ASSESSMENT OF THE POPULATION STATUS AND EVALUATION OF SUITABLE HABITATS FOR THE LOUISIANA BLACK BEAR (*URSUS AMERICANUS LUTEOLUS*) IN EAST TEXAS

By

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ABSTRACT

The Louisiana black bear (*Ursus americanus luteolus*) historically ranged throughout southeastern Texas, although it was considered extirpated from Texas by the 1940s. In 1987, the black bear was classified as a threatened species in Texas and in 1992, the U.S. Fish and Wildlife Service similarly classified the Louisiana black bear subspecies under the Endangered Species Act. The current distribution of the Louisiana black bear is restricted to portions of eastern Louisiana and western Mississippi, although recent data indicate that these populations are expanding. East Texas contains some of the largest contiguous blocks of forested habitat available to, but currently unoccupied by, black bears in the southeastern U.S.

Despite expanding populations in adjacent states, reliable black bear sightings in east Texas, and the presence of potentially suitable black bear habitat throughout the region, quantitative estimates of occupancy and habitat suitability do not exist for east and southeast Texas. We used non-invasive genetic sampling to survey areas of east Texas identified as having the highest likelihood of supporting black bears in the region. We utilized a 2-strand barbed-wire hair trap at 5 study areas totaling 463 km^2. We collected 451 hair samples from 181 hair traps from 2009-2011. We eliminated non-bear samples using microscopic sorting techniques and selected 51 samples for genetic analysis. Genetic analysis indicated that no black bears were detected during this study.

Considering the effectiveness of the hair trap method in areas of North America with established black bear populations, we concluded that no established population of black bears exist in the south black bear recovery zone; although it is likely that a transient or dispersing bear present in our study areas could remain undetected during our sampling. This study satisfies the research objectives outlined by state and federal Louisiana black bear recovery plans. Baseline occupancy data in east Texas was necessary for directing future recovery efforts and the development of sound restoration and conservation plans.

We present the first rigorous assessment of region-wide habitat suitability within the historic distribution of the Louisiana black bear in east and southeast Texas. Because of the large spatial requirements for black bears and the lack of regional habitat information, we developed a landscape-scale habitat suitability index (HSI) model in a geographic information system for evaluating the year-round habitat requirements of black bears. Our model was developed at 10 m resolution and encompassed the 43,553 km^2 south black bear recovery zone. We measured hard and soft mast production, understory vegetation density, and tree den availability at 516 survey points in 38 habitat classes (82% of the total land cover) in the region. We developed GIS-based models for summer food productivity, fall food availability, productivity, and diversity, protection cover, tree den availability, distance to roads, and human development. We combined index models and calculated overall HSI scores per pixel in a continuous dataset. Habitat suitability index scores ranged from 0.00-0.76 throughout the region. Our model indicated that highly (<1%) and moderately (16%) suitable habitat existed in the south recovery zone although the majority of the area (84%) was classified as marginal or

unsuitable habitat. We identified 4 recovery units capable of sustaining viable populations of black bears using our model. Recovery units ranged in size from 31,583 to 74,285 ha and from 0.58 to 0.60 in HSI scores. Estimated HSI scores for each recovery unit were comparable to those previously reported for occupied range in the southeastern U.S. and acreage of suitable habitat for all recovery units exceeded those estimated to support existing Louisiana black bear populations. Our model may be used to highlight habitat quality deficiencies related to the year-round habitat requirements for black bears in the south recovery zone of east Texas. Region-wide habitat suitability data was necessary to direct future habitat conservation and improvement programs towards achieving the goals outlined by state and federal Louisiana black bear recovery plans.

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CHAPTER I: INTRODUCTION

The American black bear (*Ursus americanus*) is the most widely distributed bear species in North America, historically ranging from Alaska east across Canada and south into northern Mexico (Hall 1981, Chapman and Feldhammer 1982). Overhunting and habitat loss had reduced its range from occurring in all 48 contiguous U.S. states to only 23 by the middle of the 20th century (Chapman and Feldhammer 1982, U.S. Fish and Wildlife Service 1995). With the establishment of national reserve lands and the development of state resource agencies and laws regulating bear hunting and management, black bear populations have recovered throughout much of the U.S. outside of the Midwest and Southeast. Currently, black bear populations have expanded into 39 U.S. states and remain stable throughout Canada (Pelton 2000).

The Louisiana black bear (*U. a. luteolus*), one of 16 subspecies of the American black bear, has undergone particularly extensive range and population reduction. Historically, this subspecies ranged throughout eastern Texas, southern Arkansas, southern Mississippi, and all of Louisiana. Following Anglo-American settlement in the early 1800s, the Louisiana black bear was hunted as a source of food, oil, and fur by early settlers and Native American Indians. By the late 1800s, indiscriminate and unregulated hunting coupled with extensive habitat loss and clearing of bottomland hardwood forests for agriculture resulted in greatly decreased and scattered populations (Black Bear

Conservation Coalition 2005, Texas Parks and Wildlife Department 2005). Historic Louisiana black bear habitat was reduced by more than 80 percent by 1980 (U.S. Fish and Wildlife Service 1995) and by the early 1990s, three small populations remained in the Tensas (60-100 bears) and Atchafalaya (30-60 bears) River Basins in Louisiana and in southwest Mississippi (unknown abundance).

In January of 1992, with mounting concerns that the Louisiana black bear population was approaching the minimum viable threshold due to human-related mortality and increased habitat destruction, the U.S. Fish and Wildlife Service classified the Louisiana black bear as a threatened species under the Endangered Species Act of 1973 (U.S. Fish and Wildlife Service 1995). The listing provided federal protection to all black bears within the historic range of the Louisiana black bear due to the similarity in appearance between *U. americanus americanus* and *U. a. luteolus* (U.S. Fish and Wildlife Service 1995). During this time period, bottomland hardwood deforestation in the Lower Mississippi Alluvial Valley significantly slowed. Conservation and habitat restoration efforts by state and federal agencies and the Black Bear Conservation Coalition (BBCC: a cooperative of over 60 government agencies, universities, corporations, and private organizations) increased, along with awareness of, and access to, government easement programs by private landowners (Black Bear Conservation Coalition 2005). From 1990-2005, approximately 400,000 ha of habitat was established within the historic range of the Louisiana black bear under the Conservation Reserve Program and Wetland Reserve Program and >40,500 ha of forest was established by utility corporations (Black Bear Conservation Coalition 2005). Translocation programs were implemented in order to connect disjunct bear populations (Benson and Chamberlain 2007b). Political intolerance regarding the illegal killing of black bears grew as civil penalties were created to prosecute individuals for such actions. Ultimately, the combination of sound scientific management strategies and increased public acceptance and understanding of black bears in the region allowed populations to persist and increase in abundance. Current population estimates suggest that 600-700 bears exist in Louisiana and 80-120 in Mississippi (Black Bear Conservation Coalition, Unpublished Data). In the White River National Wildlife Refuge in southeast Arkansas, a small population of black bears exists with current evidence suggesting that the population is genetically similar to that in Louisiana; however, further research is required to determine subspecific affinity (Warrillow et al. 2001).

By the beginning of the twentieth century, the Louisiana black bear had become rare in east Texas and by the 1940s, the species was considered extirpated from the state. Beginning in the late 1970s, reliable black bear sightings have been recorded in east Texas with increasing occurrence (Texas Parks and Wildlife Department, Unpublished Data). In 1973, restrictions were placed on black bear hunting with an eventual statewide prohibition. In 1987, the black bear was placed on the state endangered species list with no legal distinction between the Louisiana black bear in east Texas and the Mexican (*U. a. eremicus*), New Mexican (*U. a. amblyceps*), or American (*U. a. americanus*) subspecies, all of which occur in western Texas (U.S. Fish and Wildlife Service 1995, Texas Parks and Wildlife Department 2005). In 2005, the state of Texas drafted, in cooperation with state and federal representatives and corporate and private stakeholders, a comprehensive 10-year (2005-2015) conservation and management plan for black bears in east Texas (Texas Parks and Wildlife Department 2005). The scope of the plan was to reestablish the black bear as a viable native component of the east Texas ecosystem. In order to achieve this outcome, the plan established the framework for the East Texas Black Bear Task Force (ETBBTF: a consortium of state and federal agencies, universities, and corporate and private stakeholders charged with coordinating and funding projects aimed at completing the goals and objectives outlined in the management plan). These goals included 1) conservation and restoration of critical habitats, 2) public education through the development of outreach programs and informational handouts, 3) reducing and minimizing human-bear conflicts through education and technical assistance, and 4) increased scientific research aimed at evaluating the current black bear population status, quantifying and describing potentially suitable habitats and delineating recovery units, and evaluating public attitudes towards black bears in east Texas. Since the establishment of the ETBBTF, continued progress has been made in the form of habitat restoration and public education by representative agencies and groups. By 2007, initial research evaluating resident attitudes regarding black bears and their potential population recovery was completed through public opinion surveys (Morzillo et al. 2005, Keul 2007), yet efforts to evaluate the status of the current population and suitability of habitats in the region had not begun.

Much of the recent Louisiana black bear research focused on identifying and quantitatively describing potentially suitable habitats, determining current habitat use and occupancy, and developing abundance estimates for known populations (Benson and

Chamberlain 2006, 2007a, 2007b, Hooker 2010, T. Siegmund, Stephen F. Austin State University, Unpublished Data). Research has been targeted in 1) the Tensas and Atchafalaya River Basins in eastern Louisiana where three known breeding populations persist (Boersen et al. 2003, Hooker 2010, Lowe 2011), 2) western Mississippi where 5-10 breeding bears exist (Brad Young, Mississippi Department of Wildlife, Fisheries, and Parks, Personal Communication), and 3) east Texas where no stable breeding population exists but 10-15 reliable bear sightings occur annually (Texas Parks and Wildlife Department, Unpublished Data). Preliminary analyses indicated that east Texas contains some of the largest blocks of forested habitat suitable for, but currently unoccupied by, black bears in the southeast United States (Wooding et al. 1996).

In the late 1990s, two studies were conducted to evaluate potentially suitable black bear habitats in east Texas. Garner and Willis (1998) utilized a habitat suitability index (HSI) model developed by Van Manen (1991) and adapted for use in east Texas to evaluate habitats large enough to support minimum viable populations of black bears in the Big Thicket National Preserve and the Middle and Lower Neches River Basins in east Texas, and the Sulphur River Basin in northeast Texas. Epps (1997) evaluated suitable bear habitat in the Neches River Bottom and Jack Gore Baygall Units of the Big Thicket National Preserve by estimating the carrying capacity of habitats based on hard mast production and tree den availability. Although both studies concluded that suitable bear habitat existed in their respective study areas, little quantitative information is available regarding the suitability of habitat throughout the region. The habitat information that is available from these studies was collected more than 10 years ago and was spatially limited in scope. Although confirmed bear sightings have been documented in east Texas since the late 1970s, little to no empirical data exist regarding the current population status of black bears in the region. Because of this lack of information for east Texas combined with increasing black bear sightings region-wide, further research was warranted under the provisions of the East Texas Black Bear Conservation and Management Plan (ETBBCMP).

In 2007, in an effort to meet the recovery goals set forth by state and federal Louisiana black bear recovery plans, Stephen F. Austin State University in partnership with the Texas Parks and Wildlife Department (TPWD), the BBCC, and the ETBBTF, began a 2-phase, 5-year project to assess the current occupancy and suitability of habitats for black bears in east Texas. The ETBBTF established 2 black bear recovery zones in order to complete the project: the north recovery zone which included Bowie, Cass, Fannin, Franklin, Harrison, Lamar, Marion, Morris, Panola, Red River, Titus, and Upshur counties in northeast Texas, and the south recovery zone which included Anderson, Angelina, Chambers, Cherokee, Hardin, Houston, Jasper, Jefferson, Liberty, Nacogdoches, Newton, Orange, Polk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, and Tyler counties in east and southeast Texas (Fig. 1.1).

Phase I of the project was conducted from 2007-2009 in the north recovery zone along the Red, Sulphur, and Cypress River Basins. These study areas were composed of relatively large contiguous forested habitats, potentially capable of supporting viable populations of black bears, and were in proximity to the expanding Ouachita Mountains black bear (*U. a. americanus*) population in Oklahoma (Bales et al. 2005). Siegmund (T.

Siegmund, Stephen F. Austin State University, Unpublished Data) used non-invasive hair-trap methodologies to evaluate the current occupancy of black bears in these study areas (Woods et al. 1999, Dreher et al. 2007). Although sample size was inadequate to estimate occupancy for each study area, Siegmund (T. Siegmund, Stephen F. Austin State University, Unpublished Data) recorded 1 black bear detection, showing that black bears were capable of dispersing into northeast Texas. Furthermore, using an established HSI model, Siegmund (T. Siegmund, Stephen F. Austin State University, Unpublished Data) concluded that suitable habitat capable of meeting the year-round habitat requirements of black bears existed in the Red, Sulphur, and Cypress River Basins.

In 2009, this study was initiated to assess the population status and habitat suitability for the Louisiana black bear in east and southeast Texas. This study constitutes phase II of efforts to meet the research requirements set forth by the ETBBTF and ETBBCMP. With access to novel GIS-based habitat classification data for east Texas (2009 Texas Vegetation Classification Project: Phase II; 119 habitat classifications, 10 m pixel resolution), we developed a landscape-scale HSI model for the 19-county south black bear recovery zone based on the HSI model developed by Van Manen (1991) and adapted for use in east Texas (Garner and Willis 1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data). In the past, most HSI models were used to develop a mean habitat suitability score for distinct political or administrative boundaries such as a national forest (U.S. Fish and Wildlife Service 1980). Because of the large spatial requirements for black bears and increasing number of confirmed black bear reports throughout east Texas, our objective was to develop a landscape-scale HSI model that could be used to evaluate the year-round habitat requirements of black bears and direct conservation efforts region-wide. Research suggests that simpler black bear habitat models consisting of food and cover components reflect habitat selection better at a population level than complex models consisting of abiotic components (Mitchell et al. 2002). Additionally, resource availability is more important to black bear habitat quality than abiotic habitat components (Larson et al. 2003). Our model thus incorporated food, cover, and human-impact components.

To assess the current population status in east and southeast Texas, we conducted non-invasive genetic sampling in areas that 1) had recent black bear sightings and 2) were targeted by the TPWD as important habitat for future recovery efforts. We utilized a two-strand barbed-wire hair trap (Woods et al. 1999, Dreher et al. 2007) and based our survey methodology on the home range size for female Louisiana black bears in established populations in Louisiana (Mowat and Strobeck 2000, Bittner et al. 2002, Boersen et al. 2003). The development of baseline population occupancy and distribution data throughout the historic range of the Louisiana black bear in east Texas is an important step in the recovery of this federally threatened species. When combined with habitat suitability data, efforts may be made to protect critical habitats and further promote the expansion and re-colonization of black bears throughout east Texas.

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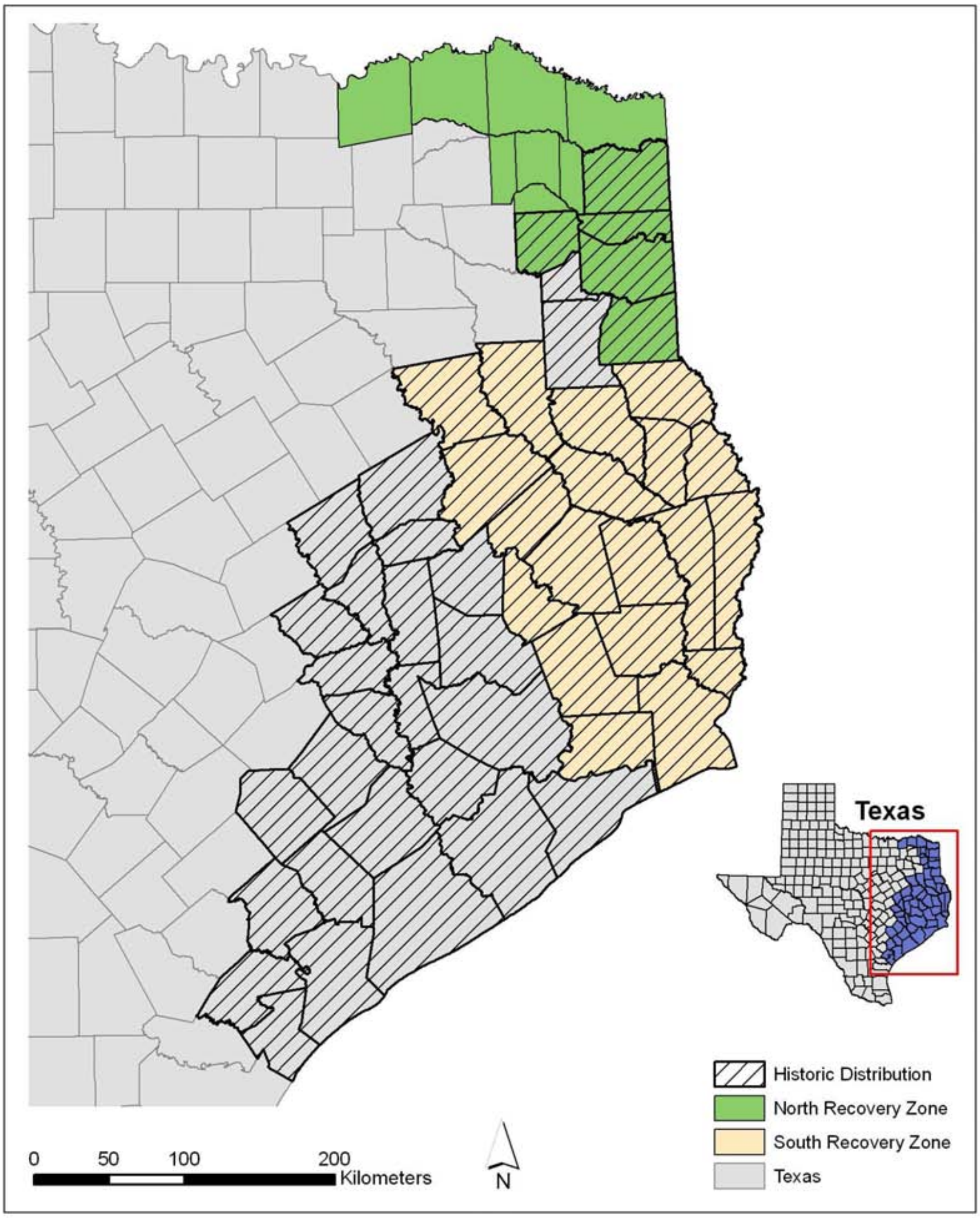

Figure 1.1. The historic distribution of the Louisiana black bear and the north and south black bear recovery zones developed by the East Texas Black Bear Conservation Coalition in east Texas, USA.

CHAPTER II: ASSESSMENT OF THE POPULATION STATUS FOR THE LOUISIANA BLACK BEAR (*URSUS AMERICANUS LUTEOLUS*) IN EAST TEXAS

ABSTRACT

The Louisiana black bear (*Ursus americanus luteolus*) was considered extirpated from east Texas by the 1940s. Despite reliable black bear sightings in the region since the late 1970s, quantitative estimates of occupancy and population distribution do not exist. We used non-invasive genetic sampling to survey 5 areas of east Texas (totaling 463 km^2) believed to have the highest likelihood of supporting black bears in the region. We collected 451 hair samples from 181 hair traps from 2009-2011. We used microscopic sorting to eliminate non-bear hair samples and selected 51 samples for genetic analysis. Genetic analysis indicated that no black bears were detected during this study. Because we lacked black bear detections, we used the detection probability of 0.18 reported in the literature for the hair trap technique to estimate the probability of non-detection for our efforts. We surveyed hair traps for 2 7-day sampling occasions in 2009 and 4 7-day sampling occasions in 2010-2011. We estimated probabilities of non-detection of 0.67 and 0.45 for efforts in 2009 and 2010-2011, respectively. Considering the effectiveness of the hair-trap method in areas containing established black bear populations in North America, our data suggest that no established populations exists in the region, although it is likely that we did not detecting a transient or dispersing individual. State and federal recovery plans mandate the establishment of viable populations of the Louisiana black bear within the historic range. Our study provides critical base-line data necessary for directing conservation efforts and developing restoration plans in east Texas.

INTRODUCTION

The Louisiana black bear (*Ursus americanus luteolus*) historically ranged throughout east Texas but had become rare by the turn of the 20th century. By the early 1940s, the Louisiana black bear was considered extirpated from the state (Texas Parks and Wildlife Department 2005a). In 1987, the black bear (including all subspecies) was classified as a state threatened species in Texas. Due to rising concerns that existing populations were approaching the minimum viable threshold for long-term survival due to human-related mortality and increasing habitat fragmentation and destruction, in 1992 the Louisiana black bear subspecies was listed as a threatened species under the Endangered Species Act of 1973 (U.S. Fish and Wildlife Service 1995). The current distribution of the Louisiana black bear is restricted to portions of central and eastern Louisiana and western Mississippi; although recent reports indicate that these populations are expanding (P. Davidson, Black Bear Conservation Coalition, Unpublished Data).

Since the late 1970s, reliable bear sightings have been recorded in east Texas with increasing frequency (Texas Parks and Wildlife Department, Unpublished Data). Eastern Texas contains some of the largest blocks of forested habitat available to but currently unoccupied by black bears in the southeast (Wooding et al. 1996) and previous research has confirmed that suitable habitat exists throughout the region (Epps 1997, Garner and Willis 1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data). Since 1978, 42 reliable bear sightings have been recorded in the region (Texas Parks and

Wildlife Department, Unpublished Data). Despite expanding populations in adjacent states and the presence of suitable habitat in the region, systematic or quantitative estimates of occupancy do not exist for east and southeast Texas. Baseline occupancy data are necessary to assist management activities and conservation programs and to evaluate progress toward achieving the recovery goals outlined by state and federal recovery plans (U.S. Fish and Wildlife Service 1995, Texas Parks and Wildlife Department 2005*a*).

A variety of survey methods exist to estimate abundance, density, and occupancy for wildlife populations. In recent years, non-invasive genetic sampling (NGS) has become the most widely used method for surveying free-ranging bear (*Ursus* spp.) populations (Boersen et al. 2003, Dreher et al. 2007, Kendall et al. 2009, Tredick and Vaughan 2009, Gardner et al. 2010). Advances in genetic technologies, microsatellite markers, and field and laboratory methodologies used to minimize genotyping error have allowed biologists to develop precise population estimates using DNA collected from non-invasive genetic samples (Paetkau 2003, Waits and Paetkau 2005, Kendall et al. 2009). When compared with traditional capture-mark-recapture methods, NGS has been shown to be more efficient at capturing individuals, more economical, and less invasive than the physical capture and restraint of wildlife to mark individuals (Woods et al. 1999, Tredick and Vaughan 2009).

Baited hair trap stations are a common and widely accepted method for collecting genetic material and surveying black bears (Bittner et al. 2002, Boersen et al. 2003, Dreher et al. 2007, Settlage et al. 2008) and grizzly bears (*U. arctos*; Mowat and Strobeck

2000, Poole et al. 2001, Boulanger et al. 2004a, Kendall et al. 2009) in North America. Hair traps consist of a centralized lure and a perimeter strand of barbed-wire. As animals enter traps, barbed-wire snags hair providing "capture" of their individual genetic identification (Woods et al. 1999). Hair samples contain sufficient DNA to determine species (Kendall et al. 2008), sex (Fathpour and Moshkelani 2009, Tredick and Vaughan 2009), and individual identity (Mowat and Paetkau 2002). Resulting data can be used to estimate population density (Gardner et al. 2010) and abundance (Mowat and Strobeck 2000, Bittner et al. 2002) using capture-mark-recapture techniques. Typically, hair traps are aligned within a systematic grid in which cell size is based on female home range size in or around the study area (Mowat and Strobeck 2000, Bittner et al. 2002, Boersen et al. 2003, Romain-Bondi et al. 2004). Hair traps are surveyed on ≥2 occasions to collect "recaptures" for development of parameter estimates (Woods et al. 1999, Romain-Bondi et al. 2004, Settlage et al. 2008).

For spatially rare or elusive species (e.g., the Louisiana black bear in east Texas), sample size obtained from non-invasive hair samples may not be adequate to estimate abundance precisely. In this instance, presence-absence or occupancy models may be used to define a species' distribution. MacKenzie et al. (2002) outlined a method for estimating occupancy similar to closed-population capture-mark-recapture models which included several core assumptions: occupancy remains constant on the study area during the survey period (i.e., a "closed" population), individuals are identified correctly when surveyed, and detection of the species at a site is independent of detections at other sites. Detection of the species at a site indicates "presence" of the species whereas non-detection indicates that a species was not detected (rather than absent) because a species may go undetected when present. The results of repeated sampling are used to create a capture history for each survey site. Capture histories can then be used to estimate the probability that a species is present at a site and the conditional probability that a species is detected at a site when present (MacKenzie et al. 2002, Bailey et al. 2004).

In light of the general lack of quantitative information regarding black bear distribution in east Texas, in 2007 we initiated a two-phase study designed to rigorously evaluate the current status of the black bear population in east Texas. Phase I was conducted in northeast Texas between 2007 and 2009 (T. Siegmund, Stephen F. Austin State University, Unpublished Data). We began Phase II in the southeastern portion of the region in 2009. We conducted non-invasive genetic sampling using the hair trap design developed by Woods et al. (1999). Our objective was to determine occupancy and distribution for the current Louisiana black bear population in east and southeast Texas. We targeted specific areas of the region based on reliable historic sightings data and recommendations of expert Texas Parks and Wildlife Department (TPWD) biologists.

STUDY AREA

The south Louisiana black bear recovery zone encompasses 43,553 km^2 and 19 counties in east Texas. Within the south recovery zone, the East Texas Black Bear Task Force (a cooperative of state and federal agencies, private landowners, companies, and conservation organizations) established 3 focal recovery units based on the presence of perceived bear habitat in the south recovery zone and their proximity to established source populations of the Louisiana black bear in Louisiana (Fig. 2.1). We selected 5 study areas within the recovery focal units totaling 463.4 km^2. We selected study areas based on the historic sightings data catalogued by the TPWD, presence of perceived suitable bear habitat, and our ability to gain access to private properties. These areas were located in bottomland habitats in which reliable black bear sightings have been documented over the past 40 years, in which land ownership has remained consistent, which represent relatively contiguous forested lands capable of supporting viable populations of black bears, and based on expert opinion of TPWD biologists (Fig. 2.2). In 2009-2010, hair traps were located in several blocks of forested habitat along the Sabine River Basin on the Texas/Louisiana border. These areas consisted of the Tony Houseman WMA in Orange County (15.5 km^2; Fig. 2.3), private timber company properties in Newton County (214.2 km^2; Fig. 2.4), and private timber company properties and portions of the Sabine National Forest in Sabine and Newton counties (21.3 km^2; Fig. 2.5). In 2011, hair traps were surveyed in areas of the Middle Neches

River Basin. This area encompassed private timber company properties in Jasper, Tyler, and Hardin counties (135.1 km^2) and areas of the Big Thicket National Preserve in Hardin County (54.4 km^2; Fig. 2.6), and a small portion of the Angelina National Forest in San Augustine County (5.1 km^2; Fig. 2.7).

All study areas were located in the Pineywoods Ecoregion of east Texas and consisted of rolling topography primarily dominated by closed or nearly closed canopy pine or pine-hardwood forests in the uplands and hardwood forest in the bottomlands. Elevations within the region ranged from 15 to 150 meters (Nixon 2000, Texas Parks and Wildlife Department 2005b). The climate was mesothermal and characterized by hot, humid summers and mild winters (Nixon 2000). The mean annual temperature in the region ranged from 8.4-18.7° C while annual rainfall ranged from 89-152 cm (National Oceanic and Atmospheric Administration 2002b;a).

In 2009, the TPWD released the GIS-based Texas Vegetation Classification Project (Phase II; TVCP) habitat classification model. The TVCP was derived from remote sensing of Landsat satellite imagery, aerial photo interpretation, digital soil surveys, digital elevation models, and ground-truthing surveys, and included 119 habitat classifications. According to the TVCP, 38% of the land-cover in the south recovery zone was in pine forest, 26% in hardwood forest, 15% in grassland or pasture, 5% in mixed pine-hardwood forest, 5% in open water, 4% in agriculture, 3% in marsh, 2% in herbaceous, 2% in urban, and <1% in each of the following: swamp, shrub, barren, and juniper forest. Uplands and mesic uplands were typically dominated by loblolly pine (*Pinus taeda*), southern red oak (*Quercus falcata*), post oak (*Q. stellata*), water oak (*Q.*

nigra), and sweetgum (*Liquidamber styraciflua*) while mesic creeks and river bottoms were typically dominated by white oak (*Q. alba*), swamp laurel oak (*Q. laurifolia*), water oak, willow oak (*Q. phellos*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), sweetbay magnolia (*Magnolia virginiana*), sweetgum, and blackgum (*Nyssa sylvatica*). Common swamp species included bald cypress (*Taxodium distichum*), water tupelo (*N. aquatica*), water elm (*Planera aquatica*), and Carolina ash (*Fraxinus caroliniana*). Typical understory species included peppervine (*Ampelopsis arborea*), American beautyberry (*Callicarpa americana*), pawpaw (*Asimina* spp.), flowering dogwood (*Cornus florida*), hawthorn (*Crataegus* spp.), viburnum (*viburnum* spp.), holly (*Ilex* spp.), wax myrtle (*Morella cerifera*), bay (*Persea* spp), blackberry (*Rubus* spp.), sassafras (*Sassafras albidum*), greenbriar (*Smilax* spp.), blueberry (*Vaccinium* spp), and wild grape (*Vitis* spp).

Even-aged timber production was the dominant land use on private lands and clearcutting the most common silvicultural practice. Pine production with rotation ages ≤60 years were common. State and federal properties were managed with rotation ages typically >100 years. Prescribed fire was common on public properties to minimize dense understory vegetation although infrequently utilized on private lands. Urban development was minimal and constituted <2% of the total land cover in the south recovery zone. County populations ranged from 8,865 in San Augustine County to 252,273 in Jefferson County ($\bar{x}$ = 54,681). Roads in the south recovery zone included 17,738 km of county roads (paved and unpaved) and 9,629 km of state roads, U.S.

highways, and interstates. Open road density by county ranged from 0.36 km/km^2 in Chambers County to 0.97 km/km^2 in Orange County ($\bar{x}$ = 0.64).

METHODS

To designate survey locations, we established a systematic grid system consisting of 1.6 x 1.6 km cells over each study area. We randomly identified 5 potential hair trap locations in each cell using ArcGIS 9.3 (ESRI, Redlands, CA). From these 5 potential sites, we subjectively chose one location for survey in the field based on site accessibility and the potential for seasonal flooding. Each trap location was ≥1 km from all other locations. Because black bears are spatially rare in east Texas, we followed the recommendations of Boersen et al. (2003) and Boulanger et al. (2004b) to place ≥4 hair traps per mean female home range ($\bar{x}$ = 4.69). Because home range data for bears in east Texas were not available, we based cell size on the home range size for female Louisiana black bears in Louisiana ($\bar{x}$ = 12 km^2; Mowat and Strobeck 2000, Bittner et al. 2002, Benson and Chamberlain 2007).

We used the hair trap design developed by Woods et al. (1999) and modified to a two-strand barbed-wire design by Dreher et al. (2007) and Siegmund (Stephen F. Austin State University, Unpublished Data) due to concerns that relatively small or large bears may not be sampled using the 1-strand design (Woods et al. 1999, Bittner et al. 2002, Boulanger et al. 2004a). We stretched 2 strands of barbed-wire (4-point, 15.5 gauge, 5 inch spread between barbs) parallel to the ground around ≥3 trees at heights of 20 and 60 cm (T. Siegmund, Stephen F. Austin State University, Unpublished Data). We filled any low areas underneath the wire with forest debris to prevent bears from passing under the wires without contacting the barbs. Barbed-wire was installed as to allow ≥2 m distance from the perimeter wire to the center of the trap (where an olfactory lure was placed).

The primary lure used for the hair trap was a 3:1 mixture of aged cattle blood and commercially produced fish oil (Track and Trap Guide Service, Sidney, ME, USA; Mowat and Strobeck 2000, Romain-Bondi et al. 2004, Kendall et al. 2008). We added a 1:9 mixture of anticoagulant (1:7 mixture sodium citrate to water) to cattle blood as the blood was collected (~300 grams sodium citrate:1.9 L water:18.9 L blood) and aged the mixture in sealed 30-gallon metal trash cans lined with plastic bags for >3 months. At each hair trap location, we strung a rope across the center of the trap ≥2 m above the ground and hung an open-air 1-L wide-mouth bottle containing the blood mixture. We additionally hung a tampon soaked in a jelly donut scented lure (Bear Bait®, Evolved, New Roads, LA, USA) at the center of each trap as a secondary lure (Settlage et al. 2008, Tredick and Vaughan 2009). At each trap we placed warning signs in the four cardinal directions and marked the area with orange flagging.

We checked traps every 7 days (1 sampling occasion) to remove hair and replenish lures (if necessary). At each visit, we collected all visible hairs from each set of barbs as individual hair samples using sterilized tweezers. We placed hair samples into individually labeled coin envelopes and stored them in plastic bags containing silica desiccant (Dri Splendor®, Miracle Coatings, Anaheim, CA, USA; Poole et al. 2001, Bittner et al. 2002, Settlage et al. 2008). Following hair collection, we sterilized sites by burning all barbs and wire with a propane torch (Settlage et al. 2008). In general, we operated hair traps in fixed locations for a total of 4 weeks or 4 7-day sampling occasions per hair trap (Bittner et al. 2002, Boersen et al. 2003). The exception was in 2009, when we operated 13 hair traps for a total of 2 weeks or 2 7-day sampling occasions per hair trap.

Because our grid design was an irregular shape and our study area did not contain geographic features which enclosed any of our study areas, we likely did not meet the assumptions of geographic population closure (Romain-Bondi et al. 2004, Tredick and Vaughan 2009). We likely met or minimized bias associated with demographic closure by using standardized short sampling periods (≤10 weeks; White et al. 1982) and by using a dense trap arrangement; minimizing the effects of dependent, less mobile cubs on adult females (Boersen et al. 2003, Kendall et al. 2008). We sampled during the summer when no births occurred (Weaver and Pelton 1994, Poole et al. 2001) and deaths were unlikely due to the high survival rates for bears during these months (Etter et al. 2002, Tredick and Vaughan 2009). We began sampling no earlier than early May which is a conservative estimate for when all bears would be out of their winter dens in the southeastern U.S. (Hellgren and Vaughan 1987, Weaver and Pelton 1994, Oli et al. 1997). Lastly, we used a two-strand barbed-wire hair trap designed to sample all size or age demographics (Woods et al. 1999, Bittner et al. 2002, Boulanger et al. 2004a).

We used a combination of microscopic and genetic analysis of hairs to identify species and other characteristics of hair samples. First, we used the microscopic sorting methods developed by Woods et al. (1999) to sort samples into 3 categories: bear, non-bear, and unknown species. Woods et al. (1999) showed that microscopic identification of black bear hair was highly successful, even in a population with a highly similar species (e.g., the grizzly bear), and reported that 98% of samples classified as black bear were positively identified as such using mitochondrial DNA (mtDNA) analysis. Although various color phases of black bears make color a difficult descriptive characteristic for identifying black bear hair; black bear hairs are uniform in color (yellowish-brown to black; Tumlison 1983), glossy in appearance (D. Paetkau, Wildlife Genetics International, personal communication), measure a maximum 153 µm in midshaft diameter (Tumlison 1983) and 100 mm in length (Mayer 1952, Tumlison 1983), and do not constrict at the root (D. Paetkau, Wildlife Genetics International, personal communication).

We evaluated hair samples using a dissecting microscope on low magnification (4X) with 35 W laboratory lamps placed on both sides (D. Paetkau, Wildlife Genetics International, personal communication). Each hair sample was placed on a new, 25 x 75 mm pre-cleaned micro slide (Propper Select®, Propper Manufacturing Co., Long Island City, NY, USA) with sterilized tweezers. We measured the diameter of hair samples using a micrometer eyepiece calibrated with a 0.01 mm unit stage micrometer (Stage Micrometer, Hausser Scientific, Horsham, PA, USA). We discarded all samples identified as 'non-bear' or containing no hair roots as determined from microscopic analysis (Mowat and Strobeck 2000, Poole et al. 2001, Bittner et al. 2002, Kendall et al. 2008). Because black bears are rare in our study areas, our *a priori* protocol was to test all samples identified as 'bear' or 'unknown species' and containing ≥1 hair root for species identification through analysis of the amelogenin gene (Waits and Paetkau 2005, Kendall et al. 2008). All samples identified as 'bear' through analysis of the amelogenin marker were then evaluated for sex and individual identification using the following 7 microsatellite markers: G1A, G10B, and G1D (Paetkau and Strobeck 1994, Boersen et al. 2003), G10J (Boersen et al. 2003, Tredick and Vaughan 2009), G10M and G10P (Boersen et al. 2003, Settlage et al. 2008), and G10H (Tredick and Vaughan 2009). All genetic analyses were performed at Wildlife Genetics International (Nelson, British Columbia, Canada); a commercial genetics laboratory specializing in non-invasive genetics and low quantity DNA samples.

RESULTS

In 2009, we operated 13 hair traps (4 Aug, 2009-20 Aug, 2009) for 2 7-day sampling occasions at the Tony Houseman WMA located along the Lower Sabine River Basin. We collected 37 hair samples during 189 trap-nights ($\bar{x}$ = 14.5 trap-nights/hair trap). Ten of 13 hair traps (78%) collected hair during ≥1 sampling occasion. Of the hair traps that collected hair, the number of samples collected ranged from 1-11 per trap ($\bar{x}$ = 3.7) and 0-9 per sampling occasion ($\bar{x}$ = 1.9).

In 2010, we operated 28 hair traps (3 May, 2010-7 June, 2010) along the Lower Sabine River Basin at Devil's Pocket and 64 hair traps (n = 31, 12 June, 2010-13 Aug, 2010; n = 33, 10 Aug, 2010-17 Sept, 2010) along the Upper Sabine River Basin at Scrappin' Valley for 4 7-day sampling occasions. We collected 187 hair samples (n = 104 at Devil's Pocket; n = 83 at Scrappin' Valley) during 2582 trap-nights ($\bar{x}$ = 28.0 trap-nights/hair trap). Sixty-three of 92 hair traps (68%; 86% at Devils Pocket; 61% at Scrappin' Valley) collected hair during ≥1 sampling occasion. Of the hair traps that collected hair, the number of samples collected ranged from 1-8 per trap ($\bar{x}$ = 3.0; 1-8 samples, $\bar{x}$ = 4.3 at Devil's Pocket; 1-4 samples, $\bar{x}$ = 2.1 at Scrappin' Valley) and 0-8 samples per sampling occasion ($\bar{x}$ = 0.7; 0-8 samples, $\bar{x}$ = 1.1 at Devil's Pocket; 0-4 samples, $\bar{x}$ = 0.5 at Scrappin' Valley).

In 2011, we operated 2 hair traps on the Angelina National Forest (4 March, 2011-1 April, 2011) in response to a report that a bear scat was discovered in the area and

74 hair traps (*n* = 34, 23 May, 2011-24 June, 2011; *n* = 40, 27 June, 2011-29 July, 2011) along the Middle Neches River Basin for 4 7-day sampling occasions. We collected 236 hair samples (*n* = 6 at the Angelina National Forest; *n* = 230 along the Middle Neches River Basin) during 2127 trap-nights ($\bar{x}$ = 28.0 trap-nights/hair trap). Fifty-nine of 76 hair traps (77%) collected hair during ≥1 sampling occasion. Of the hair traps that collected hair, the number of samples collected ranged from 1-12 per trap ($\bar{x}$ = 4.0) and 0-12 per sampling occasion ($\bar{x}$ = 1.0). For all sites with ≥4 sampling occasions, the number of hair samples collected was relatively evenly distributed among sampling occasions (e.g., weeks), although slightly more samples were collected during the first occasion: 33.2% of hair samples were collected during the first occasions (1182 trap-nights), 21.3% were collected during the second occasions (1163 trap-nights), 22.0% were collected during the third occasions (1176 trap-nights), and 23.5% were collected during the fourth occasions (1175 trap-nights).

We sorted all hair samples into three categories; bear, non-bear, and unknown species. All hair samples (*n* = 39) collected in 2009 at Tony Houseman WMA were identified as 'non-bear' and discarded. We classified 35 of 187 (19%) samples collected in 2010 at Devil's Pocket and Scrappin' Valley along the Sabine River Basin as 'unknown species'. We classified 16 of 230 (7%) samples collected in 2011 along the Middle Neches River Basin as 'unknown species'. Hair samples collected from 2 hair traps established on the Angelina National Forest were all identified as 'non bear' (*n* = 6). We genetically analyzed 51 hair samples of which zero were identified as black bear.

Because we did not detect our target species during this study, we were unable to use established occupancy models to calculate *a posteriori* detection probabilities (p) and occupancy estimates (Ψ). Furthermore, detection at some proportion of sites is necessary for establishing an occupancy estimator and estimated p for use in a two step, ad hoc approach (MacKenzie et al. 2006). Tredick et al. (2007) reported a value for p of 0.18 per sampling occasion which equates to a probability of non-detection (i.e., the probability that we did not detect a black bear that was in fact present at site i during sampling occasion K) of 0.82 per site per occasion (= 1-0.18; MacKenzie 2005). The probability of non-detection for an entire survey is thus $(1 - p)^K$, where K equals the number of sampling occasions (i.e., weeks; MacKenzie 2005). We sampled for 2 occasions per season at Tony Houseman WMA resulting in a probability of non-detection of 0.67 (= 0.82^2). We sampled for 4 occasions per season at Devil's Pocket, Scrappin' Valley, the Angelina National Forest, and Middle Neches River Basin study areas resulting in a probability of non-detection of 0.45 (= 0.82^4).

DISCUSSION

This study represents the first rigorous evaluation of black bear occupancy in the south Louisiana black bear recovery zone in east Texas. We surveyed 1.1 and 2.1% of the south recovery zone and recovery focal units, respectively and 1.6 and 4.6% of forested habitat and potential suitable habitat (see Chapter III), respectively in the south recovery zone. We chose our study areas due to the proximity of these habitats to source populations of the Louisiana black bear, based on historic sightings data from east Texas, and expert opinion of TPWD field personnel. These areas thus reflect the most likely locations to harbor black bears in the region. Since 1978, 6 Category I (black bear sightings confirmed with physical data such as trail camera photos, tracks, or scats) and 36 Category II (black bear sightings reported by reliable sources but lack tangible proof for verification) sightings have been recorded in the south recovery zone. Although our study areas encompass <3% of the south recovery zone and associated recovery units, these areas contain 18% of the historic black bear sightings in the region. During this study (2009-2011), 3 Category I and 7 Category II sightings were documented. In 2009, 1category I sighting (trail camera photo) was documented within the Scrappin' Valley study area and in 2010,1 category II (visual sighting of a bear crossing a road) was documented approximately 150 km from the Middle Neches River Basin study area. Even though we did not confirm the presence of black bears through our hair trapping efforts, confirmed reports from private landowners substantiate that black bears reach the south recovery zone.

We used the hair trap technique developed by Woods et al. (1999) and specifically designed to survey free-ranging bear populations. The technique is well-established and commonly applied to black bear research in North America (Bittner et al. 2002, Boersen et al. 2003, Dreher et al. 2007, Tredick and Vaughan 2009, Hooker 2010). These methods can result in high quality and quantity data capable of developing precise parameter estimates and thus our results do not reflect limitations of the methodology (Woods et al. 1999, Mowat and Strobeck 2000, Boersen et al. 2003, Kendall et al. 2009, Tredick and Vaughan 2009).

When modeling species occupancy, detection of a species indicates "presence" of the species, however, non-detection does not necessarily equate to "absence" given that a species may go undetected when present (MacKenzie et al. 2002, MacKenzie 2005). Detection probabilities for black bears are expectedly imperfect (p_{iK} <1) even though survey methods are specifically designed to sample bear species and provide ≥1 opportunity for each individual in a study area to encounter a trap (MacKenzie et al. 2002, Kendall et al. 2009). MacKenzie et al. (2006) outlined multiple two-step, ad hoc approaches for estimating occupancy probability for sites lacking detections. These processes require estimating the detection probability ($\hat{p}$) from the number of occupied sites at which a species of interest was detected on ≥1 occasion and subsequently estimating the occupancy parameter ($\widehat{\Psi}$). However, MacKenzie et al. (2006) concluded that more appropriate methods involve simultaneously modeling $\hat{p}$ and $\widehat{\Psi}$ within a single framework using empirical data. Both of these approaches necessitate detection of the target species at some proportion of sites (*i*). Considering this limitation, we were unable to estimate both $\hat{p}$ and $\hat{\Psi}$ for black bears in our study.

Detection probabilities for the hair trap technique are occasionally reported in the literature, although these values are frequently biased because researchers sub-sample hair samples for genotyping due to the high costs associated with genetic analysis (Dreher et al. 2007, Settlage et al. 2008, Tredick and Vaughan 2009, Hooker 2010). Tredick et al. (2007) analyzed various sub-sampling schemes and determined that all scenarios resulted in a negative bias in population estimates. This is problematic when attempting to infer a probability of non-detection, or “false absence”, from reported detection probabilities in the literature. Tredick et al. (2007) found that *p* increased as the number of samples genotyped increased, although the increase was small and *p* remained between 0.10 and 0.20 when 40, 50, 60, 70, and 80% of collected samples were genotyped. A similar trend was noted when 1, 2, or 3 hair samples were analyzed per site. Although data did not indicate an adequate sub-sample scenario, it was evident that a robust estimator provided the least biased parameter estimates. The 2 scenarios reported by Tredick et al. (2007) in which 80% of samples or 3 sample per site were genotyped represents a relatively conservative sub-sampling scheme (Boersen et al. 2003, Dreher et al. 2007, Settlage et al. 2008). We thus chose to use the detection probability reported by Tredick et al. (2007) as the best available data for estimating the probability of false absence for our data and because they reported *p* per sampling occasion rather than sampling season. Other black bear studies have reported *p* although these values were developed per sampling seasons which varied in length compared with ours (Dreher et al. 2007, Tredick and Vaughan 2009, Gardner et al. 2010), were developed from pooled data (Settlage et al. 2008), or were developed under unique modeling schemes (Gardner et al. 2009).

Except in 2009, we sampled sites for 4 occasions (Bittner et al. 2002) which followed the recommendations of MacKenzie and Royle (2005) and Mowat and Strobeck (2000) for surveying when p is expectedly lower than 0.50. This resulted in a probability of non-detection of 0.45. Multiple hair trap studies have been conducted for 8 or 10 week seasons (7-day sampling occasions), and if using $p = 0.18$, would have resulted in a probability of non-detection of 0.20 and 0.14, respectively (Boersen et al. 2003, Settlage et al. 2008, Wegan 2008, Tredick and Vaughan 2009, Hooker 2010). These probabilities of non-detection provide a highly desired increase in precision, although time and effort per site must be at least doubled. Considering that Dreher et al. (2007) detected bears at 51% of traps after 5 7-day sampling occasions and Bittner et al. (2002) collected 330 black bear samples after 4 7-day sampling occasions and developed precise abundance estimates using this sampling scheme, we assume it is highly unlikely that an established population of black bears exists in our study areas. However, it is possible that we missed detecting an individual or transient bear that was present in our study areas during our sampling.

We surveyed areas identified by the TPWD as having the highest likelihood of detecting black bears in the south Louisiana black bear recovery zone. Our data suggest that no established population exists in the south recovery zone. Black bear populations in Oklahoma and Louisiana are both increasing with evidence suggesting that these populations are expanding (Black Bear Conservation Coalition, Unpublished Data). Confirmed reports of black bears in east Texas have been recorded, although these probably relate to isolated incidents of transient black bears rather than resident individuals. As sightings increase and data suggest that habitat use is increasing in east Texas, future monitoring efforts should continue to use the hair trap technique developed by Woods et al. (1999). The method allows for landscape-scale survey with relatively few resources and the potential for identifying the sex and subspecies (*U. a. americanus* vs. *U. a. luteolus*) of individuals. Opportunistic hair trapping may also prove effective if sightings data can be collected from the public and biologists can respond in a timely manner. It is important to note that when surveying rare species, detections may not be indicative of occupancy but rather use. “Occupancy”, as defined by MacKenzie (2005), implies that a target species is always present at a site over a specified period of time, where as “use” implies that the presence of a target species is random with respect to site and time.

State and federal Louisiana black bear recovery plans mandate the reestablishment of sustainable populations of Louisiana black bears throughout the historic range of the subspecies. Suitable recovery units capable of sustaining minimum viable populations (i.e., a population which has a ≥95% probability of surviving for ≥100 years; Shaffer 1981) have been identified in both the north (T. Siegmund, Stephen F. Austin State University, Unpublished Data) and south black bear recovery zones (see chapter III) in east Texas. However, in order to promote the reestablishment of populations in these recovery units, or to implement the reintroduction of bears in the region from source populations, it was imperative to evaluate the current population dynamics and potential effects of reintroduction on resident bears. Our data, when combined with current habitat information for the region, may direct the development of sound management plans aimed at reestablishing the black bear as a natural component of east Texas ecosystems.

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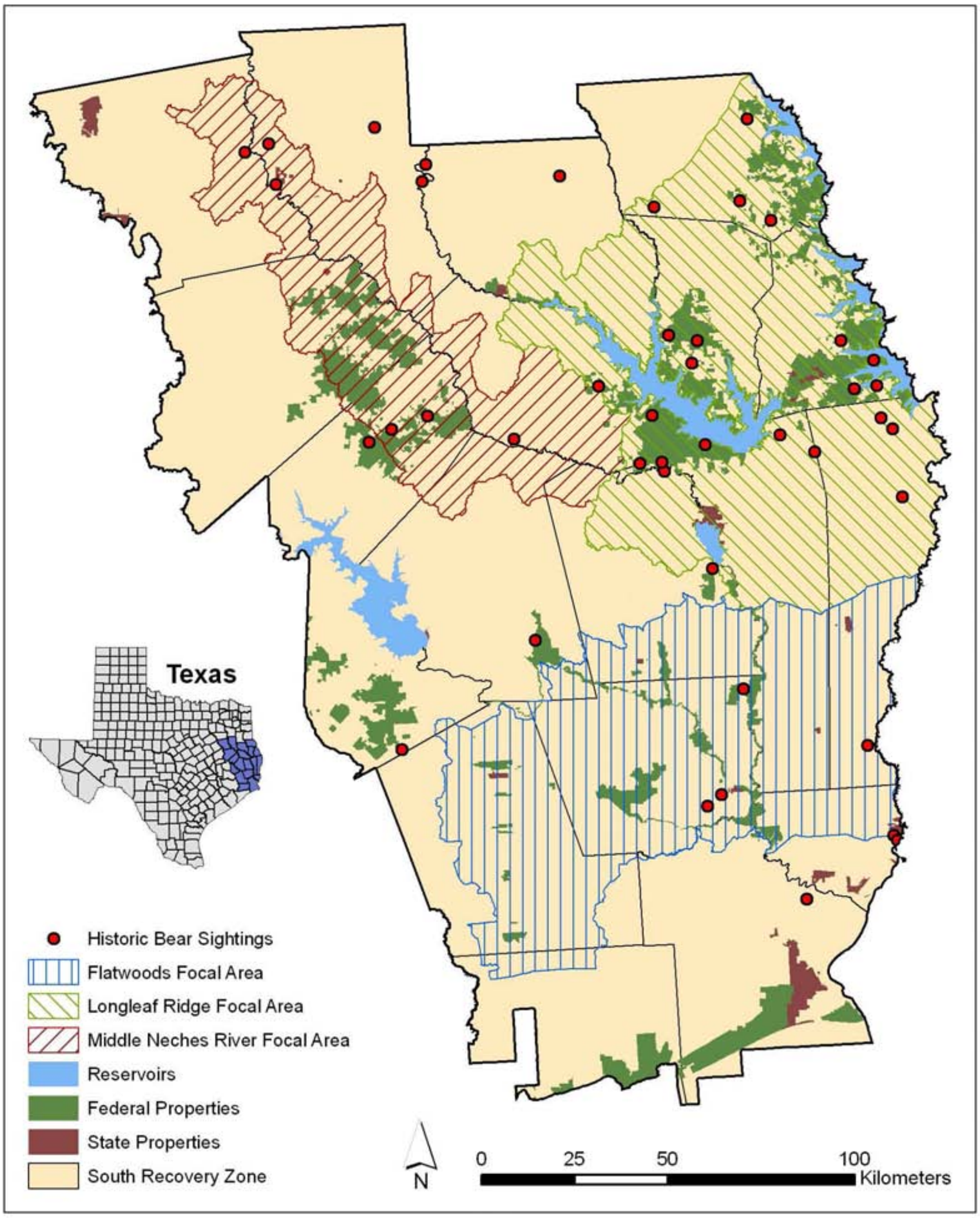

Figure 2.1. Focal restoration areas developed by the East Texas Black Bear Task Force and historic black bear sightings locations from 1978-2011 in the south Louisiana black bear recovery zone, Texas, USA.

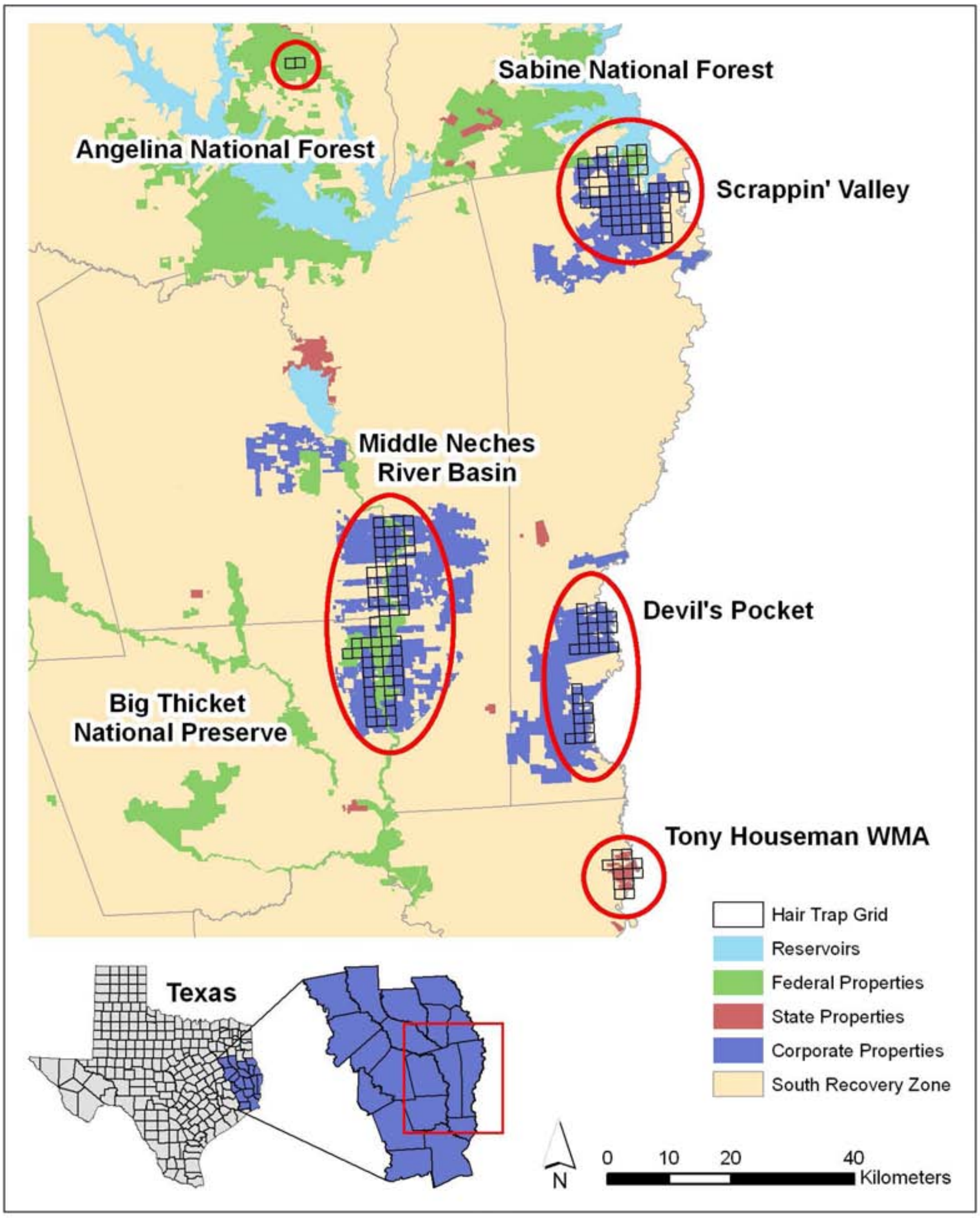

Figure 2.2. Five study area locations and hair trap grid arrangement for non-invasive genetic sampling of black bears during 2009, 2010, and 2011 in the south Louisiana black bear recovery zone, Texas, USA.

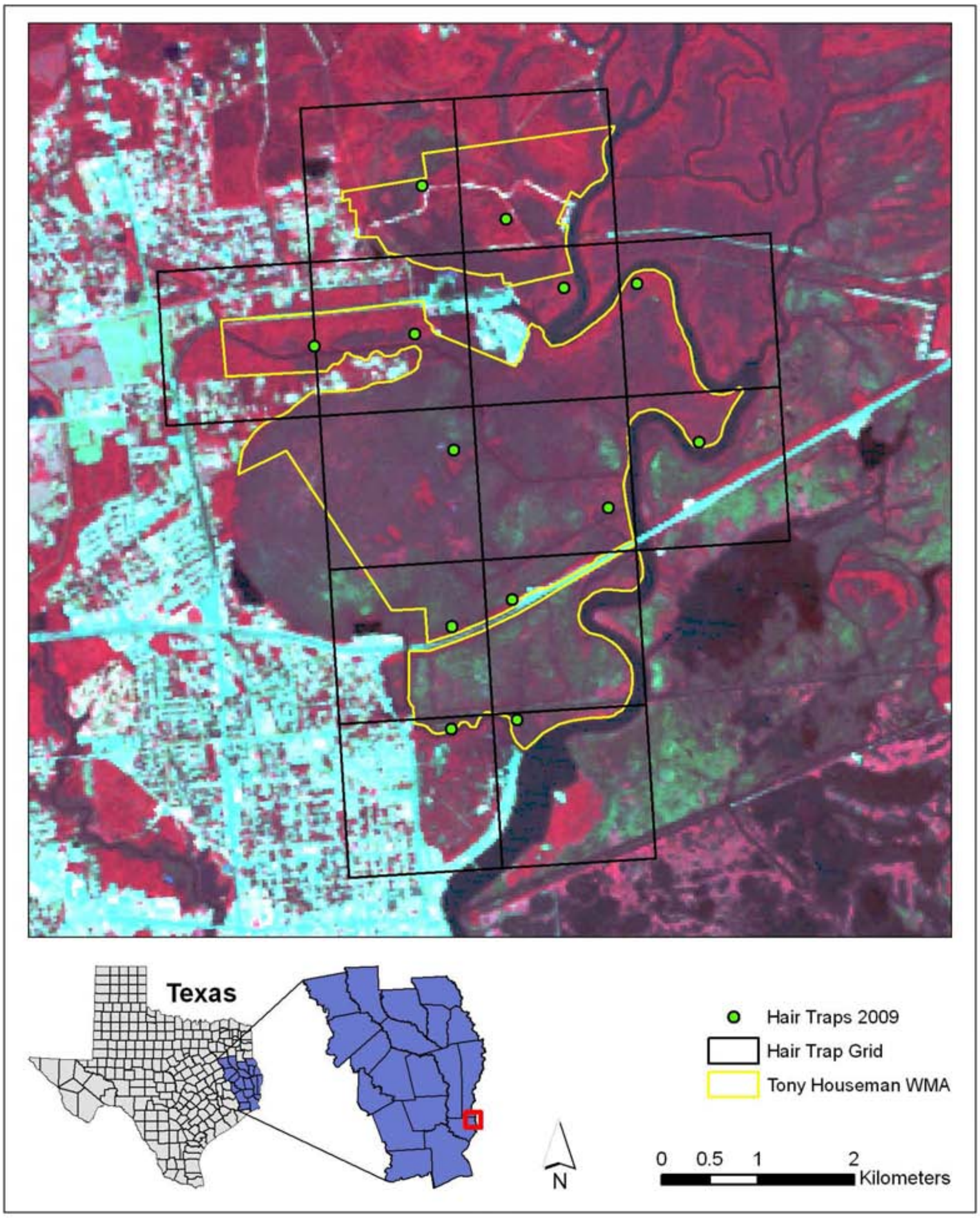

Figure 2.3. Hair trap grid and hair trap survey point locations during 2009 at the Tony Houseman WMA study area in the south Louisiana black bear recovery zone, Texas, USA.

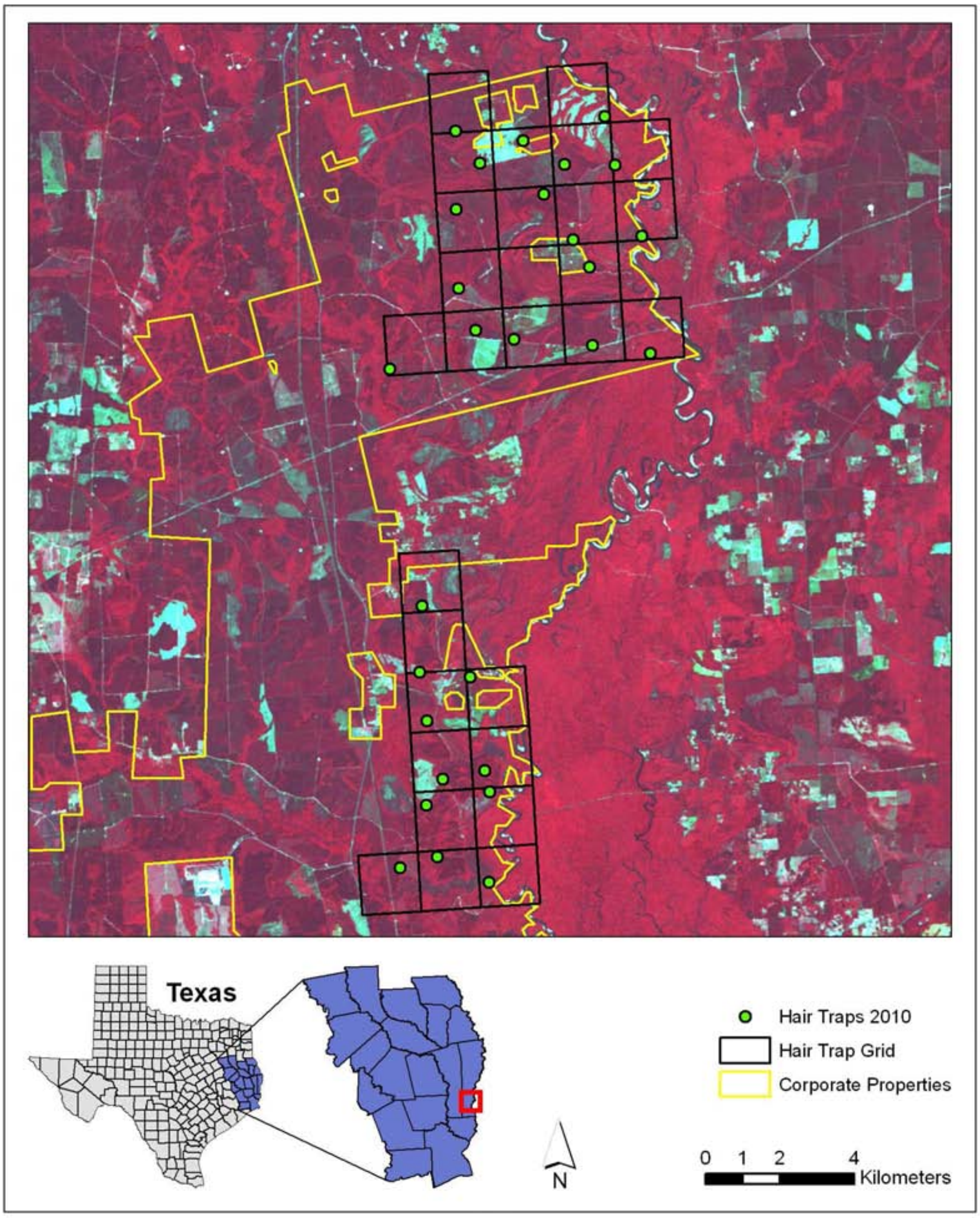

Figure 2.4. Hair trap grid and hair trap survey point locations during 2010 at the Devil's Pocket study area in the south Louisiana black bear recovery zone, Texas, USA.

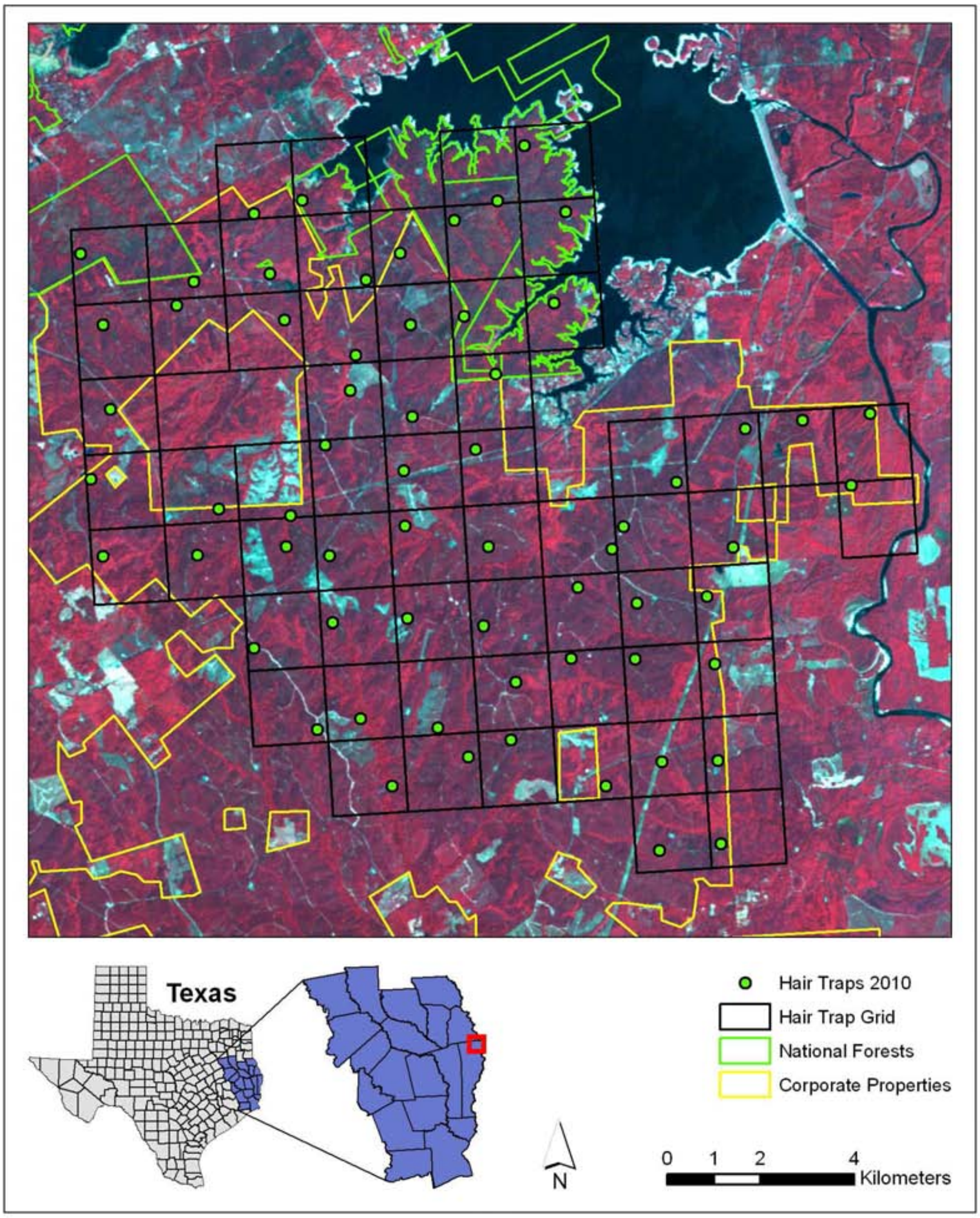

Figure 2.5. Hair trap grid and hair trap survey point locations during 2010 at the Scrappin' Valley study area in the south Louisiana black bear recovery zone, Texas, USA.

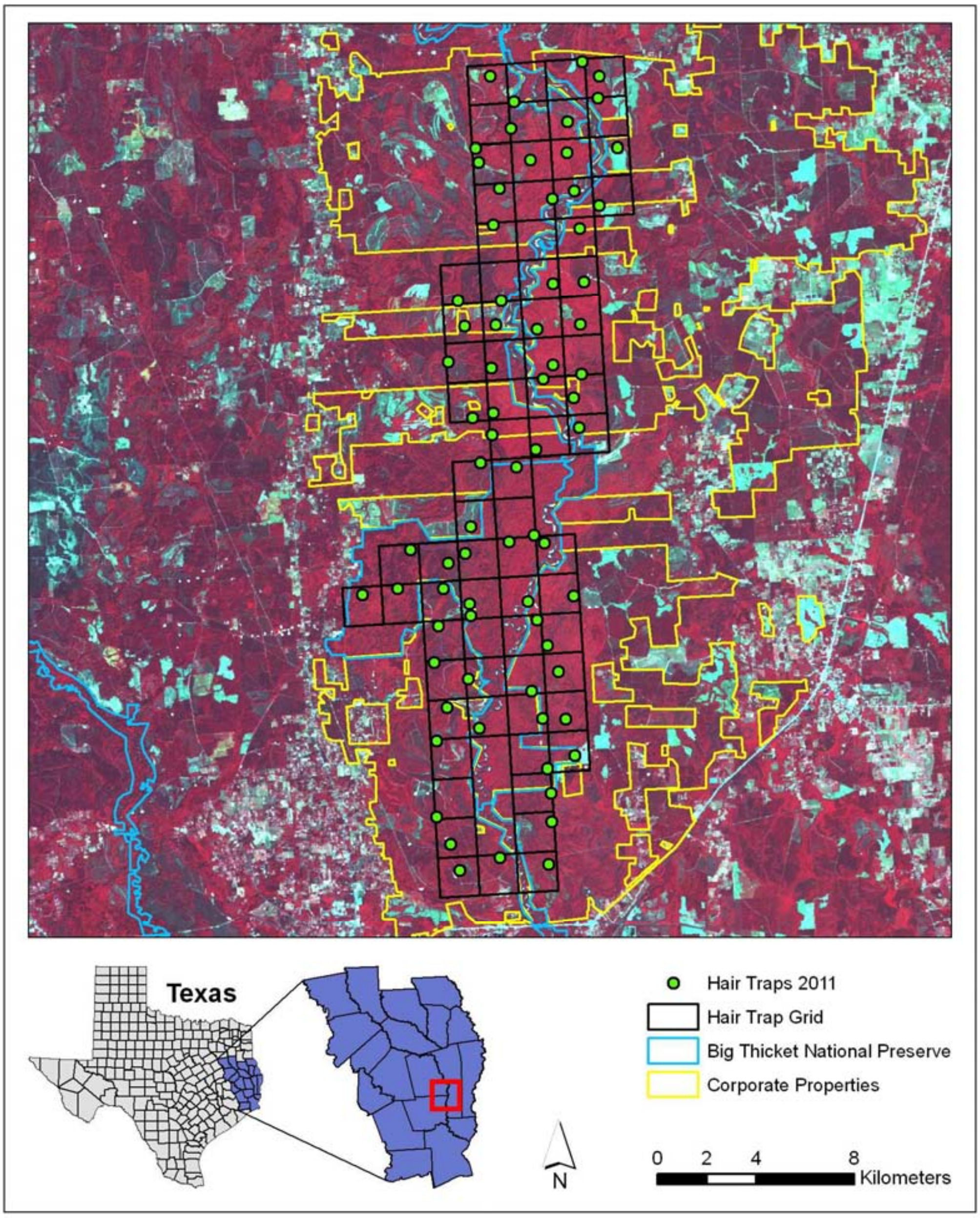

Figure 2.6. Hair trap grid and hair trap survey point locations during 2011 at the Middle Neches River Basin study area in the south Louisiana black bear recovery zone, Texas, USA.

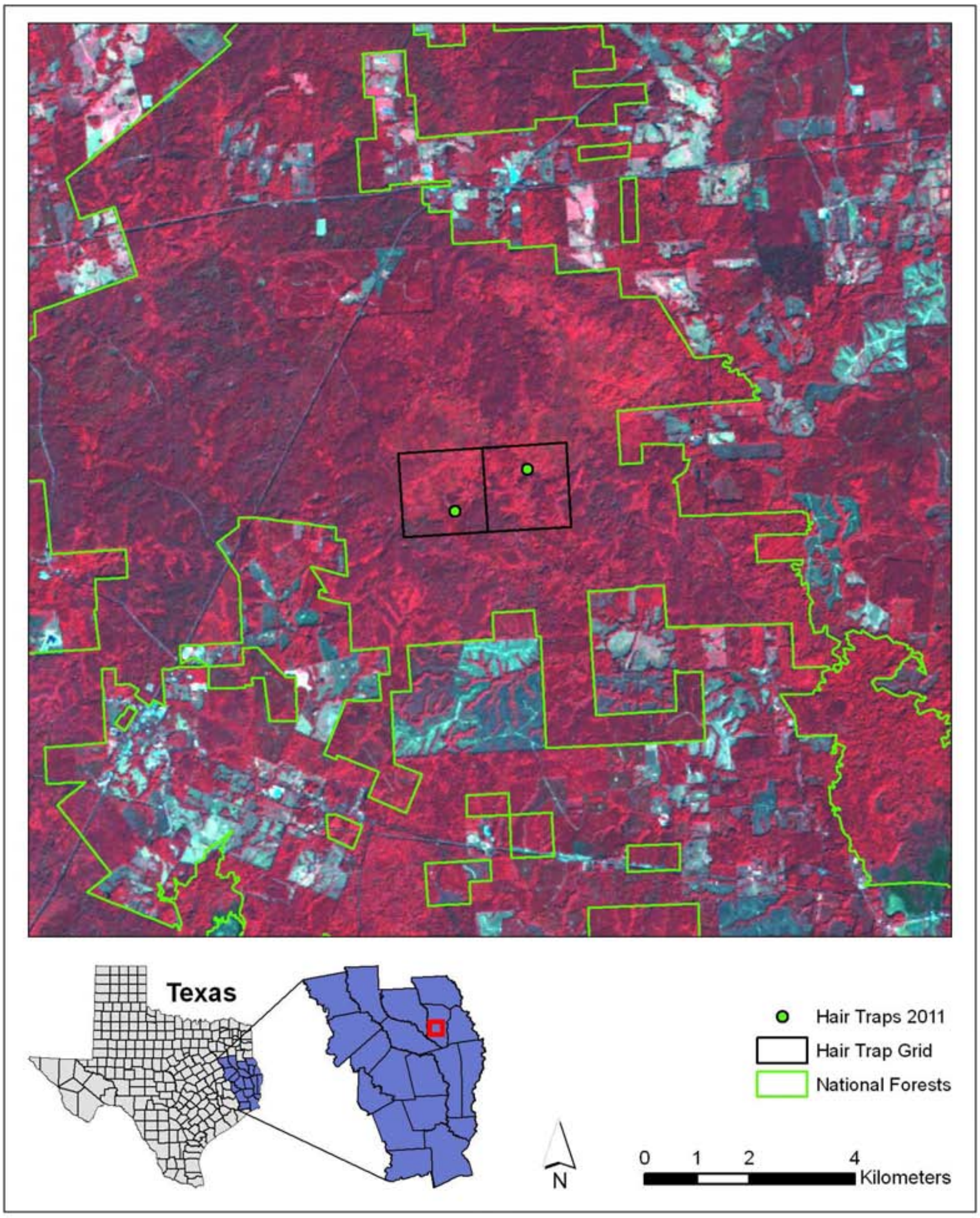

Figure 2.7. Hair trap grid and hair trap survey point locations during 2011 at the Angelina National Forest in the south Louisiana black bear recovery zone, Texas, USA.

CHAPTER III: ASSESSMENT OF HABITAT SUITABILITY FOR THE LOUISIANA BLACK BEAR (*URSUS AMERICANUS LUTEOLUS*) IN EAST TEXAS

ABSTRACT

By the 1940s, the Louisiana black bear (*Ursus americanus luteolus*) was considered extirpated from east Texas. Despite the presence of potentially suitable habitat in east Texas and expanding populations in adjacent states, quantitative estimates of regional habitat suitability do not exist. State and federal recovery plans mandate that suitable habitats for future population expansion be identified within the historic range of the Louisiana black bear. We developed a landscape-scale habitat suitability index (HSI) model in a geographic information system (GIS) to evaluate year-round habitat requirements for black bears in the 43,553 km^2 south black bear recovery zone. We measured hard and soft mast production, understory vegetation density, and tree den availability at 516 survey points in 38 habitat classes (82% of the total land cover in the south recovery zone). We developed GIS-based models for summer food availability, fall food availability, diversity, and productivity, protection cover, tree den availability, distance to roads, and human development zones and calculated HSI scores per pixel in a continuous dataset. Habitat suitability scores ranged from 0.00-0.76 throughout the region. Highly (<1%) and moderately (16%) suitable habitat existed in the region although the majority of the area (84%) was classified as marginal or unsuitable habitat. We identified 4 recovery units capable of sustaining viable black bear populations. These units were associated with major river basins (Neches, Sabine, and Trinity) and ranged from 31,583 to 74,285 ha in size and from 0.58 to 0.60 in mean HSI scores. Recovery

unit scores were comparable to those previously reported for occupied bear range in the southeastern U.S. and acreages of suitable habitat exceeded those estimated to support existing Louisiana black bear populations.

INTRODUCTION

Understanding and quantifying the relationship between wildlife and habitat is an important step in effective management of wildlife populations and the development of conservation programs. Habitat suitability index (HSI) models have been used since the early 1980s to assess environmental impacts to wildlife populations and facilitate management planning (U.S. Fish and Wildlife Service 1980, Allen 1983, Cook and Irwin 1985). More recently, HSI models have been used to predict potential habitat suitability and use by wildlife populations (Brooks and Temple 1990, Van Manen and Pelton 1997, Gurnell et al. 2002). Habitat suitability index models quantify habitat suitability based on known life requisite variables and habitat requirements for a given species. Habitat variables (e.g., food production or nest site availability) are evaluated on a suitability index (SI) scale from 0 (unsuitable habitat) to 1 (optimum suitability) and are commonly derived from expert opinion and literature review (Didier and Porter 1999, Clevenger et al. 2002, Gurnell et al. 2002, Felix et al. 2004, Rachlow and Svancara 2006) or from empirical habitat selection and use data (Gurnell et al. 2002, Toschik et al. 2006, Watrous et al. 2006, Hellgren et al. 2007). Final HSI scores are typically the weighted mean of the multiple index scores calculated according to the hypothesized relationships among variables. Traditional HSI models were designed to evaluate habitat based on the minimum area necessary for a species to reproduce and survive, evaluate habitat across a species entire range, or assign a single suitability score to simplified land-cover classifications or political and administrative boundaries (U.S. Fish and Wildlife Service 1980). With the development of Geographic Information Systems (GIS) and advances in GIS software, computer hardware, and satellite technologies, sources of data such as remote satellite and photographic imagery, land-cover models, and digital elevation models have allowed for the development of more detailed HSI models and their application to landscape-scale restoration and management efforts (Didier and Porter 1999, McComb et al. 2002, Larson et al. 2003, Felix et al. 2004).

Habitat suitability index models are commonly applied to black bear (*Ursus americanus*) populations to evaluate and predict habitat suitability (Van Manen 1991, Tankersley 1996, Hersey et al. 2005). Because management decisions regarding bears are often made at the population level, multiple landscape-scale GIS-based models have been developed to evaluate habitats for black bears (Van Manen and Pelton 1997, Bowman 1999, Mitchell et al. 2002, Larson et al. 2003). Because of the coarseness of most GIS data, HSI models are well suited for habitat generalists and species with large spatial requirements such as bears (Clark et al. 1993, Van Manen and Pelton 1997, Larson et al. 2003). Typically, these models include food, cover, and human impact life requisite components (Van Manen 1991, Tankersley 1996, Bowman 1999, Mitchell et al. 2002, Larson et al. 2003, Hersey et al. 2005). Although some models have incorporated as many as 20 variables, Mitchell et al. (2002) suggested that simpler models consisting of food and denning variables better reflect population-level habitat selection by bears and Larson et al. (2003) suggested that resource availability is more important to modeling habitat quality for bears than abiotic components (e.g., slope and aspect).

East Texas is located within the historic range of the state and federally threatened Louisiana black bear (*U. a. luteolus*). Although once common throughout eastern Texas, the Louisiana black bear had become rare by the 20th century and was considered extirpated by the 1940s (Texas Parks and Wildlife Department 2005a). The current distribution of the Louisiana black bear is restricted to three populations in central and eastern Louisiana and western Mississippi; although recent data suggest that these populations are expanding (Black Bear Conservation Coalition, Unpublished Data). East Texas is believed to contain some of the largest tracts of forested habitat available to but currently unoccupied by black bears in the southeast (Wooding et al. 1996) and may contribute to the future recovery of the Louisiana black bear. Previous studies of black bear habitat in east Texas concluded that suitable habitat existed in the Neches River Basin of southeast Texas (Garner and Willis 1998) and the Sulphur, Red, and Cypress River Basins of northeast Texas (T. Siegmund, SFASU, unpublished data). Although habitat suitability data for northeast Texas were collected recently (2007-2009), available habitat suitability information for east and southeast was collected more than 10 years ago and localized to the Neches River Basin and Big Thicket National Preserve.

In 2009, we began the second phase of a study designed to quantitatively evaluate the suitability of east Texas habitats for the Louisiana black bear. The first phase was conducted in northeast Texas between 2007 and 2009 (T. Siegmund, Stephen F. Austin State University, Unpublished Data). Because of the large spatial requirements for black bears, increasing numbers of confirmed reports of bears throughout east Texas (Texas Parks and Wildlife Department, Unpublished Data), and the lack of habitat information throughout the region, our objective was to develop a landscape-scale HSI model that could be used to evaluate year-round habitat requirements for black bears and direct conservation efforts region-wide. We developed a GIS-based approach for modeling black bear habitat suitability based on the HSI model developed by Van Manen (1991) and adapted for use in east Texas (Garner and Willis 1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data).

The Van Manen (1991) model was designed to assign a mean HSI score based on empirical habitat data to distinct boundaries capable of supporting minimum viable populations of black bears. If the habitat is not homogenous over large areas, this approach of assigning a single suitability score reduces spatial resolution over large areas (i.e., an entire recovery zone or region). To apply the model at the landscape-scale while maintaining small-scale detail, we conceptualized each pixel in a continuous data set as a distinct boundary and assigned mean suitability index (SI), component index (CI), and HSI scores to pixels based on empirical field habitat data.

In 2009, the Texas Parks and Wildlife Department released the GIS-based Texas Vegetation Classification Project (Phase II; TVCP) habitat classification model. The TVCP was derived from remote sensing of Landsat satellite imagery, aerial photo interpretation, digital soil surveys, digital elevation models, and ground-truthing surveys, and included 119 habitat classifications at 10 m resolution. The TVCP was 75% accurate at the "Mapping Systems" level (i.e., Pineywoods: Dry Pine Forest or Plantation) and 85% accurate at the "Land Cover" level (i.e., Pine Forest; A. Treuer-Kuehn, Texas Parks and Wildlife Department, Personal Communication). The availability of TVCP data allowed for the construction of a region-wide habitat model. We used the classification descriptions to derive *a priori* habitat suitability scores and construct a preliminary HSI model. We then stratified vegetation sampling efforts according to *a priori* index scores and applied our model to 98 habitat classifications within the south Louisiana black bear recovery zone in east Texas. The south Louisiana black bear recovery zone is one of the two recovery zones within the historic distribution of the Louisiana black bear in east Texas and was delineated to target habitat conservation programs and black bear restoration efforts in east and southeast Texas. Our HSI model was designed to evaluate habitat throughout this zone and identify areas capable of maintaining sustainable populations of black bears. When combined with current occupancy data (see Chapter II) and public opinion survey regarding black bears in the region, efforts may be made to protect critical habitats in and around recovery units and direct conservation programs towards achieving the goals set forth by state and federal Louisiana black bear recovery plans.

STUDY AREA

We developed our HSI model for the 43,553 km^2 south Louisiana black bear recovery zone, which included 19 counties in east Texas: Anderson, Angelina, Chambers, Cherokee, Hardin, Houston, Jasper, Jefferson, Liberty, Nacogdoches, Newton, Orange, Polk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, and Tyler (Figure 3.1). The south recovery zone was located in the Pineywoods Ecoregion of east Texas and consisted of rolling topography mostly dominated by closed or nearly closed canopy pine and pine-hardwood forests in the uplands and bottomland hardwood forest in the bottomlands. Elevations within the region ranged from 15 to 150 meters (Nixon 2000, Texas Parks and Wildlife Department 2005b). The climate was mesothermal and characterized by hot, humid summers and mild winters (Nixon 2000). The mean annual temperature in the region ranged from 8.4-18.7° C while annual rainfall ranged from 89-152 cm (National Oceanic and Atmospheric Administration 2002b;a).

According to the TVCP, 38% of the land-cover in the south recovery zone was in pine forest, 26% in hardwood forest, 15% in grassland or pasture, 5% in mixed pine-hardwood forest, 5% in open water, 4% in agriculture, 3% in marsh, 2% in herbaceous, 2% in urban (1.2% low density and 0.06% high density), and <1% in each of the following: swamp, shrub, barren, and juniper forest. Uplands and mesic uplands were typically dominated by loblolly pine (*Pinus taeda*), southern red oak (*Quercus falcata*), post oak (*Q. stellata*), water oak (*Q. nigra*), and sweetgum (*Liquidamber styraciflua*) while mesic creeks and river bottoms were typically dominated by white oak (*Q. alba*), swamp laurel oak (*Q. laurifolia*), water oak, willow oak (*Q. phellos*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), sweetbay magnolia (*Magnolia virginiana*), sweetgum, and blackgum (*Nyssa sylvatica*). Common swamp species included bald cypress (*Taxodium distichum*), water tupelo (*N. aquatica*), water elm (*Planera aquatica*), and Carolina ash (*Fraxinus caroliniana*). Typical understory species included peppervine (*Ampelopsis arborea*), American beautyberry (*Callicarpa americana*), pawpaw (*Asimina* spp.), flowering dogwood (*Cornus florida*), hawthorn (*Crataegus* spp.), viburnum (*Viburnum* spp.), holly (*Ilex* spp.), wax myrtle (*Morella cerifera*), bay (*Persea* spp), blackberry (*Rubus* spp.), sassafras (*Sassafras albidum*), greenbriar (*Smilax* spp.), blueberry (*Vaccinium* spp), and wild grape (*Vitis* spp).

Even-aged timber production was the dominant land use on private lands with clearcutting the most common silvicultural practice. Pine production with rotation ages ≤60 years were common. State and federal properties were managed with rotation ages typically >100 years. Prescribed fire was common on public properties to minimize dense understory vegetation although infrequently utilized on private lands. Urban development was minimal and constituted <2% of the total land cover in the south recovery zone. County populations ranged from 8,865 in San Augustine County to 252,273 in Jefferson County ($\bar{x}$ = 54,681). Roads in the south recovery zone included 17,738 km of county roads (paved and unpaved) and 9,629 km of state roads, U.S. highways, and interstates. Open road density by county ranged from 0.36 km/km^2 in Chambers County to 0.97 km/km^2 in Orange County ($\bar{x}$ = 0.64).

METHODS

HSI Model Description

The Van Manen (1991) HSI model quantified habitat suitability using measures of soft and hard mast production, understory density, tree den availability, and human disturbance. The basic model includes food (CI_{FOOD}), cover (CI_{COVER}), and human impact ($CI_{HUMAN\ IMPACT}$) component indices (CI) composed of 8 SI variables: summer food availability (SI_{SFA}), fall food availability (SI_{FFA}), fall food diversity (SI_{FFD}), fall food productivity (SI_{FFP}), protection cover (SI_{PC}), tree den availability (SI_{TDA}), open road density, and human-bear conflict zones. Van Manen (1991) assumed that 1) year-round habitat suitability for black bears could be modeled from food, cover, and human impact components, 2) habitat variables were not independent with respect to other variables and the relationships could be described mathematically, 3) the mathematical curves for each variable represent the true relationship between black bears and habitat, and 4) the entire model is used when developing HSI scores. Van Manen (1991) developed these assumptions based on long-term data from the southern Appalachian region. These assumptions are standard for modeling black bear habitat suitability as the importance of food, cover, and human impact variables to population viability is well documented (Clark et al. 1993, Bowman 1999, Mitchell et al. 2002, Larson et al. 2003, Dobey et al. 2005, Benson and Chamberlain 2006, Reynolds-Hogland and Mitchell 2007).

Black bear diets are composed primarily of soft mast (e.g., *Vitis* spp., *Vaccinium* spp., and *Rubus* spp.) during summer months in the southeast U.S. (Beeman and Pelton 1980, Hellgren and Vaughan 1988, Dobey et al. 2005, Benson and Chamberlain 2006). Summer food availability was considered optimal if percent cover of soft mast producing species was >10% of an area and calculated according to the following equations:

x = percent cover of all soft mast producing species [1]

when $x < 10$, $SI_{SFA} = 0.1x$

when $x \geq 10$, $SI_{SFA} = 1.0$

Hard mast (e.g., *Quercus* spp., *Carya* spp., and *Fagus grandifolia*) foods high in fat content primarily compose fall diets and are particularly important for bears as they prepare for winter denning (Beeman and Pelton 1980, Clark et al. 1987, Hellgren and Vaughan 1988, Benson and Chamberlain 2006). Although agricultural food sources potentially may increase overall reproductive success of black bears, we followed the assumption of Van Manen (1991) and assigned unsuitable scores to these classifications since the use of agricultural foods increases the likelihood of negative human-bear interactions and the potential for illegal killing, translocation, or euthanization by management officials. Furthermore, row crop agriculture is a very minor component of the land-cover in southeast Texas and its contribution to bear nutrition would be likely negligible. Fall food availability was considered optimal if the combined percent cover of all hard mast producing species was >40% and calculated according to the following equations:

$$x = \text{percent basal area cover of all hard mast producing species} \quad [2]$$

$$\text{when } x < 15,\ SI_{FFA} = 0.0$$

$$\text{when } 15 < x < 40,\ SI_{FFA} = 0.04x - 0.6$$

$$\text{when } x \geq 40,\ SI_{FFA} = 1.0$$

Fall food diversity was considered optimal if co-dominance existed between ≥2 of the following hard mast producing groups: hickory, red oak, white oak, and other (e.g., American beech, blackgum, and American holly). Although they do not produce hard mast specifically, we included tree species such as blackgum in the “other” category considering their importance in fall diets to black bears and because they are fall fruiting species. Multiple hard mast producing groups in co-dominance help ensure against total crop failure in any given year due to environmental conditions or variable fruiting and flowering cycles among groups (Downs and McQuilkin 1944, Goodrum et al. 1971, Nixon et al. 1980, Spurr and Barnes 1980, Van Manen 1991). For consistency with the previous phase of this study (T. Siegmund, Stephen F. Austin State University, Unpublished Data) and the method for evaluating co-dominance in the development of the TVCP (A. Treuer-Kuehn, Texas Parks and Wildlife Department, Personal Communication), we considered groups co-dominant if the difference in percent basal area cover between two groups was ≤15%. Fall food diversity was calculated according to the following equations:

x = number of hard mast groups existing in co-dominance [3]

when $x \geq 2$, $SI_{FFD} = 1.0$

when $x = 1$, $SI_{FFD} = 0.5$

when $x = 0$, $SI_{FFD} = 0.0$

Van Manen (1991) utilized tree age as a measure of fall food productivity. Siegmund (Stephen F. Austin State University, Unpublished Data) adapted this variable for use in east Texas by using diameter at breast height (DBH) as an indicator because mast production is more strongly correlated with DBH than with tree age (Goodrum et al. 1971, Nixon et al. 1980, Greenberg 2000) and diameter data can be collected with greater efficiency and accuracy compared with tree coring methodologies. Fall food productivity was considered optimal if 40-60% of hard mast producing species were ≥40.6 cm DBH and calculated according to the following equations:

x = percent of hard mast producing trees ≥40.6 cm DBH [4]

when $0 < x < 40$, $SI_{FFP} = 0.025x$

when $40 \leq x \leq 60$, $SI_{FFP} = 1.0$

when $x > 60$, $SI_{FFP} = -0.05x + 4$

Van Manen (1991) used understory vegetation density as a measure of protection cover and evaluated SI_{PC} as a percent of evaluation area in impenetrable understory vegetation. This method was not applicable to our modeling approach because we were interested in applying HSI scores to individual habitat classifications and pixels rather than to a distinct administrative boundary. Mitchell et al. (2002) developed a protection cover index which similarly used density as a measure of protection cover, but applied scores to a continuous dataset independent of area. We considered this approach a suitable replacement since it utilized the same data as the Van Manen (1991) model. We applied the SI_{PC} developed by Mitchell et al. (2002) and calculated protection cover according to the following equations:

x = percent density of understory [5]

when $x \leq 20$, $SI_{PC} = 0$

when $20 < x < 80$, $SI_{PC} = -0.007x + (2.38 \times 10^{-4})\, x^2 + 0.06$

when $x > 80$, $SI_{PC} = 1.0$

Van Manen (1991) utilized tree age as a measure of tree den availability and considered SI_{TDA} optimal if 5-10% of an area was in old growth vegetation. However, recent research indicates that tree diameter may be a more limiting factor in the development of den cavities and tree age may not directly correlate with diameter. Oli et al. (1997) reported that the minimum DBH of trees used as winter dens by black bears in Arkansas was 84 cm. This value was also used to survey for den trees in Alabama by

Hersey et al. (2005). Siegmund (Stephen F. Austin State University, Unpublished Data) adapted SI_{TDA} for use in east Texas by using DBH as an indicator of old growth vegetation and considered tree den availability optimal if 5-10% of hardwood trees were ≥84 cm DBH. We considered this suitable for evaluating tree den availability and calculated SI_{TDA} according to the following equations:

$$x = \text{percent of trees} \geq 84 \text{ cm DBH} \qquad [6]$$

$$\text{when } 0 < x < 5,\ SI_{TDA} = 0.2x$$

$$\text{when } 5 \leq x \leq 10,\ SI_{TDA} = 1.0$$

$$\text{when } x > 10,\ SI_{TDA} = -0.0056x + 1.056$$

The Van Manen (1991) HSI utilized open road density and human-bear conflict zone indices in which the linear distance of roads and the percent cover of human-impact zones were calculated per area of interest, respectively. Since our model was designed for application to a significantly larger area than these variables were designed to assess, we implemented the distance to roads variable (SI_R) developed by Mitchell et al. (2002) and the human development (SI_{HD}) variable described by Bowman (1999).

Mitchell et al. (2002) developed the distance to roads variable assuming bears avoid areas within 1600 m of roads. Although data regarding the effects of roads on habitat quality for black bears are conflicting (Carr and Pelton 1984, Hellgren et al. 1991, Clark et al. 1993, Fecske et al. 2002, Reynolds-Hogland and Mitchell 2007), we followed Van Manen (1991) and assumed that roads have an overall negative effect through increased traffic related mortality and increased efficiency for legal and illegal killing.

Reynolds-Hogland and Mitchell (2007) found that black bears avoided areas ≤1600 m from gravel roads when establishing home ranges and males and females avoided areas ≤800 m from roads during the summer and fall, respectively. Reynolds-Hogland and Mitchell (2007) concluded that roads affect habitat quality at a relatively large spatial scale. We buffered all state and county roads in 10 m increments out to 800 m and from 800-1600 m using a single buffer in ArcGIS 9.3 (ESRI, Redlands, CA). We calculated SI_R according to the equations developed by Mitchell et al. (2002):

x = distance to road (km) [7]

when $x = 0$, $SI_R = 0$

when $0 < x < 0.8$, $SI_R = 0.156x + 0.195x^2$

when $0.8 < x < 1.6$, $SI_R = 0.25$

when $x > 1.6$ km, $SI_R = 1.0$

We converted road buffers to raster format with cell size and alignment based on the TVCP in order to generate our SI_R model. Because the state and county roads dataset was too large to process as one file, we buffered all roads by county and combined them using the mosaic function in ArcGIS 9.3. We assigned the focal median value in a 3 x 3 neighborhood to “no data” pixels created along county borders during the mosaic process.

Bowman (1999) utilized a human development variable that incorporated buffers based on female home range size around low and high density urban development. Since the TVCP model included low and high density urban classifications, we developed buffers according to Bowman (1999). Van Manen (1991) conceptualized a home range as a circle with the diameter representing the greatest distance an individual will travel. Using this simplified home range concept, we estimated a mean female Louisiana black bear home range as a circle with a diameter of 3.9 km based on home range estimates for an established population of Louisiana black bears in Louisiana ($\bar{x}$ = 12 km^2; Benson and Chamberlain 2007). We created a buffer of 3.9 km around all high density urban development in ArcGIS 9.3. We created a buffer of 1.1 km around all low density urban development according to Bowman (1999). Because the TVCP high density urban component incorporated road development, we clipped the high density urban component with incorporated urban polygons. This was done in order to eliminate redundancy of roads data in our model. The human impact component is a combination of road development and urban development in which a low score for one may compensate for a high score for the other. However, by incorporating the impact of roads twice in the calculation of $CI_{HUMAN\ IMPACT}$ scores, habitats surrounding road development would receive marginal to unsuitable scores even if they lacked urban development. We calculated SI_{HD} according to the equations reported by Bowman (1999):

within urban buffer zones, $SI_{HD} = 0.0$ [8]

outside urban buffer zone, $SI_{HD} = 1.0$

We converted urban buffers to raster format with cell size and alignment based on the TVCP in order to generate our SI_{HD} model.

Fall food variables were assumed to be of equal importance because a low SI score for one variable may be compensated by high SI scores in another. The fall food sub-component (SCI_{FF}) was calculated according to the equation developed by Van Manen (1991):

$$SCI_{FF} = (SI_{FFA} + SI_{FFD} + SI_{FFP}) / 3 \qquad [9]$$

When calculating the food component index, greater weight was assigned to fall food variables considering the greater importance of hard mast in the year-round nutrition requirements for black bears (Clark et al. 1987, Van Manen 1991, Pelton 2000, Benson and Chamberlain 2006). The food component index was calculated according to the equations developed by Van Manen (1991):

$$CI_{FOOD} = (SI_{SFA} \times (SCI_{FF})^2)^{1/3} \qquad [10]$$

Black bears are capable of utilizing a wide variety of den sites other than tree cavities and so protection cover was considered a more limiting resource than tree den availability (Hellgren and Vaughan 1987, Van Manen 1991, Weaver and Pelton 1994, Oli et al. 1997). The availability of tree dens was assumed to only increase the overall SI whereas a lack of availability may be compensated by high levels of protection cover.

The protection cover component index was calculated according to the equations developed by Van Manen (1991):

$$\text{when } SI_{TDA} > SI_{PC}\text{ ; } CI_{COVER} = (SI_{PC} + SI_{TDA}) / 2 \quad [11]$$

$$\text{when } SI_{TDA} < SI_{PC}\text{ ; } CI_{COVER} = SI_{PC}$$

Human impact variables are assumed to be of equal importance because a low SI for one may be compensated by a high SI of the other. The human impact component index was calculated according to the equations developed by Van Manen (1991):

$$CI_{HUMAN\ IMPACT} = (SI_{R} + SI_{HD}) / 2 \quad [12]$$

Overall habitat quality is a combination of food, cover, and human impact components. Food was considered of higher importance to overall habitat quality although each variable is compensatory (i.e., a low CI score for one variable may be compensated by higher scores of the others). The overall habitat suitability index was calculated according to the equation developed by Van Manen (1991):

$$HSI = ((2 \times CI_{FOOD}) + CI_{COVER} + CI_{HUMAN\ IMPACT}) / 4 \quad [13]$$

A Priori HSI Model Development

We created an *a priori* black bear HSI model for the south black bear recovery zone and used it to identify potentially suitable habitat classifications for stratifying habitat survey points and for collecting the empirical data that we used to develop our final HSI model (Table 3.1). We developed *a priori* SI scores for food and cover variables for habitat classifications of the TVCP based on habitat data collected previously in northeast Texas, the SI equations developed by Van Manen (1991), the habitat descriptions listed in the TVCP interpretive booklet (Ludeke et al. 2009), and literature review (Table 3.2). We generated a list of soft and hard mast species consumed by black bears (Appendix A) and identified suitable tree species capable of developing den cavities through literature review (Hellgren and Vaughan 1987, Weaver and Pelton 1994, Oli et al. 1997). We identified mast producing species and potential den tree species in the TVCP interpretive booklet (Ludeke et al. 2009) for each of the 98 habitat classifications located in the south recovery zone and estimated SI scores for each classification using the equations developed by Van Manen (1991).

We assigned optimal SI_{SFA} scores to forest and shrub habitats and low scores to swamp habitats since they likely contain some but few soft mast producing species (Garner and Willis 1998, Hersey et al. 2005, T. Siegmund, Stephen F. Austin State University, Unpublished Data). Hardwood habitats received optimal SI_{FFA} and SI_{FFD} scores because these had the potential for generating optimal scores, but we assigned only moderate scores for SI_{FFP} based on previous research in east Texas (Garner and Willis

1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data). We assumed that mixed pine-hardwood classifications could generate only moderate SI_{FFA} and SI_{FFD} scores since >15% of mixed classifications were composed of pine species (A. Treuer-Kuehn, Texas Parks and Wildlife Department, Personal Communication) and the hardwood component is likely composed of a mix of hard mast and non-hard mast producing species. We assigned optimal SI_{PC} scores to shrub and young pine plantation habitats (Hersey et al. 2005, T. Siegmund, Stephen F. Austin State University, Unpublished Data) and moderate high, moderate, and low scores to mature pine, hardwood, and swamp habitats, respectively, based on expert opinion (Clevenger et al. 2002). We assigned optimal SI_{TDA} scores to cypress and cypress-tupelo swamps due to the potential for producing tree species known to develop den cavities and the potential for developing trees ≥84 cm DBH (Hellgren and Vaughan 1987, Weaver and Pelton 1994, Oli et al. 1997). Although bottomland hardwood and river drainage habitats potentially contained den tree-producing species as indicated in the TVCP interpretive booklet, we assumed that the potential for developing the large size classes required for an optimal score was limited by timber practices in the region (T. Siegmund, Stephen F. Austin State University, Unpublished Data).

We assigned scores for SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, and SI_{TDA} to the TVCP dataset attribute table in ArcGIS 9.3. We created attribute fields for CI_{FOOD} and CI_{COVER} and calculated scores according to Van Manen (1991). Using the “Lookup” tool in ArcGIS 9.3, we created models for each SI and CI to maintain cell size and alignment with the TVCP. We combined CI_{FOOD}, CI_{COVER}, and $CI_{HUMAN\ IMPACT}$ indices, and calculated overall *a priori* HSI per pixel using the Raster Calculator function of ArcGIS 9.3 (Figure 3.2).

Habitat Field Survey

In order to develop our final east Texas black bear HSI for the south recovery zone, we measured overstory, understory, and vegetation density in multiple habitat classifications of the TVCP. We used habitat data to evaluate the current suitability of east Texas habitats for black bears and to develop empirical, field-based habitat suitability scores for food and cover variables. Within the south recovery zone, we selected 4 study areas totaling 3,085 km^2 to conduct habitat surveys based on study area access in a concurrent black bear occupancy study (see Chapter II) and in order to obtain statistically adequate sample sizes (developed using Student's *t*-test with an α of 0.05 and β of 0.10; Zar 2010) for all habitat classifications >2,000 ha and determined as potentially suitable black bear habitats based on the TVCP interpretive booklet (Ludeke et al. 2009). The study areas were composed of the Sabine and Angelina National Forests (1,598 km^2), private timber company properties (1,025 km^2), Big Thicket National Preserve (444 km^2), Tony Houseman WMA (16 km^2), and Masterson State Forest (2 km^2; Figure 3.3). Using our *a priori* HSI model and the TVCP interpretive booklet, we identified 38 of 98 habitat classifications in the TVCP that were >2,000 ha in total extent in the region and described as potentially suitable habitat for black bears. We did not survey most non-habitats (e.g., agriculture and urban classifications) or habitats along the periphery of the south recovery zone located outside of the Pineywoods ecoregion (e.g., “Post Oak Savanna” and “Gulf Coast” classifications).

We determined the number of survey points necessary for collecting reliable data (N) from a land-cover map using the binomial probability theory where $Z = 2$ from the standard normal deviate of 1.96 for the two-sided 95% confidence interval, p is the expected percent map accuracy, $q = 100 - p$, and E is the allowable error (Fitzpatrick-Lins 1981):

$$N = \frac{Z^2(p)(q)}{E^2} \quad [14]$$

Using the TVCP mapping system accuracy level of 75% for p and an allowable error of 5%, we calculated a minimum N of 300 survey points. We stratified random points among the 38 selected habitat classifications in ERDAS 9.3 and eliminated those that did not fall within a 3 x 3 neighborhood in which all 9 pixels were composed of the target classification.

We evaluated habitat variables for SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, and SI_{TDA} according to Van Manen (1991) and Siegmund (Stephen F. Austin State University, Unpublished Data). Survey points were located in the field using a global positioning system (GPS). Each point consisted of a 0.04 ha (11.3 m radius) circular plot and 4 5 x 5 m relevé plots. Survey points were divided into 4 quarters using the cardinal directions so quarters encompassed the areas between north and east, east and south, south and west, and west and north, respectively. One relevé plot was located in each quarter with the closest corner of the relevé plot located at the closest tree to point center in that quarter.

For estimating SI_{SFA}, we recorded the species of all soft mast producing woody plants within each relevé plot and estimated percent cover of each in 5% increments. Data from the 4 relevé plots were averaged for each survey point. For estimating SI_{FFA}, SI_{FFD}, SI_{FFP}, and SI_{TDA}, we recorded the species and DBH of all trees ≥15 cm DBH within the 0.04 ha plot.

For estimating SI_{PC}, we measured vegetation density using a vegetation profile board (Nudds 1977). We constructed a 30 x 200 cm vegetation profile board which incorporated a collapsible aluminum frame and a canvas sheet consisting of alternating 15 x 25 cm white and orange rectangle sections. The profile board was placed 15 m from point center in each quarter, in-line with the closest tree to point center to minimize bias associated with subjective placement of the profile board. We recorded density readings using the codes developed by Nudds (1977) and Griffith and Youtie (1988) in 20% increments (1 = 0-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, and 5 = 81-100% vegetation density). Density codes were recorded for every 30 x 50 cm section up to 200 cm above the ground. Data from the 4 profile board readings were averaged per height section for each survey point. We only analyzed density readings for 0-50 and 50-100 cm based on the typical maximum shoulder height of black bears. We calculated mean density code readings up to 100 cm per plot and converted readings to percent density using the following equation:

x = percent closure of understory [15]

y = mean density code reading

$x = 20y – 20$

In addition to calculating the necessary sample size for assessing the overall accuracy of a classified map, we determined the necessary sample size (n) for adequately sampling each surveyed habitat classification. We utilized a formula based on the Student's t-test with a probability of α of committing a type I error and the probability of β of committing a type II error (Zar 2010). We calculated variance (s^2), minimum detectable difference (δ), and degrees of freedom (ν; = n - 1) for food and cover indices for each habitat classification from our data. Using a confidence level of 0.95 (= $1 – \alpha$; α = 0.05) and power of 0.90 (= $1 – \beta$; β = 0.10), we calculated n according to the following equations:

$$s^2 = \sum(x^2) - \left(\frac{((\sum x)^2)}{n}\right) \quad [16]$$

$$\delta = \left(\frac{s^2}{n}\right) \times \left(t_{\alpha(2),\nu} + t_{\beta(1),\nu}\right) \quad [17]$$

$$n = \left(\frac{s^2}{\delta^2}\right) \times \left(t_{\alpha(2),\nu} + t_{\beta(1),\nu}\right)^2 \quad [18]$$

East Texas Black Bear HSI Model Development

We developed our final east Texas black bear HSI model based on field habitat survey data in a GIS. Using overstory, understory, and vegetation density data, we calculated SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, SI_{TDA}, CI_{FOOD}, and CI_{COVER} for each survey point according to Van Manen (1991). We calculated mean scores per variable among survey points for each habitat classification and assigned scores to the TVCP attribute table in ArcGIS 9.3. We created individual raster-formatted models for SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, SI_{TDA}, CI_{FOOD}, and CI_{COVER} using the "Lookup" tool in ArcGIS 9.3 to preserve cell size and alignment with the TVCP. We combined CI_{FOOD} and CI_{COVER} models with our GIS-based $CI_{HUMAN\ IMPACT}$ model and calculated HSI per pixel using the Raster Calculator function of ArcGIS 9.3.

Van Manen (1991) considered a minimum viable population (MVP) of black bears with a ≥95% probability to survive for ≥100 years to be 50-90 individuals based on estimates developed for grizzly bears (*U. arctos*) by Shaffer (1983). Garner (1994) evaluated areas ≥20,234 ha to assess suitable recovery units for a viable population of black bears in east Texas. Garner and Willis (1998) considered areas with HSI scores 0.50-0.74 as moderately suitable for black bears and Van Manen (1991) reported HSI scores of 0.49-0.56 for 3 study units containing established populations of black bears in the southern Appalachian region. To assess areas capable of supporting a MVP of black bears in the south recovery zone (i.e., recovery units), we considered areas ≥20,234 ha in size with mean HSI scores ≥0.50 to be adequate for establishing a sustainable bear population. We exported all areas with HSI scores ≥0.50 from our HSI model and identified polygons ≥4000 ha as large contiguous habitats. Based on Van Manen (1991), we considered a circular home range with a diameter of 3.9 km to represent the typical travel distance for a black bear. Thus, to delineate potential recovery units, we identified large suitable habitats ≤3.9 km from one another which were connected by contiguous forested habitats. We considered areas containing a total of ≥20,234 ha of suitable black bear habitat as potential recovery units.

RESULTS

We measured hard and soft mast production, understory vegetation density, and tree den availability at 516 survey points in 2010 and 2011 (Figure 3.4). The number of survey points per habitat classification ranged from 3 to 22 ($\bar{x}$ =13.6). We evaluated habitat in 38 of 98 habitat classifications present in the south recovery zone, accounting for 82% of the total land-cover in the south recovery zone. We calculated necessary sample sizes for collecting reliable data from each surveyed habitat classification based on food and cover component data. Using empirical data to calculate variance and minimum detectable difference, our sample population was greater than or equal to the required sample size for all classifications suggesting they were adequately sampled. We pooled data by land-cover type (i.e., hardwood, pine, mixed pine-hardwood, herbaceous, shrub, and swamp) and developed mean SI and CI scores for each type. We used these scores for unsurveyed classifications in their respective land-cover type. We measured 158 survey points in hardwood, 110 in pine, 98 in mixed pine-hardwood, 50 in swamp, 40 in herbaceous, 36 in shrub, and 24 in non-habitat land-cover types (open water, pasture, and barren). We calculated necessary sample sizes for each land-cover type and determined that all were adequately sampled.

We calculated SI and CI scores for each surveyed habitat classification and cover type using empirical habitat data (Table 3.3-Table 3.18). We assigned pooled SI and CI scores to un-surveyed habitat classifications and developed GIS-based models for SI_{SFA} (Figure 3.5), SI_{FFA} (Figure 3.6), SI_{FFD} (Figure 3.7), SI_{FFP} (Figure 3.8), SI_{PC} (Figure 3.9), SI_{TDA} (Figure 3.10), CI_{FOOD} (Figure 3.11), and CI_{COVER} (Figure 3.12). We developed GIS-based SI_R (Figure 3.13) and SI_{HD} (Figure 3.14), and $CI_{HUMAN\ IMPACT}$ (Figure 3.15) model according to our *a priori* methodology. We calculated our final *a posteriori* east Texas black bear HSI model using the "Raster Calculator" function in ArcGIS 9.3 (Figure 3.16). Our final HSI model was developed at 10 m resolution and encompassed the entire south Louisiana black bear recovery zone in east Texas. Habitat suitability index scores in the region ranged from 0.00-0.76. We considered SI, CI, and HSI scores ≥0.75 as highly suitable, 0.50-0.74 as moderately suitable, and <0.50 as marginal or unsuitable (Van Manen 1991, Garner and Willis 1998). Our model indicated that highly (<1%) and moderately (16%) suitable habitat exists throughout the south recovery zone although the majority of the area (84%) was classified as marginal or unsuitable habitat.

We identified 4 recovery units potentially capable of supporting minimum viable populations of black bears in the south recovery zone (Figure 3.17). The Middle Neches River Recovery Unit (MNRRU) was located in the Middle Neches River Basin in portions of Angelina, Cherokee, Houston, Polk, Trinity, and Tyler counties (Figure 3.18). The MNRRU primarily consisted of 7 large tracts of suitable habitat (HSI>0.50) >1,000 ha (892-18,444 ha) and totaled 38,764 ha. Landownership consisted of state (320 ha), federal (2,370 ha), and private (36,074 ha) properties. Habitat suitability index scores for the MNRRU ranged from 0.50-0.76 ($\bar{x}$ = 0.59).

The Lower Neches River Recovery Unit (LNRRU) was located in the Lower Neches River Basin in portions of Hardin, Jasper, and Tyler counties (Figure 3.19). The LNRRU primarily consisted of 11 large tracts of suitable habitat (HSI>0.50) >1,000 ha (1,040-11,941 ha) and totaled 46,820 ha. Landownership consisted of state (2936 ha), federal (6280 ha), and private (37,604 ha) properties. Habitat suitability index scores for the LNRRU ranged from 0.50-0.76 ($\bar{x}$ = 0.58).

The Sabine River Recovery Unit (SRRU) was located in the Sabine River Basin along the Texas/Louisiana border in Jasper County (Figure 3.20). The SRRU primarily consisted of 8 large tracts of suitable habitat (HSI>0.50) >1,000 ha (1,120-8,408 ha) and totaled 31,583 ha. Landownership consisted entirely of private properties. Habitat suitability index scores for the SRRU ranged from 0.50-0.76 ($\bar{x}$ = 0.58).

The Lower Trinity River Recovery Unit (LTRRU) was located in the Lower Trinity River Basin in portions of Chambers, Liberty, and San Jacinto counties, and in eastern Liberty and western Hardin counties (Figure 3.21). The LTRRU primarily consisted of 15 large tracts of suitable habitat (HSI>0.50) >1,000 ha (1,269-15,674 ha) and totaled 74,285 ha. Landownership consisted of state (212 ha), federal (10,165 ha), and private (63,908 ha) properties. Habitat suitability index scores for the LNRRU ranged from 0.50-0.75 ($\bar{x}$ = 0.60).

We compared *a priori* SI and CI scores to *a posteriori* scores developed from empirical habitat data using the *t*-test (Zar 2010; Table 3.19-Table 3.26). We calculated the percent of *a priori* scores that differed from *a posteriori* scores for SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, SI_{TDA}, CI_{FOOD}, and CI_{COVER} (Table 3.27). The percent of *a priori* scores which differed from *a posteriori* scores ranged from 16 to 47% for the 6 SI variables and 45% and 47% for the food and cover components, respectively. We tended to overestimate SI scores for all variables among hardwood classifications and SI_{SFA}, SI_{PC}, and SI_{TDA} for mixed pine-hardwood, pine, and swamp classifications. We tended to underestimate SI_{FFA}, SI_{FFD}, and SI_{FFP} for pine, herbaceous, and shrub classifications and SI_{PC} for herbaceous, shrub, and swamp classifications. We compared *a priori* and *a posteriori* HSI models by creating a difference image through pixel by pixel subtraction of *a posteriori* scores from *a priori* scores in ArcGIS 9.3. Overall, we tended to overestimate habitat suitability in bottomland and river drainage habitats and underestimate habitat suitability in upland habitats (Figure 3.22).

DISCUSSION

We developed suitability scores at the "Mapping Systems" level of the TVCP which was the finest level of resolution and had a produced map accuracy of 75% (A. Treuer-Kuehn, Texas Parks and Wildlife Department, Personal Communication). Map accuracy for the TVCP at the most general "Land Cover" level was 85%. We chose to use the "Mapping Systems" level because of ecological differences in habitat composition among classes within simplified land-cover types (i.e., differences between young "Pine Plantation 1 to 3 Meters Tall" and mature "Pineywoods: Dry Pine Forest or Plantation"). However, HSI models are relative, not absolute measures of habitat suitability. A lower or higher SI score for a single variable due to slight differences in habitat between the two TVCP levels will only slightly lower or raise the overall HSI score (Hersey et al. 2005). We therefore considered the additional 10% mapping accuracy negligible for developing HSI scores and considered the improved habitat resolution biologically more important for modeling overall habitat suitability for black bears. It is important to note that due to the lack of an established black bear population in east Texas, our HSI model lacked a "true test" for developing a level of precision according to Mitchell et al. (2002). Mitchell et al. (2002) considered an HSI model a hypothesis and a "true test" to be an evaluation of the model with independent home range data or telemetry locations. Our model assumptions were derived from long-term monitoring of established black bear populations. Van Manen (1991) compared HSI scores to home range data and showed that the HSI was reflective of habitat use in the southern Appalachian region. Additionally, our *a posteriori* SI, CI, and HSI scores were developed from empirical field data and evaluated using standard sampling statistics. We regard this combination of using a previously evaluated HSI model and statistically reliable vegetation survey to be a suitable alternative to a "true test".

Our estimates of summer food availability were comparable to scores developed previously in the southeast U.S. and likely related to the high productivity of southern bottomland ecosystems (Garner and Willis 1998, Bowman 1999, Hersey et al. 2005). Habitats in the south recovery zone generally produced highly suitable summer food availability except in swamp cover-types which contained few soft mast producing species (Smith 1996, Hersey et al. 2005). Additionally, summer food availability was higher than expected in herbaceous cover-types as a result of woody species encroachment and conversion of these habitats to young (<6 m tall) pine plantations on private lands. Considering that both mature forests and early successional shrub habitats generate high levels of soft mast producing species, SI_{SFA} scores are not likely to decrease over time or with forest management practices.

Fall food availability, productivity, and diversity scores were typically lower than those reported previously in east and northeast Texas (Garner and Willis 1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data). Because we developed SI scores by habitat classification, direct comparison of our scores with those developed previously in east Texas may not be appropriate given that scores from these studies were estimated from habitat data independent of cover-type. Although we commonly produced moderate SI_{FFA} and SI_{FFD} scores, fall food development was limited in the south recovery zone by the young age of hardwood and mixed pine-hardwood stands and the high prevalence of non-hard mast producing species in these types. First, fall food availability and diversity scores were limited by the low percent cover of hard mast producing species in hardwood (26-35%), mixed pine-hardwood (31-38%), and swamp (0-35%) classifications. Our data indicated that high percentages of habitats were composed of non-hard mast producing species and ≤1 hard mast producing groups were commonly found in co-dominance. Sweetgum was the first and second most common hardwood species in mixed pine-hardwood and hardwood classifications, respectively, although it does not contribute to hard mast production. Additionally, *Nyssa* species are the dominant fall food producing species in swamp habitats although they typically share dominance with bald cypress.

Second, fall food productivity was limited by the young age of forests stands and the small diameter of hard mast producing trees; this was similarly reported by Siegmund (Stephen F. Austin State University, Unpublished Data) in northeast Texas. The percent cover of hard mast producing species ≥40.6 cm DBH was considerably less than optimal in hardwood (2-18%), mixed pine-hardwood (6-21%), and swamp (0-15%) classifications. The mean DBH of all hard mast producing species was 31.6, 30.6, and 37.1 cm for hardwood, mixed pine-hardwood, and swamp classifications, respectively. Although growth rates vary considerably with species, site quality, and stocking rates, diameter growth rates for mixed bottomland hardwood, mixed pine-hardwood, and swamp classifications are estimated at 0.76, 0.51-1.27, and 1.27-7.62 cm per year in the southern region (Barrett 1995). We estimate that optimal mean percent cover of hard mast producing species ≥40.6 cm DBH could be achieved in 7-18, 1-8, and 5 years for mixed hardwood, mixed pine-hardwood, and swamp cover-types, respectively.

However, clearcutting is the most common silvicultural practice in southern forests and rotation ages commonly range from 60 to 80 years and 20 to 30 years for sawlog and fiber production, respectively (Barrett 1995). Goodrum et al. (1971) reported that oak species typically do not produce high acorn yields until 40-100 years of age. Even if trees were allowed to reach the optimal size or age for large mast production under even-aged management, the percent cover of hard mast producing species ≥40.6 cm DBH would likely exceed the optimal range allowed by the HSI model (60%), and decrease SI_{FFP} scores. Uneven-aged management has proven successful at improving the growth and quality of residual trees in bottomland hardwood forests while simultaneously providing the appropriate conditions for the establishment and development of advanced regeneration (Barrett 1995, Meadows and Stanturf 1997). Uneven-aged management could allow for retention of suitable hard mast species while providing suitable growing stock to improve fall food availability, diversity, and productivity (Goodrum et al. 1971, Barrett 1995). However, it is unlikely that timber management practices will be adjusted at a regional scale to accommodate the development of mature fall food producing tree species.

Our estimates of protection cover were typically lower than those developed previously in east Texas (Garner and Willis 1998, T. Siegmund, Stephen F. Austin State University, Unpublished Data). This is in-part due to our use of the GIS-based approach for evaluating protection cover developed by Mitchell et al. (2002). Mitchell et al. (2002) considered protection cover as impenetrable vegetation densities ≥80% whereas Van Manen (1991) utilized impenetrable vegetation densities ≥60%. Overall, swamp habitats typically produced low SI_{PC} scores because they developed little understory vegetation due to high levels of seasonal flooding (Smith 1996, Hersey et al. 2005). Alternatively, protection cover resources were greatest in shrub habitats (Hersey et al. 2005). As shrub habitats develop successionally, decreasing levels of protection cover should be expected as stem density gives way to fewer, larger woody species (Gilliam et al. 1995). Our data indicated that forested habitats commonly produced moderately suitable SI_{PC} scores. However, it is unclear to what level protection cover would decrease as stand ages increase. It is important to note that the east Texas landscape is a mosaic of habitats and timber harvests are ongoing. Shrub habitats are constantly regenerated as new clearcuts are created. Although we identified areas of highly suitable shrub cover, these habitats should be renewed as shrub habitats age and mature forests are harvested.

Our estimates of tree den availability were comparable to those developed previously in the south recovery zone (SI_{TDA} = 0.00; Garner and Willis 1998), although considerably lower than those developed in northeast Texas (SI_{TDA} = 0.67; T. Siegmund, Stephen F. Austin State University, Unpublished Data). Overall, we detected a total of 8 (12.5/ha), 4 (6.3/ha), and 1 (1.25/ha) hardwood trees ≥84 cm DBH in seasonally or temporarily flooded hardwood forests, bottomland bald cypress swamp, and temporarily flooded mixed pine-hardwood forest classifications, respectively. Considering timber management practices in the region and our low SI_{TDA} scores for all habitats, tree den availability is not likely to improve in the short-term. Although tree dens are believed to provide additional protection against predation and increase reproductive success, their availability is not a requirement for sustaining populations of black bears in the southeast U.S when suitable protection cover exists (Weaver and Pelton 1994, Oli et al. 1997).

We identified large, contiguous areas in the south recovery zone lacking significant human development. Urban development was typically highest in the southern, western, and northern portions of the south recovery zone although high density, incorporated cities existed scattered throughout the eastern portion. State and county road networks were highest around urban development and lowest along major river basins. Our SI_{HD} and SI_R models highlight important areas to focus habitat conservation programs considering these areas currently lack high levels of human development and correspond closely with identified recovery units. However, human development will continue to be a major ecological force in the south recovery zone as their effects are currently in-place on the landscape, acting as a source for increased mortality and habitat avoidance by black bears (Forman and Alexander 1998, Clevenger et al. 2002).

The HSI scores estimated for our 4 recovery units (0.59, 0.58, 0.58, and 0.60) are comparable to those developed by Van Manen (1991; 0.49, 0.55, 0.56, 0.63, and 0.71) for occupied areas of the southern Appalachian region. Our scores equate to moderately suitable habitat which Van Manen (1991) showed was adequate for maintaining sustainable populations of black bears. Our scores are similarly comparable to those developed by Siegmund (Stephen F. Austin State University, Unpublished Data) for areas of the Sulphur, Cypress, and Red River Basins in northeast Texas (0.55, 0.66, and 0.74). However, Garner and Willis (1998) developed scores of 0.73, 0.79, and 0.89 for portions of the Big Thicket National Preserve, Lower Neches River Basin, and Middle Neches River Basin in the south recovery zone, respectively. The scores developed for the Lower and Middle Neches River Basins equate to highly suitable habitat and are considerably higher than those developed in our study.

This difference is probably related to two occurrences. First, data collected by Garner and Willis (1998) was collected 18 years prior to our study. It is likely that habitat in these river basins has changed dramatically considering the increased rate of commercial hardwood timber harvests and increased commercial value of hardwood sawlogs and pulpwood in the region. Previous to the Garner and Willis (1998) study, hardwood timber removal in east Texas decreased by 8% from 1986-1992 (Kelly et al. 1992). In 1992, hardwood removal totaled 175.4 million cubic feet throughout the region (Miller and Hartsell 1992) and hardwood sawlogs and pulpwood generated $66.49/million board feet (MBF) and $9.91/cord statewide, respectively (Texas Forest Service 2011). In 1997, hardwood sawlogs and pulpwood mean annual values increased by 44% and 104%, respectively; topping $100/MBF for sawlogs for the first time. By 2002, hardwood removal totaled 211.3 million cubic feet (Bentley and Johnson 2004) and hardwood sawlogs and pulpwood values increased to $139/million board feet and $14.67/cord statewide, respectively (Texas Forest Service 2011).

Second, our study area was geographically larger and did not focus on habitat solely in and around the Neches River Basin and Big Thicket National Preserve. These areas consisted of higher suitability bottomland hardwood habitats. Garner and Willis (1998) selected study areas based on the presence of perceived highly suitable habitats and thus generated higher overall HSI scores when compared with ours. Our GIS-based approach for identifying recovery units likely resulted in the inclusion of larger proportions of habitat on the lower end of the moderately suitable category (i.e., HSI<0.60) because we used HSI scores to delineate recovery units, independent of our field study areas. Furthermore, unless habitat survey points are stratified per habitat classification based on total area per class, over sampling in higher suitability habitats will result in a higher overall mean HSI score.

For our study, we had access to detailed, high resolution land cover information which did not exist during previous HSI studies in east Texas. We assigned HSI scores to individual pixels in a continuous data set based on habitat classifications. Because we calculated HSI scores for recovery units from pixel scores, our mean scores are reflective of the proportion of each habitat class composing each recovery unit. This method is analogous to a stratified sampling methodology by habitat classification in which each habitat class is essentially weighted according to the amount of area included in each recovery unit.

The Tensas River Basin (TRB) subpopulation of Louisiana black bears in Louisiana exists within a 29,000 ha tract of bottomland hardwood forest along the Tensas River Basin (Benson and Chamberlain 2007). Bowman (1999) estimated habitat suitability for the TRB to be 0.74 (99.2% CI = 0.56-0.92) using the Van Manen (1991) HSI. Recent reports estimate this population at 294 bears (Hooker 2010). Van Manen

(1991) estimated a minimum viable population of black bears to be 50-90 individuals based on MVP estimates developed for grizzly bears (Shaffer 1983). Considering the high population density of the TRB subpopulation, relatively similar or smaller geographic size of the TRB compared with our recovery units, and relatively similar habitat of the TRB compared with our recovery units (e.g., bottomland hardwood forest; Benson and Chamberlain 2007), we expect that our 4 recovery units are more than adequate for establishing sustainable populations of black bears in east Texas. It is important to note that high rates of agricultural food use by bears in the TRB were documented and probably attributed to the high density of the population (Benson and Chamberlain 2007). Agriculture composed approximately 4% of the land cover in the south recovery zone and likely will not contribute greatly to the year-round nutrition of black bears in the region. This is ultimately advantageous for the recovery of black bears in the south recovery zone because agricultural use is likely to negatively impact overall populations through increased negative human-bear interactions (Van Manen 1991). However, potential population densities and abundance in the south recovery zone may be lower than those documented in the TRB as a result.

Our recovery units consist of multiple large expanses of moderate to highly suitable habitats typically no further apart than the mean female Louisiana black bear home range size (Van Manen 1991). The diameter of a mean female Louisiana black bear home range is a conservative estimate for the distance a bear will travel in order to meet year-round habitat requirements because most populations of black bears in the southeast United States utilize considerably larger home range sizes (up to 55 km^2) than those documented in the TRB (Garshelis and Pelton 1981, Hellgren and Vaughan 1987, Maehr et al. 2003, Dobey et al. 2005, Moyer et al. 2007). We selected areas connected by contiguous forested habitat to ensure that appropriate habitat linkages exist among suitable patches (Kindall and Van Manen 2007). Although connecting habitats do not meet the year-round habitat requirements of black bears, they typically meet the requirements for summer food availability and protection cover. Seasonal shifts in home range are common among black bears as they exploit seasonally available food sources (Beeman and Pelton 1980, Graber and White 1983, Hellgren and Vaughan 1988) and dense protection cover is essential for hibernating bears in the absence of suitable tree dens (Weaver and Pelton 1994, Oli et al. 1997). We thus consider these areas to enhance the overall suitability of our recovery zones (rather than decrease the mean HSI score) because each unit exceeded the minimum 20,234 ha of suitable habitat necessary for establishing a MVP. Additionally, The MNRRU, LNRRU, and LTRRU recovery units are all adjacent to large expanses of federal lands managed for multiple wildlife species use (Figure 3.23). The MNRRU is located in between the Davy Crocket National Forest (75,227 ha) and the Angelina National Forest (76,458 ha), the LNRRU is located south of the Angelina National Forest and along eastern portions of the Big Thicket National Preserve (44,439 ha; BTNP), and the LTRRU is located along western portions of the BTNP and portions of the Trinity River National Wildlife Refuge (4,879 ha). Federal lands in east Texas generally produce marginal HSI scores because pine plantations are often the predominant land cover-type. However, these habitats are typically suitable for summer food availability and protection cover and may provide long-term habitat linkages managed under consistent landownership between recovery units.

Rigorous habitat evaluation can be time consuming and economically costly. Reliable SI and CI scores developed per habitat classifications may provide useful information about black bear habitat suitability in areas where empirical data are lacking and agency resources limit the ability to adequately survey habitats (Clevenger et al. 2002). We evaluated whether our *a priori* assumptions regarding habitat provided reliable estimates of black bear habitat suitability in east Texas. We did not consider our *a priori* assumptions adequate for accurately predicting SI and CI scores because a relatively high percent of *a priori* scores among land-cover types (16-47%) differed from those developed from empirical habitat survey (Table 3.27). The method of developing an *a priori* HSI was useful in identifying higher suitability study areas and potentially suitable habitat classifications for targeting field surveys. The *a priori* HSI showed a similar trend in habitat suitability when compared with our final *a posteriori* HSI model, although we tended to overestimate HSI in bottomland and river drainage habitats and underestimate HSI in upland habitats. Our final HSI scores could potentially provide more accurate *a priori* scores for natural resource managers interested in estimating landscape-scale black bear habitat suitability in similar habitats under similar habitat management practices. A HSI model developed *a priori* using our final scores would most likely indicate a trend in habitat suitability and highlight focal research areas for land managers lacking the resources for ground-truthing survey. However, conclusions derived from *a priori* modeling should be regarded with caution and verified using independent habitat data or habitat use and telemetry data (Mitchell et al. 2002).

In summary, suitable habitats exist in the south Louisiana black bear recovery zone, capable of sustaining viable populations of black bears. This study accomplished the goals outlined by the East Texas Black Bear Conservation and Management Plan (Texas Parks and Wildlife Department 2005a) for assessing the current region-wide habitat suitability for the Louisiana black bear in east and southeast Texas and for developing GIS-based habitat data. Although we showed that areas exist that are capable of supporting black bear populations, ongoing social research and outreach regarding the establishment or reintroduction of black bears is essential for the successful recovery of this threatened species. Considering that our recovery units are primarily composed of private properties, cooperation with private and corporate landowners will be fundamental for protecting critical habitats and promoting the sustainability of recovery units.

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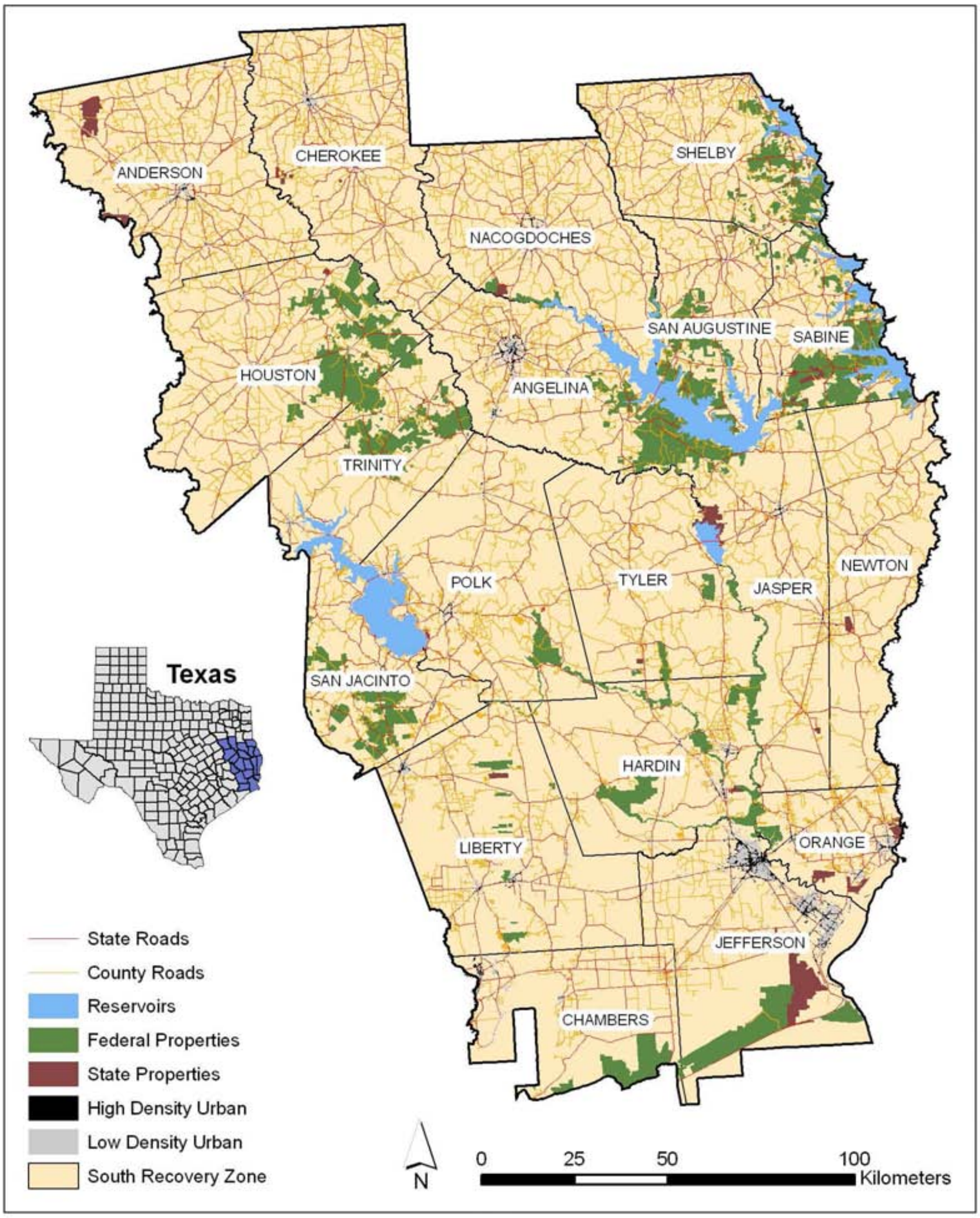

Figure 3.1. Area of eastern Texas designated as the south Louisiana black bear recovery zone.

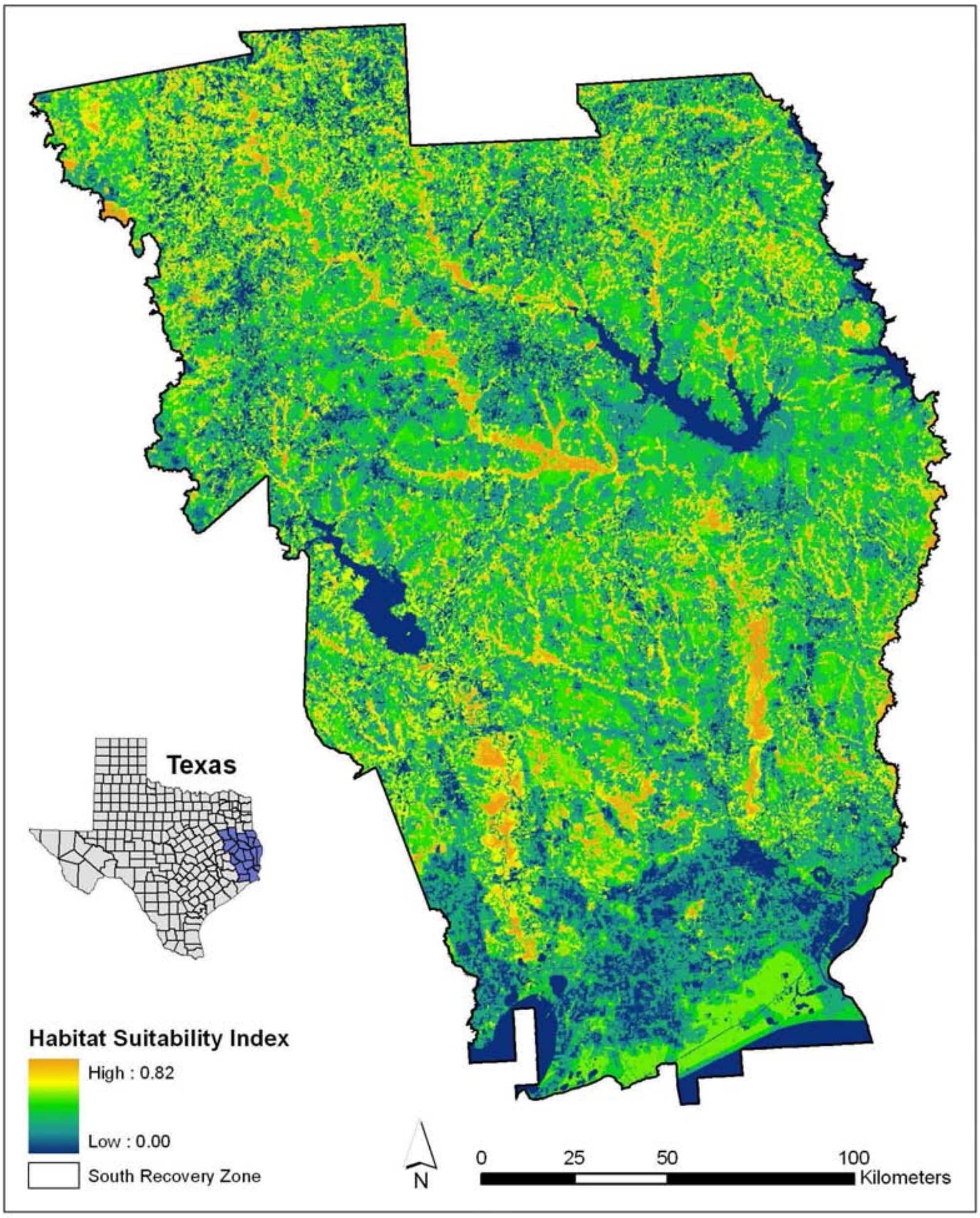

Figure 3.2. *A priori* habitat suitability index model for the south Louisiana black bear recovery zone in east Texas, USA. *A priori* assumptions regarding the suitability of habitat were derived from previously collected habitat data from northeast Texas and literature review.

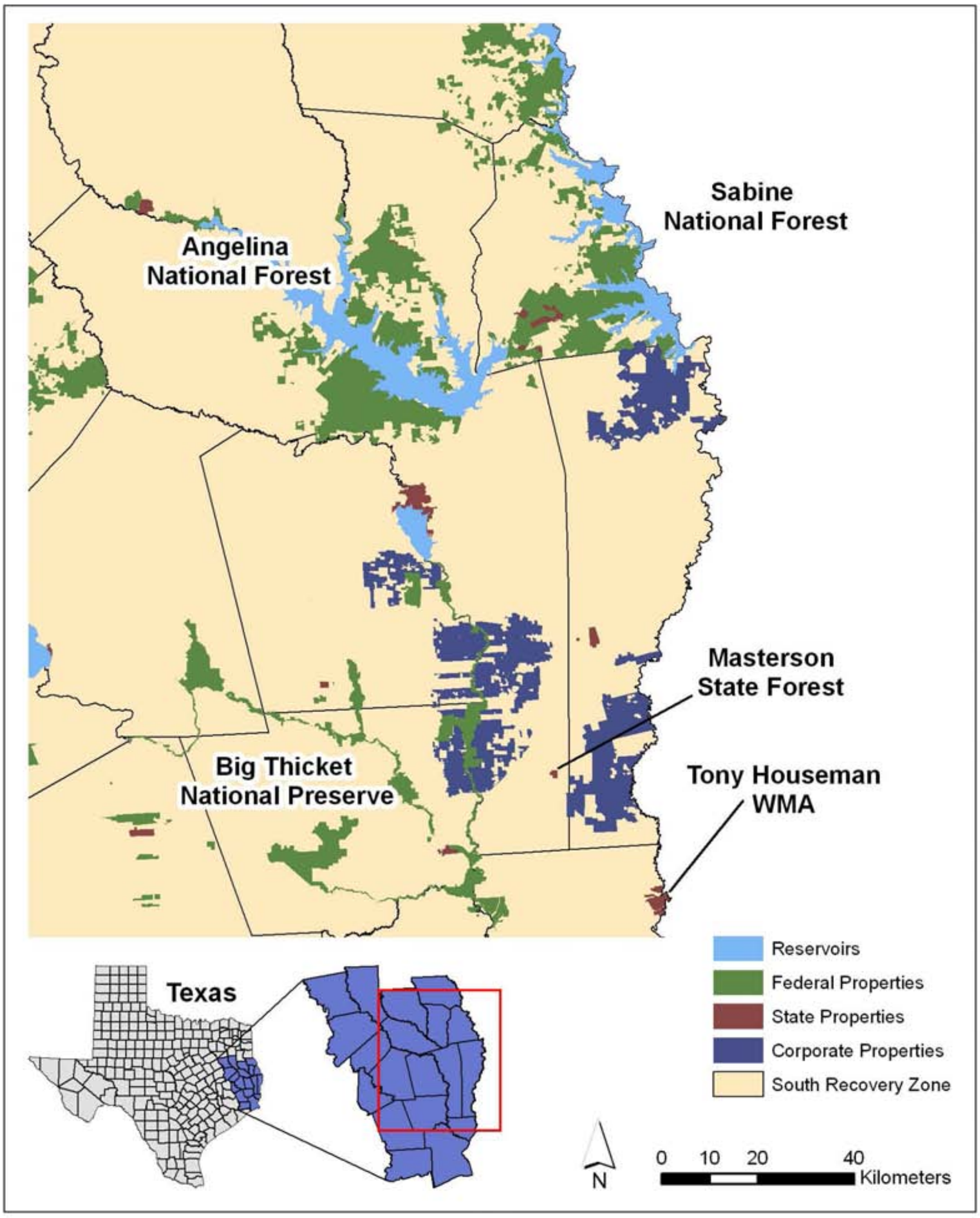

Figure 3.3. Primary study areas comprised of the Angelina National Forest, Sabine National Forest, Big Thicket National Preserve, and Tony Houseman WMA for conducting field habitat assessments in the south Louisiana black bear recovery zone, east Texas, USA.

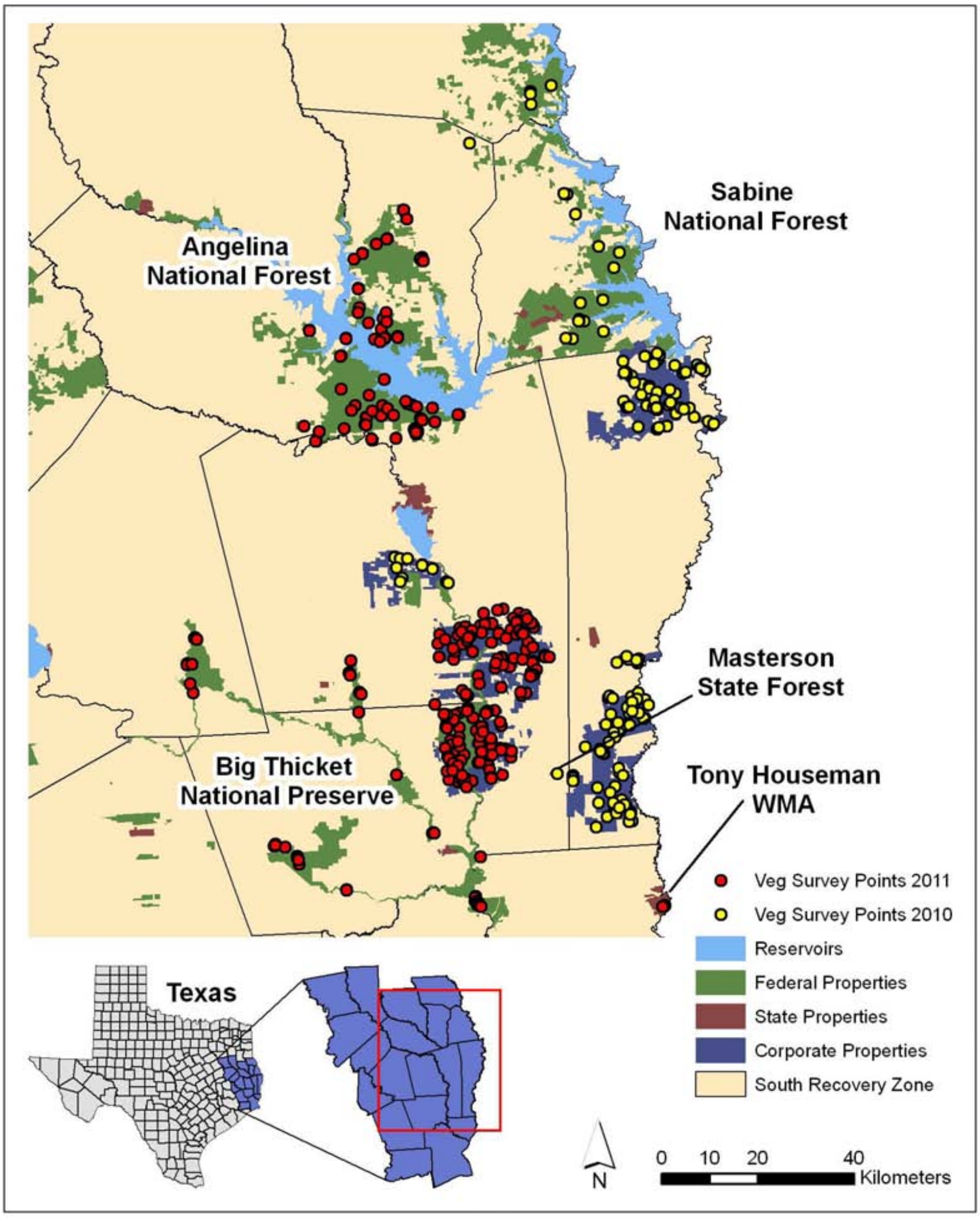

Figure 3.4. Locations for vegetation sampling conducted in 2010 and 2011 to determine habitat suitability for black bears in east Texas, USA.

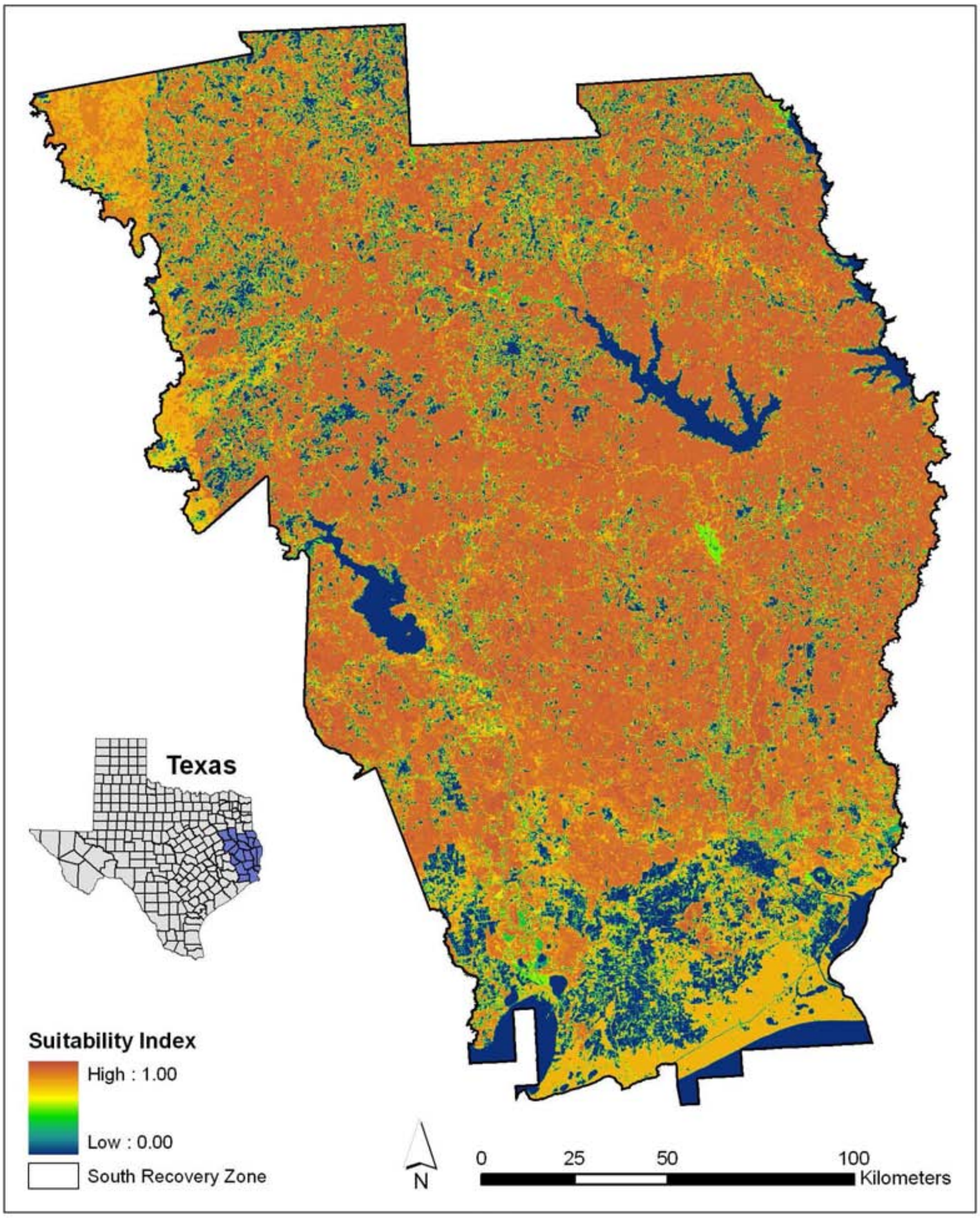

Figure 3.5. Summer food availability (SI_{SFA}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

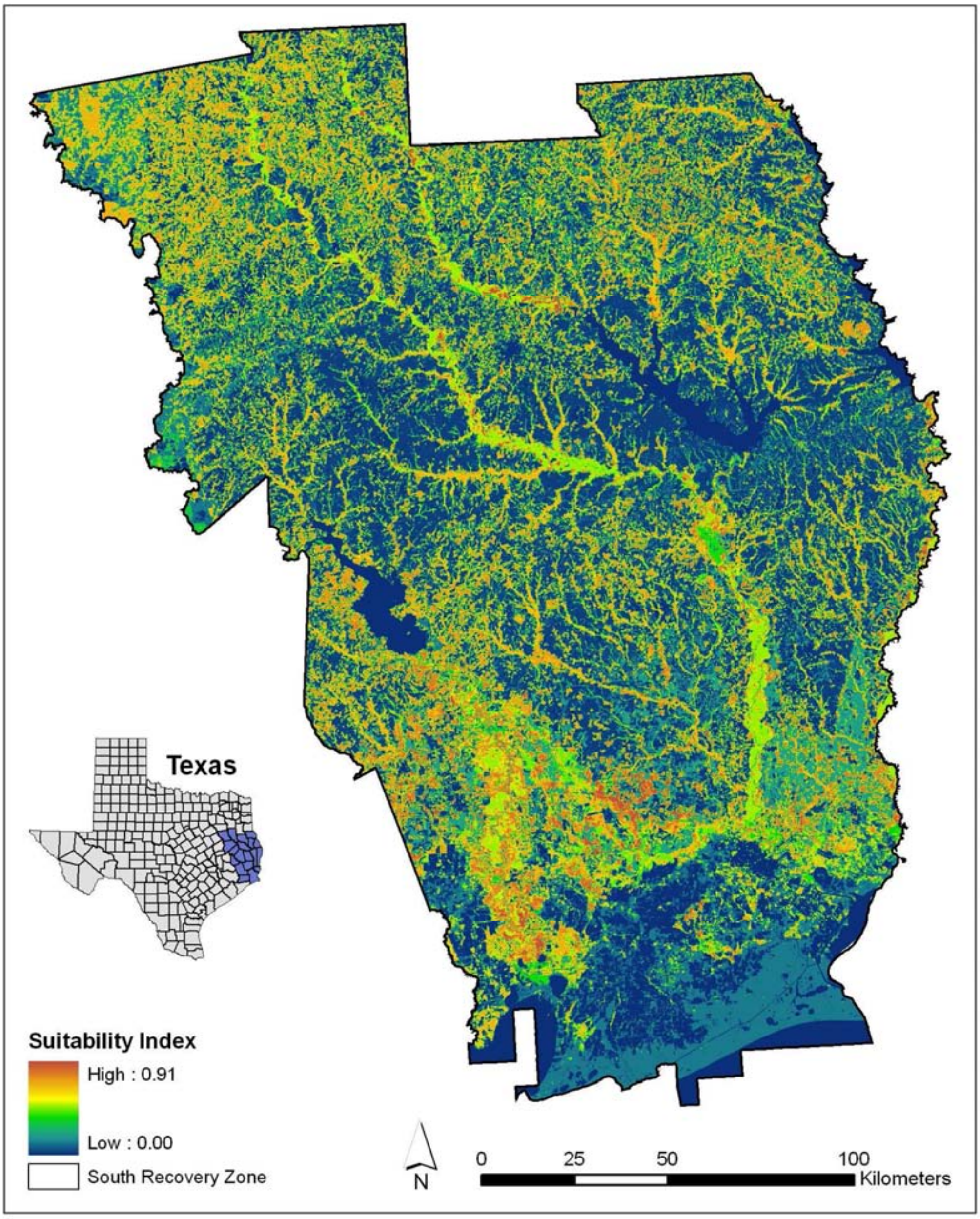

Figure 3.6. Fall food availability (SI_{FFA}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

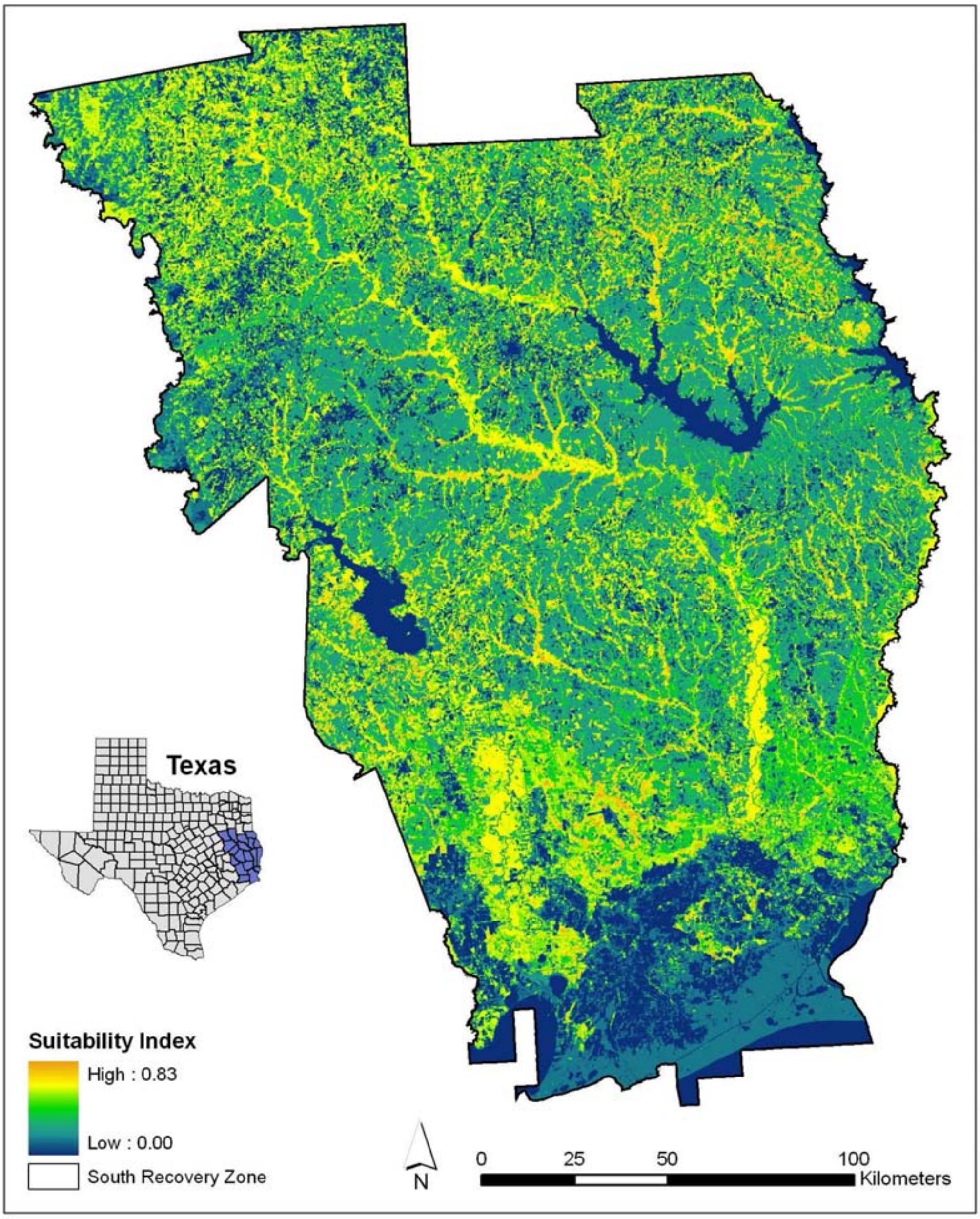

Figure 3.7. Fall food diversity (SI_{FFD}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

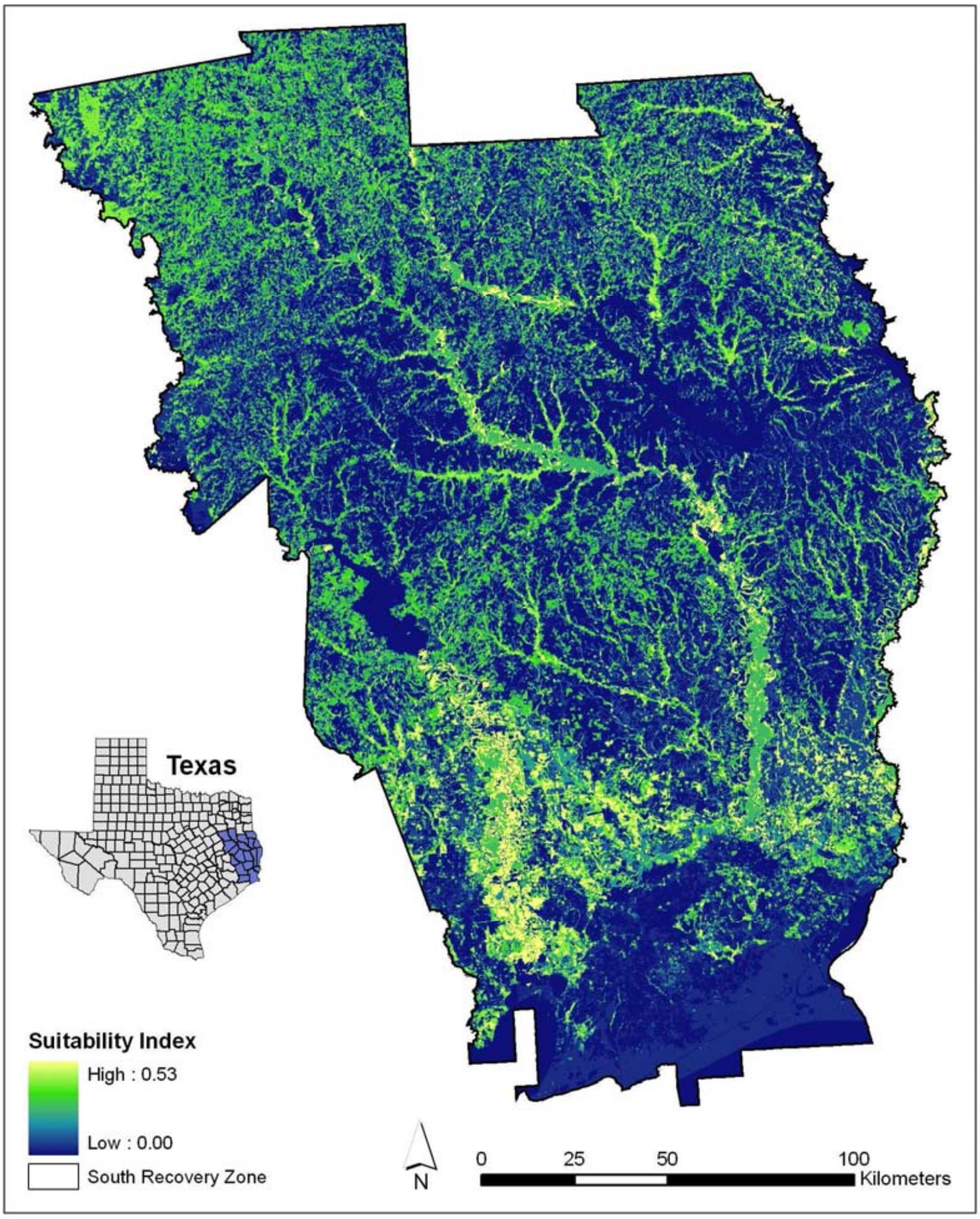

Figure 3.8. Fall food productivity (SI_{FFP}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

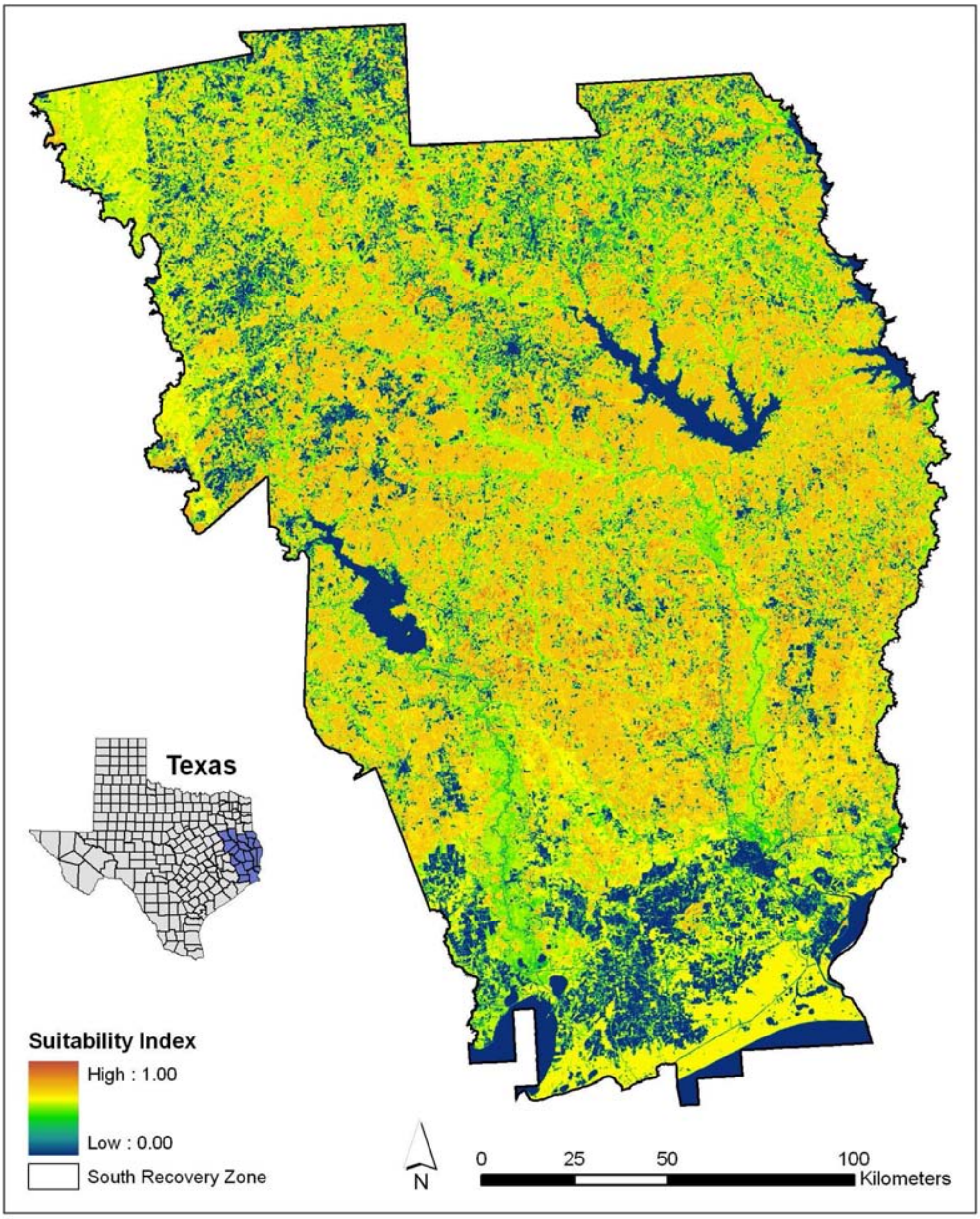

Figure 3.9. Protection cover (SI_{PC}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

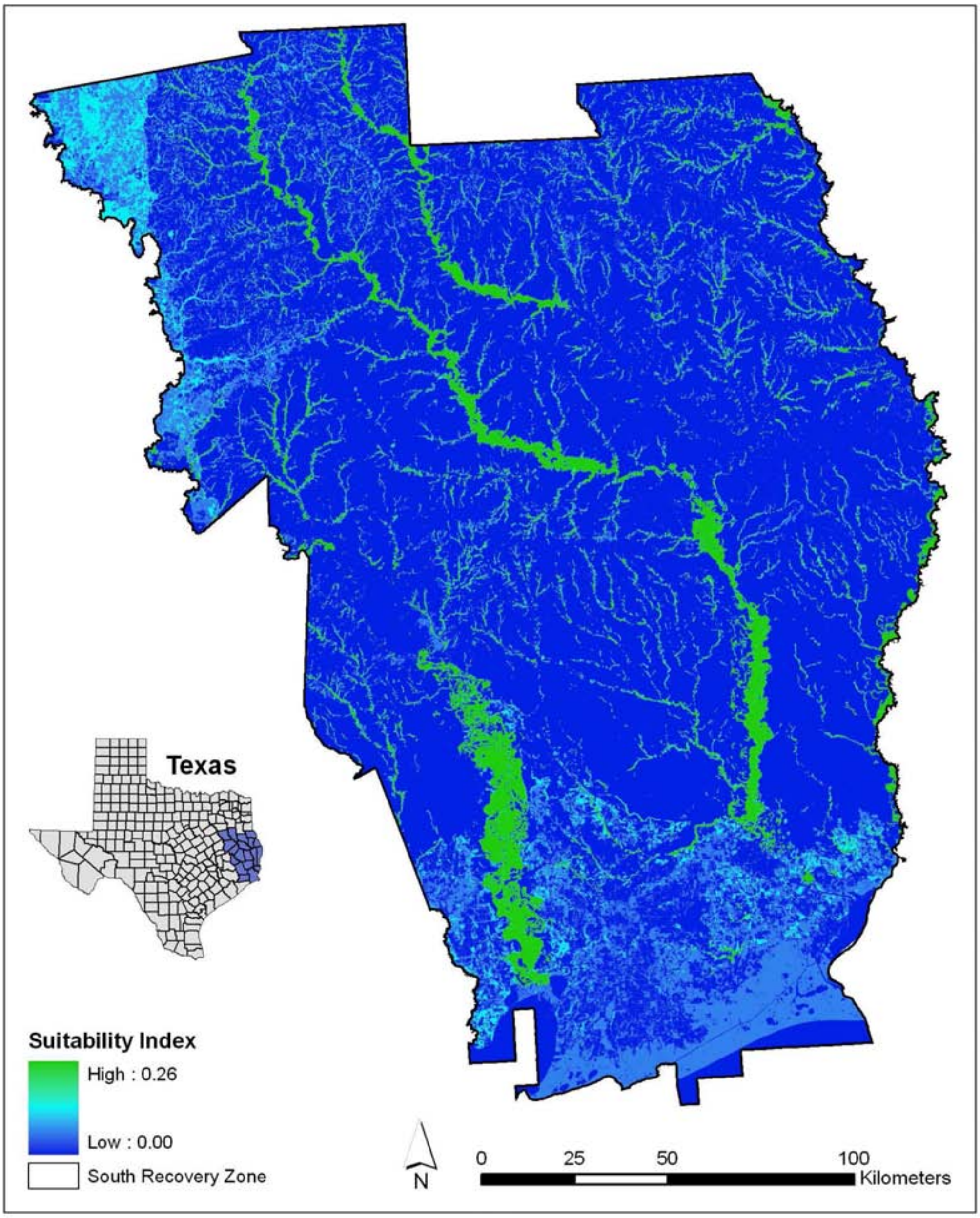

Figure 3.10. Tree den availability (SI_{TDA}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

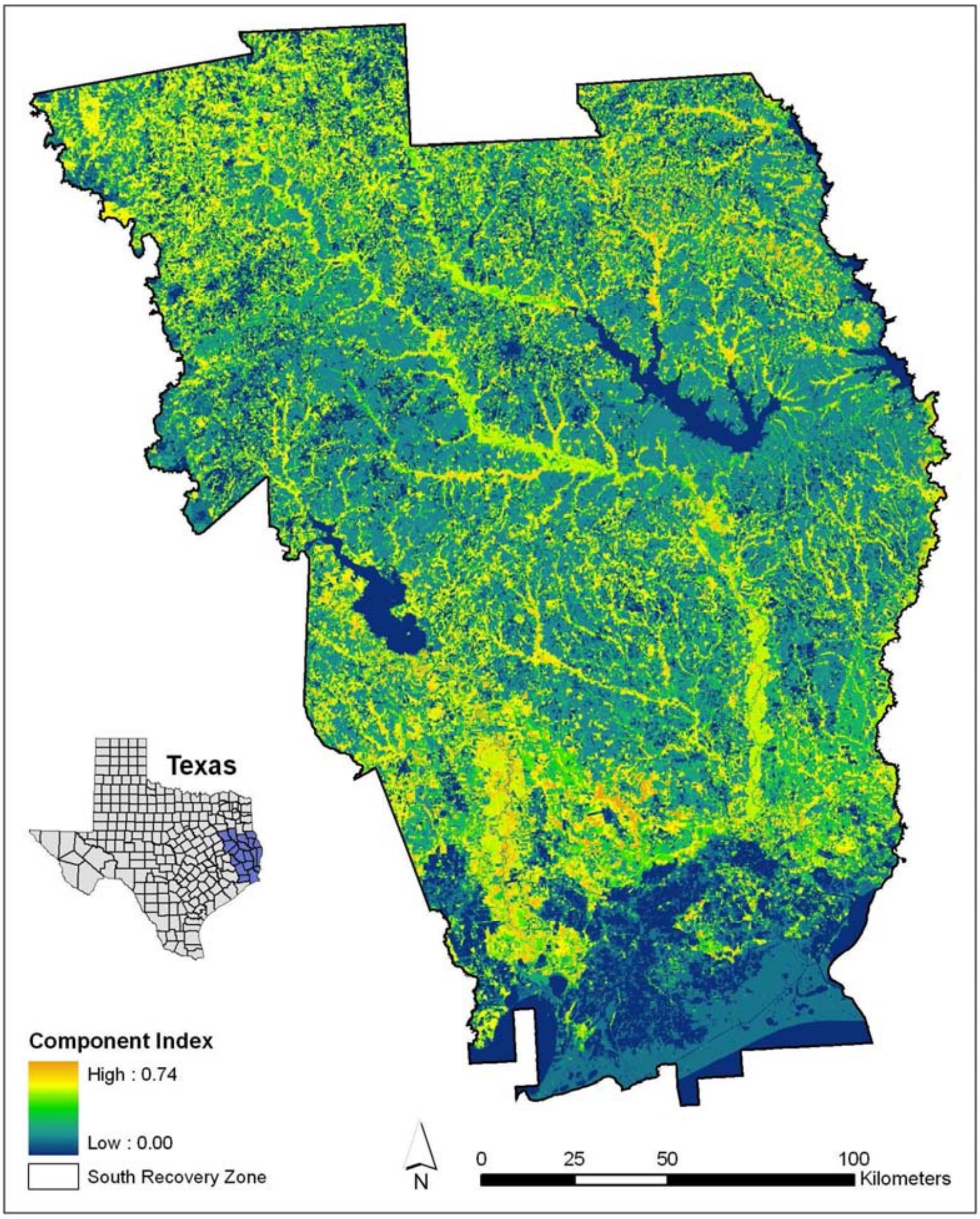

Figure 3.11. Food component (CI_{FOOD}) model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

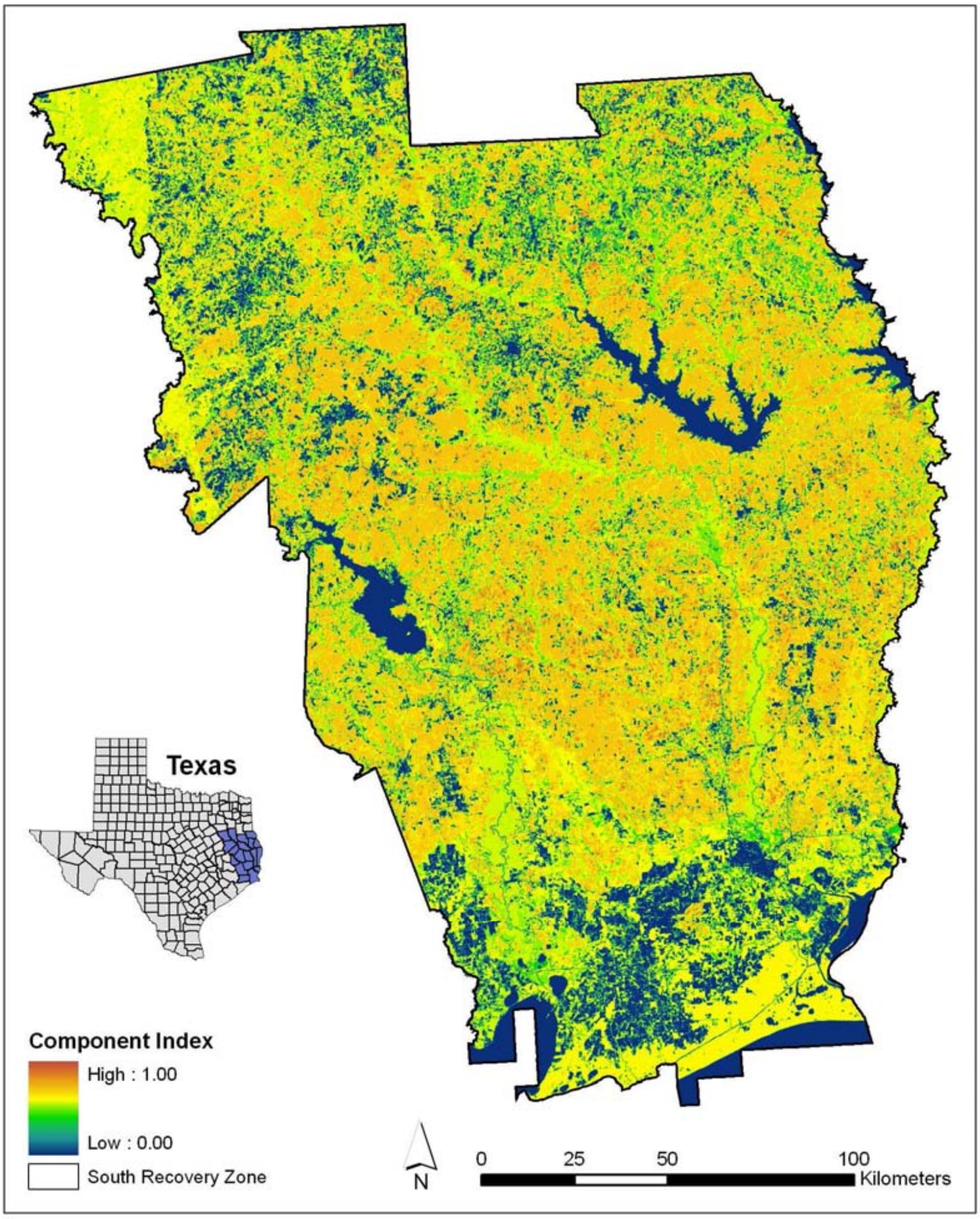

Figure 3.12. Cover component (CI_{COVER}) model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

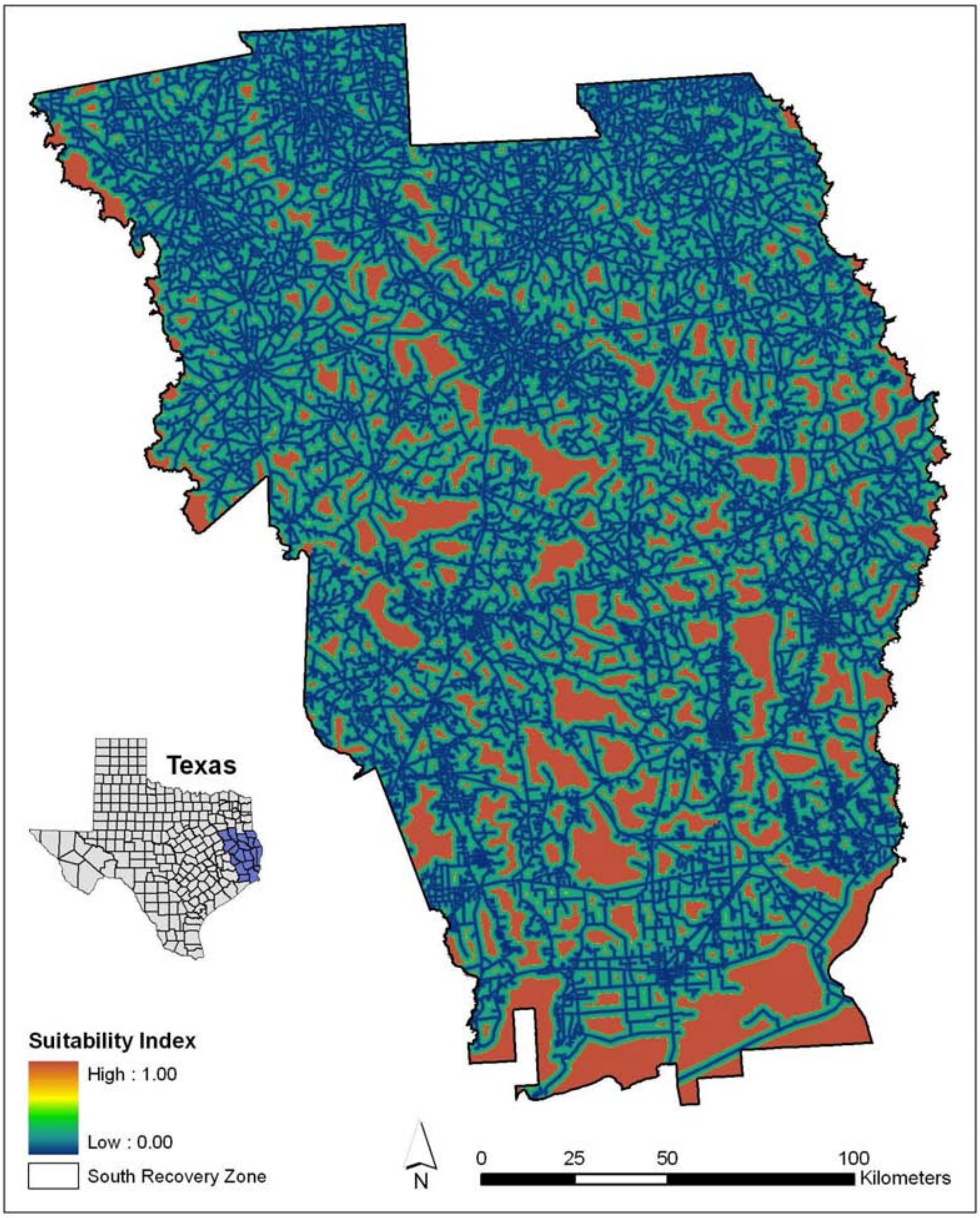

Figure 3.13. Distance to roads (SI_R) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

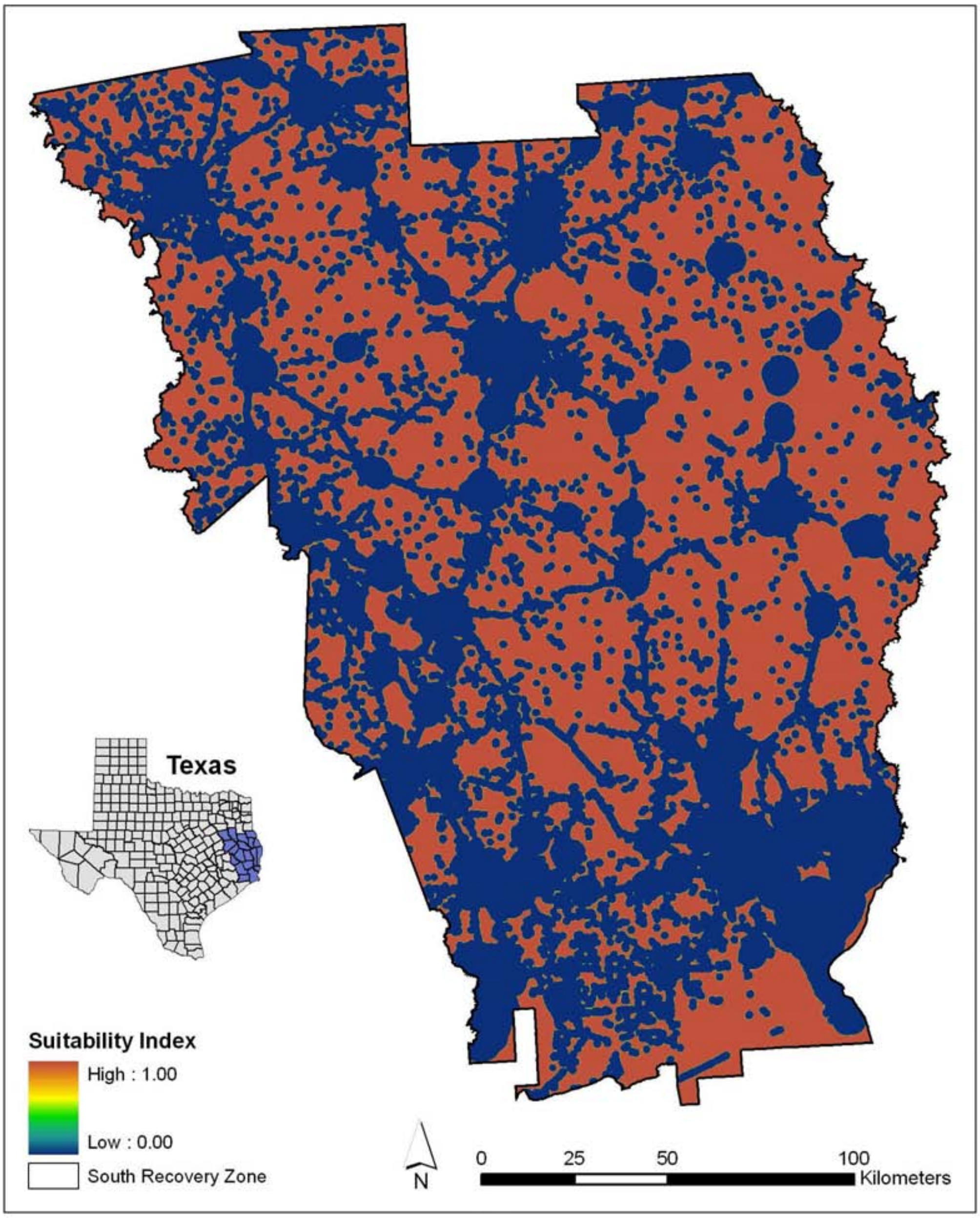

Figure 3.14. Human development (SI_{HD}) suitability model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

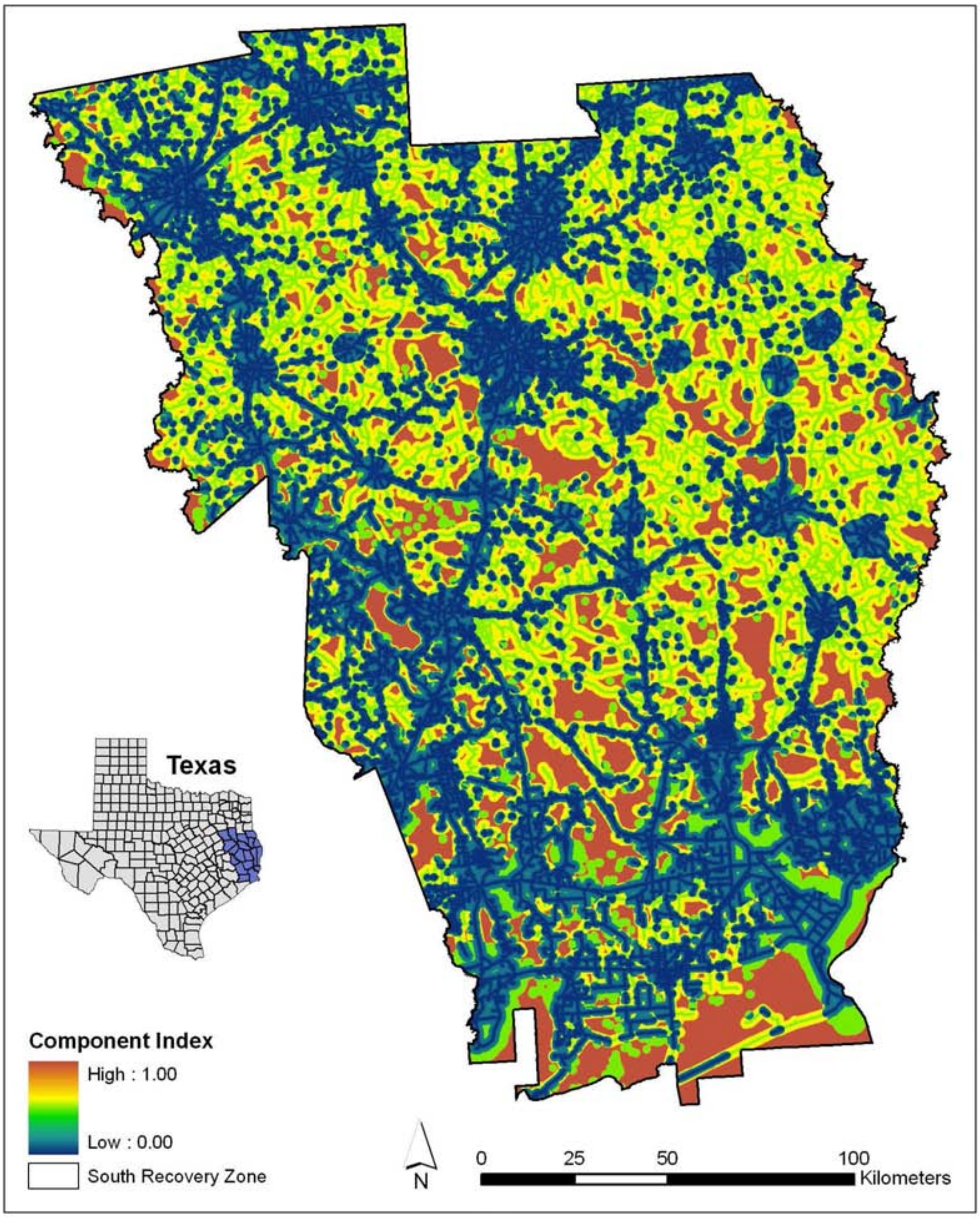

Figure 3.15. Human impact ($CI_{HUMAN\ IMPACT}$) component model of the east Texas black bear habitat suitability index model developed for the south Louisiana black bear recovery zone, east Texas, USA.

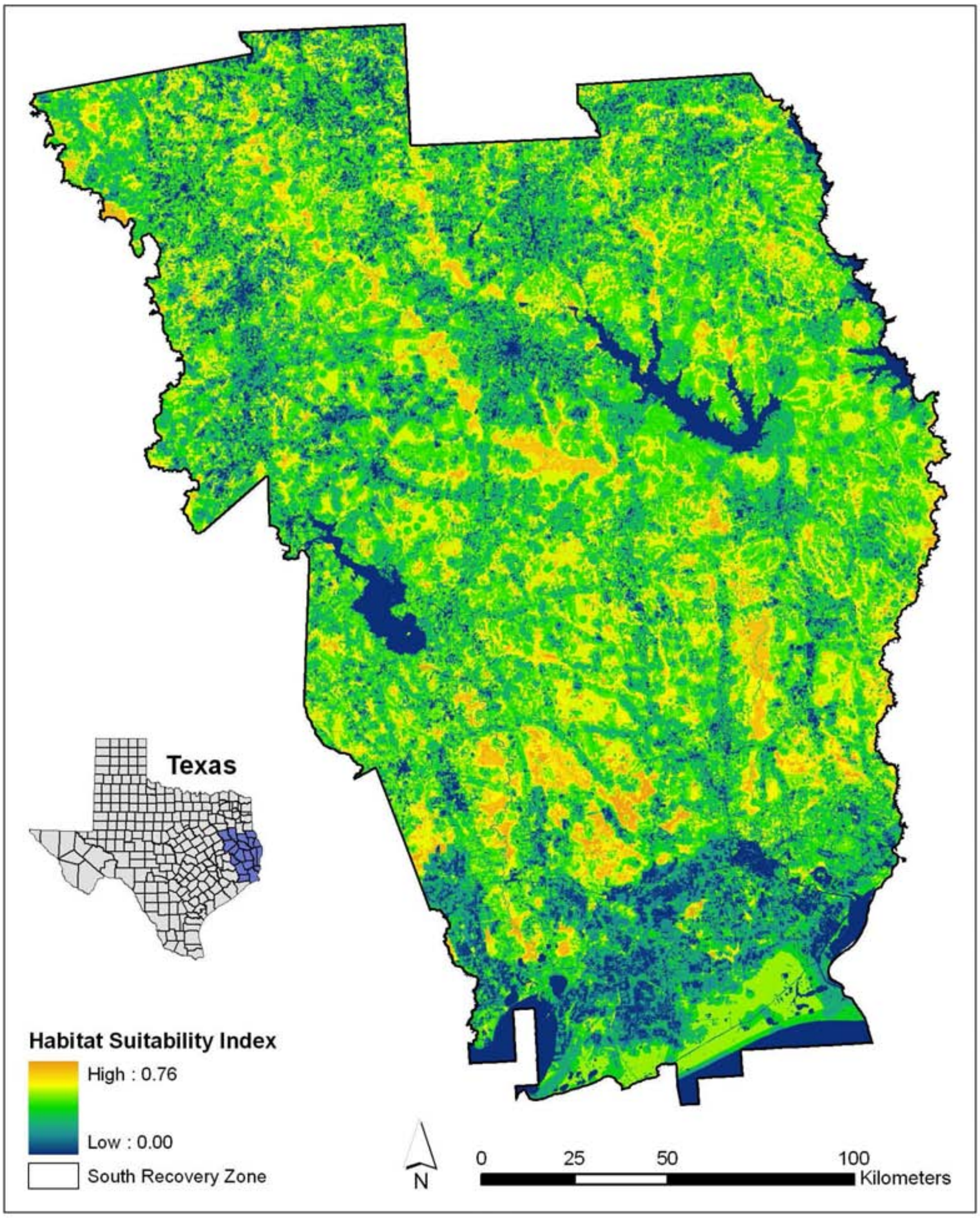

Figure 3.16. East Texas black bear habitat suitability index (HSI) model developed for the south Louisiana black bear recovery zone, east Texas, USA.

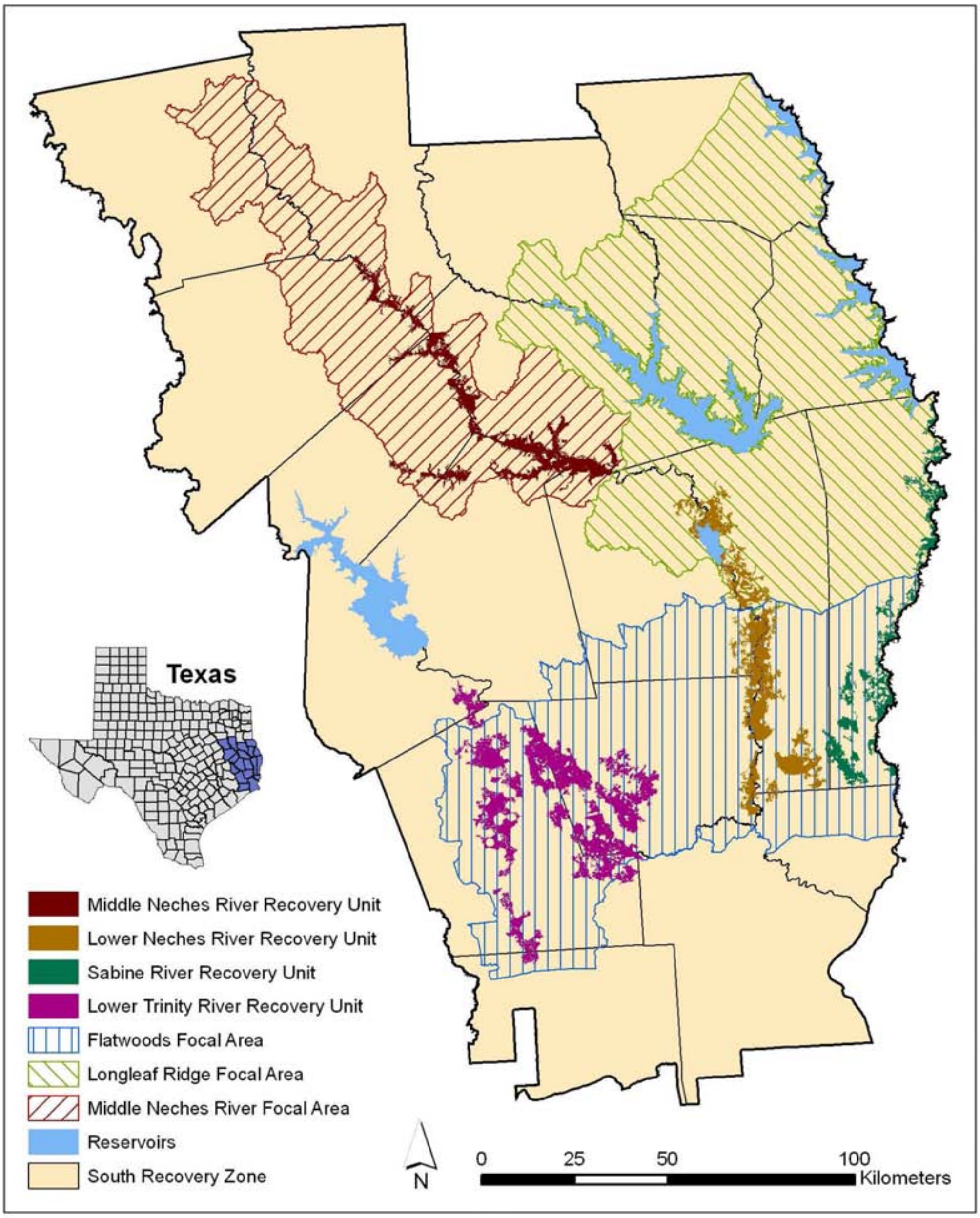

Figure 3.17. Four potential recovery units capable of supporting minimum viable populations of black bears in the south Louisiana black bear recovery zone, east Texas, USA, and original recovery focal areas developed by the East Texas Black Bear Task Force.

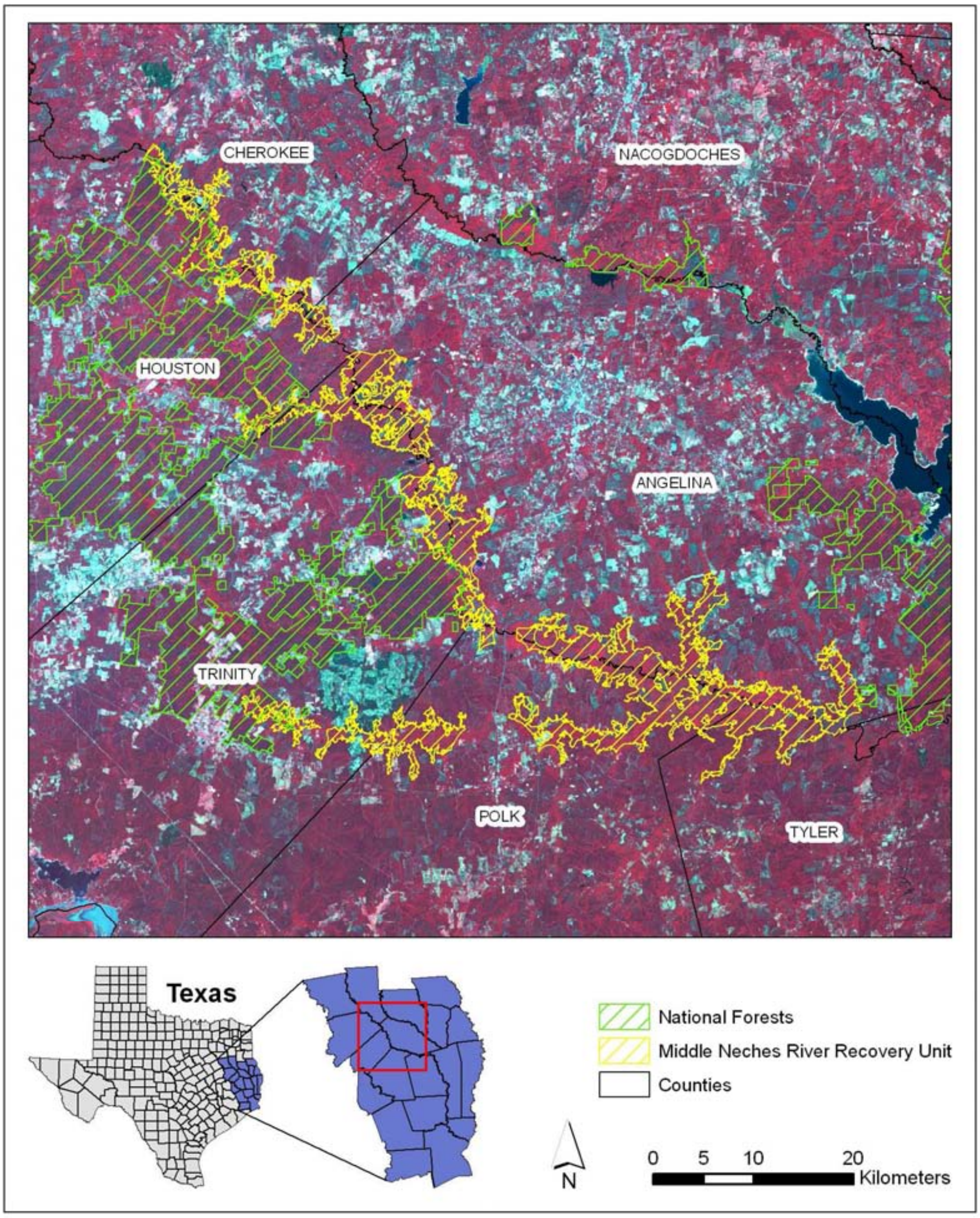

Figure 3.18. Middle Neches River Recovery Unit located along the Middle Neches River Basin in portions of Cherokee, Angelina, Houston, Trinity, Polk, and Tyler counties, east Texas, USA.

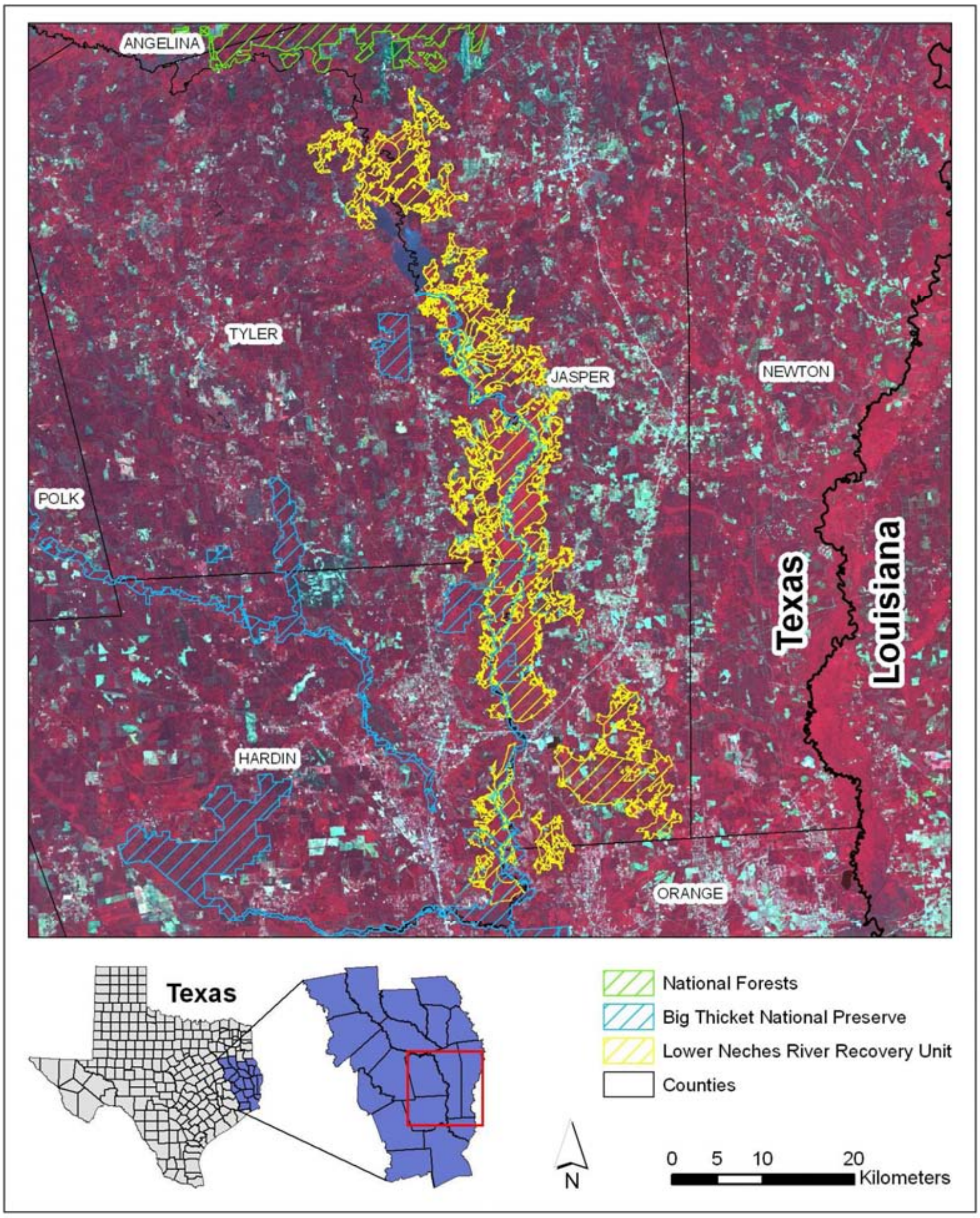

Figure 3.19. Lower Neches River Recovery Unit located along the Lower Neches River Basin in portions of Tyler, Jasper, Hardin, and Orange counties, east Texas, USA.

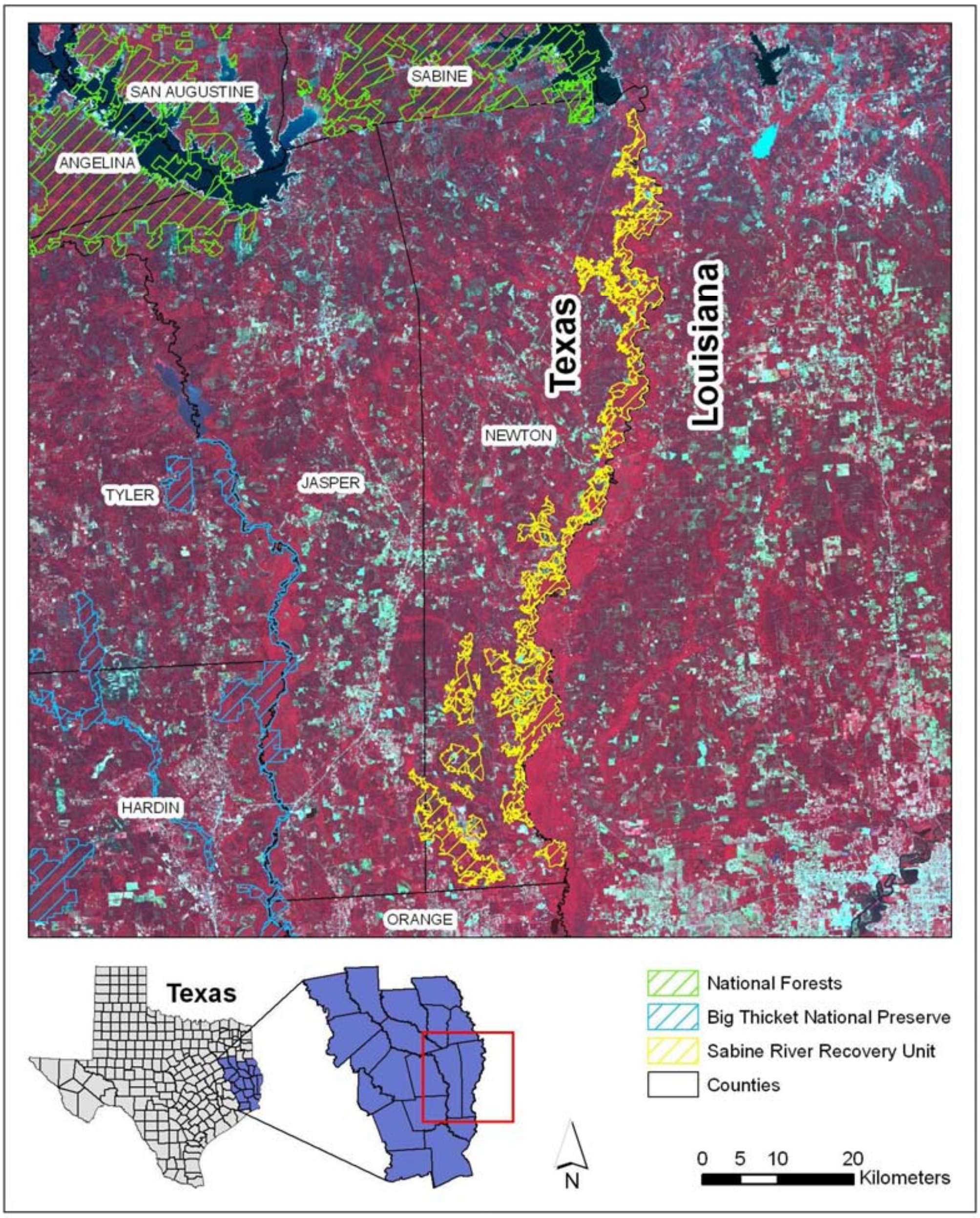

Figure 3.20. Sabine River Recovery Unit located along the Sabine River Basin and Texas-Louisiana border in portions of Newton, Jasper, and Orange counties, east Texas, USA.

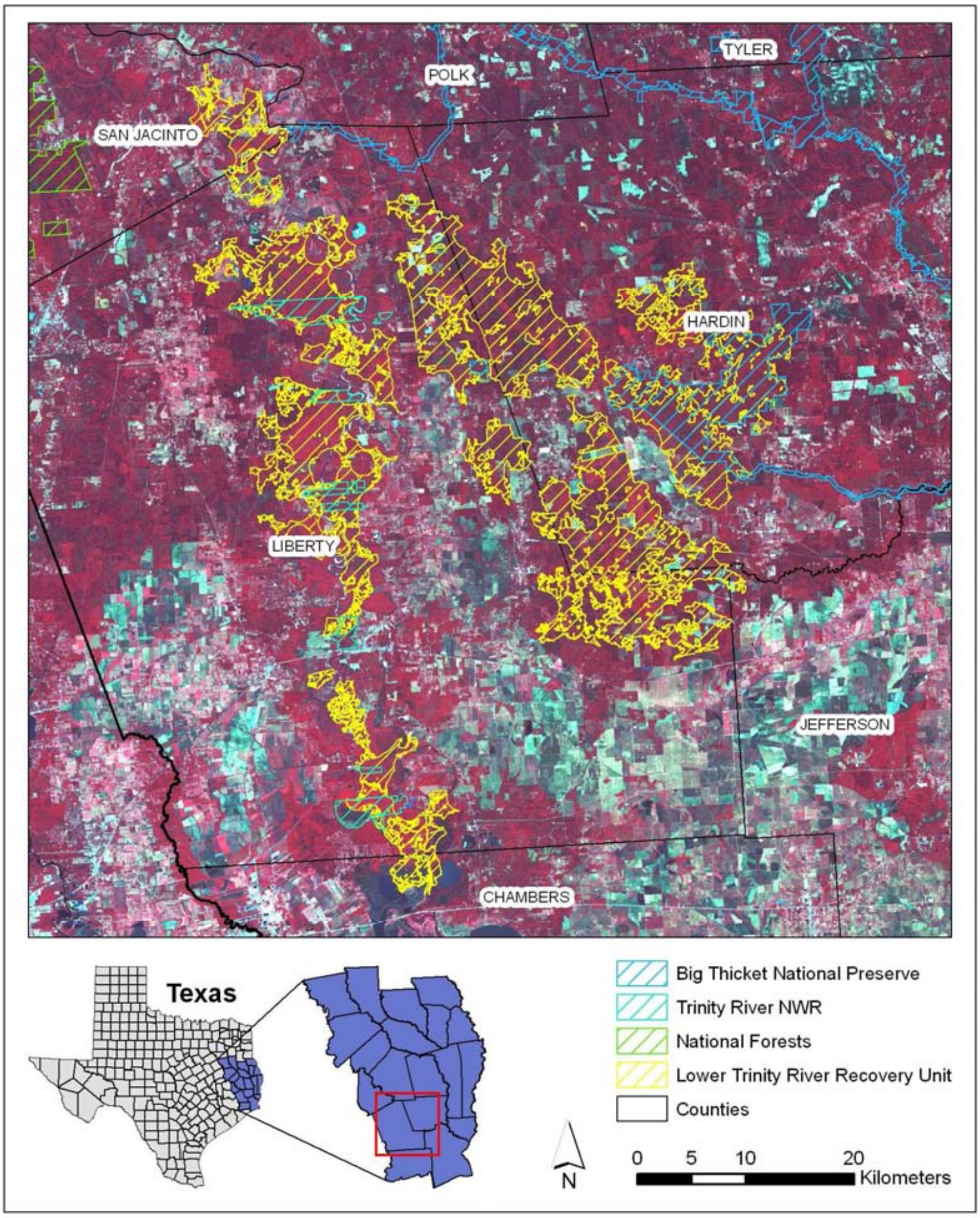

Figure 3.21. Lower Trinity River Recovery Unit located along the Lower Trinity River Basin in portions of San Jacinto, Liberty, Chambers, and Hardin counties, east Texas, USA.

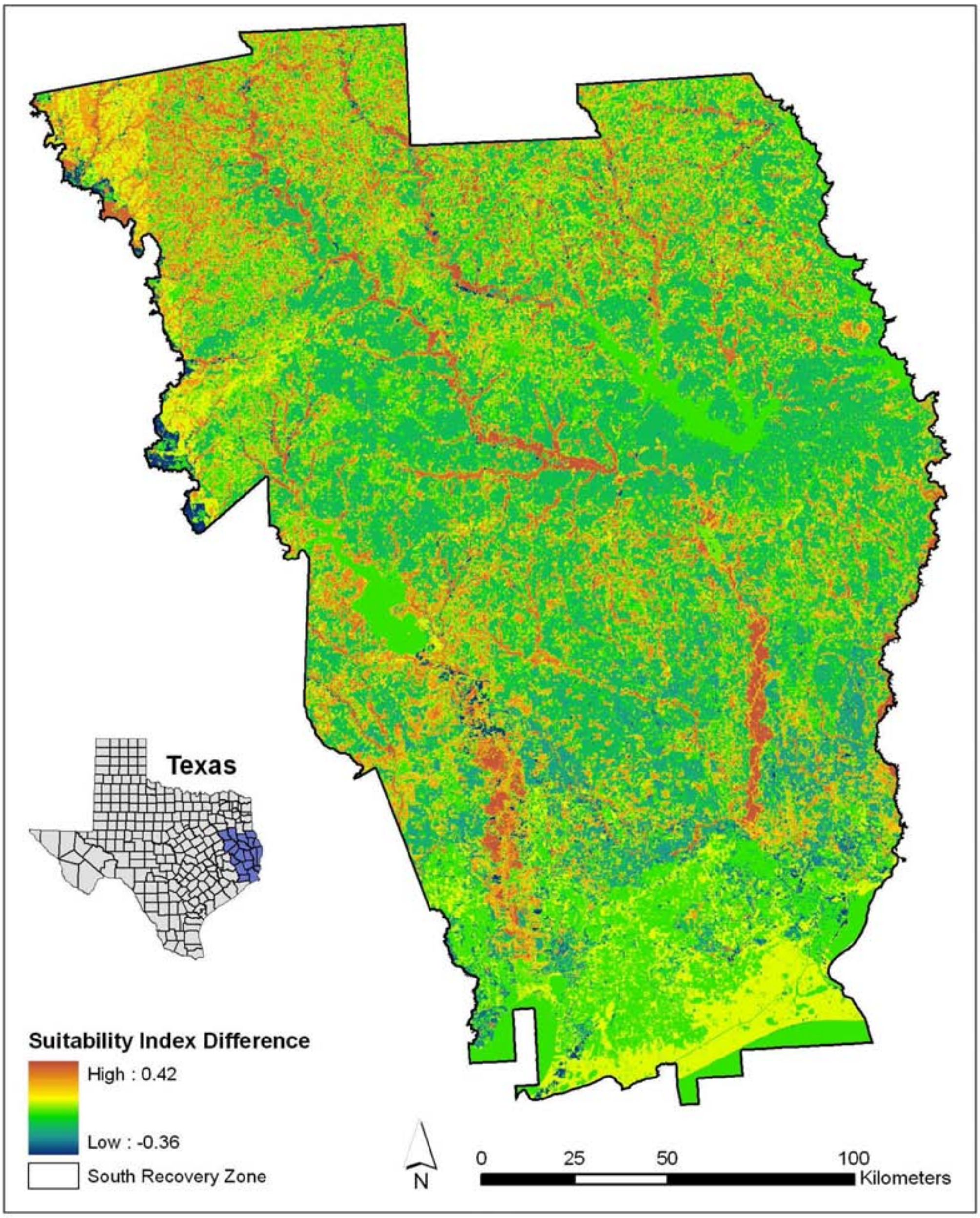

Figure 3.22. Difference image calculated using pixel by pixel subtraction between *a priori* and *a posteriori* HSI models developed for the south Louisiana black bear recovery zone, east Texas, USA. Positive values indicate an overestimation and negative values indicate underestimation of *a priori* habitat suitability.

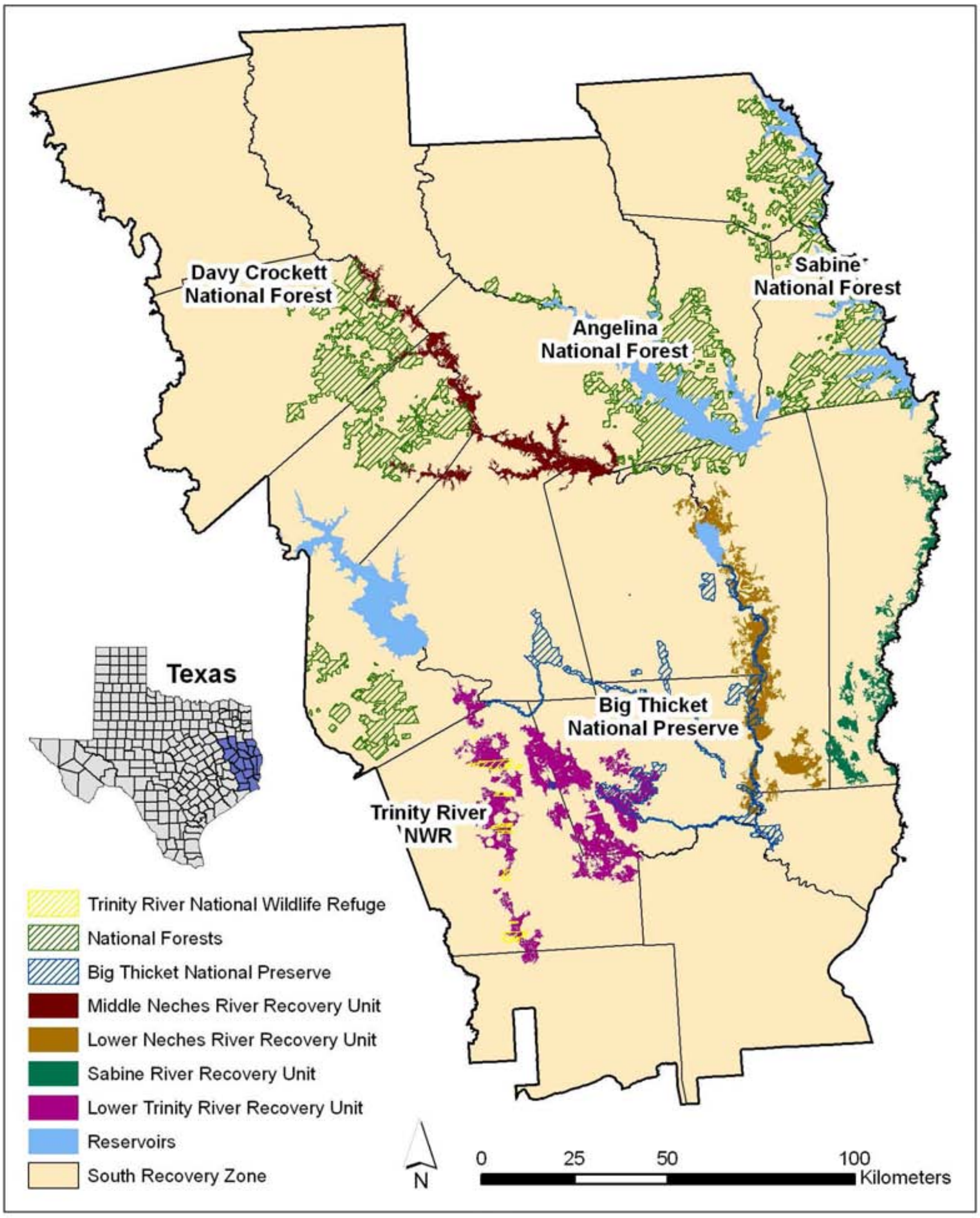

Figure 3.23. Locations of potential recovery units in relation to the Davy Crockett, Angelina, and Sabine National Forests, the Big Thicket National Preserve, and the Trinity River National Wildlife Refuge.

Table 3.1. Habitat classifications present in the south Louisiana black bear recovery zone in east Texas and their associated code values from the Texas Vegetation Classification Project: Phase II habitat classification model.

Cover-type	**Code**	**Habitat Classification**	**Hectares**
Hardwood	3	Post Oak Savanna: Post Oak Motte and Woodland	42,726
	8	Post Oak Savanna: Oak / Hardwood Slope Forest	37
	13	Pineywoods: Northern Mesic Hardwood Forest	31,897
	15	Pineywoods: Southern Mesic Hardwood Forest	26,116
	18	Pineywoods: Upland Hardwood Forest	490,443
	21	Pineywoods: Dry Upland Hardwood Forest	13,350
	24	Pineywoods: Sandhill Oak Woodland	3,798
	26	Chenier Plain: Live Oak Fringe Forest	230
	28	Chenier Plain: Hardwood Fringe Forest	194
	32	Central Texas: Floodplain Hardwood Forest	21,826
	37	Central Texas: Floodplain Seasonally Flooded Hardwood Forest	2,901
	41	Central Texas: Riparian Hardwood Forest	979
	52	Pineywoods: Bottomland Temporarily Flooded Live Oak Forest	15
	54	Pineywoods: Bottomland Temporarily Flooded Hardwood Forest	55,582
	58	Pineywoods: Bottomland Seasonally Flooded Hardwood Forest	85,772
	63	Pineywoods: Small Stream and Riparian Temporarily Flooded Hardwood Forest	130,984
	67	Pineywoods: Small Stream and Riparian Seasonally Flooded Hardwood Forest	43,697
	70	Pineywoods: Wet Hardwood Flatwoods	9,986
	77	Pineywoods: Hardwood Flatwoods	81,561
	85	Post Oak Savanna: Sandyland Woodland and Shrubland	112
	100	Native Invasive: Deciduous Woodland	6,138
	117	Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland	66,790
Herbaceous	4	Post Oak Savanna: Savanna Grassland	60,166
	25	Pineywoods: Sandhill Grassland or Shrubland	2,557
	35	Central Texas: Floodplain Herbaceous Vegetation	13,212
	44	Central Texas: Riparian Herbaceous Vegetation	1,201
	57	Pineywoods: Bottomland Herbaceous Wetland	14,086
	59	Pineywoods: Bottomland Wet Prairie	17,589
	66	Pineywoods: Small Stream and Riparian Herbaceous Wetland	2,271
	68	Pineywoods: Small Stream and Riparian Wet Prairie	40,649
	71	Pineywoods: Herbaceous Flatwoods Pond	5,834
	72	Pineywoods: Herbaceous Seepage Bog	153
	74	Pineywoods: Seepage Swamp and Baygall	805
	79	Pineywoods: Herbaceous Catahoula Barrens	36
	81	Pineywoods: Weches Herbaceous Glade	3,379
	82	Pineywoods: Southern Calcareous Mixedgrass Prairie	21,316
	84	Blackland Prairie: Disturbance or Tame Grassland	1,556
	86	Post Oak Savanna: Sandyland Grassland	58
	87	Gulf Coast: Coastal Prairie	106,729
	89	Gulf Coast: Salty Prairie	12,200
	90	Gulf Coast: Dune and Coastal Grassland	2,121
	91	Gulf Coast: Coastal Prairie Pondshore	23,313
	92	Chenier Plain: Fresh and Intermediate Tidal Marsh	72,904
	94	Chenier Plain: Salt and Brackish Low Tidal Marsh	15,889
	96	Chenier Plain: Salt and Brackish High Tidal Marsh	2,026
	97	Chenier Plain: Fresh and Intermediate Tidal Shrub Wetland	27
	108	Marsh	2,551

(Continued)

Table 3.1 (Continued). Habitat classifications present in the south Louisiana black bear recovery zone in east Texas and their associated code values from the Texas Vegetation Classification Project: Phase II habitat classification model.

Cover-type	**Code**	**Habitat Classification**	**Hectares**
Mixed Pine-Hardwood	2	Post Oak Savanna: Post Oak / Redcedar Motte and Woodland	197
	6	Post Oak Savanna: Oak / Redcedar Slope Forest	1
	7	Post Oak Savanna: Post Oak / Yaupon Motte and Woodland	32
	12	Pineywoods: Northern Mesic Pine / Hardwood Forest	5,987
	14	Pineywoods: Southern Mesic Pine / Hardwood Forest	11,153
	17	Pineywoods: Pine / Hardwood Forest or Plantation	134,578
	20	Pineywoods: Dry Pine / Hardwood Forest or Plantation	4,641
	23	Pineywoods: Sandhill Oak / Pine Woodland	1,163
	27	Chenier Plain: Mixed Live Oak / Deciduous Hardwood Fringe Forest	10,965
	31	Central Texas: Floodplain Hardwood / Evergreen Forest	222
	40	Central Texas: Riparian Hardwood / Evergreen Forest	24
	53	Pineywoods: Bottomland Temporarily Flooded Mixed Pine / Hardwood Forest	5,194
	62	Pineywoods: Small Stream and Riparian Temporarily Flooded Mixed Forest	28,003
	76	Pineywoods: Longleaf or Loblolly Pine / Hardwood Flatwoods or Plantation	23,330
Pine	5	Post Oak Savanna: Redcedar Slope Forest	2
	16	Pineywoods: Pine Forest or Plantation	1,178,030
	19	Pineywoods: Dry Pine Forest or Plantation	17,960
	22	Pineywoods: Sandhill Pine Woodland	8,481
	38	Central Texas: Riparian Juniper Forest	85
	75	Pineywoods: Longleaf or Loblolly Pine Flatwoods or Plantation	154,499
	101	Native Invasive: Juniper Woodland	1,137
	115	Pine Plantation > 3 meters tall	177,452
	116	Pine Plantation 1 to 3 meters tall	109,092
Shrub	33	Central Texas: Floodplain Evergreen Shrubland	120
	34	Central Texas: Floodplain Deciduous Shrubland	2,205
	42	Central Texas: Riparian Evergreen Shrubland	3
	43	Central Texas: Riparian Deciduous Shrubland	57
	55	Pineywoods: Bottomland Evergreen Successional Shrubland	11
	56	Pineywoods: Bottomland Deciduous Successional Shrubland	642
	65	Pineywoods: Small Stream and Riparian Deciduous Successional Shrubland	1,210
	78	Pineywoods: Woodland or Shrubland Catahoula Barrens	28
	80	Pineywoods: Weches Shrub Glade	39
	88	Gulf Coast: Salty Shrubland	4
	102	Native Invasive: Juniper Shrubland	2,924
	103	Native Invasive: Mesquite Shrubland	624
	104	Native Invasive: Common Reed	2,493
	107	Native Invasive: Deciduous Shrubland	4,876
Swamp	36	Central Texas: Floodplain Baldcypress Swamp	151
	60	Pineywoods: Bottomland Baldcypress Swamp	18,335
	69	Pineywoods: Small Stream and Riparian Baldcypress Swamp	2,623
	73	Gulf Coast: Near-Coast Baldcypress Swamp	3,602
	109	Swamp	682

(Continued)

Table 3.1 (Continued). Habitat classifications present in the south Louisiana black bear recovery zone in east Texas and their associated code values from the Texas Vegetation Classification Project: Phase II habitat classification model.

Cover-type	**Code**	**Habitat Classification**	**Hectares**
Non-habitat	98	Gulf Coast: Beach	7
	99	Pineywoods: Disturbance or Tame Grassland	448,029
	110	Barren	3,492
	111	Mud Flat	83
	112	Open Water	206,995
	113	Row Crops	162,628
	114	Grass Farm	711
	118	Urban High Intensity	24,098
	119	Urban Low Intensity	53,471

Table 3.2. A priori SI and CI scores for the 98 habitat classifications of the Texas Vegetation Classification Project: Phase II habitat classification model located in the south Louisiana black bear recovery zone in east Texas.

Cover-type	**Code**	**SI_{SFA}**	**SI_{FFA}**	**SI_{FFD}**	**SI_{FFP}**	**SI_{PC}**	**SI_{TDA}**	**CI_{FOOD}**	**CI_{COVER}**	**Hectares**
Hardwood	3	1.00	1.00	0.50	0.50	0.50	0.00	0.76	0.50	42,726
	8	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	37
	13	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	31,897
	15	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	26,116
	18	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	490,443
	21	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	13,350
	24	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	3,798
	26	1.00	1.00	0.50	0.50	0.50	0.00	0.76	0.50	230
	28	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	194
	32	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	21,826
	37	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	2,901
	41	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	979
	52	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	15
	54	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	55,582
	58	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	85,772
	63	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	130,984
	67	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	43,697
	70	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	9,986
	77	1.00	1.00	1.00	0.50	0.50	0.50	0.89	0.50	81,561
	85	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	112
	100	1.00	0.50	0.50	0.50	1.00	0.00	0.63	1.00	6,138
	117	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	66,790
Herbaceous	4	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	60,166
	25	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,557
	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13,212
	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,201
	57	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	14,086
	59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17,589
	66	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,271
	68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40,649
	71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,834
	72	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	153
	74	1.00	0.50	0.50	0.50	1.00	0.50	0.63	1.00	805
	79	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	36
	81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,379
	82	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	21,316
	84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,556
	86	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	58
	87	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	106,729
	89	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	12,200
	90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,121
	91	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	23,313
	92	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	72,904
	94	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	15,889
	96	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,026
	97	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	27
	108	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,551

(Continued)

Table 3.2 (Continued). A priori SI and CI scores for the 98 habitat classifications of the Texas Vegetation Classification Project: Phase II habitat classification model located in the south Louisiana black bear recovery zone in east Texas.

Cover-type	**Code**	**SI_{SFA}**	**SI_{FFA}**	**SI_{FFD}**	**SI_{FFP}**	**SI_{PC}**	**SI_{TDA}**	**CI_{FOOD}**	**CI_{COVER}**	**Hectares**
Mixed Pine-Hardwood	2	1.00	1.00	0.50	0.50	0.00	0.00	0.00	0.00	197
	6	1.00	0.50	0.50	0.50	0.50	0.00	0.63	0.50	1
	7	1.00	1.00	0.50	0.50	1.00	0.00	0.76	1.00	32
	12	1.00	0.50	0.50	0.50	0.50	0.00	0.63	0.50	5,987
	14	1.00	0.50	0.50	0.50	0.50	0.00	0.63	0.50	11,153
	17	1.00	0.50	0.50	0.50	0.75	0.00	0.63	0.75	134,578
	20	1.00	0.50	1.00	0.50	0.75	0.00	0.76	0.75	4,641
	23	1.00	0.50	0.50	0.50	0.75	0.00	0.63	0.75	1,163
	27	1.00	1.00	1.00	0.50	0.50	0.00	0.89	0.50	10,965
	31	1.00	0.50	0.50	0.50	0.50	0.50	0.63	0.50	222
	40	1.00	0.50	0.50	0.50	0.75	0.50	0.63	0.75	24
	53	1.00	0.50	0.50	0.50	0.75	0.50	0.63	0.75	5,194
	62	1.00	0.50	0.50	0.50	0.50	0.50	0.63	0.50	28,003
	76	1.00	0.50	0.50	0.50	0.75	0.00	0.63	0.75	23,330
Pine	5	1.00	0.50	0.50	0.50	1.00	0.00	0.63	1.00	2
	16	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.75	1,178,030
	19	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.75	17,960
	22	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.75	8,481
	38	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	85
	75	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.75	154,499
	101	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	1,137
	115	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	177,452
	116	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	109,092
Shrub	33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	120
	34	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,205
	42	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	3
	43	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	57
	55	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	11
	56	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	642
	65	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	1,210
	78	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	28
	80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39
	88	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	4
	102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2,924
	103	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	624
	104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,493
	107	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4,876
Swamp	36	0.25	0.00	0.00	0.00	1.00	1.00	0.00	1.00	151
	60	0.25	0.25	0.50	0.50	0.25	1.00	0.14	0.63	18,335
	69	0.25	0.00	0.00	0.00	0.25	1.00	0.00	0.63	2,623
	73	0.25	0.25	0.50	0.50	0.25	1.00	0.14	0.63	3,602
	109	0.25	0.25	0.50	0.50	0.25	0.00	0.14	0.25	682

(Continued)

Table 3.2 (Continued). A priori SI and CI scores for the 98 habitat classifications of the Texas Vegetation Classification Project: Phase II habitat classification model located in the south Louisiana black bear recovery zone in east Texas.

Cover-type	**Code**	**SI_{SFA}**	**SI_{FFA}**	**SI_{FFD}**	**SI_{FFP}**	**SI_{PC}**	**SI_{TDA}**	**CI_{FOOD}**	**CI_{COVER}**	**Hectares**
Non-habitat	98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7
	99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	448,029
	110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,492
	111	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	83
	112	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	206,995
	113	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	162,628
	114	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	711
	118	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24,098
	119	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53,471

Table 3.3. Summer food availability (SI_{SFA}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	15	11	0.88	1.00	0.99	±	0.03	0.01
	18	20	0.00	1.00	0.87	±	0.14	0.07
	21	10	0.13	1.00	0.73	±	0.23	0.10
	54	17	0.13	1.00	0.88	±	0.12	0.06
	58	16	0.50	1.00	0.95	±	0.07	0.03
	63	16	0.00	1.00	0.89	±	0.14	0.07
	67	16	0.38	1.00	0.90	±	0.12	0.06
	70	20	0.00	1.00	0.78	±	0.15	0.07
	77	17	0.00	1.00	0.84	±	0.15	0.07
	100	15	0.00	1.00	0.66	±	0.26	0.12
Pine	16	21	0.25	1.00	0.92	±	0.09	0.04
	19	14	0.00	1.00	0.82	±	0.18	0.08
	22	16	0.25	1.00	0.93	±	0.10	0.05
	75	19	0.13	1.00	0.91	±	0.10	0.05
	115	22	0.25	1.00	0.90	±	0.09	0.05
	116	18	0.88	1.00	0.99	±	0.01	0.01
Mixed Pine-Hardwood	14	19	0.13	1.00	0.89	±	0.12	0.06
	17	15	1.00	1.00	1.00	±	0.00	0.00
	20	9	1.00	1.00	1.00	±	0.00	0.00
	53	20	0.13	1.00	0.82	±	0.12	0.06
	62	20	0.50	1.00	0.96	±	0.06	0.03
	76	15	0.25	1.00	0.88	±	0.14	0.06
Herbaceous	57	3	0.13	1.00	0.50	±	1.12	0.26
	59	9	0.00	1.00	0.69	±	0.32	0.14
	68	8	0.00	1.00	0.72	±	0.38	0.16
	71	12	0.00	1.00	0.71	±	0.24	0.11
	72	8	0.88	1.00	0.98	±	0.04	0.02
Shrub	56	8	1.00	1.00	1.00	±	0.00	0.00
	65	6	1.00	1.00	1.00	±	0.00	0.00
	78	11	0.00	1.00	0.55	±	0.30	0.14
	107	11	1.00	1.00	1.00	±	0.00	0.00
Swamp	60	16	0.00	1.00	0.34	±	0.18	0.08
	69	6	0.63	1.00	0.90	±	0.17	0.07
	73	15	0.00	1.00	0.26	±	0.17	0.08
	109	13	0.00	1.00	0.49	±	0.27	0.12
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	1.00	0.36	±	0.24	0.11
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.4. Fall food availability (SI_{FFA}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	Min	Max	95% CI			SE
Hardwood	15	11	0.00	1.00	0.79	±	0.26	0.12
	18	20	0.00	1.00	0.63	±	0.23	0.11
	21	10	0.00	1.00	0.46	±	0.31	0.14
	54	17	0.00	1.00	0.70	±	0.22	0.10
	58	16	0.00	1.00	0.42	±	0.24	0.11
	63	16	0.00	1.00	0.59	±	0.26	0.12
	67	16	0.00	1.00	0.58	±	0.26	0.12
	70	20	0.00	1.00	0.59	±	0.23	0.11
	77	17	0.00	1.00	0.69	±	0.21	0.10
	100	15	0.00	1.00	0.47	±	0.29	0.13
Pine	16	21	0.00	0.54	0.03	±	0.05	0.03
	19	14	0.00	1.00	0.20	±	0.23	0.11
	22	16	0.00	0.00	0.00	±	0.00	0.00
	75	19	0.00	1.00	0.18	±	0.16	0.07
	115	22	0.00	1.00	0.39	±	0.19	0.09
	116	18	0.00	1.00	0.06	±	0.12	0.06
Mixed Pine-Hardwood	14	19	0.00	1.00	0.62	±	0.20	0.10
	17	15	0.00	1.00	0.67	±	0.22	0.10
	20	9	0.00	1.00	0.79	±	0.30	0.13
	53	20	0.00	1.00	0.66	±	0.20	0.09
	62	20	0.00	1.00	0.70	±	0.19	0.09
	76	15	0.00	1.00	0.91	±	0.15	0.07
Herbaceous	57	3	0.00	1.00	0.33	±	1.43	0.33
	59	9	0.00	1.00	0.28	±	0.33	0.14
	68	8	0.00	0.00	0.00	±	0.00	0.00
	71	12	0.00	0.00	0.00	±	0.00	0.00
	72	8	0.00	0.51	0.10	±	0.16	0.07
Shrub	56	8	0.00	1.00	0.25	±	0.39	0.16
	65	6	0.00	1.00	0.21	±	0.42	0.16
	78	11	0.00	0.27	0.03	±	0.05	0.02
	107	11	0.00	0.00	0.00	±	0.00	0.00
Swamp	60	16	0.00	1.00	0.80	±	0.21	0.10
	69	6	0.00	1.00	0.76	±	0.43	0.17
	73	15	0.00	1.00	0.30	±	0.25	0.12
	109	13	0.00	0.00	0.00	±	0.00	0.00
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	0.00	0.00	±	0.00	0.00
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.5. Fall food diversity (SI_{FFD}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	15	11	0.00	1.00	0.68	±	0.23	0.10
	18	20	0.00	1.00	0.50	±	0.17	0.08
	21	10	0.00	1.00	0.50	±	0.17	0.07
	54	17	0.00	1.00	0.47	±	0.14	0.07
	58	16	0.00	1.00	0.50	±	0.19	0.09
	63	16	0.00	1.00	0.47	±	0.18	0.09
	67	16	0.00	1.00	0.56	±	0.19	0.09
	70	20	0.00	1.00	0.43	±	0.17	0.08
	77	17	0.00	1.00	0.44	±	0.12	0.06
	100	15	0.00	0.50	0.23	±	0.14	0.07
Pine	16	21	0.00	1.00	0.19	±	0.13	0.06
	19	14	0.00	1.00	0.29	±	0.19	0.09
	22	16	0.00	0.50	0.03	±	0.07	0.03
	75	19	0.00	1.00	0.29	±	0.15	0.07
	115	22	0.00	1.00	0.43	±	0.17	0.08
	116	18	0.00	0.50	0.03	±	0.06	0.03
Mixed Pine-Hardwood	14	19	0.00	1.00	0.63	±	0.14	0.06
	17	15	0.00	1.00	0.57	±	0.21	0.10
	20	9	0.50	1.00	0.67	±	0.19	0.08
	53	20	0.00	1.00	0.63	±	0.13	0.06
	62	20	0.50	1.00	0.83	±	0.11	0.05
	76	15	0.00	1.00	0.57	±	0.14	0.07
Herbaceous	57	3	0.00	0.50	0.17	±	0.72	0.17
	59	9	0.00	0.50	0.17	±	0.19	0.08
	68	8	0.00	0.50	0.06	±	0.15	0.06
	71	12	0.00	0.00	0.00	±	0.00	0.00
	72	8	0.00	1.00	0.25	±	0.32	0.13
Shrub	56	8	0.00	0.50	0.13	±	0.19	0.08
	65	6	0.00	1.00	0.25	±	0.44	0.17
	78	11	0.00	0.50	0.14	±	0.16	0.07
	107	11	0.00	0.00	0.00	±	0.00	0.00
Swamp	60	16	0.00	0.50	0.41	±	0.11	0.05
	69	6	0.50	0.50	0.50	±	0.00	0.00
	73	15	0.00	0.50	0.27	±	0.14	0.07
	109	13	0.00	0.50	0.08	±	0.11	0.05
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	0.00	0.00	±	0.00	0.00
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.6. Fall food productivity (SI_{FFP}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	Min	Max	95% CI			SE
Hardwood	15	11	0.00	1.00	0.18	±	0.27	0.12
	18	20	0.00	1.00	0.20	±	0.18	0.09
	21	10	0.00	0.36	0.04	±	0.08	0.04
	54	17	0.00	1.00	0.45	±	0.21	0.10
	58	16	0.00	1.00	0.16	±	0.18	0.09
	63	16	0.00	1.00	0.21	±	0.21	0.10
	67	16	0.00	1.00	0.25	±	0.20	0.09
	70	20	0.00	1.00	0.36	±	0.21	0.10
	77	17	0.00	1.00	0.31	±	0.20	0.10
	100	15	0.00	1.00	0.10	±	0.16	0.07
Pine	16	21	0.00	0.00	0.00	±	0.00	0.00
	19	14	0.00	0.00	0.00	±	0.00	0.00
	22	16	0.00	0.00	0.00	±	0.00	0.00
	75	19	0.00	0.83	0.04	±	0.09	0.04
	115	22	0.00	1.00	0.12	±	0.14	0.07
	116	18	0.00	0.00	0.00	±	0.00	0.00
Mixed Pine-Hardwood	14	19	0.00	1.00	0.38	±	0.20	0.09
	17	15	0.00	1.00	0.16	±	0.19	0.09
	20	9	0.00	1.00	0.53	±	0.32	0.14
	53	20	0.00	1.00	0.47	±	0.21	0.10
	62	20	0.00	1.00	0.44	±	0.20	0.10
	76	15	0.00	0.71	0.24	±	0.15	0.07
Herbaceous	57	3	0.00	0.00	0.00	±	0.00	0.00
	59	9	0.00	0.00	0.00	±	0.00	0.00
	68	8	0.00	0.00	0.00	±	0.00	0.00
	71	12	0.00	0.00	0.00	±	0.00	0.00
	72	8	0.00	1.00	0.13	±	0.30	0.13
Shrub	56	8	0.00	1.00	0.13	±	0.30	0.13
	65	6	0.00	0.00	0.00	±	0.00	0.00
	78	11	0.00	0.00	0.00	±	0.00	0.00
	107	11	0.00	0.00	0.00	±	0.00	0.00
Swamp	60	16	0.00	1.00	0.39	±	0.22	0.10
	69	6	0.00	1.00	0.33	±	0.54	0.21
	73	15	0.00	0.75	0.07	±	0.12	0.05
	109	13	0.00	0.00	0.00	±	0.00	0.00
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	0.00	0.00	±	0.00	0.00
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.7. Protection cover (SI_{PC}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	15	11	0.00	0.87	0.21	±	0.22	0.10
	18	20	0.00	1.00	0.69	±	0.18	0.09
	21	10	0.00	1.00	0.30	±	0.25	0.11
	54	17	0.00	1.00	0.48	±	0.23	0.11
	58	16	0.05	1.00	0.55	±	0.19	0.09
	63	16	0.00	1.00	0.49	±	0.23	0.11
	67	16	0.00	1.00	0.52	±	0.23	0.11
	70	20	0.00	1.00	0.57	±	0.19	0.09
	77	17	0.00	1.00	0.72	±	0.19	0.09
	100	15	0.00	1.00	0.69	±	0.23	0.11
Pine	16	21	0.00	1.00	0.71	±	0.18	0.09
	19	14	0.00	1.00	0.45	±	0.21	0.10
	22	16	0.00	1.00	0.43	±	0.20	0.09
	75	19	0.00	1.00	0.64	±	0.19	0.09
	115	22	0.00	1.00	0.60	±	0.18	0.09
	116	18	0.00	1.00	0.89	±	0.13	0.06
Mixed Pine-Hardwood	14	19	0.00	0.61	0.15	±	0.08	0.04
	17	15	0.00	1.00	0.54	±	0.21	0.10
	20	9	0.03	1.00	0.57	±	0.29	0.13
	53	20	0.00	1.00	0.27	±	0.17	0.08
	62	20	0.00	1.00	0.41	±	0.14	0.07
	76	15	0.00	1.00	0.72	±	0.21	0.10
Herbaceous	57	3	0.19	1.00	0.50	±	1.09	0.25
	59	9	0.08	1.00	0.73	±	0.26	0.11
	68	8	0.00	1.00	0.54	±	0.38	0.16
	71	12	0.23	1.00	0.70	±	0.20	0.09
	72	8	0.11	1.00	0.41	±	0.26	0.11
Shrub	56	8	1.00	1.00	1.00	±	0.00	0.00
	65	6	1.00	1.00	1.00	±	0.00	0.00
	78	11	0.00	0.87	0.29	±	0.19	0.09
	107	11	0.23	1.00	0.85	±	0.18	0.08
Swamp	60	16	0.00	1.00	0.51	±	0.23	0.11
	69	6	0.03	0.61	0.38	±	0.22	0.09
	73	15	0.00	1.00	0.37	±	0.17	0.08
	109	13	0.00	1.00	0.34	±	0.25	0.12
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	1.00	0.46	±	0.30	0.13
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.8. Tree den availability (SI_{TDA}) SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	Min	Max	95% CI			SE
Hardwood	15	11	0.00	0.00	0.00	±	0.00	0.00
	18	20	0.00	0.00	0.00	±	0.00	0.00
	21	10	0.00	0.00	0.00	±	0.00	0.00
	54	17	0.00	1.00	0.18	±	0.20	0.09
	58	16	0.00	0.96	0.11	±	0.17	0.08
	63	16	0.00	0.96	0.09	±	0.14	0.07
	67	16	0.00	0.00	0.00	±	0.00	0.00
	70	20	0.00	0.00	0.00	±	0.00	0.00
	77	17	0.00	0.00	0.00	±	0.00	0.00
	100	15	0.00	0.00	0.00	±	0.00	0.00
Pine	16	21	0.00	0.00	0.00	±	0.00	0.00
	19	14	0.00	0.00	0.00	±	0.00	0.00
	22	16	0.00	0.00	0.00	±	0.00	0.00
	75	19	0.00	0.00	0.00	±	0.00	0.00
	115	22	0.00	0.00	0.00	±	0.00	0.00
	116	18	0.00	0.00	0.00	±	0.00	0.00
Mixed Pine-Hardwood	14	19	0.00	0.00	0.00	±	0.00	0.00
	17	15	0.00	0.00	0.00	±	0.00	0.00
	20	9	0.00	0.00	0.00	±	0.00	0.00
	53	20	0.00	0.00	0.00	±	0.00	0.00
	62	20	0.00	0.99	0.05	±	0.10	0.05
	76	15	0.00	0.00	0.00	±	0.00	0.00
Herbaceous	57	3	0.00	0.78	0.26	±	1.12	0.26
	59	9	0.00	0.00	0.00	±	0.00	0.00
	68	8	0.00	0.00	0.00	±	0.00	0.00
	71	12	0.00	0.00	0.00	±	0.00	0.00
	72	8	0.00	0.00	0.00	±	0.00	0.00
Shrub	56	8	0.00	0.00	0.00	±	0.00	0.00
	65	6	0.00	0.00	0.00	±	0.00	0.00
	78	11	0.00	0.00	0.00	±	0.00	0.00
	107	11	0.00	0.00	0.00	±	0.00	0.00
Swamp	60	16	0.00	0.92	0.10	±	0.15	0.07
	69	6	0.00	1.00	0.17	±	0.43	0.17
	73	15	0.00	0.00	0.00	±	0.00	0.00
	109	13	0.00	0.00	0.00	±	0.00	0.00
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	0.00	0.00	±	0.00	0.00
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.9. Food component (CI_{FOOD}) CI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	Min	Max	95% CI			SE
Hardwood	15	11	0.00	1.00	0.64	±	0.17	0.08
	18	20	0.00	0.89	0.49	±	0.15	0.07
	21	10	0.00	0.84	0.41	±	0.18	0.08
	54	17	0.00	0.89	0.58	±	0.16	0.08
	58	16	0.00	1.00	0.44	±	0.17	0.08
	63	16	0.00	0.94	0.46	±	0.19	0.09
	67	16	0.00	0.91	0.53	±	0.18	0.08
	70	20	0.00	1.00	0.47	±	0.19	0.09
	77	17	0.00	1.00	0.51	±	0.17	0.08
	100	15	0.00	0.89	0.30	±	0.19	0.09
Pine	16	21	0.00	0.49	0.12	±	0.08	0.04
	19	14	0.00	0.63	0.21	±	0.14	0.07
	22	16	0.00	0.30	0.02	±	0.04	0.02
	75	19	0.00	0.63	0.23	±	0.12	0.06
	115	22	0.00	0.90	0.36	±	0.14	0.06
	116	18	0.00	0.63	0.03	±	0.07	0.03
Mixed Pine-Hardwood	14	19	0.00	0.96	0.61	±	0.12	0.06
	17	15	0.00	0.96	0.55	±	0.18	0.08
	20	9	0.30	0.90	0.74	±	0.16	0.07
	53	20	0.00	1.00	0.62	±	0.13	0.06
	62	20	0.00	0.89	0.58	±	0.16	0.08
	76	15	0.00	0.89	0.64	±	0.12	0.06
Herbaceous	57	3	0.00	0.63	0.21	±	0.90	0.21
	59	9	0.00	0.57	0.16	±	0.19	0.08
	68	8	0.00	0.30	0.04	±	0.09	0.04
	71	12	0.00	0.00	0.00	±	0.00	0.00
	72	8	0.00	0.77	0.21	±	0.25	0.11
Shrub	56	8	0.00	0.89	0.19	±	0.30	0.13
	65	6	0.00	0.63	0.20	±	0.32	0.12
	78	11	0.00	0.40	0.07	±	0.09	0.04
	107	11	0.00	0.00	0.00	±	0.00	0.00
Swamp	60	16	0.00	0.85	0.37	±	0.17	0.08
	69	6	0.30	0.89	0.61	±	0.23	0.09
	73	15	0.00	0.44	0.07	±	0.08	0.04
	109	13	0.00	0.30	0.05	±	0.07	0.03
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	0.00	0.00	±	0.00	0.00
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.10. Cover component (CI_{COVER}) CI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	Min	Max	95% CI			SE
Hardwood	15	11	0.00	0.87	0.21	±	0.22	0.10
	18	20	0.00	1.00	0.69	±	0.18	0.09
	21	10	0.00	1.00	0.30	±	0.25	0.11
	54	17	0.00	1.00	0.56	±	0.20	0.09
	58	16	0.05	1.00	0.57	±	0.19	0.09
	63	16	0.00	1.00	0.52	±	0.22	0.10
	67	16	0.00	1.00	0.52	±	0.23	0.11
	70	20	0.00	1.00	0.57	±	0.19	0.09
	77	17	0.00	1.00	0.72	±	0.19	0.09
	100	15	0.00	1.00	0.69	±	0.23	0.11
Pine	16	21	0.00	1.00	0.71	±	0.18	0.09
	19	14	0.00	1.00	0.45	±	0.21	0.10
	22	16	0.00	1.00	0.43	±	0.20	0.09
	75	19	0.00	1.00	0.64	±	0.19	0.09
	115	22	0.00	1.00	0.60	±	0.18	0.09
	116	18	0.00	1.00	0.89	±	0.13	0.06
Mixed Pine-Hardwood	14	19	0.00	0.61	0.15	±	0.08	0.04
	17	15	0.00	1.00	0.54	±	0.21	0.10
	20	9	0.03	1.00	0.57	±	0.29	0.13
	53	20	0.00	1.00	0.27	±	0.17	0.08
	62	20	0.00	1.00	0.43	±	0.14	0.07
	76	15	0.00	1.00	0.72	±	0.21	0.10
Herbaceous	57	3	0.19	1.00	0.50	±	1.09	0.25
	59	9	0.08	1.00	0.73	±	0.26	0.11
	68	8	0.00	1.00	0.54	±	0.38	0.16
	71	12	0.23	1.00	0.70	±	0.20	0.09
	72	8	0.11	1.00	0.41	±	0.26	0.11
Shrub	56	8	1.00	1.00	1.00	±	0.00	0.00
	65	6	1.00	1.00	1.00	±	0.00	0.00
	78	11	0.00	0.87	0.29	±	0.19	0.09
	107	11	0.23	1.00	0.85	±	0.18	0.08
Swamp	60	16	0.00	1.00	0.51	±	0.23	0.11
	69	6	0.03	0.65	0.44	±	0.25	0.10
	73	15	0.00	1.00	0.37	±	0.17	0.08
	109	13	0.00	1.00	0.34	±	0.25	0.12
Non-Habitat	99	9	0.00	0.00	0.00	±	0.00	0.00
	110	11	0.00	1.00	0.46	±	0.30	0.13
	112	4	0.00	0.00	0.00	±	0.00	0.00

Table 3.11. Summer food availability (SI_{SFA}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	n	Min	Max	95% CI			SE
Hardwood	158	0.00	1.00	0.85	±	0.05	0.02
Mixed Pine-Hardwood	98	0.13	1.00	0.91	±	0.04	0.02
Pine	110	0.00	1.00	0.91	±	0.04	0.02
Herbaceous	40	0.00	1.00	0.75	±	0.00	0.06
Shrub	36	0.00	1.00	0.86	±	0.11	0.05
Swamp	50	0.00	1.00	0.42	±	0.11	0.06

Table 3.12. Fall food availability (SI_{FFA}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	n	Min	Max	95% CI			SE
Hardwood	158	0.00	1.00	0.59	±	0.06	0.04
Mixed Pine-Hardwood	98	0.00	1.00	0.71	±	0.08	0.04
Pine	110	0.00	1.00	0.15	±	0.07	0.03
Herbaceous	40	0.00	1.00	0.11	±	0.15	0.04
Shrub	36	0.00	1.00	0.10	±	0.16	0.05
Swamp	50	0.00	1.00	0.44	±	0.10	0.07

Table 3.13. Fall food diversity (SI_{FFD}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	n	Min	Max	95% CI			SE
Hardwood	158	0.00	1.00	0.47	±	0.05	0.03
Mixed Pine-Hardwood	98	0.00	1.00	0.65	±	0.06	0.03
Pine	110	0.00	1.00	0.22	±	0.06	0.03
Herbaceous	40	0.00	1.00	0.11	±	0.08	0.04
Shrub	36	0.00	1.00	0.11	±	0.08	0.04
Swamp	50	0.00	0.50	0.29	±	0.07	0.04

Table 3.14. Fall food productivity (SI_{FFP}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	n	Min	Max	95% CI			SE
Hardwood	158	0.00	1.00	0.24	±	0.03	0.03
Mixed Pine-Hardwood	98	0.00	1.00	0.37	±	0.05	0.04
Pine	110	0.00	1.00	0.03	±	0.03	0.02
Herbaceous	40	0.00	1.00	0.03	±	0.05	0.03
Shrub	36	0.00	1.00	0.03	±	0.07	0.03
Swamp	50	0.00	1.00	0.19	±	0.07	0.05

Table 3.15. Protection cover (SI_{PC}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	158	0.00	1.00	0.55	±	0.02	0.03
Mixed Pine-Hardwood	98	0.00	1.00	0.41	±	0.05	0.04
Pine	110	0.00	1.00	0.63	±	0.00	0.04
Herbaceous	40	0.00	1.00	0.60	±	0.00	0.06
Shrub	36	0.00	1.00	0.74	±	0.06	0.06
Swamp	50	0.00	1.00	0.41	±	0.10	0.05

Table 3.16. Tree den availability (SI_{TDA}) SI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	158	0.00	1.00	0.04	±	0.04	0.02
Mixed Pine-Hardwood	98	0.00	0.99	0.01	±	0.04	0.01
Pine	110	0.00	0.00	0.00	±	0.06	0.00
Herbaceous	40	0.00	0.78	0.02	±	0.14	0.02
Shrub	36	0.00	0.00	0.00	±	0.16	0.00
Swamp	50	0.00	1.00	0.05	±	0.10	0.03

Table 3.17. Food component (CI_{FOOD}) CI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	158	0.00	1.00	0.48	±	0.05	0.03
Mixed Pine-Hardwood	98	0.00	1.00	0.64	±	0.05	0.02
Pine	110	0.00	1.00	0.18	±	0.05	0.02
Herbaceous	40	0.00	0.77	0.10	±	0.07	0.03
Shrub	36	0.00	0.89	0.10	±	0.08	0.04
Swamp	50	0.00	0.89	0.23	±	0.08	0.04

Table 3.18. Cover component (CI_{COVER}) CI scores developed from field-based habitat data pooled by land-cover type for 6 land cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**n**	**Min**	**Max**	**95% CI**			**SE**
Hardwood	158	0.00	1.00	0.56	±	0.04	0.03
Mixed Pine-Hardwood	98	0.00	1.00	0.42	±	0.06	0.04
Pine	110	0.00	1.00	0.63	±	0.02	0.04
Herbaceous	40	0.00	1.00	0.60	±	0.05	0.06
Shrub	36	0.00	1.00	0.74	±	0.07	0.06
Swamp	50	0.00	1.00	0.42	±	0.08	0.05

Table 3.19. *A priori* HSI model evaluation using t-test comparison of *a priori* summer food availability (SI_{SFA}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	*A priori* SI	*A posteriori* SI	P-value
Hardwood	15	11	1.00	0.99	0.341
	18	20	1.00	0.87	0.058
	21	10	1.00	0.73	0.024
	54	17	1.00	0.88	0.046
	58	16	1.00	0.95	0.188
	63	16	1.00	0.89	0.115
	67	16	1.00	0.90	0.091
	70	20	1.00	0.78	0.007
	77	17	1.00	0.84	0.038
	100	15	1.00	0.66	0.013
Pine	16	21	1.00	0.92	0.073
	19	14	1.00	0.82	0.052
	22	16	1.00	0.93	0.167
	75	19	1.00	0.91	0.074
	115	22	1.00	0.89	0.028
	116	18	1.00	0.99	0.331
Mixed Pine-Hardwood	14	19	1.00	0.89	0.060
	17	15	1.00	1.00	1.000
	20	9	1.00	1.00	1.000
	53	20	1.00	0.82	0.006
	62	20	1.00	0.96	0.130
	76	15	1.00	0.88	0.089
Herbaceous	57	3	0.00	0.50	0.195
	59	9	0.00	0.69	0.001
	68	8	0.00	0.72	0.003
	71	12	0.00	0.71	0.000
	72	8	0.00	0.98	0.000
Shrub	56	8	1.00	1.00	1.000
	65	6	1.00	1.00	1.000
	78	11	1.00	0.55	0.007
	107	11	1.00	1.00	1.000
Swamp	60	16	0.25	0.34	0.325
	69	6	0.25	0.90	0.000
	73	15	0.25	0.26	0.918
	109	13	0.25	0.49	0.076
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.36	0.007
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.20. *A priori* HSI model evaluation using t-test comparison of *a priori* fall food availability (SI_{FFA}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	*A priori* SI	*A posteriori* SI	P-value
Hardwood	15	11	1.00	0.79	0.108
	18	20	1.00	0.63	0.003
	21	10	1.00	0.46	0.004
	54	17	1.00	0.70	0.010
	58	16	1.00	0.42	0.000
	63	16	1.00	0.59	0.004
	67	16	1.00	0.58	0.003
	70	20	1.00	0.59	0.002
	77	17	1.00	0.69	0.007
	100	15	0.50	0.47	0.806
Pine	16	21	0.00	0.03	0.329
	19	14	0.00	0.20	0.085
	22	16	0.00	0.00	1.000
	75	19	0.00	0.18	0.028
	115	22	0.00	0.36	0.001
	116	18	0.00	0.06	0.331
Mixed Pine-Hardwood	14	19	0.50	0.62	0.224
	17	15	0.50	0.67	0.119
	20	9	0.50	0.79	0.058
	53	20	0.50	0.66	0.105
	62	20	0.50	0.70	0.037
	76	15	0.50	0.91	0.000
Herbaceous	57	3	0.00	0.33	0.423
	59	9	0.00	0.28	0.092
	68	8	0.00	0.00	1.000
	71	12	0.00	0.00	1.000
	72	8	0.00	0.10	0.198
Shrub	56	8	0.00	0.25	0.170
	65	6	0.00	0.21	0.265
	78	11	0.00	0.03	0.323
	107	11	0.00	0.00	1.000
Swamp	60	16	0.25	0.80	0.000
	69	6	0.00	0.76	0.006
	73	15	0.25	0.30	0.653
	109	13	0.25	0.00	1.000
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.00	1.000
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.21. *A priori* HSI model evaluation using t-test comparison of *a priori* fall food diversity (SI_{FFD}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	***A priori* SI**	***A posteriori* SI**	**P-value**
Hardwood	15	11	1.00	0.68	0.011
	18	20	1.00	0.50	0.000
	21	10	1.00	0.50	0.000
	54	17	1.00	0.47	0.000
	58	16	1.00	0.50	0.000
	63	16	1.00	0.47	0.000
	67	16	1.00	0.56	0.000
	70	20	1.00	0.43	0.000
	77	17	1.00	0.44	0.000
	100	15	0.50	0.23	0.001
Pine	16	21	0.00	0.19	0.008
	19	14	0.00	0.29	0.006
	22	16	0.00	0.03	0.333
	75	19	0.00	0.29	0.001
	115	22	0.00	0.43	0.000
	116	18	0.00	0.03	0.331
Mixed Pine-Hardwood	14	19	0.50	0.63	0.056
	17	15	0.50	0.57	0.499
	20	9	1.00	0.67	0.004
	53	20	0.50	0.63	0.056
	62	20	0.50	0.83	0.000
	76	15	0.50	0.57	0.334
Herbaceous	57	3	0.00	0.17	0.423
	59	9	0.00	0.17	0.081
	68	8	0.00	0.06	0.351
	71	12	0.00	0.00	1.000
	72	8	0.00	0.25	0.104
Shrub	56	8	0.00	0.13	0.170
	65	6	0.00	0.25	0.203
	78	11	0.00	0.14	0.082
	107	11	0.00	0.00	1.000
Swamp	60	16	0.50	0.41	0.083
	69	6	0.00	0.50	1.000
	73	15	0.50	0.27	0.004
	109	13	0.50	0.08	0.000
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.00	1.000
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.22. *A priori* HSI model evaluation using t-test comparison of *a priori* fall food productivity (SI_{FFP}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	***A priori* SI**	***A posteriori* SI**	**P-value**
Hardwood	15	11	0.50	0.18	0.026
	18	20	0.50	0.20	0.002
	21	10	0.50	0.04	0.000
	54	17	0.50	0.45	0.626
	58	16	0.50	0.16	0.001
	63	16	0.50	0.21	0.009
	67	16	0.50	0.25	0.019
	70	20	0.50	0.36	0.170
	77	17	0.50	0.31	0.063
	100	15	0.50	0.10	0.000
Pine	16	21	0.00	0.00	1.000
	19	14	0.00	0.00	1.000
	22	16	0.00	0.00	1.000
	75	19	0.00	0.04	0.331
	115	22	0.00	0.07	0.274
	116	18	0.00	0.00	1.000
Mixed Pine-Hardwood	14	19	0.50	0.38	0.208
	17	15	0.50	0.16	0.002
	20	9	0.50	0.53	0.845
	53	20	0.50	0.47	0.736
	62	20	0.50	0.44	0.512
	76	15	0.50	0.24	0.002
Herbaceous	57	3	0.00	0.00	1.000
	59	9	0.00	0.00	1.000
	68	8	0.00	0.00	1.000
	71	12	0.00	0.00	1.000
	72	8	0.00	0.13	0.351
Shrub	56	8	0.00	0.13	0.351
	65	6	0.00	0.00	1.000
	78	11	0.00	0.00	1.000
	107	11	0.00	0.00	1.000
Swamp	60	16	0.50	0.39	0.279
	69	6	0.00	0.33	0.175
	73	15	0.50	0.07	0.000
	109	13	0.50	0.00	1.000
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.00	1.000
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.23. *A priori* HSI model evaluation using t-test comparison of *a priori* protection cover (SI_{PC}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	***A priori* SI**	***A posteriori* SI**	**P-value**
Hardwood	15	11	0.50	0.21	0.014
	18	20	0.50	0.69	0.043
	21	10	0.50	0.30	0.107
	54	17	0.50	0.48	0.835
	58	16	0.50	0.55	0.581
	63	16	0.50	0.49	0.960
	67	16	0.50	0.52	0.891
	70	20	0.50	0.57	0.438
	77	17	0.50	0.72	0.023
	100	15	1.00	0.69	0.010
Pine	16	21	0.75	0.71	0.656
	19	14	0.75	0.45	0.008
	22	16	0.75	0.43	0.004
	75	19	0.75	0.64	0.233
	115	22	1.00	0.62	0.000
	116	18	1.00	0.89	0.089
Mixed Pine-Hardwood	14	19	0.50	0.15	0.000
	17	15	0.75	0.54	0.053
	20	9	0.75	0.57	0.197
	53	20	0.75	0.27	0.000
	62	20	0.50	0.41	0.189
	76	15	0.75	0.72	0.731
Herbaceous	57	3	1.00	0.50	0.186
	59	9	0.00	0.73	0.000
	68	8	0.00	0.54	0.013
	71	12	0.00	0.70	0.000
	72	8	1.00	0.41	0.001
Shrub	56	8	1.00	1.00	1.000
	65	6	1.00	1.00	1.000
	78	11	1.00	0.29	0.000
	107	11	0.00	0.85	0.000
Swamp	60	16	0.25	0.51	0.025
	69	6	0.25	0.38	0.185
	73	15	0.25	0.37	0.140
	109	13	0.25	0.34	0.460
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.46	0.006
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.24. *A priori* HSI model evaluation using t-test comparison of *a priori* tree den availability (SI_{TDA}) SI scores and *a posteriori* SI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**n**	***A priori* SI**	***A posteriori* SI**	**P-value**
Hardwood	15	11	0.00	0.00	1.000
	18	20	0.00	0.00	1.000
	21	10	0.00	0.00	1.000
	54	17	0.50	0.18	0.004
	58	16	0.50	0.11	0.000
	63	16	0.50	0.09	0.000
	67	16	0.50	0.00	1.000
	70	20	0.50	0.00	1.000
	77	17	0.50	0.00	1.000
	100	15	0.00	0.00	1.000
Pine	16	21	0.00	0.00	1.000
	19	14	0.00	0.00	1.000
	22	16	0.00	0.00	1.000
	75	19	0.00	0.00	1.000
	115	22	0.00	0.00	1.000
	116	18	0.00	0.00	1.000
Mixed Pine-Hardwood	14	19	0.00	0.00	1.000
	17	15	0.00	0.00	1.000
	20	9	0.00	0.00	1.000
	53	20	0.50	0.00	1.000
	62	20	0.50	0.05	0.000
	76	15	0.00	0.00	1.000
Herbaceous	57	3	0.00	0.26	0.423
	59	9	0.00	0.00	1.000
	68	8	0.00	0.00	1.000
	71	12	0.00	0.00	1.000
	72	8	0.00	0.00	1.000
Shrub	56	8	0.00	0.00	1.000
	65	6	0.00	0.00	1.000
	78	11	0.00	0.00	1.000
	107	11	0.00	0.00	1.000
Swamp	60	16	1.00	0.10	0.000
	69	6	1.00	0.17	0.004
	73	15	1.00	0.00	1.000
	109	13	0.00	0.00	1.000
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.00	1.000
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.25. *A priori* HSI model evaluation using t-test comparison of *a priori* food component (CI_{FOOD}) CI scores and *a posteriori* CI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	*A priori* CI	*A posteriori* CI	P-value
Hardwood	15	11	0.89	0.64	0.011
	18	20	0.89	0.49	0.000
	21	10	0.89	0.41	0.000
	54	17	0.89	0.58	0.001
	58	16	0.89	0.44	0.000
	63	16	0.89	0.46	0.000
	67	16	0.89	0.53	0.001
	70	20	0.89	0.47	0.000
	77	17	0.89	0.51	0.000
	100	15	0.63	0.30	0.002
Pine	16	21	0.00	0.12	0.007
	19	14	0.00	0.21	0.006
	22	16	0.00	0.02	0.333
	75	19	0.00	0.23	0.001
	115	22	0.00	0.36	0.000
	116	18	0.00	0.03	0.331
Mixed Pine-Hardwood	14	19	0.63	0.61	0.729
	17	15	0.63	0.55	0.357
	20	9	0.76	0.74	0.796
	53	20	0.63	0.62	0.878
	62	20	0.63	0.73	0.007
	76	15	0.63	0.64	0.919
Herbaceous	57	3	0.00	0.21	0.423
	59	9	0.00	0.16	0.085
	68	8	0.00	0.04	0.351
	71	12	0.00	0.00	1.000
	72	8	0.00	0.21	0.095
Shrub	56	8	0.00	0.19	0.177
	65	6	0.00	0.20	0.176
	78	11	0.00	0.07	0.112
	107	11	0.00	0.00	1.000
Swamp	60	16	0.14	0.37	0.011
	69	6	0.00	0.61	0.001
	73	15	0.14	0.07	0.102
	109	13	0.14	0.05	0.012
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.00	1.000
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.26. *A priori* HSI model evaluation using t-test comparison of *a priori* cover component (CI_{COVER}) CI scores and *a posteriori* CI scores developed from field-based habitat survey for 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	n	*A priori* CI	*A posteriori* CI	P-value
Hardwood	15	11	0.50	0.21	0.014
	18	20	0.50	0.69	0.043
	21	10	0.50	0.30	0.107
	54	17	0.50	0.56	0.513
	58	16	0.50	0.57	0.470
	63	16	0.50	0.52	0.813
	67	16	0.50	0.52	0.891
	70	20	0.50	0.57	0.438
	77	17	0.50	0.72	0.023
	100	15	1.00	0.69	0.010
Pine	16	21	0.75	0.71	0.656
	19	14	0.75	0.45	0.008
	22	16	0.75	0.43	0.004
	75	19	0.75	0.64	0.233
	115	22	1.00	0.62	0.000
	116	18	1.00	0.89	0.089
Mixed Pine-Hardwood	14	19	0.50	0.15	0.000
	17	15	0.75	0.54	0.053
	20	9	0.75	0.57	0.197
	53	20	0.75	0.27	0.000
	62	20	0.50	0.43	0.289
	76	15	0.75	0.72	0.731
Herbaceous	57	3	1.00	0.50	0.186
	59	9	0.00	0.73	0.000
	68	8	0.00	0.54	0.013
	71	12	0.00	0.70	0.000
	72	8	1.00	0.41	0.001
Shrub	56	8	1.00	1.00	1.000
	65	6	1.00	1.00	1.000
	78	11	1.00	0.29	0.000
	107	11	0.00	0.85	0.000
Swamp	60	16	0.63	0.51	0.307
	69	6	0.63	0.44	0.113
	73	15	0.63	0.37	0.006
	109	13	0.25	0.34	0.460
Non-Habitat	99	9	0.00	0.00	1.000
	110	11	0.00	0.46	0.006
	112	4	0.00	0.00	1.000

* Highlighted P-values indicate statistical difference ($p < 0.05$) between *a priori* and *a posteriori* SI scores.

Table 3.27. Percent of *a priori* SI_{SFA}, SI_{FFA}, SI_{FFD}, SI_{FFP}, SI_{PC}, SI_{TDA}, CI_{FOOD}, and CI_{COVER} scores that differed from *a posteriori* SI and CI scores using *t*-test comparison for 38 surveyed habitat classifications among land-cover types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011. Differences in mean suitability scores by cover-type were calculated using mean *a priori* and *a posteriori* SI and CI scores and positive values indicated a general overestimation and negative values indicate a general underestimation of *a priori* scores.

		Difference in Mean Suitability Scores by Cover-type					
Suitability Index	Percent of *A priori* Scores Different	Hardwood	Mixed Pine-Hardwood	Pine	Herbaceous	Shrub	Swamp
SI_{SFA}	37	0.15	0.08	0.09	-0.72	0.11	-0.25
SI_{FFA}	37	0.36	-0.23	-0.14	-0.14	-0.12	-0.28
SI_{FFD}	47	0.47	-0.06	-0.21	-0.13	-0.13	0.06
SI_{FFP}	26	0.28	0.13	-0.02	-0.03	-0.03	0.18
SI_{PC}	50	0.03	0.22	0.21	-0.18	-0.04	-0.15
SI_{TDA}	16	0.26	0.16	0.00	-0.05	0.00	0.68
Component Index							
CI_{FOOD}	47	0.38	0.00	-0.16	-0.12	-0.11	-0.17
CI_{COVER}	45	0.02	0.22	0.21	0.12	-0.18	-0.04

CHAPTER IV: CONCLUSION

In 2005, the state of Texas drafted, in cooperation with state and federal representatives and corporate and private stakeholders, a comprehensive 10-year (2005-2015) conservation and management plan for black bears in east Texas (Texas Parks and Wildlife Department 2005). The goal of the plan was to reestablish the black bear as a viable native component of east Texas ecosystems. The East Texas Black Bear Conservation and Management Plan (ETBBCMP) established the framework for developing biological and ecological research programs, sociological research and public outreach programs, and a conservation plan aimed at reintroducing Louisiana black bears (*Ursus americanus luteolus*) from source populations. However, in order to develop a sound plan for the return of black bears to the region, it was essential to evaluate the current status of black bear populations, the suitability of habitats, and social and political support regarding black bears in the region. Our study was initiated in response to the general lack of quantitative data regarding black bear distribution and habitat characteristics in the south recovery zone in east Texas.

We utilized the hair trap methodologies for collecting and analyzing genetic samples from bears and developed a landscape-scale GIS-based habitat suitability index for the region pursuant to the goals and objectives outlined by the ETBBCMP. Although continued monitoring and collection of reliable bear sightings is warranted, our study satisfies the goals for quantitatively assessing the current population distribution and region-wide habitat suitability as outlined by the ETTBBCMP. Active management and restoration of black bear populations is currently ongoing in Arkansas, Oklahoma, and Louisiana. Base-line occupancy data and region-wide habitat suitability information in east Texas were necessary for developing sound management practices that were consistent with those in adjacent states. The data provided in this study may be used to evaluate current management plans, focus habitat restoration and reconstruction projects, and direct future recovery efforts in east Texas.

Our study provides the first rigorous assessment of population status and region-wide habitat suitability for the Louisiana black bear in southeastern Texas. Our data suggested that it is unlikely that a population of black bears exist within the south recovery zone. Reliable bear sightings have been recorded throughout the region with increasing frequency since the late 1970s, indicating that dispersing bears from adjacent states were capable of reaching east Texas. Furthermore, our data indicated that suitable habitats existed in the south recovery zone that were capable of supporting viable populations of black bears (i.e., a population with a ≥95% probability of persisting for ≥100 years; Shaffer 1981). We identified 4 recovery units which exceeded the minimum area requirement of suitable habitat for establishing sustainable populations of black bears. Although mean HSI scores for the recovery units were lower than those previously estimated in the south recovery zone, our scores equated to moderately suitable habitats and were consistent with recent estimates of habitat suitability in northeast Texas.

Historically, large contiguous forested timberlands in east Texas were owned and managed under long-term (>50 years) landownership by vertically integrated forest products companies (VIFPCs). Forest products companies owned both their own timberlands and timber manufacturing facilities, ensuring sustainable management of timberlands (considering their vested interest in both markets; Hickman 2007). However, over the past 30 years, landownership in the region has become increasingly unstable as large contiguous forests are fragmented and sustainable forestry gives way to potentially less renewable goals. Beginning in the mid-1980s, Timber Investment Management Organizations (TIMOs) began purchasing large portions of VIFPC properties in the southeast U.S. Timberlands were utilized as short-term (10-15 year) alternatives to investment stocks in which the goal of TIMOs was to diversify investor's portfolios and maximize stockholder returns (Hickman 2007).

Although little evidence exists to suggest that management practices employed by TIMOs will be different than those utilized by VIFPCs, the risk to the sustainability of black bear populations in east Texas is evident. Under TIMOs ownership, the overall management goal for timberlands was no longer sustainable forest production. Following the investment period, timber was either harvested or the timberlands sold; typically in smaller parcels than originally purchased (Hickman 2007). The increased risk of landscape-scale habitat fragmentation raises serious concerns regarding the sustainability of suitable black bear recovery units in the region. The Lower Neches River Recovery Unit (LNRRU), for example, is composed of at least 51% TIMOs properties. The mean HSI score for the LNRRU is on the lower end of the moderately suitable category. If management strategies on TIMOs properties significantly diminish the current or future availability and productivity of food or cover, recovery units could become unsuitable for sustaining MVPs of black bears. Ultimately, habitat conservation programs and black bear recovery efforts must be a collaborative of state and federal agencies, VIFPCs, and TIMOs if the recovery goals outlined by state and federal Louisiana black bear recovery plans are to be achieved in east Texas.

In general, human populations have increased in the south recovery zone from 2000-2010 (U.S. Census Bureau 2011). Chambers (>25%) and San Jacinto (15-25%) counties showed the greatest percent population growth, although these counties were located on the periphery of the south recovery zone. Throughout the remainder of the region, 6 counties (Houston, Jefferson, Jasper, Sabine, Shelby, and Tyler) saw increases of 0-5%, 8 counties (Anderson, Angelina, Cherokee, Hardin, Liberty, Nacogdoches, Polk, and Trinity) saw increases of 5-15%, and 3 counties (Newton, Orange, and San Augustine) decreased in total population. Decreased populations in Newton and Orange counties are favorable for the long-term sustainability of the Sabine River Recovery Unit. Low to moderate percent increases in county population size around the Middle Neches River Recovery Unit, Lower Neches River Recovery Unit, and Lower Trinity River Recovery Units may indicate increased future risks to the sustainability of these recovery units. Our data indicated that these recovery units are sufficient for sustaining viable black bear populations. However, in light of recent human population census data, increased focus on habitat improvement and conservation programs may be warranted in and around these recovery units in order to preserve them for future black bear use.

The ETBBCMP mandated the development of a Louisiana black bear reintroduction plan. Prior to implementing such efforts, it was essential to assess the status of the current population in order to identify potential impacts of such actions to existing populations. Second, large contiguous habitats capable of meeting the year-round habitat requirements for black bears and capable of supporting sustainable populations needed to be identified. Finally, sociological research aimed at evaluating public and political support for the reintroduction of the Louisiana black bear in east Texas is critical to the success of reintroduction efforts. Although our data achieved the former and suggests that suitable reintroduction zones exist in east Texas, human dimensions research is ongoing. Considering that the reintroduction zones that we presented were developed based on the biological and ecological requirements necessary for sustaining a minimum viable population of bears, our data may subsequently be used to identify communities to focus human dimensions research and outreach regarding the reintroduction of black bears in the south recovery zone. Ultimately, the combination of ecological and sociological research may provide the foundation for initiating reintroduction plans and reestablishing the Louisiana black bear as a viable component of east Texas ecosystems; achieving the goals set forth by state and federal recovery plans.

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APPENDICES

APPENDIX A

FOOD ITEMS CONSUMED BY BLACK BEARS (*URSUS AMERICANUS*) IN VARIOUS LOCATIONS IN NORTH AMERICA DURING AT LEAST ONE SEASON

Appendix A. Food items consumed by black bears (*Ursus americanus*) in various locations in North America during at least one season.

Food item	Found in east Texas	Location	Literature Review
Agriculture			
Peanut (*Arachis hypogaea*)	NA	FL, GA, LA, NC	Landers et al. 1979, Dobey et al. 2005, Benson and Chamberlain 2006
Oats (*Avena sativa*)	NA	LA	Benson and Chamberlain 2006
Soybean (*Glycine max*)	NA	LA	Benson and Chamberlain 2006
Milo (*Sorghum bicolor*)	NA	LA	Benson and Chamberlain 2006
Sorghum (*Sorghum* spp.)	NA	LA	Benson and Chamberlain 2006
Wheat (*Triticum aestivum*)	NA	LA	Benson and Chamberlain 2006
Corn (*Zea mays*)	NA	FL, GA, LA, NC	Landers et al. 1979, Hellgren and Vaughan 1988, Dobey et al. 2005, Benson and Chamberlain 2006
Millet (Unspecified)	NA	FL	Dobey et al. 2005
Tree			
Water hickory (*Carya aquatica*)	Yes	LA	Benson and Chamberlain 2006
Hickory (*Carya* spp.)	Yes	AR, NC, TN	Beeman and Pelton 1980, Clark et al. 1987
Flowering dogwood (*Cornus florida*)	Yes	AR	Clark et al. 1987
Dogwood (*Cornus* spp.)	Yes	AR, CA, LA	Clark et al. 1987, Benson and Chamberlain 2006, Greenleaf et al. 2009
Persimmon (*Diospyros virginiana*)	Yes	AR, LA	Clark et al. 1987, Benson and Chamberlain 2006
American beech (*Fagus grandifolia*)	Yes	AR, NC, TN	Beeman and Pelton 1980, Clark et al. 1987
Juniper (*Juniperus communis*)	No	Alberta, Canada	Raine and Kansas 1990
Sweetgum (*Liquidambar styraciflua*)	Yes	LA	Benson and Chamberlain 2006
Southern magnolia (*Magnolia grandiflora*)	Yes	FL	Dobey et al. 2005
Sweetbay (*Magnolia virginiana*)	Yes	NC	Landers et al. 1979, Hellgren and Vaughan 1988
Crab apple (*Malus* spp.)	Yes	NC, TN	Beeman and Pelton 1980

(Continued)

Appendix A (Continued). Food items consumed by black bears (*Ursus americanus*) in various locations in North America during at least one season.

Food item	Found in east Texas	Location	Literature Review
Tree (Cont.)			
Red mulberry (*Morus rubra*)	Yes	FL	Roof 1997
Blackgum (*Nyssa sylvatica*)	Yes	AR, FL, GA, NC	Clark et al. 1987, Landers et al. 1979, Dobey et al. 2005
Swamp blackgum (*Nyssa biflora*)	Yes	FL	Maehr and Brady 1984, Roof 1997
Tupelo (*Nyssa* spp.)	Yes	LA	Benson and Chamberlain 2006
Red bay (*Persea borbonia*)	Yes	FL, GA, NC	Landers et al. 1979, Dobey et al. 2005
Whiteback pine (*Pinus albicaulis*)	Yes	Alberta, Canada	Raine and Kansas 1990
Pine (*Pinus* spp.)	Yes	CA	Graber and White 1983
Pin cherry (*Prunus pennsylvanica*)	No	FL, GA, NC	Landers et al. 1979, Dobey et al. 2005
Black cherry (*Prunus serotina*)	Yes	NC, TN	Beeman and Pelton 1980, Garshelis and Pelton 1981
Oak (*Quercus* spp.)	Yes	CA, FL, GA, LA, NC, TN	Beeman and Pelton 1980, Garshelis and Pelton 1981, Graber and White 1983, Maehr and Brady 1984, Roof 1997, Dobey et al. 2005, Benson and Chamberlain 2006, Greenleaf et al. 2009
Shrub			
Serviceberry (*Amelanchier* spp.)	Yes	NC, TN, UT	Beeman and Pelton 1980, Auger et al. 2002
Devil's walking stick (*Aralia spinosa*)	Yes	AR, NC	Clark et al. 1987, Hellgren and Vaughan 1988
Bearberries (*Arctostaphylos uva-ursi)*	No	Alberta, Canada	Raine and Kansas 1990
Manzanita (*Arctostaphylos*spp.)	No	CA	Graber and White 1983, Greenleaf et al. 2009
Pawpaw (*Asimina triloba*)	Yes	LA	Anderson 1997
Beautyberry (*Callicarpa americana*)	Yes	LA	Benson and Chamberlain 2006

(Continued)

Appendix A (Continued). Food items consumed by black bears (*Ursus americanus*) in various locations in North America during at least one season.

Food item	Found in east Texas	Location	Literature Review
Shrub (Cont.)			
Hackberry (*Celtis tenuifolia*)	Yes	LA	Benson and Chamberlain 2006
Swamp dogwood (*Cornus foemina*)	Yes	FL	Roof 1997
Red osier dogwood (*Cornus stolonifera*)	No	Alberta, Canada	Raine and Kansas 1990
Crowberry (*Empetrum nigrum*)	No	Alberta, Canada	Raine and Kansas 1991
Loquat (*Eriobotrya japonica)*	Ornamental	LA	Benson and Chamberlain 2006
Strawberry (*Fragaria* virginiana)	Yes	Alberta, Canada	Raine and Kansas 1990
Carolina buckthorn (*Frangula caroliniana*)	Yes	AR	Clark et al. 1987
Huckleberry (*Gaylussacia* spp.)	No	GA, NC, TN	Landers et al. 1979, Beeman and Pelton 1980, Dobey et al. 2005
Baygall holly (*Ilex coriacea*)	Yes	FL, GA, NC	Landers et al. 1979, Hellgren and Vaughan 1988, Dobey et al. 2005
Inkberry holly (*Ilex glabra*)	Yes	FL, GA, NC	Landers et al. 1979, Maehr and Brady 1984, Hellgren and Vaughan 1988, Dobey et al. 2005
Winterberry holly (*Ilex verticillata*)	Yes	NC	Hellgren and Vaughan 1988, Landers et al. 1979
Holly (*Ilex* spp.)	Yes	FL, NC	Landers et al. 1979, Maehr and Brady 1984
Privet (*Ligustrum* spp.*)*	Yes	LA	Benson and Chamberlain 2006
Oregon grape (*Mahonia repens*)	Yes	UT	Auger et al. 2002
Wax myrtle (*Myrica heterophylla*)	Yes	NC	Landers et al. 1979
Squawapple (*Peraphyllum ramosissimum*)	No	UT	Auger et al. 2002
Western chokecherry (*Prunus demissa*)	No	CA	Greenleaf et al. 2009
Bitter cherry (*Prunus emarginata*)	No	CA	Graber and White 1983
Sierra plum (*Prunus subcordata*)	Yes	CA	Greenleaf et al. 2009
Chokecherry (*Prunus virginiana*)	Yes	UT	Auger et al. 2002
Coffeeberry (*Rhamnus* spp.)	Yes	CA	Greenleaf et al. 2009

(Continued)

Appendix A (Continued). Food items consumed by black bears (*Ursus americanus*) in various locations in North America during at least one season.

Food item	Found in east Texas	Location	Literature Review
Shrub (Cont.)			
Skunkbush sumac (*Rhus trilobata*)	Yes	UT	Auger et al. 2002
Gooseberry (*Ribes* spp.)	Yes	Alberta, Canada, CA	Raine and Kansas 1991, Greenleaf et al. 2009
Blackberry, raspberry, dewberry (*Rubus* spp.)	Yes	CA, FL, LA, NC, TN	Landers et al. 1979, Beeman and Pelton 1980, Maehr and Brady 1984, Hellgren and Vaughan 1988, Roof 1997, Dobey et al. 2005, Benson and Chamberlain 2006, Greenleaf et al. 2009
Blue elderberry (*Sambucus mexicana*)	Yes	CA, UT	Auger et al. 2002, Greenleaf et al. 2009
Buffaloberry (*Shepherdia canadensis*)	No	Alberta, Canada	Raine and Kansas 1991
Mountain ash (*Sorbus scopulina*)	No	Alberta, Canada	Raine and Kansas 1991
Snowberry (*Symphoricarpos oreophilus*)	No	UT	Auger et al. 2002
Blueberry (*Vaccinium* spp.)	Yes	Alberta, Canada, FL, GA, NC, TN,	Landers et al. 1979, Beeman and Pelton 1980, Maehr and Brady 1984, Hellgren and Vaughan 1988, Raine and Kansas 1991, Roof 1997, Dobey et al. 2005
Viburnum (*Viburnum* spp.)	Yes	LA	Benson and Chamberlain 2006
Cocklebur (*Xanthium* spp.)	Yes	LA	Benson and Chamberlain 2006
Palm			
Palmetto (*Sabal minor*)	Yes	FL, GA, LA	Dobey et al. 2005, Benson and Chamberlain 2006
Cabbage palmetto (*Sabal palmetto*)	No	FL	Maehr and Brady 1984, Roof 1997
Saw palmetto (*Serenoa repens*)	No	FL	Maehr and Brady 1984, Roof 1997
Vine			
Peppervine (*Ampelopsis arborea*)	Yes	FL, LA	Roof 1997, Benson and Chamberlain 2006

(Continued)

Appendix A (Continued). Food items consumed by black bears (*Ursus americanus*) in various locations in North America during at least one season.

Food item	Found in east Texas	Location	Literature Review
Vine (Cont)			
Japanese honeysuckle (Lonicera japonica)	Yes	NC	Hellgren and Vaughan 1988,
Virginia creeper (*Parthenocissus quinquefolia*)	Yes	LA	Benson and Chamberlain 2006
Greenbriar (*Smilax* spp.)	Yes	FL, GA, NC	Landers et al. 1979, Maehr and Brady 1984, Hellgren and Vaughan 1988, Dobey et al. 2005
Muscadine (*Vitis rotundifolia*)	Yes	LA, NC	Landers et al. 1979, Benson and Chamberlain 2006
Other grape (*Vitis* spp.)	Yes	AR, FL, GA, LA, NC, TN	Beeman and Pelton 1980, Clark et al. 1987, Dobey et al. 2005, Benson and Chamberlain 2006
Herbaceous (Mast Producing)			
Pokeberry (*Phytolacca americana*)	Yes	AR, LA, NC	Clark et al. 1987, Hellgren and Vaughan 1988, Benson and Chamberlain 2006
Pokeweed (*Phytolacca rigida*)	No	GA, FL	Maehr and Brady 1984, Dobey et al. 2005
Herbaceous (Non-mast Producing)			
Giant Cane (*Arundinaria gigantea*)	Yes	NC	Hellgren and Vaughan 1988

APPENDIX B

SUMMARY OF MEAN DIAMETER AT BREAST HEIGHT (DBH) AND HEIGHT FOR TREE SPECIES ≥15 CM DBH MEASURED IN 38 HABITAT CLASSIFICATIONS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix B. Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	Code	Species	n	Min	Max	Mean	Min	Max	Mean
Hardwood	15	*Pinus spp.*	32	17.1	63.5	35.9	12.0	32.0	22.1
	15	*Quercus alba*	19	17.4	58.1	29.3	10.0	18.0	14.5
	15	*Liquidambar styraciflua*	10	17.4	35.1	21.7	12.0	16.0	13.4
	15	*Nyssa spp.*	9	15.6	37.6	25.0	13.0	16.0	15.2
	15	*Nyssa sylvatica*	8	15.8	28.8	21.1	8.0	15.0	11.9
	15	*Fagus grandifolia*	6	33.4	57.0	44.3	24.0	30.0	26.2
	15	*Acer barbatum*	5	16.7	30.6	23.0	12.0	18.0	15.6
	15	*Fraxinus spp.*	4	16.4	49.8	29.3	12.0	30.0	18.0
	15	*Quercus falcata*	4	23.7	71.1	43.9	12.0	18.0	15.8
	15	*Magnolia virginiana*	3	21.5	35.9	28.0	11.0	13.0	12.0
	15	*Acer rubrum*	2	17.9	18.5	18.2	8.0	12.0	10.0
	15	*Ilex opaca*	2	15.9	17.3	16.6	8.0	10.0	9.0
	15	*Quercus nigra*	2	20.2	50.7	35.5	12.0	14.0	13.0
	15	*Carya spp.*	1	15.5	15.5	15.5	12.0	12.0	12.0
	15	*Juniperus virginiana*	1	24.6	24.6	24.6	11.0	11.0	11.0
	15	*Nyssa aquatica*	1	25.2	25.2	25.2	12.0	12.0	12.0
	15	*Ostrya virginiana*	1	18.9	18.9	18.9	16.0	16.0	16.0
	15	*Quercus spp.*	1	38.8	38.8	38.8	18.0	18.0	18.0
	15	*Quercus marilandica*	1	17.6	17.6	17.6	12.0	12.0	12.0
	15	*Quercus similis*	1	15.5	15.5	15.5	12.0	12.0	12.0
	15	*Quercus stellata*	1	37.9	37.9	37.9	12.0	12.0	12.0
	15	*Ulmus alata*	1	27.0	27.0	27.0	14.0	14.0	14.0
	15	*Ulmus spp.*	1	32.5	32.5	32.5	18.0	18.0	18.0
	18	*Pinus spp.*	46	15.0	69.1	31.3	8.0	25.0	16.3
	18	*Nyssa sylvatica*	24	15.5	46.5	25.9	4.0	18.0	10.4
	18	*Quercus laurifolia*	11	15.0	72.6	32.0	6.0	18.0	12.4
	18	*Liquidambar styraciflua*	9	15.0	45.4	28.3	9.0	17.0	13.2
	18	*Quercus alba*	8	15.0	61.7	27.4	11.0	19.0	13.1
	18	*Quercus nigra*	8	15.5	54.7	26.9	10.0	16.0	13.3
	18	*Magnolia virginiana*	7	19.0	42.1	25.4	10.0	18.0	13.4
	18	*Ilex opaca*	6	15.3	26.5	19.3	10.0	12.0	10.3
	18	*Fagus grandifolia*	4	18.4	46.3	34.6	10.0	15.0	12.3
	18	*Magnolia grandifolia*	4	28.0	68.3	45.2	10.0	18.0	14.5
	18	*Triadica sebiferum*	4	15.5	33.4	22.2	8.0	18.0	12.0
	18	*Acer rubrum*	3	16.3	49.5	27.5	10.0	13.0	11.7
	18	*Ostrya virginiana*	3	15.1	18.2	16.8	8.0	10.0	9.3
	18	*Quercus falcata*	3	31.7	39.0	36.6	15.0	18.0	17.0
	18	*Quercus stellata*	3	25.5	30.0	28.4	12.0	16.0	14.7
	18	*Carpinus caroliniana*	2	15.5	15.5	15.5	8.0	13.0	10.5
	18	*Prunus serotina*	2	18.0	44.3	31.2	16.0	18.0	17.0
	18	*Quercus michauxii*	2	19.8	31.8	25.8	10.0	12.0	11.0
	18	*Quercus phellos*	2	24.2	38.6	31.4	10.0	12.0	11.0
	18	*Acer barbatum*	1	16.1	16.1	16.1	7.0	7.0	7.0
	18	*Carya spp.*	1	38.3	38.3	38.3	10.0	10.0	10.0
	18	*Quercus muehlenbergii*	1	33.0	33.0	33.0	10.0	10.0	10.0

(Continued)

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Hardwood	21	*Pinus spp.*	58	15.3	76.8	29.3	8.0	22.0	15.5
(Continued)	21	*Quercus stellata*	24	15.0	36.6	23.6	8.0	16.0	11.3
	21	*Ilex opaca*	3	15.1	24.7	18.5	4.0	12.0	8.7
	21	*Acer rubrum*	1	20.0	20.0	20.0	12.0	12.0	12.0
	21	*Fraxinus spp.*	1	20.5	20.5	20.5	14.0	14.0	14.0
	21	*Nyssa sylvatica*	1	15.7	15.7	15.7	10.0	10.0	10.0
	21	*Quercus alba*	1	60.0	60.0	60.0	18.0	18.0	18.0
	21	*Quercus falcata*	1	30.6	30.6	30.6	14.0	14.0	14.0
	21	*Quercus marilandica*	1	16.1	16.1	16.1	6.0	6.0	6.0
	21	*Quercus nigra*	1	32.7	32.7	32.7	16.0	16.0	16.0
	21	*Ulmus alata*	1	15.7	15.7	15.7	12.0	12.0	12.0
	21	*Ulmus spp.*	1	19.0	19.0	19.0	10.0	10.0	10.0
	54	*Nyssa aquatica*	50	16.5	102.2	47.7	10.0	18.0	13.9
	54	*Taxodium distichum*	27	21.3	89.0	43.2	10.0	18.0	14.9
	54	*Liquidambar styraciflua*	14	19.3	64.1	31.9	10.0	20.0	15.1
	54	*Nyssa sylvatica*	14	19.8	74.7	45.6	10.0	18.0	13.9
	54	*Magnolia virginiana*	11	19.5	42.7	29.4	10.0	18.0	14.3
	54	*Quercus nigra*	11	18.5	69.3	37.0	8.0	22.0	13.5
	54	*Acer rubrum*	7	16.7	34.5	25.2	8.0	14.0	10.7
	54	*Pinus spp.*	6	30.3	51.5	39.7	14.0	25.0	20.0
	54	*Quercus laurifolia*	6	16.5	33.6	26.2	9.0	14.0	11.5
	54	*Carpinus caroliniana*	5	16.9	27.2	20.1	8.0	8.0	8.0
	54	*Carya spp.*	5	19.0	48.9	34.6	8.0	16.0	12.4
	54	*Quercus phellos*	5	18.6	66.1	44.3	11.0	18.0	15.0
	54	*Fraxinus spp.*	3	15.3	33.2	21.6	6.0	8.0	6.7
	54	*Quercus alba*	3	23.0	32.0	27.1	8.0	16.0	13.0
	54	*Quercus falcata*	2	15.9	16.3	16.1	10.0	10.0	10.0
	54	*Triadica sebiferum*	2	16.7	18.0	17.4	10.0	10.0	10.0
	54	*Betula nigra*	1	17.6	17.6	17.6	10.0	10.0	10.0
	54	*Celtis laevigata*	1	18.0	18.0	18.0	10.0	10.0	10.0
	54	*Fagus grandifolia*	1	21.2	21.2	21.2	14.0	14.0	14.0
	54	*Nyssa spp.*	1	16.6	16.6	16.6	11.0	11.0	11.0
	54	*Platanus occidentalis*	1	18.7	18.7	18.7	9.0	9.0	9.0
	54	*Quercus michauxii*	1	48.2	48.2	48.2	18.0	18.0	18.0
	58	*Triadica sebiferum*	24	15.4	25.0	18.6	7.0	16.0	11.7
	58	*Liquidambar styraciflua*	20	19.0	71.2	36.9	10.0	20.0	14.2
	58	*Taxodium distichum*	10	20.8	82.0	43.2	8.0	26.0	17.4
	58	*Fraxinus spp.*	9	17.2	36.1	26.3	8.0	19.0	13.7
	58	*Carpinus caroliniana*	6	17.4	23.3	19.8	6.0	12.0	8.7
	58	*Ulmus spp.*	5	20.7	37.1	25.6	12.0	14.0	13.2
	58	*Carya spp.*	4	24.3	34.3	29.0	12.0	20.0	18.0
	58	*Nyssa sylvatica*	4	24.4	53.8	41.7	14.0	18.0	16.0
	58	*Quercus nigra*	4	17.5	86.0	52.3	10.0	22.0	15.0
	58	*Quercus similis*	4	23.4	58.2	40.5	11.0	16.0	13.3
	58	*Acer spp.*	3	15.8	27.3	22.9	8.0	11.0	10.0
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Hardwood	58	*Magnolia virginiana*	3	28.2	35.7	32.2	20.0	20.0	20.0
(Continued)	58	*Quercus falcata*	3	17.4	40.4	30.3	15.0	21.0	17.3
	58	*Celtis laevigata*	2	20.0	22.7	21.4	14.0	16.0	15.0
	58	*Ilex opaca*	2	20.1	23.5	21.8	10.0	12.0	11.0
	58	*Betula nigra*	1	17.8	17.8	17.8	10.0	10.0	10.0
	58	*Nyssa spp.*	1	28.4	28.4	28.4	12.0	12.0	12.0
	58	*Prunus serotina*	1	27.0	27.0	27.0	16.0	16.0	16.0
	63	*Quercus nigra*	19	16.4	32.5	22.8	11.0	18.0	13.8
	63	*Nyssa spp.*	13	16.1	40.5	23.1	10.0	14.0	11.8
	63	*Nyssa sylvatica*	12	15.1	64.6	28.2	10.0	18.0	13.2
	63	*Pinus spp.*	12	15.1	61.1	34.4	12.0	20.0	17.4
	63	*Liquidambar styraciflua*	11	19.2	70.1	30.0	10.0	24.0	15.6
	63	*Carpinus caroliniana*	9	15.7	22.0	19.2	8.0	15.0	11.2
	63	*Quercus laurifolia*	6	17.0	22.5	19.7	10.0	14.0	12.0
	63	*Carya spp.*	5	21.0	60.3	34.8	14.0	20.0	16.0
	63	*Quercus michauxii*	5	25.5	57.8	38.1	6.0	20.0	14.4
	63	*Acer barbatum*	4	20.9	35.2	29.3	10.0	16.0	12.5
	63	*Quercus falcata*	4	29.3	107.1	49.6	14.0	32.0	19.5
	63	*Taxodium distichum*	4	27.7	78.7	56.6	12.0	18.0	15.8
	63	*Ulmus spp.*	3	18.5	33.6	26.0	12.0	17.0	14.3
	63	*Acer rubrum*	2	15.2	22.3	18.8	6.0	8.0	7.0
	63	*Magnolia virginiana*	2	18.0	18.3	18.2	12.0	12.0	12.0
	63	*Triadica sebiferum*	2	17.5	26.6	22.1	10.0	10.0	10.0
	63	*Fraxinus spp.*	1	51.0	51.0	51.0	16.0	16.0	16.0
	63	*Ilex opaca*	1	26.2	26.2	26.2	12.0	12.0	12.0
	63	*Magnolia grandifolia*	1	63.0	63.0	63.0	14.0	14.0	14.0
	63	*Nyssa aquatica*	1	22.2	22.2	22.2	11.0	11.0	11.0
	63	*Quercus hemisphaerica*	1	98.0	98.0	98.0	14.0	14.0	14.0
	67	*Liquidambar styraciflua*	33	15.3	70.6	34.8	7.0	26.0	16.2
	67	*Nyssa sylvatica*	9	16.1	32.6	25.6	12.0	18.0	14.4
	67	*Pinus spp.*	8	16.2	74.0	33.9	10.0	25.0	15.9
	67	*Nyssa aquatica*	7	17.7	59.7	41.3	7.0	16.0	13.9
	67	*Quercus nigra*	6	15.3	58.1	33.9	10.0	17.0	14.2
	67	*Taxodium distichum*	6	24.5	79.8	51.6	11.0	20.0	15.8
	67	*Acer spp.*	5	28.0	47.6	34.6	12.0	18.0	14.2
	67	*Quercus michauxii*	5	17.9	80.5	33.9	13.0	29.0	16.8
	67	*Ulmus spp.*	5	16.0	32.8	20.5	10.0	18.0	13.6
	67	*Carpinus caroliniana*	4	15.4	19.1	17.2	8.0	12.0	10.0
	67	*Fraxinus spp.*	4	18.0	32.8	22.7	10.0	16.0	13.0
	67	*Ilex opaca*	4	16.9	32.9	25.0	8.0	14.0	10.5
	67	*Ostrya virginiana*	4	16.4	22.8	20.1	12.0	16.0	13.0
	67	*Acer rubrum*	3	31.6	68.5	45.9	10.0	17.0	13.7
	67	*Platanus occidentalis*	3	39.4	51.2	44.2	20.0	28.0	24.0
	67	*Quercus laurifolia*	3	16.9	48.7	30.1	8.0	18.0	14.7
	67	*Acer barbatum*	2	16.0	17.5	16.8	12.0	12.0	12.0
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	Code	Species	n	Min	Max	Mean	Min	Max	Mean
Hardwood	67	*Carya spp.*	2	24.8	53.6	39.2	14.0	18.0	16.0
(Continued)	67	*Celtis laevigata*	2	17.2	17.6	17.4	12.0	12.0	12.0
	67	*Fagus grandifolia*	2	58.0	70.0	64.0	18.0	18.0	18.0
	67	*Nyssa spp.*	2	19.0	21.8	20.4	10.0	14.0	12.0
	67	*Quercus alba*	2	36.0	59.7	47.9	18.0	20.0	19.0
	67	*Betula nigra*	1	38.0	38.0	38.0	14.0	14.0	14.0
	67	*Magnolia virginiana*	1	25.7	25.7	25.7	12.0	12.0	12.0
	67	*Quercus falcata*	1	55.6	55.6	55.6	20.0	20.0	20.0
	67	*Quercus phellos*	1	47.5	47.5	47.5	18.0	18.0	18.0
	67	*Sassafras albidum*	1	24.1	24.1	24.1	12.0	12.0	12.0
	67	*Triadica sebiferum*	1	22.7	22.7	22.7	9.0	9.0	9.0
	70	*Taxodium distichum*	57	15.3	64.0	27.7	9.0	18.0	13.1
	70	*Nyssa sylvatica*	25	16.0	61.1	28.3	8.0	18.0	12.4
	70	*Quercus laurifolia*	25	16.7	61.1	28.4	4.0	20.0	14.0
	70	*Pinus spp.*	23	16.8	53.0	26.0	14.0	18.0	15.6
	70	*Nyssa spp.*	21	16.0	79.4	31.3	10.0	20.0	15.2
	70	*Quercus nigra*	15	16.0	55.8	29.4	10.0	18.0	13.9
	70	*Liquidambar styraciflua*	13	15.0	52.3	26.1	10.0	18.0	13.2
	70	*Fraxinus spp.*	11	15.5	29.3	19.3	6.0	16.0	10.7
	70	*Magnolia virginiana*	9	17.4	35.3	25.3	12.0	16.0	13.3
	70	*Triadica sebiferum*	6	17.9	28.1	22.9	12.0	18.0	13.5
	70	*Quercus phellos*	4	16.5	71.8	50.9	14.0	26.0	21.3
	70	*Planar aquatica*	4	15.3	23.0	17.6	7.0	10.0	8.8
	70	*Acer spp.*	3	16.3	24.5	20.3	10.0	14.0	12.7
	70	*Carpinus caroliniana*	3	16.0	29.3	22.8	9.0	12.0	10.3
	70	*Carya spp.*	3	41.1	63.2	50.4	18.0	23.0	21.0
	70	*Magnolia grandifolia*	3	21.2	34.0	26.3	12.0	14.0	13.3
	70	*Quercus alba*	3	42.2	55.4	48.9	18.0	18.0	18.0
	70	*Acer barbatum*	2	17.1	23.4	20.3	11.0	18.0	14.5
	70	*Quercus falcata*	2	18.7	29.7	24.2	10.0	10.0	10.0
	70	*Acer rubrum*	1	43.0	43.0	43.0	12.0	12.0	12.0
	70	*Ilex opaca*	1	21.3	21.3	21.3	10.0	10.0	10.0
	70	*Quercus michauxii*	1	37.6	37.6	37.6	20.0	20.0	20.0
	70	*Sassafras albidum*	1	32.9	32.9	32.9	16.0	16.0	16.0
	77	*Quercus laurifolia*	37	15.0	61.6	28.6	8.0	20.0	13.3
	77	*Nyssa sylvatica*	30	15.2	70.1	24.3	8.0	18.0	12.9
	77	*Quercus phellos*	16	16.0	63.0	26.8	12.0	20.0	15.5
	77	*Nyssa spp.*	9	21.8	44.1	30.4	11.0	16.0	14.3
	77	*Pinus spp.*	9	23.2	56.0	39.9	13.0	18.0	15.9
	77	*Quercus alba*	8	16.5	59.5	34.7	12.0	20.0	15.1
	77	*Quercus nigra*	8	16.1	65.4	36.6	10.0	20.0	13.4
	77	*Taxodium distichum*	8	16.8	55.2	34.0	10.0	16.0	12.5
	77	*Liquidambar styraciflua*	7	17.0	40.9	26.4	10.0	16.0	13.9
	77	*Magnolia virginiana*	6	15.1	52.8	26.3	10.0	18.0	14.3
	77	*Triadica sebiferum*	6	24.2	31.9	27.4	10.0	16.0	14.5
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Hardwood	77	*Quercus falcata*	4	29.2	46.7	36.6	14.0	18.0	16.0
(Continued)	77	*Fagus grandifolia*	2	27.3	29.5	28.4	16.0	16.0	16.0
	77	*Ilex opaca*	2	16.7	16.8	16.8	12.0	12.0	12.0
	77	*Acer spp.*	1	24.0	24.0	24.0	8.0	8.0	8.0
	77	*Fraxinus spp.*	1	20.0	20.0	20.0	14.0	14.0	14.0
	77	*Quercus sinuata*	1	45.6	45.6	45.6	20.0	20.0	20.0
	100	*Quercus laurifolia*	10	20.5	47.8	31.0	8.0	20.0	13.5
	100	*Nyssa sylvatica*	5	16.1	21.5	18.0	8.0	10.0	8.8
	100	*Liquidambar styraciflua*	3	31.5	34.9	33.7	13.0	20.0	16.7
	100	*Quercus nigra*	3	29.0	37.5	34.2	16.0	20.0	17.3
	100	*Pinus spp.*	1	18.8	18.8	18.8	12.0	12.0	12.0
	100	*Taxodium distichum*	1	40.7	40.7	40.7	13.0	13.0	13.0
Herbaceous	57	*Salix nigra*	6	20.8	97.8	46.0	10.0	12.0	10.7
	57	*Nyssa sylvatica*	2	21.1	35.5	28.3	12.0	16.0	14.0
	57	*Quercus stellata*	2	36.9	37.1	37.0	12.0	15.0	13.5
	57	*Liquidambar styraciflua*	1	29.7	29.7	29.7	16.0	16.0	16.0
	57	*Taxodium distichum*	1	45.8	45.8	45.8	8.0	8.0	8.0
	59	*Pinus spp.*	6	18.3	35.2	25.1	14.0	18.0	16.3
	59	*Quercus laurifolia*	5	15.7	30.1	22.2	14.0	14.0	14.0
	59	*Quercus alba*	2	19.0	25.8	22.4	12.0	16.0	14.0
	59	*Magnolia grandifolia*	1	50.8	50.8	50.8	18.0	18.0	18.0
	59	*Nyssa sylvatica*	1	25.1	25.1	25.1	12.0	12.0	12.0
	68	*Pinus spp.*	9	30.2	62.6	42.9	20.0	20.0	20.0
	68	*Carpinus caroliniana*	1	15.0	15.0	15.0	10.0	10.0	10.0
	68	*Liquidambar styraciflua*	1	37.0	37.0	37.0	18.0	18.0	18.0
	68	*Quercus falcata*	1	25.9	25.9	25.9	14.0	14.0	14.0
	71	*Pinus spp.*	23	15.1	22.0	18.3	8.0	12.0	8.8
	72	*Pinus spp.*	45	15.2	63.6	34.6	10.0	22.0	17.1
	72	*Nyssa sylvatica*	7	19.0	55.4	29.0	12.0	16.0	14.0
	72	*Liquidambar styraciflua*	4	19.5	41.7	30.2	14.0	18.0	16.5
	72	*Magnolia virginiana*	3	22.8	38.8	28.4	12.0	16.0	14.0
	72	*Acer rubrum*	1	15.3	15.3	15.3	10.0	10.0	10.0
	72	*Quercus alba*	1	17.2	17.2	17.2	8.0	8.0	8.0
	72	*Quercus stellata*	1	18.6	18.6	18.6	10.0	10.0	10.0
Mixed Pine-Hardwood	14	*Pinus spp.*	58	17.0	81.0	41.3	10.0	29.0	18.6
	14	*Liquidambar styraciflua*	28	15.6	53.5	30.8	3.0	29.0	15.9
	14	*Quercus alba*	24	15.5	61.9	33.2	9.0	20.0	16.0
	14	*Fagus grandifolia*	16	17.0	64.2	32.8	12.0	28.0	16.8
	14	*Nyssa sylvatica*	13	16.4	44.1	28.1	10.0	24.0	16.2
	14	*Magnolia virginiana*	11	19.3	48.0	31.6	17.0	26.0	22.0
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Mixed Pine-Hardwood	14	*Carpinus caroliniana*	8	16.1	24.3	19.4	8.0	16.0	11.0
(Continued)	14	*Acer rubrum*	7	17.0	29.5	23.6	7.0	18.0	14.1
	14	*Quercus falcata*	6	19.1	33.3	26.2	14.0	18.0	15.8
	14	*Acer barbatum*	5	20.0	38.9	29.4	12.0	18.0	14.0
	14	*Fraxinus spp.*	4	23.3	41.0	33.7	14.0	18.0	16.5
	14	*Ulmus spp.*	4	15.8	65.9	30.6	12.0	20.0	14.5
	14	*Magnolia grandifolia*	3	22.6	46.3	36.9	6.0	29.0	16.3
	14	*Quercus laurifolia*	3	16.2	30.3	24.3	12.0	26.0	18.0
	14	*Nyssa spp.*	2	17.8	37.0	27.4	12.0	14.0	13.0
	14	*Ostrya virginiana*	2	15.5	17.0	16.3	10.0	10.0	10.0
	14	*Quercus hemisphaerica*	2	16.3	27.6	22.0	10.0	18.0	14.0
	14	*Quercus michauxii*	2	15.4	28.4	21.9	5.0	16.0	10.5
	14	*Quercus nigra*	2	35.3	37.0	36.2	18.0	19.0	18.5
	14	*Quercus stellata*	2	22.7	34.8	28.8	12.0	14.0	13.0
	14	*Carya spp.*	1	61.2	61.2	61.2	18.0	18.0	18.0
	14	*Ilex opaca*	1	15.0	15.0	15.0	10.0	10.0	10.0
	14	*Quercus spp.*	1	38.3	38.3	38.3	18.0	18.0	18.0
	14	*Tilia americana*	1	21.4	21.4	21.4	14.0	14.0	14.0
	17	*Pinus spp.*	23	15.8	65.8	29.7	8.0	22.0	14.0
	17	*Quercus nigra*	15	15.7	54.7	26.0	12.0	20.0	14.8
	17	*Quercus alba*	13	15.4	30.1	24.4	8.0	28.0	17.5
	17	*Magnolia grandifolia*	11	23.3	62.3	39.0	4.0	20.0	15.1
	17	*Magnolia virginiana*	11	16.2	37.9	24.1	12.0	14.0	13.4
	17	*Nyssa sylvatica*	6	19.7	46.5	28.7	9.0	14.0	12.7
	17	*Quercus phellos*	5	27.0	62.1	46.1	10.0	20.0	16.8
	17	*Acer rubrum*	4	17.3	29.5	23.0	10.0	22.0	13.8
	17	*Ilex opaca*	4	21.4	32.9	25.8	11.0	12.0	11.8
	17	*Liquidambar styraciflua*	4	17.0	33.2	24.4	8.0	18.0	12.8
	17	*Quercus falcata*	3	23.2	34.6	29.2	15.0	21.0	17.3
	17	*Quercus laurifolia*	3	18.4	23.8	21.1	8.0	16.0	11.3
	17	*Carya spp.*	2	21.0	29.9	25.5	16.0	18.0	17.0
	17	*Fagus grandifolia*	2	46.1	48.2	47.2	17.0	19.0	18.0
	17	*Quercus stellata*	2	22.1	30.0	26.1	14.0	18.0	16.0
	17	*Carpinus caroliniana*	1	16.8	16.8	16.8	10.0	10.0	10.0
	17	*Fraxinus spp.*	1	33.4	33.4	33.4	16.0	16.0	16.0
	17	*Prunus serotina*	1	17.2	17.2	17.2	14.0	14.0	14.0
	17	*Quercus marilandica*	1	24.3	24.3	24.3	16.0	16.0	16.0
	17	*Quercus michauxii*	1	32.5	32.5	32.5	18.0	18.0	18.0
	17	*Triadica sebiferum*	1	17.0	17.0	17.0	10.0	10.0	10.0
	17	*Ulmus rubra*	1	20.7	20.7	20.7	12.0	12.0	12.0
	20	*Pinus spp.*	16	16.8	76.3	42.7	12.0	22.0	18.1
	20	*Quercus stellata*	13	21.9	54.9	36.5	10.0	16.0	13.7
	20	*Liquidambar styraciflua*	11	15.5	45.2	26.0	10.0	18.0	12.7
	20	*Carya spp.*	7	16.7	38.3	29.8	10.0	18.0	16.0
	20	*Quercus falcata*	4	29.6	49.8	38.6	16.0	18.0	17.0
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Mixed Pine-Hardwood	20	*Ilex opaca*	2	17.7	18.6	18.1	10.0	12.0	11.0
(Continued)	20	*Quercus alba*	2	17.7	24.6	21.2	12.0	14.0	13.0
	20	*Ulmus spp.*	2	17.2	48.0	32.6	12.0	18.0	15.0
	20	*Diospyros virginiana*	1	36.9	36.9	36.9	18.0	18.0	18.0
	20	*Fraxinus spp.*	1	25.0	25.0	25.0	16.0	16.0	16.0
	20	*Nyssa sylvatica*	1	25.7	25.7	25.7	14.0	14.0	14.0
	20	*Ostrya virginiana*	1	18.7	18.7	18.7	6.0	6.0	6.0
	20	*Quercus spp.*	1	38.5	38.5	38.5	16.0	16.0	16.0
	20	*Quercus marilandica*	1	28.2	28.2	28.2	18.0	18.0	18.0
	20	*Quercus nigra*	1	51.8	51.8	51.8	18.0	18.0	18.0
	53	*Pinus spp.*	42	17.3	93.9	41.5	12.0	28.0	18.5
	53	*Quercus phellos*	23	16.4	79.4	35.8	10.0	20.0	15.6
	53	*Liquidambar styraciflua*	17	15.8	63.0	26.0	10.0	23.0	15.0
	53	*Quercus laurifolia*	15	16.8	67.5	26.1	8.0	24.0	14.0
	53	*Quercus falcata*	13	16.4	41.6	25.9	10.0	22.0	15.5
	53	*Quercus nigra*	12	16.0	55.6	23.7	8.0	18.0	12.2
	53	*Triadica sebiferum*	7	16.4	28.5	23.3	10.0	14.0	13.4
	53	*Acer rubrum*	6	17.1	43.0	27.0	12.0	20.0	14.7
	53	*Ilex opaca*	5	15.5	22.7	18.6	10.0	20.0	12.4
	53	*Ulmus spp.*	5	19.1	38.8	27.0	10.0	16.0	12.4
	53	*Fagus grandifolia*	4	37.1	49.3	43.5	18.0	24.0	21.3
	53	*Nyssa sylvatica*	4	18.9	47.5	31.0	12.0	20.0	14.5
	53	*Quercus alba*	4	18.4	71.6	36.6	11.0	22.0	17.5
	53	*Betula nigra*	3	20.0	30.4	25.0	16.0	16.0	16.0
	53	*Carpinus caroliniana*	3	16.5	26.5	20.3	6.0	12.0	9.3
	53	*Carya spp.*	3	15.4	32.6	23.4	12.0	20.0	14.7
	53	*Nyssa spp.*	3	39.3	50.0	45.7	12.0	17.0	15.0
	53	*Taxodium distichum*	2	37.8	47.0	42.4	12.0	16.0	14.0
	53	*Magnolia spp.*	1	16.6	16.6	16.6	10.0	10.0	10.0
	53	*Platanus occidentalis*	1	27.0	27.0	27.0	14.0	14.0	14.0
	53	*Quercus michauxii*	1	48.3	48.3	48.3	18.0	18.0	18.0
	62	*Liquidambar styraciflua*	29	17.2	55.3	30.1	4.0	26.0	14.9
	62	*Pinus spp.*	28	20.7	87.0	48.6	11.0	37.0	23.8
	62	*Quercus nigra*	15	20.9	87.3	41.7	10.0	30.0	17.4
	62	*Quercus falcata*	13	17.0	72.8	42.6	15.0	33.0	19.8
	62	*Carpinus caroliniana*	12	16.0	24.8	20.0	5.0	12.0	9.5
	62	*Nyssa sylvatica*	12	16.8	59.2	36.0	11.0	25.0	15.2
	62	*Nyssa spp.*	10	16.7	44.0	33.3	12.0	18.0	15.3
	62	*Carya spp.*	9	17.1	52.7	29.2	10.0	18.0	13.8
	62	*Fagus grandifolia*	7	19.2	58.6	30.0	8.0	29.0	20.1
	62	*Taxodium distichum*	6	20.1	61.0	41.4	13.0	26.0	18.2
	62	*Acer rubrum*	4	16.4	33.5	24.1	12.0	16.0	13.5
	62	*Quercus alba*	4	16.9	51.8	32.5	14.0	16.0	15.3
	62	*Quercus hemisphaerica*	3	20.3	47.2	30.3	12.0	20.0	14.7
	62	*Quercus laurifolia*	3	40.0	46.8	43.6	16.0	20.0	17.3
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Mixed Pine-Hardwood	62	*Triadica sebiferum*	3	18.2	27.9	21.8	12.0	14.0	13.3
(Continued)	62	*Ulmus spp.*	3	22.5	35.7	29.2	14.0	16.0	14.7
	62	*Ulmus rubra*	3	26.5	29.9	28.3	10.0	14.0	12.7
	62	*Acer barbatum*	2	23.5	25.9	24.7	16.0	16.0	16.0
	62	*Ilex opaca*	2	19.8	22.4	21.1	10.0	14.0	12.0
	62	*Quercus phellos*	2	16.0	31.4	23.7	10.0	14.0	12.0
	62	*Fraxinus spp.*	1	22.0	22.0	22.0	16.0	16.0	16.0
	62	*Quercus spp.*	1	38.1	38.1	38.1	18.0	18.0	18.0
	62	*Quercus michauxii*	1	17.2	17.2	17.2	10.0	10.0	10.0
	62	*Quercus similis*	1	30.9	30.9	30.9	16.0	16.0	16.0
	62	*Sassafras albidum*	1	24.8	24.8	24.8	12.0	12.0	12.0
	76	*Pinus spp.*	27	15.8	58.0	29.5	12.0	26.0	17.1
	76	*Quercus nigra*	21	17.1	52.5	26.9	10.0	20.0	14.1
	76	*Quercus laurifolia*	20	16.0	60.1	27.9	8.0	22.0	15.3
	76	*Nyssa sylvatica*	17	15.2	40.8	25.8	10.0	18.0	13.9
	76	*Quercus falcata*	17	20.0	48.5	30.2	8.0	16.0	12.8
	76	*Fagus grandifolia*	6	18.4	36.6	29.6	12.0	20.0	16.5
	76	*Liquidambar styraciflua*	6	18.2	32.4	25.2	12.0	22.0	17.8
	76	*Magnolia virginiana*	6	15.7	40.8	25.3	10.0	16.0	13.7
	76	*Quercus alba*	3	16.3	19.8	18.6	10.0	12.0	11.0
	76	*Quercus stellata*	3	15.6	27.8	21.6	10.0	12.0	11.3
	76	*Triadica sebiferum*	3	15.2	17.0	15.9	10.0	14.0	12.0
	76	*Fraxinus spp.*	2	15.4	30.4	22.9	10.0	14.0	12.0
	76	*Magnolia grandifolia*	2	32.6	47.2	39.9	12.0	20.0	16.0
	76	*Quercus phellos*	2	26.8	27.8	27.3	12.0	18.0	15.0
	76	*Carya spp.*	1	27.9	27.9	27.9	16.0	16.0	16.0
	76	*Ilex opaca*	1	15.8	15.8	15.8	8.0	8.0	8.0
	76	*Quercus michauxii*	1	37.5	37.5	37.5	17.0	17.0	17.0
	76	*Taxodium distichum*	1	48.4	48.4	48.4	18.0	18.0	18.0
	76	*Ulmus rubra*	1	25.9	25.9	25.9	18.0	18.0	18.0
Pine	16	*Pinus spp.*	178	15.0	77.0	25.3	8.0	32.0	14.8
	16	*Quercus falcata*	6	17.6	56.5	29.6	8.0	18.0	13.5
	16	*Liquidambar styraciflua*	4	17.6	21.3	18.6	12.0	14.0	13.5
	16	*Quercus alba*	2	17.9	18.0	18.0	10.0	12.0	11.0
	16	*Quercus nigra*	2	15.6	17.8	16.7	10.0	18.0	14.0
	16	*Ulmus spp.*	2	15.0	19.2	17.1	12.0	12.0	12.0
	16	*Fagus grandifolia*	1	68.2	68.2	68.2	14.0	14.0	14.0
	16	*Quercus stellata*	1	20.0	20.0	20.0	6.0	6.0	6.0
	16	*Triadica sebiferum*	1	16.5	16.5	16.5	10.0	10.0	10.0
	19	*Pinus spp.*	141	15.0	66.8	24.3	12.0	27.0	15.5
	19	*Quercus stellata*	19	15.0	38.8	21.3	10.0	16.0	12.6
	19	*Fraxinus spp.*	3	19.1	46.3	28.2	12.0	16.0	13.3
	19	*Ilex opaca*	3	16.1	27.4	21.9	8.0	12.0	10.7
	19	*Nyssa sylvatica*	3	19.2	28.4	23.5	17.0	20.0	18.3
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Pine	19	*Liquidambar styraciflua*	2	28.9	66.9	47.9	16.0	18.0	17.0
(Continued)	19	*Quercus alba*	2	18.6	20.9	19.8	10.0	12.0	11.0
	19	*Carya spp.*	1	27.2	27.2	27.2	16.0	16.0	16.0
	19	*Quercus falcata*	1	30.5	30.5	30.5	12.0	12.0	12.0
	22	*Pinus spp.*	131	15.0	55.9	29.2	8.0	22.0	16.8
	22	*Liquidambar styraciflua*	1	38.5	38.5	38.5	18.0	18.0	18.0
	22	*Quercus stellata*	1	18.3	18.3	18.3	14.0	14.0	14.0
	75	*Pinus spp.*	150	15.0	59.8	24.4	7.0	21.0	12.8
	75	*Quercus laurifolia*	8	15.9	24.4	17.8	10.0	12.0	11.8
	75	*Quercus stellata*	7	18.2	45.5	34.2	10.0	18.0	13.1
	75	*Nyssa sylvatica*	5	16.2	22.8	18.6	8.0	10.0	9.6
	75	*Liquidambar styraciflua*	4	16.5	30.0	24.7	10.0	15.0	13.0
	75	*Fraxinus spp.*	3	15.3	20.2	17.9	10.0	12.0	11.3
	75	*Quercus phellos*	3	18.9	21.0	20.3	12.0	13.0	12.3
	75	*Triadica sebiferum*	3	15.5	28.3	20.2	7.0	14.0	10.3
	75	*Quercus alba*	2	36.8	38.9	37.9	16.0	16.0	16.0
	75	*Acer rubrum*	1	15.0	15.0	15.0	8.0	8.0	8.0
	75	*Quercus falcata*	1	33.3	33.3	33.3	15.0	15.0	15.0
	75	*Quercus michauxii*	1	19.5	19.5	19.5	9.0	9.0	9.0
	75	*Quercus nigra*	1	15.3	15.3	15.3	10.0	10.0	10.0
	75	*Taxodium distichum*	1	55.0	55.0	55.0	14.0	14.0	14.0
	115	*Pinus spp.*	87	15.4	86.0	32.6	12.0	27.0	17.7
	115	*Magnolia virginiana*	13	16.5	55.4	27.7	10.0	20.0	13.0
	115	*Quercus alba*	10	20.4	63.0	33.5	12.0	20.0	16.2
	115	*Quercus nigra*	9	16.2	29.5	21.4	12.0	22.0	16.0
	115	*Liquidambar styraciflua*	8	17.7	46.8	26.1	10.0	20.0	14.3
	115	*Fagus grandifolia*	7	17.7	59.9	37.6	7.0	18.0	15.3
	115	*Quercus falcata*	6	17.7	77.5	38.1	10.0	20.0	16.3
	115	*Quercus laurifolia*	6	16.0	28.3	22.1	10.0	12.0	11.7
	115	*Acer rubrum*	5	16.2	27.0	21.8	9.0	24.0	13.6
	115	*Nyssa sylvatica*	5	18.0	42.5	24.2	12.0	16.0	13.2
	115	*Nyssa spp.*	3	21.8	51.8	33.7	11.0	18.0	13.7
	115	*Quercus hemisphaerica*	3	19.7	25.5	22.0	12.0	14.0	12.7
	115	*Fraxinus spp.*	1	20.5	20.5	20.5	12.0	12.0	12.0
	115	*Ilex opaca*	1	21.9	21.9	21.9	12.0	12.0	12.0
	115	*Persea borbonia*	1	46.4	46.4	46.4	10.0	10.0	10.0
	115	*Tilia americana*	1	16.6	16.6	16.6	12.0	12.0	12.0
	115	*Ulmus spp.*	1	26.0	26.0	26.0	14.0	14.0	14.0
	116	*Pinus spp.*	166	15.1	35.5	19.0	7.0	16.0	10.5
	116	*Magnolia grandifolia*	2	18.5	21.0	19.8	10.0	10.0	10.0
	116	*Nyssa spp.*	2	16.2	19.0	17.6	9.0	10.0	9.5
(Continued)									

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Shrub	56	*Quercus michauxii*	2	20.0	30.1	25.1	8.0	14.0	11.0
	56	*Liquidambar styraciflua*	1	35.0	35.0	35.0	16.0	16.0	16.0
	56	*Quercus falcata*	1	75.0	75.0	75.0	18.0	18.0	18.0
	65	*Pinus spp.*	8	15.0	40.4	22.9	8.0	16.0	11.0
	65	*Nyssa sylvatica*	1	17.8	17.8	17.8	7.0	7.0	7.0
	65	*Quercus laurifolia*	1	17.7	17.7	17.7	12.0	12.0	12.0
	65	*Quercus nigra*	1	47.5	47.5	47.5	22.0	22.0	22.0
	78	*Pinus spp.*	60	15.0	50.3	26.1	8.0	22.0	14.0
	78	*Quercus marilandica*	2	15.0	17.7	16.4	6.0	6.0	6.0
	78	*Nyssa sylvatica*	1	29.3	29.3	29.3	14.0	14.0	14.0
	78	*Quercus stellata*	1	20.2	20.2	20.2	8.0	8.0	8.0
	107	*Taxodium distichum*	2	29.7	47.3	38.5	12.0	16.0	14.0
Swamp	60	*Nyssa aquatica*	99	15.6	102.3	40.9	8.0	20.0	15.1
	60	*Taxodium distichum*	72	15.3	73.7	33.3	8.0	20.0	14.9
	60	*Nyssa sylvatica*	26	18.6	100.0	32.8	10.0	18.0	14.4
	60	*Nyssa spp.*	22	16.5	66.0	31.4	8.0	20.0	15.1
	60	*Fraxinus spp.*	17	15.6	34.7	21.4	6.0	14.0	9.1
	60	*Pinus spp.*	4	29.8	42.6	34.2	18.0	20.0	19.5
	60	*Acer spp.*	3	15.4	29.5	23.0	10.0	16.0	12.7
	60	*Carya spp.*	3	21.3	29.8	26.7	12.0	14.0	12.7
	60	*Ulmus spp.*	3	18.0	22.7	21.1	6.0	8.0	6.7
	60	*Acer rubrum*	1	19.8	19.8	19.8	8.0	8.0	8.0
	60	*Magnolia virginiana*	1	16.6	16.6	16.6	10.0	10.0	10.0
	60	*Quercus falcata*	1	77.8	77.8	77.8	25.0	25.0	25.0
	60	*Quercus laurifolia*	1	85.0	85.0	85.0	16.0	16.0	16.0
	60	*Quercus phellos*	1	62.1	62.1	62.1	30.0	30.0	30.0
	60	*Quercus sinuata*	1	61.5	61.5	61.5	11.0	11.0	11.0
	69	*Taxodium distichum*	24	15.3	50.0	27.0	8.0	20.0	13.1
	69	*Nyssa aquatica*	16	15.8	127.7	50.0	8.0	18.0	12.8
	69	*Nyssa spp.*	9	15.5	35.0	23.5	8.0	18.0	13.2
	69	*Nyssa sylvatica*	4	17.2	32.5	24.2	7.0	14.0	10.8
	69	*Liquidambar styraciflua*	3	20.6	47.8	30.8	11.0	16.0	13.7
	69	*Quercus phellos*	3	19.2	30.0	24.8	10.0	16.0	13.0
	69	*Acer rubrum*	2	22.4	23.1	22.8	14.0	16.0	15.0
	69	*Quercus laurifolia*	2	22.5	55.0	38.8	13.0	13.0	13.0
	69	*Quercus nigra*	2	21.3	53.2	37.3	12.0	16.0	14.0
	69	*Triadica sebiferum*	2	16.3	28.6	22.5	10.0	10.0	10.0
	69	*Acer spp.*	1	15.8	15.8	15.8	10.0	10.0	10.0
	69	*Fraxinus spp.*	1	15.4	15.4	15.4	8.0	8.0	8.0
	69	*Quercus falcata*	1	32.2	32.2	32.2	10.0	10.0	10.0

(Continued)

* Tree heights were estimated during surveys.

Appendix B (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

				DBH (cm)			Height (m)		
Cover-type	**Code**	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Swamp	73	Taxodium distichum	72	15.1	75.8	34.4	6	20	13.3
(Continued)	73	Nyssa aquatica	38	15.3	66.5	32.5	8	20	12.8
	73	Planar aquatica	6	17.4	32.2	23.7	6	12	9.3
	73	Liquidambar styraciflua	4	18.9	29.8	25.6	12	14	13.5
	73	Nyssa sylvatica	2	20	23.3	21.7	8	8	8.0
	109	Pinus spp.	17	22.2	56.1	46.8	12.0	25.0	24.2
	109	*Liquidambar styraciflua*	2	32.9	45.3	39.1	18.0	25.0	21.5
	109	*Quercus falcata*	1	22.0	22.0	22.0	14.0	14.0	14.0
	109	*Quercus marilandica*	1	17.0	17.0	17.0	12.0	12.0	12.0

* Tree heights were estimated during surveys.

APPENDIX C

SUMMARY OF MEAN DIAMETER AT BREAST HEIGHT (DBH) AND HEIGHT FOR TREE SPECIES ≥15 DBH MEASURED IN 5 COVER-TYPES IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix C. Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 5 cover-types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

			DBH (cm)			Height (m)		
Cover-type	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Hardwood	*Pinus spp.*	195	15.0	76.8	31.7	8.0	32.0	17.1
	Nyssa sylvatica	132	15.1	74.7	28.1	4.0	18.0	12.5
	Liquidambar styraciflua	120	15.0	71.2	31.3	7.0	26.0	14.8
	Taxodium distichum	113	15.3	89.0	35.6	8.0	26.0	14.1
	Quercus laurifolia	105	15.0	72.6	29.4	4.0	20.0	13.2
	Quercus nigra	77	15.3	86.0	31.3	8.0	22.0	13.9
	Nyssa aquatica	59	16.5	102.2	46.1	7.0	18.0	13.8
	Nyssa spp.	56	15.6	79.4	27.6	10.0	20.0	14.1
	Triadica sebiferum	45	15.4	33.4	20.9	7.0	18.0	12.1
	Quercus alba	44	15.0	61.7	32.6	8.0	20.0	14.8
	Magnolia virginiana	42	15.1	52.8	26.9	10.0	20.0	14.0
	Fraxinus spp.	34	15.3	51.0	23.9	6.0	30.0	12.6
	Carpinus caroliniana	29	15.4	29.3	19.3	6.0	15.0	9.8
	Quercus phellos	28	16.0	71.8	34.5	10.0	26.0	16.0
	Quercus stellata	28	15.0	37.9	24.6	8.0	16.0	11.7
	Acer rubrum	26	15.2	68.5	26.3	6.0	17.0	11.2
	Quercus falcata	24	15.9	107.1	37.0	10.0	32.0	15.9
	Carya spp.	21	15.5	63.2	35.6	8.0	23.0	15.8
	Ilex opaca	21	15.1	32.9	20.4	4.0	14.0	10.3
	Fagus grandifolia	15	18.4	70.0	40.7	10.0	30.0	19.2
	Ulmus spp.	15	16.0	37.1	24.0	10.0	18.0	13.7
	Acer barbatum	14	16.0	35.2	23.0	7.0	18.0	13.4
	Quercus michauxii	14	17.9	80.5	35.5	6.0	29.0	15.4
	Acer spp.	12	15.8	47.6	27.2	8.0	18.0	12.3
	Magnolia grandifolia	8	21.2	68.3	40.3	10.0	18.0	14.0
	Ostrya virginiana	8	15.1	22.8	18.7	8.0	16.0	12.0
	Planera aquatica	6	15.3	30.0	20.8	7.0	14.0	10.2
	Celtis laevigata	5	17.2	22.7	19.1	10.0	16.0	12.8
	Quercus similis	5	15.5	58.2	35.5	11.0	16.0	13.0
	Platanus occidentalis	4	18.7	51.2	37.8	9.0	28.0	20.3
	Betula nigra	3	17.6	38.0	24.5	10.0	14.0	11.3
	Prunus serotina	3	18.0	44.3	29.8	16.0	18.0	16.7
	Quercus marilandica	2	16.1	17.6	16.9	6.0	12.0	9.0
	Sassafras albidum	2	24.1	32.9	28.5	12.0	16.0	14.0
	Ulmus alata	2	15.7	27.0	21.4	12.0	14.0	13.0
	Ulmus rubra	2	21.8	24.2	23.0	12.0	12.0	12.0
	Juniperus virginiana	1	24.6	24.6	24.6	11.0	11.0	11.0
	Quercus spp.	1	38.8	38.8	38.8	18.0	18.0	18.0
	Quercus hemisphaerica	1	98.0	98.0	98.0	14.0	14.0	14.0
	Quercus muehlenbergii	1	33.0	33.0	33.0	10.0	10.0	10.0
	Quercus sinuata	1	45.6	45.6	45.6	20.0	20.0	20.0
Mixed Pine-Hardwood	*Pinus spp.*	194	15.8	93.9	39.5	8.0	37.0	18.5
	Liquidambar styraciflua	95	15.5	63.0	28.5	3.0	29.0	15.1
	Quercus nigra	66	15.7	87.3	30.1	8.0	30.0	14.8
	Quercus falcata	56	16.4	72.8	32.2	8.0	33.0	15.9
	Nyssa sylvatica	53	15.2	59.2	29.4	9.0	25.0	14.6

(Continued)

* Tree heights were estimated during surveys.

Appendix C (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 5 cover-types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

			DBH (cm)			Height (m)		
Cover-type	**Species**	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Mixed Pine-Hardwood	*Quercus alba*	50	15.4	71.6	29.8	8.0	28.0	16.0
(Continued)	*Quercus laurifolia*	44	16.0	67.5	27.6	8.0	26.0	14.9
	Fagus grandifolia	35	17.0	64.2	33.7	8.0	29.0	18.0
	Quercus phellos	32	16.0	79.4	36.1	10.0	20.0	15.5
	Magnolia virginiana	28	15.7	48.0	27.3	10.0	26.0	16.8
	Carpinus caroliniana	24	16.0	26.5	19.7	5.0	16.0	10.0
	Carya spp.	23	15.4	61.2	29.6	10.0	20.0	15.1
	Acer rubrum	21	16.4	43.0	24.5	7.0	22.0	14.1
	Quercus stellata	20	15.6	54.9	32.4	10.0	18.0	13.5
	Magnolia grandifolia	16	22.6	62.3	38.7	4.0	29.0	15.4
	Ilex opaca	15	15.0	32.9	20.4	8.0	20.0	11.5
	Nyssa spp.	15	16.7	50.0	35.0	12.0	18.0	14.9
	Triadica sebiferum	14	15.2	28.5	20.9	10.0	14.0	12.9
	Ulmus spp.	14	15.8	65.9	29.3	10.0	20.0	13.9
	Fraxinus spp.	9	15.4	41.0	29.0	10.0	18.0	15.3
	Taxodium distichum	9	20.1	61.0	42.4	12.0	26.0	17.2
	Acer barbatum	7	20.0	38.9	28.0	12.0	18.0	14.6
	Quercus michauxii	6	15.4	48.3	29.9	5.0	18.0	14.0
	Quercus hemisphaerica	5	16.3	47.2	26.9	10.0	20.0	14.4
	Ulmus rubra	5	20.7	29.9	26.3	10.0	18.0	13.6
	Betula nigra	3	20.0	30.4	25.0	16.0	16.0	16.0
	Ostrya virginiana	3	15.5	18.7	17.1	6.0	10.0	8.7
	Quercus spp.	3	38.1	38.5	38.3	16.0	18.0	17.3
	Quercus marilandica	2	24.3	28.2	26.3	16.0	18.0	17.0
	Diospyros virginiana	1	36.9	36.9	36.9	18.0	18.0	18.0
	Magnolia spp.	1	16.6	16.6	16.6	10.0	10.0	10.0
	Platanus occidentalis	1	27.0	27.0	27.0	14.0	14.0	14.0
	Prunus serotina	1	17.2	17.2	17.2	14.0	14.0	14.0
	Quercus similis	1	30.9	30.9	30.9	16.0	16.0	16.0
	Sassafras albidum	1	24.8	24.8	24.8	12.0	12.0	12.0
	Tilia americana	1	21.4	21.4	21.4	14.0	14.0	14.0
Herbaceous	*Pinus spp.*	83	15.1	63.6	30.3	8.0	22.0	15.0
	Nyssa sylvatica	10	19.0	55.4	28.5	12.0	16.0	13.8
	Liquidambar styraciflua	6	19.5	41.7	31.2	14.0	18.0	16.7
	Salix nigra	6	20.8	97.8	46.0	10.0	12.0	10.7
	Quercus laurifolia	5	15.7	30.1	22.2	14.0	14.0	14.0
	Magnolia virginiana	3	22.8	38.8	28.4	12.0	16.0	14.0
	Quercus alba	3	17.2	25.8	20.7	8.0	16.0	12.0
	Quercus stellata	3	18.6	37.1	30.9	10.0	15.0	12.3
	Acer rubrum	1	15.3	15.3	15.3	10.0	10.0	10.0
	Carpinus caroliniana	1	15.0	15.0	15.0	10.0	10.0	10.0
	Magnolia grandifolia	1	50.8	50.8	50.8	18.0	18.0	18.0
	Quercus falcata	1	25.9	25.9	25.9	14.0	14.0	14.0
	Taxodium distichum	1	45.8	45.8	45.8	8.0	8.0	8.0
(Continued)								

* Tree heights were estimated during surveys.

Appendix C (Continued). Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured in 5 cover-types in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

			DBH (cm)			Height (m)		
Cover-type	***Species***	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Shrub	*Pinus spp.*	68	15.0	50.3	25.7	8.0	22.0	13.7
	Nyssa sylvatica	2	17.8	29.3	23.6	7.0	14.0	10.5
	Quercus marilandica	2	15.0	17.7	16.4	6.0	6.0	6.0
	Quercus michauxii	2	20.0	30.1	25.1	8.0	14.0	11.0
	Taxodium distichum	2	29.7	47.3	38.5	12.0	16.0	14.0
	Liquidambar styraciflua	1	35.0	35.0	35.0	16.0	16.0	16.0
	Quercus falcata	1	75.0	75.0	75.0	18.0	18.0	18.0
	Quercus laurifolia	1	17.7	17.7	17.7	12.0	12.0	12.0
	Quercus nigra	1	47.5	47.5	47.5	22.0	22.0	22.0
	Quercus stellata	1	20.2	20.2	20.2	8.0	8.0	8.0
Swamp	*Taxodium distichum*	168	15.1	75.8	32.9	6.0	20.0	14.0
	Nyssa aquatica	153	15.3	127.7	39.8	8.0	20.0	14.3
	Nyssa sylvatica	32	17.2	100.0	31.1	7.0	18.0	13.6
	Nyssa spp.	31	15.5	66.0	29.1	8.0	20.0	14.6
	Pinus spp.	21	22.2	56.1	44.4	12.0	25.0	23.3
	Fraxinus spp.	18	15.4	34.7	21.1	6.0	14.0	9.0
	Liquidambar styraciflua	9	18.9	47.8	30.3	11.0	25.0	15.3
	Planera aquatica	9	17.4	32.2	22.8	6.0	12.0	8.4
	Acer spp.	4	15.4	29.5	21.2	10.0	16.0	12.0
	Quercus phellos	4	19.2	62.1	34.1	10.0	30.0	17.3
	Acer rubrum	3	19.8	23.1	21.8	8.0	16.0	12.7
	Carya spp.	3	21.3	29.8	26.7	12.0	14.0	12.7
	Quercus falcata	3	22.0	77.8	44.0	10.0	25.0	16.3
	Quercus laurifolia	3	22.5	85.0	54.2	13.0	16.0	14.0
	Quercus nigra	2	21.3	53.2	37.3	12.0	16.0	14.0
	Triadica sebiferum	2	16.3	28.6	22.5	10.0	10.0	10.0
	Magnolia virginiana	1	16.6	16.6	16.6	10.0	10.0	10.0
	Quercus marilandica	1	17.0	17.0	17.0	12.0	12.0	12.0
	Quercus sinuata	1	61.5	61.5	61.5	11.0	11.0	11.0

* Tree heights were estimated during surveys.

APPENDIX D

SUMMARY OF MEAN DIAMETER AT BREAST HEIGHT (DBH) AND HEIGHT FOR TREE SPECIES ≥15 CM DBH MEASURED FOR ALL SURVEY POINTS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix D. Summary of mean diameter at breast height (DBH) and height for tree species ≥15 cm DBH measured for all survey points in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

			DBH (cm)			Height (m)	
Species	**n**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Pinus spp.	1414	15.0	93.9	28.6	7.0	37.0	15.4
Taxodium distichum	294	15.1	89.0	34.4	6.0	26.0	14.1
Liquidambar styraciflua	250	15.0	71.2	29.9	3.0	29.0	14.9
Nyssa sylvatica	242	15.1	100.0	28.4	4.0	25.0	13.1
Nyssa aquatica	212	15.3	127.7	41.5	7.0	20.0	14.2
Quercus laurifolia	172	15.0	85.0	28.3	4.0	26.0	13.6
Quercus nigra	158	15.3	87.3	30.1	8.0	30.0	14.4
Quercus alba	113	15.0	71.6	30.7	8.0	28.0	15.3
Nyssa spp.	107	15.5	79.4	29.0	8.0	20.0	14.2
Quercus falcata	99	15.9	107.1	34.3	8.0	33.0	15.8
Magnolia virginiana	87	15.1	55.4	27.1	10.0	26.0	14.7
Quercus stellata	80	15.0	54.9	26.7	6.0	18.0	12.4
Fraxinus spp.	68	15.3	51.0	23.7	6.0	30.0	12.0
Quercus phellos	67	16.0	79.4	34.6	10.0	30.0	15.7
Triadica sebiferum	65	15.2	33.4	20.8	7.0	18.0	12.1
Fagus grandifolia	58	17.0	70.0	36.6	7.0	30.0	17.9
Acer rubrum	57	15.0	68.5	24.6	6.0	24.0	12.5
Carpinus caroliniana	54	15.0	29.3	19.4	5.0	16.0	9.9
Carya spp.	48	15.4	63.2	32.0	8.0	23.0	15.3
Ilex opaca	40	15.0	32.9	20.5	4.0	20.0	10.8
Ulmus spp.	32	15.0	65.9	25.9	10.0	20.0	13.7
Magnolia grandifolia	27	18.5	68.3	38.2	4.0	29.0	14.7
Quercus michauxii	23	15.4	80.5	32.5	5.0	29.0	14.4
Acer barbatum	21	16.0	38.9	24.7	7.0	18.0	13.8
Acer spp.	16	15.4	47.6	25.7	8.0	18.0	12.2
Planar aquatica	15	15.3	32.2	22.0	6.0	14.0	9.1
Ostrya virginiana	11	15.1	22.8	18.3	6.0	16.0	11.1
Quercus hemisphaerica	9	16.3	98.0	33.2	10.0	20.0	13.8
Quercus marilandica	7	15.0	28.2	19.4	6.0	18.0	10.9
Ulmus rubra	7	20.7	29.9	25.4	10.0	18.0	13.1
Betula nigra	6	17.6	38.0	24.7	10.0	16.0	13.7
Quercus similis	6	15.5	58.2	34.8	11.0	16.0	13.5
Salix nigra	6	20.8	97.8	46.0	10.0	12.0	10.7
Celtis laevigata	5	17.2	22.7	19.1	10.0	16.0	12.8
Platanus occidentalis	5	18.7	51.2	35.7	9.0	28.0	19.0
Prunus serotina	4	17.2	44.3	26.6	14.0	18.0	16.0
Quercus spp.	4	38.1	38.8	38.4	16.0	18.0	17.5
Sassafras albidum	3	24.1	32.9	27.3	12.0	16.0	13.3
Quercus sinuata	2	45.6	61.5	53.6	11.0	20.0	15.5
Tilia americana	2	16.6	21.4	19.0	12.0	14.0	13.0
Ulmus alata	2	15.7	27.0	21.4	12.0	14.0	13.0
Diospyros virginiana	1	36.9	36.9	36.9	18.0	18.0	18.0
Juniperus virginiana	1	24.6	24.6	24.6	11.0	11.0	11.0
Magnolia spp.	1	16.6	16.6	16.6	10.0	10.0	10.0
Persea borbonia	1	46.4	46.4	46.4	10.0	10.0	10.0
Quercus muehlenbergii	1	33.0	33.0	33.0	10.0	10.0	10.0

* Tree heights were estimated during surveys.

APPENDIX E

SUMMARY OF MEAN BASAL AREA (M^2) FOR TREE SPECIES ≥15 CM DIAMETER AT BREAST HEIGHT (DBH) MEASURED IN 38 HABITAT CLASSIFICATIONS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix E. Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Basal Area (m^2)**
Hardwood	15	*Pinus spp.*	7/11	0.326
	15	*Quercus alba*	6/11	0.132
	15	*Fagus grandifolia*	2/11	0.087
	15	*Quercus falcata*	4/11	0.066
	15	*Nyssa spp.*	1/11	0.042
	15	*Liquidambar styraciflua*	8/11	0.037
	15	*Fraxinus spp.*	3/11	0.029
	15	*Nyssa sylvatica*	5/11	0.027
	15	*Quercus nigra*	2/11	0.021
	15	*Acer barbatum*	2/11	0.020
	15	*Magnolia virginiana*	1/11	0.018
	15	*Quercus spp.*	1/11	0.011
	15	*Quercus stellata*	1/11	0.010
	15	*Ulmus spp.*	1/11	0.008
	15	*Ulmus alata*	1/11	0.005
	15	*Acer rubrum*	1/11	0.005
	15	*Nyssa aquatica*	1/11	0.005
	15	*Juniperus virginiana*	1/11	0.004
	15	*Ilex opaca*	1/11	0.004
	15	*Ostrya virginiana*	1/11	0.003
	15	*Quercus marilandica*	1/11	0.002
	15	*Carya spp.*	1/11	0.002
	15	*Quercus similis*	1/11	0.002
	18	*Pinus spp.*	9/20	0.221
	18	*Nyssa sylvatica*	8/20	0.071
	18	*Quercus laurifolia*	5/20	0.058
	18	*Magnolia grandifolia*	2/20	0.036
	18	*Liquidambar styraciflua*	7/20	0.032
	18	*Quercus alba*	3/20	0.030
	18	*Quercus nigra*	5/20	0.028
	18	*Fagus grandifolia*	3/20	0.021
	18	*Magnolia virginiana*	3/20	0.019
	18	*Quercus falcata*	2/20	0.016
	18	*Acer rubrum*	2/20	0.012
	18	*Quercus stellata*	1/20	0.010
	18	*Ilex opaca*	3/20	0.009
	18	*Prunus serotina*	1/20	0.009
	18	*Triadica sebiferum*	1/20	0.008
	18	*Quercus phellos*	2/20	0.008
	18	*Carya spp.*	1/20	0.006
	18	*Quercus michauxii*	2/20	0.006
	18	*Quercus muehlenbergii*	1/20	0.004
	18	*Ostrya virginiana*	1/20	0.003
	18	*Carpinus caroliniana*	2/20	0.002
	18	*Acer barbatum*	1/20	0.001
	21	*Pinus spp.*	10/10	0.461
	21	*Quercus stellata*	8/10	0.112
	21	*Quercus alba*	1/10	0.028

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Basal Area (m^2)**
Hardwood	21	*Ilex opaca*	1/10	0.009
(Continued)	21	*Quercus nigra*	1/10	0.008
	21	*Quercus falcata*	1/10	0.007
	21	*Fraxinus spp.*	1/10	0.003
	21	*Acer rubrum*	1/10	0.003
	21	*Ulmus spp.*	1/10	0.003
	21	*Quercus marilandica*	1/10	0.002
	21	*Nyssa sylvatica*	1/10	0.002
	21	*Ulmus alata*	1/10	0.002
	54	*Nyssa aquatica*	5/17	0.639
	54	*Taxodium distichum*	4/17	0.273
	54	*Nyssa sylvatica*	4/17	0.149
	54	*Quercus nigra*	5/17	0.082
	54	*Liquidambar styraciflua*	7/17	0.078
	54	*Quercus phellos*	1/17	0.052
	54	*Magnolia virginiana*	2/17	0.047
	54	*Pinus spp.*	3/17	0.045
	54	*Carya spp.*	2/17	0.031
	54	*Acer rubrum*	3/17	0.021
	54	*Quercus laurifolia*	4/17	0.020
	54	*Quercus michauxii*	1/17	0.011
	54	*Quercus alba*	3/17	0.010
	54	*Carpinus caroliniana*	2/17	0.010
	54	*Fraxinus spp.*	2/17	0.007
	54	*Triadica sebiferum*	2/17	0.003
	54	*Quercus falcata*	1/17	0.002
	54	*Fagus grandifolia*	1/17	0.002
	54	*Platanus occidentalis*	1/17	0.002
	54	*Celtis laevigata*	1/17	0.001
	54	*Betula nigra*	1/17	0.001
	54	*Nyssa spp.*	1/17	0.001
	58	*Liquidambar styraciflua*	9/16	0.155
	58	*Taxodium distichum*	3/16	0.106
	58	*Quercus nigra*	4/16	0.076
	58	*Quercus laurifolia*	2/16	0.066
	58	*Triadica sebiferum*	5/16	0.041
	58	*Nyssa sylvatica*	3/16	0.036
	58	*Quercus similis*	3/16	0.036
	58	*Fraxinus spp.*	5/16	0.033
	58	*Acer rubrum*	3/16	0.017
	58	*Carya spp.*	2/16	0.017
	58	*Ulmus spp.*	3/16	0.017
	58	*Magnolia virginiana*	1/16	0.015
	58	*Quercus falcata*	2/16	0.015
	58	*Carpinus caroliniana*	4/16	0.012
	58	*Acer spp.*	2/16	0.008
	58	*Planar aquatica*	1/16	0.007
	58	*Ulmus rubra*	1/16	0.005

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Hardwood	58	*Ilex opaca*	2/16	0.005
(Continued)	58	*Celtis laevigata*	2/16	0.004
	58	*Nyssa spp.*	1/16	0.004
	58	*Prunus serotina*	1/16	0.004
	58	*Betula nigra*	1/16	0.002
	63	*Pinus spp.*	5/16	0.081
	63	*Taxodium distichum*	3/16	0.071
	63	*Quercus falcata*	2/16	0.070
	63	*Liquidambar styraciflua*	6/16	0.059
	63	*Nyssa sylvatica*	5/16	0.058
	63	*Quercus nigra*	7/16	0.051
	63	*Quercus hemisphaerica*	1/16	0.047
	63	*Quercus michauxii*	4/16	0.040
	63	*Nyssa spp.*	1/16	0.037
	63	*Carya spp.*	2/16	0.035
	63	*Magnolia grandifolia*	1/16	0.019
	63	*Acer barbatum*	3/16	0.018
	63	*Carpinus caroliniana*	2/16	0.016
	63	*Fraxinus spp.*	1/16	0.013
	63	*Quercus laurifolia*	4/16	0.012
	63	*Ulmus spp.*	2/16	0.011
	63	*Triadica sebiferum*	1/16	0.005
	63	*Acer rubrum*	2/16	0.004
	63	*Ilex opaca*	1/16	0.003
	63	*Magnolia virginiana*	1/16	0.003
	63	*Nyssa aquatica*	1/16	0.002
	67	*Liquidambar styraciflua*	12/16	0.230
	67	*Taxodium distichum*	1/16	0.090
	67	*Nyssa aquatica*	1/16	0.064
	67	*Pinus spp.*	3/16	0.058
	67	*Quercus michauxii*	3/16	0.042
	67	*Fagus grandifolia*	1/16	0.041
	67	*Quercus nigra*	4/16	0.040
	67	*Acer rubrum*	2/16	0.035
	67	*Nyssa sylvatica*	3/16	0.031
	67	*Acer spp.*	2/16	0.031
	67	*Platanus occidentalis*	1/16	0.029
	67	*Quercus alba*	1/16	0.024
	67	*Carya spp.*	2/16	0.017
	67	*Quercus laurifolia*	2/16	0.016
	67	*Quercus falcata*	1/16	0.015
	67	*Ilex opaca*	4/16	0.013
	67	*Ulmus spp.*	3/16	0.011
	67	*Quercus phellos*	1/16	0.011
	67	*Fraxinus spp.*	2/16	0.011
	67	*Ostrya virginiana*	2/16	0.008
	67	*Betula nigra*	1/16	0.007
	67	*Carpinus caroliniana*	4/16	0.006

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Hardwood	67	*Nyssa spp.*	2/16	0.004
(Continued)	67	*Magnolia virginiana*	1/16	0.003
	67	*Celtis laevigata*	2/16	0.003
	67	*Sassafras albidum*	1/16	0.003
	67	*Acer barbatum*	1/16	0.003
	67	*Triadica sebiferum*	1/16	0.003
	70	*Taxodium distichum*	6/20	0.198
	70	*Nyssa spp.*	2/20	0.109
	70	*Nyssa sylvatica*	7/20	0.091
	70	*Quercus laurifolia*	9/20	0.091
	70	*Pinus spp.*	5/20	0.071
	70	*Quercus nigra*	6/20	0.062
	70	*Quercus phellos*	3/20	0.047
	70	*Liquidambar styraciflua*	8/20	0.043
	70	*Carya spp.*	2/20	0.031
	70	*Quercus alba*	1/20	0.029
	70	*Magnolia virginiana*	2/20	0.024
	70	*Fraxinus spp.*	5/20	0.017
	70	*Triadica sebiferum*	4/20	0.013
	70	*Magnolia grandifolia*	2/20	0.008
	70	*Acer rubrum*	1/20	0.007
	70	*Carpinus caroliniana*	1/20	0.006
	70	*Quercus michauxii*	1/20	0.006
	70	*Planar aquatica*	2/20	0.005
	70	*Acer spp.*	1/20	0.005
	70	*Quercus falcata*	2/20	0.005
	70	*Sassafras albidum*	1/20	0.004
	70	*Acer barbatum*	1/20	0.003
	70	*Ilex opaca*	1/20	0.002
	77	*Quercus laurifolia*	7/17	0.168
	77	*Nyssa sylvatica*	7/17	0.099
	77	*Pinus spp.*	6/17	0.069
	77	*Quercus phellos*	2/17	0.064
	77	*Quercus nigra*	4/17	0.059
	77	*Quercus alba*	3/17	0.051
	77	*Taxodium distichum*	2/17	0.047
	77	*Nyssa spp.*	2/17	0.040
	77	*Quercus falcata*	3/17	0.026
	77	*Liquidambar styraciflua*	3/17	0.025
	77	*Magnolia virginiana*	3/17	0.024
	77	*Triadica sebiferum*	3/17	0.021
	77	*Quercus sinuata*	1/17	0.010
	77	*Fagus grandifolia*	1/17	0.007
	77	*Acer spp.*	1/17	0.003
	77	*Ilex opaca*	1/17	0.003
	77	*Fraxinus spp.*	1/17	0.002
(Continued)				

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Hardwood	100	*Quercus laurifolia*	5/15	0.054
(Continued)	100	*Quercus nigra*	2/15	0.019
	100	*Liquidambar styraciflua*	1/15	0.018
	100	*Taxodium distichum*	1/15	0.009
	100	*Nyssa sylvatica*	2/15	0.009
	100	*Pinus spp.*	1/15	0.002
Pine	16	*Pinus spp.*	18/21	0.485
	16	*Quercus falcata*	4/21	0.024
	16	*Fagus grandifolia*	1/21	0.017
	16	*Liquidambar styraciflua*	3/21	0.005
	16	*Quercus alba*	2/21	0.002
	16	*Ulmus spp.*	1/21	0.002
	16	*Quercus nigra*	2/21	0.002
	16	*Quercus stellata*	1/21	0.001
	16	*Triadica sebiferum*	1/21	0.001
	19	*Pinus spp.*	11/14	0.533
	19	*Quercus stellata*	4/14	0.052
	19	*Liquidambar styraciflua*	2/14	0.030
	19	*Fraxinus spp.*	1/14	0.016
	19	*Nyssa sylvatica*	1/14	0.010
	19	*Ilex opaca*	1/14	0.008
	19	*Quercus falcata*	1/14	0.005
	19	*Quercus alba*	1/14	0.004
	19	*Carya spp.*	1/14	0.004
	22	*Pinus spp.*	14/16	0.598
	22	*Liquidambar styraciflua*	1/16	0.007
	22	*Quercus stellata*	1/16	0.002
	75	*Pinus spp.*	19/19	0.417
	75	*Quercus stellata*	3/19	0.037
	75	*Taxodium distichum*	1/19	0.013
	75	*Quercus alba*	1/19	0.012
	75	*Quercus laurifolia*	2/19	0.011
	75	*Liquidambar styraciflua*	1/19	0.011
	75	*Nyssa sylvatica*	2/19	0.007
	75	*Triadica sebiferum*	3/19	0.005
	75	*Quercus phellos*	3/19	0.005
	75	*Quercus falcata*	1/19	0.005
	75	*Fraxinus spp.*	3/19	0.004
	75	*Quercus michauxii*	1/19	0.002
	75	*Quercus nigra*	1/19	0.001
	75	*Acer rubrum*	1/19	0.001
	115	*Pinus spp.*	15/22	0.394
	115	*Quercus alba*	5/22	0.045
	115	*Fagus grandifolia*	4/22	0.041
	115	*Magnolia virginiana*	4/22	0.040

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Basal Area (m^2)**
Pine	115	*Quercus falcata*	4/22	0.039
(Continued)	115	*Liquidambar styraciflua*	6/22	0.023
	115	*Quercus nigra*	3/22	0.015
	115	*Nyssa spp.*	3/22	0.014
	115	*Nyssa sylvatica*	4/22	0.012
	115	*Quercus laurifolia*	5/22	0.011
	115	*Acer rubrum*	4/22	0.009
	115	*Persea borbonia*	1/22	0.008
	115	*Quercus hemisphaerica*	1/22	0.005
	115	*Ulmus spp.*	1/22	0.002
	115	*Ilex opaca*	1/22	0.002
	115	*Fraxinus spp.*	1/22	0.002
	115	*Tilia americana*	1/22	0.001
	116	*Pinus spp.*	15/18	0.270
	116	*Magnolia grandifolia*	1/18	0.003
	116	*Nyssa spp.*	1/18	0.003
Mixed Pine-Hardwood	14	*Pinus spp.*	13/19	0.470
	14	*Quercus alba*	11/19	0.130
	14	*Liquidambar styraciflua*	16/19	0.120
	14	*Fagus grandifolia*	9/19	0.087
	14	*Magnolia virginiana*	2/19	0.049
	14	*Nyssa sylvatica*	8/19	0.046
	14	*Ulmus spp.*	4/19	0.022
	14	*Fraxinus spp.*	3/19	0.019
	14	*Acer barbatum*	4/19	0.019
	14	*Magnolia grandifolia*	3/19	0.018
	14	*Quercus falcata*	5/19	0.018
	14	*Acer rubrum*	4/19	0.016
	14	*Carya spp.*	1/19	0.015
	14	*Carpinus caroliniana*	3/19	0.013
	14	*Quercus nigra*	1/19	0.011
	14	*Quercus laurifolia*	3/19	0.008
	14	*Quercus stellata*	2/19	0.007
	14	*Nyssa spp.*	2/19	0.007
	14	*Quercus spp.*	1/19	0.006
	14	*Quercus michauxii*	1/19	0.004
	14	*Quercus hemisphaerica*	2/19	0.004
	14	*Ostrya virginiana*	2/19	0.002
	14	*Tilia americana*	1/19	0.002
	14	*Ilex opaca*	1/19	0.001
	17	*Pinus spp.*	8/15	0.132
	17	*Magnolia grandifolia*	5/15	0.096
	17	*Quercus nigra*	7/15	0.061
	17	*Quercus phellos*	3/15	0.061
	17	*Quercus alba*	4/15	0.042
	17	*Magnolia virginiana*	2/15	0.036
	17	*Nyssa sylvatica*	3/15	0.029
(Continued)				

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Mixed Pine-Hardwood	17	*Fagus grandifolia*	1/15	0.023
(Continued)	17	*Ilex opaca*	3/15	0.014
	17	*Quercus falcata*	3/15	0.014
	17	*Liquidambar styraciflua*	4/15	0.013
	17	*Acer rubrum*	2/15	0.011
	17	*Quercus stellata*	2/15	0.007
	17	*Quercus laurifolia*	2/15	0.007
	17	*Carya spp.*	1/15	0.007
	17	*Fraxinus spp.*	1/15	0.006
	17	*Quercus michauxii*	1/15	0.006
	17	*Quercus marilandica*	1/15	0.003
	17	*Ulmus rubra*	1/15	0.002
	17	*Prunus serotina*	1/15	0.002
	17	*Triadica sebiferum*	1/15	0.002
	17	*Carpinus caroliniana*	1/15	0.001
	20	*Pinus spp.*	7/9	0.293
	20	*Quercus stellata*	6/9	0.167
	20	*Liquidambar styraciflua*	6/9	0.072
	20	*Carya spp.*	3/9	0.057
	20	*Quercus falcata*	3/9	0.054
	20	*Quercus nigra*	1/9	0.023
	20	*Ulmus spp.*	2/9	0.023
	20	*Quercus spp.*	1/9	0.013
	20	*Diospyros virginiana*	1/9	0.012
	20	*Quercus alba*	2/9	0.008
	20	*Quercus marilandica*	1/9	0.007
	20	*Nyssa sylvatica*	1/9	0.006
	20	*Ilex opaca*	2/9	0.006
	20	*Fraxinus spp.*	1/9	0.005
	20	*Ostrya virginiana*	1/9	0.003
	53	*Pinus spp.*	13/20	0.326
	53	*Quercus phellos*	8/20	0.138
	53	*Liquidambar styraciflua*	10/20	0.055
	53	*Quercus laurifolia*	6/20	0.051
	53	*Quercus falcata*	6/20	0.037
	53	*Quercus nigra*	7/20	0.031
	53	*Fagus grandifolia*	2/20	0.030
	53	*Quercus alba*	2/20	0.028
	53	*Nyssa spp.*	1/20	0.025
	53	*Acer rubrum*	4/20	0.019
	53	*Nyssa sylvatica*	3/20	0.017
	53	*Triadica sebiferum*	3/20	0.015
	53	*Ulmus spp.*	3/20	0.015
	53	*Taxodium distichum*	2/20	0.014
	53	*Quercus michauxii*	1/20	0.009
	53	*Betula nigra*	1/20	0.008
	53	*Carya spp.*	3/20	0.007
	53	*Ilex opaca*	3/20	0.007

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Mixed Pine-Hardwood	53	*Carpinus caroliniana*	2/20	0.005
(Continued)	53	*Platanus occidentalis*	1/20	0.003
	53	*Magnolia spp.*	1/20	0.001
	62	*Pinus spp.*	7/20	0.299
	62	*Quercus nigra*	13/20	0.121
	62	*Liquidambar styraciflua*	12/20	0.111
	62	*Quercus falcata*	6/20	0.103
	62	*Nyssa sylvatica*	6/20	0.068
	62	*Nyssa spp.*	3/20	0.046
	62	*Taxodium distichum*	3/20	0.044
	62	*Carya spp.*	6/20	0.034
	62	*Fagus grandifolia*	2/20	0.030
	62	*Quercus laurifolia*	2/20	0.022
	62	*Carpinus caroliniana*	7/20	0.019
	62	*Quercus alba*	3/20	0.019
	62	*Quercus hemisphaerica*	1/20	0.012
	62	*Ulmus spp.*	3/20	0.010
	62	*Acer rubrum*	3/20	0.010
	62	*Ulmus rubra*	2/20	0.009
	62	*Triadica sebiferum*	2/20	0.006
	62	*Quercus spp.*	1/20	0.006
	62	*Quercus phellos*	2/20	0.005
	62	*Acer barbatum*	1/20	0.005
	62	*Quercus similis*	1/20	0.004
	62	*Ilex opaca*	2/20	0.004
	62	*Sassafras albidum*	1/20	0.002
	62	*Fraxinus spp.*	1/20	0.002
	62	*Quercus michauxii*	1/20	0.001
	76	*Pinus spp.*	8/15	0.140
	76	*Quercus laurifolia*	5/15	0.102
	76	*Quercus nigra*	5/15	0.089
	76	*Quercus falcata*	6/15	0.087
	76	*Nyssa sylvatica*	6/15	0.065
	76	*Fagus grandifolia*	1/15	0.029
	76	*Magnolia virginiana*	2/15	0.022
	76	*Liquidambar styraciflua*	4/15	0.021
	76	*Magnolia grandifolia*	2/15	0.017
	76	*Taxodium distichum*	1/15	0.012
	76	*Quercus phellos*	2/15	0.008
	76	*Quercus stellata*	1/15	0.008
	76	*Quercus michauxii*	1/15	0.007
	76	*Fraxinus spp.*	2/15	0.006
	76	*Quercus alba*	3/15	0.005
	76	*Carya spp.*	1/15	0.004
	76	*Triadica sebiferum*	2/15	0.004
	76	*Ulmus rubra*	1/15	0.004
	76	*Ilex opaca*	1/15	0.001

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Basal Area (m^2)
Herbaceous	57	*Salix nigra*	2/3	0.442
	57	*Quercus stellata*	1/3	0.072
	57	*Taxodium distichum*	1/3	0.055
	57	*Nyssa sylvatica*	1/3	0.045
	57	*Liquidambar styraciflua*	1/3	0.023
	59	*Pinus spp.*	1/9	0.035
	59	*Magnolia grandifolia*	1/9	0.023
	59	*Quercus laurifolia*	1/9	0.022
	59	*Quercus alba*	1/9	0.009
	59	*Nyssa sylvatica*	1/9	0.005
	68	*Pinus spp.*	1/8	0.173
	68	*Liquidambar styraciflua*	1/8	0.013
	68	*Quercus falcata*	1/8	0.007
	68	*Carpinus caroliniana*	1/8	0.002
	71	*Pinus spp.*	4/12	0.051
	72	*Pinus spp.*	8/8	0.582
	72	*Nyssa sylvatica*	3/8	0.067
	72	*Liquidambar styraciflua*	3/8	0.040
	72	*Magnolia virginiana*	2/8	0.025
	72	*Quercus stellata*	1/8	0.003
	72	*Quercus alba*	1/8	0.003
	72	*Acer rubrum*	1/8	0.002
Shrub	56	*Quercus falcata*	1/8	0.055
	56	*Quercus michauxii*	2/8	0.013
	56	*Liquidambar styraciflua*	1/8	0.012
	65	*Pinus spp.*	3/6	0.063
	65	*Quercus nigra*	1/6	0.030
	65	*Nyssa sylvatica*	1/6	0.004
	65	*Quercus laurifolia*	1/6	0.004
	78	*Pinus spp.*	11/11	0.334
	78	*Nyssa sylvatica*	1/11	0.006
	78	*Quercus marilandica*	1/11	0.004
	78	*Quercus stellata*	1/11	0.003
	107	*Taxodium distichum*	1/11	0.022
Swamp	60	*Nyssa aquatica*	9/16	0.958
	60	*Taxodium distichum*	10/16	0.460
	60	*Nyssa sylvatica*	8/16	0.184
	60	*Nyssa spp.*	3/16	0.122
	60	*Fraxinus spp.*	6/16	0.042
	60	*Quercus laurifolia*	1/16	0.035
	60	*Quercus falcata*	1/16	0.030

(Continued)

Appendix E (Continue). Summary of mean basal area (m^2) for tree species ≥15 cm diameter at breast height (DBH) measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Basal Area (m^2)**
Swamp	60	*Pinus spp.*	1/16	0.023
(Continued)	60	*Quercus phellos*	1/16	0.019
	60	*Quercus sinuata*	1/16	0.019
	60	*Carya spp.*	2/16	0.011
	60	*Acer spp.*	2/16	0.008
	60	*Planar aquatica*	2/16	0.007
	60	*Acer rubrum*	1/16	0.002
	60	*Magnolia virginiana*	1/16	0.001
	69	*Nyssa aquatica*	1/6	0.692
	69	*Taxodium distichum*	5/6	0.257
	69	*Nyssa spp.*	2/6	0.071
	69	*Quercus laurifolia*	2/6	0.046
	69	*Liquidambar styraciflua*	3/6	0.043
	69	*Quercus nigra*	2/6	0.043
	69	*Nyssa sylvatica*	2/6	0.032
	69	*Quercus phellos*	2/6	0.025
	69	*Triadica sebiferum*	1/6	0.014
	69	*Quercus falcata*	1/6	0.014
	69	*Acer rubrum*	1/6	0.014
	69	*Crataegus spp.*	1/6	0.004
	69	*Acer spp.*	1/6	0.003
	69	*Fraxinus spp.*	1/6	0.003
	73	*Taxodium distichum*	14/15	0.545
	73	*Nyssa aquatica*	7/15	0.255
	73	*Planar aquatica*	2/15	0.019
	73	*Liquidambar styraciflua*	2/15	0.014
	73	*Nyssa sylvatica*	1/15	0.005
	109	*Pinus spp.*	3/13	0.231
	109	*Liquidambar styraciflua*	1/13	0.019
	109	*Quercus falcata*	1/13	0.003
	109	*Quercus marilandica*	1/13	0.002

APPENDIX F

SUMMARY OF MEAN PERCENT COVER OF UNDERSTORY SPECIES MEASURED IN 38 HABITAT CLASSIFICATIONS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix F. Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Hardwood	15	*Ilex vomitoria*	10/11	8.75
	15	*Ilex glabra*	2/11	7.39
	15	*Callicarpa americana*	11/11	5.68
	15	*Ilex opaca*	5/11	3.86
	15	*Smilax spp.*	11/11	3.18
	15	*Vaccinium spp.*	5/11	2.61
	15	*Vitis rotundifolia*	6/11	1.82
	15	*Sebastiania fruticosa*	1/11	1.02
	15	*Asimina parviflora*	2/11	0.45
	15	*Morella spp.*	1/11	0.45
	15	*Crataegus spp.*	2/11	0.34
	15	*Toxicodendron vernix*	1/11	0.34
	15	*Persea spp.*	1/11	0.23
	15	*Alnus serrulata*	1/11	0.23
	15	*Chionanthus virginicus*	1/11	0.23
	15	*Cornus florida*	2/11	0.23
	15	*Parthenocissus quinquefolia*	2/11	0.23
	15	*Prunus serotina*	2/11	0.23
	15	*Rubus spp.*	1/11	0.23
	15	*Styrax grandifolius*	1/11	0.23
	15	*Vitis aestivalis*	1/11	0.23
	15	*Viburnum dentatum*	1/11	0.23
	15	*Vitis spp.*	1/11	0.23
	15	*Aralia spinosa*	1/11	0.11
	15	*Crataegus marshallii*	1/11	0.11
	15	*Erythrina herbacea*	1/11	0.11
	15	*Viburnum acerifolium*	1/11	0.11
	15	*Viburnum spp.*	1/11	0.11
	18	*Ilex vomitoria*	18/20	11.13
	18	*Rubus spp.*	7/20	4.31
	18	*Cyrilla racemiflora*	6/20	3.94
	18	*Callicarpa americana*	14/20	3.81
	18	*Vitis rotundifolia*	14/20	3.81
	18	*Ilex opaca*	10/20	3.38
	18	*Morella cerifera*	4/20	3.00
	18	*Vitis spp.*	3/20	2.19
	18	*Rhus copallinum*	2/20	1.88
	18	*Ilex glabra*	2/20	1.81
	18	*Smilax spp.*	14/20	1.75
	18	*Vaccinium spp.*	7/20	1.56
	18	*Cornus florida*	1/20	1.44
	18	*Persea spp.*	4/20	1.06
	18	*Ampelopsis arborea*	4/20	1.00
	18	*Lonicera sempervirens*	1/20	0.94
	18	*Diospyros virginiana*	2/20	0.81
	18	*Viburnum dentatum*	3/20	0.75
	18	*Symplocos tinctoria*	4/20	0.69
	18	*Campsis radicans*	3/20	0.50

(Continued)

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Hardwood	18	*Aralia spinosa*	2/20	0.44
(Continued)	18	*Parthenocissus quinquefolia*	3/20	0.44
	18	*Sassafras albidum*	3/20	0.44
	18	*Styrax americanus*	1/20	0.44
	18	*Morus rubra*	1/20	0.38
	18	*Chionanthus virginicus*	2/20	0.31
	18	*Crataegus marshallii*	2/20	0.31
	18	*Styrax spp.*	2/20	0.31
	18	*Hamamelis virginiana*	1/20	0.19
	18	*Morella caroliniensis*	1/20	0.19
	18	*Styrax grandifolius*	1/20	0.13
	18	*Viburnum nudum*	1/20	0.13
	18	*Asimina triloba*	1/20	0.06
	18	*Berchemia scandens*	1/20	0.06
	18	*Cephalanthus occidentalis*	1/20	0.06
	18	*Clethera alnifolia*	1/20	0.06
	18	*Crataegus spp.*	1/20	0.06
	18	*Dioclea spp.*	1/20	0.06
	18	*Halesia diptera*	1/20	0.06
	18	*Prunus serotina*	1/20	0.06
	18	*Sebastiania fruticosa*	1/20	0.06
	18	*Sideroxylon lanuginosum*	1/20	0.06
	18	*Vitis aestivalis*	1/20	0.06
	18	*Viburnum spp.*	1/20	0.06
	18	*Wisteria spp.*	1/20	0.06
	21	*Ilex vomitoria*	9/10	17.75
	21	*Vaccinium spp.*	7/10	3.38
	21	*Callicarpa americana*	5/10	2.25
	21	*Ilex opaca*	1/10	1.88
	21	*Vitis rotundifolia*	4/10	1.25
	21	*Crataegus spp.*	5/10	1.13
	21	*Smilax spp.*	5/10	0.63
	21	*Prunus serotina*	3/10	0.50
	21	*Viburnum spp.*	3/10	0.50
	21	*Morella cerifera*	2/10	0.38
	21	*Parthenocissus quinquefolia*	3/10	0.38
	21	*Rhus copallinum*	2/10	0.38
	21	*Chionanthus virginicus*	1/10	0.13
	21	*Rubus spp.*	1/10	0.13
	54	*Ilex opaca*	7/17	9.93
	54	*Cyrilla racemiflora*	3/17	5.96
	54	*Clethera alnifolia*	3/17	5.81
	54	*Ampelopsis arborea*	9/17	3.68
	54	*Vitis spp.*	6/17	3.16
	54	*Ilex glabra*	2/17	2.72
	54	*Vitis rotundifolia*	6/17	2.72
	54	*Rubus spp.*	3/17	2.35
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Hardwood	54	*Vitis aestivalis*	3/17	2.28
(Continued)	54	*Vaccinium spp.*	3/17	2.21
	54	*Campsis radicans*	6/17	1.99
	54	*Toxicodendron vernix*	2/17	1.69
	54	*Crataegus spp.*	1/17	1.62
	54	*Sebastiania fruticosa*	3/17	1.25
	54	*Smilax spp.*	8/17	1.18
	54	*Parthenocissus quinquefolia*	3/17	1.03
	54	*Itea virginica*	5/17	0.96
	54	*Callicarpa americana*	4/17	0.88
	54	*Viburnum dentatum*	2/17	0.51
	54	*Cephalanthus occidentalis*	2/17	0.44
	54	*Ilex vomitoria*	4/17	0.29
	54	*Persea spp.*	1/17	0.15
	54	*Wisteria spp.*	1/17	0.15
	54	*Berchemia scandens*	1/17	0.07
	54	*Diospyros virginiana*	1/17	0.07
	54	*Morella cerifera*	1/17	0.07
	54	*Styrax americanus*	1/17	0.07
	54	*Styrax spp.*	1/17	0.07
	58	*Ilex opaca*	6/16	8.05
	58	*Ampelopsis arborea*	11/16	5.00
	58	*Vitis rotundifolia*	10/16	3.36
	58	*Rubus spp.*	10/16	2.89
	58	*Viburnum dentatum*	3/16	2.81
	58	*Campsis radicans*	11/16	2.73
	58	*Celtis laevigata*	3/16	2.73
	58	*Ilex vomitoria*	4/16	2.50
	58	*Smilax spp.*	8/16	2.27
	58	*Crataegus spp.*	2/16	1.56
	58	*Parthenocissus quinquefolia*	6/16	1.48
	58	*Callicarpa americana*	9/16	1.25
	58	*Vitis spp.*	5/16	0.94
	58	*Sebastiania fruticosa*	3/16	0.63
	58	*Berchemia scandens*	3/16	0.47
	58	*Cornus florida*	1/16	0.39
	58	*Halesia diptera*	2/16	0.39
	58	*Vitis aestivalis*	2/16	0.39
	58	*Symplocos tinctoria*	1/16	0.31
	58	*Toxicodendron vernix*	1/16	0.31
	58	*Diospyros virginiana*	2/16	0.16
	63	*Ilex vomitoria*	6/16	8.83
	63	*Ilex glabra*	3/16	7.89
	63	*Ilex opaca*	9/16	6.48
	63	*Vitis rotundifolia*	8/16	5.86
	63	*Arundinaria gigantea*	4/16	2.97
	63	*Smilax spp.*	10/16	2.89
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Percent Cover**
Hardwood	63	*Callicarpa americana*	5/16	1.80
(Continued)	63	*Cyrilla racemiflora*	2/16	1.80
	63	*Vaccinium spp.*	4/16	1.80
	63	*Viburnum dentatum*	3/16	1.17
	63	*Halesia diptera*	2/16	1.02
	63	*Sabal minor*	2/16	1.02
	63	*Styrax americanus*	2/16	1.02
	63	*Ampelopsis arborea*	2/16	0.86
	63	*Rhododendron spp.*	2/16	0.86
	63	*Symplocos tinctoria*	2/16	0.86
	63	*Campsis radicans*	4/16	0.70
	63	*Rubus spp.*	3/16	0.63
	63	*Cornus florida*	1/16	0.55
	63	*Vitis spp.*	1/16	0.55
	63	*Morella cerifera*	3/16	0.47
	63	*Cephalanthus occidentalis*	1/16	0.39
	63	*Aralia spinosa*	1/16	0.31
	63	*Parthenocissus quinquefolia*	2/16	0.31
	63	*Sassafras albidum*	1/16	0.31
	63	*Vitis aestivalis*	1/16	0.31
	63	*Crataegus spp.*	3/16	0.23
	63	*Sebastiania fruticosa*	2/16	0.16
	63	*Berchemia scandens*	1/16	0.08
	63	*Hamamelis virginiana*	1/16	0.08
	63	*Itea virginica*	1/16	0.08
	63	*Persea spp.*	1/16	0.08
	63	*Vitis cordifolia*	1/16	0.08
	67	*Ilex opaca*	12/16	9.14
	67	*Vitis rotundifolia*	10/16	5.70
	67	*Ilex vomitoria*	7/16	4.45
	67	*Viburnum dentatum*	3/16	4.14
	67	*Itea virginica*	7/16	3.13
	67	*Smilax spp.*	12/16	2.58
	67	*Campsis radicans*	3/16	2.50
	67	*Crataegus spp.*	4/16	2.03
	67	*Vaccinium spp.*	4/16	1.95
	67	*Callicarpa americana*	7/16	1.48
	67	*Vitis spp.*	4/16	1.25
	67	*Forestiera acuminata*	1/16	1.17
	67	*Rubus spp.*	7/16	1.09
	67	*Halesia diptera*	2/16	0.94
	67	*Parthenocissus quinquefolia*	5/16	0.94
	67	*Symplocos tinctoria*	2/16	0.70
	67	*Vitis aestivalis*	1/16	0.70
	67	*Ampelopsis arborea*	3/16	0.63
	67	*Arundinaria gigantea*	2/16	0.47
	67	*Sebastiania fruticosa*	3/16	0.47
	67	*Morella cerifera*	1/16	0.39
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Percent Cover**
Hardwood	67	*Toxicodendron vernix*	3/16	0.31
(Continued)	67	*Celtis laevigata*	1/16	0.23
	67	*Sassafras albidum*	1/16	0.23
	67	*Morella spp.*	1/16	0.16
	67	*Persea spp.*	1/16	0.16
	67	*Viburnum spp.*	2/16	0.16
	67	*Aralia spinosa*	1/16	0.08
	67	*Cornus florida*	1/16	0.08
	67	*Frangula caroliniana*	1/16	0.08
	67	*Hamamelis virginiana*	1/16	0.08
	67	*Ilex spp.*	1/16	0.08
	67	*Styrax grandifolius*	1/16	0.08
	70	*Ilex opaca*	12/20	3.31
	70	*Cyrilla racemiflora*	2/20	3.00
	70	*Crataegus spp.*	4/20	2.69
	70	*Morella spp.*	1/20	2.50
	70	*Clethera alnifolia*	2/20	2.06
	70	*Vaccinium spp.*	6/20	1.63
	70	*Smilax spp.*	13/20	1.56
	70	*Viburnum dentatum*	3/20	1.56
	70	*Campsis radicans*	5/20	1.25
	70	*Persea borbonia*	2/20	1.06
	70	*Ilex vomitoria*	5/20	1.00
	70	*Vitis rotundifolia*	7/20	1.00
	70	*Ampelopsis arborea*	7/20	0.94
	70	*Callicarpa americana*	4/20	0.88
	70	*Itea virginica*	2/20	0.69
	70	*Parthenocissus quinquefolia*	2/20	0.69
	70	*Styrax spp.*	5/20	0.69
	70	*Rubus spp.*	6/20	0.63
	70	*Morella cerifera*	4/20	0.56
	70	*Symplocos tinctoria*	1/20	0.38
	70	*Vitis aestivalis*	1/20	0.38
	70	*Frangula caroliniana*	2/20	0.31
	70	*Ilex glabra*	1/20	0.31
	70	*Toxicodendron vernix*	2/20	0.31
	70	*Cephalanthus occidentalis*	4/20	0.25
	70	*Cornus florida*	2/20	0.25
	70	*Rhododendron spp.*	2/20	0.25
	70	*Styrax americanus*	1/20	0.25
	70	*Alnus serrulata*	1/20	0.19
	70	*Berchemia scandens*	3/20	0.19
	70	*Vitis spp.*	1/20	0.19
	70	*Diospyros virginiana*	1/20	0.13
	70	*Forestiera acuminata*	1/20	0.06
	70	*Morella caroliniensis*	1/20	0.06
	70	*Persea spp.*	1/20	0.06

(Continued)

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Hardwood	70	*Sebastiania fruticosa*	1/20	0.06
(Continued)	70	*Viburnum spp.*	1/20	0.06
	77	*Ilex vomitoria*	8/17	11.10
	77	*Smilax spp.*	13/17	6.76
	77	*Cyrilla racemiflora*	7/17	5.74
	77	*Ilex opaca*	10/17	4.85
	77	*Rubus spp.*	6/17	3.82
	77	*Vaccinium spp.*	8/17	3.75
	77	*Callicarpa americana*	8/17	3.24
	77	*Ampelopsis arborea*	2/17	2.43
	77	*Vitis spp.*	2/17	2.28
	77	*Cornus florida*	1/17	1.40
	77	*Vitis rotundifolia*	5/17	1.40
	77	*Morella cerifera*	2/17	1.10
	77	*Clethera alnifolia*	1/17	0.96
	77	*Styrax spp.*	4/17	0.81
	77	*Symplocos tinctoria*	4/17	0.81
	77	*Lonicera japonica*	1/17	0.74
	77	*Cephalanthus occidentalis*	1/17	0.59
	77	*Crataegus spp.*	3/17	0.51
	77	*Toxicodendron vernix*	2/17	0.51
	77	*Persea spp.*	2/17	0.29
	77	*Viburnum dentatum*	1/17	0.29
	77	*Campsis radicans*	1/17	0.22
	77	*Sebastiania fruticosa*	1/17	0.22
	77	*Itea virginica*	2/17	0.15
	77	*Prunus serotina*	1/17	0.15
	77	*Sassafras albidum*	1/17	0.15
	77	*Chionanthus virginicus*	1/17	0.07
	77	*Parthenocissus quinquefolia*	1/17	0.07
	77	*Rhus copallinum*	1/17	0.07
	77	*Rhododendron spp.*	1/17	0.07
	77	*Wisteria spp.*	1/17	0.07
	100	*Rubus spp.*	7/15	10.33
	100	*Smilax spp.*	7/15	5.83
	100	*Cyrilla racemiflora*	3/15	3.50
	100	*Cephalanthus occidentalis*	9/15	2.25
	100	*Vitis spp.*	4/15	2.17
	100	*Callicarpa americana*	5/15	2.00
	100	*Morella cerifera*	3/15	2.00
	100	*Ampelopsis arborea*	2/15	1.83
	100	*Aralia spinosa*	1/15	1.50
	100	*Ilex opaca*	6/15	1.50
	100	*Hypericum spp.*	1/15	1.25
	100	*Vaccinium spp.*	3/15	0.83
	100	*Ilex vomitoria*	3/15	0.33
	100	*Diospyros virginiana*	1/15	0.17
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Hardwood	100	*Sambucus canadensis*	1/15	0.17
(Continued)	100	*Viburnum dentatum*	2/15	0.17
	100	*Campsis radicans*	1/15	0.08
	100	*Crataegus spp.*	1/15	0.08
	100	*Morus rubra*	1/15	0.08
	100	*Persea borbonia*	1/15	0.08
	100	*Rhus copallinum*	1/15	0.08
	100	*Viburnum spp.*	1/15	0.08
Pine	16	*Ilex vomitoria*	20/21	28.15
	16	*Callicarpa americana*	20/21	12.26
	16	*Vitis rotundifolia*	14/21	9.05
	16	*Rubus spp.*	9/21	3.33
	16	*Cyrilla racemiflora*	1/21	3.21
	16	*Vitis spp.*	5/21	2.74
	16	*Smilax spp.*	16/21	2.56
	16	*Ilex opaca*	9/21	2.32
	16	*Ilex glabra*	2/21	1.49
	16	*Sassafras albidum*	8/21	1.31
	16	*Prunus serotina*	4/21	1.07
	16	*Parthenocissus quinquefolia*	6/21	1.01
	16	*Symplocos tinctoria*	3/21	0.77
	16	*Cornus florida*	3/21	0.54
	16	*Morella cerifera*	3/21	0.54
	16	*Vaccinium spp.*	5/21	0.54
	16	*Persea spp.*	3/21	0.42
	16	*Viburnum dentatum*	4/21	0.42
	16	*Asimina parviflora*	3/21	0.36
	16	*Frangula caroliniana*	1/21	0.24
	16	*Vitis aestivalis*	3/21	0.24
	16	*Ampelopsis arborea*	2/21	0.18
	16	*Asimina triloba*	1/21	0.18
	16	*Berchemia scandens*	3/21	0.18
	16	*Diospyros virginiana*	3/21	0.18
	16	*Rhus copallinum*	3/21	0.18
	16	*Chionanthus virginicus*	2/21	0.12
	16	*Morella spp.*	1/21	0.12
	16	*Sebastiania fruticosa*	2/21	0.12
	16	*Campsis radicans*	1/21	0.06
	16	*Crataegus spp.*	1/21	0.06
	16	*Hamamelis virginiana*	1/21	0.06
	16	*Toxicodendron vernix*	1/21	0.06
	19	*Ilex vomitoria*	13/14	21.70
	19	*Callicarpa americana*	9/14	4.73
	19	*Smilax spp.*	9/14	4.11
	19	*Crataegus spp.*	6/14	3.84
	19	*Vaccinium spp.*	4/14	2.41
	19	*Ilex opaca*	2/14	2.05
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Pine	19	*Rubus spp.*	4/14	1.43
(Continued)	19	*Berchemia scandens*	1/14	1.16
	19	*Vitis rotundifolia*	5/14	1.16
	19	*Crataegus marshallii*	2/14	0.80
	19	*Rhus copallinum*	1/14	0.71
	19	*Viburnum dentatum*	2/14	0.71
	19	*Sassafras albidum*	1/14	0.45
	19	*Sideroxylon lanuginosum*	1/14	0.27
	19	*Cornus florida*	1/14	0.18
	19	*Morella cerifera*	1/14	0.18
	19	*Parthenocissus quinquefolia*	2/14	0.18
	19	*Vitis spp.*	1/14	0.18
	19	*Asimina parviflora*	1/14	0.09
	19	*Chionanthus virginicus*	1/14	0.09
	19	*Prunus serotina*	1/14	0.09
	19	*Viburnum spp.*	1/14	0.09
	19	*Wisteria spp.*	1/14	0.09
	22	*Ilex vomitoria*	12/22	20.63
	22	*Callicarpa americana*	16/22	16.17
	22	*Vitis spp.*	6/22	6.56
	22	*Sassafras albidum*	14/22	5.16
	22	*Cornus florida*	4/22	2.19
	22	*Vitis aestivalis*	5/22	1.95
	22	*Vitis rotundifolia*	2/22	1.41
	22	*Smilax spp.*	5/22	1.25
	22	*Morella spp.*	2/22	1.02
	22	*Ilex opaca*	2/22	0.55
	22	*Persea spp.*	3/22	0.55
	22	*Asimina parviflora*	3/22	0.47
	22	*Rubus spp.*	4/22	0.47
	22	*Rhus copallinum*	3/22	0.39
	22	*Vaccinium spp.*	3/22	0.31
	22	*Morella cerifera*	2/22	0.16
	22	*Viburnum rufidulum*	1/22	0.16
	22	*Frangula caroliniana*	1/22	0.08
	75	*Ilex vomitoria*	15/19	13.95
	75	*Smilax spp.*	16/19	4.34
	75	*Ilex opaca*	14/19	3.95
	75	*Callicarpa americana*	13/19	2.70
	75	*Rubus spp.*	7/19	2.30
	75	*Vitis rotundifolia*	7/19	2.17
	75	*Morella cerifera*	10/19	2.11
	75	*Morella spp.*	2/19	1.71
	75	*Vaccinium spp.*	12/19	1.58
	75	*Symplocos tinctoria*	5/19	1.38
	75	*Persea spp.*	2/19	1.05
	75	*Ampelopsis arborea*	3/19	0.86
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Pine	75	*Crataegus spp.*	5/19	0.79
(Continued)	75	*Viburnum dentatum*	2/19	0.66
	75	*Vitis spp.*	2/19	0.26
	75	*Arundinaria gigantea*	1/19	0.13
	75	*Asimina parviflora*	1/19	0.13
	75	*Berchemia scandens*	2/19	0.13
	75	*Cornus florida*	1/19	0.13
	75	*Diospyros virginiana*	1/19	0.13
	75	*Morus rubra*	1/19	0.13
	75	*Styrax spp.*	2/19	0.13
	75	*Viburnum spp.*	2/19	0.13
	75	*Prunus serotina*	1/19	0.07
	75	*Sebastiania fruticosa*	1/19	0.07
	75	*Vitis aestivalis*	1/19	0.07
	115	*Ilex glabra*	4/22	11.76
	115	*Cyrilla racemiflora*	6/22	8.98
	115	*Ilex vomitoria*	13/22	8.69
	115	*Vitis rotundifolia*	12/22	5.68
	115	*Vaccinium spp.*	10/22	3.35
	115	*Rubus spp.*	6/22	3.24
	115	*Callicarpa americana*	12/22	3.07
	115	*Smilax spp.*	15/22	1.99
	115	*Vitis spp.*	3/22	1.82
	115	*Arundinaria gigantea*	3/22	1.76
	115	*Ilex opaca*	10/22	1.70
	115	*Cephalanthus occidentalis*	1/22	1.36
	115	*Persea spp.*	7/22	1.25
	115	*Morella cerifera*	5/22	0.91
	115	*Symplocos tinctoria*	3/22	0.57
	115	*Rhododendron spp.*	4/22	0.40
	115	*Sebastiania fruticosa*	2/22	0.40
	115	*Campsis radicans*	1/22	0.34
	115	*Frangula caroliniana*	1/22	0.34
	115	*Hamamelis virginiana*	2/22	0.34
	115	*Parthenocissus quinquefolia*	4/22	0.34
	115	*Alnus serrulata*	2/22	0.28
	115	*Morella caroliniensis*	2/22	0.28
	115	*Sabal minor*	1/22	0.28
	115	*Asimina parviflora*	3/22	0.23
	115	*Cornus florida*	1/22	0.23
	115	*Crataegus spp.*	3/22	0.23
	115	*Clethera alnifolia*	1/22	0.17
	115	*Morella spp.*	2/22	0.17
	115	*Viburnum dentatum*	2/22	0.17
	115	*Ampelopsis arborea*	2/22	0.11
	115	*Berchemia scandens*	2/22	0.11
	115	*Halesia diptera*	1/22	0.11
	115	*Sassafras albidum*	1/22	0.11
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Pine	115	*Chionanthus virginicus*	1/22	0.06
(Continued)	115	*Crataegus marshallii*	1/22	0.06
	115	*Itea virginica*	1/22	0.06
	116	*Ilex vomitoria*	16/18	27.15
	116	*Rubus spp.*	10/18	6.39
	116	*Vitis rotundifolia*	6/18	5.83
	116	*Ilex opaca*	14/18	4.93
	116	*Callicarpa americana*	14/18	3.96
	116	*Smilax spp.*	11/18	2.36
	116	*Campsis radicans*	2/18	2.15
	116	*Morella cerifera*	9/18	2.01
	116	*Symplocos tinctoria*	4/18	1.39
	116	*Vitis spp.*	6/18	1.25
	116	*Vaccinium spp.*	6/18	1.18
	116	*Vitis aestivalis*	4/18	1.18
	116	*Rhus copallinum*	3/18	0.83
	116	*Morella spp.*	1/18	0.56
	116	*Ampelopsis arborea*	1/18	0.49
	116	*Viburnum dentatum*	2/18	0.42
	116	*Asimina parviflora*	4/18	0.35
	116	*Cornus florida*	1/18	0.28
	116	*Parthenocissus quinquefolia*	3/18	0.28
	116	*Sassafras albidum*	2/18	0.28
	116	*Asimina triloba*	1/18	0.21
	116	*Crataegus spp.*	2/18	0.21
	116	*Frangula caroliniana*	1/18	0.21
	116	*Crataegus marshallii*	1/18	0.14
	116	*Cephalanthus occidentalis*	1/18	0.07
	116	*Dioclea spp.*	1/18	0.07
	116	*Persea spp.*	1/18	0.07
Mixed Pine Hardwood	14	*Ilex opaca*	15/19	8.03
	14	*Ilex vomitoria*	13/19	6.84
	14	*Callicarpa americana*	15/19	3.16
	14	*Smilax spp.*	17/19	2.70
	14	*Vitis rotundifolia*	11/19	2.63
	14	*Vaccinium spp.*	9/19	2.04
	14	*Arundinaria gigantea*	4/19	1.51
	14	*Cornus florida*	6/19	1.45
	14	*Ilex glabra*	2/19	0.92
	14	*Crataegus spp.*	2/19	0.66
	14	*Vitis spp.*	4/19	0.59
	14	*Parthenocissus quinquefolia*	4/19	0.39
	14	*Prunus spp.*	1/19	0.39
	14	*Sebastiania fruticosa*	3/19	0.39
	14	*Persea spp.*	1/19	0.33
	14	*Chionanthus virginicus*	2/19	0.20
	14	*Itea virginica*	2/19	0.20

(Continued)

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Percent Cover**
Mixed Pine Hardwood	14	*Viburnum dentatum*	3/19	0.20
(Continued)	14	*Asimina parviflora*	2/19	0.13
	14	*Hamamelis virginiana*	1/19	0.13
	14	*Prunus serotina*	2/19	0.13
	14	*Symplocos tinctoria*	1/19	0.13
	14	*Aralia spinosa*	1/19	0.07
	14	*Berchemia scandens*	1/19	0.07
	14	*Campsis radicans*	1/19	0.07
	14	*Cercis canadensis*	1/19	0.07
	14	*Melia azedarach*	1/19	0.07
	14	*Styrax spp.*	1/19	0.07
	14	*Vitis aestivalis*	1/19	0.07
	14	*Viburnum spp.*	1/19	0.07
	17	*Ilex vomitoria*	12/15	14.50
	17	*Ilex opaca*	11/15	6.92
	17	*Callicarpa americana*	10/15	4.83
	17	*Vitis rotundifolia*	9/15	4.58
	17	*Cyrilla racemiflora*	3/15	4.50
	17	*Campsis radicans*	3/15	3.92
	17	*Vitis spp.*	3/15	3.75
	17	*Symplocos tinctoria*	2/15	2.50
	17	*Persea spp.*	6/15	1.92
	17	*Ilex glabra*	3/15	1.75
	17	*Smilax spp.*	10/15	1.75
	17	*Viburnum dentatum*	6/15	1.33
	17	*Vaccinium spp.*	5/15	1.25
	17	*Clethera alnifolia*	2/15	1.17
	17	*Rubus spp.*	4/15	1.17
	17	*Crataegus spp.*	3/15	0.83
	17	*Parthenocissus quinquefolia*	3/15	0.58
	17	*Morella cerifera*	2/15	0.42
	17	*Rhododendron spp.*	1/15	0.42
	17	*Cornus florida*	2/15	0.33
	17	*Persea borbonia*	1/15	0.33
	17	*Aralia spinosa*	1/15	0.17
	17	*Itea virginica*	1/15	0.17
	17	*Prunus serotina*	2/15	0.17
	17	*Sassafras albidum*	1/15	0.17
	17	*Styrax americanus*	1/15	0.17
	17	*Ampelopsis arborea*	1/15	0.08
	17	*Asimina parviflora*	1/15	0.08
	17	*Crataegus marshallii*	1/15	0.08
	17	*Hamamelis virginiana*	1/15	0.08
	17	*Mitchella repens*	1/15	0.08
	17	*Sebastiania fruticosa*	1/15	0.08
	17	*Sideroxylon lanuginosum*	1/15	0.08
	17	*Styrax grandifolius*	1/15	0.08
	17	*Vitis aestivalis*	1/15	0.08
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Mixed Pine Hardwood	20	*Callicarpa americana*	9/9	8.06
(Continued)	20	*Smilax spp.*	9/9	5.69
	20	*Vitis rotundifolia*	8/9	4.03
	20	*Aralia spinosa*	3/9	3.61
	20	*Ilex opaca*	4/9	3.61
	20	*Frangula caroliniana*	1/9	1.53
	20	*Ilex vomitoria*	4/9	1.39
	20	*Vaccinium spp.*	6/9	1.39
	20	*Viburnum rufidulum*	4/9	1.39
	20	*Vitis aestivalis*	2/9	1.11
	20	*Crataegus spp.*	3/9	0.83
	20	*Asimina triloba*	2/9	0.69
	20	*Parthenocissus quinquefolia*	3/9	0.56
	20	*Prunus serotina*	4/9	0.56
	20	*Chionanthus virginicus*	2/9	0.42
	20	*Rubus spp.*	3/9	0.42
	20	*Sassafras albidum*	2/9	0.42
	20	*Cornus florida*	1/9	0.28
	20	*Diospyros virginiana*	1/9	0.28
	20	*Hamamelis virginiana*	1/9	0.14
	20	*Rhus copallinum*	1/9	0.14
	20	*Viburnum dentatum*	1/9	0.14
	53	*Ilex opaca*	12/20	5.94
	53	*Ilex vomitoria*	11/20	3.63
	53	*Parthenocissus quinquefolia*	8/20	3.56
	53	*Vitis rotundifolia*	10/20	3.56
	53	*Campsis radicans*	11/20	2.31
	53	*Smilax spp.*	11/20	2.25
	53	*Callicarpa americana*	8/20	2.00
	53	*Sebastiania fruticosa*	8/20	1.69
	53	*Vitis aestivalis*	4/20	1.56
	53	*Ampelopsis arborea*	6/20	1.50
	53	*Vaccinium spp.*	6/20	1.38
	53	*Hamamelis virginiana*	3/20	1.13
	53	*Rubus spp.*	7/20	1.06
	53	*Symplocos tinctoria*	3/20	1.00
	53	*Halesia diptera*	4/20	0.69
	53	*Arundinaria gigantea*	3/20	0.63
	53	*Viburnum dentatum*	3/20	0.50
	53	*Crataegus spp.*	3/20	0.38
	53	*Ligustrum spp.*	1/20	0.38
	53	*Vitis spp.*	3/20	0.38
	53	*Berchemia scandens*	3/20	0.31
	53	*Itea virginica*	2/20	0.19
	53	*Cornus florida*	1/20	0.13
	53	*Diospyros virginiana*	1/20	0.13
	53	*Persea spp.*	1/20	0.13
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Mixed Pine Hardwood	53	*Prunus serotina*	1/20	0.13
(Continued)	53	*Sambucus canadensis*	1/20	0.13
	53	*Toxicodendron vernix*	1/20	0.13
	53	*Morella cerifera*	1/20	0.06
	53	*Sassafras albidum*	1/20	0.06
	53	*Sabal minor*	1/20	0.06
	62	*Ilex opaca*	19/20	11.00
	62	*Vitis rotundifolia*	16/20	7.31
	62	*Ilex vomitoria*	18/20	6.19
	62	*Arundinaria gigantea*	7/20	3.06
	62	*Smilax spp.*	17/20	2.94
	62	*Ilex glabra*	2/20	2.63
	62	*Sebastiania fruticosa*	7/20	2.56
	62	*Callicarpa americana*	13/20	2.06
	62	*Vaccinium spp.*	8/20	1.94
	62	*Rubus spp.*	5/20	1.06
	62	*Alnus serrulata*	1/20	0.94
	62	*Symplocos tinctoria*	3/20	0.94
	62	*Vitis aestivalis*	4/20	0.94
	62	*Crataegus spp.*	4/20	0.81
	62	*Parthenocissus quinquefolia*	3/20	0.56
	62	*Halesia diptera*	1/20	0.38
	62	*Hamamelis virginiana*	2/20	0.31
	62	*Itea virginica*	1/20	0.31
	62	*Viburnum dentatum*	3/20	0.25
	62	*Vitis spp.*	2/20	0.25
	62	*Asimina parviflora*	2/20	0.19
	62	*Cornus florida*	2/20	0.19
	62	*Persea spp.*	2/20	0.19
	62	*Chionanthus virginicus*	2/20	0.13
	62	*Crataegus marshallii*	2/20	0.13
	62	*Bignonia capreolata*	1/20	0.06
	62	*Campsis radicans*	1/20	0.06
	62	*Diospyros virginiana*	1/20	0.06
	62	*Sassafras albidum*	1/20	0.06
	62	*Styrax spp.*	1/20	0.06
	62	*Viburnum spp.*	1/20	0.06
	76	*Ilex vomitoria*	6/15	13.17
	76	*Ilex opaca*	10/15	8.67
	76	*Ilex glabra*	2/15	6.25
	76	*Sabal minor*	2/15	4.08
	76	*Symplocos tinctoria*	3/15	2.67
	76	*Smilax spp.*	9/15	2.58
	76	*Cyrilla racemiflora*	1/15	2.17
	76	*Vitis rotundifolia*	8/15	1.92
	76	*Callicarpa americana*	7/15	1.83
	76	*Morella cerifera*	1/15	1.75
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Mixed Pine Hardwood	76	*Vaccinium spp.*	6/15	1.67
(Continued)	76	*Persea spp.*	5/15	1.58
	76	*Viburnum dentatum*	3/15	1.33
	76	*Vitis spp.*	1/15	0.83
	76	*Sebastiania fruticosa*	1/15	0.58
	76	*Styrax spp.*	1/15	0.58
	76	*Campsis radicans*	2/15	0.50
	76	*Asimina parviflora*	1/15	0.33
	76	*Rubus spp.*	1/15	0.33
	76	*Sassafras albidum*	2/15	0.33
	76	*Cornus florida*	2/15	0.25
	76	*Crataegus spp.*	1/15	0.25
	76	*Berchemia scandens*	2/15	0.17
	76	*Frangula caroliniana*	1/15	0.17
	76	*Hamamelis virginiana*	1/15	0.17
	76	*Prunus serotina*	1/15	0.17
	76	*Bignonia capreolata*	1/15	0.08
	76	*Cephalanthus occidentalis*	1/15	0.08
	76	*Diospyros virginiana*	1/15	0.08
	76	*Rhus copallinum*	1/15	0.08
	76	*Rhododendron spp.*	1/15	0.08
Herbaceous	57	*Cephalanthus occidentalis*	2/3	10.42
	57	*Smilax spp.*	1/3	2.08
	57	*Callicarpa americana*	1/3	1.67
	57	*Diospyros virginiana*	2/3	1.25
	57	*Viburnum spp.*	1/3	0.83
	57	*Vitis rotundifolia*	1/3	0.83
	57	*Ampelopsis arborea*	1/3	0.42
	57	*Campsis radicans*	1/3	0.42
	57	*Prunus serotina*	1/3	0.42
	59	*Callicarpa americana*	6/9	7.36
	59	*Vitis rotundifolia*	5/9	3.61
	59	*Cyrilla racemiflora*	4/9	3.06
	59	*Ilex vomitoria*	5/9	3.06
	59	*Ilex opaca*	4/9	1.94
	59	*Vitis aestivalis*	2/9	1.94
	59	*Rubus spp.*	5/9	1.25
	59	*Arundinaria gigantea*	1/9	0.97
	59	*Morella cerifera*	3/9	0.69
	59	*Campsis radicans*	3/9	0.56
	59	*Smilax spp.*	2/9	0.56
	59	*Persea spp.*	2/9	0.42
	59	*Styrax spp.*	2/9	0.42
	59	*Symplocos tinctoria*	2/9	0.42
	59	*Asimina parviflora*	1/9	0.14
	59	*Rhus copallinum*	1/9	0.14
	59	*Sebastiania fruticosa*	1/9	0.14

(Continued)

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Herbaceous	68	*Morella cerifera*	5/8	3.59
(Continued)	68	*Rubus spp.*	5/8	2.34
	68	*Callicarpa americana*	5/8	1.88
	68	*Ilex vomitoria*	4/8	1.72
	68	*Smilax spp.*	5/8	1.41
	68	*Ilex opaca*	1/8	1.25
	68	*Parthenocissus quinquefolia*	1/8	0.78
	68	*Vitis rotundifolia*	2/8	0.78
	68	*Campsis radicans*	2/8	0.47
	68	*Rhus copallinum*	2/8	0.31
	68	*Prunus serotina*	1/8	0.16
	68	*Sebastiania fruticosa*	1/8	0.16
	68	*Vaccinium spp.*	1/8	0.16
	68	*Viburnum spp.*	1/8	0.16
	71	*Ilex vomitoria*	7/12	4.79
	71	*Morella cerifera*	10/12	3.65
	71	*Callicarpa americana*	7/12	2.71
	71	*Smilax spp.*	6/12	1.77
	71	*Rubus spp.*	6/12	1.46
	71	*Ilex opaca*	5/12	0.83
	71	*Vaccinium spp.*	3/12	0.42
	71	*Vitis rotundifolia*	2/12	0.42
	71	*Diospyros virginiana*	1/12	0.31
	71	*Styrax spp.*	2/12	0.21
	71	*Symplocos tinctoria*	2/12	0.21
	71	*Cyrilla racemiflora*	1/12	0.10
	71	*Rhus copallinum*	1/12	0.10
	71	*Sassafras albidum*	1/12	0.10
	72	*Persea spp.*	8/8	9.84
	72	*Callicarpa americana*	5/8	4.22
	72	*Ilex vomitoria*	7/8	2.97
	72	*Morella caroliniensis*	3/8	2.66
	72	*Vaccinium spp.*	3/8	1.72
	72	*Sassafras albidum*	4/8	1.41
	72	*Morella cerifera*	4/8	1.25
	72	*Rhus copallinum*	4/8	1.25
	72	*Smilax spp.*	5/8	1.09
	72	*Rubus spp.*	3/8	0.78
	72	*Toxicodendron vernix*	2/8	0.78
	72	*Alnus serrulata*	1/8	0.47
	72	*Cyrilla racemiflora*	1/8	0.47
	72	*Ilex opaca*	3/8	0.47
	72	*Ilex glabra*	1/8	0.31
	72	*Frangula caroliniana*	1/8	0.16
	72	*Itea virginica*	1/8	0.16
	72	*Prunus serotina*	1/8	0.16
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Herbaceous	72	*Rhododendron spp.*	1/8	0.16
(Continued)	72	*Vitis rotundifolia*	1/8	0.16
Shrub	56	*Campsis radicans*	2/8	10.47
	56	*Vitis rotundifolia*	6/8	9.22
	56	*Rubus spp.*	8/8	6.25
	56	*Ampelopsis arborea*	4/8	3.91
	56	*Crataegus spp.*	4/8	3.13
	56	*Callicarpa americana*	4/8	2.97
	56	*Ilex vomitoria*	4/8	2.81
	56	*Vitis aestivalis*	6/8	2.50
	56	*Smilax spp.*	5/8	2.03
	56	*Arundinaria gigantea*	2/8	1.25
	56	*Ilex opaca*	3/8	1.25
	56	*Parthenocissus quinquefolia*	2/8	0.63
	56	*Diospyros virginiana*	1/8	0.16
	56	*Wisteria spp.*	1/8	0.16
	65	*Callicarpa americana*	6/6	32.29
	65	*Ilex vomitoria*	5/6	18.13
	65	*Vitis rotundifolia*	5/6	17.08
	65	*Rubus spp.*	5/6	5.83
	65	*Vitis spp.*	1/6	2.29
	65	*Crataegus spp.*	2/6	2.08
	65	*Sassafras albidum*	4/6	1.67
	65	*Morella caroliniensis*	1/6	1.04
	65	*Vitis aestivalis*	1/6	1.04
	65	*Ilex opaca*	2/6	0.83
	65	*Smilax spp.*	3/6	0.63
	65	*Vaccinium spp.*	3/6	0.63
	65	*Aralia spinosa*	1/6	0.42
	65	*Celtis laevigata*	1/6	0.42
	65	*Persea spp.*	1/6	0.42
	65	*Prunus spp.*	1/6	0.21
	65	*Sideroxylon lanuginosum*	1/6	0.21
	78	*Ilex vomitoria*	10/11	6.93
	78	*Vaccinium spp.*	7/11	5.11
	78	*Callicarpa americana*	3/11	0.80
	78	*Morella cerifera*	2/11	0.80
	78	*Smilax spp.*	5/11	0.80
	78	*Vitis rotundifolia*	3/11	0.68
	78	*Rubus spp.*	2/11	0.34
	78	*Ilex opaca*	2/11	0.23
	78	*Rhus copallinum*	1/11	0.11
	78	*Sassafras albidum*	1/11	0.11
	107	*Ilex vomitoria*	9/11	8.86
	107	*Morella cerifera*	7/11	6.70
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	Code	Species	Proportion of Plots	Mean Percent Cover
Shrub	107	*Callicarpa americana*	10/11	6.59
(Continued)	107	*Campsis radicans*	5/11	5.34
	107	*Rubus spp.*	10/11	3.18
	107	*Vitis rotundifolia*	3/11	1.14
	107	*Diospyros virginiana*	3/11	0.91
	107	*Ampelopsis arborea*	1/11	0.68
	107	*Smilax spp.*	5/11	0.57
	107	*Vaccinium spp.*	3/11	0.57
	107	*Asimina parviflora*	2/11	0.45
	107	*Symplocos tinctoria*	3/11	0.45
	107	*Ilex opaca*	3/11	0.34
	107	*Rhus copallinum*	2/11	0.23
	107	*Vitis aestivalis*	2/11	0.23
	107	*Wisteria spp.*	1/11	0.11
Swamp	60	*Cephalanthus occidentalis*	7/16	8.28
	60	*Clethera alnifolia*	1/16	4.61
	60	*Cyrilla racemiflora*	2/16	3.98
	60	*Itea virginica*	6/16	2.19
	60	*Prunus spp.*	1/16	1.17
	60	*Vitis aestivalis*	1/16	1.02
	60	*Sebastiania fruticosa*	2/16	0.86
	60	*Vitis rotundifolia*	4/16	0.86
	60	*Ilex opaca*	1/16	0.70
	60	*Smilax spp.*	3/16	0.39
	60	*Ampelopsis arborea*	2/16	0.31
	60	*Campsis radicans*	3/16	0.31
	60	*Viburnum nudum*	1/16	0.23
	60	*Berchemia scandens*	1/16	0.16
	60	*Parthenocissus quinquefolia*	2/16	0.16
	60	*Rubus spp.*	2/16	0.16
	60	*Vaccinium spp.*	1/16	0.16
	60	*Callicarpa americana*	1/16	0.08
	60	*Crataegus spp.*	1/16	0.08
	60	*Styrax americanus*	1/16	0.08
	60	*Styrax spp.*	1/16	0.08
	60	*Viburnum dentatum*	1/16	0.08
	60	*Vitis spp.*	1/16	0.08
	69	*Crataegus spp.*	4/6	11.25
	69	*Ampelopsis arborea*	3/6	4.38
	69	*Sebastiania fruticosa*	2/6	2.08
	69	*Smilax spp.*	3/6	2.08
	69	*Itea virginica*	1/6	1.46
	69	*Styrax spp.*	2/6	1.04
	69	*Berchemia scandens*	2/6	0.83
	69	*Callicarpa americana*	2/6	0.83
	69	*Viburnum dentatum*	1/6	0.63
	69	*Vaccinium spp.*	1/6	0.42
(Continued)				

* Data regarding non-soft mast producing species were not recorded during all surveys

Appendix F (Continued). Summary of mean percent cover of understory species measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-Type	**Code**	**Species**	**Proportion of Plots**	**Mean Percent Cover**
Swamp	69	*Halesia diptera*	1/6	0.21
(Continued)	69	*Ilex vomitoria*	1/6	0.21
	69	*Persea borbonia*	1/6	0.21
	69	*Rubus spp.*	1/6	0.21
	69	*Toxicodendron vernix*	1/6	0.21
	69	*Vitis spp.*	1/6	0.21
	73	*Morella cerifera*	4/15	1.67
	73	*Cephalanthus occidentalis*	3/15	0.67
	73	*Rubus spp.*	3/15	0.42
	73	*Campsis radicans*	2/15	0.25
	73	*Sabal minor*	2/15	0.25
	73	*Smilax spp.*	2/15	0.25
	73	*Ampelopsis arborea*	1/15	0.17
	73	*Vitis aestivalis*	1/15	0.17
	73	*Berchemia scandens*	1/15	0.08
	73	*Crataegus spp.*	1/15	0.08
	73	*Vitis rotundifolia*	1/15	0.08
	109	*Cyrilla racemiflora*	2/13	5.00
	109	*Morella cerifera*	6/13	5.00
	109	*Callicarpa americana*	3/13	1.25
	109	*Sassafras albidum*	3/13	1.25
	109	*Vitis rotundifolia*	2/13	1.25
	109	*Smilax spp.*	3/13	0.96
	109	*Vaccinium spp.*	3/13	0.96
	109	*Rubus spp.*	5/13	0.87
	109	*Rhus copallinum*	3/13	0.77
	109	*Vitis aestivalis*	2/13	0.19
	109	*Cephalanthus occidentalis*	1/13	0.10
	109	*Crataegus spp.*	1/13	0.10
	109	*Ilex vomitoria*	1/13	0.10
Non-Habitat	110	*Ilex vomitoria*	6/11	6.36
	110	*Morella cerifera*	3/11	4.20
	110	*Callicarpa americana*	7/11	2.73
	110	*Vitis rotundifolia*	2/11	2.50
	110	*Vaccinium spp.*	3/11	1.14
	110	*Rhus copallinum*	2/11	0.45
	110	*Smilax spp.*	2/11	0.45
	110	*Sassafras albidum*	1/11	0.23
	110	*Sambucus canadensis*	1/11	0.23
	110	*Cephalanthus occidentalis*	1/11	0.11
	110	*Crataegus spp.*	1/11	0.11
	110	*Parthenocissus quinquefolia*	1/11	0.11
	110	*Rubus spp.*	1/11	0.11
	110	*Vitis aestivalis*	1/11	0.11
	110	*Wisteria spp.*	1/11	0.11

APPENDIX G

SUMMARY OF MEAN VEGETATION DENSITY FROM 0-50, 50-100, 100-150, AND 150-200 CM ABOVE THE GROUND MEASURED IN 38 HABAITAT CLASSIFICAIONS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix G. Summary of mean vegetation density from 0-50, 50-100, 100-150, and 150-200 cm above the ground measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**Height (cm)**	**Mean Density Board Reading**	**Mean Percent Cover**
Hardwood	15	50	2.8	36.4
		100	2.5	30.0
		150	2.6	31.4
		200	2.6	31.8
	18	50	4.3	65.5
		100	4.2	64.0
		150	4.1	62.8
		200	4.2	64.0
	21	50	3.3	45.5
		100	2.9	38.0
		150	2.5	30.0
		200	2.4	28.0
	54	50	3.6	52.1
		100	3.5	49.7
		150	3.7	53.2
		200	3.8	55.3
	58	50	4.0	60.3
		100	3.9	58.4
		150	3.8	56.6
		200	4.0	60.9
	63	50	3.7	54.7
		100	3.5	50.0
		150	3.5	50.0
		200	3.6	52.5
	67	50	3.8	55.3
		100	3.6	52.5
		150	3.6	52.5
		200	3.5	50.9
	70	50	3.8	56.5
		100	3.8	56.0
		150	3.8	56.0
		200	3.8	55.8
	77	50	4.3	66.2
		100	4.2	63.5
		150	4.2	64.4
		200	4.3	65.3
	100	50	4.3	66.0
		100	4.0	59.3
		150	3.9	57.3
		200	3.6	52.7

(Continued)

Appendix G (Continued). Summary of mean vegetation density from 0-50, 50-100, 100-150, and 150-200 cm above the ground measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	Height (cm)	Mean Density Board Reading	Mean Percent Cover
Pine	16	50	4.4	67.1
		100	4.1	62.1
		150	4.0	60.5
		200	4.0	59.8
	19	50	3.7	53.9
		100	3.4	48.6
		150	3.2	43.9
		200	3.0	40.7
	22	50	4.1	61.3
		100	3.2	43.1
		150	3.0	40.0
		200	2.8	35.9
	75	50	4.1	61.3
		100	3.9	57.6
		150	3.8	55.5
		200	3.8	56.3
	115	50	4.1	62.0
		100	3.8	55.7
		150	3.7	53.4
		200	3.6	53.0
	116	50	4.7	74.4
		100	4.7	73.3
		150	4.7	73.6
		200	4.7	73.6
Mixed Pine-Hardwood	14	50	2.8	36.1
		100	2.4	28.9
		150	2.7	33.7
		200	2.6	31.8
	17	50	4.0	59.0
		100	3.7	54.3
		150	3.6	51.3
		200	3.7	54.7
	20	50	4.2	63.3
		100	3.8	56.1
		150	3.5	50.6
		200	3.0	39.4
	53	50	3.0	40.0
		100	2.8	35.5
		150	2.9	37.5
		200	2.9	37.8

(Continued)

Appendix G (Continued). Summary of mean vegetation density from 0-50, 50-100, 100-150, and 150-200 cm above the ground measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	Code	Height (cm)	Mean Density Board Reading	Mean Percent Cover
Mixed Pine-Hardwood	62	50	3.7	54.0
(Continued)		100	3.5	49.8
		150	3.4	48.5
		200	3.5	49.3
	76	50	4.3	66.0
		100	4.1	62.7
		150	3.9	58.0
		200	3.8	55.3
Herbaceous	57	50	4.3	65.0
		100	3.5	50.0
		150	3.0	40.0
		200	3.2	43.3
	59	50	4.5	70.0
		100	4.3	66.1
		150	4.2	63.3
		200	4.3	65.6
	68	50	3.9	58.1
		100	3.4	48.8
		150	3.2	43.8
		200	3.2	43.8
	72	50	4.2	63.1
		100	3.2	43.8
		150	2.5	29.4
		200	1.8	15.0
Shrub	56	50	5.0	80.0+
		100	5.0	80.0+
		150	5.0	80.0+
		200	5.0	80.0+
	65	50	5.0	80.0+
		100	5.0	80.0+
		150	5.0	80.0+
		200	4.9	78.3
	78	50	3.4	48.6
		100	2.8	35.9
		150	2.4	27.7
		200	2.3	25.5

(Continued)

Appendix G (Continued). Summary of mean vegetation density from 0-50, 50-100, 100-150, and 150-200 cm above the ground measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**Height (cm)**	**Mean Density Board Reading**	**Mean Percent Cover**
Shrub	107	50	4.8	75.9
(Continued)		100	4.6	71.4
		150	4.8	76.4
		200	4.8	75.5
Swamp	60	50	3.8	56.9
		100	3.7	53.1
		150	3.4	48.4
		200	3.4	47.2
	69	50	4.0	60.0
		100	3.2	44.2
		150	3.3	46.7
		200	3.5	49.2
	73	50	3.8	55.3
		100	3.1	42.0
		150	3.1	41.0
		200	3.0	40.7
	109	50	3.3	46.5
		100	2.7	33.1
		150	2.3	25.0
		200	2.1	21.9

APPENDIX H

SUMMARY OF MEAN VEGETATION DENSITY FROM 0-100 CM ABOVE THE GROUND IN 38 HABITAT CLASSIFICATIONS IN THE SOUTH LOUISIANA BLACK BEAR RECOVERY ZONE IN EAST TEXAS DURING 2010 AND 2011

Appendix H. Summary of mean vegetation density from 0-100 cm above the ground measured in 38 habitat classifications in the south Louisiana black bear recovery zone in east Texas during 2010 and 2011.

Cover-type	**Code**	**Mean Density Board Reading**	**Percent Cover**
Hardwood	15	2.7	33.2
	18	4.2	64.8
	21	3.1	41.8
	54	3.5	50.9
	58	4.0	59.4
	63	3.6	52.3
	67	3.7	53.9
	70	3.8	56.3
	77	4.2	64.9
	100	4.1	62.7
Herbaceous	57	3.9	57.5
	59	4.4	68.1
	68	3.7	53.4
	71	0.0	0.0
	72	3.7	53.4
Mixed Pine-Hardwood	14	2.6	32.5
	17	3.8	56.7
	20	4.0	59.7
	53	2.9	37.8
	62	3.6	51.9
	76	4.2	64.3
Pine	16	4.2	64.6
	19	3.6	51.3
	22	3.6	52.2
	75	4.0	59.5
	115	3.9	58.9
	116	4.7	73.9
Shrub	56	5.0	80.0
	65	5.0	80.0
	78	3.1	42.3
	107	4.7	73.6
Swamp	60	3.8	55.0
	69	3.6	52.1
	73	3.4	48.7
	109	3.0	39.8

* The average shoulder height of an American black bear was estimated at 100 cm.

VITA

Dan J. Kaminski was born in Des Moines, Iowa on January 31, 1982 and graduated from Herbert Hoover High School in May of 2000. He received his Bachlor of Science degree with a double major in Animal Ecology and Forestry from Iowa State University in December of 2004. After spending 5 years working seasonal wildlife employments for the National Park Service, U.S. Forest Service, Maine Department of Inland Fisheries and Wildlife, Nebraska Game and Parks Commission, Purdue University, and University of Washington, he entered the Graduate School of Stephen F. Austin State University and the Arthur Temple College of Forestry and Agriculture as a Graduate Research Assistant. In December of 2011, Dan received a Master of Science degree with a minor in Spatial Sciences from Stephen F. Austin State University.

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This thesis was typed by Dan J. Kaminski