversity, demographics, dispersal, home range size, movement patterns, population density, population viability (Hellgren and Maehr 1992). However, many of these effects are not well understood. This study and previous studies (Marchinton 1995; K. Weaver, unpubl. data) on the same study area can provide insight into the effects of forest fragmentation.

There are a number of intuitive effects of forest fragmentation on bear ecology that are difficult to investigate with field data. Bears in fragmented habitats are less insulated from catastrophic events, bears in fragmented and isolated habitats have a greater probability for inbreeding, and there is increased competition for resources.

The bear population of the Deltic study area is likely a remnant population and not a population formed from the dispersal of bears from the Tensas River National Wildlife Refuge (TRNWR). Bears exist on the TRNWR which is approximately 4 km to the south. Interstate 20, which was constructed in the 1960's, bisects the Deltic study area and the TRNWR. Since bear research began in 1988, 65 different bears have been marked (31 Deltic, 34 TRNWR), but only 1 (subadult male) has been documented crossing the Interstate. The TRNWR is largely continuous forested habitat, with the small, isolated forested tracts of the Deltic study area to the north. If the TRNWR were considered the source of bears for the Deltic study area, then 2 events related to MacArthur and Wilson's (1967) theory of island biogeography should occur. Large habitat islands should have higher bear densities than smaller habitat islands, and habitat islands closer to TRNWR should have higher bear densities than islands that are farther away. However, the largest and closest tract, Brownie, had the lowest bear density, whereas the farthest and smallest tract, Bluecat, had the highest bear density. Thus it seems that TRNWR is not the source of bears for the Deltic study area. I attribute these differences in bear densities to habitat quality differences between the 4 tracts (see Relative Habitat Index) and also to the killing of bears prior to receiving federal protection in 1992. People who hunted these areas in the 1970's and 1980's indicated that it was not uncommon for bears to be shot illegally, particularly when bears frequented corn intended to bait deer. People also stated that Bluecat was the first hunting club in this area to strictly prohibit shooting bears, whereas other hunting clubs still had problems with illegally shooting bears. I demonstrated that Bluecat had more agricultural crops, hard mast, and soft mast available to bears than any other tract. Bluecat also had low levels of human disturbance. I demonstrated that Brownie had a lower quality habitat and that human activities were greater than any other tract.

Increased home range size is often cited as an effect of forest fragmentation (Hellgren and Maehr 1992, Mollohan and LeCount 1989). However, I demonstrated the opposite effect in this study. In Arizona, Mollohan and LeCount (1989) found bears in fragmented habitats had home ranges of 611 and 104 km^2 for males and females, respectively, whereas bears in unfragmented habitats had home ranges of 40 and 19 km^2 for males and females, respectively. Smith (1985) studied the ecology of black bears on White River National Wildlife Refuge (WRNWR), which is unfragmented and has a similar habitat composition as the Deltic study area, and determined home ranges of 116 and 12 km^2 for adult males and females, respectively. In the unfragmented habitat of TRNWR, home ranges averaged 90 and 17 km^2 for males and females, respectively (T. Edwards and D. Anderson, unpubl. data). However, in the fragmented habitat of the Deltic study area, home ranges averaged only 42 and 13 km^2 for males and females, respectively. Additionally, the home range estimates for the Deltic study area included forested and open field habitat. I subtracted the average amount of open field habitat from home range estimates and calculated that the "usable" or forested home ranges averaged 19 and 7 km^2 for males and females, respectively. These small home ranges are contrary to most accounts that fragmentation increases home range size. I attribute these small home ranges, particularly females, to behavioral influences. The open agricultural fields were largely unused by bears, possibly because they were less willing to cross open areas. I also attribute these small home ranges on the Deltic study area to the overall richness of the habitat, particularly to the abundance of agricultural crops (corn and wheat), soft mast, and hard mast. The habitats of the TRNWR and the Deltic study area are nearly identical with the exception of 2 components. On the Deltic study area, agricultural crops are much more available to bears than on the TRNWR. Second, paw

paw is abundant on the Deltic study area, but is rarely found on the TRNWR. Paw paw seemed to be a preferred food item in the early fall on the Deltic study area as it accounted for 28% of the fall diet by volume (see Feeding Ecology).

Fragmentation also may affect dispersal and mortality. Mollohan and LeCount (1989) found that mortality rates of black bears were higher in the fragmented portion of their study area. This higher mortality rate was attributed to greater human access into the fragmented areas which resulted in more hunting mortalities. On the Deltic study area, estimates of survival were high (>0.90). With few mortalities and high documented cub recruitment, this population likely is increasing. If subadult males disperse and subadult females establish their home range within the maternal range, I hypothesize that fragmentation can have an effect on sex ratios, skewing it towards females. Since 1992, only 3 adult males (> 5 years) have been captured on the study area, compared to 11 adult females. Adult males have large home ranges that could encompass nearly the entire forested portion of the study area. Adult males may only tolerate a certain portion of home range overlap with other adult males and may discourage settlement by subadult males. Females seem to be staying in one forested tract, which supports that subadult females establish their range within the maternal range (Rogers 1987). There has been an increase of confirmed bear activity in the area surrounding the study area (T. Edwards, USFWS, pers. commun.), which provides further evidence for this hypothesis. Also related to dispersal, mortality rates can be affected by fragmentation. Bears are more likely to be killed from crossing roads or by being spotted and killed in areas that lack any forested cover.

Fragmentation can affect bears by concentrating them into smaller areas. In this study, population densities in the forested tracts were much higher than most reported bear population densities. Based on bear captures and observations, I estimated that approximately 60 bears occupy the 4 forested tracts on the study area. These 4 tracts total 31.1 km^2 resulting in a density of 1.9 bears/km^2. I speculate that a concentration of this magnatude can have negative effects. Not only does concentrations of bears increase competition for resources, it may cause social pressures. With more bears being concentrated into smaller areas, human disturbances are exacerbated and chances of human/bear conflicts are increased. Also, the likelihood of adult males encountering females with cubs is increased in fragmented habitats. These encounters could effect cub recruitment through infanticide.

Fragmentation can make it more difficult to replace animals removed, particularly females. Female survival is critical if isolated bear populations are to remain viable. Managers must ensure high female survival or sufficient recruitment of young for isolated bear populations, particularly in fragmented habitats. I demonstrated that males moved frequently between habitat fragments and documented the first dispersal from the study area by a subadult male. However, I also demonstrated that female movements between habitat fragments were minimal and only occurred between fragments connected with a corridor. This, coupled with the fact that females disperse at much lower rates than males, makes it more difficult for female bears to recolonize fragmented areas that have experienced high female mortality. In fragmented areas unoccupied by bears, it may require human intervention to translocate females, and perhaps even males, to populate or augment bears into the forested tracts.

HOME RANGES AND MOVEMENTS

Many factors affect the size and shape of the annual home range of bears. These factors can include age, sex, season, population density, and the spatiotemporal distribution of food (Armstrup and Beecham 1976, Garshelis and Pelton 1980, Pelton 1982, and Hellgren 1988). In this study, the available forested habitat and the configuration of the isolated forested tracts also appeared to influence home range size and shape. A similar situation occurred in a bear population on an island in Washington (Lindzey and Meslow 1977). This island analogy is similar to the Deltic study area where the isolated forested tracts are like "islands in a sea of agriculture."

Black bear habitat is associated with forests throughout the range of the species (Pelton 1982). The home ranges of bears in this study were closely linked to the forested tracts. Females generally remained in 1 tract with occasional excursions. Male movements seemed to be less affected by the fragmentation of the forested cover, because they all used several forested tracts. Males used larger areas than females, both annually and seasonally. Armstrup and Beecham (1976) hypothesized that adult males can increase their reproductive fitness by using areas that encompass the ranges of several adult females. Armstrup and Beecham (1976) also hypothesized that female ranges may be related to habitat quality and should be large enough to support adequate resources for production. These hypotheses seem to apply to the bears on the Deltic study area. Home ranges of females were relatively small and there was considerable home range overlap among both males and females in this study.

I hypothesized that the "actual" home ranges of the bears in this study were smaller than reported. The configuration of the isolated forested habitat may have caused an overestimation of the range of radio-collared animals. Forested habitat within home ranges accounted for 44.6% and 62.8% for males and females, respectively (see Habitat Within Home Ranges), yet only 4.9% of the locations were in agricultural fields; I attributed this to the method of home range estimation. The nonparametric home range methods (AK and HM) seemed to fit the locations slightly better than the parametric home range methods (MCP). Due to the locations of the "islands" of forested habitat, the MCP method included larger areas of open agricultural fields that were generally not used by bears. Perhaps other methods of home range estimators that take habitat configuration into consideration should be used in fragmented habitats.

Dispersal and survival rates of subadult black bears from the time of family breakup until sexual maturity are poorly documented (Alt 1978, Rogers 1987, Clevenger and Pelton 1990). Black bears generally provide parental care for 16-17 months (Rogers 1987), and family breakup occurs in early summer, which coincides with the onset of the breeding season. Female offspring generally remain within their maternal range, whereas male offspring disperse (Rogers 1987). It has been hypothesized that social intolerance is the impetus for dispersal (Beecham 1980).

From 1988 to 1995, there was no documentation of bears dispersing from the study area (T. Edwards, USFWS, pers. commun., Marchinton 1995). However, of 3 yearling males radio-collared in Blue Cat in 1995, all remained in Blue Cat until late October and early November, when they dispersed to other tracts. All 3 males settled in Brownie where they spent most of their time in 1996. Marchinton (1995) also radio-collared a yearling male in Blue Cat that dispersed to Brownie. Data indicate that Brownie contains a lower density of bears compared to the other 3 forested tracts (see Forested Tract Use Indices). These data may support the hypothesis that adult males are likely to discourage immigration and settlement by transient male subadults (Jonkel and Cowen 1971, Rogers 1987).

In October 1996, subadult male #210 was captured on the TRNWR by USFWS personnel (T. Edwards, USFWS, pers. commun.). The capture site was approximately 15 km southeast of the Brownie tract (Deltic study area) where the bear dropped its radio-collar in September 1996. This was the first documentation of a bear dispersing from the Deltic study area and crossing I-20.

POPULATION ISOLATION

The viability and degree of isolation of the bear population on the Deltic study area was largely unknown. Minimum reserve sizes for bears have not been defined. Apparently stable bear populations occurred on the Great Dismal Swamp (Hellgren and Vaughan 1989*a*) and the White River National Wildlife Refuge (Smith 1985) with study area sizes of 555 and 457 km^2, respectively. Both of these study areas were almost entirely forested. The Deltic study area was 350 km^2, but < 37 km^2 was forested.

Fifty bears have been recommended as an effective population size for short-term population survival and 500 bears for long-term population survival (Franklin 1980). Effective populations sizes have been estimated at 53-90 bears for White River National Wildlife Refuge (Smith 1985) and 56 bears for the Great Dismal Swamp (Hellgren and Vaughan 1989*a*). Based on reproduction and survival, the bear population seemed to be stable to increasing during this study. In 1995, I documented 30 different bears using the Blue Cat tract (including residents, yearlings, cubs, and transient bears). A population estimate was not an objective of this study, but considering the small total forested acreage (<37 km^2) and the number of bears captured and observed, densities would far exceed reported bear densities in the literature. These high densities could be a result of female black bear philopatry and low rates of dispersal (Rogers 1987). In Minnesota, Rogers (1987) only documented 3 of 31 females dispersing. In Alaska, Swartz and Franzmann (1992) only documented 1 of 30 females dispersing from their birth place. Since 1988, 22 different bears have been captured on Blue Cat, of which 14 were females. This study, and Marchinton (1995), documented the dispersal of 4 young males from Blue Cat to other tracts. This indicates that young females are remaining in the tract of birth, whereas young males are dispersing to other tracts or to fringe habitat outside of the study area.

The amount of genetic interchange between the Deltic study area and the Tensas River National Wildlife Refuge has not been well documented. Only 1 bear has been documented crossing Interstate 20 since research began in 1988. This indicates that Interstate 20 hinders movements between these 2 bear populations. Ralls et al. (1985) estimated that 1 successful migrant per generation may be sufficient to prevent losses of genetic variation. Given the mobility of bears, particularly of males, these populations may not be as effectively isolated as previously believed.

CORRIDORS

In a population that functions as a single demographic unit, movements between fragmented habitat patches may be important. The importance to native animals of corridors between remnants of natural vegetation that remain as a result of habitat fragmentation is often stressed by landscape ecologists (MacClintock et al. 1977). Corridors may provide many benefits such as dispersal that can increase genetic diversity. Also, natural river corridors may fulfill other important life requisites (Simberloff and Cox 1987). These benefits are difficult to demonstrate with field data, particularly for secretive, wide-ranging mammals, such as black bears.

I observed 3 characteristics of corridors related to bear use. First, bears preferred wooded corridors to agricultural fields when outside of a forested tract. Second, corridors allowed bears to move farther away from a forested tract than agricultural fields. Telemetry data showed that bears moved greater distances from a forested tract using corridors rather than using agricultural fields. Lastly, bear movements between corridor-connected forested tracts were more frequent than between unconnected forested tracts, especially among females.

The use of the word "corridor" often implies that their primary function is to provide movements from one place to another. Telemetry locations indicated that wooded corridors may not only be used for movements between forested tracts, but also for other reasons. Radio-collared bears that were located in major corridors were sometimes found back in a forested tract in < 1 hour. Conversely, several bears remained in corridors for days at a time. Female #194 spent nearly all of July 1994 in Panther Lake corridor. I speculate that she used the corridor to gain access to corn, because it was the closest corn within her range. For female #208, from 5 May 1995 to 3 August 1995, 49 of 61 locations were in Macon South corridor. Additionally, adult male #212 was in the same area as female #208 in Macon South corridor from 6 July 1995 to 13 July 1995, which coincided with the breeding season.

Seasonal use of corridors was highest during the summer, with June and July having the most corridor locations of any month; I attributed this to 2 factors. First, corn generally ripens at this time, and bears are likely to be attracted to this food source. Second, June and July coincide with the breeding season and male bears may increase their movements in search of estrous females.

Telemetry data from this study indicated that males may not be affected by fragmentation as much as females. All males ($n = 6$) were located in at least 3 of the 4 forested tracts, whereas only 3 of 13 females were located in a tract other than the tract of capture. Radio-collared males moved readily between linked and unlinked tracts, whereas radio-collared females only moved between corridor-linked tracts. Since bear research began on the Deltic study area in 1988, 18 females were radio-collared on Blue Cat and Wade Bayou, but none moved to either tract (T. Edwards, USFWS. pers. commun.). Blue Cat and Wade Bayou are separated by 1.4 km of open agricultural fields. These data indicate that females may not be willing to cross open agricultural fields and provide further evidence for the importance of corridors. It was difficult to determine whether the level of fragmentation affected female movements, or if a single forested tract contained all the life requisites making movement to another tract unnecessary.

The functionality of a corridor is in part determined by its width. The importance of corridor width, however, is influenced by factors such as length, topography, vegetative cover, species of interest, and adjacent human activities (Harris 1984). A particular corridor is "wide enough" when it meets these factors for the species of interest. On the Deltic study area, radio-collared bears used 4 major wooded corridors. The vegetative community and amount of cover along these corridors were similar. Radio-collared bears also were located on tree-lined ditches 5 m wide. In this study, the corridors contained sufficient vegetative cover to conceal bear movements, and had little or no human activities nearby. These are the characteristics that make corridors suitable to bears as habitat linkages when traversing open agricultural fields.

HABITAT

A variety of habitat types are important to fulfill various requirements of bears throughout the year (Landers et al. 1979). Numerous studies have addressed which habitats bears prefer and which they avoid (Lindzey and Meslow 1977, Landers et al. 1979, Garner 1986, Hellgren 1988, Hellgren et al. 1991, Nyland 1995, Jones 1996).

Habitat data (GIS satellite imagery) indicated that Blue Cat had the best habitat, followed by Wade Bayou, Panther Lake, and Brownie. Blue Cat contained the highest percentage of bottomland hardwood and cut/thin habitats, and the lowest percentage of wet bottomland hardwood habitat. The bottomland hardwood and cut/thin habitat types were generally associated with the most cover, soft mast, and hard mast, while the wet bottomland hardwood habitat type often lacked protective cover and soft mast. Brownie had the lowest percentage of bottomland hardwood habitat and had the highest percentage of wet bottomland hardwood habitat.

The Relative Habitat Index (RHI) results showed a similar pattern as seen in the GIS habitat data. Blue Cat scored the highest, followed by Wade Bayou, Brownie, and Panther Lake. The results of the RHI also paralleled the habitat use indices used to determine which tracts the bears used the most. Again, Blue Cat had much more bear use, followed by Wade Bayou, Panther Lake, and Brownie.

The food component was highest in Blue Cat and lowest in Panther Lake. I attributed this to the abundance of corn, wheat, soft mast, and paw paw in this tract. Paw paw was very abundant in both Blue Cat and Wade Bayou. The cover component was highest in Brownie and lowest in Blue Cat. Brownie scored high in this component because of the abundance of palmetto and switchcane. Blue Cat scored the lowest in the cover component, yet scored as the best overall habitat; this could indicate that cover is sufficient at the level that Blue Cat contained. The den component scored highest in

Wade Bayou and lowest in Panther Lake. Wade Bayou has several large cypress sloughs, which explains the high score. Low human disturbance resulted in a high index. The human disturbance component was highest in Wade Bayou and Blue Cat and lowest in Panther Lake and Brownie. Blue Cat and Wade Bayou are hunted by relatively few of the Deltic Farm and Timber managers. Panther Lake is hunted by a larger group of Deltic Farm and Timber employees, while Brownie is leased to a private hunting club with up to 40 members. This intensive hunting associated human disturbance could help to explain the lesser degree of bear activity on Brownie.

The results from the RHI provided some important information. It indicated that the abundance of soft mast, corn, and paw paw on Blue Cat may explain the high density of bears in that tract. A number of factors indicate that Blue Cat has the highest quality bear habitat among the 4 tracts. Such factors include the high percentage of bottomland hardwood and the low percentage of wet bottomland hardwood, the amount of preferred agricultural crops planted around Blue Cat, and the abundance of paw paw. The slightly higher elevation of Blue Cat seems to provide a higher diversity of plant species. The RHI indicated that protective cover and den trees may not be a limiting factor to bears on the study area. Blue Cat scored low in both the cover and den component. Lastly, the RHI indicated that the amount of hunters during fall and winter may affect how bears use individual forested tracts in the study area. The Brownie tract had the lowest amount of bear activity and the highest amount of human disturbance with hunters in the fall and winter.

Both the trap site and bear sign indices indicated that Blue Cat had the most bear activity. Blue Cat, the smallest of the 4 forested tracts had the highest density of bears. Marchinton (1995) estimated that 20 different bears regularly occupied the 5.5 km^2 tract (3.6 bears/km^2) in 1993. In this study, I documented 30 different bears using the Blue Cat tract in 1995; this included resident bears, cubs, yearlings, and transient bears. I speculate that this high density of bears is related to the rich habitat of the Blue Cat tract. Blue Cat had an abundance of soft mast (particularly paw paw) and hard mast species. Additionally, corn was grown in large fields surrounding Blue Cat and was available to bears from mid-June until September, and into December as waste corn in the fields.

Smith (1985) found evidence of a relationship between home range size and habitat quality in bottomland hardwood habitat in Arkansas. In that study, bears had smaller home ranges in the portion of the study area that had the best bear habitat. A similar trend was found in this study. The Relative Habitat Index indicated that Blue Cat had the best bear habitat of the 4 forested tracts. The average home range for females on Blue Cat ($n = 6$) was 7.10 km^2, and 24.14 km^2 for females on the other tracts ($n = 4$); this provides further evidence that Blue Cat may contain better quality habitat for bears.

FEEDING ECOLOGY

Ninety-six percent of the annual diet of bears on the Deltic study area was of plant origin, and followed similar shifts in food habits as other studies in the southeastern United States (Landers et al. 1979, Smith 1985, Eagle and Pelton 1983, Hellgren 1988, Clapp 1990, Maddrey 1995). This study was unique with respect to the high percentage of agricultural crops that were used in all seasons and also to the amount of paw paw that was used in the fall. Agricultural crops including corn, wheat, and oats comprised 49% of the annual diet by volume. In a study in coastal North Carolina, agricultural crops were used frequently in all seasons (Maddrey 1995).

Spring has been considered a "negative foraging period" (Poelker and Hartwell 1973) for black bears because of low availability of quality foods and the resulting weight loss during that period (Eagle and Pelton 1983, Hellgren 1988). Spring diets of bears were dominated by wheat and oats, which accounted for 62% of the volume. Wheat was a minor spring food item in some studies (Smith 1985, Hellgren 1988), whereas it was used heavily in another (Maddrey 1995). Wheat was not planted extensively on the Deltic study area, but was used heavily by bears when it was near forested habitats. The early maturation of the wheat seed in May provided bears with a nutritional food source 4-6 weeks before most soft mast fruits and corn were available. Bears used white-tailed deer food plots planted in oats in the same fashion as wheat.

Corn was the dominant food item in summer scats. Bears switched almost exclusively to corn as soon as it ripened, which generally occurred in mid-June. Frequent use of corn has been documented in other bear studies in the eastern United States (Landers et al. 1979, Hellgren 1988, Hellgren and Vaughan 1988, Maddrey 1995). As the corn hardened in late summer, bears gradually switched to soft mast. Paw paw and muscadines were important late summer foods. Paw paw generally ripened in late June, but did not show up in scats until late August or early to mid September.

Corn remained an important food item in winter scats. Corn fields were typically disced under after harvest and bears were observed feeding on corn into December. It is possible that corn in winter scats could have been from hunters who use corn to bait deer. However, this practice was uncommon in all but the Brownie tract.

Animal matter comprised a small but consistent part of the annual diet, accounting for 3% of the volume. Beetles showed up frequently in scats in spring, summer, and fall, but only made up 1% of the annual volume. Although ants substantially contributed to the diets of bears in other areas in the southeastern United States (Garner 1986, Hellgren 1988, Clapp 1990, Brandenburg 1996), they were lacking in the diets of Deltic bears, despite their abundance. One possible explanation may be the abundance of high quality agricultural crops.

Scat analysis indicated substantial use of agricultural crops by bears during this study. Wheat was important in the spring diet and corn was important in all seasons except spring. The fertile bottomland hardwood tracts generally provide an abundance and variety of soft and hard mast. With the addition of high quality agricultural crops, the carrying capacity for bears may be artificially increased; this explains the high density of bears in the relatively small forested tracts.

DENNING

An understanding of denning ecology is important for the conservation of the Louisiana black bear. Denning and hibernation enable black bears to survive a period with limited food supplies and sometimes severe winter (Johnson and Pelton 1980*b*). It is also a time when pregnant females give birth to altricial young. Bears in mild climates, such as the Southeastern Coastal plain of the U.S., generally den for ≤ 3.5 months (Hamilton and Marchinton 1980, Johnson and Pelton 1980*b*, Smith 1985, Hellgren and Vaughan 1989).

Bears in the southeastern United States use both ground nests and cavity trees for denning activity. Within the TRB, ground nests were scooped-out depressions often lined with vegetation such as palmetto, switchcane, or leaves. These ground dens were typically in areas of dense vegetation on higher sites that were not prone to inundation. In this study bears denned in brushpiles or treetops from logging activity. Black bear use of ground dens have been documented in other southeastern studies (Landers et al. 1979, Hamilton and Marchinton 1980, Johnson and Pelton 1980*b*, Smith 1986, Hellgren and Vaughan 1989*b*).

Tree dens offer advantages over ground dens, such as protection from the elements and added seclusion from disturbances (Pelton et al. 1980). Den trees in this study were located in bald cypress ($n = 2$) and overcup oak ($n = 1$). Weaver and Pelton (1995) in the TRB, and Smith (1985) in Arkansas observed that cypress and overcup oak were the most common species used for denning. This study, and Marchinton (1995) on the Deltic study area, monitored 23 radio-collared bears from 1992-1995, and only 6 (26%) used tree dens. Hamilton and Marchinton (1980) and Hellgren and Vaughan (1989*b*) also reported little use of tree dens. Conversely, Smith (1985) reported extensive use of den trees in the White River National Wildlife Refuge, Arkansas. He reported that females used tree dens exclusively, and males used both ground and tree dens. Weaver and Pelton (1995) reported that 62% of all bears in the TRB used tree dens, but they did not identify which bears were on the Deltic study area. Den trees are abundant on the TRNWR and females den almost exclusively in trees; males use both tree and ground dens (T. Edwards, USFWS, pers. commun.). Although not surveyed, I speculate that there were not enough available den trees for bears, especially for females, on the Deltic study area. Most of the cypress had been cut in the past and the timber harvesting had left a relatively young forest.

Denning chronology in this study was consistent with Weaver and Pelton (1995). Mean denning period for females in this study ($\bar{x}$ = 95 days, n = 8) was similar to Weaver and Pelton (1995) ($\bar{x}$ = 95 days, n = 9) and longer than Marchinton ($\bar{x}$ = 77 days, n = 4). This study had one subadult male denned ($\bar{x}$ = 38 days), which was shorter than both Weaver and Pelton (1995) ($\bar{x}$ = 71 days) and Marchinton (1995) ($\bar{x}$ = 58 days). The onset of denning (late Nov. - early Jan.) was consistent with Weaver and Pelton (1995) and earlier than Marchinton (1995) (early - late Jan.). Emergence dates were consistent with both Marchinton (1995) and Weaver and Pelton (1995) (late Feb. - mid Apr.).

CHAPTER VI

MANAGEMENT IMPLICATIONS

Prior to October 1996, there had been no evidence of immigration or emigration of bears from the Deltic study area. In October 1996, USFWS personnel captured a subadult male bear #210 on the TRNWR (T. Edwards, USFWS, pers. commun.). This bear was captured approximately 10 km south of the Deltic study area had to traverse Interstate 20. There has been a recent increase in bear reports in the areas surrounding the study area (T. Edwards, USFWS, pers. commun.) which may indicate dispersal. Telemetry data collected during this study indicated that females were less likely to cross open agricultural fields. Males traveled frequently between forested tracts whereas females generally remained on a single forested tract. Additionally, female movements between forested tracts lacking wooded corridors did not occur.

This study demonstrated that wooded corridors between forested tracts were used by both male and female bears. Long-term management should include maintenance and enhancement of wooded corridors that link substantial forested tracts and construction of new corridors. A corridor connecting the Deltic population to the TRNWR population would be important because only 1 bear has been documented crossing Interstate 20. Another potential corridor could be constructed to the east of the Deltic study area to connect with the Mississippi River corridor (Fig. 10). This corridor would enable bears to use the forested habitat along the Mississippi River to move north towards the bear

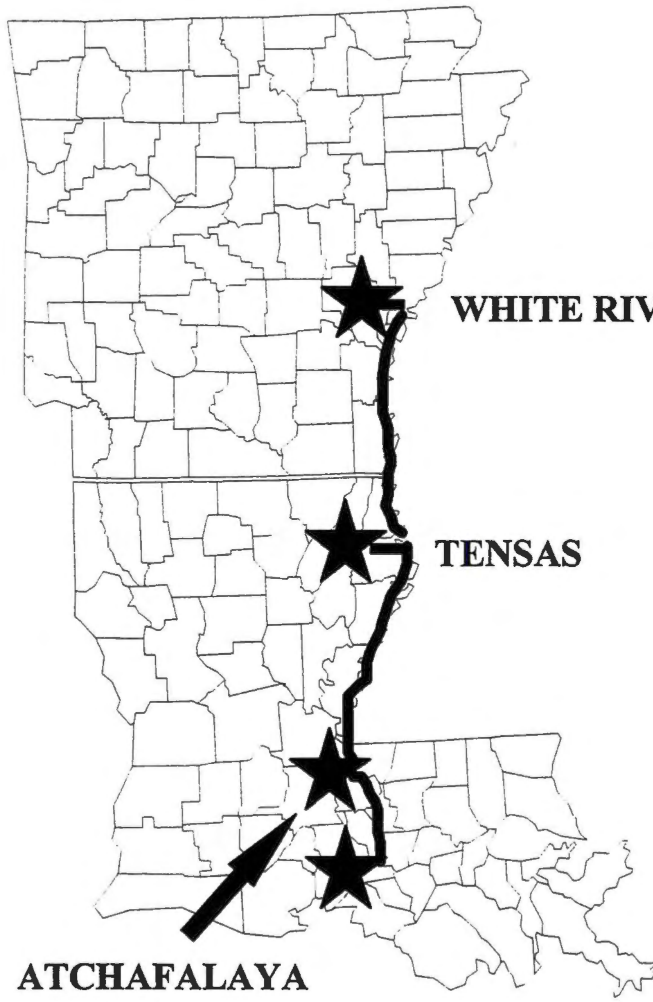

Figure 10. Potential sites for corridor construction and enhancement which would provide forested habitat for bears to travel between populations.

population at the White River National Wildlife Refuge or south towards the Atchafalaya River Basin bear population.

Generic corridor parameters have not been defined for black bears. Year-round thickness of the understory is one of the most important characteristics of a corridor. A situation where a bear can move undetected in a thick understory would be desirable. The level of human disturbance is also an important consideration when creating corridors. In areas of little human disturbance, corridor quality can be less ambitious. The distance between the habitat patches being connected needs to be evaluated. Perhaps, as a general rule, the farther the habitat patches, the wider and better quality the corridor should be. When creating corridors, generally the wider the corridor is, the more vegetative cover it will provide. Because of different characteristics of bear metapopulations throughout North America, it is difficult to put quantitative values on corridor qualities. When considering the creation of corridors, a list of factors should be identified and prioritized. Corridors should be created as wide as economics, social acceptance, and land use dictates.

Although fragmentation and habitat loss occurred primarily because of land-clearing for agriculture, the extensive agricultural crops (particularly corn and wheat) are important in the diet of the bears. The availability of high-quality crops may explain the relatively high densities of bears in this area. Changes in agricultural practices (e.g. conversion of corn and wheat to cotton or soybeans) could substantially affect this bear population.

Protection of the remaining forested habitat is vital for the long-term survival of bears in this area. Forest management should ensure that the life requisites are met for bears in this area. Management should include reforestation, particularly of marginal farm land. Creation of additional forested habitat, particularly adjacent to existing habitat patches would be beneficial. Den trees and potential den trees, especially cypress and overcup oak, should be protected to ensure suitable tree den sites.

RESEARCH IMPLICATIONS

The high densities of bears on relatively small forested tracts on the Deltic study area is an unusual situation. Research is needed to address cub survival and juvenile dispersal. Cub survival appears to be high, so at what level might social intolerance take effect? Additionally, an attempt should be made to radio-collar yearlings and juveniles to determine survival and dispersal patterns.

Considering the federally threatened status of the Louisiana black bear, an accurate population estimate for the Deltic study area and the TRNWR would be important to assess recovery goals outlined in the U. S. Fish and Wildlife Service Recovery Plan.

Human activities on this study area have been minimal. In 1996, construction began on a recreational and residential lake (Poverty Point Reservoir) within the study area. This 685-ha impoundment is being constructed on the west side of Bayou Macon, adjacent to the Blue Cat tract. Based on my findings, the development will not only destroy bear habitat, but the close proximity of human activities to bear Blue Cat will likely negatively affect the bear population. Future research should assess the extent of this impact on bears on the Blue Cat tract and the rest of the study area. Also, forest management has become more intense on the study area. Research is needed to assess the impacts of this level of forest management on bears.

CHAPTER VII

SUMMARY AND CONCLUSIONS

1. Bear research was conducted on a privately owned study area (350 km^2) in the Tensas River Basin in northeast Louisiana, from May 1994 to December 1995. Corridor use, feeding ecology, and habitat relationships were determined in fragmented bottomland hardwood tracts.

2. Twenty bears were captured 23 times in 488 trap-nights, for an average of 21 trap-nights per capture. Nine males and 14 females were captured and 19 were radio-collared (6 males and 13 females).

3. A total of 2,417 telemetry locations were obtained from 19 bears. Of these telemetry locations, 1,561 were considered independent ($\geq$ 12 hours apart) and were used in home range estimates.

4. The average for overall home range estimates (95% Adaptive Kernel) was 41.6 km^2 and 13.2 km^2 for males and females, respectively. Seasonal home ranges were largest in summer, with males having larger ranges than females in all seasons.

5. Radio-collared females generally remained in the tract of capture with their home range centered on that tract. All radio-collared males (n = 6) were located in more than 1 of the forested tracts, whereas only 3 females (n = 13) were located in a tract other than the tract of capture.

6. During the study, no radio-collared bears were documented leaving or entering the study area. However, in October 1996, a subadult male bear was captured south of

the study area on the Tensas River National Wildlife Refuge. This bear had been previously captured on the Blue Cat tract of the Deltic study area. This was the first documented evidence of dispersal out of the study area and the first bear within the Tensas River Basin to cross Interstate 20.

7. Both male and female radio-collared bears were located in wooded corridors. Four major corridors were used by bears during the study. Radio-collared bears were located in corridors and in forested tracts more than expected in proportion to their occurrence, whereas there were fewer locations than expected in agricultural fields.

8. The average of all locations found in corridors ($n = 115$) was farther away from a forested tract than were the average of all locations found in agricultural fields ($n = 69$). There was no difference between males and females in the distances traveled into corridors and agricultural fields.

9. Data suggested that when bears traveled in agricultural fields, they preferred the cover of crops (corn) or the cover of night. Of the 69 field locations, 69.6% occurred in corn fields that provided cover, 14.5% occurred at night, and 15.9% occurred in open fields during daylight hours.

10. Summer seemed to be the season of greatest use of corridors. This coincides with the breeding season and shifts in food availability (e.g. corn). June and July had the most telemetry locations in corridors of any month, and searches along corridors for bear sign indicated the most activity in May, June, and July.

11. There were 47 documented instances of radio-collared bears moving from 1 isolated tract to another. Of the male movements, 51% were from tracts linked with a

corridor, whereas 100% of the female movements were from tracts linked with a corridor. This may indicate that females may not easily move across open agricultural fields.

12. Agricultural crops (corn, wheat, and oats) comprised 49% of the annual diet of bears on the Deltic study area. Paw paw (*Asimina triloba*) was used frequently in the fall and comprised 28% of the fall diet by volume.

13. Two indices of bear activity indicated that Blue Cat had the most bear activity, followed by Wade bayou, Panther Lake, and Brownie. Similar results were observed in an index to determine relative habitat quality among the 4 forested tracts.

14. Mean denning chronology for the 9 radio-collared bears during 1994-1995 was 89.0 days. Two females denned in hollow trees; the remaining denned in brushpiles or open nests. Two females had cubs with litter sizes of 1 and 3, respectively.

15. Two mortalities of bears occurred during the study. A radio-collared female was killed by a vehicle and another radio-collared female was killed by unknown causes.

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APPENDICES

Table A-1. Used and available habitats for individual radio-collared bears on the Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

ID#	Habitat Type	Total Ha	Ha %	Observed %	Observed Freq.	Expected Freq.	95% CI	+,-[b]
F108[a]	Ag. Field	38.72	0.316	0.000	0	3	0.000-0.000	-
	Forested	83.11	0.679	1.000	10	7	1.000-1.000	+
	Corridor	0.60	0.005	0.000	0	0	0.000-0.000	-
F124	Ag. Field	92.59	0.155	0.025	3	18	-0.008-0.058	-
	Forested	497.24	0.832	0.966	115	99	0.928-1.000	+
	Corridor	7.80	0.013	0.008	1	2	-0.011-0.027	
F126	Ag. Field	57.91	0.145	0.035	5	20	-0.001-0.071	-
	Forested	335.05	0.841	0.964	134	117	0.928-1.001	+
	Corridor	5.28	0.013	0.000	0	2	0.000-0.000	-
F128	Ag. Field	168.22	0.028	0.009	1	22	-0.012-0.030	-
	Forested	626.14	0.775	0.944	101	83	0.893-0.996	+
	Corridor	13.38	0.016	0.037	4	2	-0.005-0.079	
F156	Ag. Field	152.27	0.256	0.007	1	39	-0.009-0.023	-
	Forested	429.71	0.724	0.941	143	110	0.897-0.985	+
	Corridor	11.69	0.021	0.053	8	3	0.011-0.095	
F162	Ag. Field	61.72	0.146	0.000	0	9	0.000-0.000	-
	Forested	359.26	0.851	1.000	59	50	1.000-1.000	+
	Corridor	1.23	0.003	0.000	0	0	0.000-0.000	
F180	Ag. Field	1684.3	0.605	0.013	1	47	-0.017-0.043	-
	Forested	1062.28	0.382	0.923	72	30	0.853-0.993	+
	Corridor	35.91	0.013	0.064	5	1	0.000-0.128	+
M182	Ag. Field	3812.90	0.580	0.015	2	75	-0.010-0.039	-
	Forested	2675.03	0.407	0.800	104	53	0.719-0.881	+
	Corridor	87.38	0.013	0.185	24	2	0.106-0.264	+
F184	Ag. Field	188.27	0.343	0.102	15	50	0.044-0.160	-
	Forested	359.36	0.655	0.898	132	96	0.840-0.956	+
	Corridor	0.94	0.002	0.000	0	0	0.000-0.000	
F192	Ag. Field	393.14	0.416	0.020	2	42	-0.012-0.052	-
	Forested	551.68	0.584	0.980	100	60	0.948-1.012	+
	Corridor	0.00	0.000	0.000	0	0	0.000-0.000	
F194[a]	Ag. Field	133.59	0.451	0.000	0	7	0.000-0.000	-
	Forested	151.76	0.512	0.471	8	9	0.173-0.769	+
	Corridor	11.03	0.037	0.529	9	1	0.249-0.809	+
F196	Ag. Field	2312.68	0.758	0.024	3	96	-0.008-0.056	-
	Forested	684.48	0.213	0.905	114	27	0.845-0.965	+
	Corridor	54.22	0.018	0.071	9	2	0.018-0.124	+
F200	Ag. Field	1459.98	0.507	0.013	1	39	-0.017-0.043	-
	Forested	1364.21	0.474	0.921	70	36	0.850-0.993	+
	Corridor	55.72	0.019	0.066	5	1	0.000-0.132	+
F208	Ag. Field	814.82	0.545	0.064	6	51	0.006-0.122	-
	Forested	648.77	0.434	0.553	52	41	0.434-0.672	+
	Corridor	32.96	0.022	0.383	36	2	0.267-0.499	+
M210	Ag. Field	645.60	0.372	0.203	14	26	0.091-0.315	-
	Forested	1089.95	0.628	0.797	55	43	0.685-0.909	+
	Corridor	0.00	0.000	0.000	0	0	0.000-0.000	

Table A-1. (cont.)

ID#	Habitat Type	Total Ha	Ha %	Observed %	Observed	Expected	95% CI	+,-[b]
M212	Ag. Field	1912.26	0.371	0.029	2	25	-0.021-0.079	-
	Forested	3176.06	0.617	0.739	51	43	0.609-0.869	
	Corridor	62.48	0.012	0.116	8	1	-0.014-0.211	+
M226[a]	Ag. Field	3875.32	0.536	0.069	2	16	-0.040-0.178	-
	Forested	3282.63	0.454	0.759	22	13	0.576-0.943	+
	Corridor	77.98	0.011	0.172	5	0	0.010-0.334	
M228[a]	Ag. Field	1298.56	0.437	0.067	2	13	-0.038-0.172	-
	Forested	1643.38	0.553	0.900	27	17	0.774-1.027	+
	Corridor	27.91	0.009	0.033	1	0	-0.042-0.108	
M230[a]	Ag. Field	627.93	0.543	0.000	0	9	0.000-0.000	-
	Forested	527.71	0.457	1.000	16	7	1.000-1.000	+
	Corridor	0.00	0.000	0.000	0	0	0.000-0.000	

[a] Minimum convex polygon
[b] (+ preference) (- avoidance)

Table A-2. Characteristics of corridor locations for radio-collared black bears, Deltic study area, Tensas River Basin, Louisiana, 1994 - 1995.

ID#	Date	Time	Distance to Nearest Forested Tract (m)	Corridor
M182	14 Jul 1994	0815	650	Panther Lake
	15 Jul 1994	1750	125	Panther Lake
	16 Jul 1994	0935	300	Panther Lake
	18 Jul 1994	1439	540	Panther Lake
	21 Jul 1194	1545	700	Panther Lake
	29 Jul 1994	1723	330	Panther Lake
	30 Jul 1994	0937	950	Panther Lake
	31 Jul 1994	1715	975	Panther Lake
	05 Aug 1994	0945	700	Panther Lake
	03 Sep 1994	1013	1210	Tensas
	08 Dec 1994	0954	1425	Tensas
	17 Dec 1994	1557	510	Tensas
	18 Dec 1994	1450	900	Tensas
	03 Jan 1995	1332	950	Tensas
	04 Jan 1995	1602	950	Tensas
	10 Mar 1995	1118	910	Tensas
	30 Jun 1995	1020	700	Tensas
	01 Jul 1995	1228	1710	Tensas
	26 Jul 1995	0903	980	Tensas
	14 Aug 1995	0935	1500	Tensas
	16 Aug 1995	1508	810	Tensas
	29 Aug 1995	1424	625	Tensas
	08 Sep 1995	1248	1220	Tensas
	18 Sep 1995	0926	740	Tensas
M210	-	-	-	-
M212	30 Jun 1995	1134	2020	Macon South
	06 Jul 1995	1006	2200	Macon South
	07 Jul 1995	0809	1800	Macon South
	12 Jul 1995	1320	2340	Maocn South
	13 Jul 1995	1206	2170	Macon South
	14 Jul 1995	1224	370	Macon South
	03 Aug 1995	1000	910	Tensas
	05 Aug 1995	1600	1510	Panther Lake
M226	27 Jun 1995	2203	1100	Blue Cat North
	24 Jul 1995	0823	1440	Tensas
	04 Aug 1995	0749	520	Panther Lake
	14 Aug 1995	0930	1420	Mason North
	25 Aug 1995	1452	720	Macon North
M228	05 Nov 1995	1030	990	Tensas
M230	-	-	-	-

Table A-2. (cont.)

ID#	Date	Time	Distance to Nearest Forested Tract (m)	Corridor
F108	-	-	-	-
F124	10 Oct 1994	1024	1100	Macon North
F126	-	-	-	-
F128	07 Nov 1994	1149	1350	Macon North
	19 Nov 1994	2211	1120	Macon North
	22 Nov 1994	0724	1150	Macon North
	05 Dec 1994	1612	1510	Macon North
F156	24 Sep 1994	0953	620	Macon North
	27 Sep 1994	1219	400	Macon North
	29 Sep 1994	0747	110	Macon North
	05 Oct 1994	1250	600	Macon North
	06 Oct 1994	1320	1220	Macon North
	28 Oct 1994	0727	700	Maocn North
	16 Nov 1994	1420	520	Macon North
	20 Oct 1995	0907	490	Macon North
F162	-	-	-	-
F180	26 Sep 1994	1420	1300	Panther Lake
	17 Oct 1994	1428	1600	Panther Lake
	17 Nov 1994	1106	1150	Panther Lake
	18 Nov 1994	0850	1400	Panther Lake
	03 Jan 1995	1423	600	Panther Lake
F184	-	-	-	-
F192	-	-	-	-
F194	05 Jul 1994	1830	500	Panther Lake
	07 Jul 1994	1935	1400	Panther Lake
	08 Jul 1994	1927	1450	Panther Lake
	11 Jul 1994	1627	1375	Panther Lake
	13 Jul 1994	1505	200	Panther Lake
	19 Jul 1994	1311	160	Panther Lake
	21 Jul 1994	0854	975	Panther Lake
	22 Jul 1994	1452	425	Panther Lake
	24 Jul 1994	0935	320	Panther Lake
F196	01 Jul 1994	1530	900	Macon North
	08 Jul 1994	2019	820	Macon North
	17 Oct 1994	1223	2100	Macon North
	17 Nov 1994	1142	2200	Macon North
	21 Nov 1994	1651	1710	Macon North
	23 May 1995	1400	420	Macon North

Table A-2. (cont.)

ID#	Date	Time	Distance to Nearest Forested Tract (m)	Corridor
	04 Jun 1995	2333	260	Macon North
	17 Jun 1995	0115	1630	Macon North
F200	13 Jun 1995	1728	950	Tensas
	14 Jun 1995	0823	790	Tensas
	28 Jun 1995	1600	1650	Tensas
	24 Jul 1995	0759	1210	Tensas
	25 Jul 1995	1221	1010	Tensas
F208	07 May 1995	1045	600	Macon South
	18 May 1995	2015	2600	Macon South
	19 May 1995	1022	2420	Macon South
	20 May 1995	1136	2750	Macon South
	21 May 1995	0957	2610	Macon South
	04 Jun 1995	1143	2900	Macon South
	5 Jun 1995	1040	2910	Macon South
	6 Jun 1995	1016	3020	Macon South
	7 Jun 1995	0830	2720	Macon South
	08 Jun 1995	1200	2810	Macon South
	09 Jun 1995	0513	2490	Macon South
	10 Jun 1995	1102	3200	Macon South
	11 Jun 1995	0758	2990	Macon South
	12 Jun 1995	1547	2800	Macon South
	13 Jun 1995	1400	2880	Macon South
	14 Jun 1995	1000	1380	Macon South
	17 Jun 1995	2324	2910	Macon South
	18 Jun 1995	1519	2550	Macon South
	27 Jun 1995	2132	2500	Macon South
	28 Jun 1995	2329	3000	Macon South
	29 Jun 1995	0927	2660	Macon South
	30 Jun 1995	1133	2060	Macon South
	06 Jul 1995	1008	2200	Macon South
	07 Jul 1995	0812	2650	Macon South
	10 Jul 1995	1624	610	Macon South
	11 Jul 1995	1247	760	Macon South
	12 Jul 1995	1310	3120	Macon South
	13 Jul 1995	0625	2980	Macon South
	14 Jul 1995	1223	380	Macon South
	17 Jul 1995	1244	2670	Macon South
	19 Jul 1995	1023	2820	Macon South
	22 Jul 1995	1216	2960	Macon South
	01 Aug 1995	1448	2610	Macon South
	02 Aug 1995	1543	2780	Macon South
	03 Aug 1995	0840	2640	Macon South
	05 Aug 1995	1215	320	Macon South

Table A-3. Amount (ha) and percentage of each habitat type within the home range of individual radio-collared black bears, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

ID #	BLH	Wet BLH	Cut/Thin	Cypress/Willow	Lake/Pond	Ag. Field	Total	%Forested
F108	48.64 / 39.7	9.51/7.8	27.75/22.7	0.81/0.7	0.18/0.1	34.60/28.3	122.43	71.7
F124	306.46 / 50.3	49.16/8.1	118.03/19.4	22.52/3.7	12.03/2.0	101.41/16.6	609.61	83.4
F126	166.65 / 40.8	25.63/6.3	108.48/26.7	18.66/4.6	20.91/5.1	67.12/16.5	406.45	83.5
F128	359.57 / 44.2	67.72/8.3	158.10/19.4	27.82/3.4	24.63/3.0	175.06/21.5	812.90	78.5
F156	252.73 / 41.48	50.65/8.4	105.05/17.2	17.52/2.9	16.43/2.7	164.28/27.1	605.33	72.9
F162	215.97 / 50.1	44.52/10.3	84.35/19.6	11.23/2.6	4.60/1.1	69.09/16.0	430.86	84.0
F180	492.63 / 17.7	243.84/8.8	288.82/10.4	53.86/1.9	18.88/0.7	1687.18/60.6	2785.31	39.4
M182	970.01/14.81	697.12/10.6	792.65/12.1	137.73/2.1	157.78/2.4	3812.60/58.1	6567.39	41.9
F184	65.72/29.4	42.73/7.6	142.07/25.2	9.29/1.6	0.30/0.1	203.31/36.1	563.28	63.9

Table A-3. (cont.)

ID #	BLH	Wet BLH	Cut/Thin	Cypress/Willow	Lake/Pond	Ag. Field	Total	%Forested
F192	275.90/28.8	94.79/9.9	127.28/13.3	46.93/4.9	6.47/0.7	407.16/42.5	958.16	57.5
F194	103.41/34.9	24.04/8.1	21.96/7.4	5.39/1.8	8.43/2.8	133.05/44.9	296.28	55.1
F196	188.14/7.3	73.64/2.9	384.76/15.0	78.53/3.1	103.11/4.0	1734.39/68.0	2562.93	32.0
F200	392.46/13.7	549.51/19.2	310.40/10.8	62.12/2.2	96.19/3.4	1455.83/50.8	2865.37	49.2
F208	319.69/21.4	60.38/4.0	189.50/12.7	48.32/3.2	65.65/4.4	814.45/54.4	1496.83	45.6
M210	612.53/34.8	140.77/8.0	247.42/14.1	57.61/3.3	29.66/1.7	670.15/38.1	1760.26	61.9
M212	730.65/14.3	498.25/9.7	578.59/11.3	103.62/2.0	102.43/2.0	3113.92/60.7	5126.71	39.3
M226	1077.72/14.8	326.73/4.5	809.31/11.2	258.17/3.6	108.95/1.5	4654.20/64.3	7235.08	35.7
M228	644.13/21.7	113.23/3.8	409.78/13.8	53.88/1.8	63.62/2.1	1685.07/56.7	2969.71	43.3
M230	268.60/23.2	61.72/5.3	133.27/11.5	42.72/3.7	21.36/1.8	627.98/54.3	1155.65	45.7

APPENDIX A

Habitat Inventory

A 1% sample of vegetation was performed on all 4 forested tracts. A grid system of plots (0.04 ha) was surveyed along transect lines. Transect lines ran north- south, except for Panther Lake (east-west).

Within each vegetation plot, all plants were inventoried in 3 canopy layers. Overstory was ≥ 9 m, midstory was 1.4 - 9 m, and understory was ≤ 1.4 m. Some abundant ground cover species, such as poison ivy (*Rhus toxicodendron*), were estimated as the percentage covering the plot.

Elevational differences within the forested tracts were very minor. Habitat types within the forest were difficult to distinguish. Understory species were the most effected by elevational differences. Most overstory species could tolerate seasonal flooding. In the permanently flooded areas, black willow (*Salix nigra*), and baldcypress (*Taxodium distichum*) were predominant.

Predominant overstory species included several oak species (*Quercus* spp.), sugarberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), pecan (*Carya illinoensis*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*).

Predominant midstory species included eastern redbud (*Cercis canadensis*), honeylocust (*Gleditsia triacanthos*), hawthorn (*Crataegus* spp.), switchcane (*Arundanaria gigantea*), hophornbeam (*Ostrya virginia*), and paw paw (*Asimina triloba*).

Predominant understory species include poison-ivy, saw palmetto (*Sabal minor*), muscadine (*Vitis rotundifolia*), greenbriar (*Smilax* spp.), blackberry (*Rubus* spp.), and Virginia creeper (*Parthenocissus quincuefolia*).

Much of the forested habitat that had no logging activity in a long time had relativley little under and midstory. These areas typically had abundant hardmast, but lacked the softmast species. Areas with recent logging activity often had a dense understory with inpenetrable thickets. These recently logged areas often contained abundant softmast species and an important cover component.

APPENDIX B

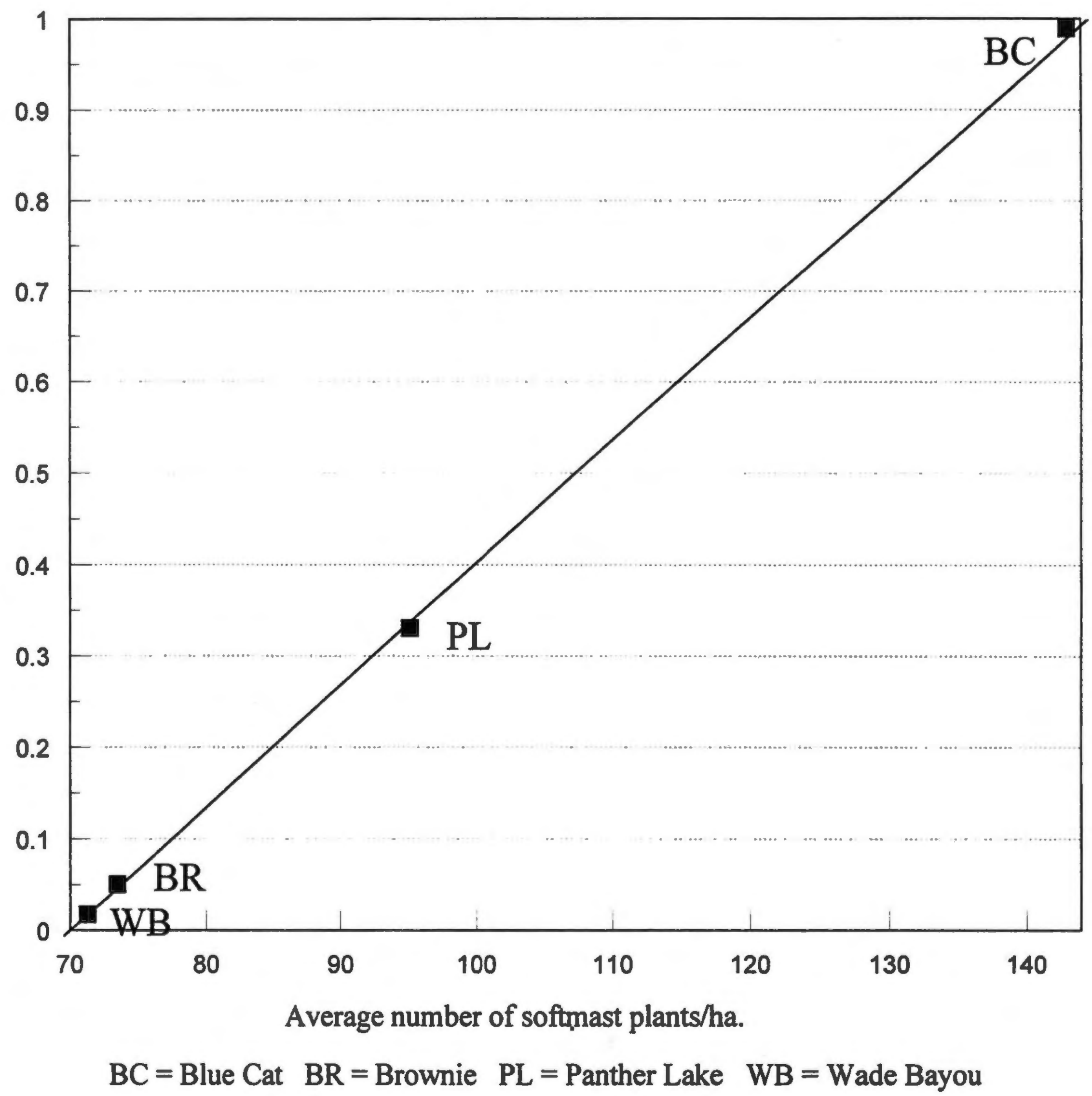


Figure B-1. Individual values (IV) for habitat variable softmast and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

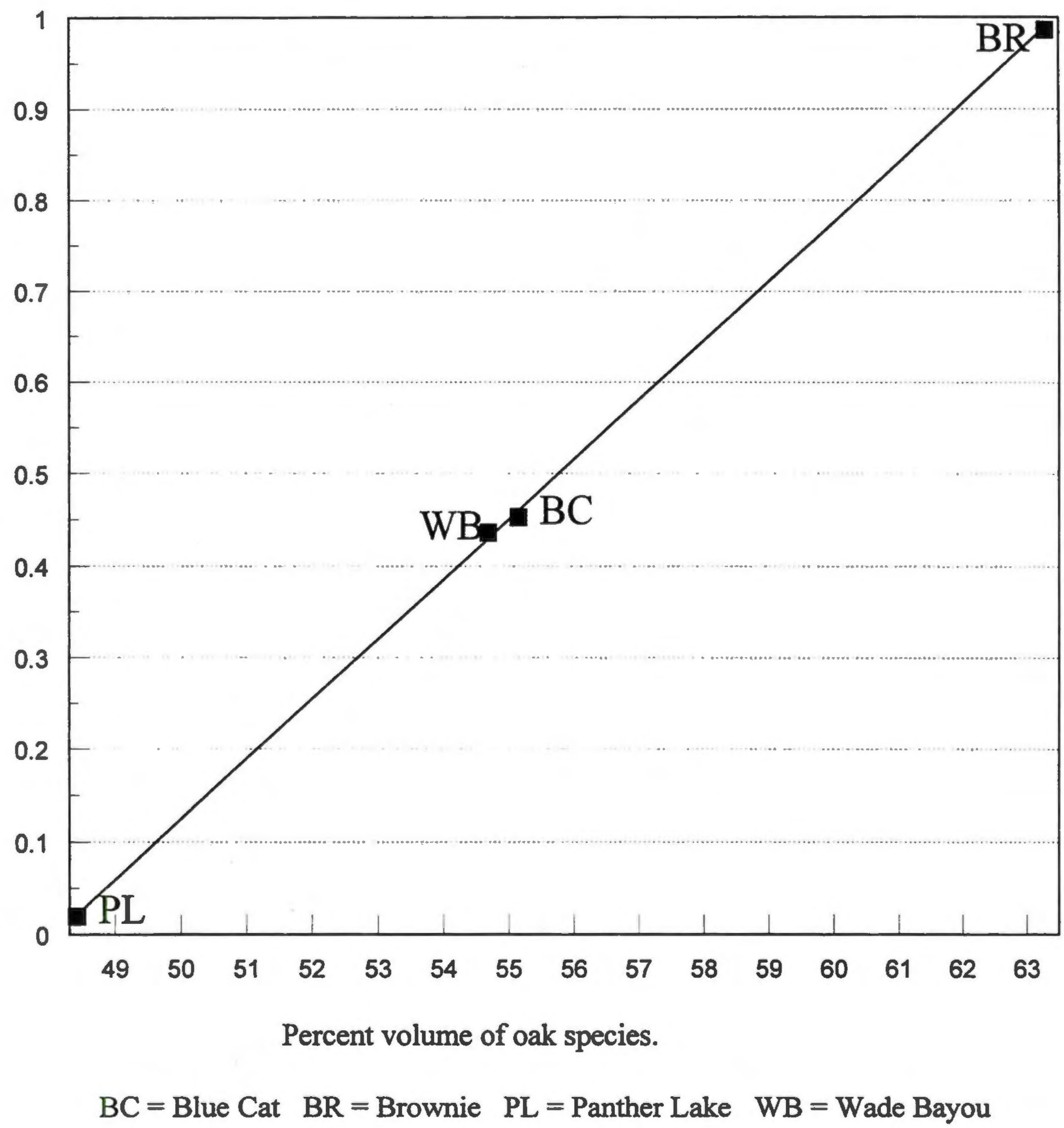


Figure B-2. Individual values (IV) for habitat variable hardmast and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

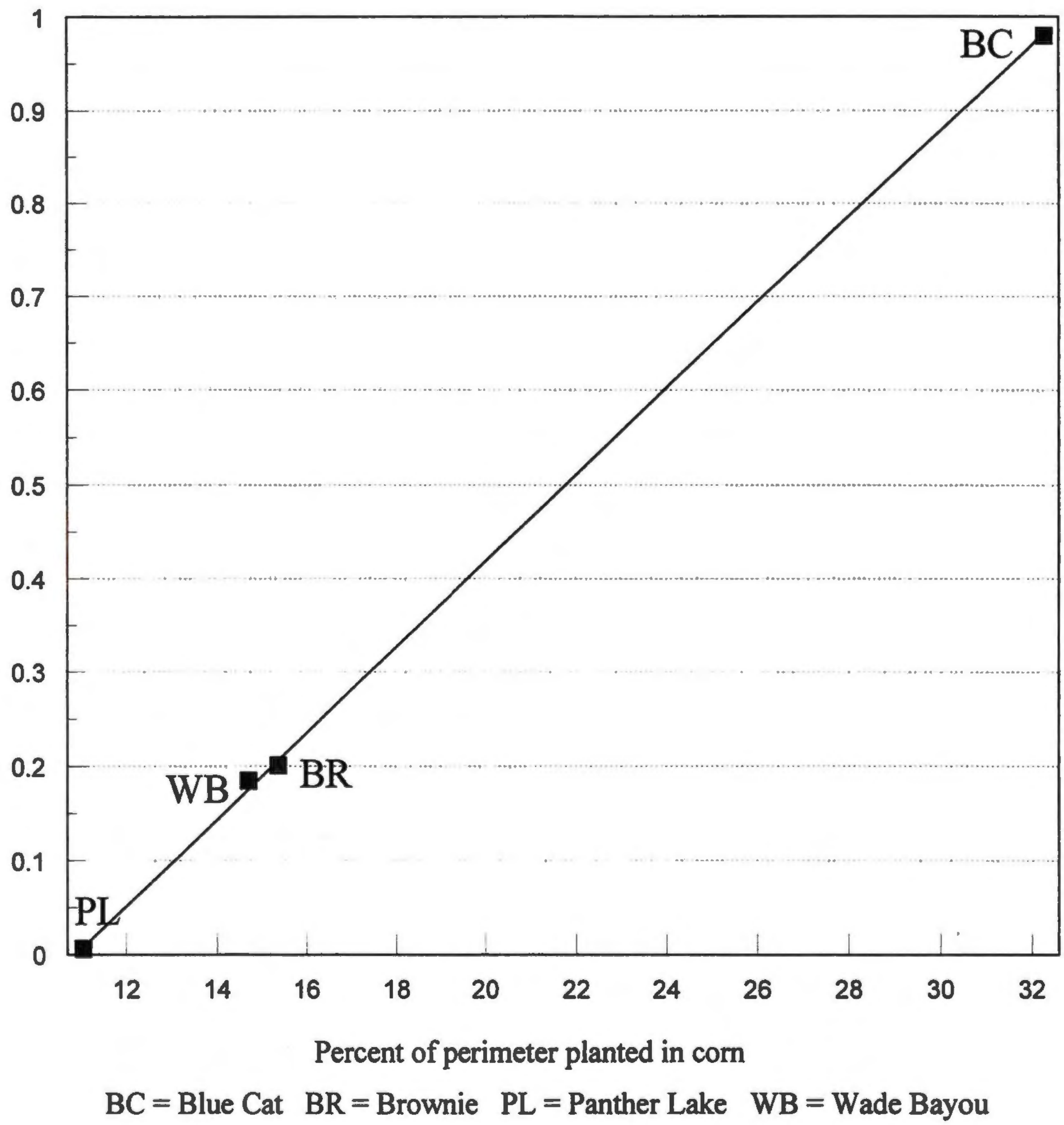


Figure B-3. Individual values (IV) for habitat variable corn and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

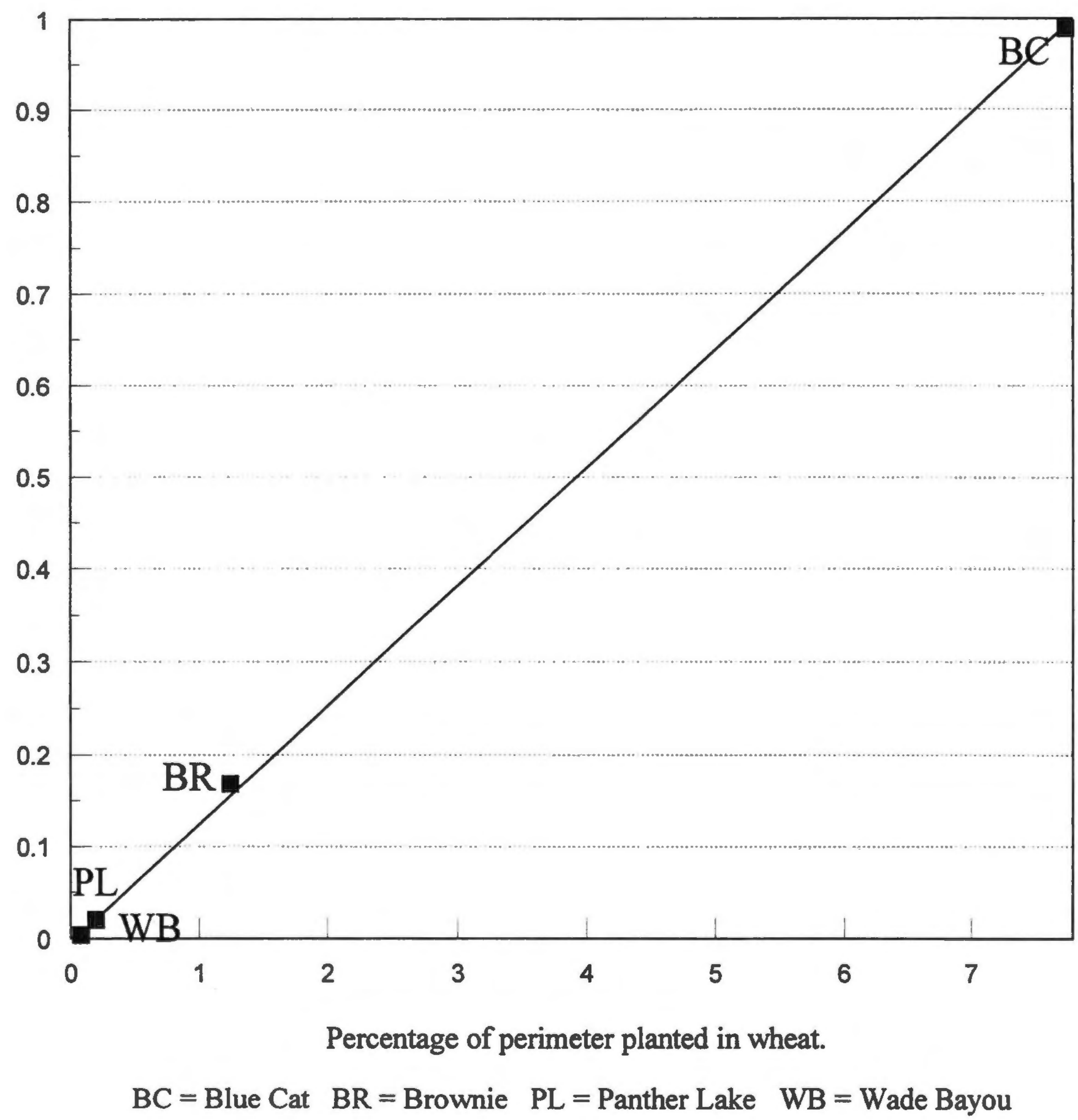


Figure B-4. Individual values (IV) for habitat variable wheat and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

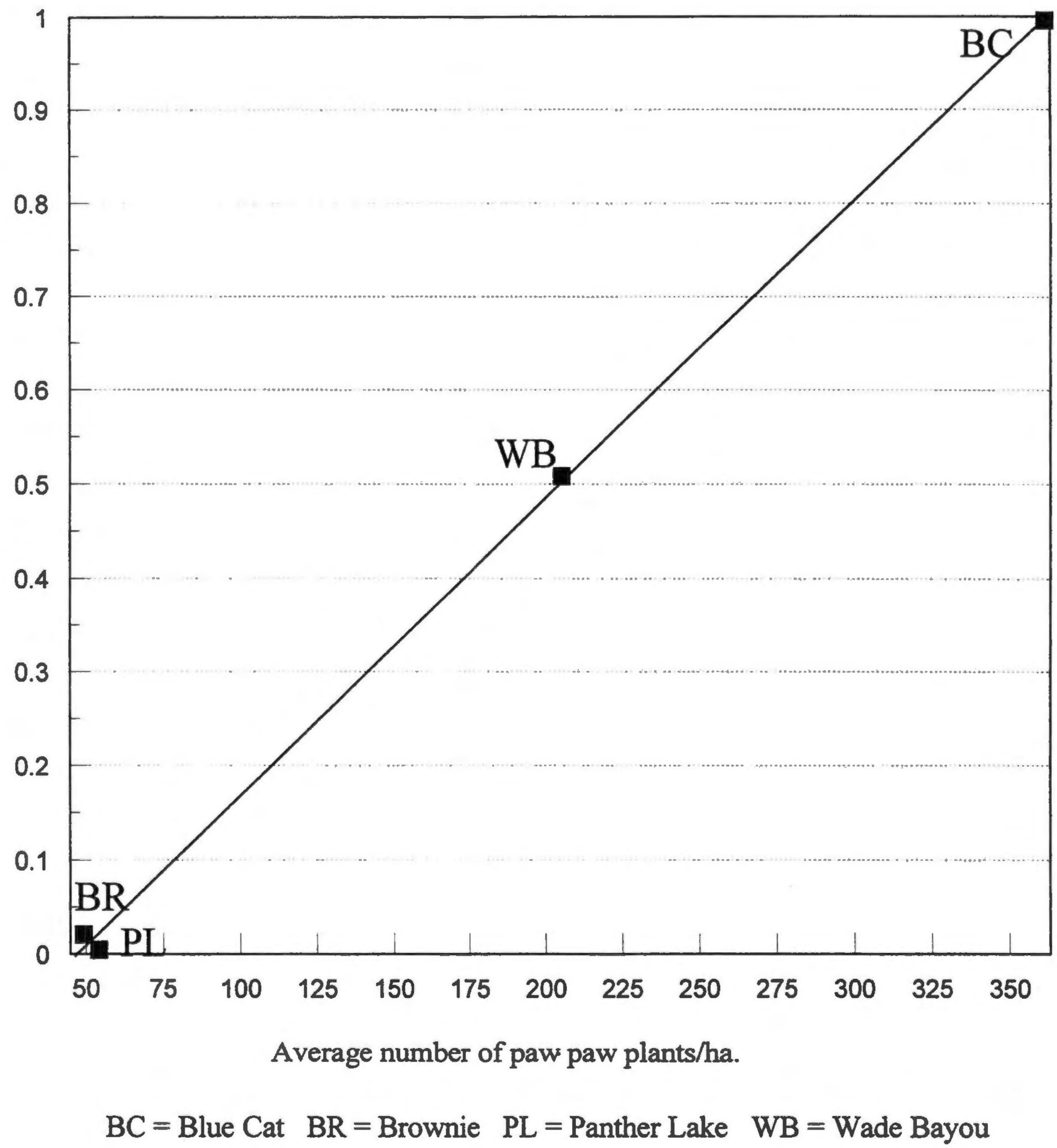


Figure B-5. Individual values (IV) for habitat variable paw paw and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

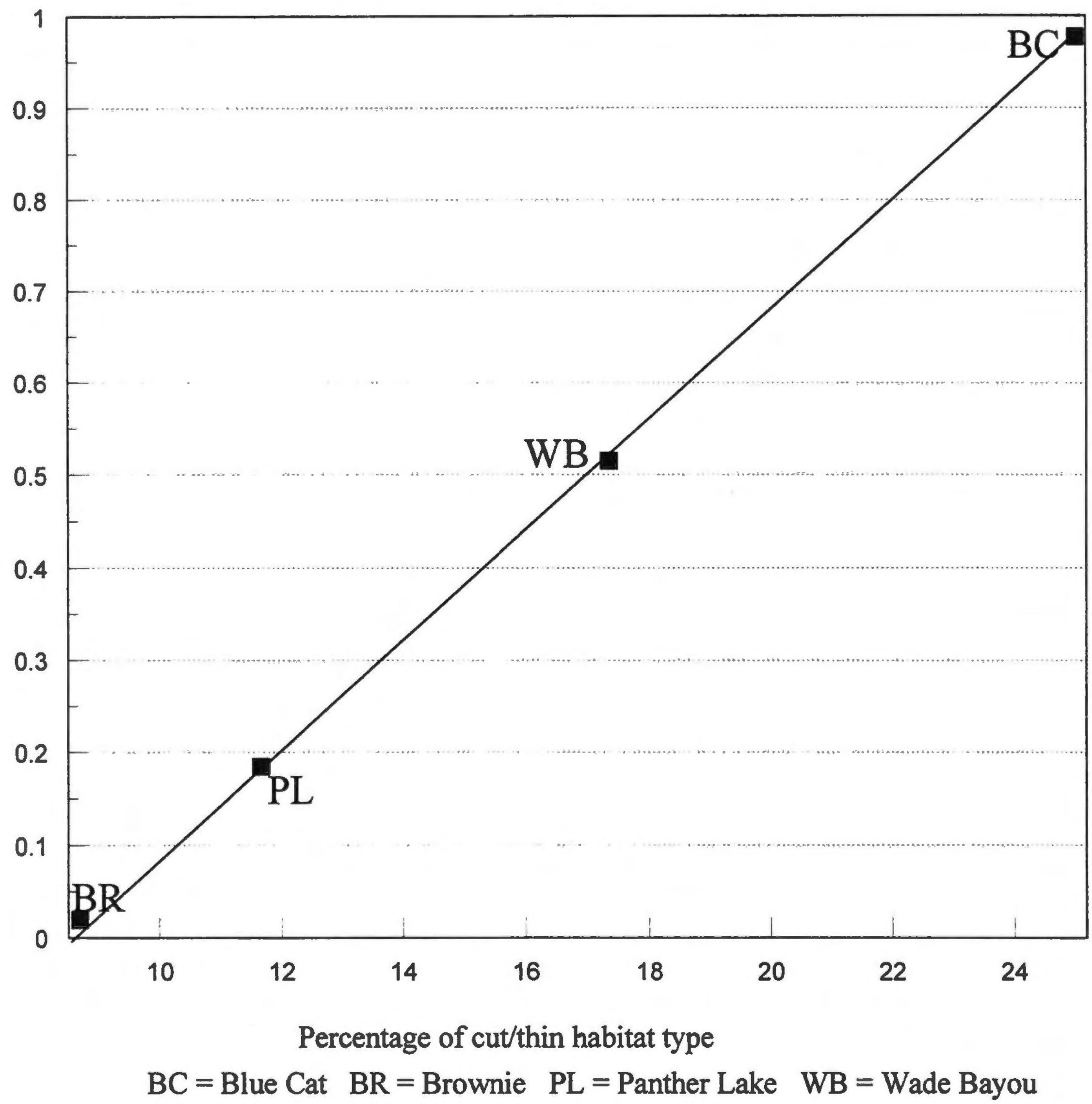


Figure B-6. Individual values (IV) for habitat variable cut/thin habitat type and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

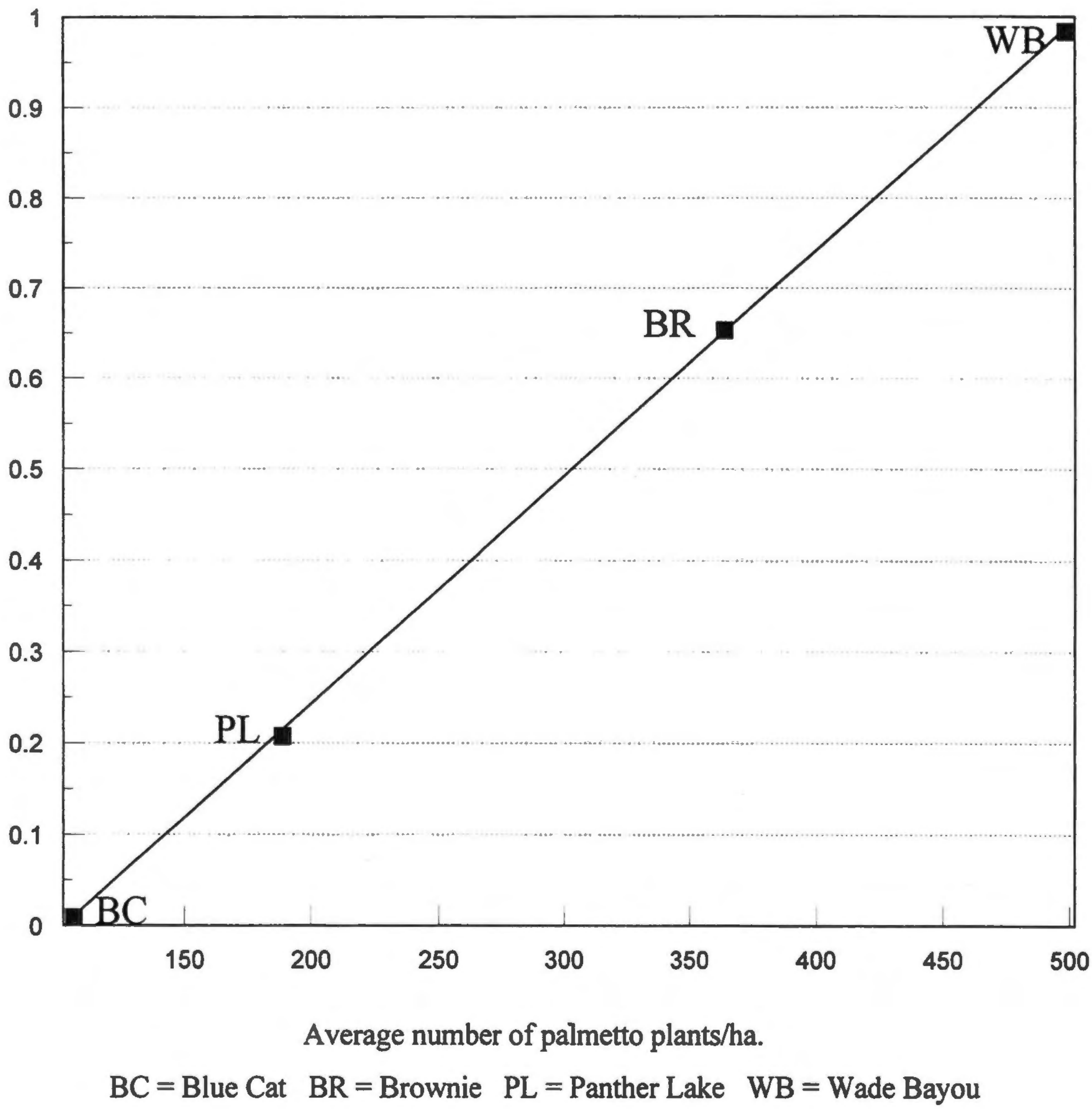


Figure B-7. Individual values (IV) for habitat variable palmetto and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

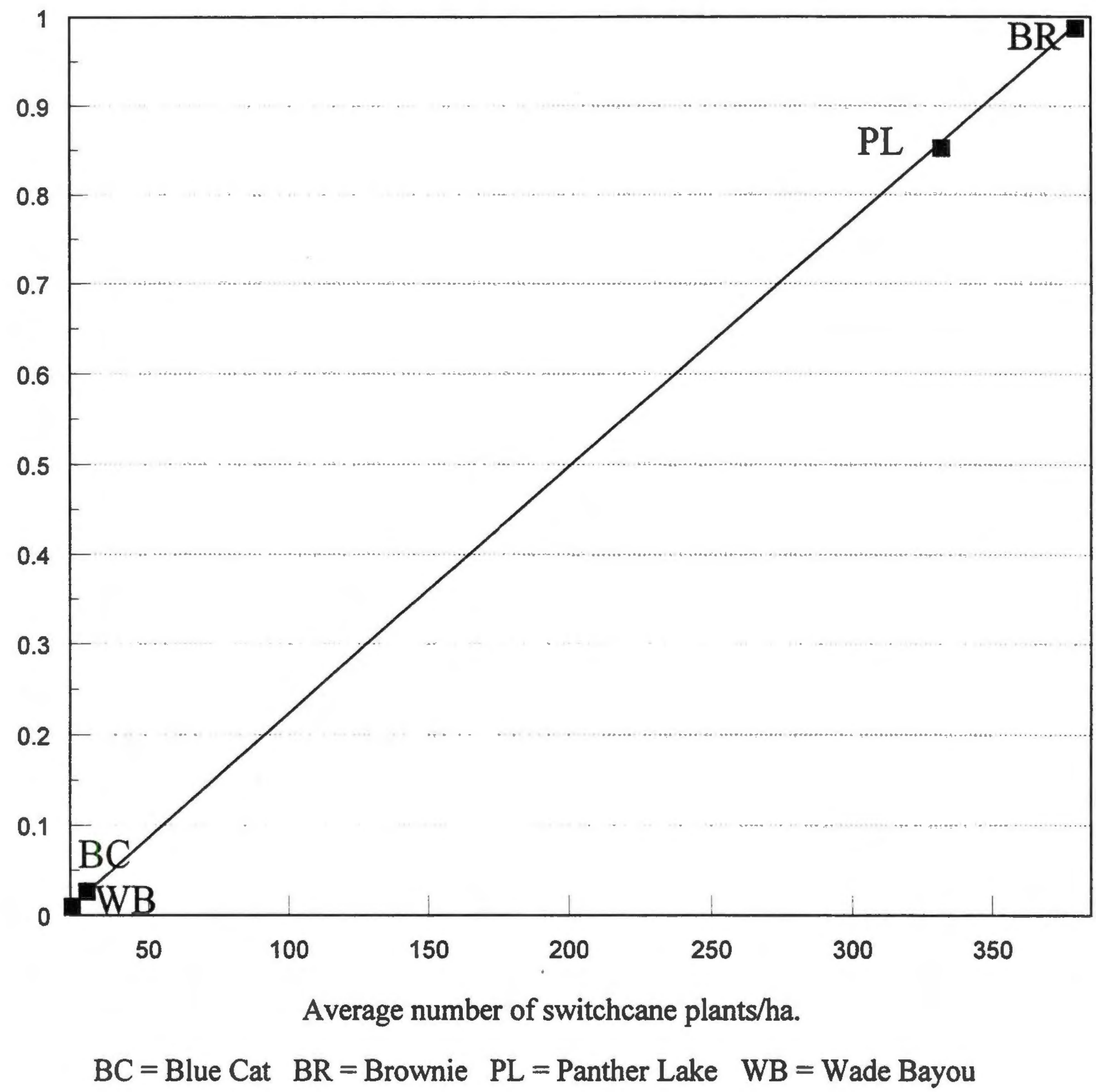


Figure B-8. Individual values (IV) for habitat variable switchcane and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

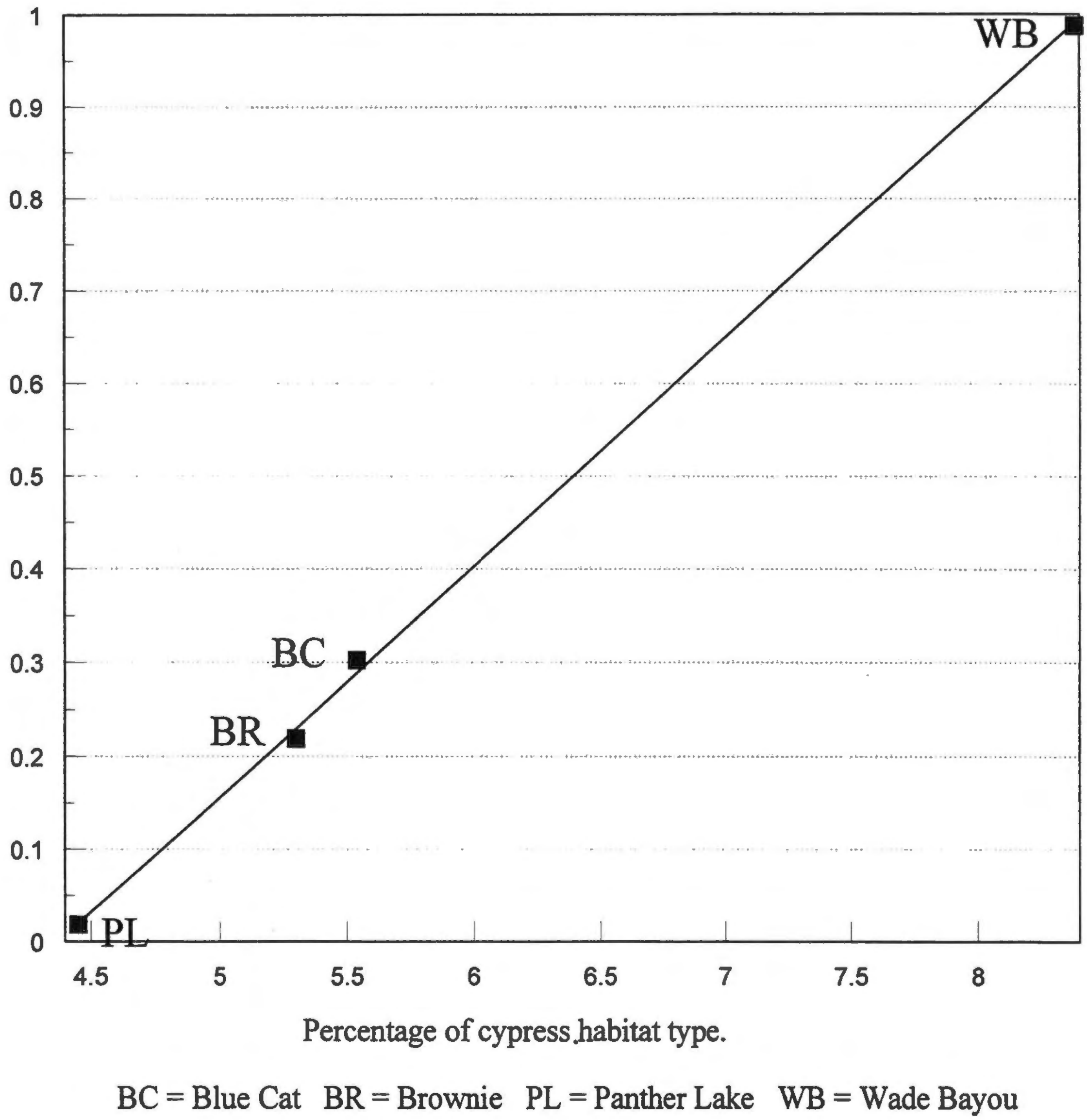


Figure B-9. Individual values (IV) for habitat variable cypress and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

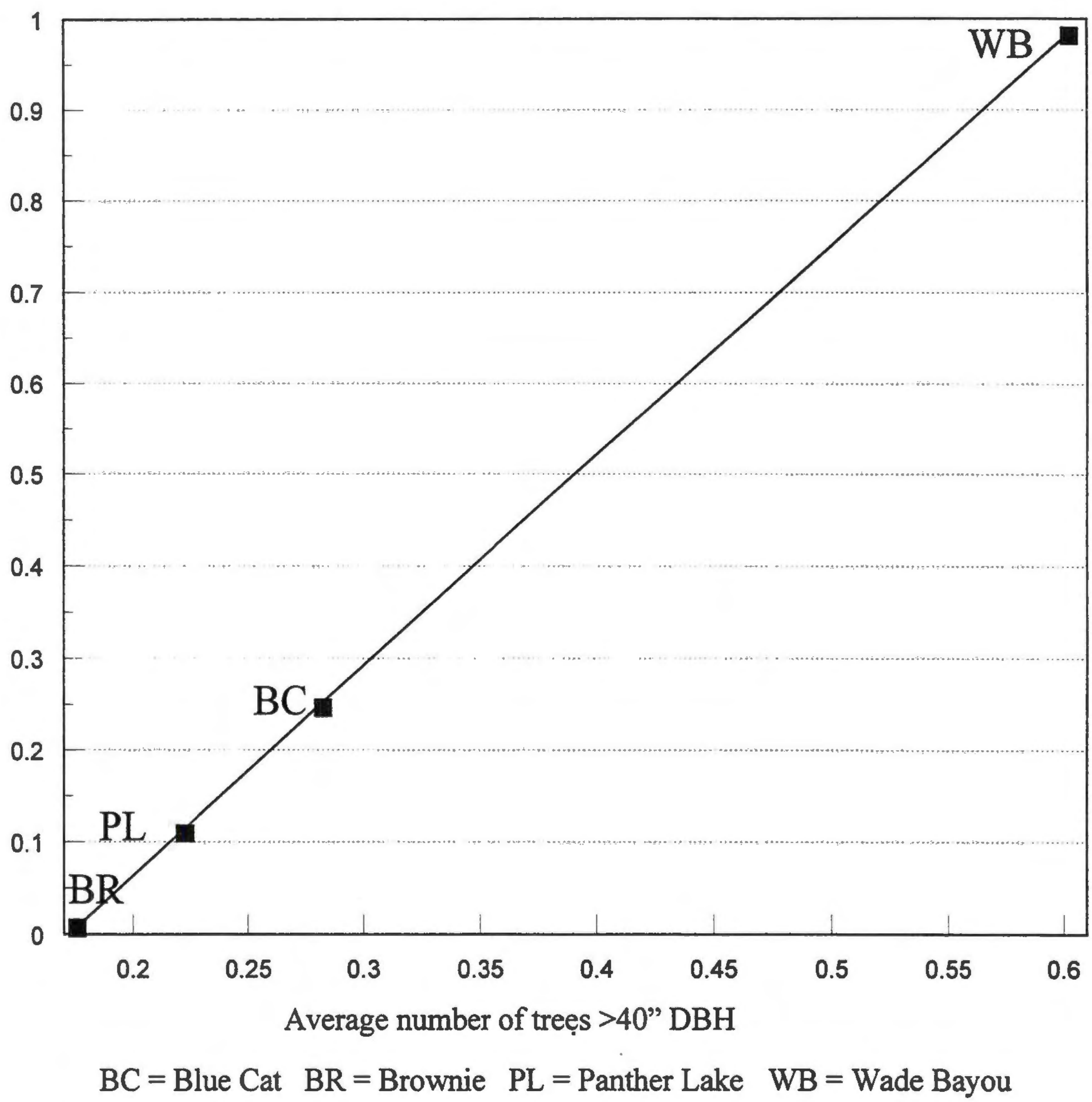
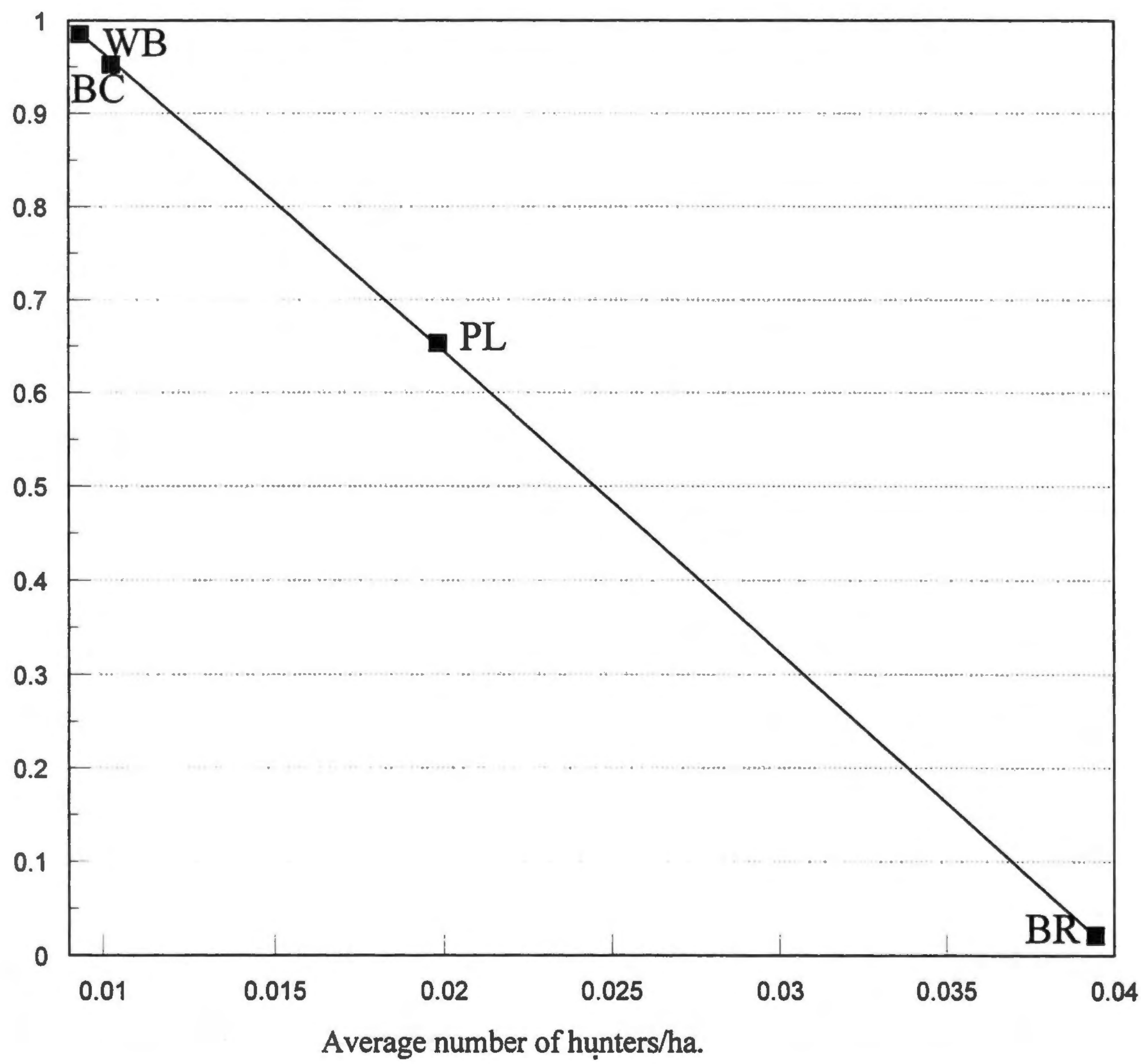


Figure B-10. Individual values (IV) for habitat variable old growth and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.



BC = Blue Cat   BR = Brownie   PL= Panther Lake   WB = Wade Bayou

Figure B-11. Individual values (IV) for habitat variable human disturbance and corresponding scores for each forested tract, Deltic study area, Tensas River Basin, Louisiana, 1994-1995.

APPENDIX C

Den Characteristics

1994/1995

F126 -- 11/21-3/5 (105 days)

Observed with 2 yearling cubs in a leaf lined open ground nest at base of large oak. Most of locations were in this area with a few excursions. Bears were semi-active, but spent most of time in bed at base of tree. Bears ran away when approached. Nest was located 50 m west of duckpond levee in westcentral Blue Cat.

F156 -- 11/29-2/26 (90 days)

Observed under fallen tree in cutover area in northeast Bluecat. I later walked-in and the bear left densite, observed 200 m, away 50 m up large oak. The nest was in the crotch of two big limbs and lined with palmetto fronds. There was no evidence of cubs.

F128 -- 12/5-3/19 (105 days)

Denned from 12/5-12/21 on Bayou Macon corridor 1\2 km north of Bluecat. Observed on 3 different occasions with 3 yearling cubs around northwest corner of duckpond in westcentral Bluecat. Most telemetry locations were located in this area with a few excursions. The den was a palmetto lined open ground nest at base of large oak.

F180 -- 1/17- 2/22 (37 days)

Observed on 2 occasions with 3 yearling cubs in cane/palmetto lined open nest at base of large oak. The nest is located in northeast Panther Lake, northeast of Raffman Lake.

F124 -- 11/29-4/12 (135 days)

Observed on 2 occasions in brushpile from logging slash in cutover area of northeast Bluecat. On both occasions, cub noises were heard. One cub observed on 24 March 1995.

F196 -- 12/2- 3/20 (108 days)

Den in living overcup oak with top torn off with the cavity 15 m from ground. The tree is located in a 75-ha tract of woods approximately 1 km southwest of lodge lakes in Richland parish.

F192 -- 11/30-3/25 (117 days)

Unknown densite along Joe's Bayou in southeast Wade Bayou. Moved to cypress tree in Ray Brake in Wade Bayou on 13 January 1995. Den tree was large cypress with top broken out approximately 35 m from water surface. Water depth was 2 m.

F184 -- 12/17-2/20 (66 days)

Denned in brushpile slash from logging activity located in east Carson Woods. The 45-ha Carson woods were heavily logged in the summer of 1994. I walked in on 2 occasions and observed bear under brushpile. The nest was leaf lined and 5 scats were found just outside of brushpile.

M182 --1/25-3/3 (38 days)

Denned in cane thicket along Tensas River corridor located 1/2 km east of Talla Bena woods. Had a mound of cane for a nest. Walked in on 3 occasions and bear did not leave nest.

1995/96

Denning chronology was not determined for bears during winter 1995/1996, but den sites were located.

F126 Denned in Blue Cat, 100 m west of Duckpond. Den was shallow dug-out depression at base of large oak. Female was due to have cubs, but no cubs were ever documented.

F156 Denned in northeast Blue Cat. Den was located on ground with shallow depression, lined with palmetto. Two cubs were observed.

F162 Denned in eastcentral Blue Cat. Den was shallow depression at base of large oak tree, lined with leaves.

F184 Denned in western Carson Woods, a 45-ha tract of forest located south of Blue Cat. Den was under brushpile piled up from logging activities. One cub was documented.

F200 Denned in western Talla Bena. Den was located in a hollow cypress tree located on the Tensas River. Cavity was 25 m from the base.

M210 Denned in northeast Wade Bayou. Ground den located in switchcane thicket and bed consisted of switchcane.

M228 Denned in southeastern Talla Bena. Ground den was a shallow depression at base of large oak.

M230 Denned in northeast Wade Bayou. Ground den located in switchcane thicket and bed consisted of switchcane.

VITA

Donald Robert Anderson, son of Gerald and Beverlee Anderson, was born in Dubuque, Iowa on 7 November, 1968. He graduated from Lassiter High School in Marietta, Georgia in 1987. He received a Bachelor of Science in Forest Resources (Wildlife Management) from the University of Georgia in 1993. In the spring of 1994, he began his field research in the Tensas River Basin in Louisiana and received a Master of Science degree in Wildlife and Fisheries Science from the University of Tennessee in the spring of 1997.