Draft Strategic Management Plan for Black Bears in Georgia (2018-2027)

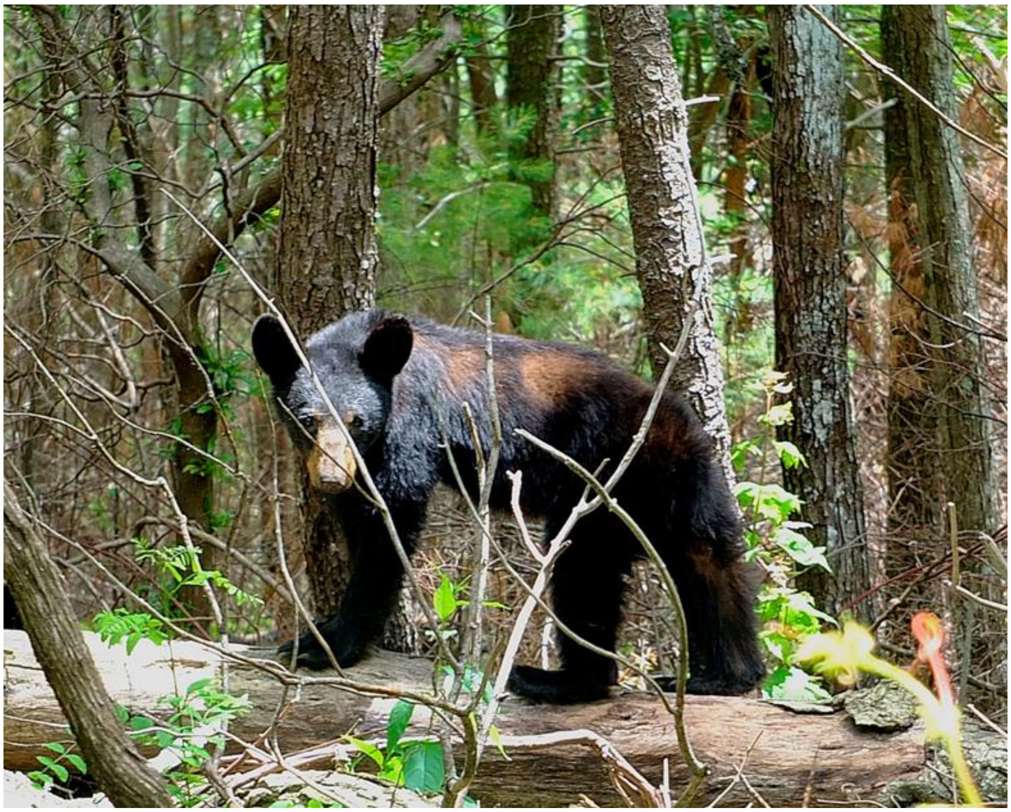

Photo by Nate Thomas

Georgia Department of Natural Resources
Wildlife Resources Division
Game Management Section

STRATEGIC MANAGEMENT PLAN FOR BLACK BEARS IN GEORGIA (2018-2027)

Department of Natural Resources
Wildlife Resources Division

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Mark Williams, Commissioner

Rusty Garrison, Director

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Date

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STRATEGIC MANAGEMENT PLAN FOR BLACK BEARS IN GEORGIA (2018-2027)

DRAFT

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PLAN DEVELOPMENT AND ACKNOWLEDGMENTS

This management plan was developed by Wildlife Resources Division (WRD) biologists using the best available science to support plan goals, objectives, and strategies.

The WRD Game Management Section's Black Bear Committee would like to thank all the staff and biologists across the years who have collected and analyzed data and managed the datasets that we currently use to inform management and regulatory decisions. We thank Dr. Tina Johannsen and John Bowers for providing leadership and guidance throughout the process of developing this management plan, and for reviewing earlier versions of this plan.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Purpose Statement

The purpose of Georgia's black bear (*Ursus americanus*) strategic management plan is to ensure the long-term conservation of Georgia's black bear population through science-based decision-making and biologically-sound management principles to provide sustainable harvest opportunities and promote the black bear's intrinsic value in Georgia's natural landscape while minimizing human-bear conflicts.

Black Bear Management Goals and Objectives

To achieve the overarching objective of the Purpose Statement, the Wildlife Resources Division has identified four fundamental goals with supporting objectives for the management of Georgia's black bear population:

1. Population Goal: Ensure long-term conservation of Georgia's black bear population

Objective: *Monitor the population status and trends with specific goals for each population*
Objective: *Ensure/enhance genetic diversity for the central Georgia population*
Objective: *Allow and support geographic expansion of the bear population into suitable, but unoccupied bear habitat*
Objective: *Increase habitat availability and connectivity between populations*
Objective: *Educate the public about the intrinsic value of black bears*

2. Use Goal: Provide sustainable black bear harvest opportunity

Objective: *Provide hunting opportunities with specific, biologically appropriate harvest goals for each population*
Objective: *Maintain bear hunting tradition*
Objective: *Better identify and understand the bear hunting population in Georgia and its desires*

3. Conflict Goal: Minimize conflicts and complaints related to black bears

Objective: *Protect and provide for public safety in situations involving bears*
Objective: *Educate the public about living responsibly with bears*

4. Research Goal: Advance our knowledge of black bear management through applied research

Objective: *Maintain a prioritized list of research needs*
Objective: *Propose new research as appropriate*

INTRODUCTION

Historically, black bears could be found in forested areas in almost every U.S. state and every province and territory in Canada (Scheick and McCown 2014; Figure 1). Bears were commonly reported in Georgia by early explorers (Timberlake 1765, Arthur 1914). As early settlers cleared land, bear populations declined. From 1900 to 1930, large scale logging operations greatly reduced bear habitat. Unregulated hunting and trapping, combined with the effects of forest clearing, had reduced the bear population to just a few remaining isolated areas. In mountainous portions of Georgia, North Carolina, and Tennessee, black bear populations were further reduced with the loss of the American Chestnut (*Castanea dentata*) by the 1950s. Bear hunting seasons continued in North Carolina and Tennessee, but Georgia closed the bear season in the early 1920s and did not re-open it until 1979 (Carlock et al. 1983).

Currently, black bears occupy about 60% of their historic range and only 10% of their historic southeastern U.S. range (Scheick and McCown 2014; Figure 2). This has resulted in 30 distinct, disjunct populations in the southeastern U.S., including three separate populations in Georgia (Figure 3). Our largest and northernmost population in Georgia (*U. a. americanus*) is associated with the Appalachian Mountains of north-central and northeast Georgia. This population is associated with a larger population of bears extending across the mountainous regions of North Carolina, South Carolina, and Tennessee. Our smallest population (also *U. a. americanus*) is associated with the Ocmulgee River drainage and is generally isolated and somewhat genetically bottlenecked in the central portion of Georgia. The southernmost population (*U. a. floridanus*) of bears in the state is in and around the Okefenokee Swamp of southeast Georgia and is associated with the Osceola population in northeast Florida.

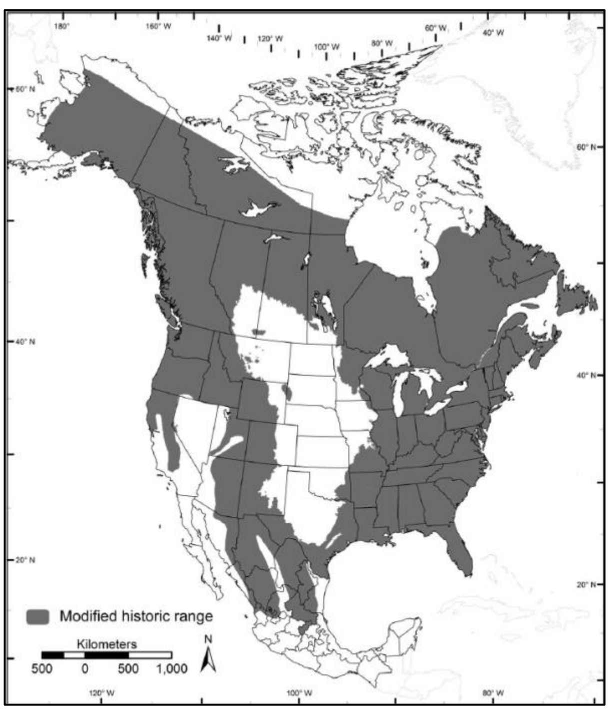


Figure 1. Historic Black Bear Range

In the early 1970s, there was interest from the public, natural resource agencies, and universities to learn more about bears in the southeastern US. Georgia, North Carolina, and Tennessee each started separate research projects on their respective bear populations. They soon realized that the Appalachian Mountain population of bears was a shared resource, and the three states decided to work together on a common research project that became known as the Tri-State Black Bear Study. The study began in 1976 and examined bear ecology in the southern Appalachians (Carlock et al. 1983).

In addition to the Tri-State Black Bear Study, there have been a variety of research projects completed on bears in Georgia. In the early 1980s, a small, general project was conducted on the central Georgia population to estimate population size and learn basic population parameters (Grahl 1985). In the mid-1990s, genetics research was conducted on all southeastern populations, including Georgia (Miller 1995). In the 2000s, an ecological study and a human dimensions study were conducted on the central Georgia population to estimate population size, population parameters, and public opinions about bear conservation and management (Cook 2007, Agee and Miller 2008, Sanderlin 2009). Dobey et al. (2005) conducted a comprehensive 4-year study of the Okefenokee-Osceola population in 1995-1999 that compared habitat use, food habits, reproduction, and survival estimates in a hunted Georgia study area and an unhunted area in Florida. In the 2010s, a more in-depth and intense ecological study on the central Georgia population was completed in association with the Georgia Department of Transportation in advance of a planned expansion of Georgia Highway 96 and the expected impacts on bears (Sylvest 2014, Gray 2015, Ashley 2016, Hooker 2017). A bear habitat corridor identification project also was completed about the same time that centered around the southern Georgia population (Kennedy 2014).

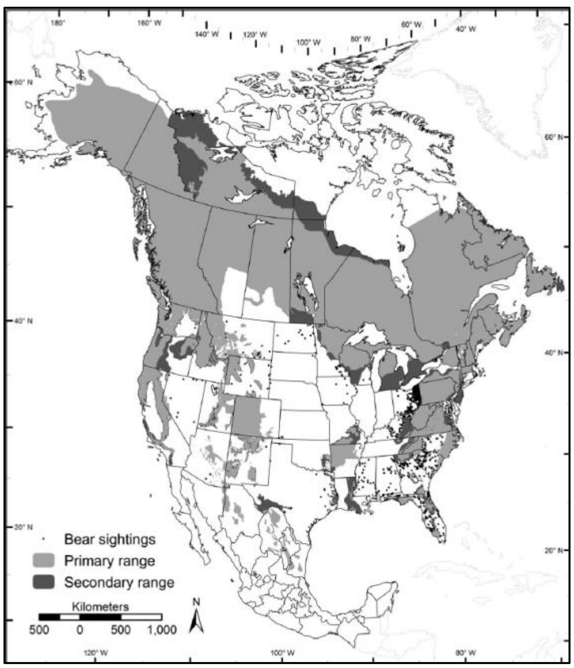


Figure 2. Current Black Bear Range

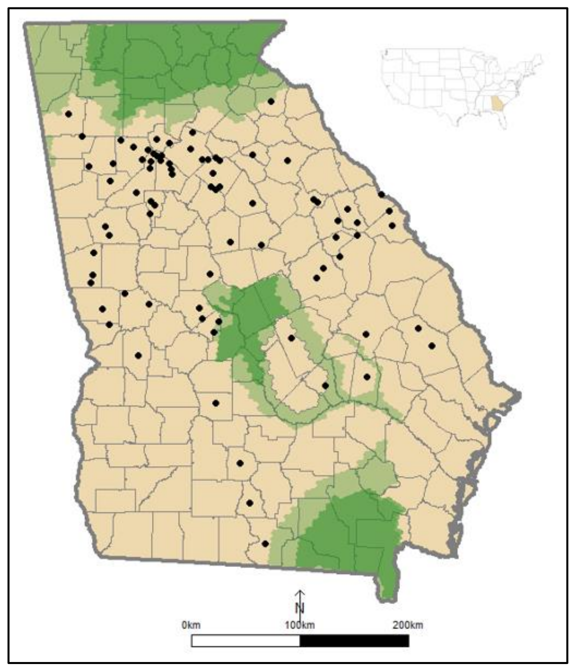


Figure 3. Current Range and Sightings in Georgia.

The purpose of this strategic management plan is to ensure the long-term conservation of Georgia's black bear population through science-based decision-making and biologically-sound management principles to provide sustainable harvest opportunities and promote the black bear's intrinsic value in Georgia's natural landscape while minimizing human-bear conflicts. The goals and objectives outlined in this plan were developed by trained and experienced wildlife biologists using their combined 70+ years of experience managing bears, results of the research projects listed above, information contained in previous management plans, and data from the agency's existing bear monitoring programs. The plan lays out specific information, goals, and objectives for each of the three populations, followed by a section on common statewide goals and objectives.

NORTH GEORGIA BLACK BEAR POPULATION

CURRENT STATUS OF BLACK BEARS IN NORTH GEORGIA

POPULATION

The north Georgia black bear population (NGA) is the largest of three distinct populations of bears within the state (Fig. 3) and is part of the greater southern Appalachian bear population extending into North Carolina, South Carolina, Tennessee, and other southern Appalachian states farther to the north (Fig. 2). Although bears may occasionally be seen anywhere in the state, the dark-colored areas of Figure 3 were considered primary range, or known breeding range, in 2011, when Scheick and McCown updated range maps for Georgia's black bears. Range maps for black bears across North America were finalized in 2014 (Scheick and McCown 2014).

Population Estimates

In 1953, it was estimated that there were only 50 bears remaining in the NGA (Jenkins 1953). With the collection of research data beginning in the 1970s, it became obvious that the NGA was much greater than originally thought. By 1980, Carlock estimated the NGA at 600-750 animals. The NGA was estimated to have grown to 900-1,100 bears by 1999 (Carlock et al. 1999). From there, estimates of the number of bears in the NGA gradually continued to rise as the bear population increased to a peak population of about 3,000 bears around 2010. Since then, our data indicate that the population has remained stable and/or fluctuated near the 3,000 level.

The rate at which bears can be removed from a population without changing the total population numbers over time relates to the age at which females first reproduce and how many cubs are in each litter. Bunnell and Tait (1980) determined that for a black bear population where females first breed at age 2.5, reproduce at 3 years of age, and have an average litter size of 2 cubs per litter, the absolute maximum sustainable mortality rate is 23% of the total population per year. This represents total mortality (e.g., hunting, roadkill, illegal harvest). At this mortality rate, a bear population with these reproductive parameters is expected to remain stable. With mortality rates below this threshold, a bear population is expected to grow, and mortality rates above this threshold would typically result in a declining population. The figure at right shows the maximum mortality rate as a function of age at first reproduction and average natality rate (litter size divided by years between litters).

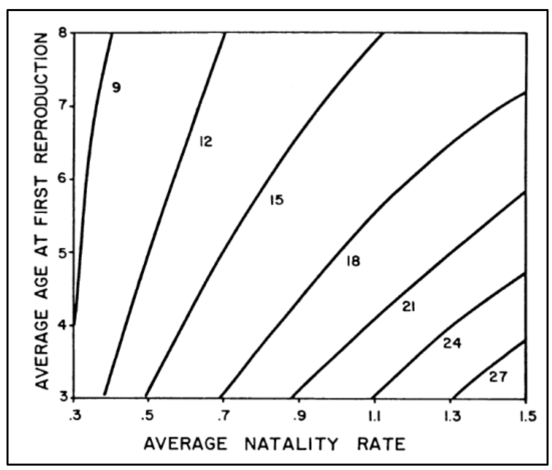


Figure 4. Maximum mortality rate.

In the Tri-State Black Bear Study report (Carlock et al., 1983), bear biologists and managers from Georgia, North Carolina, and Tennessee estimated bear population size based on an assumption that 20% of the population is legally harvested annually. In doing so, they admit the limitations of this simplistic approach and acknowledge that long-term harvest trends - especially when evaluated with other data sources/indicators - may yield more useful information for management.

Demographic Parameters

Specific data on reproduction and survival of black bears in the NGA are not available. However, estimates of survival and reproduction for black bears in other parts of the southern Appalachians and across North America exist elsewhere in the literature (Bunnell and Tait 1985; Eiler et al. 1989; Elowe and Dodge 1989; Hellgren and Vaughan 1989; Clark and Smith 1994; Kasbohm et al. 1996; Schrage and Vaughan 1998; Bridges et al. 2011). Though we have no local estimates of survival, we agree with the conclusions presented by Bunnell and Tait (1985) that cubs from birth to 1-year old experience the highest mortality rate for any age class, followed by sub-adult bears, with adult bears having the lowest mortality rate for all age classes. Published estimates of annual survival to 1 year of age (aka "cub survival") vary from 62% in the Great Smoky Mountains National Park in eastern TN (Eiler et al. 1989), to 65% in Shenandoah National Park in Virginia (Schrage and Vaughan 1998), to 70-75%, as reported by Bunnell and Tait (1985) for North American bear populations. Yearling and subadult bears often disperse from their mother's home range, which is a violation of one of the assumptions of survival analyses (i.e., no immigration/emigration), making it difficult to accurately estimate survival of this age class. Recognizing this fact, Bunnell and Tait (1985) reported annual survival of the subadult age class as varying from 65-85%. Reported estimates of adult survival are high: 96% for males and females in Virginia (Schrage and Vaughan 1998) and 98% annually for females and 85-95% annually for males in Arkansas (Clark and Smith 1994).

Black bears are a long-lived species with a relatively slow reproductive maturity, a prolonged reproductive cycle, and small litter sizes (Pelton 2003). Average age of first reproduction in females is 4 years (Eiler et al. 1989; Bridges et al. 2011). Bear cubs are typically born in the den in January or February and den with their mother the following winter. The family unit usually breaks up in the second spring/summer that the cubs have been with the sow, and the female will often be successfully bred and may give birth again that winter (Eiler et al. 1989). As a result, it is commonly reported that black bears have a 2-yr interval between litters (Eiler et al. 1989, McDonald and Fuller 2001) although missed reproductive opportunities (i.e., "skips") are not uncommon and are usually attributable to natural food shortages, primarily the lack of oak acorns in certain years (Schrage and Vaughan 1998; Bridges et al. 2011). Extremely poor acorn years may lead to delayed age of first reproduction (Clark 2004), low cub survival (Pelton 1989), and may also result in reproductive synchrony in the female segment of the population (Clark 2004; Vaughan 2009; Bridges et al. 2011), where 80-100% of the females successfully reproduce in one year followed by 0-20% the next year (Vaughan 2009). Litter sizes have been observed in north Georgia in recent years ranging from 1-6, with the majority having either 2 or 3 cubs per litter (Hammond, pers. comm.). This is similar to the litter size of 2-2.25 cubs/litter reported by Schrage and Vaughan (1998) and 2.6/litter reported by Eiler et al. (1989) for females in ground dens in the southern Appalachians.

Because specific parameters are unavailable, management of the NGA is primarily based on collecting and monitoring multiple long-term datasets and evaluating trends in the population over time. These data include black bear harvest data, bait station survey data, road-killed bear statistics, human-bear conflict data, and fall oak mast survey data for the north Georgia mountains.

Harvest Data

In the NGA, all legally-harvested bears must be reported within 24 hours of harvest and physically tagged by WRD personnel within 3 business days. This process allows for the collection of biological data (sex, premolar for aging, and estimated weight) on nearly 100% of legally-harvested bears. Our goal is to maintain a 4-year average annual harvest of 400 bears. Using the 20% mortality rate identified by Carlock et al. (1983) and Bunnell and Tait (1980) as our guide, and assuming a population of 2600 bears with 15% of mortality being legal harvest and 5% being other causes, our average harvest to maintain or slightly decrease the NGA population is about 400 bears.

Population Growth Rate

Using harvest data from 1979 to 2011, we produced estimates of population growth rate (Lambda) using a modified Downing's population reconstruction model (Davis et al. 2007). Lambda less than 1.0 indicates a decreasing population, Lambda equal to 1.0 indicates a stable population, and Lambda greater than 1.0 indicates a growing population. Our estimated Lambda during this time was 1.108 for females and 1.113 for males (Little et al. 2017). These values are indicative of a growing population, and the population was growing to its peak in 2010, but recent data indicate a slight decline in total population. Given our overall objective to either stabilize or slightly reduce the NGA population, over time we should begin to see our Lambda values level off slightly from their current level.

Bait Station Survey: Bait station surveys have been used as an index to determine distribution and relative trends in black bear populations in north Georgia since 1983 (GA DNR 2012). Designated routes have been conducted in July either every year or every other year since that time. Routes extend across 11 counties and 10 Wildlife Management Areas (WMAs) covering approximately 280 linear miles of bear habitat throughout the Chattahoochee National Forest and associated contiguous habitat. Physiographic types sampled include Blue Ridge Mountains, Ridge and Valley, and Upper Piedmont. Bait station sites were originally established along paved and gravel roads, major trails, and wooded paths. Baits are hung from small diameter trees or trees with smooth bark and left for 5 nights. Bait sites are checked, visitation activity recorded, and bait site debris removed following examination. Visitation is recorded as "no activity", "visited by a bear", or "visited by another animal." If the bait is taken by another animal, then that station is not used in the calculation of the final visitation rate. Independent of harvest, these data serve as an index to population change over time. Percent visitation rates increased steadily between 1983 and the early 2000s but have stabilized in recent years.

Fall Oak Mast Survey

Bears in the southern Appalachians rely heavily on oak acorns to build fat reserves prior to the winter denning season (Eiler et al. 1989; Pelton 1989; Vaughan 2002; Bridges et al. 2011). Understanding fall mast crops, which are highly variable from year to year, helps to predict where hunters are more likely to find bears during the hunting season (e.g., high vs. low elevations). When oak acorns are scarce in the fall, bears move around more and experience higher mortality due to hunting and vehicle collisions (Figure 5) and may be more likely to engage in nuisance bear behavior – elevated numbers of complaints and more serious situations, extending later in the summer into the fall. However, when oak acorns are abundant and widely distributed across the landscape, bear movements and home range sizes are smaller, and bears experience lower mortality than during years of scare food supply. Poor fall acorn crops also have been shown to affect various important reproductive parameters including age of first reproduction, litter size, cub survival, and size or body condition (Eiler et al. 1989; Pelton 1989; Vaughan 2002; Clark 2004; Bridges et al. 2011) and have been shown to cause reproductive synchrony in the female portion of the population (Bridges et al. 2011).

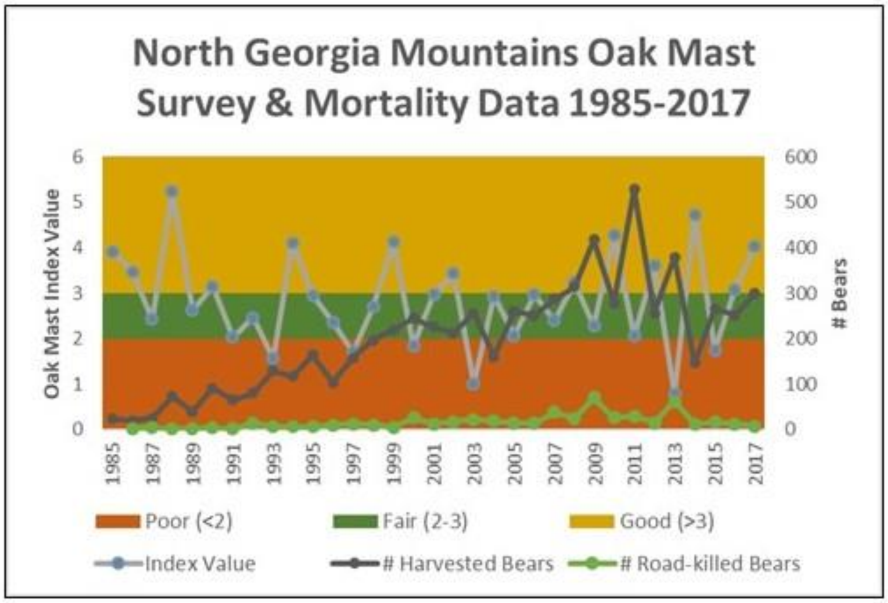


Figure 5. Oak mast survey vs. bear mortality

HABITAT

When Georgia's 1999 Bear Management Plan was developed, bear habitat was described as "large areas of forested land associated with low levels of human disturbance." Furthermore, there was discussion in the plan about widespread logging around the turn of the 20th century that destroyed thousands of acres of bear habitat across north Georgia and the subsequent loss of the American chestnut (*Castanea dentata*) entirely by the 1950s (Carlock et al. 1983). When the plan was written, biologists and managers had a good understanding of black bears and quality habitat needs, emphasizing the need for mast-producing trees – primarily oaks, and older-age class trees to serve as den trees. However, the ever-increasing use of the Chattahoochee National Forest (CNF) by recreational users and the development of the north Georgia area for mountain homes and retirement communities made bear biologists and managers at the time somewhat unsure of the effect that these changes would have on the NGA and bear habitat in the future. This concern existed despite increasing bear populations at the time and an overall goal to stabilize the bear population. In the two decades that have followed, our bear population has more than doubled, despite the obvious increases in recreational use of the national forest in north Georgia and the continued development of the north Georgia mountains for homes and businesses. The same increasing trends observed in north Georgia's bear population are also occurring in neighboring southern Appalachian states (Hammond, pers. comm.).

When we think about habitat needs today for the NGA, we understand and agree that bears and oaks in southeastern uplands are inseparably linked (Clark 2004) and critically important to southern Appalachian bear populations (Eiler et al. 1989; Pelton 1989; Vaughan 2002; Bridges et al. 2011). However, we also need to emphasize the benefits of early successional forests that provide good escape cover, ground denning habitat, and spring/summer soft mast that is highly favored by bears and somewhat limited today on the CNF. These spring/summer fruits are often overlooked in bear management yet are an important component of quality bear habitat. Soft mast may be particularly important to bears during times of hard mast (acorns and nuts) failure (Weaver 2000). The availability of spring/summer soft mast coincides with the increased nutritional demands of lactating females and young cubs at a time when they are experiencing phenomenal growth rates.

Bear populations have proven to be extremely resilient and bears seem to be more adaptable to living/thriving around human habitations than previously thought. In many cases, biological carrying capacity (i.e., the number of bears that the land can support) may exceed the cultural carrying capacity (i.e., the number of bears that the public will tolerate). Areas that once were primarily rural have now been developed and the wildland-urban interface (WUI), the area where houses meet or intermingle with undeveloped wildland vegetation (Radeloff et al. 2005), has expanded. Too often, people leave known bear attractants (e.g., garbage, pet foods, bird seed) in areas that invite bears closer to residential and commercial areas and cause bears to lose their natural fear of people. This process often results in bears becoming conditioned to human-provided foods.

HUNTING OPPORTUNITY

Bear hunting in north Georgia has been gradually expanded as bear populations have grown and as bears have begun to expand their range outside of traditional bear areas. Georgia closed the bear season in the early 1920s and did not re-open it until 1979 (Carlock et al. 1983). Currently, bear hunting is offered in 39 counties across northern Georgia and runs concurrently with deer season, opening the 2^{nd} Saturday in September for archery, followed by a 1-week primitive weapons season, and an extended firearms season that ends on the 2^{nd} Sunday in January. During the 2017-18 hunting season, this represented 121 days of bear hunting opportunity on private land.

A serious concern is whether hunting areas within the WUI will continue to be available for bear hunting and whether support for bear hunting will remain sufficiently high among residents - the majority of whom are nonhunters. This concern is even greater in urban/suburban areas where people have less of a "land connection." Survey results reported by Responsive Management (2015) indicate that although support for hunting among the general population of Americans is high (73-78%), support for hunting bear is much lower (only 47% support). It is worth noting that most Americans are opposed to hunting over bait (59% oppose, only 27% support). These survey results were not specific to our state, and although it is currently illegal to hunt bear over bait in Georgia, it seems likely that some of these same trends may be true for Georgia. As such, we should carefully consider the impact of future proposed management regimes to avoid eroding support for Georgia's long-standing bear hunting tradition.

HUMAN-BEAR CONFLICTS

Bear populations and human populations in north Georgia have grown tremendously since the development of the 1999 Georgia Bear Management Plan. Areas that once were primarily rural have now been developed, the WUI has expanded, and we have experienced an associated increase in human-bear conflicts. Human-bear conflicts are generally avoidable, simply by minimizing the availability of human-provided, non-natural foods like bird seed, garbage, and pet foods. In some cases, especially where bears regularly receive human-provided foods, intentionally or otherwise, human-bear conflicts result and may lead to property damage, a perception among people that bears are a nuisance and human safety concerns. The challenge in dealing with hundreds of bear complaints each year across the state, especially within the WUI, is how to properly balance the needs of bears with the public's desires and our own logistical constraints. Understanding normal bear behavior and educating the public about bears is critical when dealing with human-bear conflicts. To this end, BearWise, a regional bear education initiative sponsored by the Southeastern Association of Fish and Wildlife Agencies seeks to do just that. BearWise is anchored by a website (www.BearWise.org) and is designed to help people live responsibly with bears.

There has never been a fatal bear attack in Georgia (in recorded history); however, bears are a capable predator, and in other states, there have been situations where bears caused harm to people. In a few such situations, black bears have caused human fatalities, including two since 2000 in Tennessee. Several of the more recent black bear attacks on people that occurred in Florida took place within residential areas where bears had become habituated to people and in some cases, were intentionally being fed by residents (Telesco, pers. comm.). As much as possible, we hope to avoid these dangerous situations through public education on how to live responsibly with bears, proper bear management including legal hunting as a management tool, and an effective policy for handling human-bear conflicts. Our purpose statement reflects this contention through our desire to use legal hunting seasons and methods as a management tool to help minimize Georgia's human-bear conflicts statewide. This is especially true in north Georgia, where approximately 70% of our black bears and a large majority of the state's human population resides and recreates.

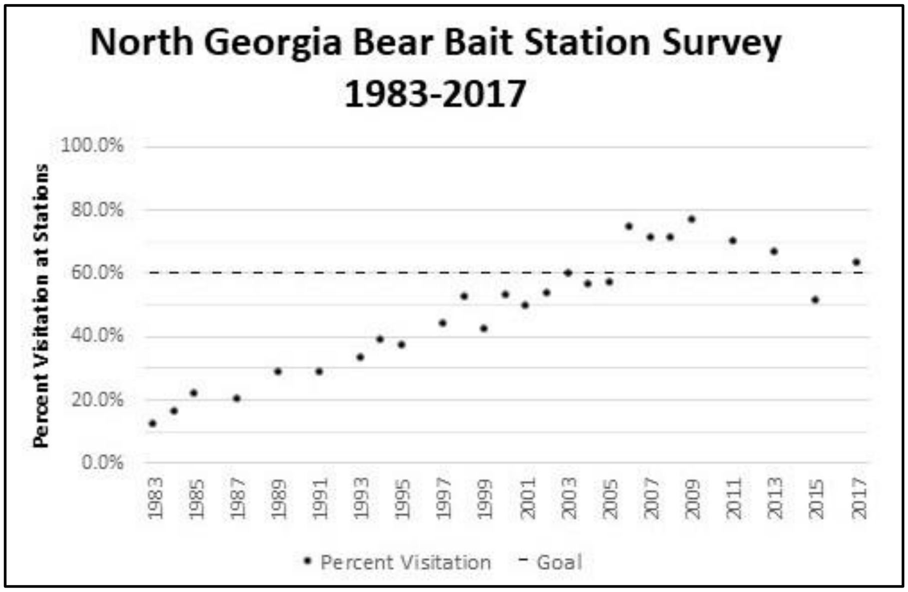
PROGRAM GOALS, OBJECTIVES, AND STRATEGIES
FOR THE NORTH GEORGIA POPULATION

<u>Population Goal: Ensure long-term conservation of Georgia's black bear population</u>

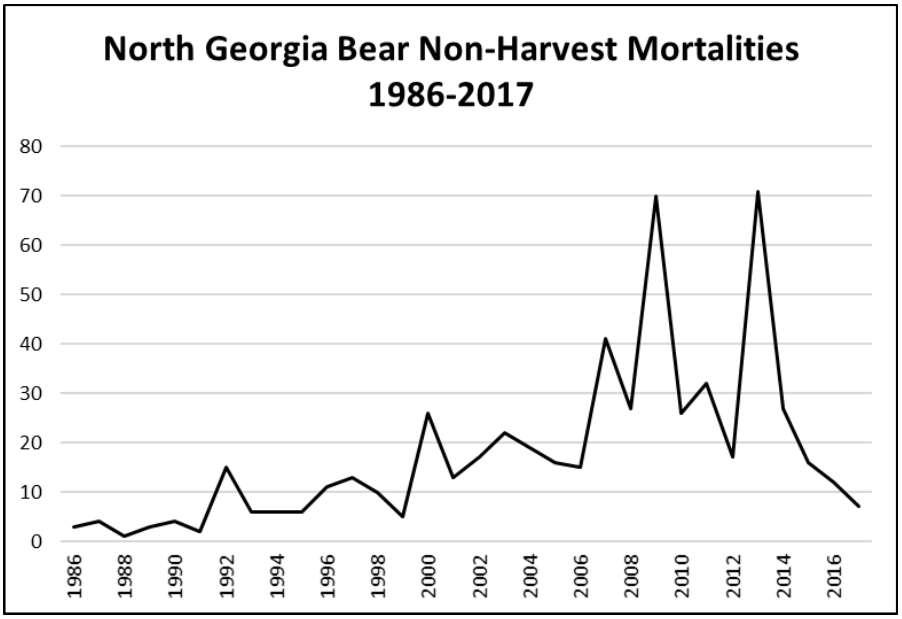
Objective: *Monitor the population status and trends*

Strategies:

1. Maintain a running 4-year average of 60% visitation rate on the NGA bait station survey



2. Monitor and record the number of non-harvest mortalities of bears in the NGA



3. Assess the feasibility of developing a population estimate for the NGA every 5 years
    a. A DNA capture-recapture study, designed to estimate bear population size and density for the Southern Appalachian region of GA, NC, SC, & TN, was initiated in the summer of 2017. The University of Tennessee (UT) was contracted to collect bear hair from barbed wire hair snares placed across black bear range on public and private lands in mountainous areas of the 4-state study area. Field data collections took place in GA, SC, and TN in 2017 and NC in 2018. Results are due March 31, 2020.

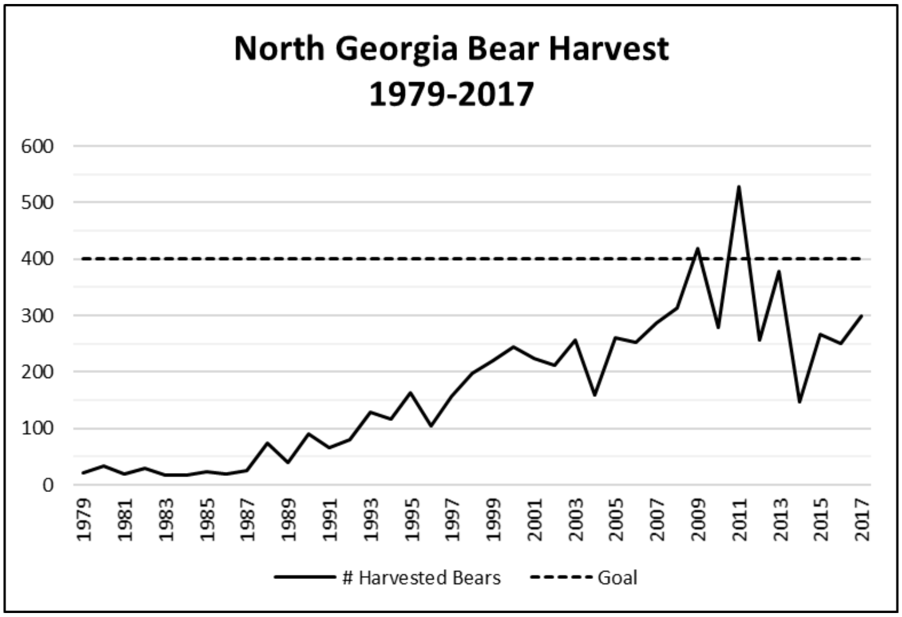
Objective: *Increase habitat availability and connectivity between populations*

Strategies:
1. Promote habitat management on private lands to provide an abundance and diversity of natural foods, quality denning habitat, and to provide for the year-round needs of black bears
2. Purchase/lease additional lands to provide improved public hunting opportunities and facilitate connectivity with other bear populations within the state
3. Increase conservation easements in locations that will assist in connecting bear populations within the state

Use Goal: Provide sustainable black bear harvest opportunity

Objective: *Provide hunting opportunities where and when feasible*

Strategies:
1. Collect and monitor WMA and private land hunter and harvest data
    a. Maintain a running 4-year average annual harvest of 400 bears in the NGA

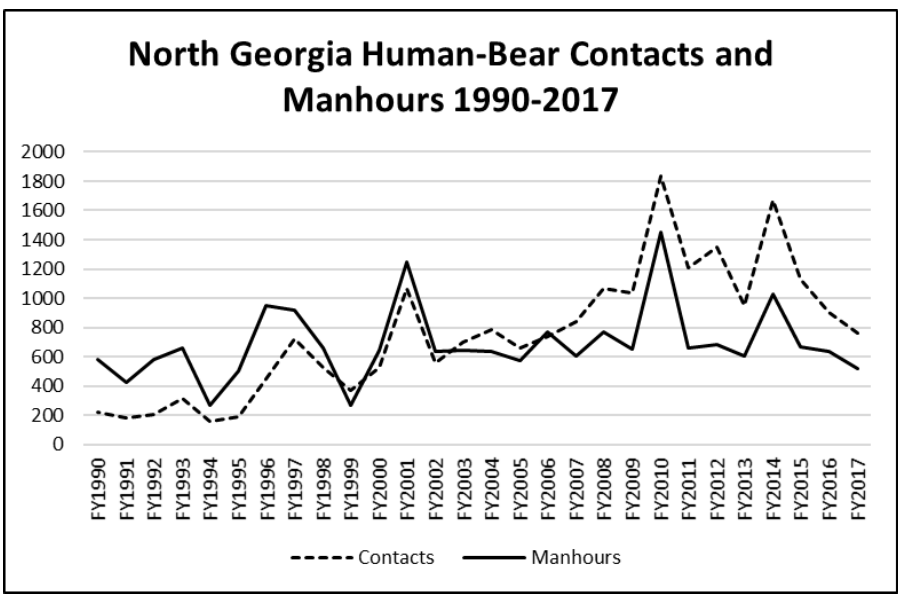


Conflict Goal: Minimize conflicts and complaints related to black bears

Objective: *Protect and provide for public safety in situations involving bears*

Strategies:

1. Track number of contacts and man-hours expended



2. Track other nuisance-related statistics (e.g. euthanized bears, human injuries, deaths)

<u>CENTRAL GEORGIA BLACK BEAR POPULATION</u>

CURRENT STATUS OF BLACK BEARS IN CENTRAL GEORGIA

POPULATION

The central Georgia black bear population (CGA) is restricted to the Ocmulgee River drainage, located along the Fall Line where the Piedmont and Upper Coastal Plain meet. CGA is the least abundant and most geographically isolated bear population in Georgia (Figure 3). The core areas for the CGA include Oaky Woods and Ocmulgee WMAs and much of the surrounding private, industrial forestland. In the past few decades, sightings of bears in central Georgia have increased. These sightings may be due to greater bear numbers and/or increased housing developments encroaching on bear habitat.

Population Estimates

Jenkins (1953) was the first to report on the CGA and estimated it to be <40 bears. Later, Grahl (1985) reported an estimate of 64 bears. Sanderlin (2009) derived seasonal estimates ranging from 106 to 213. Using data from 2012-13, Hooker et al. (2015) derived an abundance estimate of ~240 bears (140 females and 100 males) within a 250,000+ acre area and indicated that his estimate should be considered conservative. Using data from 2012-16, a re-analysis estimating the annual population size ranged from 309-439 bears (females ranged from 189-269 and males ranged from 120-170) and averaged across that period as 368 bears (females = 225 and males = 143, Hooker, pers. comm.). Given the range of estimates from the two separate analyses, we believe that the actual population is between 240 and 368 and likely around 300 bears. Direct comparisons between these estimates are difficult because of different estimation methods used and various methods by which study areas were delineated (Hooker et al. 2015). Hooker et al. (2015) and Ashley (2016) recommended continued monitoring of abundance and density, as well as demographic parameters (such as recruitment, survival, and population growth rate) which would provide an improved understanding of factors driving population dynamics.

Demographic Parameters

<u>Survival:</u> From 2003-06, when there was only a 1-day hunt on Ocmulgee WMA, adult annual survival rates were 86% for females and 85% for males (Sanderlin 2009). After the 3-county hunt started in 2011 (from 2012-16), the annual adult survival rate was slightly lower (females = 78.3% and males = 79.3%, Hooker, pers. comm.). Aside from legal hunting, potential mortality factors include road-kills and illegal harvest, which have been estimated at 5% (Grahl 1985) but are now believed to be about 10% (Bond, pers. comm.).

<u>Reproduction:</u> Reproductive rates and recruitment into the breeding population drive bear abundance (Oli and Dobson 2003, Wildt et al. 2003) and become increasingly important when managing small bear populations (Hooker et al. 2015). Female recruitment and mortality are especially important because females drive reproductive rates and population numbers (Hooker et al. 2015, Ashley 2016). Cub production is also important because females only breed every two years, and cubs experience considerable mortality in the first year (Beston 2011). Gray et al. (2016) studied bears in the CGA and estimated cub survival for 6 months at 77%, similar to the 75% estimate for cubs in the southeastern Coastal Plain (Freedman et al. 2003). Bear

reproduction is unique compared to other large mammals because females reach sexual maturity between the ages of 3-5 years and breed only every other year during the summer. In the CGA, the average age of first reproduction was 4 years and the mean breeding interval per female was 2 years (Sanderlin 2009). Females typically give birth to 2 to 4 cubs, after which the sows care for and protect the cubs during their first 16-17 months (Gray 2015). Average litter size in the CGA is 2 cubs (Grahl 1985, Sanderlin et al. unpublished, Gray et al. 2016).

Population Growth Rate: Population viability analyses on the CGA, using a combination of local data and data collected from other studies of eastern bear populations, were conducted prior to 2011, when hunting opportunity in CGA was expanded from one day of hunting on one WMA to the current 3-county area. Up until 2011, bear harvest in the CGA remained extremely low, averaging <1 bear harvested per season from 1984-2010. Sanderlin (2009) and Sanderlin et al. (unpublished data) estimated population growth rates using a "zero-harvest" model. Growth rates (i.e. lambda values) were estimated between 0.902-1.078 using CGA data and between 1.111-1.125 using eastern population data alone. Lambda values < 1.0 indicate a declining population, 1.0 indicates a stable population, and lambda values > 1.0 indicate a growing population. From 2012-2016, after the county-wide hunt was established, estimated population growth rates averaged 1.05 (1.01-1.08, Hooker, pers. comm.). Legal harvest averaged 8 bears per season in the CGA during this time. Survival rates were lower after the hunting opportunity was expanded. Gray et al. (2016) reported that the growth rates of the CGA may be lower than other populations and may fluctuate greatly from year to year. These concerns, in combination with observed male-biased litters (17 M: 9 F) and a slightly skewed female-biased historical harvest (1984-2017; 44 M: 55 F), justifies a conservative management approach for the CGA.

Data from the CGA indicate that average age at first reproduction is 4 years and average natality rate is 0.9 (1.95 litter size/2.1 breeding interval rate). These data indicate that the maximum sustainable total mortality for the CGA is 18-19% (Bunnell and Tait 1980, Figure 4). Based on an estimated population size of 300 bears and considering all sources of non-harvest mortality, it seems that existing harvest levels (2011-2018) are low enough to at least maintain the population.

Bait Station Survey: In 1986 and 1988, bait stations were attempted using the NGA method, resulted in no visitations and therefore were discontinued. In 2007, we restarted the bait station survey. Stations were located primarily along roads on both public and private properties across 6 counties (Bleckley, Houston, Laurens, Pulaski, Twiggs, and Wilkinson). To be consistent with both NGA and the south Georgia black bear population (SGA), surveys were conducted annually in July. Baits (3 partially-opened cans of sardines) were nailed to trees, spaced approximately 0.5 miles apart, then were later checked for bear visitation (e.g., cans removed, clawed trees, cans bitten), and cans and nails were removed. The number of stations changed from year to year based on land ownership therefore data presented here are from the76 stations utilized continuously since 2007, from Bleckley, Houston, Pulaski, and Twiggs counties.

Population Threats

Habitat Loss: Direct habitat losses include urban/suburban development and conversion of habitat to pine plantations, agriculture or more recently to solar farms. Urban development has increased by 20% since 1974 and is likely to continue to increase (Kennedy 2014). The CGA lies within the 2nd largest WUI in GA (Cook 2007). Nearby human population centers include Macon, Warner Robins, Bonaire, Cochran, and Hawkinsville. Indirect habitat losses include degradation of habitat quality primarily through human disturbances.

Barriers to Movement: The CGA is not contiguous with any other bear population and is almost surrounded by human development and fragmented agricultural land. These urban environments, agricultural areas, and large highways may act as barriers to bear movement and dispersal. Understanding potential barriers that may hinder bear movements in this population is important (Bond et al. 2012). Specific barriers to bear movement in the CGA include Interstate 16, three major highways, and the Ocmulgee River. Although bears are capable of long-distance movements, their dispersals are limited by their relatively low numbers, slow reproductive rates, and propensity to create conflicts while moving through urban areas (Hooker 2017, Hooker et al. In review). Dispersal of young males appears to be mostly eastward and southward from the CGA presumably because human development seems to limit dispersal to the north and west.

Interstate-16 is believed to be a significant barrier to CGA movements (Cook 2007). Ashley (2016) documented only males north of I-16; suggesting that the breeding portion of the CGA may fail to extend north of I-16. Other highways can affect bear movements as well. From 2012-2014, three main highways in central Georgia accounted for 70% of all road-killed bears: State Routes 87, 96, and 247/247spur. Movements and behavior of transmittered bears within the State Route 96 corridor were affected by the highway and its daily traffic load of >8,000 vehicles (Hooker 2017). Even in protected areas, disturbance by humans may have affected bears, as bears used WMAs more during the nonhunting season (when gates were closed) than during hunting season (when gates were open) and visited roads closed to vehicle traffic more than open roads (Bond and Balkcom 2015). Bond et al. (2012) investigated bear crossings of the Ocmulgee River and observed that when bears crossed the river, water flow rate and depth were significantly lower and that the river appeared to be a barrier to females, presumably due to smaller home ranges and behavioral differences related to cub-rearing.

Low Genetic Diversity: For many wildlife populations, the greatest threat to long-term persistence is continued isolation as the result of lost connectivity between populations, and fragmentation of habitat which subdivides already isolated populations (Hilty et al. 2006). Hellgren and Vaughan (1994) identified alleviation of negative demographic and genetic consequences caused by habitat loss and fragmentation as conservation and management priorities for southeastern bear populations. The CGA is a small, isolated population with no natural corridors to other populations, low genetic diversity relative to other populations, and observed genetic defects (e.g., 7.5% of males from 2012-14 showing some form of cryptorchidism (i.e. the failure of one or both testicles to fully descend into the scrotum)); Miller 1995, Sanderlin et al. 2009, Hooker 2017, Hooker et al. In Review). Of the 16 populations of bears sampled in the southeast, the CGA was the second most genetically similar (Miller 1995). The NGA and SGA are more similar to each other than either is to the CGA, suggesting the CGA may have experienced a genetic bottleneck and genetic drift because of small population size and isolation (Hooker et al., In Review).

To increase genetic diversity, new bears (migrants) need to be added to the population and become successful breeders. More than three migrants per generation are typically needed to increase variation and positively influence population fitness (Murphy et al. 2017). In terms of distance, both the NGA and the SGA could be sources of immigrants into the CGA; however, of 356 bears in CGA sampled, only 1 immigrant was detected, and it was a road-killed bear likely from the Apalachicola bear population in FL. While the detection of an immigrant is encouraging, this individual was road-killed at 3 years of age and was likely a non-breeding sub-adult (Hooker 2017). Low reproductive rates combined with dispersal behavior being highly biased toward sub-adult males means the number of potential dispersers can be quite limited as there is risk involved in traversing and exploring unfamiliar territory, and survival rates are often decreased for dispersing bears (Hooker et al. In Review). Hooker (2017) and Hooker et al. (In Review) simulated 100 1-year-long male bear movements emanating from the NGA, SGA, and Apalachicola, FL bear population to determine if any could possibly make it to CGA. None of the simulated routes intersected with CGA. This does not mean that immigrants are incapable of reaching the CGA, but demonstrates that the rate at which bears from elsewhere could be expected to reach the CGA is far lower than what would be necessary to constitute demographic or genetic connectivity between the CGA and other regional bear populations (Hooker 2017, Hooker et al. In Review). Connectivity or corridors between the CGA and other bear populations is limited by a lack of landscapes conducive to bear travel and (likely the larger issue) distances too great for there to be consistent reliable movement of bears into the CGA (Hooker 2017).

Neither demographic closure or genetic isolation are likely to abate within the CGA without management action. Reduction of the CGA without demographic or genetic support from other bear populations risks further loss of diversity within the CGA (Hooker 2017). Recent researchers have recommended the introduction of genetic material (i.e., bears from populations other than the CGA) into the CGA (Sanderlin 2009, Hooker 2017, Hooker et al. In Review). This could be accomplished by corridor development to encourage natural dispersal of bears or by translocation of bears into the CGA (likely resulting in the most rapid genetic admixture), or a combination (Hooker 2017, Hooker et al. In Review). Likewise, managers could consider development of additional populations that would have a direct influence on the CGA, and function as “stepping stones” for bears moving among populations, and thus enhancing connectivity (Hooker 2017, Hooker et al. In Review). Cook (2007) produced predicted habitat use areas throughout central and south GA that could assist in identification of areas for habitat improvement, land acquisition, and/or where bears could be restocked into suitable but unoccupied habitat. Kennedy (2014) identified three potential corridor areas between Okefenokee National Wildlife Refuge (ONWR) and the Altamaha River complex. Land acquisitions in these areas should include consideration of bear movement in the decision-making process.

A survey of people in central GA revealed that 61% supported releasing bears into suitable habitat currently void of bears (Agee and Miller 2008). Public opinion studies in Mississippi and Arkansas focused on gathering data for a wide geographic area of potential habitat ahead of planning a specific reintroduction site (Bowman et al. 2004). Similar methods could be employed here to assess public support for a potential reintroduction effort.

HABITAT

The CGA encompasses approximately 300,000 acres with most of the habitat being east of the Ocmulgee River. The Oaky Woods (12,750) and Ocmulgee (15,000 acres) WMAs provide key habitat components and are characteristic of bear habitat in central Georgia with timber stand types of various age-class planted pine, bottomland hardwoods, and upland pine-hardwood mix. The area with the largest concentration of bears is virtually uninhabited by people and contains few heavily traveled roads. Bear numbers decrease as the distance from these large forested areas increases which may be attributed to an increase in human activity outside these core areas. The key to improving the quality of bear habitat is to provide habitat diversity e.g. a mosaic of habitats conducive to movements, foraging, denning, bedding, escape cover and dispersal; (Weaver 2000). Much of the land immediately to the west is dominated by urban development, whereas land to the south and east is primarily agricultural land (e.g., cotton, corn, peanut, sorghum, grain crops, peaches, pecans and bee hives, Hooker et al. 2015). In fact, quite a few male bears shift their home ranges during the fall to these agricultural areas for 1.5-4 months (Cook 2007). Though surrounded by urban and agricultural land uses, bears can survive and coexist with human habitation nearby if the bears are afforded a forest that satisfies their life requisites (Weaver 2000). Murphy et al. (2017) stated that conserving remaining natural habitats in the area occupied by small, genetically isolated populations of bears is likely the most important immediate step to ensuring continued population persistence. Within central Georgia 60% of survey respondents agreed the state should buy land for bear conservation, suggesting public support exists to acquire and conserve habitat within the CGA's range.

Since much of the land in central Georgia is owned and controlled by industrial forest companies, substantial acreages are dominated by pine plantations and timber management practices will likely have a significant impact on bear populations in this part of the state. Forest management in central Georgia consists primarily of even-aged short to medium rotation pine plantations. Hardwoods are being harvested and converted to pine which could, in the long-run, be detrimental to bear populations. Logging operations continue in parts of the swamp along the Ocmulgee River and the effect this will have on the bear population is unknown because bear densities were greater in upland areas than bottomlands (Ashley 2016). However, many creek drainages and the Ocmulgee River swamp remain in hardwoods and mixed pine-hardwood forest types with upland forests characterized by dense understories. Areas of dense or impenetrable vegetation that limits visibility and hinders human disturbance can provide high quality habitat for bears (Weaver 2000). Management and conservation of bear habitat likely depend on maintaining extensive areas of low road density that provide a mix of pine and hardwood forest in this developing region (Cook 2007). Gray (2015) found upland forests were the preferred overall habitat type, while smaller upland forest patch sizes were preferred instead of large patches of a singular habitat type. Abundant patches of upland forests and clear-cuts (providing spring/summer foods and winter/spring den sites) would create a more diverse mosaic of habitat types from which bears could benefit (Cook 2007, Gray 2015). After an area is cutover, an abundance of fruit-producing vegetation often provides food for bears. Where feasible, hard mast producing species, particularly oaks, should be encouraged as a major forest habitat component in silvicultural and prescribed fire treatments. Although hard mast crops are important for bears, they are seasonally sporadic producers. Soft mast is a vital food source that also should be managed as a viable component of bear habitat. Food supplies should be abundant, stable, and diverse (Weaver 2000) as food abundance directly affects reproductive success (Cook 2007). Bear habitat and landscape management should be directed toward: forest conservation, habitat diversity, providing food supplies throughout the year, denning habitat, escape cover, establishment of habitat linkages, reforestation programs, and human access management (e.g., closing roads to reduce vehicular access; Weaver 2000).

Prescribed Burning: Prescribed fire treatments that promote soft mast (fruiting increased 2-5 years following burning) as a forest component in conjunction with hard mast are highly encouraged (Weaver 2000). Burning rotations of 3-10 years were recommended for maintaining adequate bear foods in coastal North Carolina and elsewhere (Hamilton 1981, Landers 1987). Among burned areas, bear use was greatest in 3- and 5-year-old burns and related to production of several soft-mast species (Stratman and Pelton 2007). Stratman and Pelton (2007) recommended a burning cycle >5 years be used to maintain adequate food supplies and escape cover for bears. Planning for juxtaposition of various successional stages is the best approach for managing habitats to maintain cover and availability of primary bear foods and effectively minimize the area needed to satisfy the needs of bears in the Southeastern Coastal Plain (Stratman and Pelton 2007).

Denning: The quality of available denning habitat influences recruitment and subsequent population growth (Gray 2015). Habitat within CGA often lacks the types of den sites (such as rock crevices, cavities, and tree dens) commonly used in other populations (Powell et al. 1997, Pelton 2003). Most bears within the CGA den on the ground (Gray 2015), and most of those ground dens were in forested areas (Weaver and Pelton 1994, Crook and Chamberlain 2010, Gray 2015). Early successional habitats associated with upland forests were important to denning females because of the availability of dense understory vegetation at lower risk of flooding and can increase litter survival via reduction of energetic costs associated with relocating dens (Linnell et al. 2000, White et al. 2001, Gray 2015, Gray et al. 2016). In these habitats, bears often selected residual trees left standing or downed trees that remained after timber harvest, suggesting that bears preferred areas with greater concealment (Gray et al. 2016).

For CGA, the mean den entrance was January 7th. Ground dens can be more susceptible to disturbance caused by human activities such as land management and recreational use (Gray 2015). Bears using ground dens in Tennessee without sufficient cover exhibited decreased survival and productivity (Johnson and Pelton 1981). In recent CGA research projects, four cases of den disturbances were recorded. These disturbances were caused by timber management activities (e.g., heavy machinery use, prescribed fire in an adjacent stand, timber cruising, tree planting), and in all cases the female relocated to a new den site (Gray 2015, Gray et al. 2016).

An integrated approach of providing early successional habitat (regeneration) and maintaining dense shrub thickets would diversify and expand availability of ground denning habitat (Weaver 2000). Management and conservation of preferred denning habitat will continue to be an essential component to sustain CGA because of the small litter sizes and the reproductive isolation (Gray 2015). Maintaining forested habitats with dense understory vegetation, preferably in upland forest stands, will be important to ensuring sustainable management of the CGA (Gray et al. 2016). Upland forests and vertical cover were important to denning bears in the CGA (Gray 2015). Gray (2015) observed no denning bears within areas that had been burned within the last 7 years, likely due to the lack of dense understory associated with burned areas. Therefore, longer burn rotations may increase suitable bear denning habitat.

Roads: Roadways affect wildlife populations connectivity (Kennedy 2014). Plans to widen Georgia State Route (SR) 96, which bisects the CGA, may negatively impact the population. Bears were more likely to cross SR 96 in upland habitat types and on sections closer to forest edges, agriculture fields, and intersections of drainages. The occurrence of bear crossings increased as the distance between the roadway and forest edge decreased (Hooker 2017). Cook (2007) observed that crossings occurred during shifts in activity centers and infrequent excursions, which suggests that highway crossing is avoided (Cook 2007). The planned widening project calls for the inclusion of 7 wildlife underpasses, which are intended to minimize occurrences of wildlife on the highway surface by allowing local wildlife to cross underneath the highway (Hooker 2017). Hooker (2017) recommended that vegetation management be used to connect underpass openings to forest edges along the highway rights-of-way.

Corridors: Conservation or creation of habitat linkages between disjunct tracts of forest can help provide corridors for bear movements in search of food, dens, and mates, juvenile dispersal, and facilitate bear population expansion (Weaver 2000). Karelus et al. (2017) suggested that habitat management efforts should be placed on the best available habitat areas and the linkages among those areas. Bears' predisposition for large home ranges and occupation of a variety of habitats makes the species a great candidate for wildlife corridors (Kennedy 2014). Furthermore, bears' ability to travel great distances suggests they will take advantage of a corridor network's full extent (Kennedy 2014). Cook (2007) developed a potential predictive bear habitat model from central to SE GA, however she did not develop corridors like Kennedy (2014). To maintain viable bear populations and minimize conflict with humans, habitat connectivity must be addressed at a regional scale (Kennedy 2014). Kennedy's (2014) study area, from the ONWR up to the Altamaha River complex, could create potential population growth and increased genetic exchange as it calls for the enhancement of bear habitat connectivity within Georgia (Kennedy 2014). The Altamaha drainage and surrounding area are an ideal preliminary target for bear connectivity (GA DNR 2005, Kennedy 2014). In addition, the Altamaha's linkage with the Ocmulgee River creates the opportunity for future corridor extensions to CGA which may help expand the genetic diversity of the currently fragmented bear populations (Kennedy 2014). Kennedy (2014) used existing conservation land as her starting (ONWR) and ending point (Altamaha River) and used protected areas in between to develop and map a network of three corridors within the study area. Viable corridors through the middle of the study area (SE and south-central GA) follow larger rivers in the area. It is essential to create a wildlife connectivity plan that will protect portions of the currently rural region from development (Kennedy 2014). However, before implementation of Kennedy's corridors, it would be beneficial to test them using the recent bear movement models created by researchers at the University of Georgia (Hooker, pers. comm.).

Relatively low abundance and potential isolation from other bear populations make conservation of the CGA a special concern. The CGA has experienced anthropogenic habitat loss, fragmentation, and lies >94 mi from either the NGA or SGA (Hooker, et al. 2015 Gray et al. 2016), resulting in little dispersal and poor connectivity among the populations (Hooker 2017). It is assumed that the CGA is reproductively isolated because of lack of suitable habitat corridors (Gray et al. 2016). Models suggest connectivity between the CGA and surrounding bear populations is poor, and management actions should be taken to improve this connectivity. An initial step in corridor establishment should be an evaluation of landscape connectivity among populations, considering not only availability of habitat, but also life history traits and movement capabilities of the focal species (Hooker 2017). The WRD's Wildlife Conservation Section was tasked to complete a State Wildlife Action Plan (SWAP), and within the plan they created a draft Greenway priorities map (also referred to as the Wildlife Corridor Map, Figure 6;). The draft Greenway map was created from multiple data layers, including public and private conservation lands, natural and semi-natural vegetation, models of landscape diversity and connectivity, species-based habitat connectivity models, and expert opinion. This map depicts large patches of natural habitat as well as other areas that could be conserved or restored to provide for greater habitat connectivity within the Georgia landscape for wildlife (GA DNR 2015). Three of the potential corridors are similar to Kennedy's (2014) bear corridors (1, 2, 3). Hooker (2017) developed a step selection function model that could be used to test the effectiveness of these three Greenway corridors that connect the SGA to the Altamaha River complex to hopefully increase the success of the corridor construction to facilitate exchange among regional bear populations.

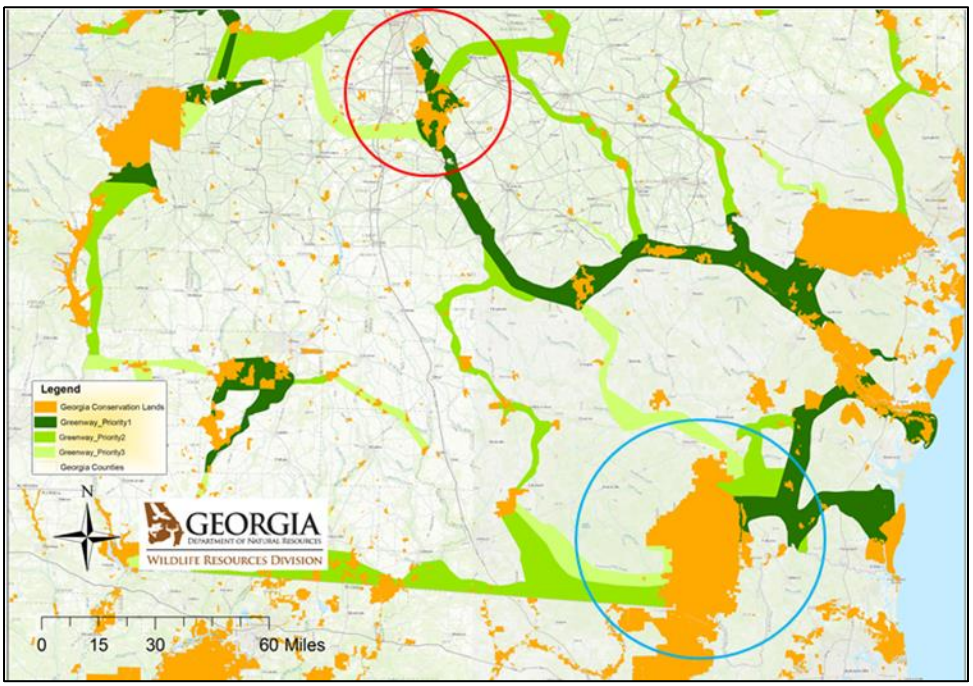


Figure 6. Proposed greenways in the Georgia SWAP. The red circle is the general location of the CGA and the blue circle is the general location of the SGA

HUNTING OPPORTUNITY

Starting in the early 1980s, bear hunting in the CGA was a one-day season with a one bear limit and was only allowed on two WMAs (until about 1990 when only one WMA was open), and average annual harvest was 0-1 bear. Hunting regulations were changed in 2011, and bear hunting was allowed on private property across three counties (Bibb, Houston and Twiggs) rather than on WMAs, but the season remained at one-day with a one bear limit. All bears are checked out at a WMA check station to collect data and tag the bear. In 2011, harvest was 34 bears (17 male:17 female), and since 2011, bear harvest has ranged from 1-14, averaging about eight bears per year. In 3 of 6 years, greater than 50% of the harvest was female. A survey of people across 4 counties in central Georgia revealed that 55% supported bear hunting (31% were unsure), while 68% found using regulated hunting to manage bear numbers acceptable in some or all cases (Agee and Miller 2008).

Harvest should be closely monitored for this population because of its relatively small size (Hooker et al. 2015). Hunting can have negative impacts on small bear populations, primarily because they are disproportionately affected by the loss of adult females (Miller 1990). Because productivity is a function of the number of females, overharvest of females could cause the CGA population to decrease (Gray 2015). Recently, Gray et al. (2016) recommended managers consider adjusting the timing of bear hunting in the CGA to reduce harvest of females based on the den entrance dates. Gray (2015) suggested bear hunting be delayed until early to mid-January, which should protect most pregnant females from harvest because most have entered the den or shown decreased movement by this time (Gray et al. 2016). Long-term, females should comprise no more than 50% of the harvest, and average age of harvested females should be held at or above 3.75 years to ensure that recruitment rates are not lowered (Carlock et al. 1999). Recently, the one-day hunt was moved to the second Saturday in January in response to biologically informed conservation efforts.

To continue the harvest of bears within this population, we have a population goal of Lambda >1. We used a maximum harvest rate of 6% to meet the Lambda goal because a harvest rate of 7% resulted in a Lambda <1 (Sanderlin 2009). All scenarios where harvest was below 7% indicated that harvest should be sustainable without causing population declines (Sanderlin 2009). Sylvest (2014) suggested that if high harvests of females continue to occur, then perhaps increasing the minimum harvest size of bears to 100 lbs. would reduce the harvest of females, as the size of breeding age females in this population varies widely and adult females have been captured that were less than 100 lbs. (M. Hooker, personal communication). We also caution against reduction of the CGA in the absence of efforts to alleviate the population’s isolation (Hooker et al. In Review). Reducing the population in its current state has potential to further erode its genetic diversity and may threaten long-term conservation (Miller 1995, Sanderlin et al. 2009, Hooker 2017, Hooker et al. In Review).

HUMAN-BEAR CONFLICTS

As with any wildlife population, the objectives and attitudes of land owners, land managers, resource users, legislators, and the public will determine if bears are considered a positive or negative resource, and ultimately, if bears can survive (Weaver 2000). A public opinion survey of central GA residents revealed that 71% enjoyed seeing bears, 82% said seeing bears made them appreciate nature, 88% said it was important to know bears exist in GA even if they didn’t see any, 80% said they are an important part of the ecosystem, and 88% said bears should be conserved for future generations (Agee and Miller 2008). Even with this widespread support for the local bear population, human-bear conflicts still occur. Responsible bear management includes the recognition that carrying capacity has biological and socioeconomic aspects (Weaver 2000). Both must be considered for their relevance to providing adequate resources for bears, reducing human-bear conflicts, and fostering public acceptance of bears. Bear damage complaints usually increase when shortages of natural foods occur, which provides additional justification for establishing and maintaining suitable habitats for bears (Weaver 2000). Urban development in Houston County is rapidly encroaching into bear range, and human-bear interactions continue to occur with residents living along creek drainages and wooded areas that connect to bear habitat. As opportunistic foragers, bears readily adapt to urban environments that offer food in trashcans, vegetable gardens, and other accessible locations. In a bear-related survey of natural resource agencies, Georgia had the second-highest number of bear complaints-per-person in the continental United States (Spencer et al. 2007). In the same study, agencies identified garbage or food attraction as the most common source of conflict.

Bears engaging in nuisance behavior can be grouped into 2 broad categories: 1) bears out of normal range and 2) depredating bears (Carlock et al. 1999). Bears out of normal range include bears that wander into towns and cities and other areas far removed from typical bear habitat. Although these bears attract a great deal of attention, they usually cause little property damage, and most of them are young males (1.5 to 2.5 years old) that are dispersing into new areas because they have been pressured by larger adult males (Carlock et al. 1999). These bears will normally leave the area on their own and return to typical bear habitat if given a chance. The second type is depredating bears that are involved in property damage (Carlock et al. 1999). Most depredation complaints in Georgia arise from bears raiding garbage; however, damage also occurs to apiaries (bee hives), corn fields, apple trees, homes, deer feeders, trash cans, and bird feeders (Carlock et al. 1999, Agee and Miller 2008). A survey of people across 4 counties in central Georgia revealed the most commonly reported damages were vehicle collisions (44%) and agricultural damage (23%; Agree and Miller 2008). From the same survey, 65% thought bears were not a nuisance and 54% responded that they would not call anyone regarding seeing a bear once near their home (Agee and Miller 2008). However, when it came to agricultural damage, attitudes were changed; 50% wanted bears removed if the bears were damaging crops, and 66% wanted bears removed if the bears were threatening livestock (Agee and Miller 2008).

PROGRAM GOALS, OBJECTIVES, AND STRATEGIES
FOR THE CENTRAL GEORGIA POPULATION

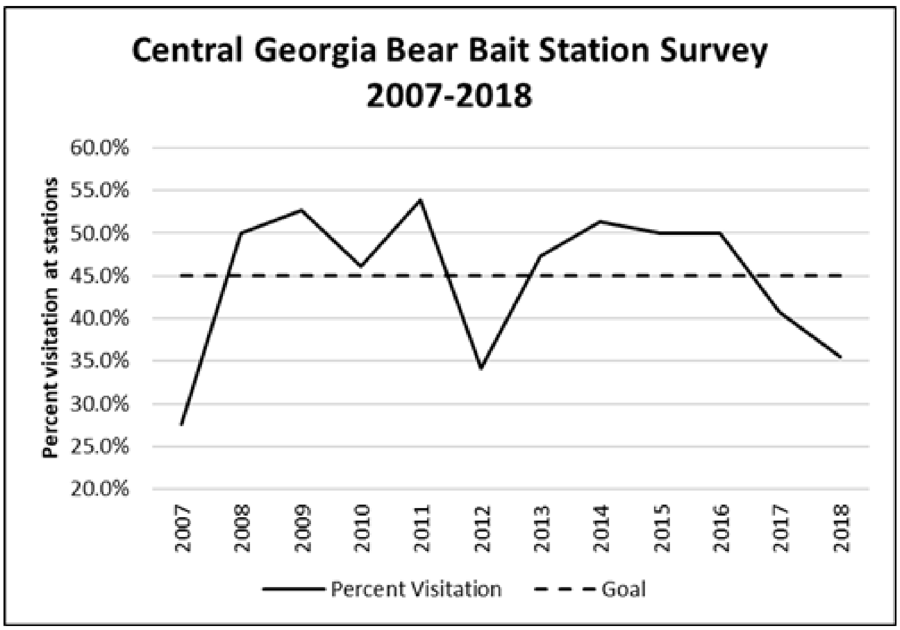
Population Goal: Ensure long-term conservation of Georgia's black bear population

Objective: *Monitor the population status and trends*

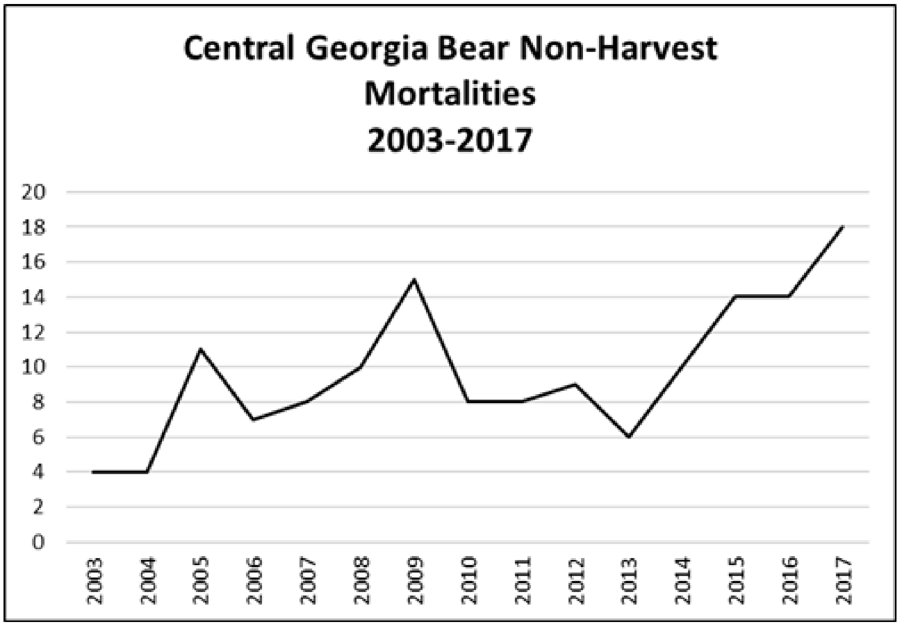
Strategies:

1. Monitor CGA through a bait station survey with a goal of maintaining a running 4-year average of 45% visitation rate

   The overall population, as indexed by a bait station survey was relatively stable between 2008 and 2016 at 45% visitation based on 76 stations utilized since 2007.



2. Monitor and record the number of non-harvest mortalities on bears in the CGA



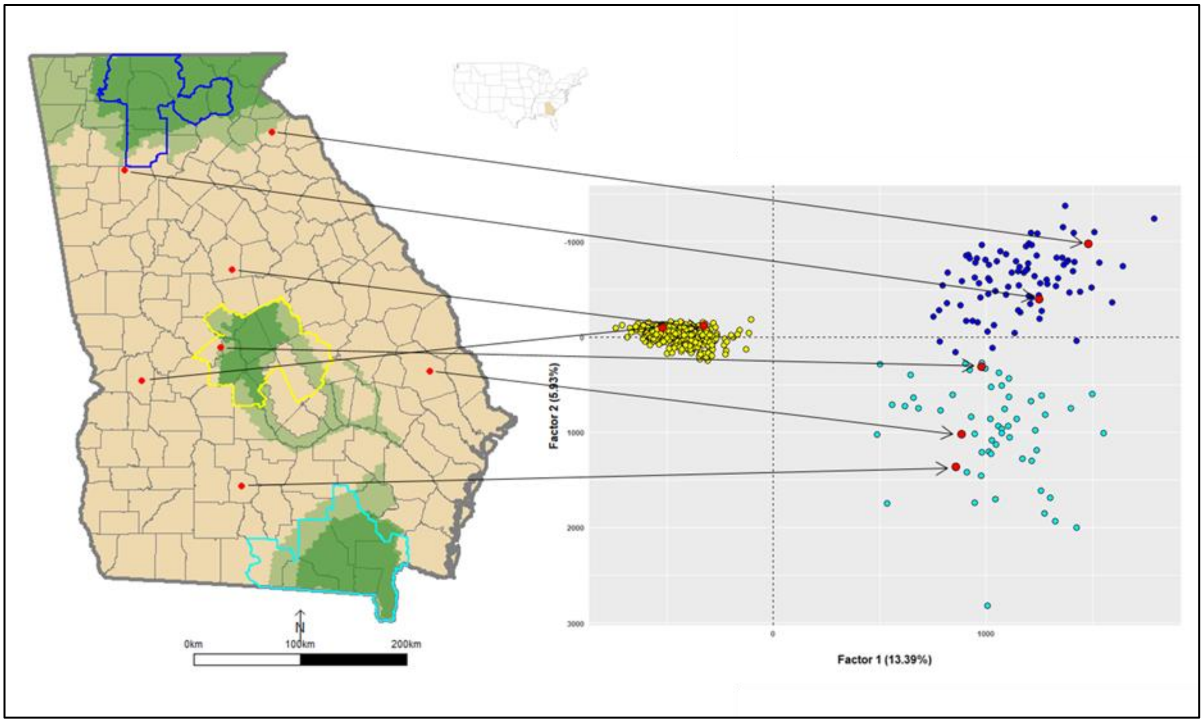
3. Maintain Lambda > 1
4. Assess the feasibility of developing a population estimate for the CGA every 5 years
    a. Researchers at the University of Georgia conducted a DNA capture-recapture hair snare study to estimate density and abundance of bears in the CGA using data collected from 2012-2016.

Objective: *Ensure/enhance genetic diversity for the CGA*

Strategies:

1. Monitor genetic diversity of CGA by collecting genetic material from bears that have been road killed, harvested, etc.

   Below is a figure depicting genetic analysis of 507 bears (2012-16) in all 3 Georgia populations (samples came from the counties outlined in color as follows: NGA = Blue [86 bears], CGA = Yellow [364 bears] and SGA = Aqua [54 bears]) and how closely they relate to each individual bear and as a population. The Dark Green (Primary range) shaded areas have had known reproduction and the Light Green areas (Secondary range) have no documented reproduction but have had bear use as of 2011. The Red dots are 7 outlying bears that were sampled and what population they were the closest to or part of, genetically. Two dots (Bulloch and Tift counties) were bears that were similar in genetics to SGA but were more of a hybrid most likely with bears from Florida populations. One dot (Peach County) was a bear most genetically similar to a Florida bear (Apalachicola population).



2. Investigate the creation and enhancement of habitat corridors between all populations
3. Assess the feasibility of trapping and relocating females with cubs in dens (or possibly lone females in late summer) from other Georgia populations into the CGA

Objective: *Increase habitat availability and connectivity between populations*

Strategies:
1. Work with partners to plan and create corridors between populations
2. Examine the effectiveness of the SWAP draft Greenway priorities for bear movements
3. Promote habitat management on private lands in and around the CGA to assist in expanding the population and/or connecting with other bear populations within the state
4. Purchase/lease additional lands in and around the CGA to assist in expanding the population and/or connecting with other bear populations within the state
5. Increase conservation easements within central Georgia in and around the CGA to assist in expanding the population and/or connecting with other bear populations within the state

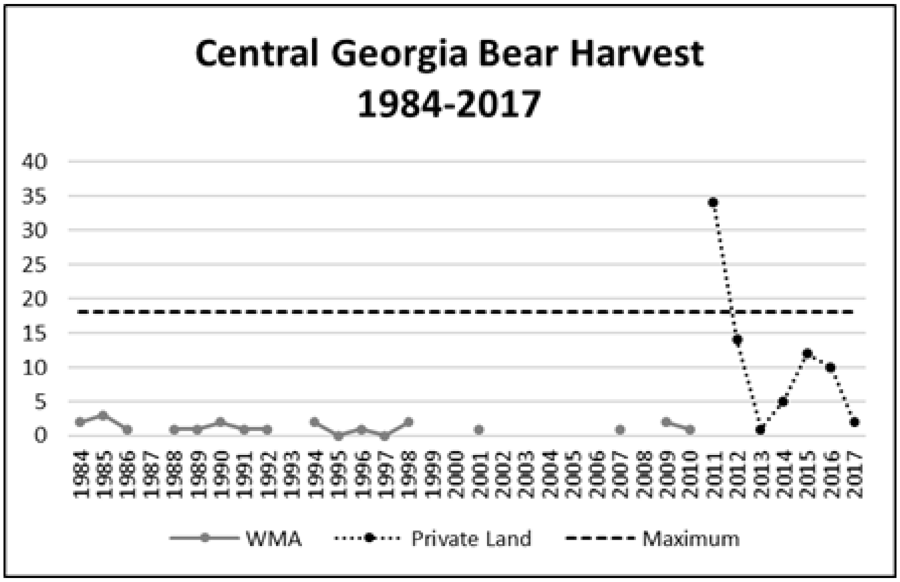
Use Goal: Provide sustainable black bear harvest opportunity

Objective: *Provide hunting opportunities where and when feasible*

Strategies:
1. Track private land hunter and harvest data (all historic through current data).

2. Do not exceed a 4-yr average annual harvest of 6% (18) assuming a population of 300 bears.

CGA bear harvest from 1984 to 2017. From 1984-2010, only WMAs were hunted; from 2011-2017 only private land was hunted. The dashed line depicts the maximum harvest level (18 bears) calculated as 6% harvest (Sanderlin 2009) and a population of 300 bears.

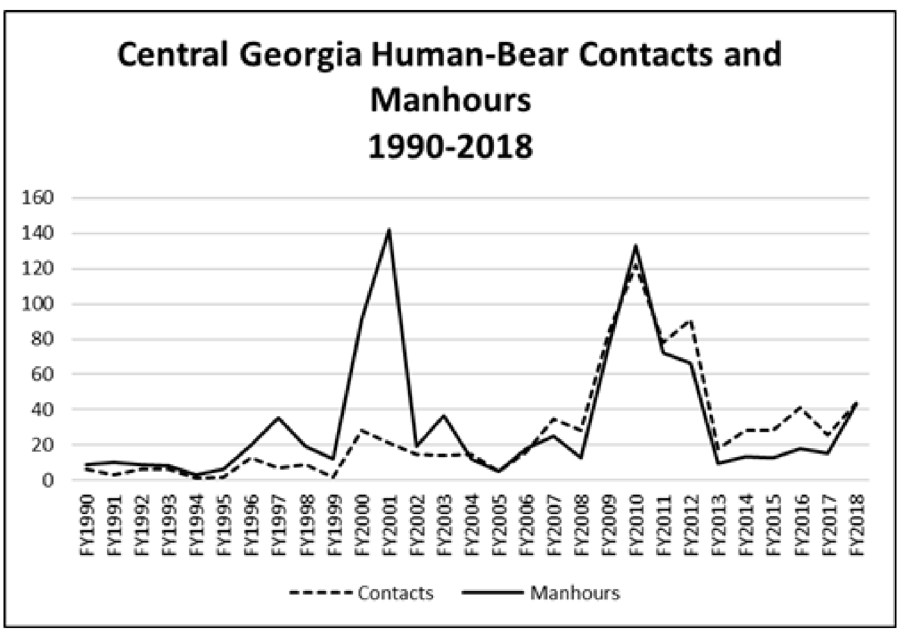


Conflict Goal: Minimize conflicts and complaints related to black bears

Objective: *Protect and provide for public safety in situations involving bears*

Strategies:

1. Track number of contacts and man-hours expended



SOUTH GEORGIA BLACK BEAR POPULATION

CURRENT STATUS OF BLACK BEARS IN SOUTH GEORGIA

POPULATION

The south Georgia black bear population (SGA) is found mostly in and around the Okefenokee Swamp in Ware, Charlton, Clinch, and Brantley counties and along the Florida border in Echols county. An increasing trend in sightings and complaints has been observed along the border from Echols county west to Seminole county. There are occasional scattered sightings, mostly of individual male bears, in counties across the coastal plain. From 1995-99, the SGA (specifically Charlton, Clinch, and Ware counties) was studied to obtain multiple parameters on survival, reproduction and home range (Dobey et al. 2005).

Population Estimate
Dobey et al. (2005) estimated a density of 0.12 bears/km^2 (or 1 bear/2,059 acres). When extrapolated to the primary southern Georgia range, this density yields a population estimate of approximately 800 bears. Dobey et al. (2005) considered the hunter harvest rate on their study area (average 43 bears/year during the study, or about 5.3%) sustainable but relatively high in the southern U.S. With the average annual harvest more than doubling (average 89, with a maximum of 165) since that time, it may be inferred that the population can sustain higher harvest, or the population has grown at a much higher rate than estimated by their simulations.

Bunnell and Tait (1980) previously determined that for a black bear population where females first breed at age 2.5, reproduce at 3 years of age, and have an average litter size of 2 cubs per litter, the absolute maximum mortality rate is 23% per year (see Figure 4). This represents total mortality (i.e. hunting, roadkill, illegal harvest). Using a Downing's population reconstruction (Downing 1980), harvest rates until 2007 were about 16%, well below the maximum estimated by Bunnell and Tait (1980), and low enough to allow the bear population to grow. Assuming current harvest and non-harvest mortality together (130 bears, 5-yr avg.) are below 20%, the current population would still be estimated somewhere around 800.

<u>Survival:</u> Dobey et al. (2005) estimated survival rates for females at 89% (range 79-95%) and males at 71% (range 53-88%). Seasonal movements in relation to food availability significantly affected survival rates of females in SGA (Dobey et al. 2005). Autumn diets of bears in SGA were dominated by black gum fruit (61%), which typically became available in late September to early October. Bears left upland areas and traveled into ONWR to feed on black gum fruit and remained there until the onset of denning. This bear movement coincided with the onset of the bear hunting season in counties surrounding ONWR, and many female bears were unavailable for harvest. Conversely, bears tended to use upland habitats when palmetto fruits were abundant. An unusually abundant crop of palmetto fruit occurred in 1999 that remained available throughout the fall, and females expanded their home ranges into upland habitats away from ONWR during that time to feed on palmetto and were exposed to greater harvest (Dobey et al. 2005).

Reproduction: Reproductive rates and recruitment into the breeding population drive bear abundance (Oli and Dobson 2003, Wildt et al. 2003). Cub production is important because cubs can experience considerable mortality in the first year of life (Beston 2011). Among females in the SGA, Dobey et al. (2002) documented no cub production among radio-collared bears < 3 years old. The average litter size observed for the SGA from 1995-99 was 2 (Dobey et al. 2005). Reproductive synchrony was documented in the SGA following a black gum shortage in the fall of 1995 with only 1 of 15 radio-collared females producing cubs the following winter, whereas 21 of 22 females produced cubs in the winter of 1997 that followed heavy black gum production (Dobey et al. 2005). Other researchers also have found strong relationships between food availability and cub production (Rogers 1976, Elowe and Dodge 1989, McDonald and Fuller 2001).

Bait Station Survey: Abler (1984) tested 3 different techniques to index bears within the SGA and found that the best technique was sardine-baited stations. In 1985-86, Abler (1988) conducted another research project within the SGA to determine the most effective method of applying a sardine-baited survey. He reported no difference between hanging versus nailing cans to trees, that May was the best month, and that checking on 8-day interval was the optimum timing (Abler 1988). Even though May appeared to be the best month, the survey is conducted in July to be consistent with the sampling time frame across the other populations. This survey methodology was first employed in the SGA beginning in 1994. Using the bait station index as a gauge of population change over time has been complicated in the SGA by the occurrence of 3 major wildfires (2007, 2011, 2017), each impacting a significant portion of the range. The disturbance by firefighting and salvage logging equipment along survey routes noticeably changed visitation rates and halted what had been an increasing trend in visitation from 1994 to 2006. The index has been variable with no discernable trend since 2006.

Potential Limiting Factors: This population is likely limited by intensive land use outside the protected core area, namely short rotation industrial forest practices which reduce food sources (especially black gum fruit, saw palmetto fruit, and oak acorns) through simplification of understory plant diversity and elimination of potential undisturbed den sites. As an indication of this impact, Dobey et al. (2002) found that 90% of the den sites in their Georgia study area were within the ONWR boundary.

If there is increased use of herbicides on private land for timber management it could have negative consequences for bears by reducing or eliminating upland soft mast foods (Litt et al. 2001); however, application methods such as band spraying may improve retention of some soft mast within herbicide-treated stands (Dobey et al. 2005). Additionally, more frequent burn rotations are being used to promote longleaf pine-wiregrass communities, thus saw palmetto and gallberry fruit production could be negatively affected (Glitzenstein et al. 2003, Dobey et al. 2005).

HABITAT

Most of the South Georgia bear habitat is slash pine (*Pinus elliottii*) flatwoods, lowland mixed hardwoods, cypress/gum wetlands, and emergent freshwater prairie. The core of the range is a contiguous area of protected public lands totaling 666,107 acres including Dixon Memorial State Forest (and WMA) and ONWR in Georgia, and Osceola National Forest and John Bethea State Forest in Florida. Pinelands on most federal uplands are managed on a long timber harvest cycle and short prescribed burning rotation (dormant and growing season) favoring the development of habitat for the endangered red-cockaded woodpecker (*Picoides borealis*). The state forests are typically managed with intensive site preparation, shorter pine rotations, longer burning rotations, and protection of wetlands. Most of the perimeter of the core area is industrial forest land which is managed with intensive pine site preparation and short timber rotations. In addition, some companies use mid-rotation herbicide application to clean stands for pine straw raking. Based on residence time, bears spent most of their time in non-plantation habitats, but when those plantations were used, most time was spent in 1-15 year-old stands suggesting that the younger pine stands were more important for food production. (Dobey et al. 2002).

Most (97%) of the diet of SGA bears was of plant origin, with the top 3 food items being black gum, saw palmetto, and acorns. Home ranges of adult female bears were in areas with disproportionately high loblolly bay (*Gordonia lasianthus*) and gum-bay-cypress (*Taxodium* spp.) vegetation associations (Dobey et al. 2005). Although Dobey et al.'s (2005) analyses did not rank pine associations highly, 57% of the summer diet of bears was comprised of food items found almost exclusively in pine (i.e., huckleberry, blueberry, bitter gallberry).

For bears to have access to all life requisites, they need to be located within the home range of the bear. The mean annual home-range size for females in the SGA was 13,813 acres and they expanded their home ranges during years of poor black gum production (Dobey et al. 2005). The expansion was most apparent between autumn 1998 and 1999 when the average home-range size for females increased from 3,583 acres to 19,373 acres and included a larger proportion of upland areas open to hunting (Dobey et al. 2005). The SGA home-range size in 1998 was comparable to the CGA home range size; however, the SGA study showed how lack of food production can alter female bear movements and space use. Dobey et al. (2005) reported that because of this increased expansion, 5 females were harvested in the SGA during the 1999 bear hunting season compared with only 7 harvested from 1996 to 1998. Male home-range size was 84,708 acres (Dobey et al. 2005) and was double the size that was reported within the CGA.

<u>Denning:</u> For SGA, the mean den entrance was December 19th (Dobey et al. 2005). Tree cavities and ground nests accounted for 65% of all dens used by females (Dobey et al. 2002). Bears within the SGA used stumps and cavities at the base of trees in shrub, blackgum, mixed shrub, and cypress habitats (Dobey et al. 2002).

<u>Corridors</u>: Florida is working to implement a wildlife corridor from the southern Everglades to the ONWR in southern Georgia (FL DEP 2014). The Florida corridor will allow bears to pass north and south with minimal conflict with highways and urban areas. It is essential that Georgia account for an eventual influx of bears into the Okefenokee region by developing a comprehensive plan for habitat connectivity within the state (Kennedy 2014). The Wildlife Corridor Project and Greenway map referenced earlier in the CGA section could be used to identify a continuous corridor from Florida through the ONWR and up the Altamaha River into the CGA.

HUNTING OPPORTUNITY

The hunting season began in 1981 with a 3-day hunt on Dixon Memorial WMA. Three counties opened for 2 days of firearms hunting with dogs in 1983. Eventually 5 counties were opened for 6 days of hunting. Hunting was discontinued on Dixon Memorial WMA from 1990-1997 due to the prevalence of females in the harvest in previous years. Hunting opportunity has slowly increased with the addition of counties and hunt days. Current hunting opportunity includes 12 firearms hunt days in late September – early October with dog hunting allowed in 5 of the 7 open counties; 3 archery hunt dates, 6 primitive weapons dates, and 3 still-hunt-only firearms dates on Dixon Memorial WMA; and 12 archery hunt dates on 2 WMA/VPA properties.

HUMAN-BEAR CONFLICTS

Historically, most nuisance bear issues in the SGA have centered around the widespread honey industry. These have been greatly reduced as solar fence chargers became available and the installation of electric fences around beeyards became a standard practice (Dobey et al. 2002). From 1996–1998, 12 instances of bears raiding fenced beeyards were documented, and in all cases when the damage occurred, the fence was not active because of depleted batteries (Dobey et al. 2002). Other issues typically occur around rural residences or outbuildings and are normally resolved by removal of attractants. Total annual nuisance complaints have been relatively low with no discernible trend.

PROGRAM GOALS, OBJECTIVES, AND STRATEGIES FOR THE SOUTH GEORGIA POPULATION

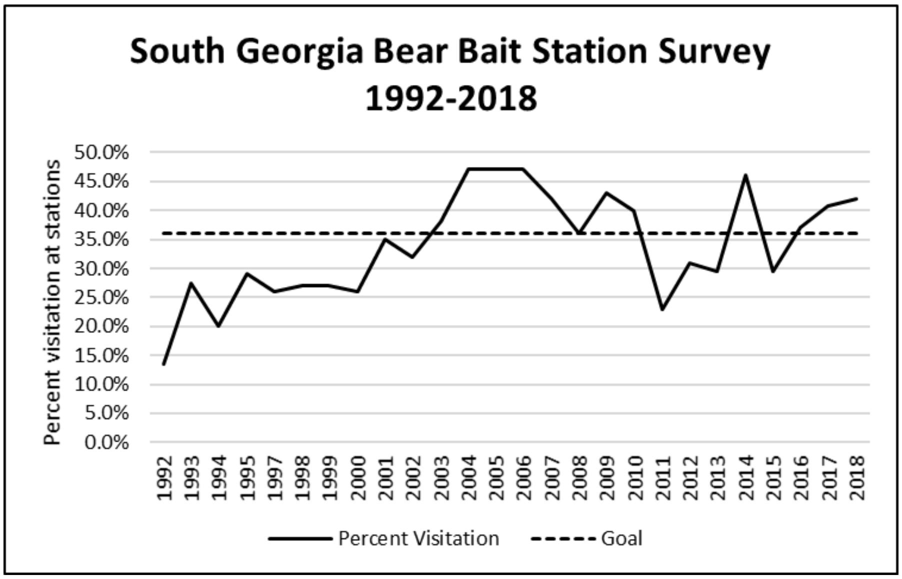
<u>Population Goal: Ensure long-term conservation of Georgia's black bear population</u>

Objective: *Monitor the population status and trends*

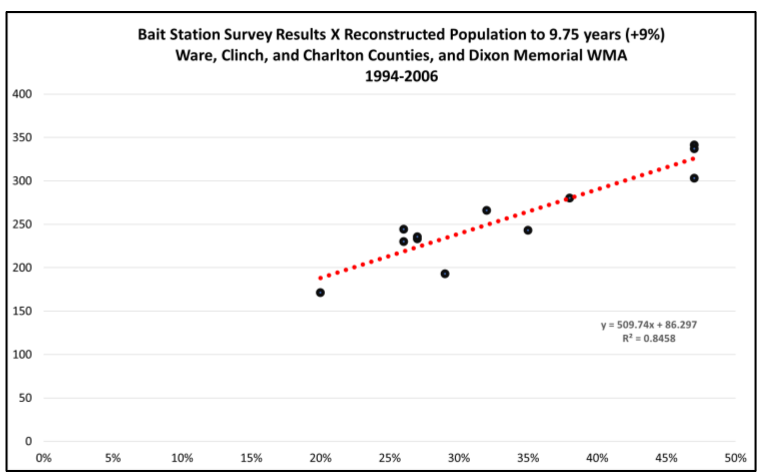
Strategies:

a. Maintain a running 4-yr average of 36% visitation rate on the SGA bait station survey

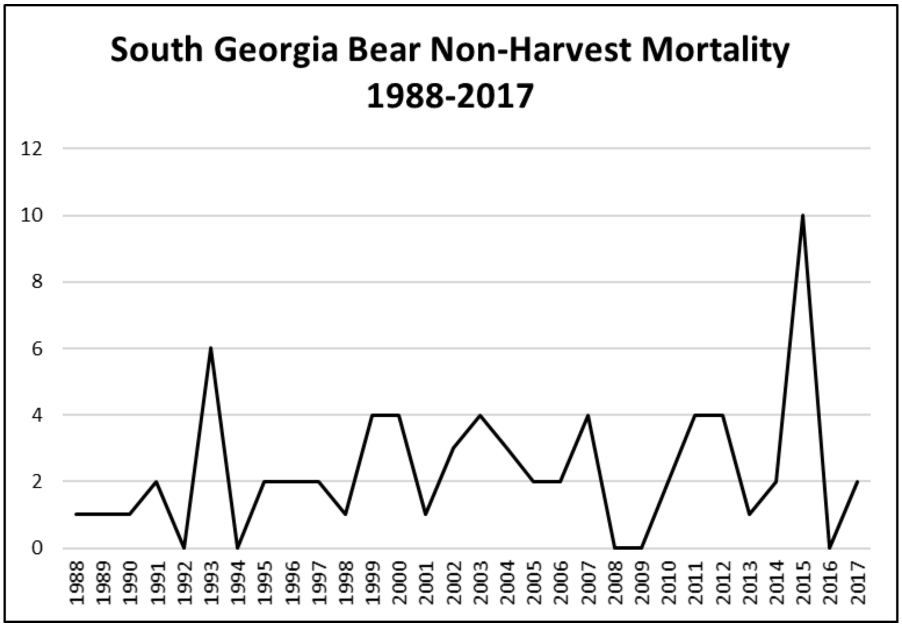
   Ideally, a 45% visitation would be our goal, but catastrophic fires in recent years have impacted surveys results; therefore, given the variability of habitat conditions across years, an average 36% visitation rate is more realistic.



Using a Downing's population reconstruction (Downing 1980) to estimate population size in the same counties where the bait station survey is conducted, there is a good correlation between the bait station survey and the reconstructed population between 1981 and 2007. The reconstruction method, by default, has a time lag between current year and reconstructed results. For SGA bears, that time lag is about 10 years, so data are only available through 2007.



2. Monitor and record the number of non-harvest mortalities on bears in the SGA



3. Assess the feasibility of developing a population estimate for the SGA every 5 years
    a. In 1999, researchers at UT estimated population size and density for the SGA using live-trapping data and DNA mark-recapture techniques from hair collected at barbed wire hair snares in the Okefenokee-Osceola ecosystem of southern Georgia and northern Florida. Although multiple abundance estimates have been calculated for the Osceola population since that time, no similar estimates have been determined for the Okefenokee population since 1999.

Objective: *Ensure/enhance genetic diversity for the central Georgia population*

Strategies:

1. Investigate the creation and enhancement of habitat corridors between populations

   Corridors identified by Kennedy (2014) in South Georgia should be evaluated for current and potential use.
2. Assess the feasibility of trapping and relocating female bears into the central Georgia population

Objective: *Increase habitat availability and connectivity between populations*

Strategies:

1. Promote habitat management on private lands, particularly on industrial timber lands
2. Consider bear conservation needs in land acquisition efforts and decisions where applicable

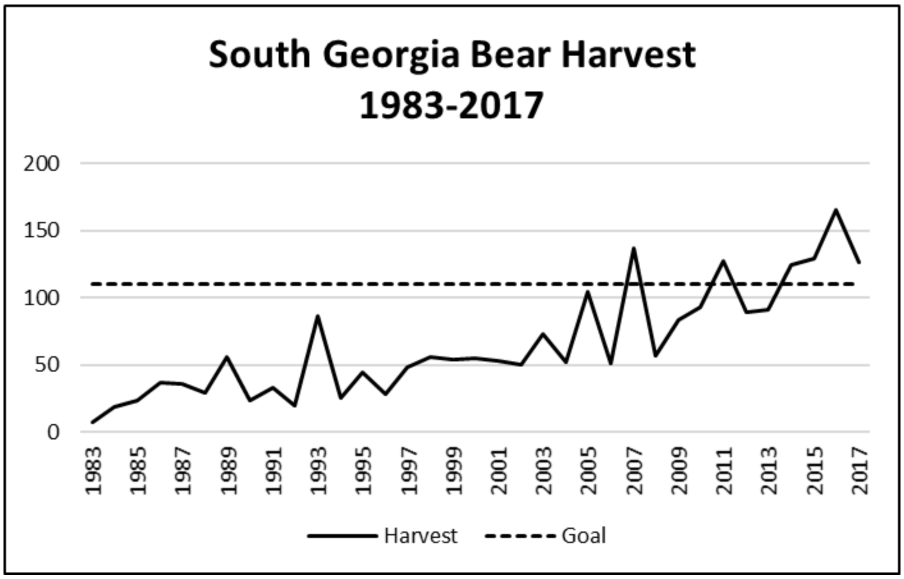
3. Increase conservation easements concentrating on known corridors already used by bears (Altamaha, Satilla River watersheds)

Use Goal: Provide sustainable black bear harvest opportunity

Objective: *Provide hunting opportunities where and when feasible*

Strategies:

1. Track WMA and private land hunter and harvest data
   a. Maintain a running 4-yr average annual harvest of 110 bears

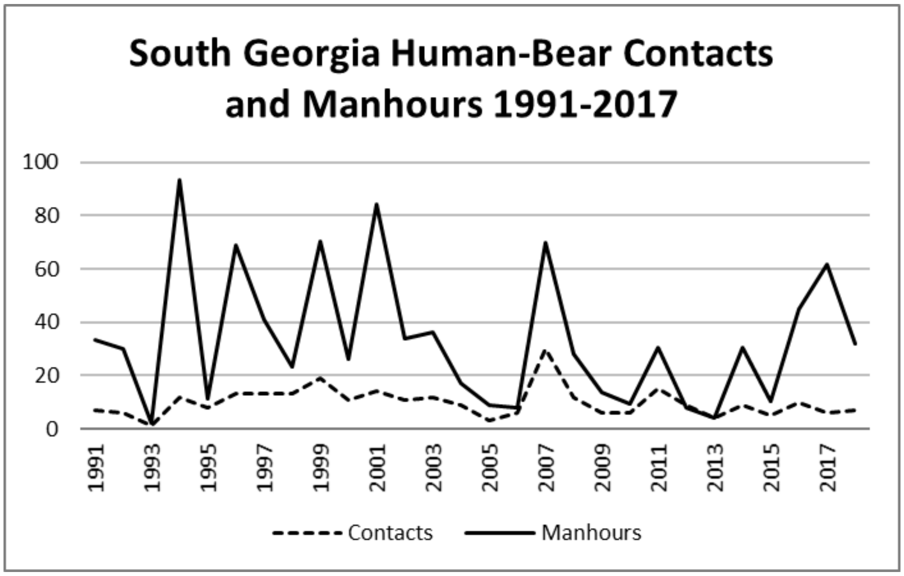


Conflict Goal: Minimize conflicts and complaints related to black bears

Objective: *Protect and provide for public safety in situations involving bears*

Strategies:

1. Track number of contacts and man-hours expended


South Georgia Human-Bear Contacts and Manhours 1991-2017
100
80
60
40
20
0
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Contacts
Manhours

STATEWIDE PROGRAM GOALS, OBJECTIVES, AND STRATEGIES:

Population Goal: Ensure long-term conservation of Georgia's black bear population

Objective: *Monitor the population status and trends*

Strategies:

1. Assess the feasibility of creating a standardized database for tracking sightings statewide (could potentially be done using Survey 123)
2. Assess the feasibility of monitoring reproduction through methods such as den surveys, camera surveys, or collection of reproductive tracts, etc.
3. Review bait station protocol and establish criteria for starting/stopping bait station surveys in a given area

Objective: *Allow and support geographic expansion of the bear population into suitable, but unoccupied, bear habitat*

Strategies:

1. Re-assess number of counties with confirmed bear reproduction by 2021 (update every 10 yrs.)
2. Identify suitable but unoccupied habitat by the year 2023, using existing data and information to show current vs. potential habitat maps
3. Assess the feasibility of trapping and relocating bears into suitable but unoccupied habitat
4. Promote habitat management on private lands

Objective: *Educate the public about the intrinsic value of black bears*

Strategies:

1. Develop outreach materials, including information on not feeding bears
    a. Bearwise.org website, WRD website, Facebook posts, etc.
    b. Bear-related topics in other education and outreach programs
2. Develop a public opinion survey about bears to find out:
    a. General public's opinions about bear conservation, bear hunting, etc.

Use Goal: Provide sustainable black bear harvest opportunity

Objective: *Provide private and public hunting opportunities where and when feasible*

Strategy:

1. Develop a survey method to estimate bear hunter numbers (potentially a survey of big-game license holders)
2. Formally evaluate and consider adjustments to seasons frameworks and harvest opportunity, as appropriate, when females exceed 50% of the harvest in more than 3 of 5 consecutive years for any of the 3 populations.
3. Ideally, average age of harvested females should be > 3.75 years over a 4-yr period

4. Evaluate opportunities to improve data collection system to reduce burden on hunters and personnel without compromising quality of biological data collected
5. Track opportunity, changes in regulations, and potential for additional public hunting lands to be added, particularly for the NGA
6. Establish criteria for opening/closing hunting season in a given county

Objective: *Maintain bear hunting tradition*

Strategies:

1. Recruit new bear hunters
    a. Hunt and learn program, youth hunts, and education programs should be developed and evaluated
2. Promote support for bear hunting: administrative, political, and public
    a. Be proactive in taking steps to build and maintain long-term support for bear hunting among Georgia's non-hunting public
    b. Support bear management strategies that lead to improved support for bear hunting among Georgia's non-hunting public and avoid those that erode such support
3. Track hunter numbers, hunter success rate, and other related statistics
4. Track hunter satisfaction (bear hunter survey)

Objective: *Better identify and understand the bear hunting population in Georgia and its desires*

Strategies:

1. Bear hunter opinion survey, mine existing data, survey existing hunters
    a. Potentially use existing database of successful hunters
    b. Potentially survey database of big game license holders to identify bear hunters

<u>Conflict Goal: Minimize conflicts and complaints related to black bears</u>

Objective: *Protect and provide for public safety in situations involving bears*

Strategies:

1. Provide education for our staff and other agency staff on policies and procedures and techniques
    a. Refine guidelines (nuisance policy) for bears in urban areas.
    b. Finalize black bear kill permit policy
2. Properly handle human-bear conflicts to avoid and minimize future problems
3. Make feeding bears illegal
4. Track number of contacts and man-hours expended statewide

Objective: *Educate the public about living responsibly with bears*

Strategies:

1. Use and advertise the "bearwise.org" website

2. Create outreach information for website and printed materials (pamphlets, etc.)
    a. Include information on alleviating bear damage in agricultural areas

Research Goal: Advance our knowledge of black bear management through applied research

Objective: Maintain a prioritized list of research needs

Priority Research List:

1. Understanding current bear range, and why they are not expanding in some areas, and develop predictive habitat model
2. Translocation study in middle Georgia (moving new bears into CGA)
3. Examine the effectiveness of corridors being developed on the SWAP draft Greenway priorities map from the SGA to the CGA for utilization by bears using the latest models developed by UGA (Mike Hooker).
4. Urban/suburban bear study in north Georgia (denning, etc.)
5. Resource competition between deer, bear, and hogs
6. Evaluation of effects of fire on black bears

Objective: Propose new research as appropriate

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