FINAL REPORT

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COMBINING GOBBLE COUNTS, INFRARED CAMERA SURVEYS, AND GIS TO IMPROVE SURVEY ACCURACY, ESTIMATE METAPOPULATION SIZE, AND EVALUATE HABITAT USE OF EASTERN WILD TURKEYS IN EAST TEXAS

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INTRODUCTION

Current management practices have allowed eastern wild turkey (*Meleagris gallopavo silvestris*) populations to become reestablished throughout much of the U.S., including portions of the Pineywoods region of east Texas (Boyd and Oglesby 1975, Dickson 1992). Although generally successful, efforts to restore and maintain populations have been a trial and error mission for state wildlife biologist during the last 80 years (Newman 1945, Boyd and Oglesby 1975, Campo et al. 1984). Through unregulated market and subsistence hunting combined with habitat loss and degradation, wild turkey populations in the southern U.S. were decimated in the late 1800s, and biologically extirpated by 1930 (Dickson 1992). Records of Rio Grande wild turkey (*M. g. intermedia*) releases in east Texas as early as 1924 indicate concern of the Texas Game, Fish and Oyster Commission for waning turkey populations in the region (Newman 1945).

Efforts to restore turkeys were first made with releases of semi-wild pen-reared eastern wild turkeys in the early 1940s, but proved largely unsuccessful (Boyd and Oglesby 1975). From the late 1940s through the early 1950s, approximately 2,000 Rio Grande turkeys were released in 27 east Texas counties, where numbers increased during the first 3-5 years, but declined rapidly afterwards (Boyd and Oglesby 1975). Faced with repeated failed attempts to reestablish eastern wild turkey populations with Rio Grande and pen-reared birds, biologists devised ways to live-capture free-ranging wild turkeys using rocket nets, which permitted restoration in areas where they had been extirpated and encouraged establishment of huntable populations in their historical geographic range (Mosby 1975).

An additional challenge for early restoration efforts was the characterization and identification of suitable habitats in potential release sites (Dichneite 1973). Changes in land use practices throughout the southeastern United States would alter traditional ideas concerning optimal wild turkey habitat, resulting in many successful restoration projects in areas once considered as marginal or sub-marginal habitat (Bailey 1973). Early descriptions of optimal wild turkey habitat were a combination of coniferous and hardwood forests with mature oaks (*Quercus* spp.), grassy open understories, nearby water sources; far removed from human disturbance (Hurst and Dickson 1992). Urbanization, livestock grazing, and changes in commercial timber production throughout the Southeast combined to change and negatively impact eastern wild turkey habitat (Bailey 1980, Zwank et al. 1988, Bidwell et al. 1989, Campo et al. 1989). Regional commercial timber production has been implicated as a primary factor for declines in eastern wild turkey habitat quality and quantity. In general, commercial timber production promotes full site occupancy by commercially desirable species, a short interval between investment and return, high growth and yield rates, and economic efficiency (Dickson and Maughan 1987). As a result, most commercially owned forests in east Texas represent unsuitable habitat for wild turkeys with large, homogeneous, even aged, short-rotation stands of loblolly (*Pinus taeda)* and shortleaf pine (*P. echinata*) (Rudis et al. 2008).

Accurate population estimates are critical to management and evaluation of habitat conditions, habitat management practices, and harvest regulations on any given population (Kurzejeski and Vangilder 1992). However, the ability to monitor populations with high accuracy and precision remains a persistent shortcoming of wild turkey management throughout its range (Cobb et al. 2001). Several indirect techniques, such as hunter reports, brood surveys, and observational/auditory-based surveys are generally used to monitor turkey population trends rather than provide reliable population estimates (Kurzejeski and Vangilder 1992). While lacking the precision of quantitative density estimates, these methods and resulting indices generally provide valuable and easily obtained data, on which to base management recommendations (Kurzejeski and Vangilder 1992). Surveys generating indices frequently are less expensive and require less effort than formal estimation methods (Williams et al. 2002), and although indices can be easily generated over large geographic areas and produce trend data over time, they do not provide true population estimates based for the surveyed areas. As such, gobbling surveys for turkeys may more accurately reflect habitat changes than population changes, and fail to provide accurate trend data over time (Link and Sauer 1998, Keller and Scallan 1999).

Gobbling counts involve recording the number of distinctive vocalizations (i.e., gobbles) heard from regularly spaced listening stations along fixed transects (Healy and Powell 1999). Initiated in Minnesota in 1973 to monitor gobbling phenology and expansion in newly established/released wild turkeys (Porter and Ludwig 1980), gobbling counts are annually conducted during the mate acquisition period (which varies regionally) and were. However, the ability of gobble counts to provide useful data for turkey management has been questioned, because of difficulties associated with gobbling count precision (Porter and Ludwig 1980). Nonetheless, combinations of extensive and intensive gobbling survey data can provide adequate estimates of relative abundance and distribution over time (Porter and Ludwig 1980).

Developing accurate population estimates for eastern wild turkeys in east Texas presents a difficult challenge. Despite an extensive trap and transplant program, including translocation of > 7000 eastern wild turkeys to east Texas, wide ranging sustainable populations have yet to become established. Because of the long history of reintroductions in the region, hypotheses have been formulated that populations are both disjunct and variable in their permanence and habitat use. Moreover, because of rapid habitat changes from intensively managed commercial timber operations throughout the region, habitat suitability for wild turkeys likely changes on annual or semi-annual bases. Such variability in population permanence in a given area, combined with rapid habitat changes, likely has limited the value of current fixed route gobble count surveys for developing reliable population estimates and monitoring large scale distribution patterns. Current routes may actually be located in areas where (1) birds no longer exist (as a local subpopulation may have been extirpated) or (2) habitats are no longer suitable for wild turkeys. Moreover, current gobble count routes may no longer sample areas that meet minimum proportions of habitat types used by wild turkeys during periods of peak gobbling activity (approximately 15 March – 15 April) and provide little information as to the of success of past reintroductions. Improvements to aspects of gobble count sampling design should aid in technique standardization and refinement, allowing for more effective surveys and habitat evaluations in areas where populations (may) exist.

As such, the overall goal of this research was to refine, modify, and improve the fashion in which gobble counts are performed and physically placed on the landscape to better evaluate the effectiveness of eastern wild turkey restoration efforts throughout east Texas. Development of adaptive gobble count survey protocols, where route placement is flexible among years based upon habitat availability on the landscape, should standardize area(s) of habitat sampled and focus sample efforts in areas where turkeys likely exist within the region. Specifically, overall goal of this research was to quantify and evaluate turkey habitat use during periods of peak gobbling activity (15 March – 15 April) and to refine gobble count route placement to allow for biannual or triannual adjustments to route placement in response to large-scale habitat changes in east Texas. Within the overall goal of improving gobble count survey methodology, the specific objectives of this research was to: (1) use wild captured, radio marked male wild turkeys in areas where gobble counts are currently performed and areas of proposed route placement to quantify survival and habitat use throughout the annual cycle, (2) to map and classify suitable wild turkey habitat in east Texas by using geospatial analysis, and to evaluate route placement validity, (3) to develop a technique for gobble count route placement on the landscape using geospatial analysis, and (4) perform gobble counts along current and newly developed gobble count routes, in order to verify (a) turkey use of current and predicted habitat along existing and newly developed routes, respectively and (b) to assess the accuracy of suitable turkey habitat in east Texas identified through geospatial analysis.

METHODS

Study Area

This research was conducted primarily upon the southern portion of Angelina National Forest (ANF) located in Angelina and Jasper counties in east Texas. Sam Rayburn Reservoir divides the ANF, with the southern portion encompassing > 30,000 ha. A second and third growth forest covers the gently rolling topography with longleaf and loblolly pine dominating most of the uplands. Although relatively homogenous in overstory species composition, age, and stand structure, unique plant communities associated with hillside seeps, perennial and intermittent streams as well as mixed pine hardwood stands do exist within the forest. The U. S. Forest Service (USFS) conducts an intensive prescribed fire program with each management unit/compartment on roughly a 3-year burning rotation.

Capture, Handling, and Transmitter Attachment

Through prior knowledge of TPWD biologists and scouting, areas large enough to discharge a rocket net were identified as potential capture sites on the southern portion of Angelina National Forest in Angelina and Jasper counties (Figure 1). Areas used by turkeys on a relatively consistent basis, as determined by tracks, signs, and motion activated digital scouting cameras were the focus of bait/capture efforts. Potential capture sites were baited with corn starting in mid-January 2006 and 2007. To comply with USFS law enforcement requests baiting ceased on 15 March 2006 and 2007 in order for all bait to be consumed prior to 1 April 2006 and 2007. All potential capture sites identified were pre-baited with chopped corn to entice feeding and maximize capture potential. Bait sites were checked daily, from mid-morning to mid-afternoon to avoid encountering birds feeding at the sites. A Cuddeback Expert® digital scouting camera was placed at each bait site to monitor frequency and timing of visits as well as number and gender of individuals within groups.

Potential capture sites were cleared of woody debris and large enough to accommodate a discharging rocket net. Trapping only occurred when temperatures were $< 20^{\circ}$ C and relative humidity was $> 40\%$ to reduce potential capture related mortality

(Bailey et al. 1980). Trapping attempts were initiated at bait sites that exhibited turkey activity for ≥ 2 consecutive days. A skirted net (9 m x 18 m) and 3 Winn-Star® rocket were launched from ground-level ramps to capture turkeys. Researchers were concealed in camouflage blinds located in the vicinity to determine the moment when turkeys were feeding at net center. Rockets were discharged when all individuals were (1) positioned at net center, (2) feeding with head down, and (3) a maximum of 1.5 m from the center rocket to avoid injury and maximize trapping success.

Once captured, each turkey was removed from the net, placed individually in a ventilated cardboard box. Each male was banded above the spur with a uniquely numbered aluminum band provided by Texas Parks and Wildlife Department. Each male was also be fitted with a backpack style Advanced Telemetry Systems (ATS) radio transmitter (Series A1300 ±2.5kHz). Transmitters were fitted to allow for growth and full range of motion using shock-cord and a series of knots, glue and cable-ties. Blood samples were collected from each bird using brachial veinopuncture with a 29 gauge 1.0 cc syringe. Blood samples were placed in lysis buffer (Longmire et al. 1997) and preserved for future genetic analysis. Beard length (cm) and spur length (cm) were also measured on each male. Birds were released at the capture site immediately after transmitter attachment. In an attempt to maintain flock size and social structure all birds were released towards the direction from which they arrived at the trap location.

Transmitter Relocations

Transmittered turkeys were located daily, in a random order, from one-week post capture, from 15 March – 1 May 2006 and 2007 (corresponding to the period of peak gobbling activity). For the remainder of the annual cycle, attempts were made to locate transmittered turkeys once weekly. Locations of marked birds were obtained using an ATS R2000 receiver (2MHz frequency range, 1 kHz channel spacing) with a 3-element folding Yagi antenna.

Fixed telemetry stations were established along roads in areas birds consistently occupied throughout the Angelina National Forest. If a transmittered individual was located in the same area on two consecutive days, permanent stations consisting of three geospatially referenced points 100 m apart were established. These stations were used when appropriate to obtain three azimuths in direction(s) of maximum signal strength for individual birds. Fixed stations were used when transmittered individuals were in close proximity, allowing each outside azimuth to intersect at approximately 90°. If the initial recorded azimuth and signal strength indicated that transmittered individuals were close to the road, personnel collecting telemetry data walked between points to avoid influencing turkey movement. When not using fixed stations, personnel collecting telemetry data drove between points and used a handheld consumer grade global positioning system (GPS) to obtain Universal Transverse Mercator (UTM) coordinates in North American Datum 83 (NAD 83) UTM zone 15 for each location from where an azimuth was recorded. A maximum of 6 min was allowed to obtain three azimuths from three locations to minimize error associated with turkey movement (Heezen and Tester 1967, Schmutz and White 1990). For all potential telemetry locations, Locate *III*® software was used to estimate polygon closure and x-y coordinates for turkey locations.

The kernel analysis tool within the home range extension (Rogers and Carr 1998) of Arc GIS 9.2 was used to calculate 95% adaptive kernel home range polygons for each transmittered individual. Adaptive kernel polygons were used to identify areas of annual and spring core (1 March - 30 April) habitat use. Dates for spring season were set to ensure a sample of locations during the period generally accepted as the peak of gobbling activity (15 March – 15 April). Areas of core habitat use during spring (1 March – 30 April) was identified by overlaying polygons created from 20% kernel isopleths onto Unites States Geological Survey (USGS) 2004 land cover forest cover type classifications. Using ArcGIS 9.3, area and percent cover of classified cover types contained within 20% core use areas was calculated. These data were used to help develop habitat-sampling criteria for experimental route placement within east Texas.

Existing Gobble Count Route Habitat

Habitat data were collected along 3 current fixed gobble count routes within the study area (Figure 2) (i.e., Big Creek route (19 listening stations), Boykin route (24 listening stations), and the Trout Creek route (20 listening stations)). These data were collected between 1 May – 31 August, to (1) obtain detailed habitat descriptions of existing gobble count survey routes and measurements of habitat currently sampled by TPWD and (2) verify accuracy of spatial forest classification used in the identification and placement of experimental routes during 2008 (see below).

Four, fixed radius 1/25th ha plots were installed at each gobble count listening station along each route within the study area (252 plots). Two plots were installed 50 and 100 m perpendicular from each road edge at each gobble count listening station. The following variables were measured at each plot: (1) tree species presence and diameter ($\geq$ 15.25 cm) to quantify midstory/overstory forest composition; (2) basal area from point center using a 10-factor prism, (3) tree species and height within each plot, (4) distance (m) to nearest ephemeral/perennial stream, permanent water source, and road or hard edge (either man-made or natural), if < 100 m. If distance measures > 100m, GIS was used to calculate those distances. Any mid-rotation silvicultural treatment (i.e., 1st or 2nd thinning operation) was noted for plots that occurred within intensively managed pine plantations. Evidence or records of recent prescribed fire was also recorded.

Geospatial Identification of Experimental Gobble Count Routes

Areas of core habitat use during the spring season (1 March – 30 April) were identified by overlaying polygons created from 20% kernel isopleths onto Unites States Geological Survey (USGS) 2001 Landcover forest cover type classification. Using tools within ArcGIS 9.2, area and mean percent cover types contained within 20% core use areas were measured to determine habitat-sampling criteria for experimental route placement. The following ten counties were incorporated into the spatial analysis for new route placement based upon historical release data and proximity to U.S. National Forests within the region: Angelina, Houston, Jasper, Nacogdoches, Newton, Polk, Trinity, Tyler, San Augustine, and Sabine. Experimental routes were identified using a combination of GIS tools and spatial products. Texas Department of Transportation (TX DOT) shapefiles of all secondary roads within each county in the 10 county region were obtained from Texas Natural Resource Information Systems (TNRIS). A 400m buffer was placed on all secondary roads within each county and overlaid onto 2004 USGS landcover forest cover type classification land cover data. The zonal statistics feature within the spatial analyst tool of ArcGIS 9.3 was used to calculate percent (%) area of each forest cover type within the 400m buffer zone. Road segment buffers that contained $\geq$ 50% of the dominant forest cover type as defined by of core use areas and their associated roads were exported to a new shape file. Road segments within the accepted road buffer file created a population of acceptable roads within each county that could be incorporated into new routes. All accepted road segments were visually examined for proximity and continuity to become incorporated into newly established 14-16 km routes with listening stations every 0.8 km. For a potential route to qualify, $\geq$ 70% of its linear extent must overlap dominant forest cover type(s) as identified within core use areas. New routes were overlaid onto the latest Digital Orthophoto Quarter Quadrangles (DOQQ) to ensure roads were publicly accessible and verify habitat type, proximity to residential structures, major highways and other sources of noise pollution.

Gobbling Count Survey Execution

Gobbling counts surveys were performed during 2006-2007 along current TPWD survey routes using current TPWD methods, including enticing vocalizations by use of artificial calls, similar to those described by Healy and Powell (1999). At each listening station, observers recorded (during a 2 min. listening period) the number of individual birds heard gobbling, the total number of gobbles heard, and any noise interference. Observers also recorded the estimated distance (m) to each call and an azimuth in the approximate direction of each gobble. Surveys were initiated 15 March and completed by 1 April in each year, where each route was surveyed at least 4 times, twice weekly depending on weather conditions, with alternating starting points. Surveys began 30 min. before sunrise, but were not conducted during periods of adverse weather. In 2008, experimental routes were also sampled. Survey methodology was similar as described above, but sample duration (per listening station) on new experimental routes was extended to 4 min, to comply with U.S. Fish and Wildlife Service technical guidelines (Healy and Powell 1999).

Data Analysis

For each transmittered male, 95% adaptive kernel home range estimates were calculated using the kernel analysis tool within the home range extension of ArcGIS 9.2 for both spring and annual home ranges. Adaptive kernel polygons generate contours that connect areas with an equal probability of occurrence and were used to identify areas of annual and spring core (1 March - 30 April) habitat use. This approach uses probability of occurrence to identify home ranges, is less sensitive to telemetry error estimates, and also identifies areas of concentrated use (Kernohan et al. 1998). Analysis of variance (ANOVA) will be used to examine differences in home range size and core use areas within home ranges (as identified from kernel estimation) between years (i.e., 2006 and 2007), and between spring and annual home range estimates. Similarly, area and percent cover of habitat cover types identified from USGS Landcover classifications were calculated for each transmittered individual, for both spring and annual periods. To examine differences in home range and habitat use over time, a two-way factorial ANOVA will be used to examine how habitat varies between spring and annual periods, between concentrated home ranges, and between years (i.e., 2006 and 2007).

Habitat data collected at existing gobble count routes were primarily used to verify classification accuracy of USGS Landcover classifications, but were also used to describe macrohabitat existing along current gobble count routes. In the final thesis resulting from this research, these data will be used to examine how transmittered turkeys use habitat (defined by home range estimate polygons) as compared to existing habitat (defined by habitat along existing gobble count routes). These analyses will be restricted to only those individually transmittered birds in which portions of their home range spatially overlapped areas in which field-level habitat data were collected. In the final thesis resulting from this research, compositional analyses will be used to determine if turkeys used habitats disproportionately to their availability on the landscape, following Aebischer et al. (1993). For these analyses, field habitat (used) will be converted to percent frequencies (i.e., the number of points per cover type as compared to the total number of points), while classified landcover data already existing in proportion form within the study area will be defined as "available".

For all gobble count surveys performed, descriptive statistics are provided. In the final thesis resulting from this research, logistic regression will be used to quantify combinations of relevant habitat metrics useful for determining or predicting the presence/absence of turkeys among existing gobble count surveys and newly established surveys. In these analyses, the response variable (Y) will be binary and coded 0 or 1, where routes in which at least one gobble was detected will be coded 1 and routes in which no turkeys were detected will be coded 0. Both field-based and geospatially calculated habitat will be used in all regression models; habitat variables will excluded if correlated ($P < 0.05$). Akaike's Information Criteria (AIC) corrected for small sample sizes (AIC_c) will be used to select the best model from the set of candidate models developed, where $AIC_c < 2$ indicates a plausible model (Burnham and Anderson 2002).

RESULTS

Between 2006 and 2007, twenty-two male Eastern wild turkeys were captured, banded, and fitted with transmitters on the Angelina National Forest (Table 1). Also, in March 2006, seven male Eastern wild turkeys were captured in South Carolina, transported to Texas, banded, fitted with transmitters and translocated on the Angelina National Forest (Table 2). After releasing wild captured and translocated turkeys, > 1300 individual locations were obtained during intensive daily transmitter relocations (from March – May, 2006 and 2007) and weekly transmitter relocations (from June 2006/2007 – February 2007/2008) (Table 3).

For all transmittered turkeys combined, 95% adaptive kernel annual home ranges ranged from 550 ha to > 3200 ha, with an average annual 95% home range estimate of >1880 ha (Table 4). Spring home ranges (95% adaptive kernels) varied from 345 ha to >2700 ha with an average spring 95% home range estimate of 1443 ha (Table 4). In general spring home ranges were smaller than annual home ranges (Table 4). When considering just wild trapped adult male turkeys, both 95% adaptive kernel annual and spring home range estimates were very similar to previously mentioned estimates (Table 5). Similarly, translocated turkeys from South Carolina, exhibited similar annual and spring home range sizes (Table 6) while wild trapped juvenile male turkeys tended to have smaller annual home ranges and larger spring home ranges than wild captured adults (Table 7). Home range estimates are presented for each individual's annual 95% adaptive kernel home range (Figures 3 – 26) and each individual's 95% adaptive kernel spring home range (Figures 27 - 50).

Habitat along the three existing gobble count survey routes (Big Creek, Boykin, and Trout Creek) on the Angelina National Forest were generally similar, and primarily dominated by evergreen forest (Tables 8, 9, 10). Using these data and the 20% iospleth core spring home range habitats for transmittered male Eastern wild turkeys (see above; Table 11). Core use areas for all individuals combine contained 89% evergreen forest, 9% mixed forest, and lesser amounts of other habitats (Table 11).

With evergreen forest dominating percent cover type within core use areas during the period of peak gobbling activity, road segments were selected within this cover type for experimental route placement. Using Texas Department of Transportation (TXDOT) road shapefiles from Texas Natural Resource Information System (TNRIS) for Angelina, Houston, Jasper, Nacogdoches, Newton, Polk, Trinity, Tyler, San Augustine, and Sabine counties, a 400 m buffer was placed on all road segments within each county. Road segment buffers were then overlaid onto the NLCD 2001 and zonal statistics feature in ArcGIS 9.2 was used to analyze forest cover type within all buffer zones. All road buffers containing ≥ 50% evergreen forest were exported to a new shapefile within ArcMap, then a new shapefile was created and all of these secondary road segments with buffer zones ≥ 50% evergreen forest were used as potential candidates for experimental routes. Secondary road segments meeting selection criteria were joined to create 14-16 km routes, but were not used unless ≥ 70% of each route's length was composed of accepted road segments. All existing Texas

Parks and Wildlife Department (TPWD) gobble count routes within the 10 county study area met new route placement criteria.

Gobble counts were performed in each year during this study, and a summary of gobble count surveys are presented in Table 12. A more detailed breakdown of individual route data are presented in Table 13. In 2008, 10 routes were sampled (7 experimental routes and 3 wildlife management area routes) (Figures 51 – 58) During 2008, 7 routes detected gobbling turkeys.

DISCUSSION/LESSONS LEARNED

This report provides the basic materials, methods, and coarse-grained results obtained during the execution of this research project. Upon completion of Mr. Bass' thesis, Texas Parks and Wildlife Department will receive both physical and electronic/digital versions of the thesis. Included therein, will be the much more formalized data analyses, results, and discussion. However, in an attempt to be transparent I provide a brief discussion, with a focus upon lessons learned from this research.

Capturing widely dispersed Eastern wild turkeys on public lands in east Texas remains a challenge. We exerted a tremendous effort attempting to capture turkeys on public lands, during winters of both 2006 and 2007, with relatively limited success. However, we were able to transmitter and monitor nearly two dozen male turkeys during this project, which provided the basis for the evaluation and experimental placement of new gobble count survey routes. One of the initial goals of this research was to use the transmittered male turkeys to verify survey accuracy and turkey detectability during gobble count surveys in east Texas. We were unable to really even attempt to answer these types of questions due to the widely disbursed nature of the transmittered males during our study, and the relatively low density of transmittered males scattered through the gobble count survey areas. Nonetheless, we were able to use habitat use and movement patterns of these transmittered males to quantify spring and annual habitat use and estimate home range sizes; both of which were crucial for the development of the experimental gobble count survey routes.

Although Texas Parks and Wildlife Department staff normally conduct gobble count surveys, the location of old routes was based upon perceived location of birds and known (generalized) release/translocation areas. As such, there has been concern that the normal surveys executed do not accurately reflect potential turkey habitats or turkey population trends. Through detailed habitat measurements, both in the field and using GIS and landcover analyses, we were able to deploy experimental routes. This approach will be useful in relocating routes in east Texas when potentially suitable habitats change or age, or when a more extensive turkey survey approach is developed for east Texas turkey monitoring. Although the experimental routes were not necessarily superior in detecting turkeys from the previously established routes, turkeys were detected on these experimental routes. Most importantly, turkeys were detected in areas of the Angelina National Forest and in the 10 county area that are not normally surveyed. As such, the approach used herein (to develop/identify new routes) has significant potential to rapidly deploy new routes as turkey populations expand, retreat, or stabilize throughout east Texas.

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Figure 1. Location of United States Forest Service National Forests (Sam Houston, Davy Crockett, Angelina, and Sabine) in east Texas.

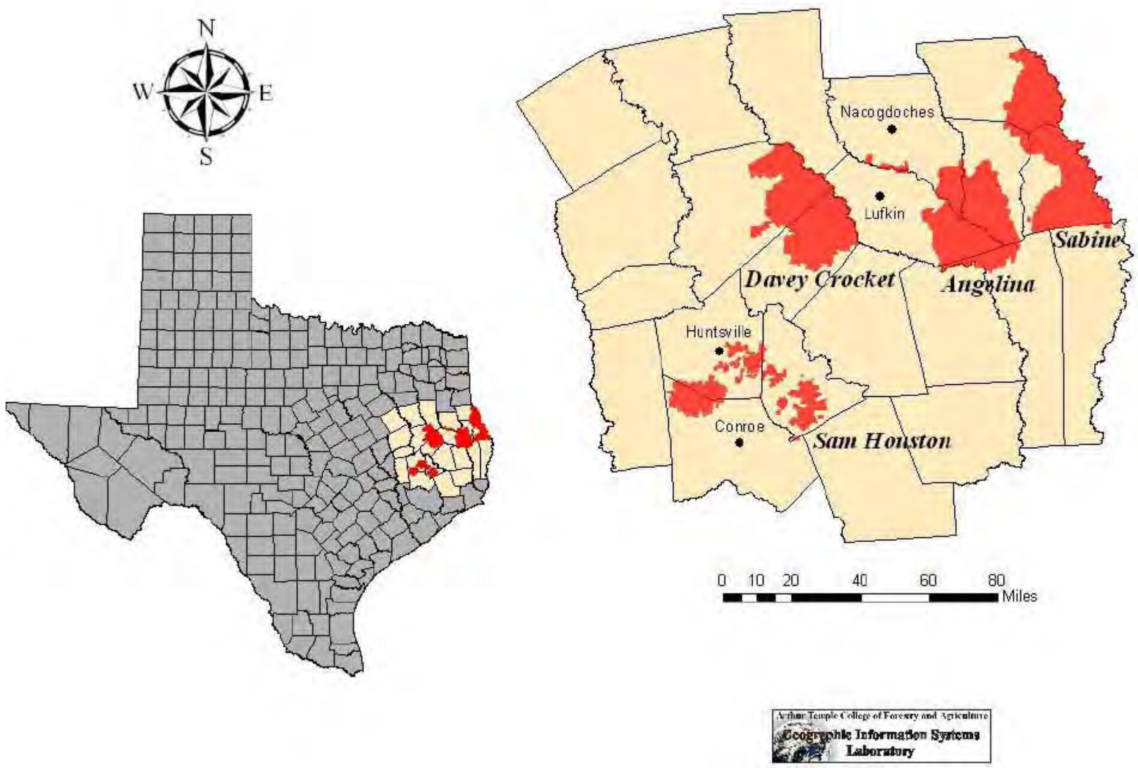

Figure 2. Location of historical Texas Parks and Wildlife Department Eastern wild turkey gobble count survey routes associated with the Angelina National Forest in east Texas.

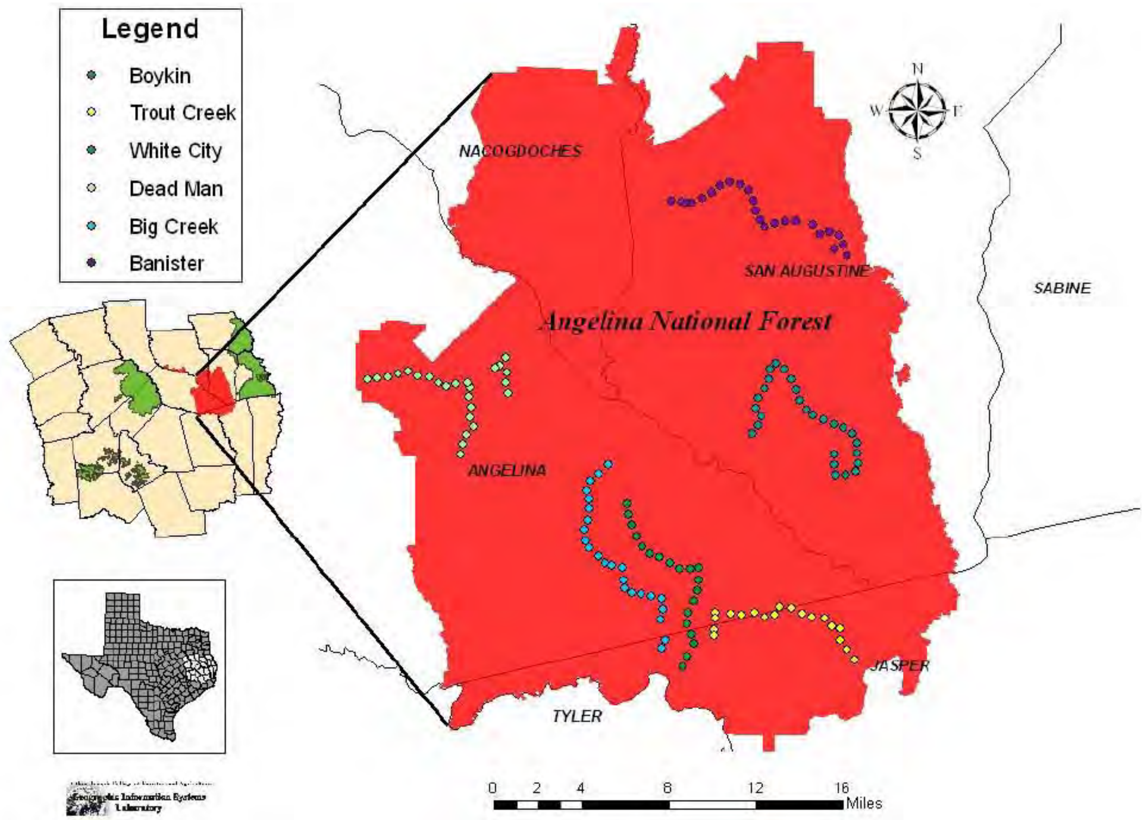

Figure 3. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.012) on the Angelina National Forest, 2006-2008.

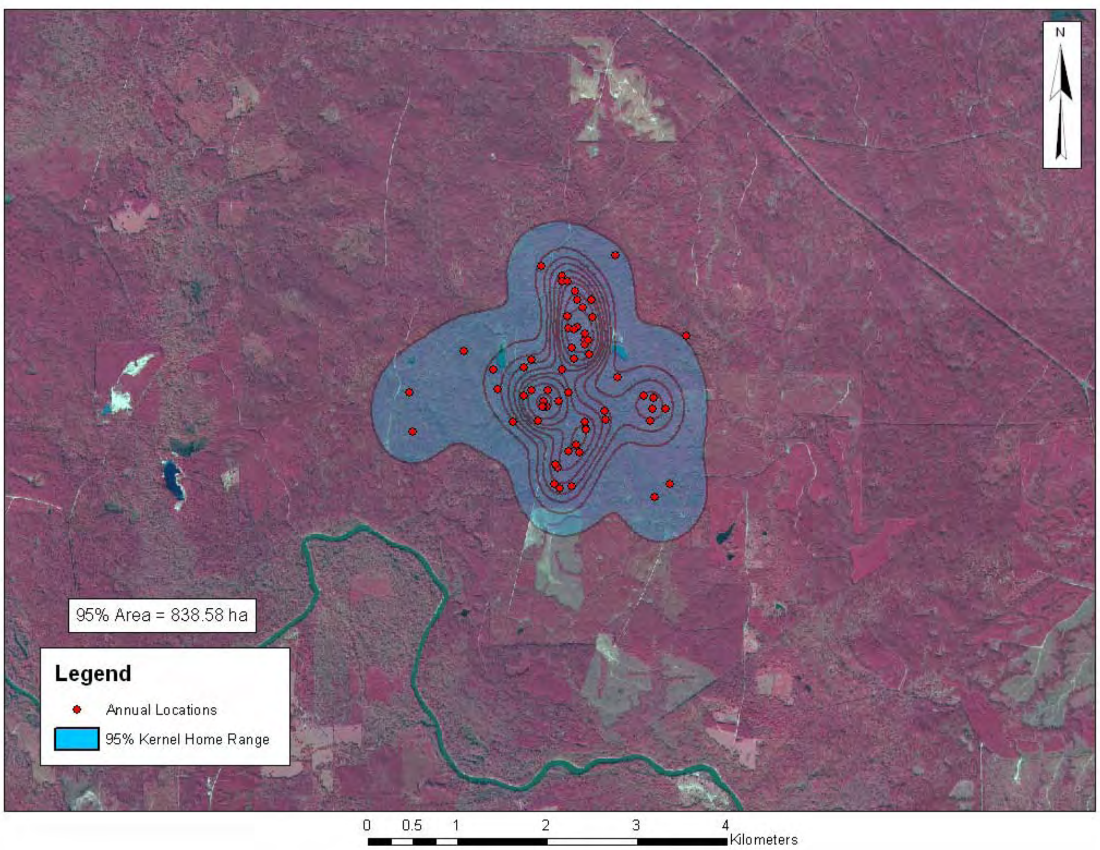

Figure 4. Telemetry locations and 95% adaptive kernel annual home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.054) on the Angelina National Forest, 2006-2008.

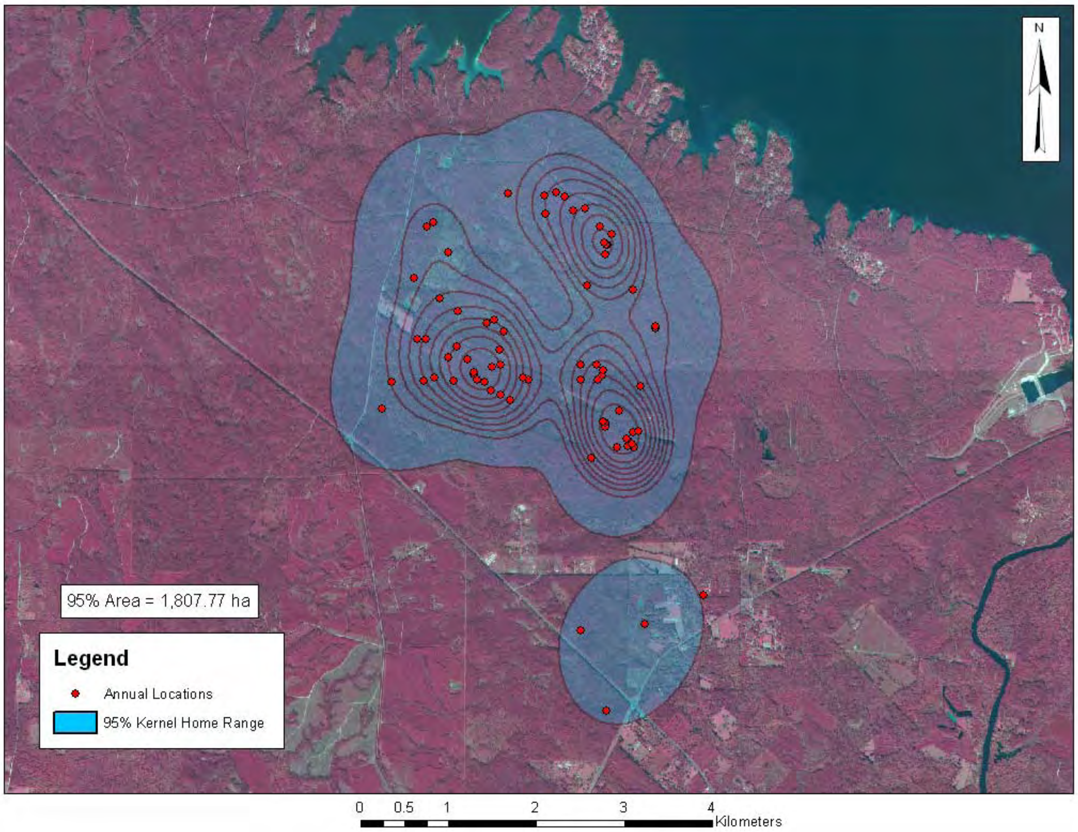

Figure 5. Telemetry locations and 95% adaptive kernel annual home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.067) on the Angelina National Forest, 2006-2008.

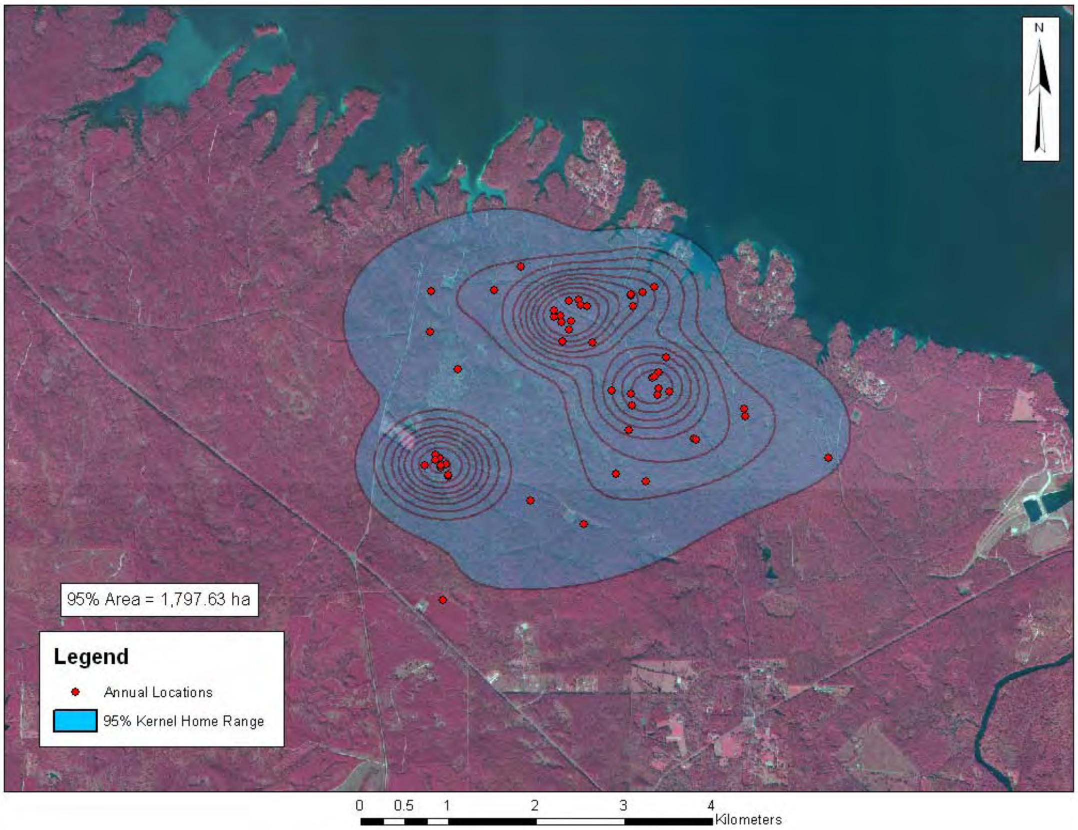

Figure 6. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.086) on the Angelina National Forest, 2006-2008.

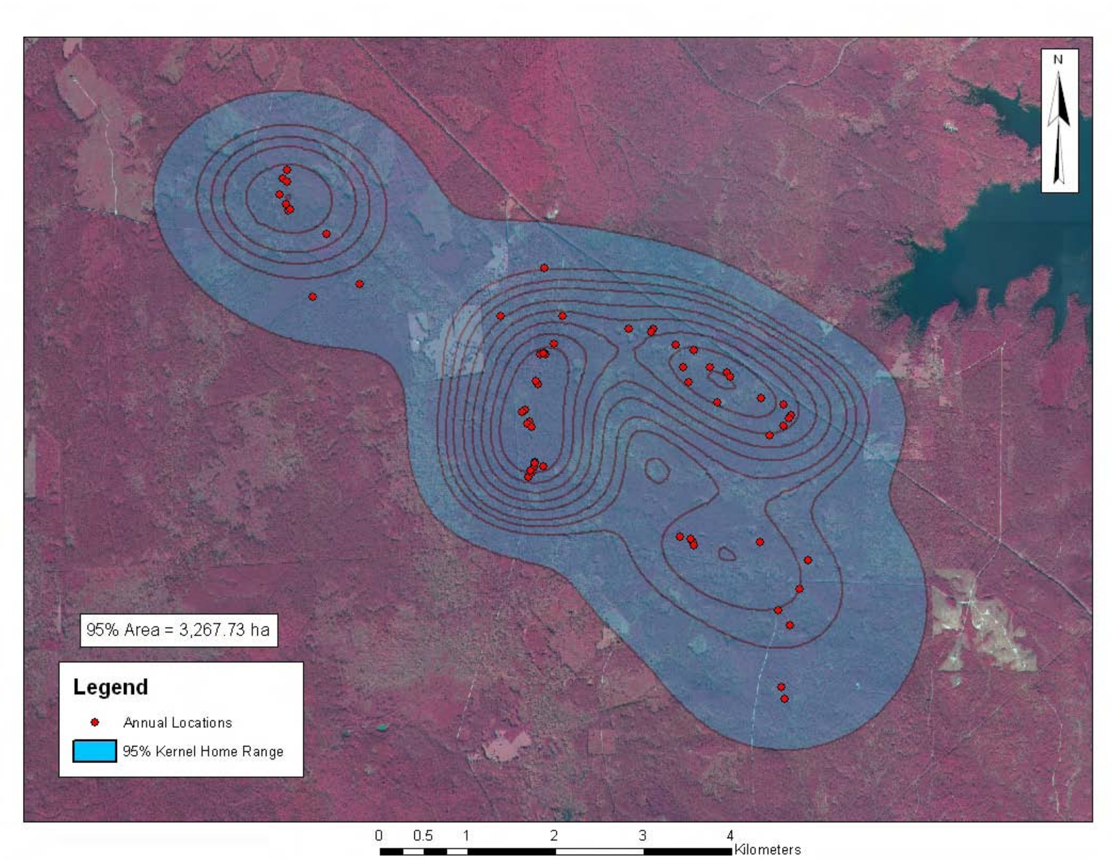

Figure 7. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.096) on the Angelina National Forest, 2006-2008.

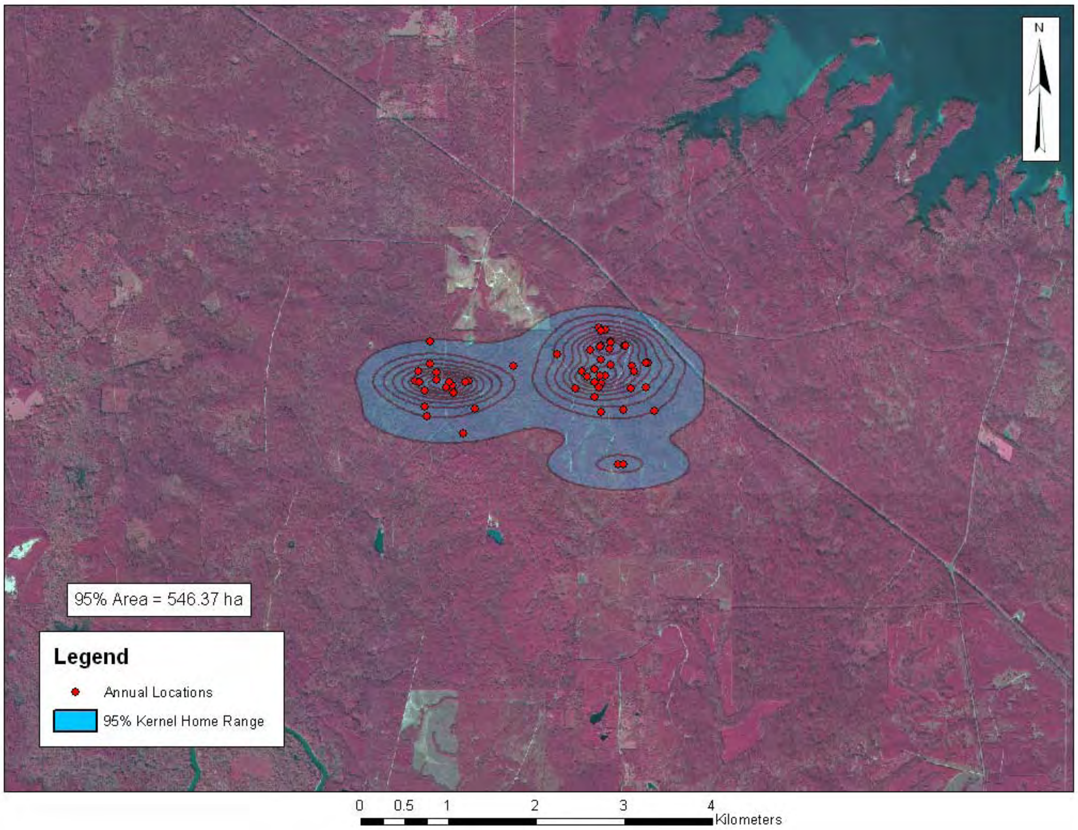

Figure 8. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.116) on the Angelina National Forest, 2006-2008.

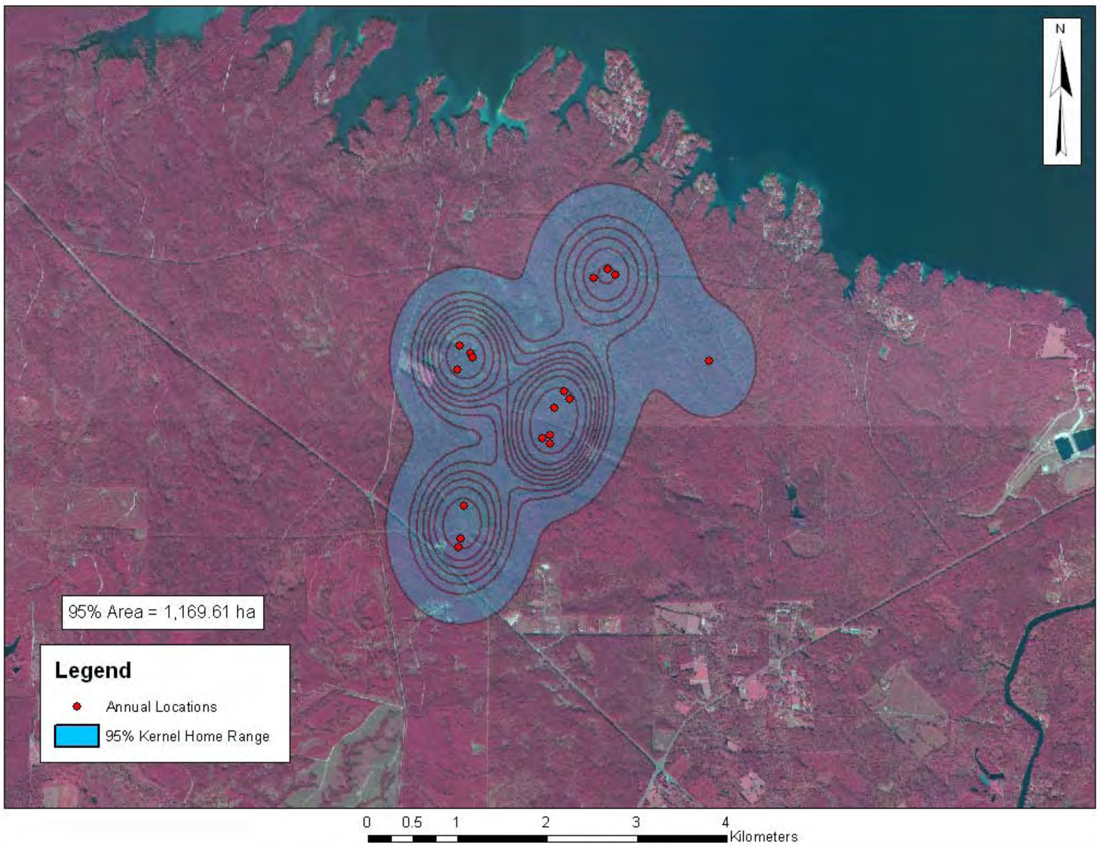

Figure 9. Telemetry locations and 95% adaptive kernel annual home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.126) on the Angelina National Forest, 2006-2008.

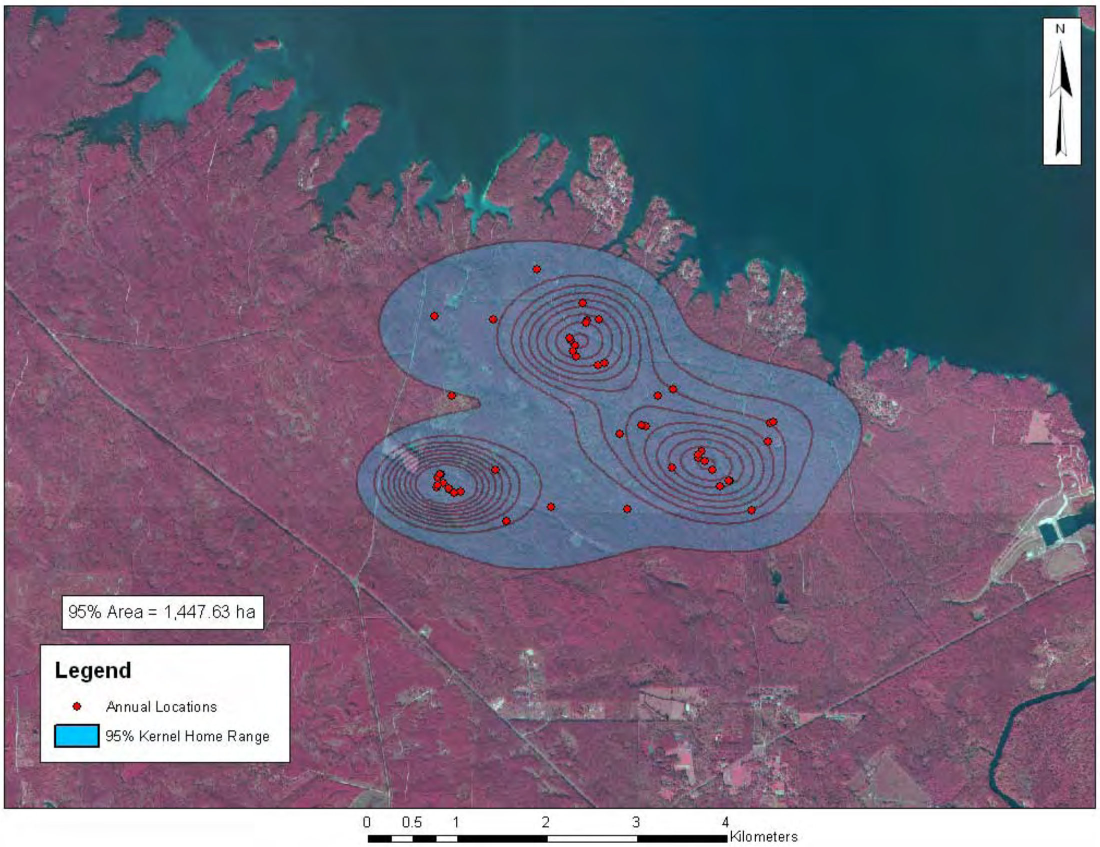

Figure 10. Telemetry locations and 95% adaptive kernel annual home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.193) on the Angelina National Forest, 2006-2008.

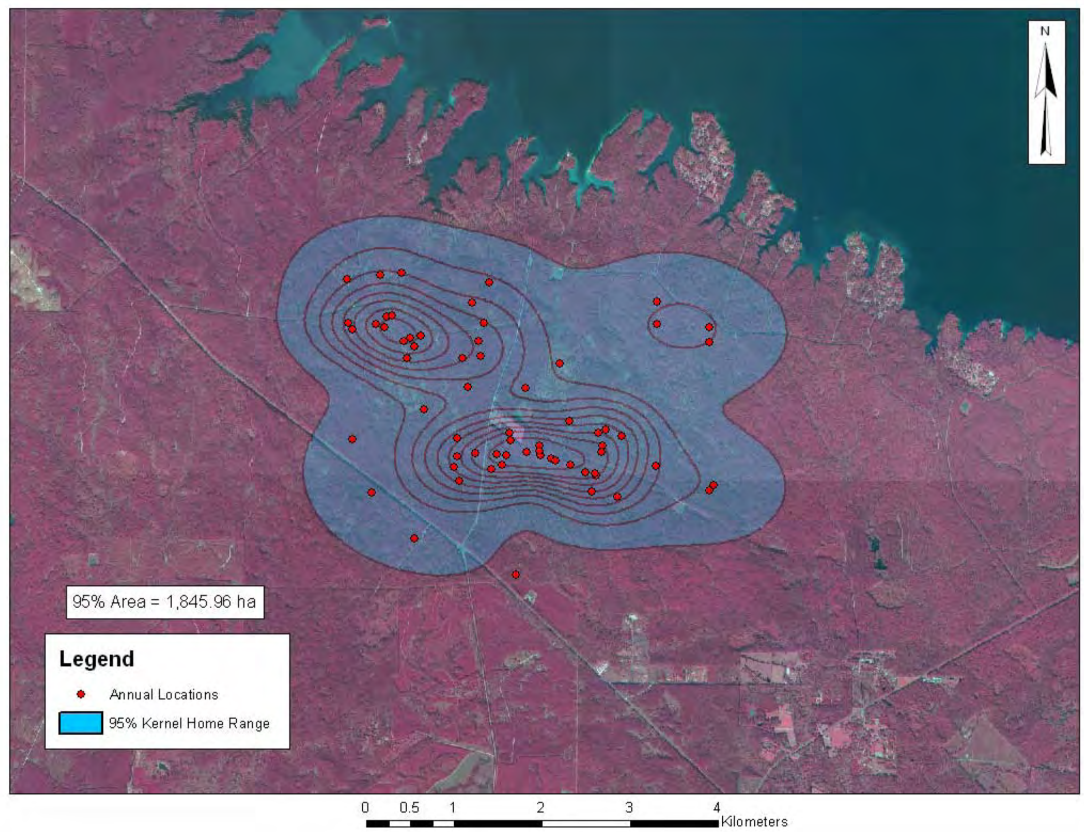

Figure 11. Telemetry locations and 95% adaptive kernel annual home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.253) on the Angelina National Forest, 2006-2008.

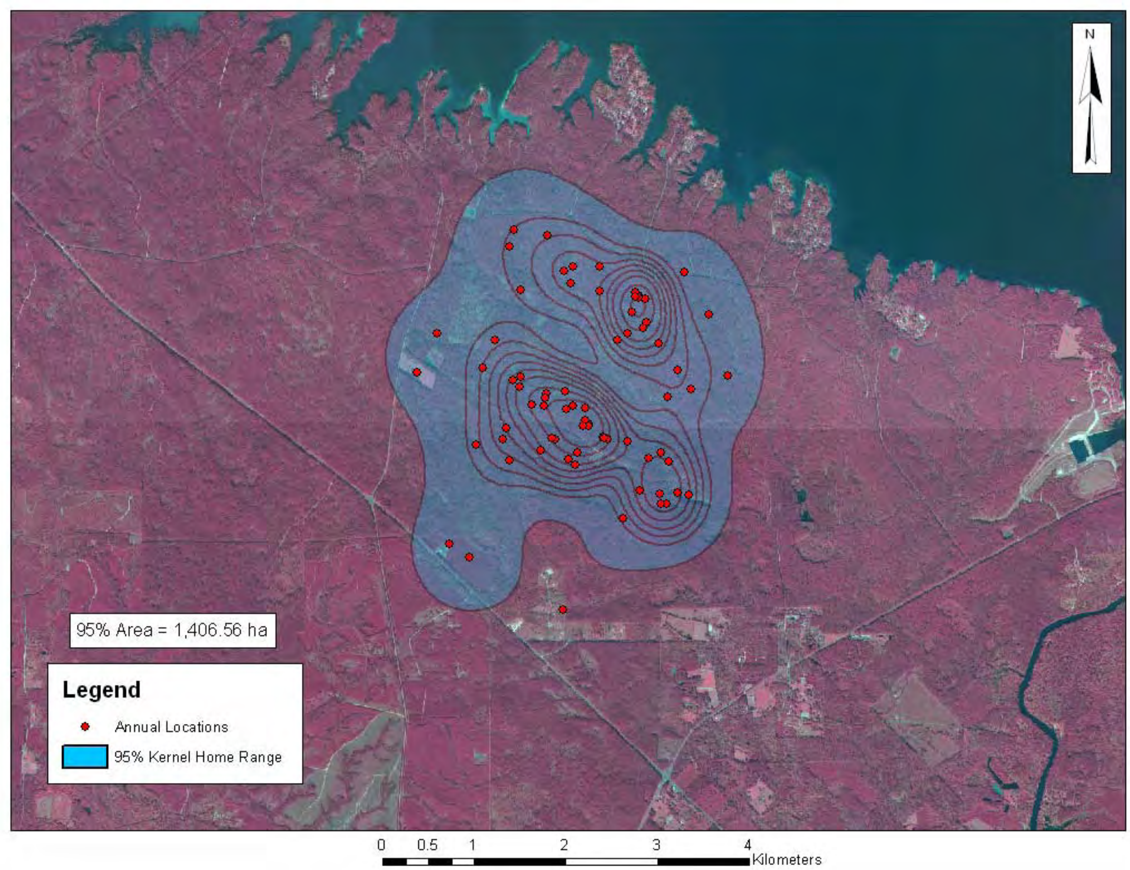

Figure 12. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.333) on the Angelina National Forest, 2006-2008.

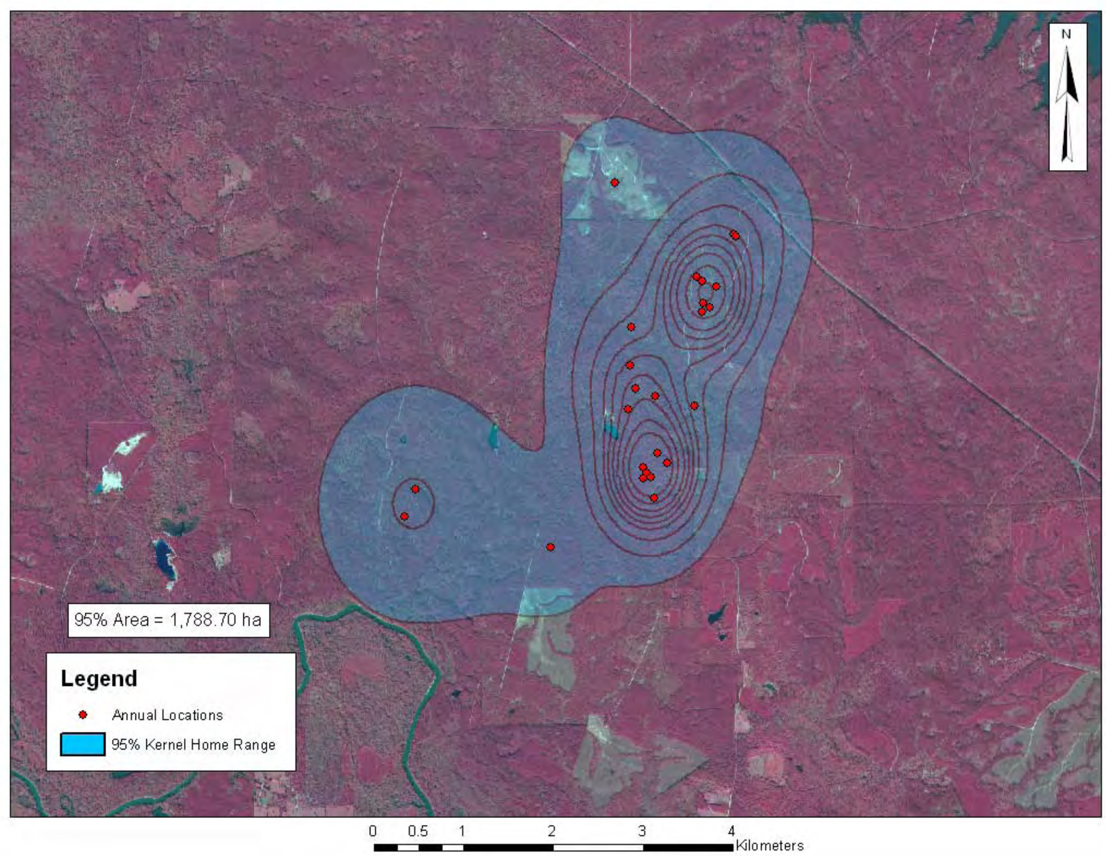

Figure 13. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.396) on the Angelina National Forest, 2006-2008.

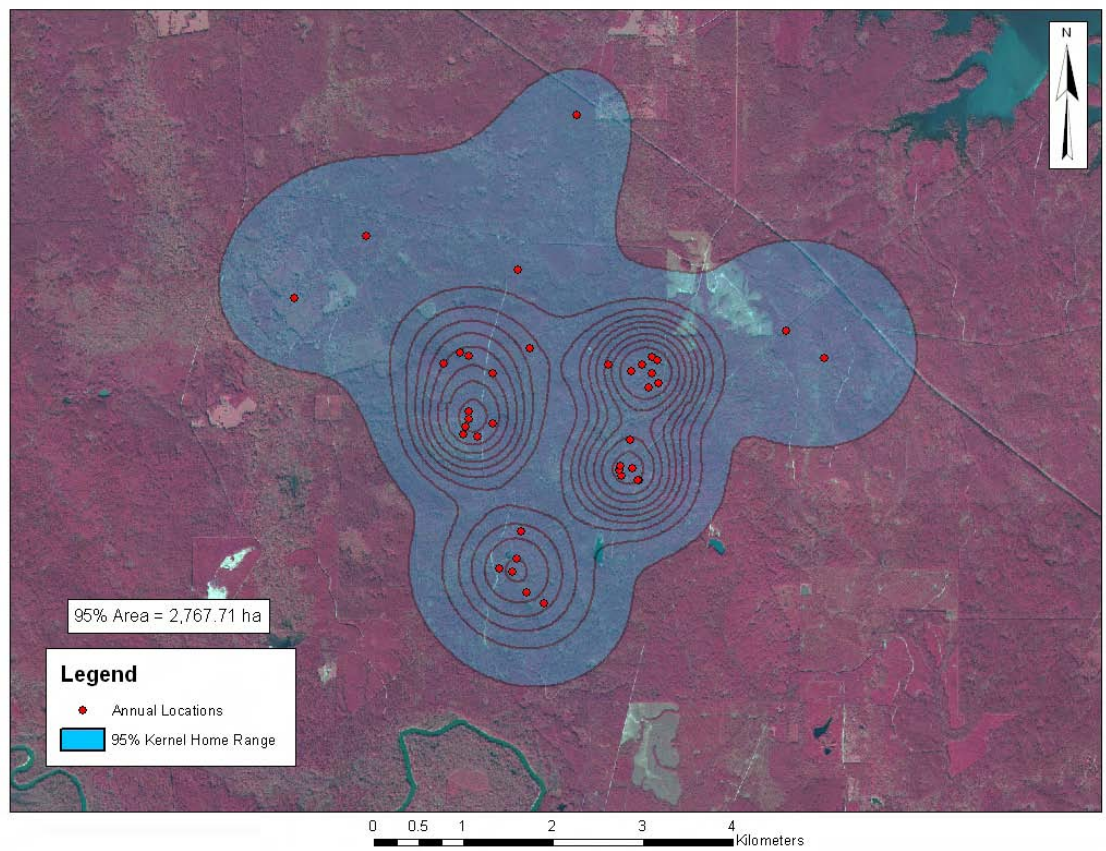

Figure 14. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.405) on the Angelina National Forest, 2006-2008.

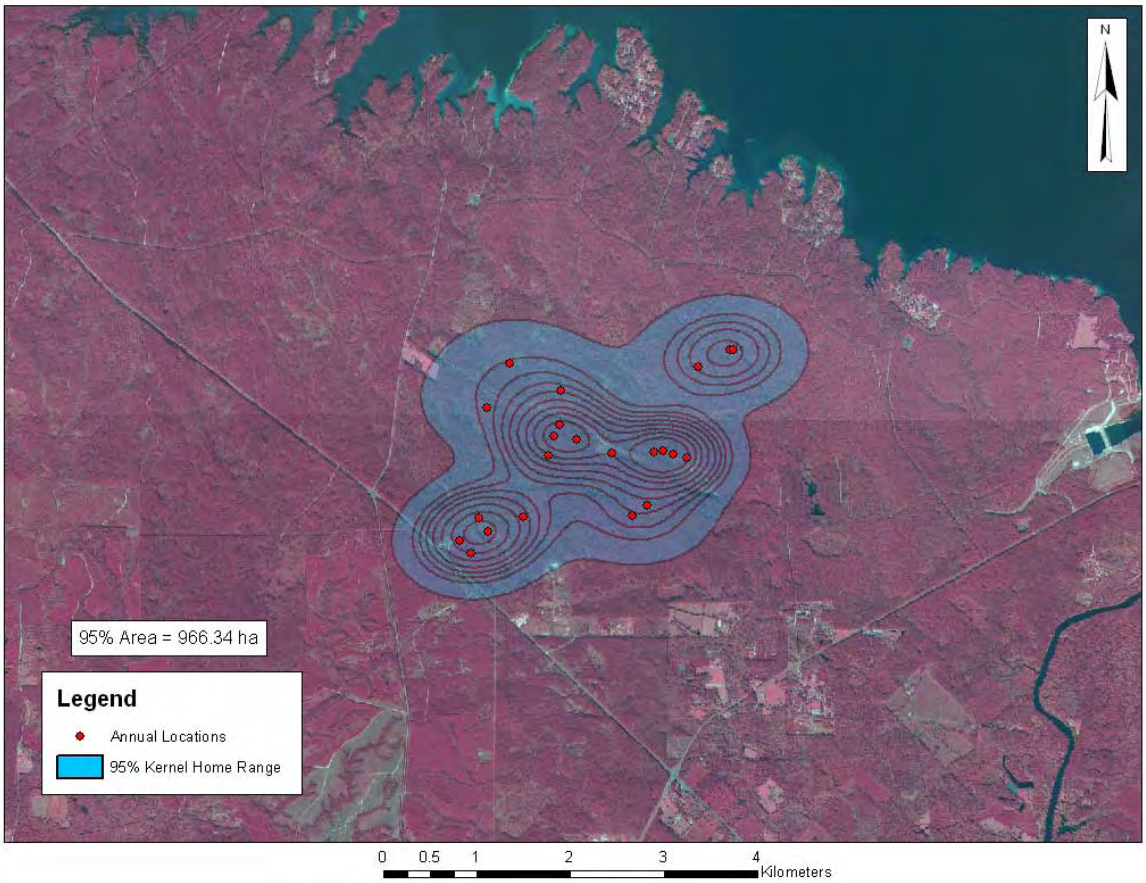

Figure 15. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.473) on the Angelina National Forest, 2006-2008.

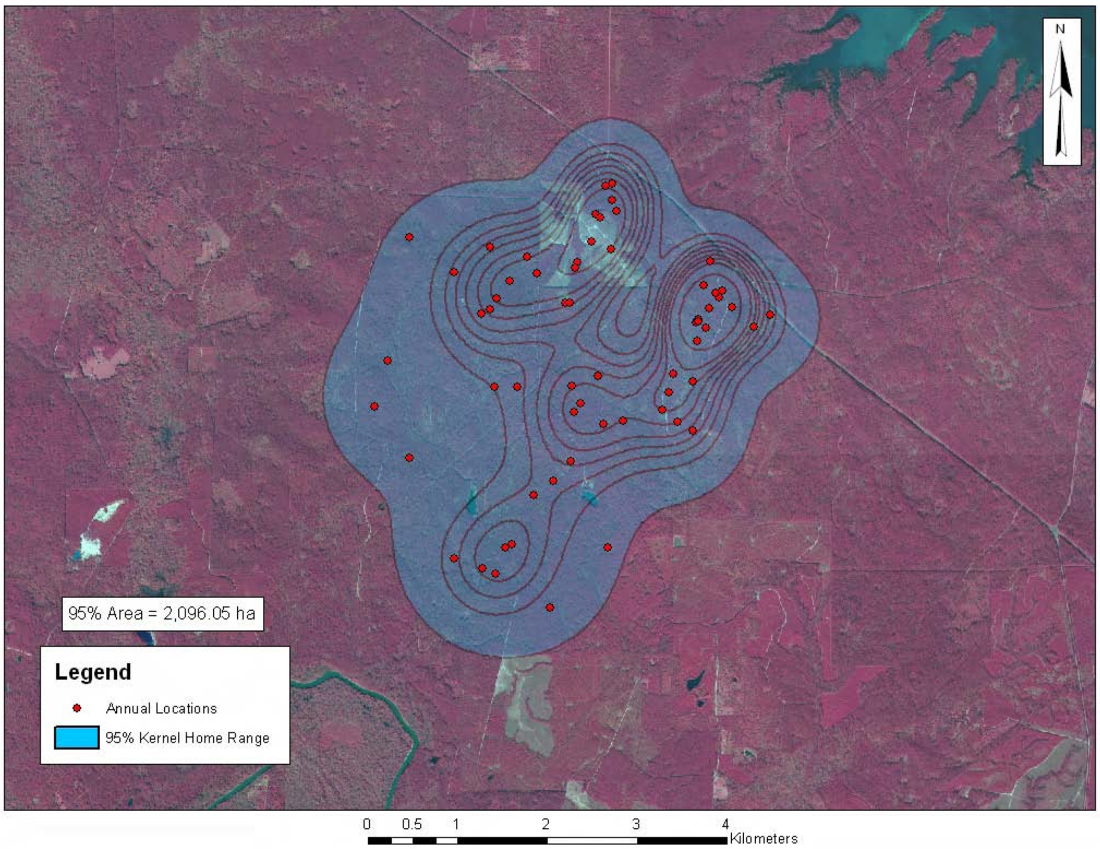

Figure 16. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.533) on the Angelina National Forest, 2006-2008.

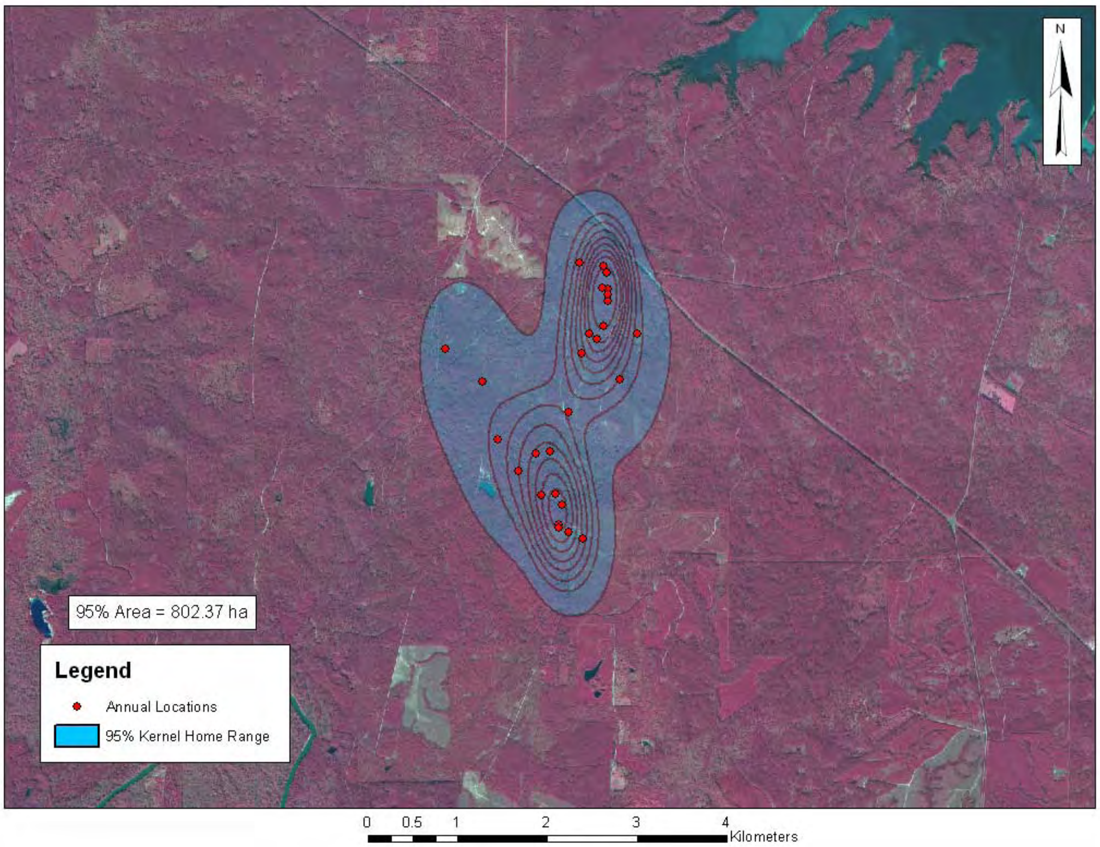

Figure 17. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.574) on the Angelina National Forest, 2006-2008.

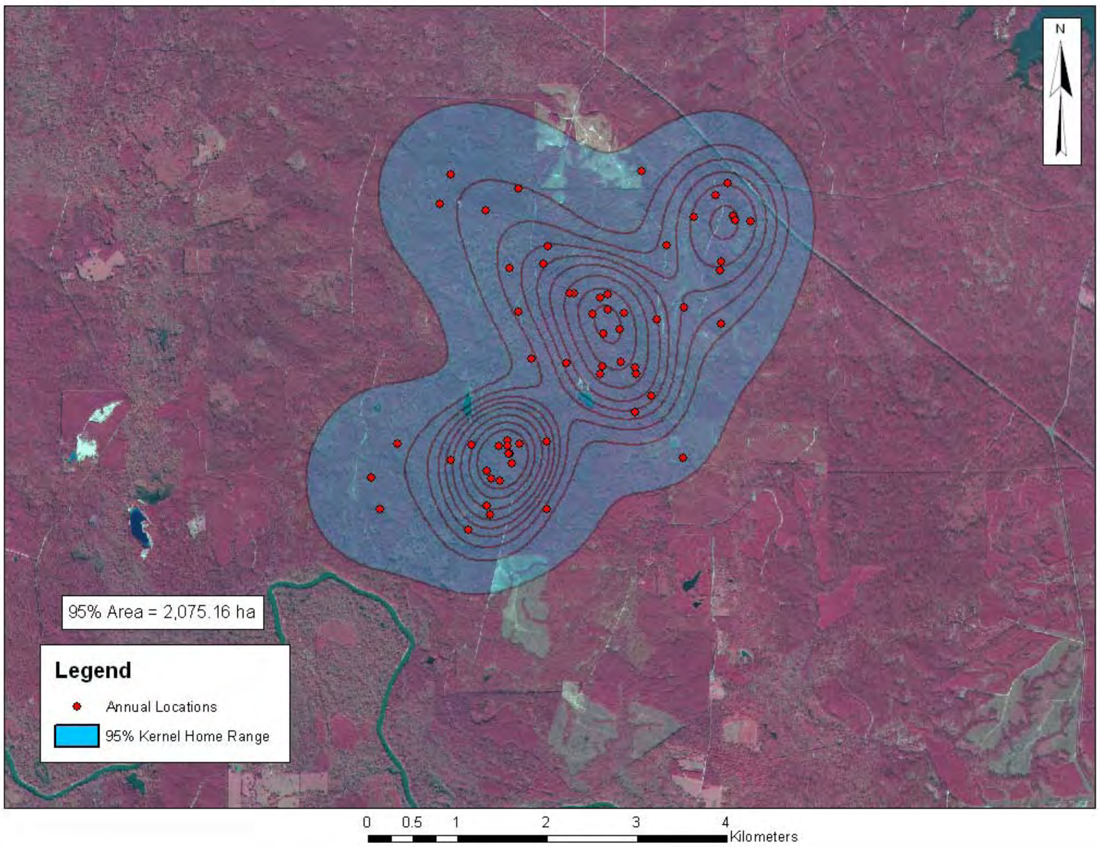

Figure 18. Telemetry locations and 95% adaptive kernel annual home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.614) on the Angelina National Forest, 2006-2008.

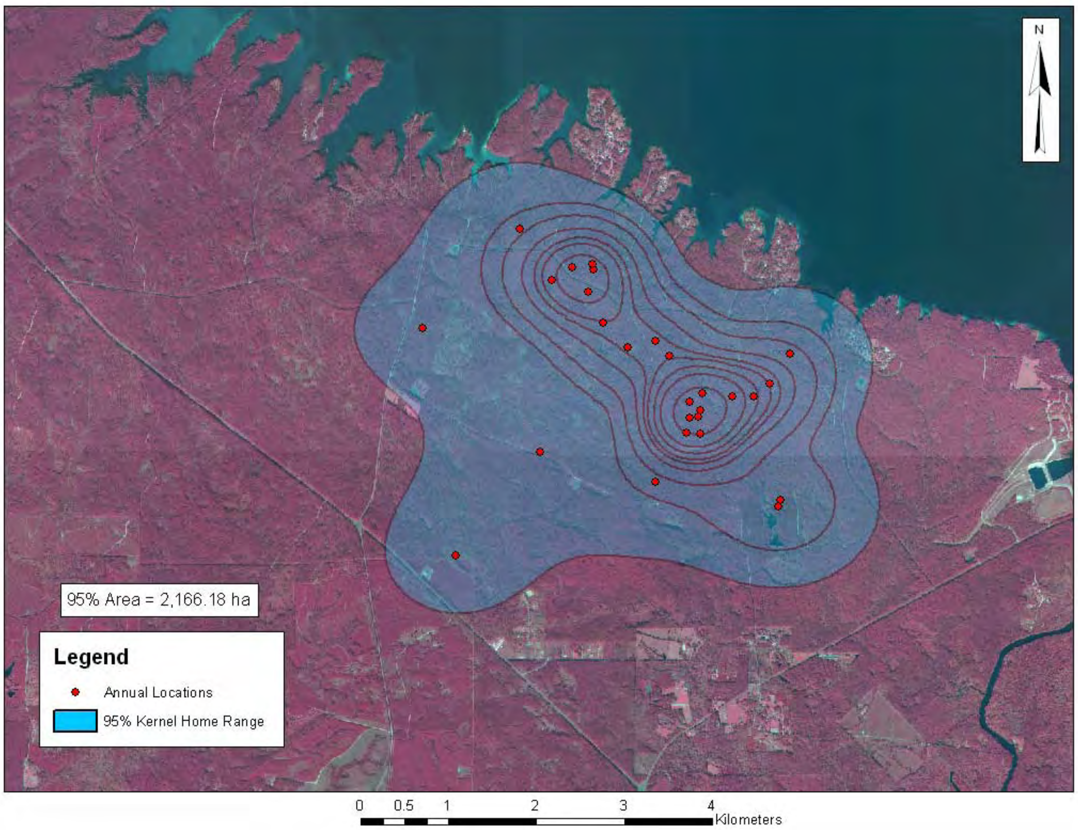

Figure 19. Telemetry locations and 95% adaptive kernel annual home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.626) on the Angelina National Forest, 2006-2008.

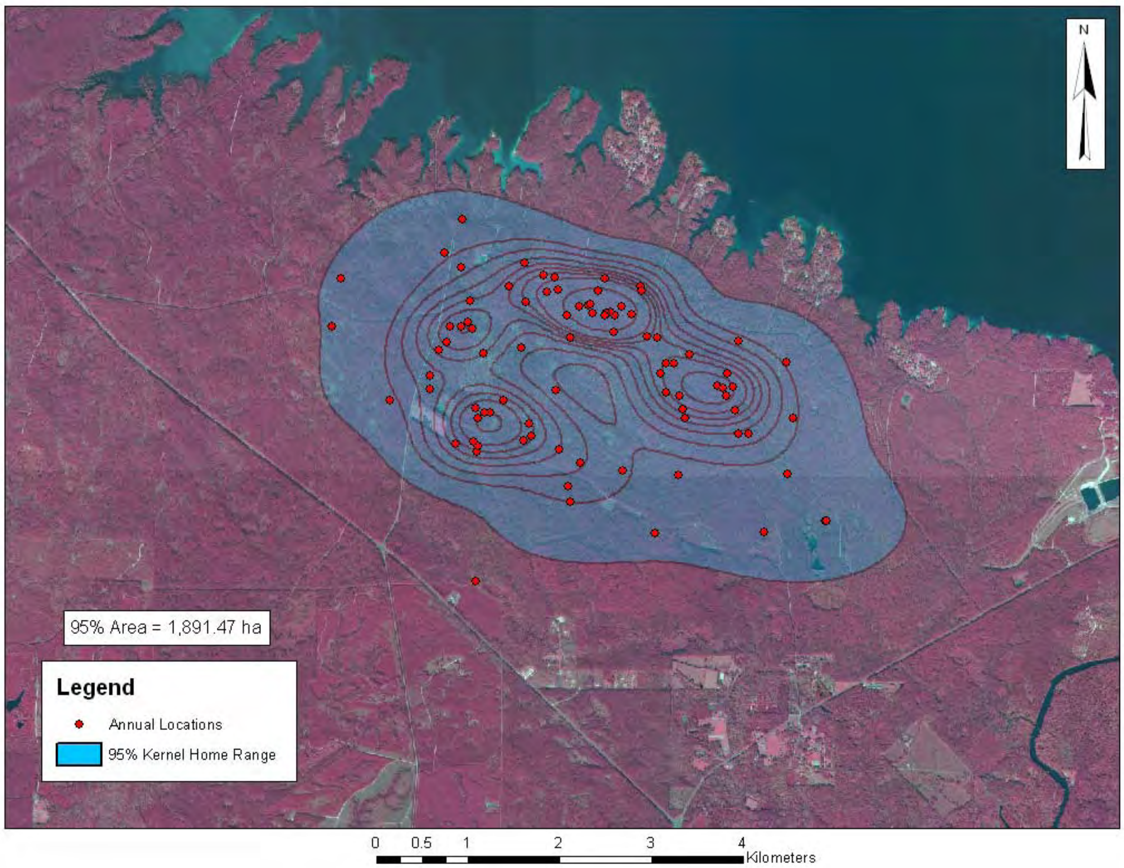

Figure 20. Telemetry locations and 95% adaptive kernel annual home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.654) on the Angelina National Forest, 2006-2008.

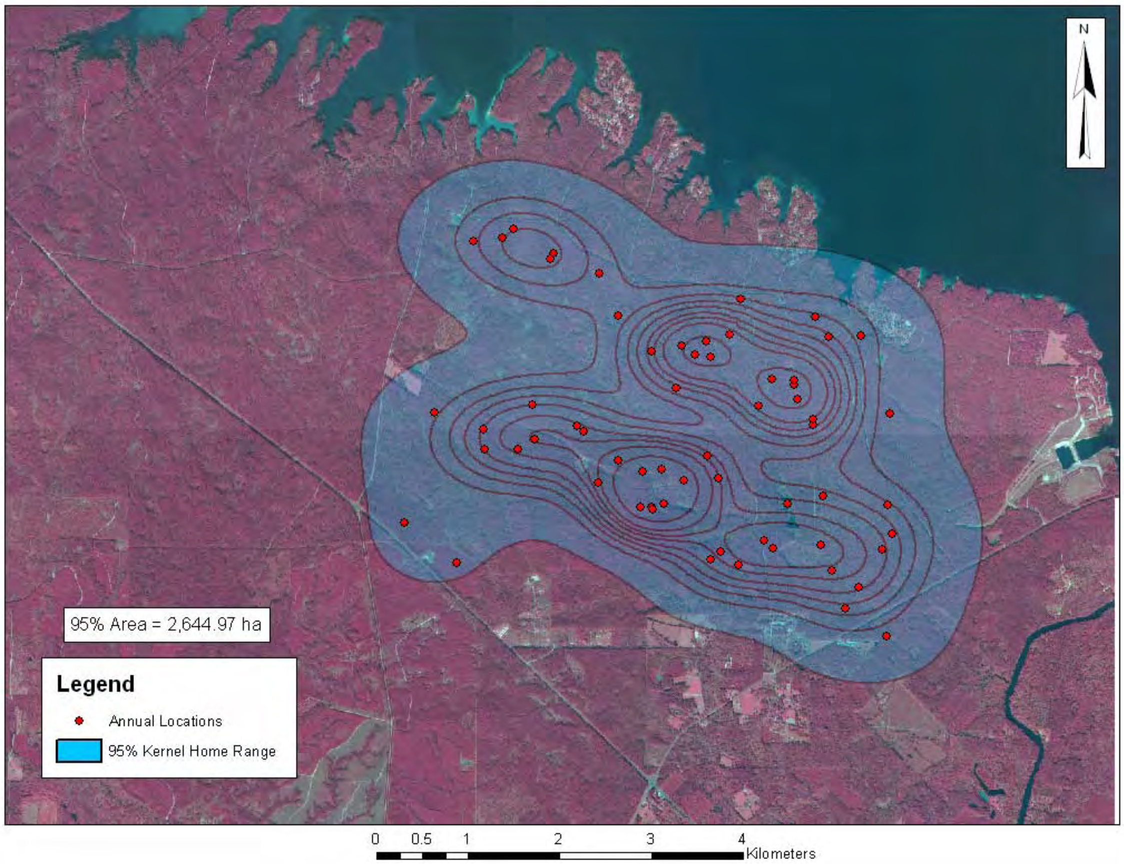

Figure 21. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.694) on the Angelina National Forest, 2006-2008.

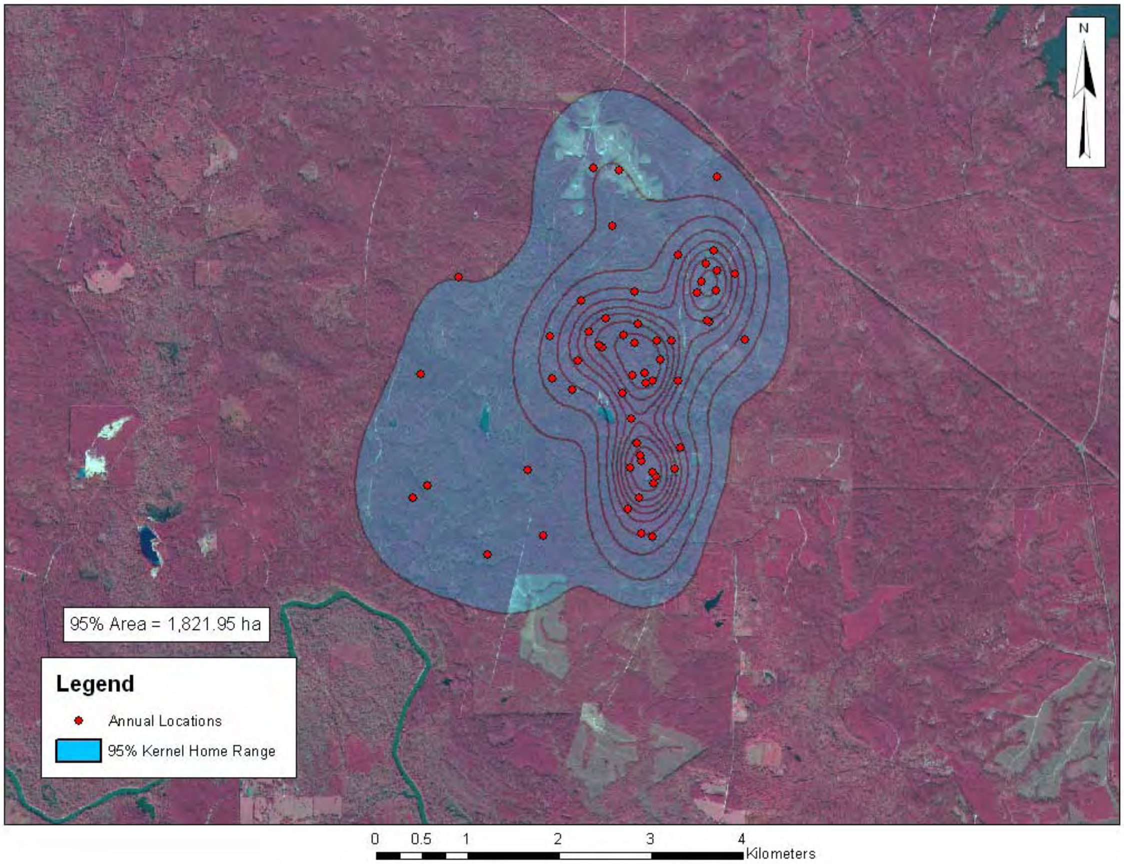

Figure 22. Telemetry locations and 95% adaptive kernel annual home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.773) on the Angelina National Forest, 2006-2008.

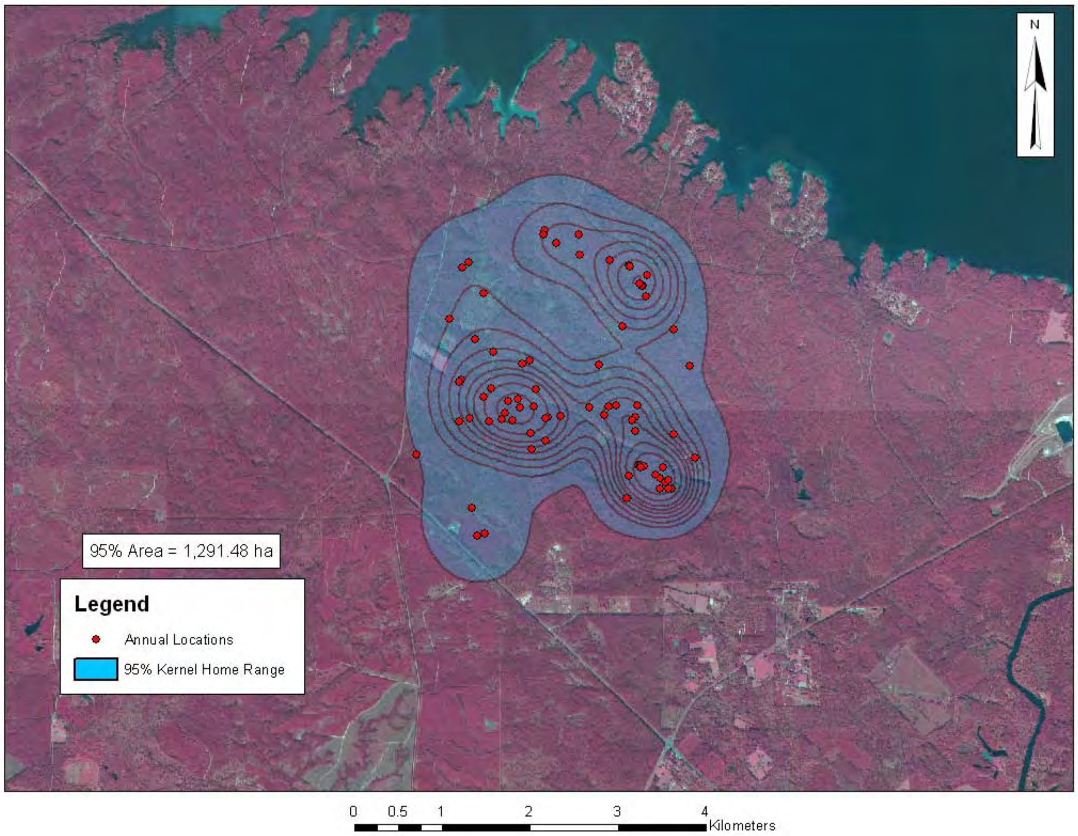

Figure 23. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.325) on the Angelina National Forest, 2006-2008.

Figure 24. Telemetry locations and 95% adaptive kernel annual home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 151.336) on the Angelina National Forest, 2006-2008.

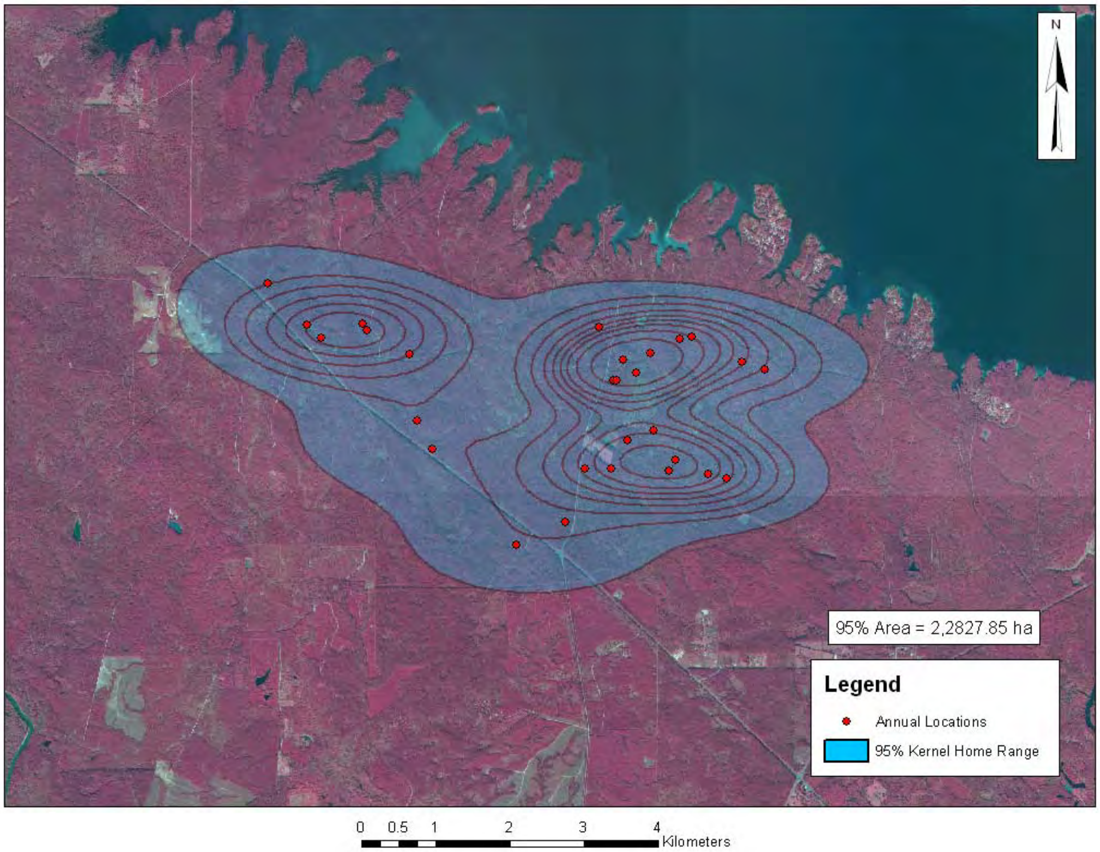

Figure 25. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.344) on the Angelina National Forest, 2006-2008.

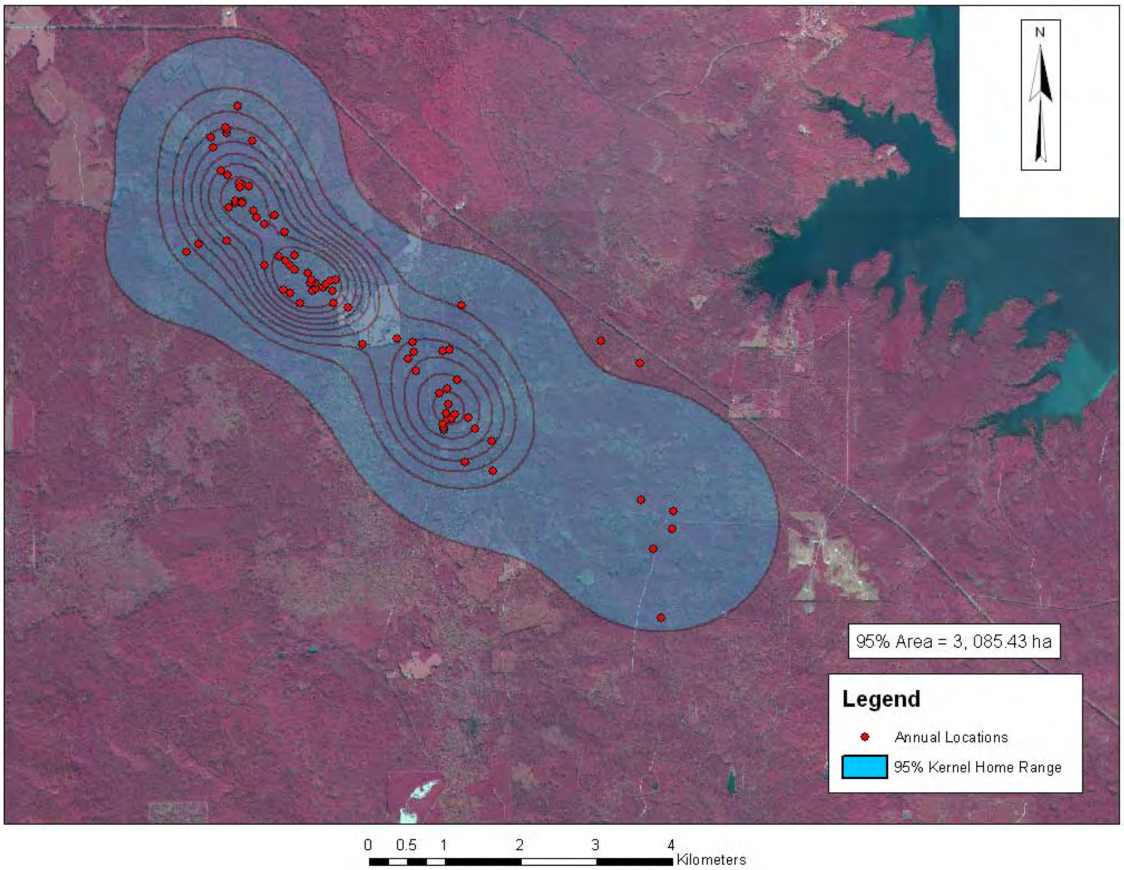

Figure 26. Telemetry locations and 95% adaptive kernel annual home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.377) on the Angelina National Forest, 2006-2008.

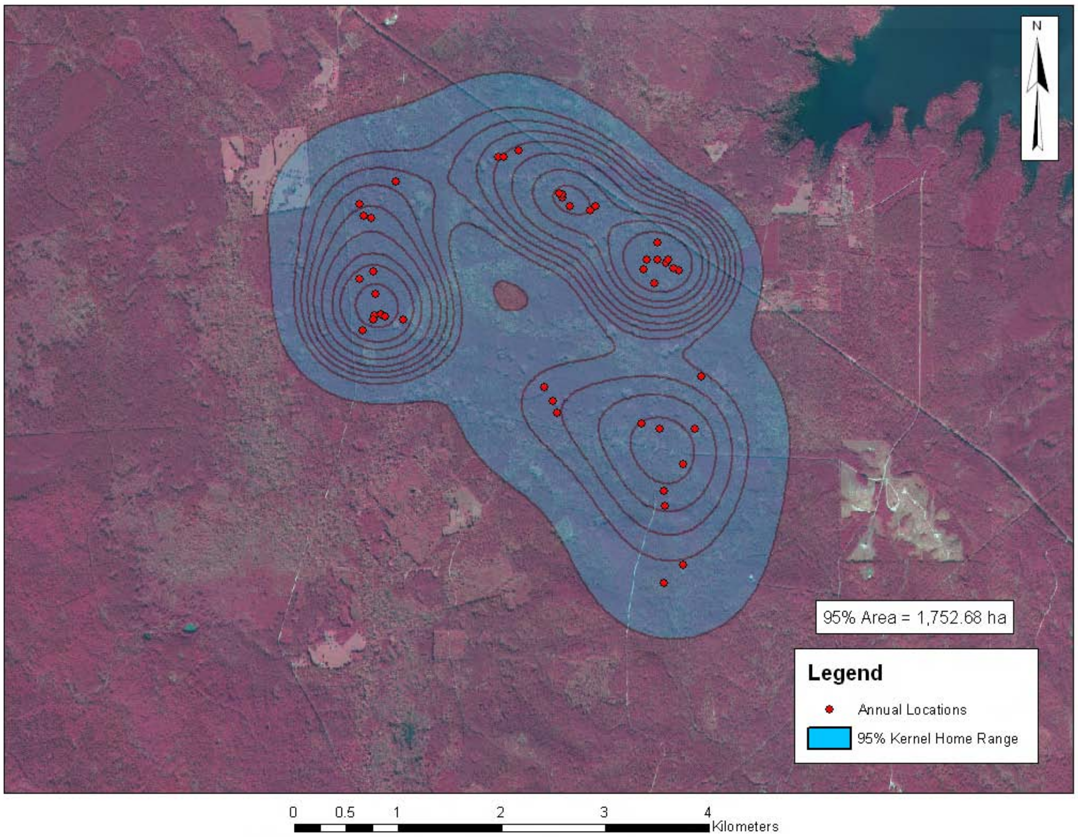

Figure 27. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.012) on the Angelina National Forest, 2006-2008.

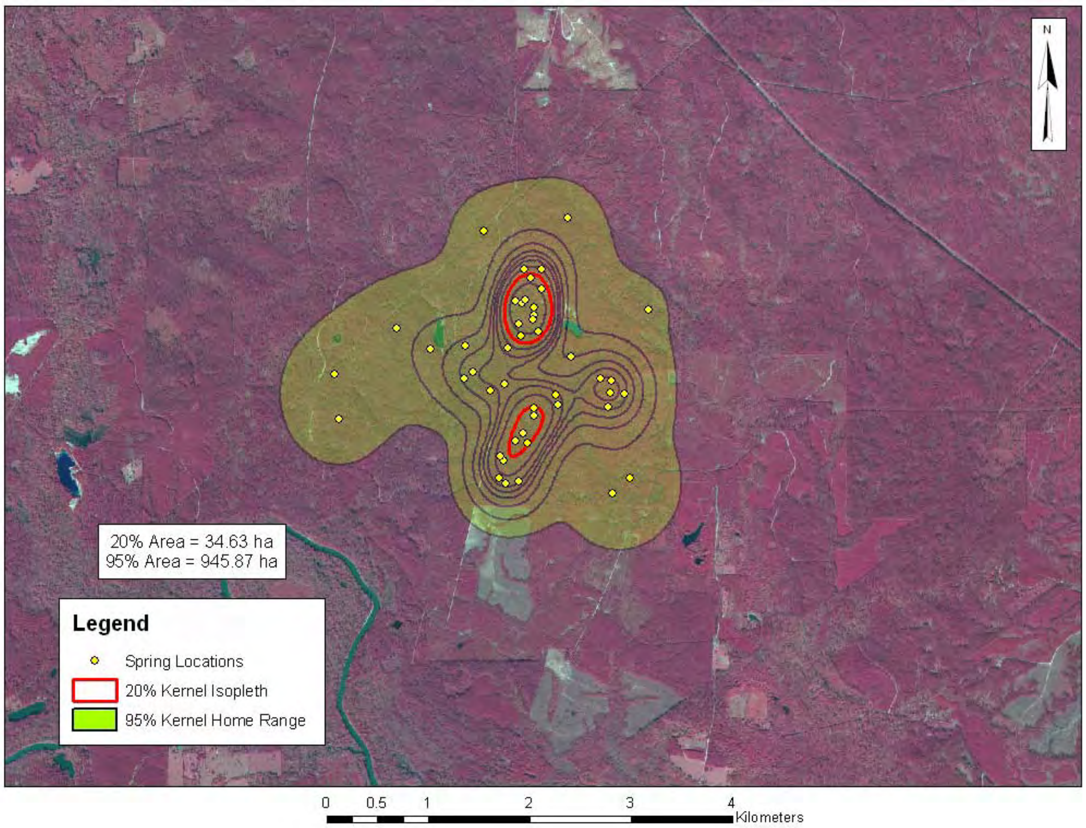

Figure 28. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.054) on the Angelina National Forest, 2006-2008.

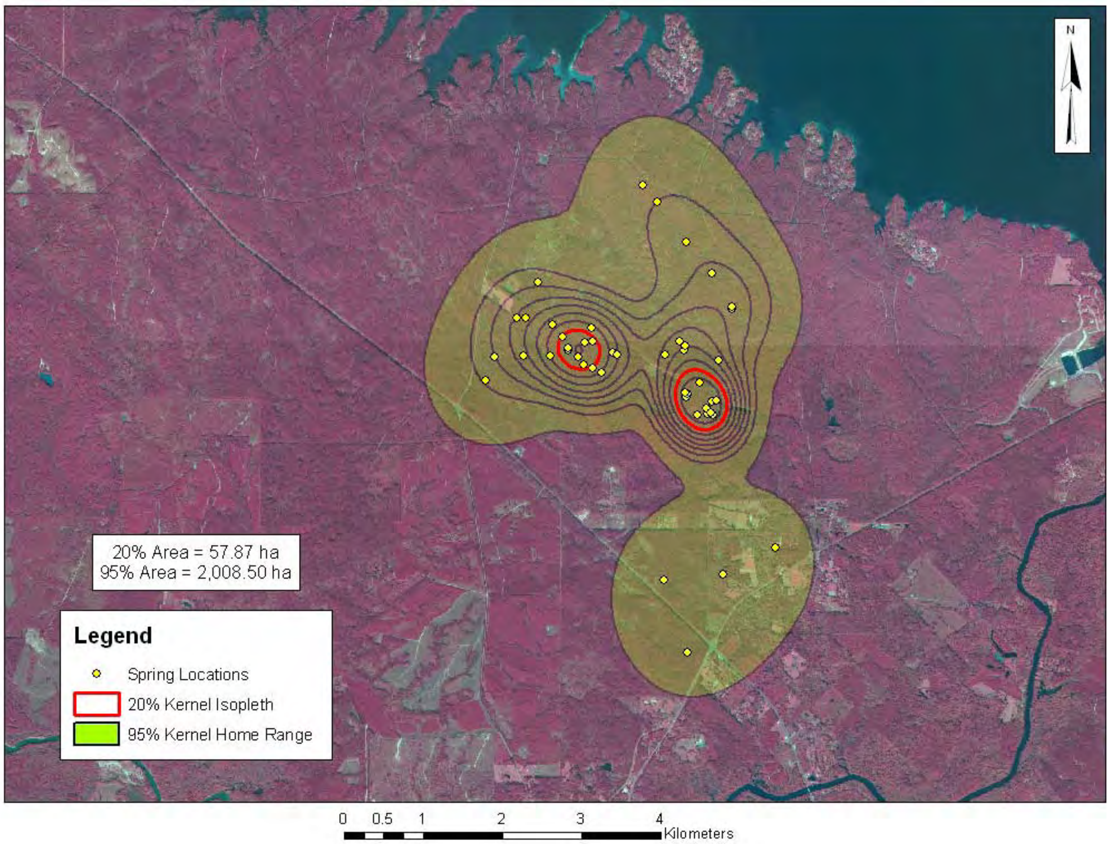

Figure 29. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.067) on the Angelina National Forest, 2006-2008.

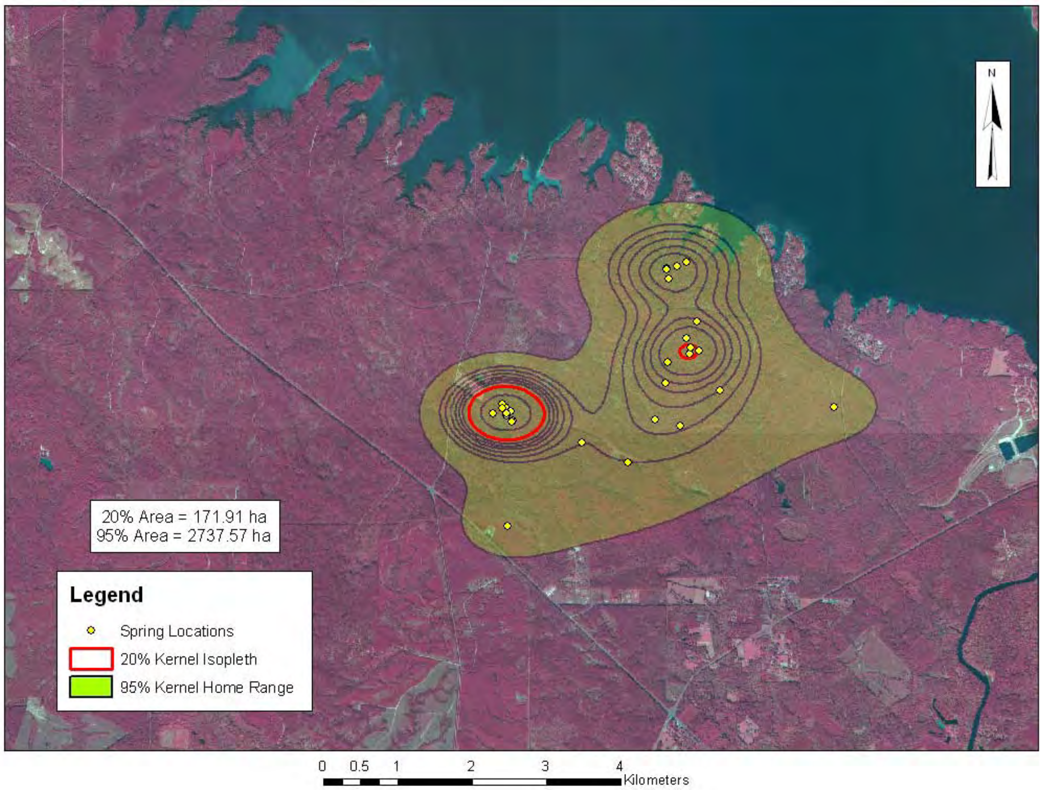

Figure 30. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.086) on the Angelina National Forest, 2006-2008.

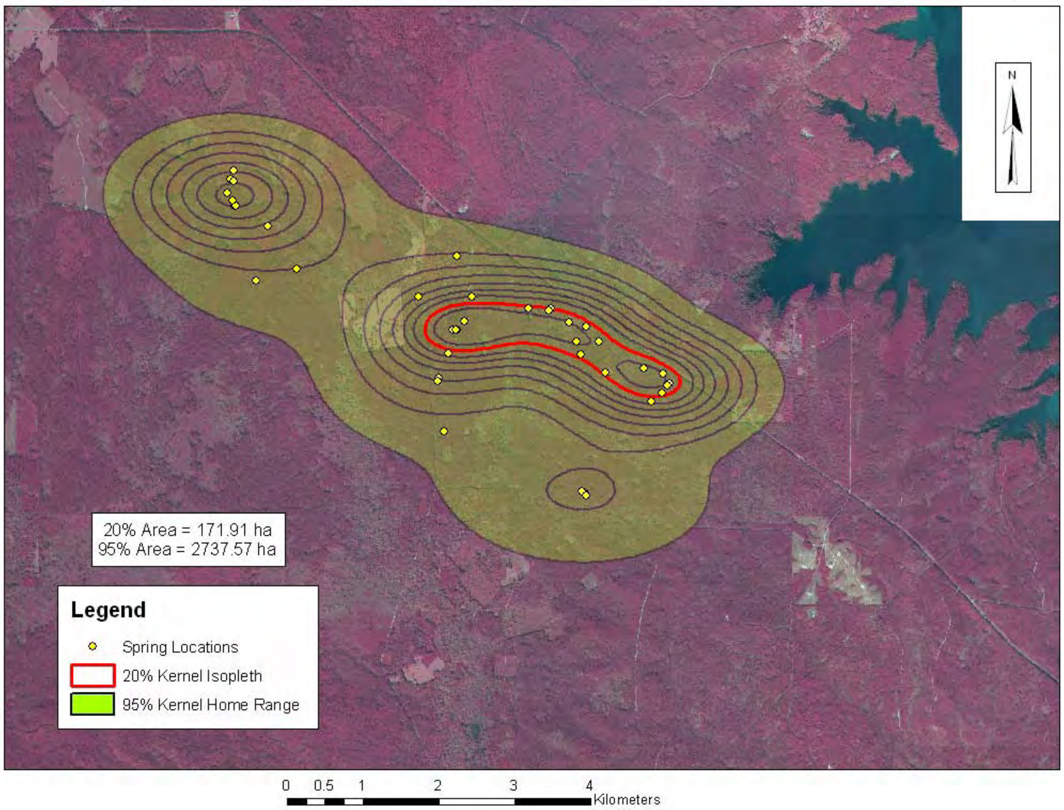

Figure 31. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.096) on the Angelina National Forest, 2006-2008.

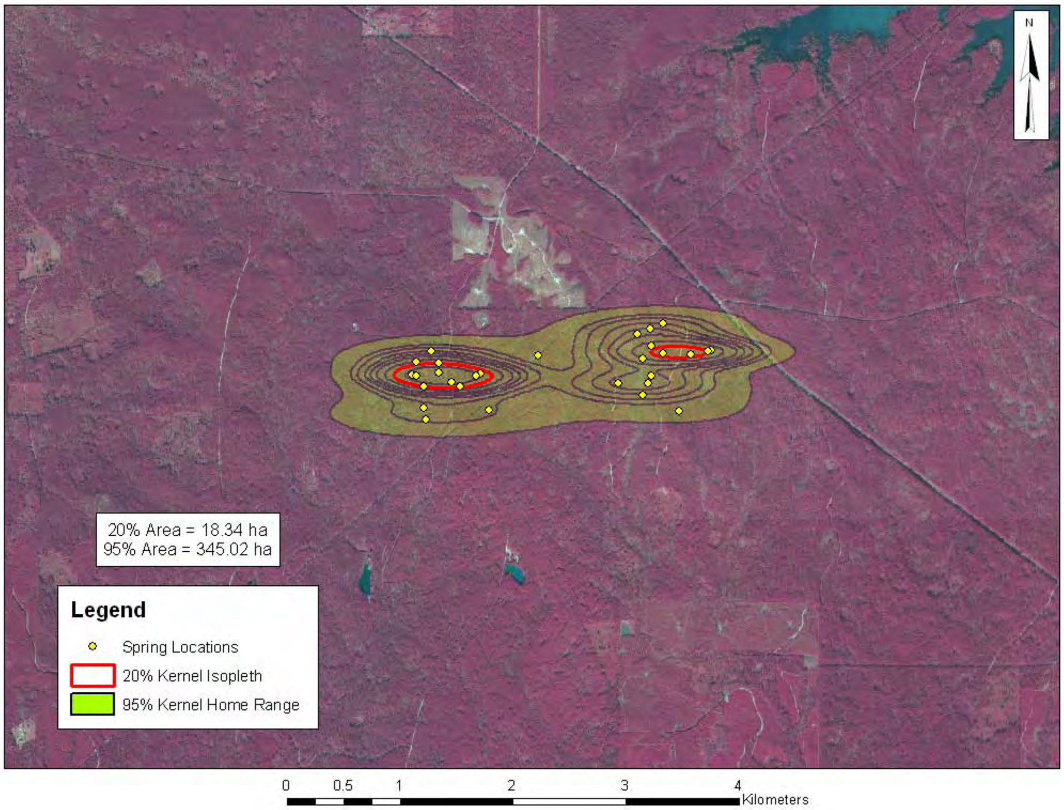

Figure 32. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.116) on the Angelina National Forest, 2006-2008.

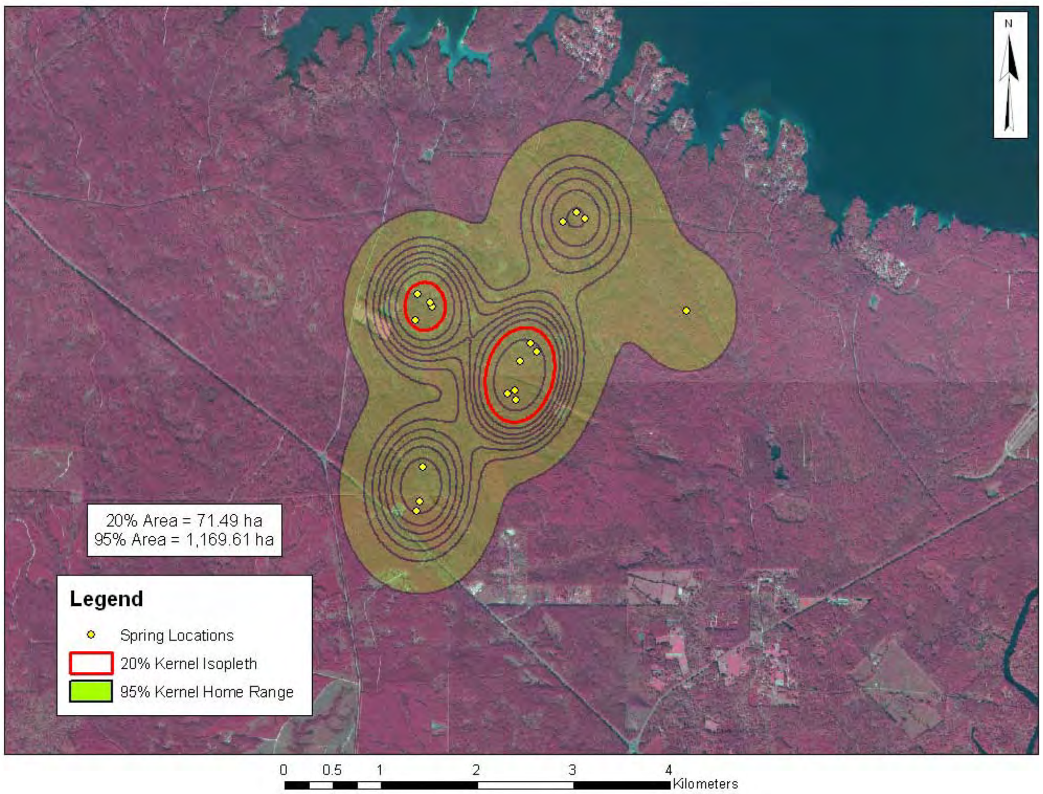

Figure 33. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.126) on the Angelina National Forest, 2006-2008.

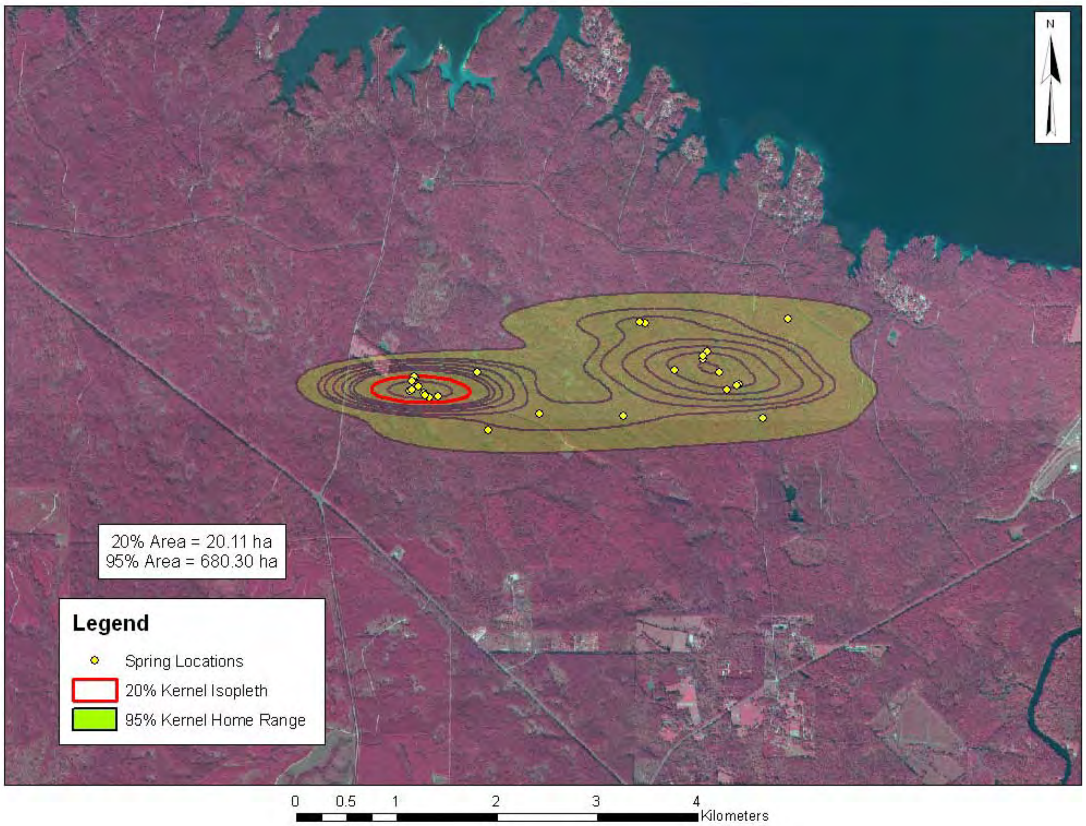

Figure 34. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.193) on the Angelina National Forest, 2006-2008.

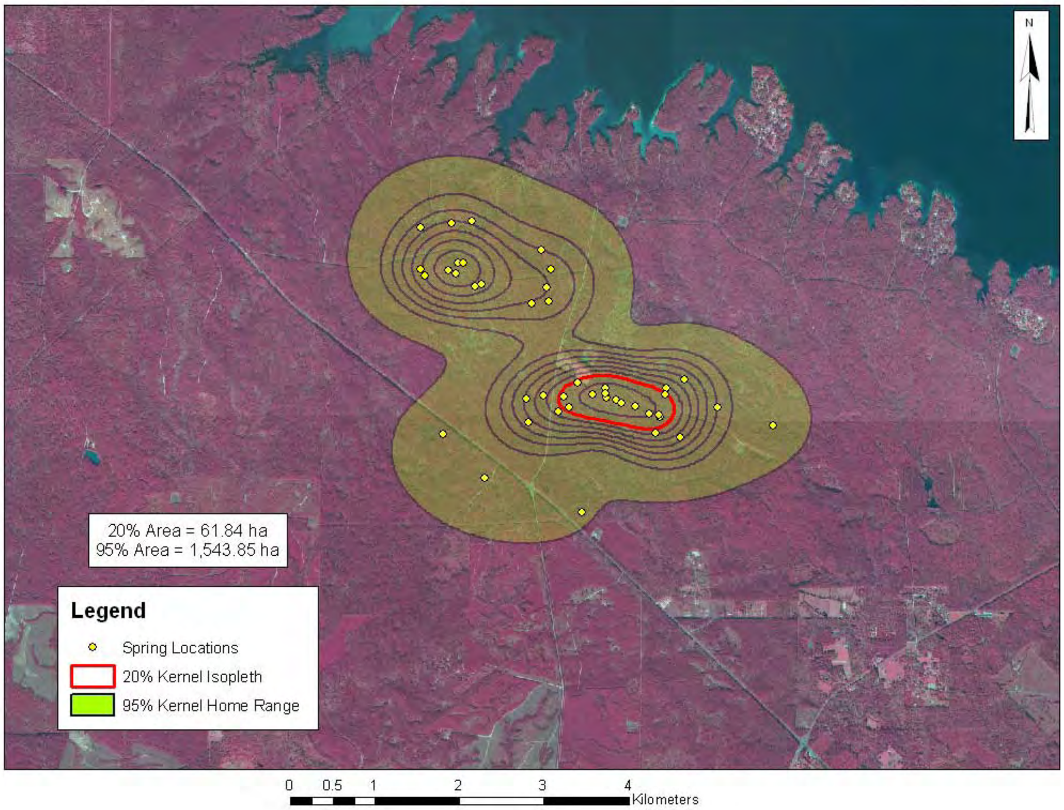

Figure 35. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.253) on the Angelina National Forest, 2006-2008.

Figure 36. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.333) on the Angelina National Forest, 2006-2008.

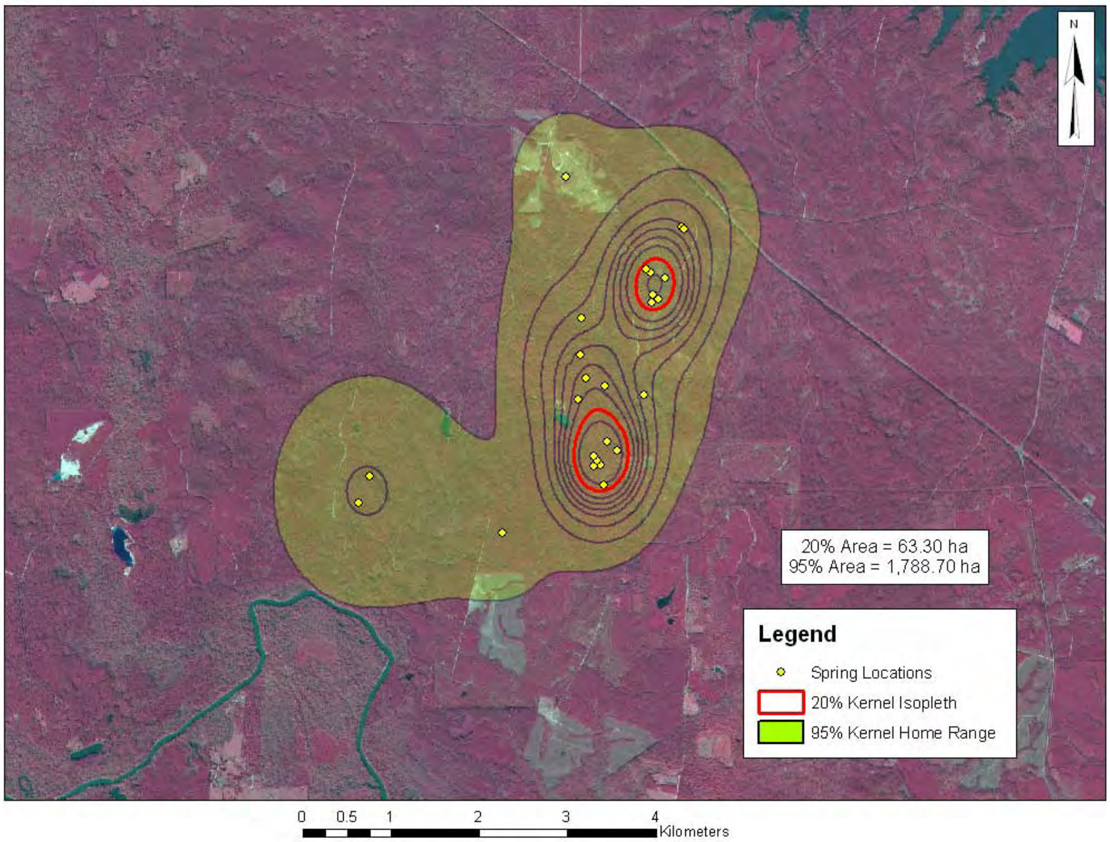

Figure 37. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.396) on the Angelina National Forest, 2006-2008.

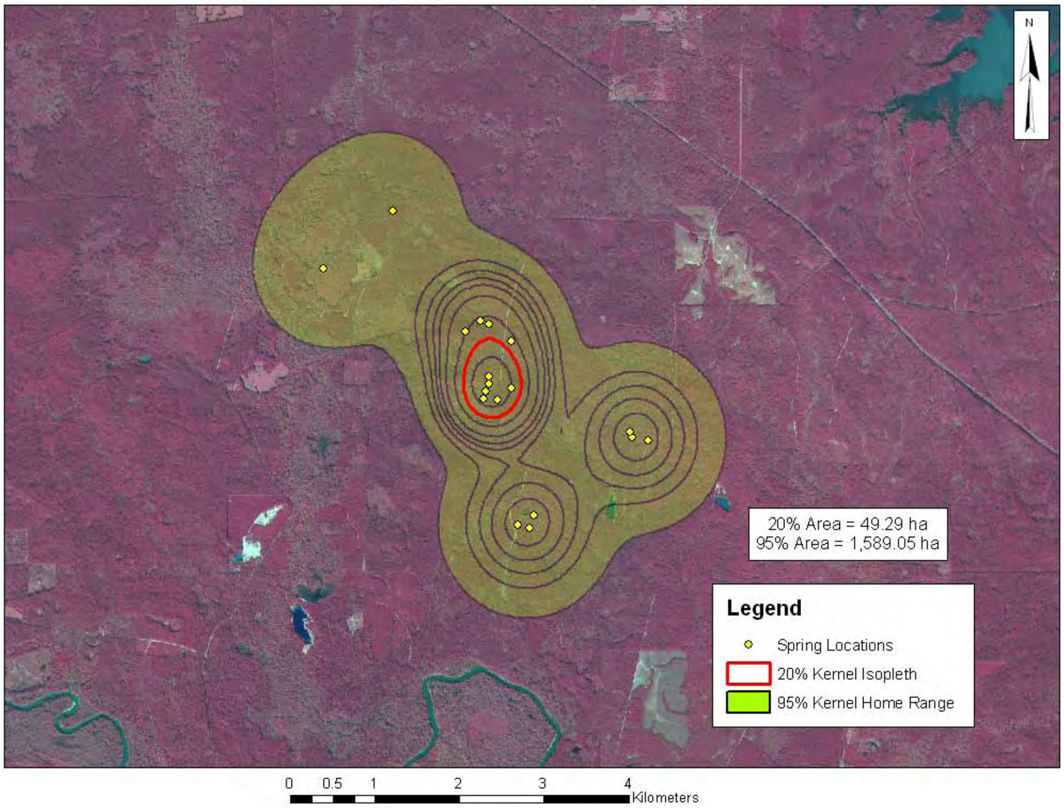

Figure 38. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.405) on the Angelina National Forest, 2006-2008.

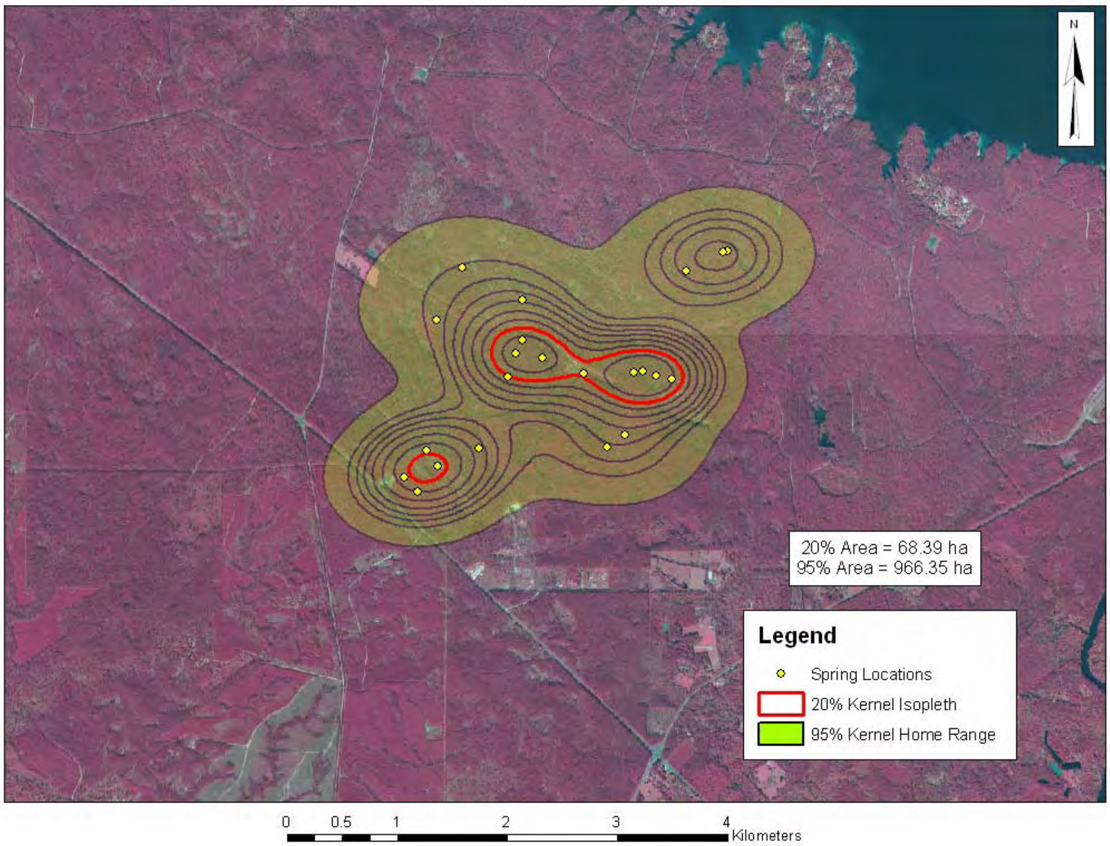

Figure 39. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.473) on the Angelina National Forest, 2006-2008.

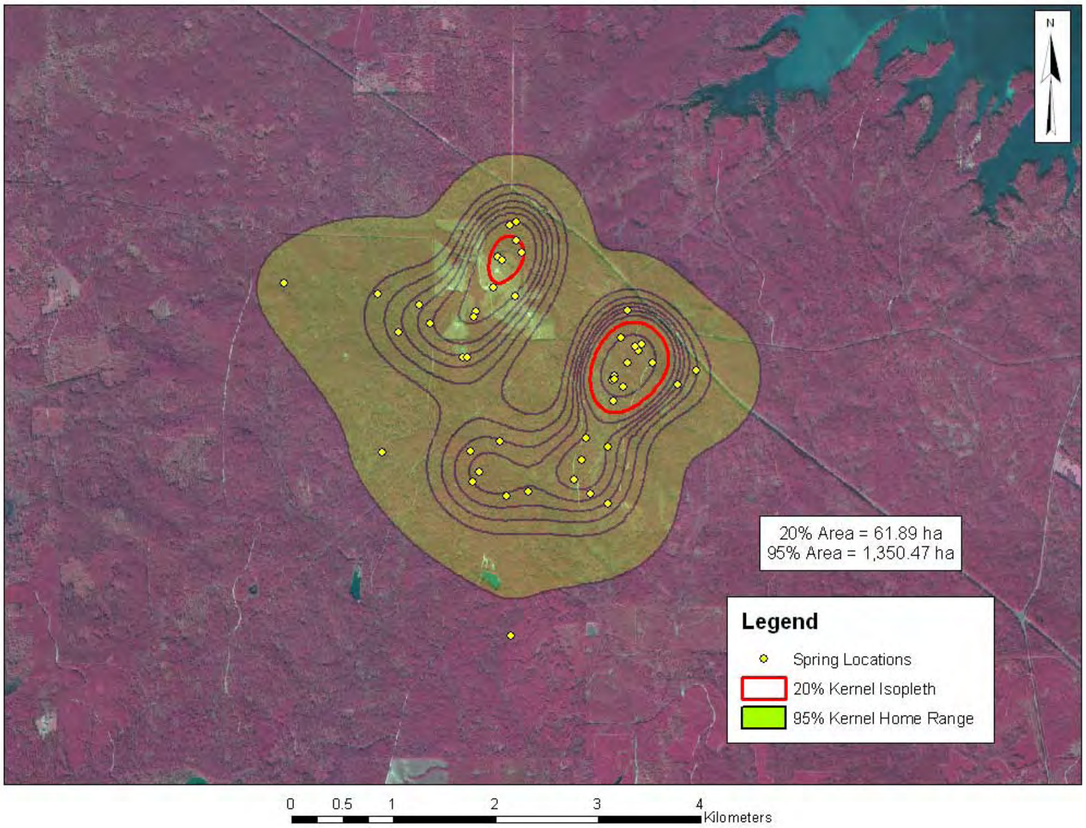

Figure 40. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.533) on the Angelina National Forest, 2006-2008.

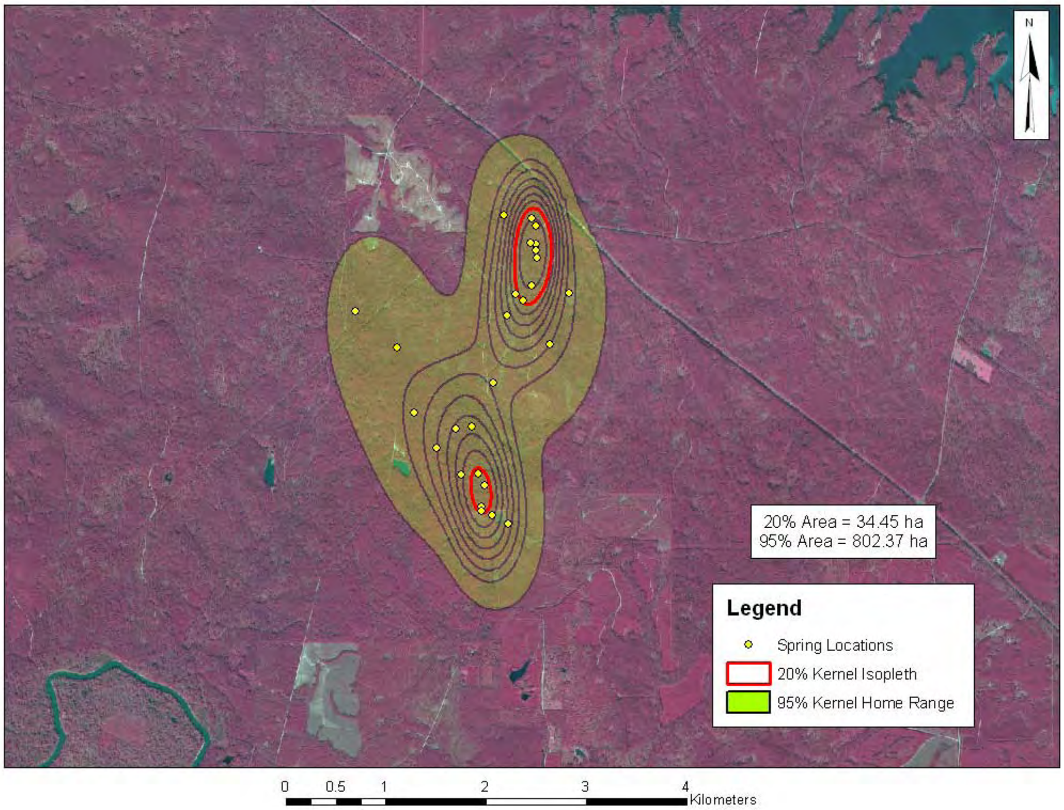

Figure 41. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.574) on the Angelina National Forest, 2006-2008.

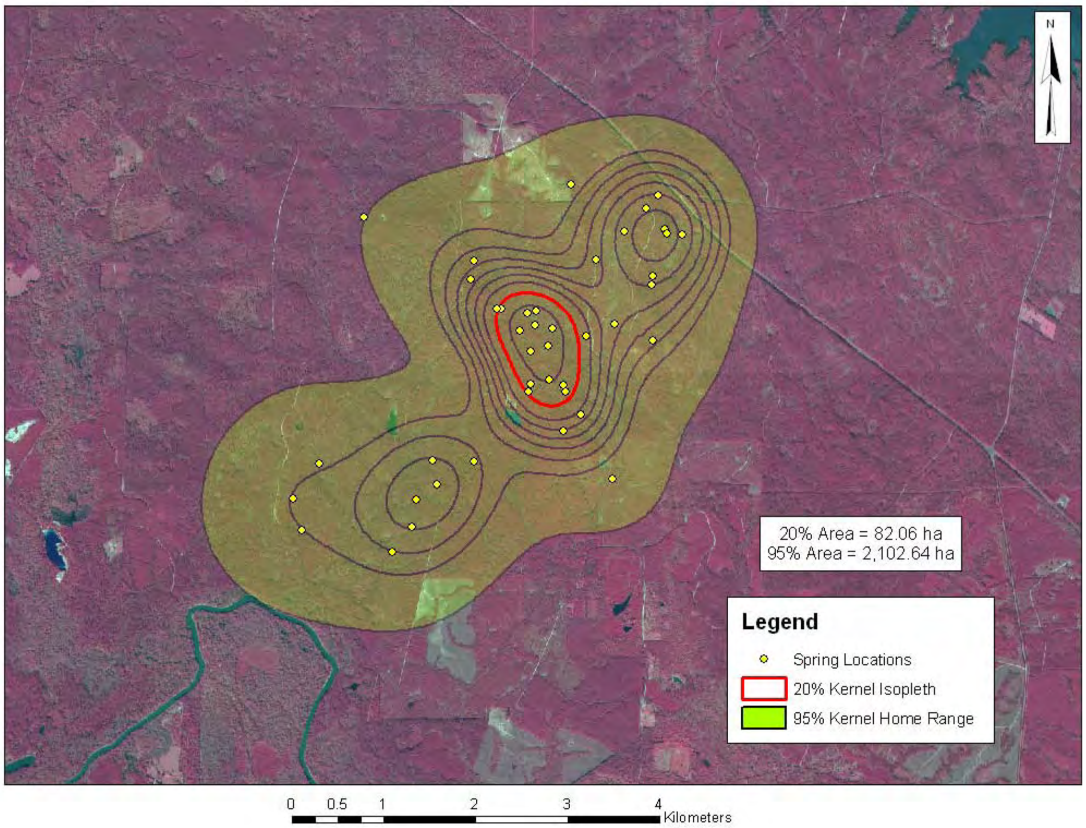

Figure 42. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.614) on the Angelina National Forest, 2006-2008.

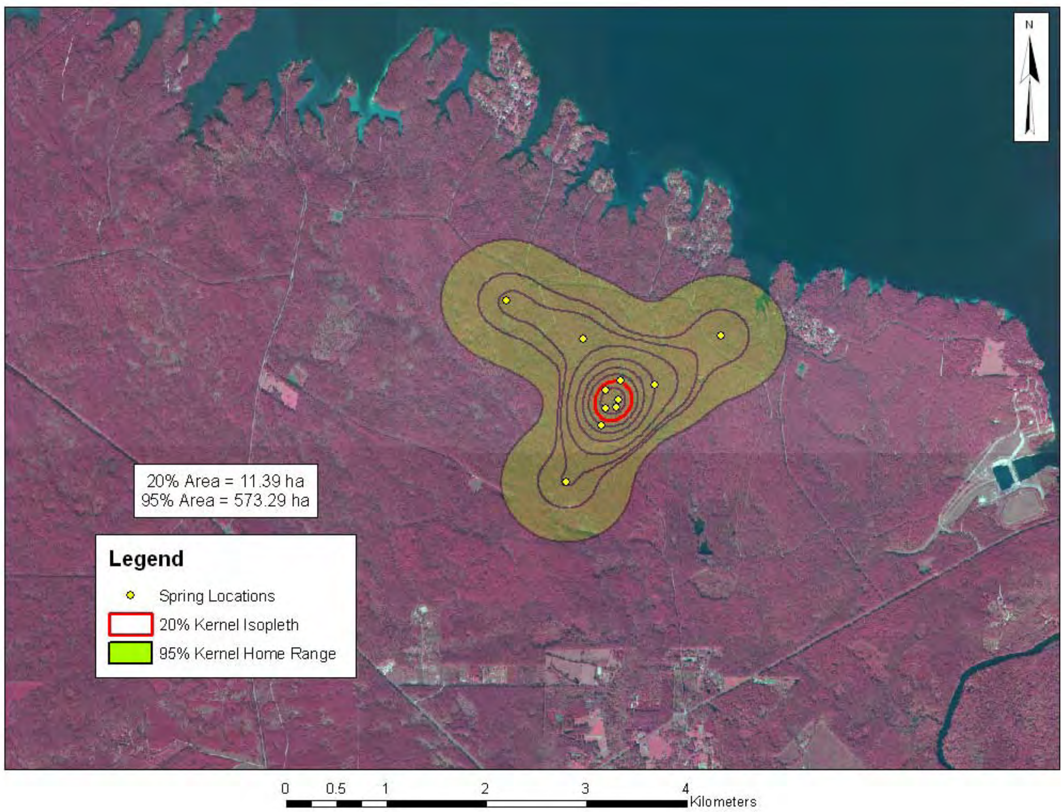

Figure 43. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 150.626) on the Angelina National Forest, 2006-2008.

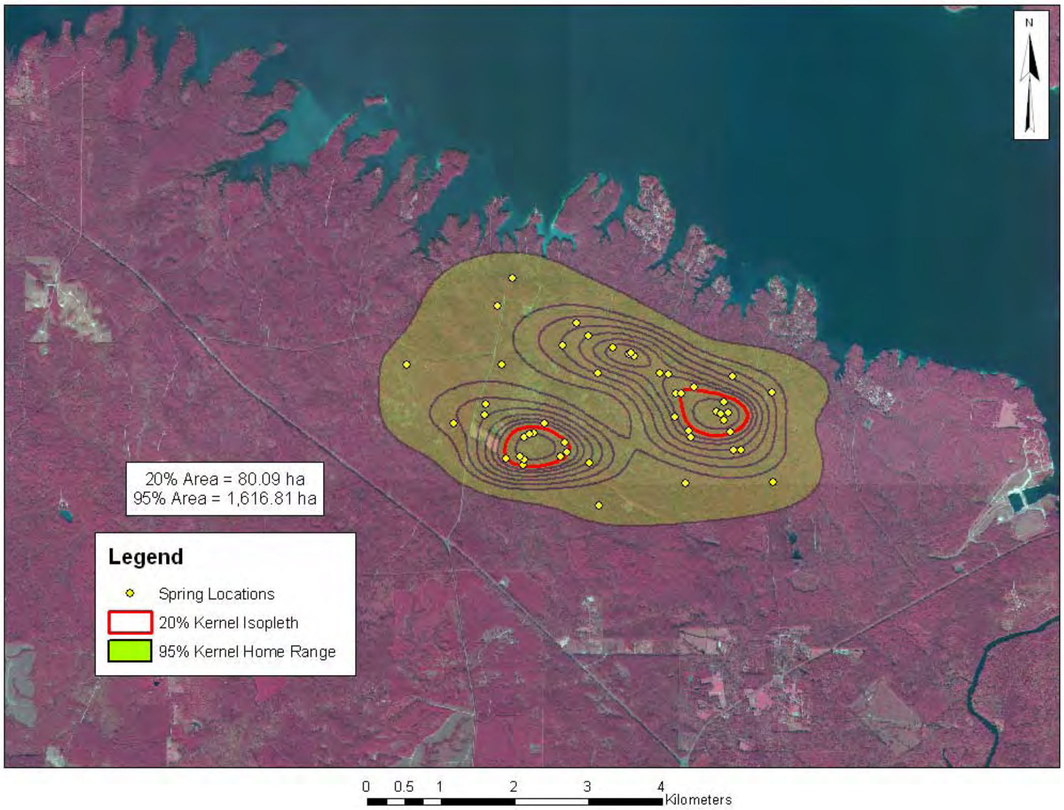

Figure 44. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.654) on the Angelina National Forest, 2006-2008.

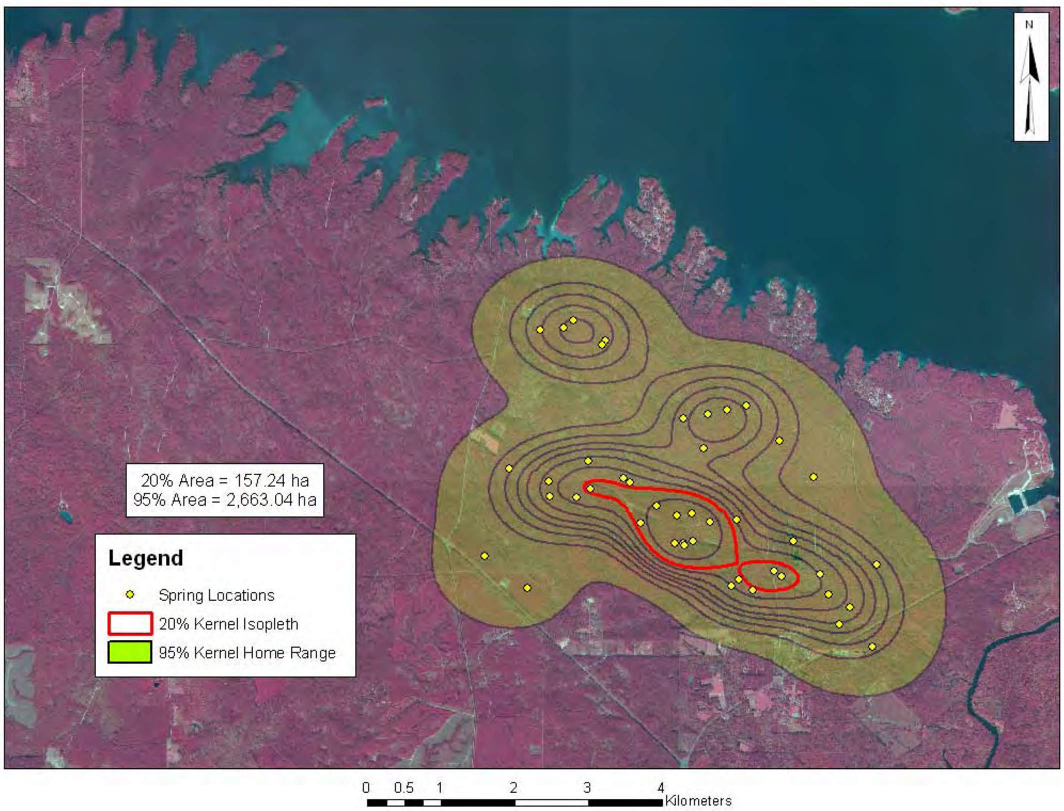

Figure 45. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 150.694) on the Angelina National Forest, 2006-2008.

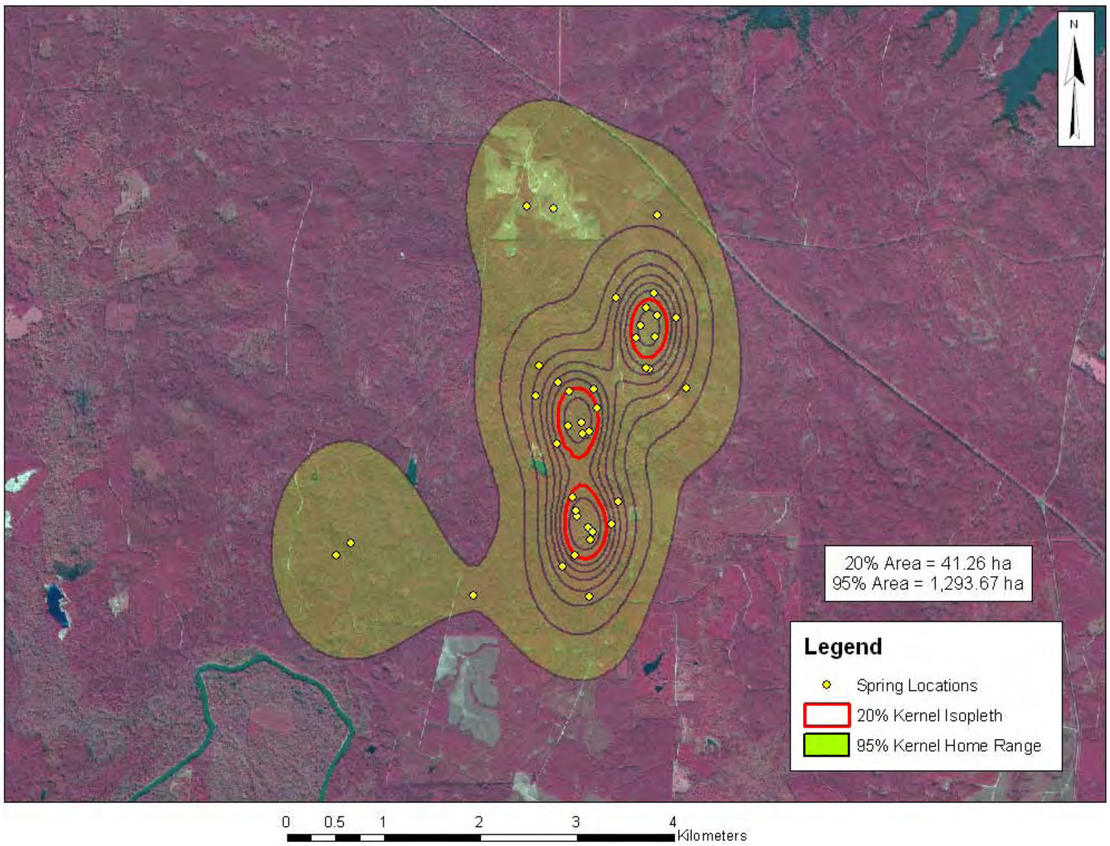

Figure 46. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for juvenile (at time of capture) Eastern wild turkey (transmitter 150.773) on the Angelina National Forest, 2006-2008.

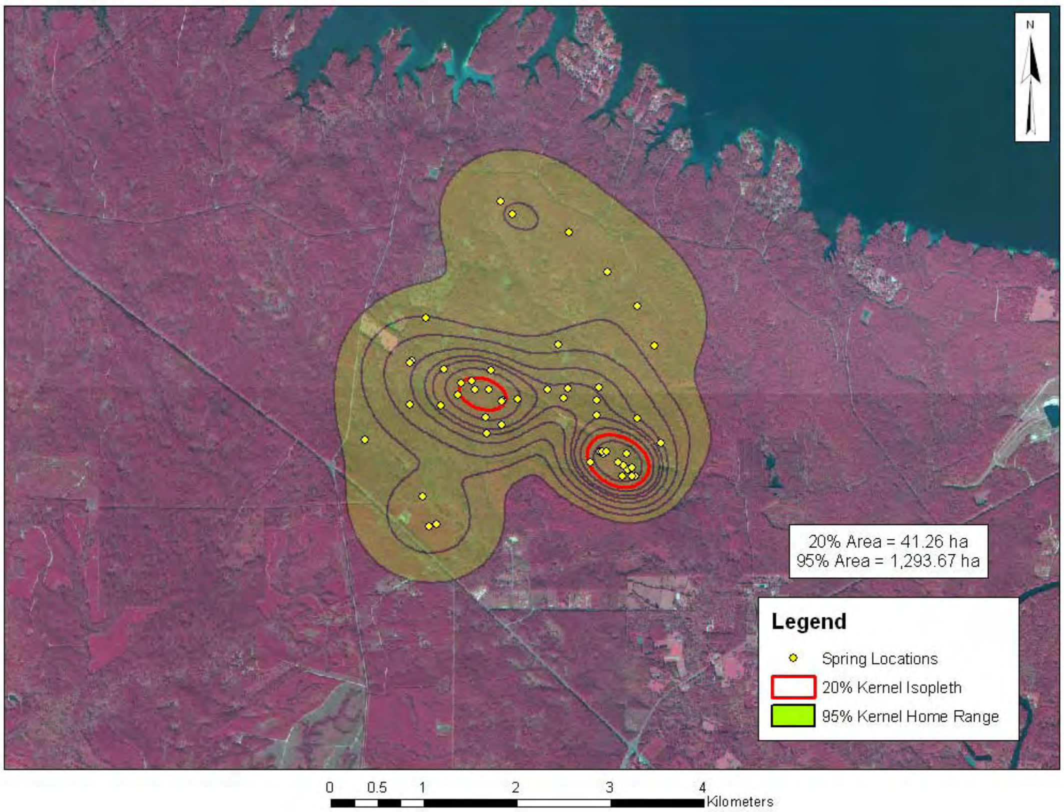

Figure 47. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.325) on the Angelina National Forest, 2006-2008.

Figure 48. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for translocated (from South Carolina) Eastern wild turkey (transmitter 151.336) on the Angelina National Forest, 2006-2008.

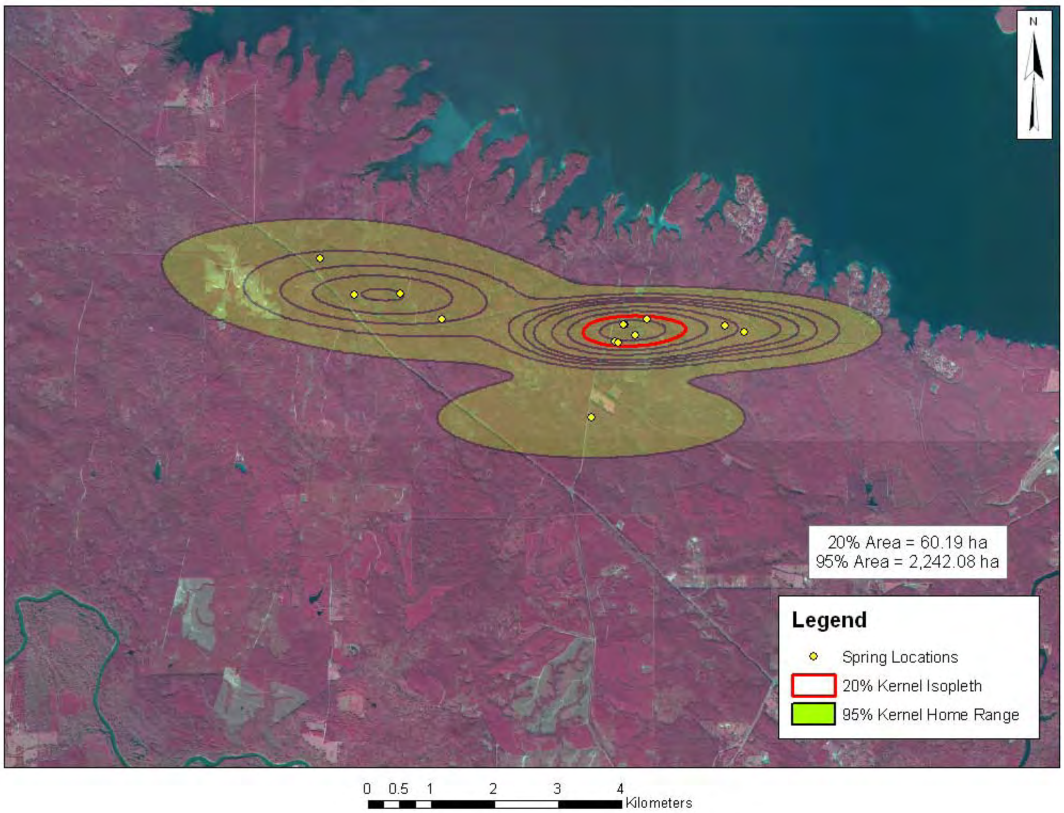

Figure 49. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.344) on the Angelina National Forest, 2006-2008.

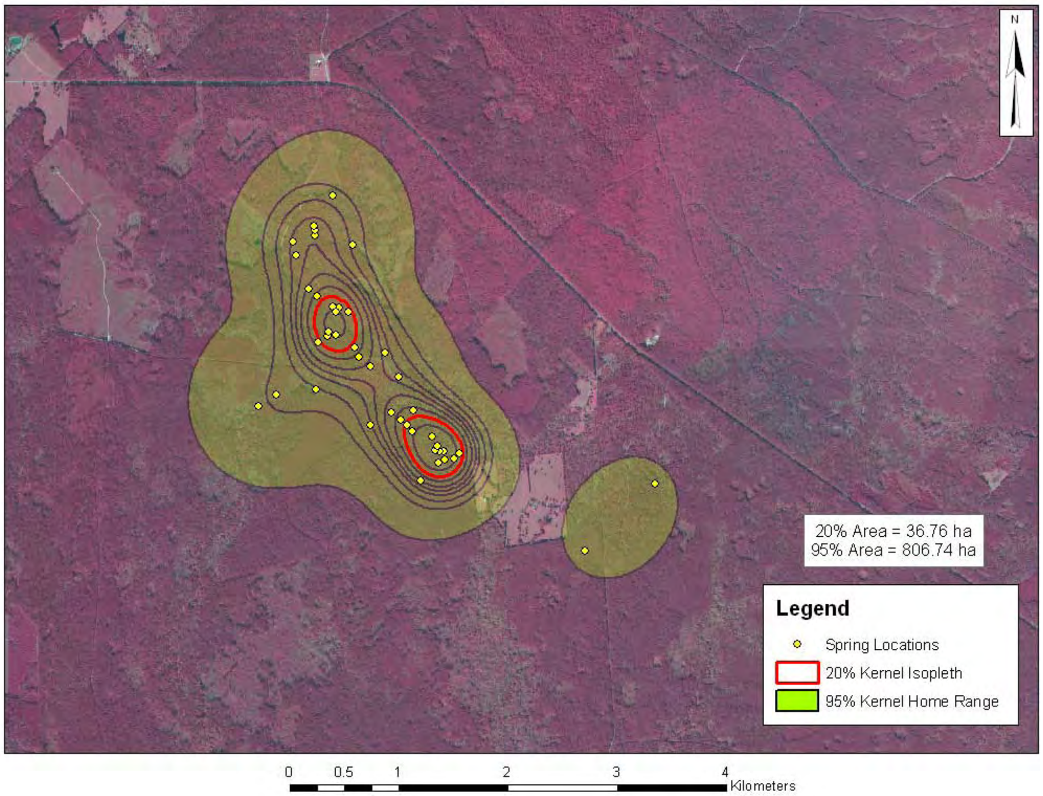

Figure 50. Telemetry locations, 95% adaptive kernel, and 20% kernel isopleths spring home range estimate for adult (at time of capture) Eastern wild turkey (transmitter 151.377) on the Angelina National Forest, 2006-2008.

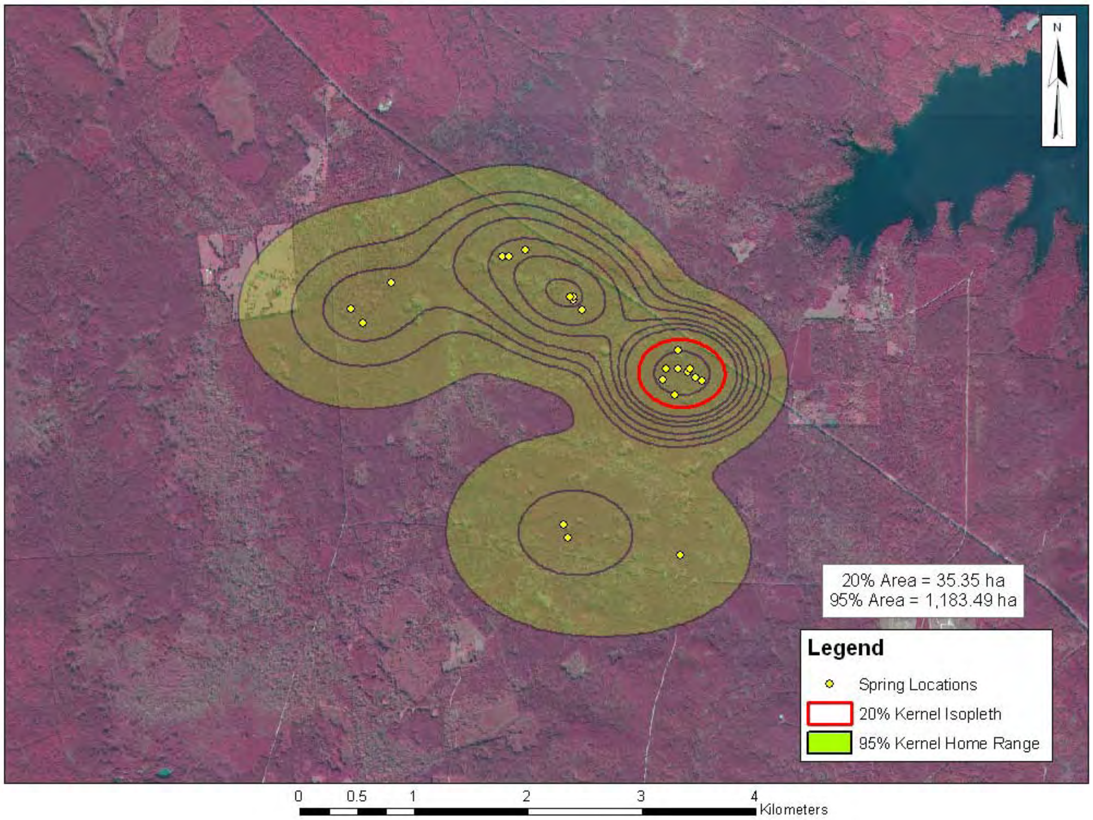

Figure 51. Experimental gobble count survey route located in Houston County, Texas (Houston County route 1).

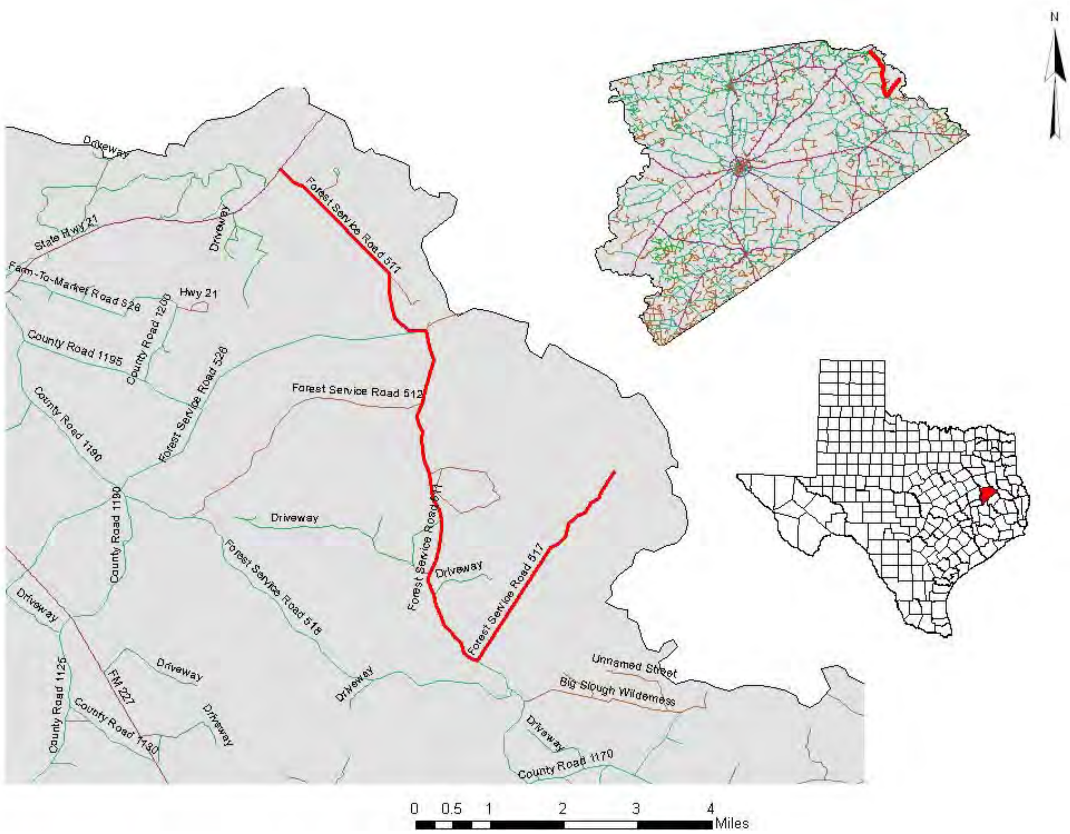

Figure 52. Experimental gobble count survey route located in Houston County, Texas (Houston County route 2).

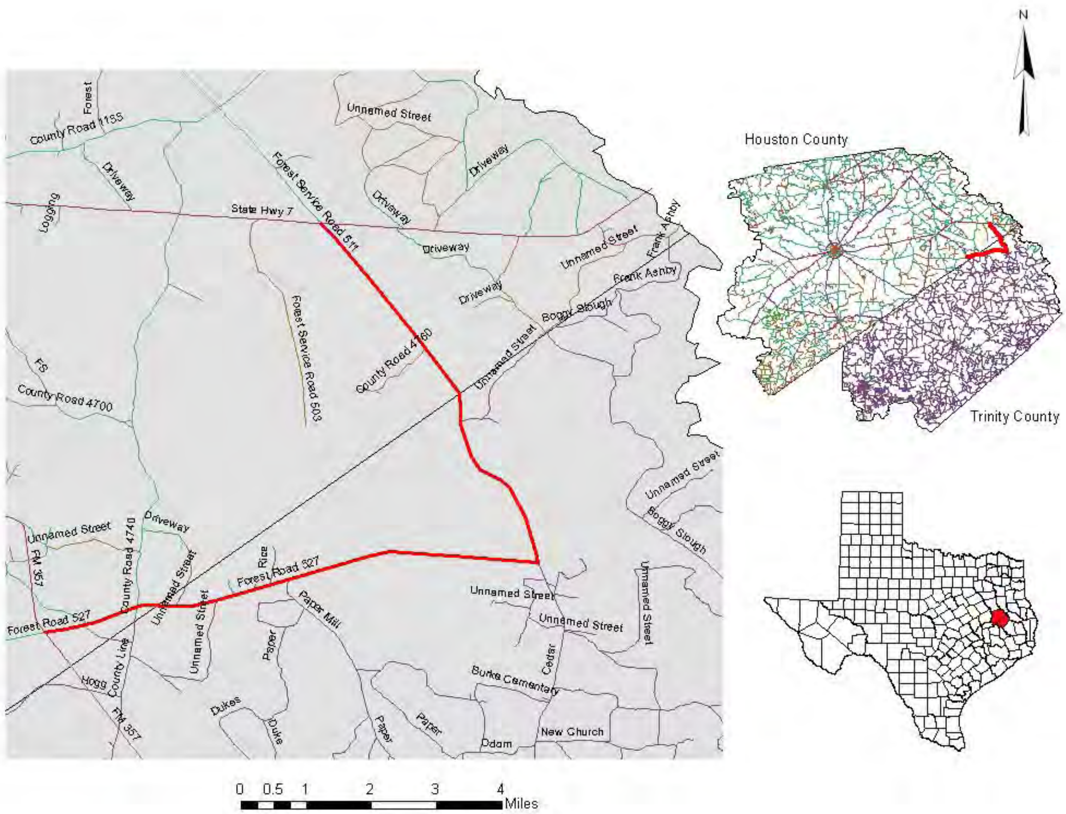

Figure 53. Experimental gobble count survey route located in Jasper County, Texas (Jasper County route 1).

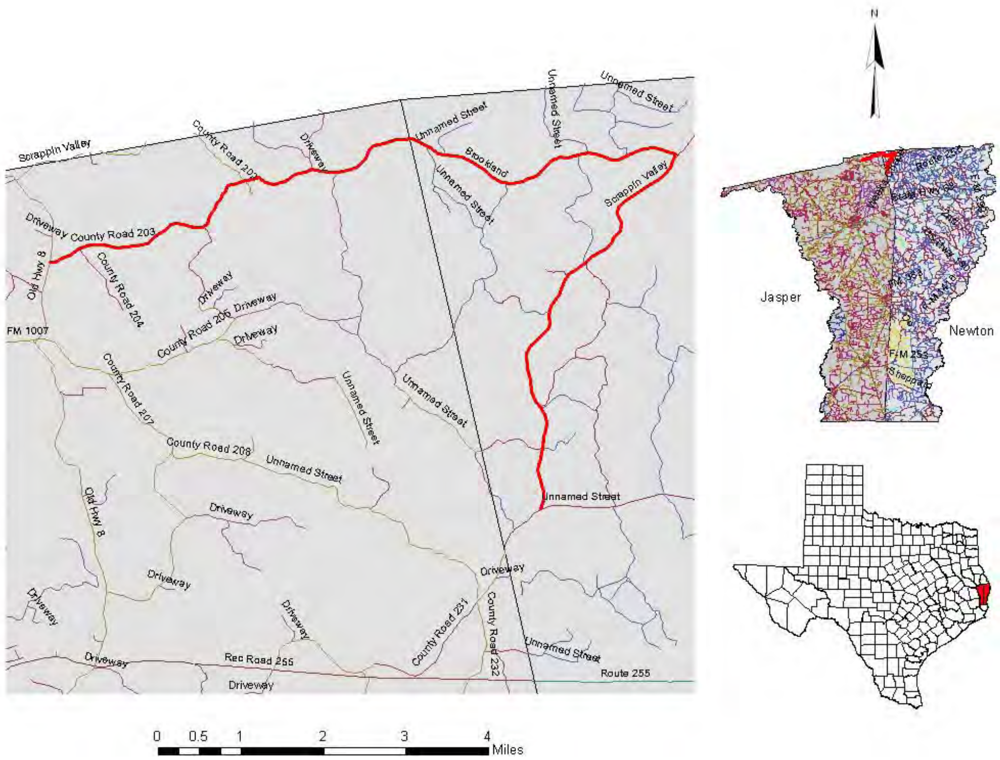

Figure 54. Experimental gobble count survey route located in Nacogdoches County, Texas (Nacogdoches County route 1).

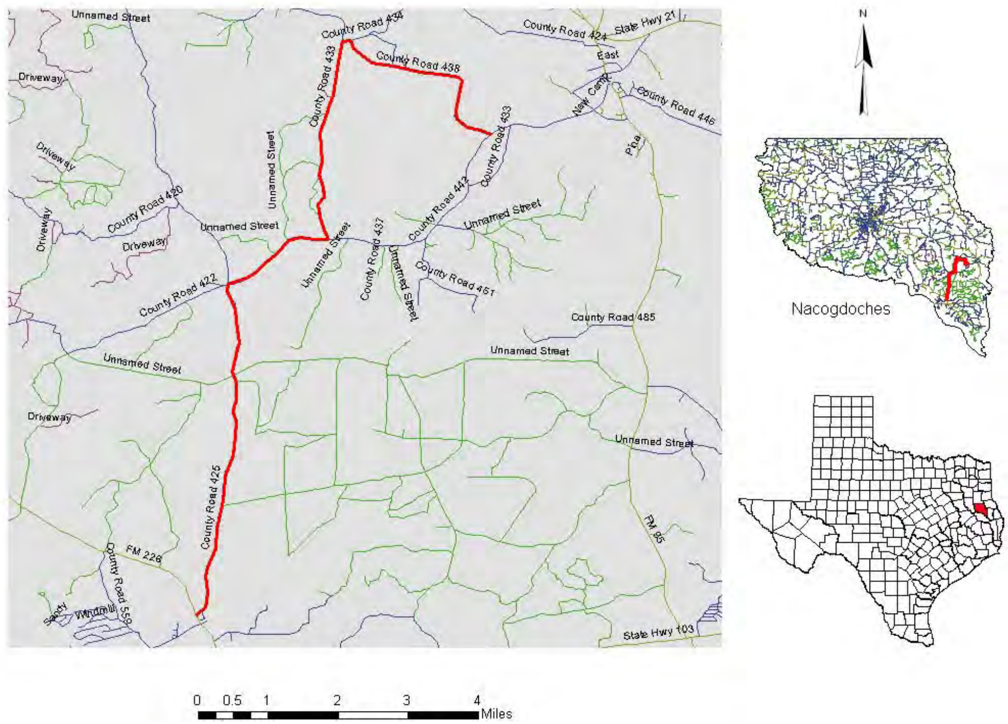

Figure 55. Experimental gobble count survey route located in Sabine County, Texas (Sabine County route 2).

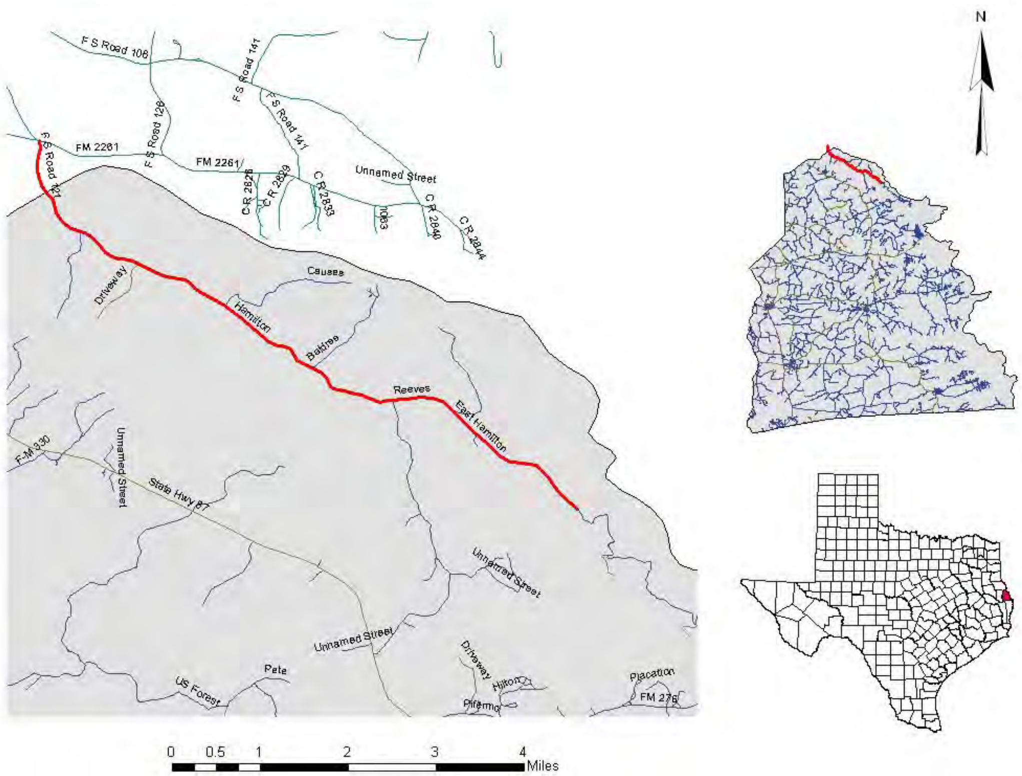

Figure 56. Experimental gobble count survey route located in San Augustine County, Texas (San Augustine County route 1).

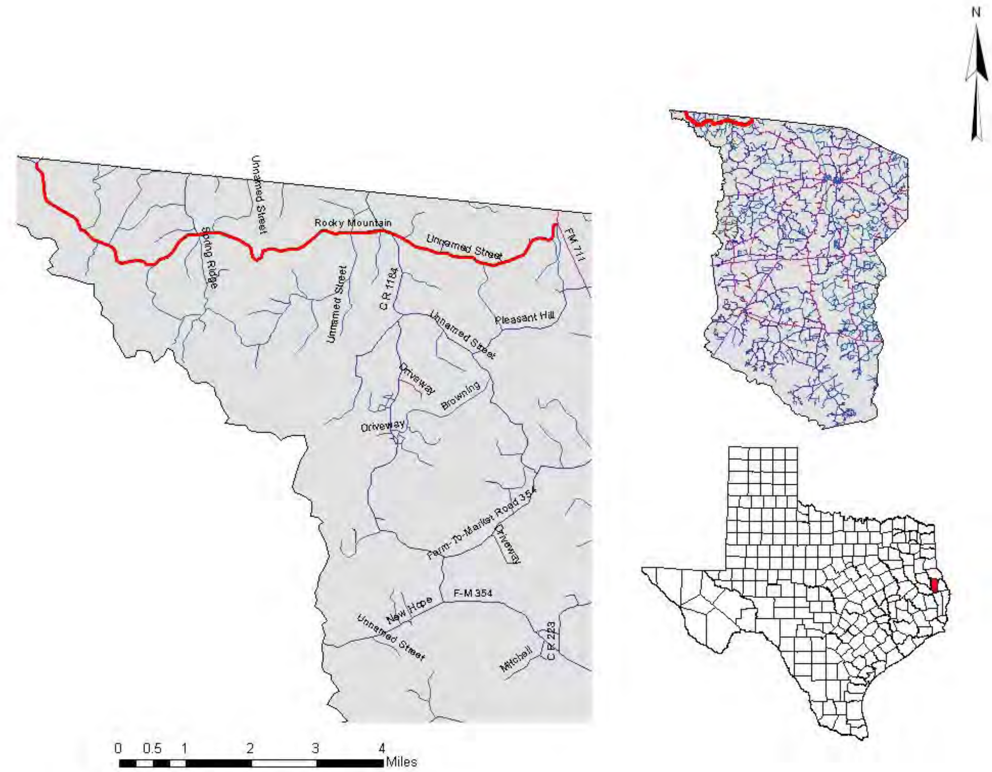

Figure 57. Experimental gobble count survey route located in Trinity County, Texas (TrinityCounty route 1).

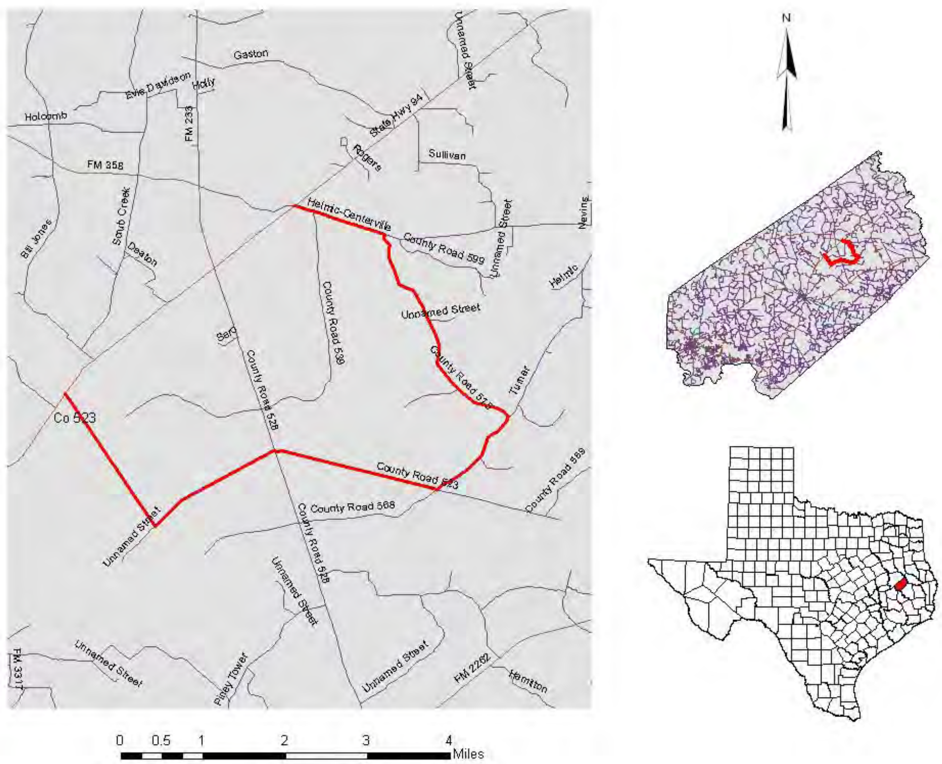

Figure 58. Experimental gobble count survey route located in Tyler County, Texas (Tyler County route 1).

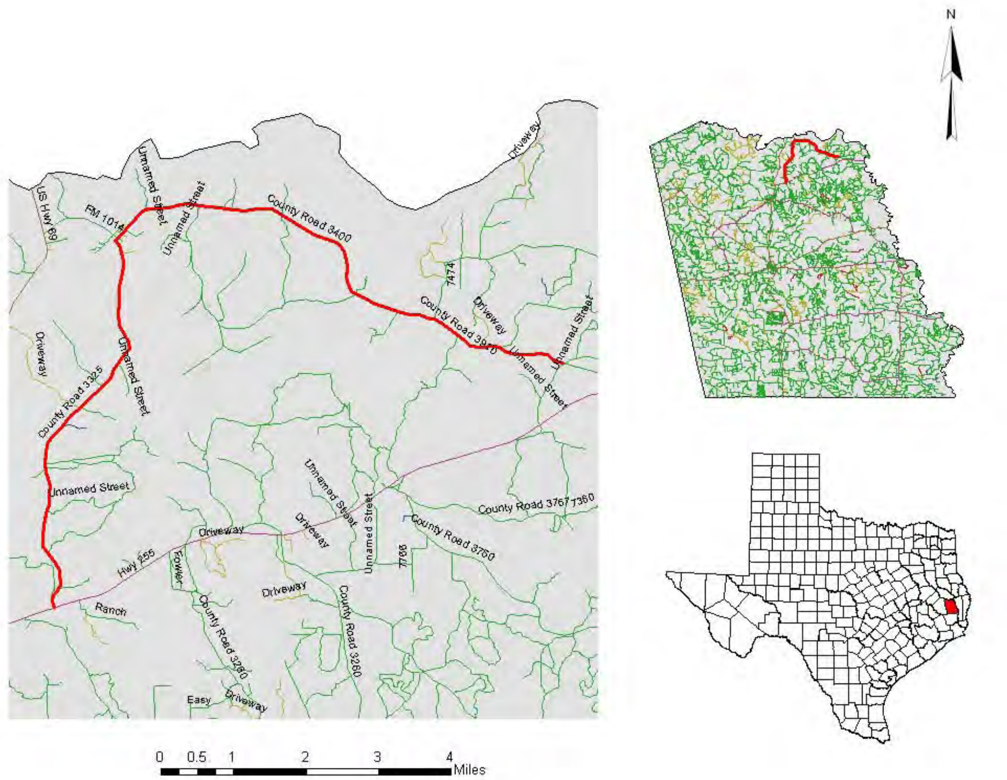

Table 1. Identification band number, age, sex, and capture date of Eastern wild turkeys captured on the Angelina National Forest in east Texas, 23 February– 8 March 2006 and 1 January – 23 February, 2007.

Band ID	Sex	Age	Spur length (cm)	Beard length (cm)	Capture date	County
45451	Male	Adult	R 2.2 – L 2.3	24.0	2/23/2006	Angelina
45452	Male	Adult	R 2.5 – L 2.6	27.0	2/23/2006	Angelina
45453	Male	Adult	R 2.2 – L 2.5	25.5	2/23/2006	Angelina
45454	Male	Adult	R 2.1 – L 2.3	26.0	2/23/2006	Angelina
45455	Male	Adult	R 2.4 – L2.6	26.0	2/26/2006	Jasper
45456	Male	Adult	R 2.4 – L 2.5	25.0	2/28/2006	Jasper
45457	Male	Adult	R 2.2 – L 2.1	25.0	2/28/2006	Jasper
45458	Male	Adult	R 2.8 – L 2.8	26.0	3/03/2006	Jasper
45459	Male	Adult	R 1.9 – L 1.6	24.0	3/03/2006	Angelina
45460	Male	Juvenile	R 1.0 – L 0.7	10.1	3/07/2006	Angelina
2534	Male	Adult	R 1.8 – L 1.8	22.2	1/30/2007	Jasper
2533	Male	Adult	R 2.1 – L 2.3	22.2	1/30/2007	Jasper
2545	Male	Adult	R 2.2 – L 2.5	22.8	1/30/2007	Jasper
t2546	Male	Juvenile	R 0.6 – L 0.6	7.0	1/31/2007	Jasper
t2537	Male	Juvenile	R 0.5 – L 0.4	8.9	1/31/2007	Jasper
t2538	Male	Juvenile	R 0.4 – L 0.4	7.6	1/31/2007	Jasper
A461	Male	Juvenile	R 0.4 – L 0.4	6.3	2/14/2007	Jasper
A462	Male	Juvenile	R 0.4 – L 0.5	7.6	2/14/2007	Jasper
45216	Male	Adult	R 2.4 – L 2.8	26.1	2/15/2007	Jasper

45215	Male	Adult	R 2.6 – L 2.7	20.4	2/15/2007	Jasper
45214	Male	Adult	R 2.7 – L 2.7	28.7	2/15/2007	Jasper
A-460	Male	Adult	R 2.1 – L 2.6	25.5	2/23/2007	Jasper

Table 2. Identification band number, age, sex, and release county of Eastern wild turkeys captured in South Carolina and released on the Angelina National Forest in east Texas, 10 March 2006 – 11 March 2006.

Band ID	Sex	Age	Spur length (cm)	Beard length (cm)	County
A-408	Male	Juvenile	R 0.6 – L 0.4	11.9	Jasper
A-409	Male	Juvenile	R 0.8 – L 0.2	6.5	Jasper
A-410	Male	Juvenile	R 0.4 – L 0.3	3.9	Jasper
A-411	Male	Juvenile	R 0.3 – L 0.4	7.2	Jasper
45461	Male	Juvenile	R 0.5 – L 0.4	10.0	Jasper
45462	Male	Juvenile	R 0.8 – L 0.5	9.8	Jasper
A-407	Male	Juvenile	R 0.8 – L 0.7	12.0	Jasper

Table 3. Year, season, and total number of bearings and locations of transmittered Eastern wild turkeys on the Angelina National Forest, east Texas, 2006-2008.

Year	March – May (spring)		June - February		Total	
	Bearings	Locations	Bearings	Locations	Bearings	Locations
2006	867	289	747	249	1614	538
2007	2078	693	246	82	2324	775
Total	***2945***	***982***	***993***	***331***	***3938***	***1313***

Table 4. Individual (by transmitter frequency) annual and spring 95% adaptive kernel and 20% isopleth home range estimates for male Eastern wild turkeys on the Angelina National Forest, 2006-2008.

Frequency	Annual (ha)	Spring (ha)	Spring20% Isopleth (ha)	Locations (*n*, annual)	Locations (*n*, spring)
150.012	838.58	945.87	34.63	62	47
150.054	1807.77	2008.5	57.87	77	50
150.067	1797.63	1695.24	60.94	52	28
150.086	3267.73	2737.57	171.91	61	41
150.096	546.37	345.02	18.34	56	29
150.116	na	1169.61	71.49	18	18
150.126	1447.63	680.3	20.11	47	26
150.145	na	1588.74	51.82	10	10
150.193	1845.96	1543.85	61.84	64	43
150.253	1406.56	1155.69	39.68	72	52
150.333	na	1788.7	63.3	25	25
150.396	2767.71	1589.05	49.29	38	18
150.405a	na	966.35	68.39	22	22
150.405b	na	na	na	na	na
150.416	na	na	na	na	na
150.473	2096.05	1350.47	61.89	62	45
150.533	na	802.37	34.45	27	27

150.574	2075.16	2102.64	82.06	60	42
150.614	2166.18	573.29	11.39	27	11
150.626	1891.47	1616.81	80.09	88	48
150.654	2644.97	2663.04	157.24	62	44
150.694	1821.95	1597.44	65.07	58	39
150.731	na	2566.22	85.27	11	11
150.773	1291.48	1293.67	41.26	74	50
151.063	1237.01	919.3	45.15	41	26
151.325	1031.79	1041.92	27.75	49	22
151.336	2827.85	2242.08	60.19	29	13
151.344	3085.43	806.74	36.76	82	44
150.377	1752.68	1183.49	35.35	43	28

Table 5. Individual (by transmitter frequency) annual and spring 95% adaptive kernel and 20% isopleth home range estimates for wild trapped adult (at time of capture) male Eastern wild turkeys on the Angelina National Forest, 2006-2008.

Frequency	Annual (ha)	Spring (ha)	Spring20% Isopleth (ha)	Locations (*n*, annual)	Locations (*n*, spring)
150.012	838.58	945.87	34.63	62	47
150.086	3267.73	2737.57	171.91	61	41
150.096	546.37	345.02	18.34	56	29
150.116	na	1169.61	71.49	18	18
150.145	na	1588.74	51.82	10	10
150.333	na	1788.7	63.3	25	25
151.377	1752.68	1183.49	35.35	43	28
150.396	2767.71	1589.05	49.29	38	18
150.405a	na	966.35	68.39	22	22
150.473	2096.05	1350.47	61.89	62	45
150.533	na	802.37	34.45	27	27
150.574	2075.16	2102.64	82.06	60	42
150.694	1821.95	1597.44	65.07	58	39
150.731	na	2566.22	85.27	11	11
151.325	1031.79	1041.92	27.75	49	22
151.344	3085.43	806.74	36.76	82	44

Table 6. Individual (by transmitter frequency) annual and spring 95% adaptive kernel and 20% isopleth home range estimates for male Eastern wild turkeys translocated from South Carolina onto the Angelina National Forest, 2006-2008.

Frequency	Annual (ha)	Spring (ha)	Spring20% Isopleth (ha)	Locations (*n*, annual)	Locations (*n*, spring)
150.067	1797.63	1695.24	60.94	52	28
150.126	1447.63	680.3	20.11	47	26
150.405b	na	na	na	na	na
150.416	na	na	na	na	na
150.614	2166.18	573.29	11.39	27	11
150.626	1891.47	1616.81	80.09	88	48
151.336	2827.85	2242.08	60.19	29	13

Table 7. Individual (by transmitter frequency) annual and spring 95% adaptive kernel and 20% isopleth home range estimates for wild captured juvenile (at time of capture) male Eastern wild turkeys on the Angelina National Forest, 2006-2008.

Frequency	Annual (ha)	Spring (ha)	Spring20% Isopleth (ha)	Locations (*n*, annual)	Locations (*n*, spring)
150.054	1807.77	2008.5	57.87	77	50
150.193	1845.96	1543.85	61.84	64	43
150.253	1406.56	1155.69	39.68	72	52
150.654	2644.97	2663.04	157.24	62	44
150.773	1291.48	1293.67	41.26	74	50
151.063	1237.01	919.3	45.15	41	26

Table 8. Stops, numbers and proportion (%) of pine and hardwood trees, and basal area (BA) at each stop (L) and random locations (R) on the Big Creek gobble count survey route located on the Angelina National Forest, 2006-2008.

Stop	Pine (*n*)	Hardwood (*n*)	Total	Pine (%)	Hardwood (%)	BA R50	BA R100	BA L50	BA L100	BA (mean)
1	23	5	28	0.82	0.18	70	70	10	20	42.5
2	26	0	26	1.00	0.00	90	110	90	160	112.5
3	56	9	65	0.86	0.14	130	120	130	130	127.5
4	84	1	85	0.99	0.01	120	190	160	130	150
5	102	1	103	0.99	0.01	110	130	170	120	132.5
6	7	17	24	0.29	0.71	120	60	40	40	65
7	29	25	54	0.54	0.46	100	60		150	103.3
8	15	19	34	0.44	0.556	140	110	120	110	120
9	5	16	21	0.24	0.76	120	60	70	50	75
10	35	19	54	0.65	0.35	120	130	140	170	140
11	33	27	60	0.55	0.45	170	140	160	150	155
12	33	23	56	0.59	0.41	110	160	200	180	162.5
13	0	0	0			0	0	0	0	0
14	28	9	37	0.76	0.24	110	110	150	170	135
15	39	20	59	0.66	0.34	150	90	150	110	125
16	29	3	32	0.91	0.09	110	110	80		100
17	41	2	43	0.95	0.05	160	90	90	70	102.5

18	10	12	22	0.45	0.55	40	70	120	20	62.5
19	31	2	33	0.94	0.06	120	90	80	80	92.5
20	47	8	55	0.85	0.15	220	150	90	90	137.5
21	22	28	50	0.44	0.56	110	80	100	160	112.5
22	0	0	0			0	0	0	0	0
23	39	5	44	0.89	0.11	70	60	80	120	82.5
24	22	25	47	0.47	0.53	130	70	140	150	122.5

Table 9. Stops, numbers and proportion (%) of pine and hardwood trees, and basal area (BA) at each stop (L) and random locations (R) on the Boykin gobble count survey route located on the Angelina National Forest, 2006-2008.

Stop	Pine (*n*)	Hardwood (*n*)	Total	Pine (%)	Hardwood (%)	BA R50	BA R100	BA L50	BA L100	BA (mean)
1	20	3	23	0.86	0.13	100	130	0	40	67.5
2	43	3	46	0.93	0.07	120	130	100	90	110
3	36	3	39	0.92	0.08	50	30	40	120	60
4	26	0	26	1.00	0.00	120	80	90	60	87.5
5	22	3	25	0.88	0.12	100	130	50	70	87.5
6	44	5	49	0.89	0.11	0	0	140	110	62.5
7	5	15	20	0.25	0.75	60	140	0	0	50
8	91	3	94	0.96	0.04	110	140	70	130	112.5
9	48	3	51	0.94	0.06	110	0	30	80	55
10	23	15	38	0.60	0.40	140	150	100	160	137.5
11			0							
12	53	6	59	0.89	0.11	0	70	140	140	87.5
13	41	14	55	0.74	0.26	140	150	150	130	142.5
14	47	8	55	0.85	0.15	90	100	120	140	112.5
15	26	1	27	0.97	0.03	90	160	140	50	110
16	19	19	38	0.50	0.50	90	50	60	60	65
17	33	0	33	1.00	0.00	140	160	120	130	137.5

18	36	3	39	0.92	0.08	190	140	160	150	160
19	21	21	42	0.50	0.50	160	150	130	80	130

Table 10. Stops, numbers and proportion (%) of pine and hardwood trees, and basal area (BA) at each stop (L) and random locations (R) on the Trout Creek gobble count survey route located on the Angelina National Forest, 2006-2008.

Stop	Pine (*n*)	Hardwood (*n*)	Total	Pine (%)	Hardwood (%)	BA R50	BA R100	BA L50	BA L100	BA (mean)
1	13	1	14	0.93	0.07	110	80			95
2	23	3	26	0.89	0.11	120	120	60	140	110
3	31	5	36	0.86	0.14	70	120	60	90	85
4	16	5	21	0.77	0.23	90	90	100		93.3
5	29	1	30	0.97	0.03	110	90	80	90	92.5
6	33	0	33	1.00	0.00	90	50	60	70	67.5
8	48	4	52	0.92	0.08	140	40	130	80	97.5
9	35	0	35	1.00	0.00	110	80	120	120	107.5
10	34	0	34	1.00	0.00	90	100	110	110	102.5
11	38	10	48	0.79	0.21	80	120	110	110	105
12	34	15	49	0.70	0.30	140	100	150	70	115
13	59	3	62	0.95	0.05	160	160	180	140	160
14	27	16	43	0.63	0.37	80	130	50	100	90
15	40	27	67	0.60	0.40	240	140	170	150	175
16	38	21	59	0.64	0.36	150	100	80	90	105
17	54	8	62	0.87	0.13	90	140	130	80	110
18	45	5	50	0.90	0.10	70	80	70	150	92.5

19	35	6	41	0.85	0.15	80	60	120	30	72.5
20	24	0	24	1.00	0.00	40	40	100	110	72.5

Table 11. Bird identification number (band number), and habitat characteristics of spring (March – May) 20% kernel isopleths for individual male Eastern wild turkeys on the Angelina National Forest, 2006 and 2007.

Bird	Area	Evergreen		Mixed Forest		Shrub/Scrub		Woody Wetland (ha)		Developed/Open		Herbaceous	
	Ha	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
45216	34.63	33.55	96.88	0.63	1.82	0.45	1.30						
t2537	57.87	47.79	82.58	2.88	4.98	0.18	0.31	1.44	2.49	5.58	9.64		
45461	60.94	55.70	91.41			0.27	0.44	0.86	1.40	3.29	5.34	0.82	1.35
45453	171.91	160.75	93.51	1.53	0.89	1.44	0.84	3.69	2.15	4.50	2.62		
45455	18.34	15.77	86.01	1.49	8.10					1.08	5.89		
45457	71.49	67.58	94.52	0.72	1.01	1.17	1.64			2.03	2.83		
45462	20.12	18.50	91.95					0.09	0.45	1.53	7.60		
45451	51.82	43.95	84.81	0.72	1.39			3.11	5.10	4.05	7.82		
t2538	61.843	55.31	89.44			0.45	0.73	0.99	1.60	4.19	6.77	0.91	1.47
A-462	39.68	37.52	94.56			0.23	0.57			1.94	4.88		
45215	63.30	54.65	86.34			1.62	2.56	1.80	2.84	3.87	6.11	1.29	2.04
45459	49.29	37.43	75.93			0.41	0.82	8.40	17.04	3.06	6.21		
A-407	68.39	55.51	81.17	4.19	6.13	2.66	3.89	1.53	2.24	4.50	6.58		
2545	61.89	55.42	89.55	2.69	4.34					3.78	6.11		
2533	34.45	29.16	84.66			0.09	0.26	3.62	10.51	1.53	4.44		
2534	82.06	63.44	77.31	9.17	11.18			3.69	4.50	5.76	7.02		
A-411	11.39	10.18	89.33					0.41	3.56	0.81	7.11		
A-409	80.09	66.68	83.25	7.52	9.39	0.05	0.06	1.26	1.57	4.59	5.73		
A-461	157.24	125.22	79.64	11.07	7.04	5.88	3.74	5.04	3.21	10.04	6.38		
45214	65.07	56.03	86.10			1.62	2.49	2.61	4.01	4.46	6.85	0.36	0.55

A460	85.27	78.03	91.50	1.04	1.21			5.76	6.75	0.45	0.53
t2546	41.26	34.74	84.19	2.34	5.67	0.05	0.11	1.26	3.05	2.88	6.98
45460	45.15	41.14	91.13					0.81	1.79	3.20	7.08
45456	27.75	24.29	87.52			1.71	6.16	0.45	1.61	1.31	4.70
A-410	60.19	53.53	88.93	0.81	1.35			3.51	5.83	2.34	3.89
45454	36.76	32.31	87.91					2.93	7.97	1.49	4.04
45452	33.35	30.72	92.10							2.63	7.90

Table 12. Year, generalized survey location, number of routes surveyed, and turkey detection summaries for gobble count surveys performed in east Texas, 2003-2008. .

Year	Generalized location		Routes sampled (*n*)	Total routes sampled (*n*)	Routes with gobbles (*n*)	Individual detections (*n*)
2003	Angelina N.F.		4	12	3	30
		Totals	***4***	***12***	***3***	***30***
2004	Angelina N.F.		4	16	3	59
		Totals	***4***	***16***	***3***	***59***
2005	Angelina N.F.		4	16	3	35
2005	Davey Crocket N.F.		1	3	0	0
		Totals	***5***	***19***	***3***	***35***
2006	Angelina N.F.		4	13	3	11
2006	Davey Crocket N.F.		1	4	0	0
		Totals	***5***	***17***	***3***	***11***
2007	Angelina N.F.		5	20	4	8
2007	Davey Crocket N.F.		1	4	0	0
2007	Sabine N.F.		5	15	2	7
2007	Sam Houston N.F.		8	32	0	0
		Totals	***19***	***71***	***6***	***15***
2008[1]	Houston County		2	8	1	1
2008	Jasper County		1	4	1	8
2008	Nacogdoches County		1	3	1	8
2008	Sabine County		2	6	2	7
2008	San Augustine County		2	6	1	4
2008	Trinity County		2	9	1	1

2008	Tyler County		1	1	1	7
		Totals	***11***	***37***	***8***	***36***

[1] Gobble count surveys performed in 2008 utilized experimental gobble count survey routes established using habitat and home range analyses from male Eastern wild turkeys on the Angelina National Forest during 2006 and 2007.

Table 13. Summary of Texas Parks and Wildlife Department gobble count survey data, collected 15 March - 1 April, 2003 – 2008.

Year	Route Name	Samples	Number of Individuals Detected	Number of Recorded Gobbles
2003	Boykin	2	2,10	4,35
	Deadman	4	0,0,0,0	0,0,0,0
	Trout Creek	4	1,2,8,7	3,14,23,17
	Unit 106	2	0,2,	0,16
2004	Big Creek	4	2,0,4,10	5,0,7,44
	Boykin	4	4,0,10,4	5,0,28,18
	Deadman	4	0,0,0,0	0,0,0,0
	Trout Creek	4	12,0,6,7	41,0,17,18
2005	*ACWMA	3	0,0,0,0	0,0,0,0
	Big Creek	4	8,1,5,0	38,2,28,0
	Boykin	4	0,3,3,1	0,8,7,4
	Deadman	4	0,0,0,0	0,0,0,0
	Trout Creek	4	0,3,5,1	0,6,26,2
2006	Alabama Creek WMA	4	0,0,0,0	0,0,0,0
	Big Creek	3	1,0,1	3,0,4
	Boykin	4	0,1,1,3	0,1,1,7
	Deadman	2	0,0	0,0
	Trout Creek	4	4,0,0,0	4,0,0,0
2007	Banister WMA	3	1,2,1	5,6,5
	Big Creek	4	3,1,0,1	17,1,0,3
	Big Sandy	4	0,1,3,0	0,2,5,0
	Big Woods	4	0,0,0,0	0,0,0,0
	Boles Field	3	0,0,0	0,0,0
	Boykin	4	0,0,0	0,0,0
	Fostoria	4	0,0,0,0	0,0,0,0
	Goober Hill	3	0,0,0	0,00

	Indian Mounds	4	0,0,0,0	0,0,0,0
	Moore Plantation WMA	2	0,2	0,10
	Popper's Creek	4	0,0,0,0	0,0,0,0
	Sam Houston N.F. Work Center	4	0,0,0,0	0,0,0,0
	Stark	4	0,0,0,0	0,0,0,0
	Trout Creek	4	1,0,0,0	12,0,0,0
	White City	4	0,0,1,0	0,0,2,0
2008	Alabama Creek WMA	5	1,0,0,0,0	1,0,0,0,0
	Banister WMA	3	3,0,1	5,0,10
	Houston_1	4	0,0,0,0	0,0,0,0
	Houston_2	4	0,1,0,0	0,3,0,0
	Jasper_1	4	3,1,1,2	6,3,2,3
	Nacogdoches_1	3	8,0,0	41,0,0
	Moore Plantation WMA	4	3,1,2,0	12,1,2,0
	Sabine_2	2	1,0	2,0
	San Augustine_1	4	0,0,0,0	0,0,0,0
	Trinity_1	4	0,0,0,0	0,0,0,0
	Tyler_1	4	3,2,2,0	17,8,19,0

APPENDIX A

LITERATURE REVIEW

History of Wild Turkey Restoration

The eastern wild turkey has been an important game bird in North America since pre-European settlement (Wright 1914, Dickson 1992). Habitat loss and unrestricted harvesting throughout the Southeast caused turkey populations to crash in the early 1900s (Mosby 1975, Dickson 1992, Lewis 2000) and by 1942, the native eastern wild turkeys in east Texas were estimated to be < 100 individuals (Boyd and Oglesby 1975). The demise of east Texas wild turkey populations were a concern for the Texas Game, Fish and Oyster Commission, which unsuccessfully reintroduced Rio Grande turkeys in the region in 1924 (Newman 1945). In the early 1940s efforts were again initiated to restore the wild turkey population with introductions of semi wild eastern pen-reared turkeys with limited success (Boyd and Oglesby 1975). The late 20th Century brought improvements to capturing techniques, which allowed for development of a highly successful trap and transfer program. During the 1940s, eastern wild turkey populations only existed in 16 states, but in 1979 as a result of successful reintroductions, eastern wild turkey populations existed in 34 states and was estimated at 1.2 million (Bailey 1980). Several decades of active restoration programs have returned wild turkey numbers from an estimated 30,000 in the 1930s, to 5.4 million in 1999 (Tapley et al. 2000).

Between 1978- 2004, the Texas Parks and Wildlife Department (TPWD) translocated > 7,000 wild-captured eastern wild turkeys throughout the Pineywoods ecoregion, from a multitude of states, including Tennessee, South Carolina, Georgia, and Iowa (G. Calkins; T. W. Schwertner, Texas Parks and Wildlife Department (TPWD), personal communication). Despite these efforts, regional TPWD staff estimated the eastern wild turkey population to be < 10,000 in east Texas during 2005 (G. Calkins; T.

W. Schwertner, TPWD, personal communication). Although based upon harvest trends and gobble count data, this coarse population estimate did not dramatically differ from the number of translocated turkeys released regionally. Despite 30 years of restoration efforts, the expansion and proliferation of translocated populations has not matched the success of other restoration programs throughout the Southeast (Kennamer and Kennamer 1995).

Habitat

During the past 50 years, eastern wild turkeys have responded dramatically from one of the most successful restoration efforts in the history of wildlife management in the U.S. (Lewis 2000). There have been tremendous efforts to collect and analyze eastern wild turkey habitat data throughout its range, as technological advances have allowed biologists to obtain detailed insight to all aspects of wild turkey seasonal activities and habitat relationships (Hillestad and Speake 1970, Lewis 2000). In east Texas, and throughout the Southeast, there has been concern as to eastern wild turkeys' ability to adapt to major shifts in land use practices, primarily conversion to even-age, short rotation pine plantations (Kennamer et al. 1980, Smith et al. 1987, Burk et al. 1990, Stys et al. 1992, Eichler 2004). Originally, this change in land management was viewed as detrimental (Mosby 1975, Kennamer et al. 1980, Dickson 1992), but more clear understanding of wild turkeys use of pine plantations has shown otherwise (Smith et al. 1987, Burk et al. 1990). In general, turkeys have been successful in incorporating pine plantations into annual cycles of habitat use, which is typically considered a contributing factor to restoration success throughout much of the southeastern U.S. (Smith et al. 1987, Burk et al. 1989, Burk et al. 1990, Stys et al. 1992).

Throughout east Texas, 16% of the 4.8 million ha of forestland are managed for commercial timber production (Texas Forest Service 2005). During the late 20th Century, commercial producers implemented new silvicultural practices to protect water quality, ensure sustainable wood fiber yield, and improve wildlife habitat within plantations (Dickson and Maughan 1987, Burk et al. 1990). In 1975, the U.S. Forest Service (USFS) and the Environmental Protection Agency (EPA) developed and promoted "Best Management Practices" (BMPs) to reduce non-point source water pollution caused by commercial timber production (Dana and Fairfax 1980), resulting in widespread use of Stream Side Management Zones (SMZs) in commercial forests throughout much of the Southeast. Composed primarily of mast-producing species, SMZs provide an important ecotone between pine plantations and riparian areas; have a lower basal area, and a more diverse understory than surrounding plantations (Dickson 1987). In general, SMZs consisting of hardwoods located within short-rotation, even aged pine plantations are used extensively by turkeys (Burk et al. 1990, Palmer and Hurst 1996), and hens use SMZs of all widths in most instances (Burk et al. 1990). At local levels, SMZs can be maintained in mature hardwoods to permit turkey use of a variety of habitats for foraging, nesting, and dispersal (Palmer and Hurst 1996). In general, protection of SMZs along all creeks in a drainage system benefits wild turkeys by providing quality habitat (Palmer and Hurst 1996).

The Sustainable Forestry Initiative® (SFI) is another program that benefits wild turkeys by combining perpetual growth and harvest with long-term protection of wildlife, plants, soil, and water quality (SFI 2005). Two core elements required to comply with SFI policy have direct impacts on wild turkey habitat. First, program participants develop and adopt appropriate policies for managing clearcut size (< 48.5 ha) and placement (SFIS 2004). Second, program participants have a "green up" requirement that provides age, habitat, and aesthetic diversity; where trees in clearcuts are at least 1.5 m tall at the desired level of stocking before adjacent areas are clearcut (SFIS 2004). Although commercial timberlands are typically homogenous pine monocultures, following SFI guidelines creates a mosaic of habitat types at various successional stages on the landscape (Smith et al. 1997). In combination with these guidelines, mid-rotational treatments such as pre-commercial or commercial thinning and prescribed fires greatly aid wildlife habitat enhancement within plantations (Stys et al. 1992, Smith et al. 1997).

Eastern wild turkeys have incorporated even-age pine plantations into many aspects of seasonal activities (Kennamer et al. 1980, Bidwell 1989, Burk 1990). In areas intensively managed for timber production, wild turkey hens use regenerated pine stands for nesting and brood rearing (Smith and Teitelbaum 1986, Burk et al. 1990), and are likely to choose nesting locations in close proximity to potential brood rearing habitat (Miller et al. 1999). Hens are possibly attracted to regenerated pine stands because of the preponderance of lateral, concealing cover that is considered ideal nesting and brood cover (Hurst and Dickson 1992, Miller et al. 1999). Both nesting and brood rearing habitat quality is vital for wild turkey population success (Hillestad and Speake 1970). For example, turkey broods in east Texas use a variety of habitat types including pine-hardwood and bottomland hardwood forests in association with clearcuts, utility rightsof-way, and open fields (Campo et al. 1989). Although broods will use recent clearcuts in intensively managed pine forests, broods tends to use mature stands that have received some intermediate silvicultural treatment (i.e., thinning or controlled burning) more than clearcuts (Campo et al. 1989). Pre-merchantable and merchantable thinning operations improve brood habitat in pine plantations by reducing stocking levels and canopy closure, both of which promote understory vegetation (Smith et al. 1997). Brood habitat can also be improved in mature pine forests through prescribed fire, which opens the understory and promotes growth of herbaceous vegetation (Wade and Lunsford 1988, Campo et al. 1989, Stys et al. 1992). Brood habitat management on areas intensively managed for pine production should be directed towards providing abundant herbaceous vegetation, maintaining an open canopy by moderate timber stocking, precommercial and commercial thinning, maintaining mature mast producing hardwoods in SMZs, and prescribed burning of pine stands (Campo et al. 1989).

Although seasonal male wild turkey habitat relationships have been well documented (Fleming and Webb 1974, Wigley et al. 1985, Hurst and Dickson 1992, Lelmini et al. 1992), most habitat research has focused on hen nesting and brood rearing. Regional comparisons of turkey populations with broadly defined landscape patterns have revealed few differences in spatial distribution of habitats and core habitat requirements for male and female wild turkeys throughout their annual cycle (Schroeder 1985, Porter 1992). Despite regional variation in habitat composition, the most common shift in local habitat use occurs during the breeding season where both males and females frequently and consistently use forest openings near nesting sites (Fleming and Webb 1974, Hurst and Dickson 1992).

Roost site selection of eastern wild turkeys is important, especially during periods of adverse weather (Chamberlain et al. 2000). Use of 11-20 year old pine plantations as roost sites is common in the Southeast (Smith and Teitelbaum 1986, Chamberlain et al. 2000). However, bottomland hardwood stands adjacent to permanent water sources have also been noted as roosting sites (Zwank et al. 1988, Chamberlain et al. 2000). Individual roost tree characteristics include large diameters and height, open crowns and layered, horizontal branching (Kilpatrick et al. 1988).

Longleaf Pine and Prescribed Fire

Historically, longleaf pines comprised one of the most extensive upland forest cover types in the Southeast, but only disconnected fragments remain (Hardin et al. 2001). Native longleaf pine stands have been heavily impacted by naval stores, logging, disruption of natural fire regimes, grazing, and more recently, by loss due to development, agriculture, and conversion to loblolly pine plantations (Hardin et al. 2001). Natural longleaf pine stands harbor an extraordinarily high number of vascular plant species, but conversion to even-aged plantations result in reduced numbers of understory species (Smith et al. 1997, Hardin et al. 2001). The importance of understory vegetation is well documented for successful wild turkey management, and its reduction in plantations is the basis for most hypotheses for wild turkey declines regionally (Holbrook 1973, Dickson 1992, Stys et al. 1992, Peoples et al. 1995).

Frequent summer fires are common throughout the range of longleaf pine and are thought to be a primary force in maintaining healthy longleaf pine stands (Hardin et al. 2001). Better understanding of fire effects on timber management has led to prescribed fire being commonly used to improve timber production and has also improved turkey habitat quality (Sisson et al. 1990, Smith et al. 1997), as fire promotes fresh growth of forbs, grasses, and cover while improving their nutritional qualities and palatability (Holbrook 1973). Careful and well-timed prescribed fire is also a critically important tool for wild turkey management within longleaf and loblolly pine forests in the Southeast (Holbrook 1973, Stys et al. 1992). Stys et al. (1992) found wild turkey hens used plantations with various burning regimes, indicating that there is a wide “window” of acceptable conditions regarding time since burning. Site-specific burning plans should be developed to best provide for seasonal turkey needs and scheduled to avoid nesting and brood rearing periods (Sisson et al. 1990, Stys et al. 1992).

Population Estimates/Gobble Counts

Estimating animal abundance presents many problems, especially for species such as wild turkeys that are elusive, mobile, and wide ranging (Healy and Powell 1999). The ability to accurately monitor population levels at a reasonable cost remains a persistent shortcoming in eastern wild turkey management (Cobb et al. 2001). Ideally, turkey population surveys should allow biologists to evaluate the influence of habitat conditions and habitat management practices on turkey population trends, so as to develop more reliable harvest management strategies and regulations (Kurzejeski and Vangilder 1992).

There are many different techniques that have been used to estimate wild turkey populations including mark-recapture, line or strip transects and direct flock counts; all with variable success (Kurzejeski and Vangilder 1992). Given the wide range of habitat types occupied by wild turkeys, no single method has been universally effective in estimating population sizes (Healy and Powell 1999). For example, direct winter counts and line or strip transects are seldom used in forested habitats because of difficulty in (1) obtaining an adequate sample size (i.e., detections) in areas with minimal roadside visibility and (2) meeting assumptions that individuals do not move before they are spotted (Healy and Powell 1999). However, throughout the Texas range of the Rio Grande subspecies, direct winter counts are sometimes used, assuming that all turkeys aggregate into observable flocks, that flock range and composition are stable and that all flocks can be located (Healy and Powell 1999). Sometimes, identification of some population demographic characteristics can be used as an index to the actual population (Williams et al. 2002), where such a reliable index changes in a predictable manner corresponding to changes in population size. However, no index estimates population size directly (Healy and Powell 1999), although indices are often used to monitor population trends at state and regional levels (Kurzejeski and Vangilder 1992).

A common low cost survey technique for turkeys is the call count (i.e., gobbling count). Gobbling counts were initiated in Minnesota in 1973 to monitor newly established turkey populations (Porter and Ludwig 1980). Gobbling counts provide three types of information: gobbling phenology, population distribution, and relative population abundance (Porter and Ludwig 1980, Healy and Powell 1999). Gobbling counts consist of a system of road survey routes that are sampled annually over a period of weeks during peak gobbling activity (Porter and Ludwig 1980, Healy and Powell 1999). Permanent listening stations are established at approximately 0.8 km internals along routes that are typically 14.5 to 19 km long (Porter and Ludwig 1980, Healy and Powell 1999). Each listening station is sampled for 4 min where the number of individual birds heard gobbling, the total number of gobbles heard, and any interference noises are recorded (Porter and Ludwig 1980, Healy and Powell 1999).

However, several key assumptions exist for use of gobble counts as reliable indices of abundance (Healy and Powell 1999). It is assumed that (1) the survey does not influence gobbling activity, (2) all observers are equally efficient at detecting vocalizations, (3) gobbling activity is influenced by time of day, weather, and time of year, and (4) the relationship between population size and gobbling activity is constant (or consistent) (Healy and Powell 1999). Of these, this final assumption presents the most serious potential problem concerning validity of gobbling counts as an indicator of turkey population distribution and abundance. For example, there are substantial variations among individuals within populations, and gobbling seems to be influenced by age structure and physical condition of the population, not just density (Healy and Powell 1999). In Minnesota, the maximum number of groups of gobblers heard in spring, adjusted by average number of individuals per male group, was significantly correlated with winter flock counts (Porter and Ludwig 1980). Disjunct populations in east Texas may not meet this assumption, resulting in incorrect estimation of turkey abundance, depending upon the nature of gobbling activity for a given year. Nonetheless, call counts (gobble counts) can provide basic presence/absence data (detection/non-detection), and over time, be used to monitor long-term trends in distribution of populations within a region (Royle and Nichols 2003).

Gobble counts are particularly useful for detecting the presence of low-density populations and determining the distribution of flocks prior to spring hunting season (Healy and Powell 1999). In addition to providing a reduced-effort approach to large scale monitoring, presence/absence surveys directed at occupancy and distribution are very useful for metapopulation studies (Royle and Nichols 2003). This technique is also cost effective, as related to the type of data they can provide (Porter and Ludwig 1980). Advantages to using gobbling counts as indices to abundance include (1) the distance at which gobbles can be detected, (2) the lack of disturbance to the population, and (3) the ability of the survey to be conducted in all habitat types. The use of such indices may be sufficient, if the only goal is to determine occupancy or gross-scale distribution in an area or region (Healy and Powell 1999). The use of indices to monitor population trends may be the only practical method in situations where obtaining accurate counts of animals is difficult (Healy and Powell 1999).

There are several disadvantages and uncontrollable aspects to consider when applying call counts as indices to abundance. Gobbling counts are highly influenced by day-to-day variations in turkey gobbling activity (Scott and Boeker 1972, Dickson 1992). Daily gobbling activity is affected by chronology of breeding activity, population age and sex ratios, gobbler condition, weather, and individual variation, all of which are difficult to control or predict within the constraints of a sampling design (Healy and Powell 1999). Some means to control sources of extrinsic variation include standardization of some survey elements, such as conducting surveys only in appropriate weather conditions, careful selection of listening positions, and obtaining a large sample of simultaneous survey records (Kurzejeski and Vangilder 1992). Variability among participants conducting surveys is also an important component (Healy and Powell 1999), as observers should be thoroughly trained and meet a minimum hearing requirement before being allowed to participate in the survey (Healy and Powell 1999).

Geographic Information Systems

The analysis of species-habitat relationships has long been a central issue in ecology and wildlife sciences (Guisan and Zimmermann 2000). Improvements in quality of spatial imagery and analytical tools and techniques using geographic information systems (GIS) have greatly aided in understanding and predicting wildlife-habitat relationships (Franklin et al. 2002, Mason et al. 2003). Such geospatially linked data, combined with advances in software-technology now provide a set of powerful tools that allow spatial data to be collected, stored, maintained, transformed and displayed, eventually allowing for analyses of complex spatial problems (Danks and Klein 2002). The use of GIS in wild turkey research has only recently become popular, but GIS has been used to analyze many aspects of wild turkey behavior and biology including large-scale habitat suitability, local habitat selection, landscape attributes associated with nest site selection and mortality as well as regional population distribution, home range size, and daily movements (Donovan et al. 1987, Kimmel at al. 1999, Miller et al.1999, Thogmartin and Schaeffer 2000). With continued improvements to remote sensing products the use of GIS as a tool to analyze turkey distribution in relation to habitat variables will greatly contribute to understanding and implementing land management practices that will aid future wild turkey management decisions.

APPENDIX B

CITATIONS FOR PROFESSIONAL AND INVITED PRESENTATIONS DELIVERED

AS A PORTION OF RESEARCH RELATED TO

TPWD-SFASU CONTRACT 153496

Professional and Invited Presentations: (* presenter).

9. *Conway, W. C. 2009. Eastern wild turkey research in East Texas: research update addressing regional turkey population management. Invited Presentation to the Texas Upland Game Bird Council and Migratory Game Bird Advisory Committee Spring Council Meeting. Austin, Texas. March 10, 2009.

8. *Conway, W. C. 2008. Eastern wild turkey research and management in East Texas: ideas for small private landowners. Invited Presentation for the Texas Parks and Wildlife Department Conference on Managing Small Acres for Wildlife. Tyler, Texas. September 13, 2008.

7. *Conway, W. C. 2008. Eastern wild turkeys in East Texas: historical and current research on regional wild turkey population management. Invited Presentation for 42nd Annual Meeting of the Texas Council of Chapters, Soil and Water Conservation Society. Nacogdoches, Texas. June 12, 2008.

6. Bass, J. R., **W. C. Conway**, G. E. Calkins, and T. W. Schwertner. 2008. Annual and spring home range size of male Eastern wild turkeys on the Angelina National Forest in East Texas. 2nd Bright Ideas Conference. Stephen F. Austin State University, Nacogdoches, Texas. April 24-25, 2008.

5. Comer, C. E., *W. C. Conway, B. C. Koerth, J. C. Kroll, and D. G. Scognamillo. 2008. Wildlife management research at Stephen F. Austin State University: program development and initiation of the Simon and Louise Henderson Wildlife Research Institute. Spotlight Presentation for the Arthur Temple College of Forestry and Agriculture; 2nd Bright Ideas Conference. Stephen F. Austin State University, Nacogdoches, Texas. April 24-25, 2008.

4. *Bass, J. R., W. C. Conway, G. E. Calkins, and T. W. Schwertner. 2008. Annual and spring home range size of male Eastern wild turkeys on the Angelina National Forest in East Texas. 43rd Annual Meeting of the Texas Chapter of The Wildlife Society. San Antonio, Texas. February 14-16, 2008.

3. *Bass, J. R., W. C. Conway, and C. E. Comer. 2007. Use of GIS analyses to evaluate and adjust gobble count survey routes in East Texas. Eastern Wild Turkey Research Update Meeting, 2007. Nacogdoches, Texas. November 12, 2007.

2. *Conway, W. C. 2007. Eastern wild turkey research in East Texas: genesis and approaches to addressing turkey population management issues in the region. Eastern Wild Turkey Research Update Meeting, 2007. Nacogdoches, Texas. November 12, 2007.

1. *Conway, W. C. 2007. Wildlife management research highlights at Stephen F. Austin State University. 10th Annual WildLife Convention of the Texas Wildlife Association, San Antonio, Texas. June 30, 2007.

Use of GIS Analysis to Evaluate and Adjust Gobble Count Survey Routes in East Texas

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Introduction

- Eastern Wild Turkey (*Meleagris gallopavo silvestris*) populations in East Texas reached an all time low in the early 1900's due to unregulated market and subsistence hunting combined with habitat alteration and destruction.

- Texas Game, Fish and Oyster Commission began restocking efforts as early as 1924 with releases of Rio Grande Turkeys (*Meleagris gallopavo intermedia*) into East Texas.

- Continued releases of Rio's and semi-wild pen-reared Eastern Wild Turkeys into the early 1950's proved largely unsuccessful.

Introduction

- With the advent of rocket nets during the 1950's, trapping and releasing of Eastern Wild Turkeys led to one of the most successful wildlife restoration programs in U.S. history.

Introduction

- Despite repeated attempts to restock Eastern Wild Turkeys in East Texas, wide spread establishment of a sustainable population has yet to become a reality.

- Restocking success has come in the form of isolated populations that are largely centered around public lands within the region.

- Small populations do exist on private lands although their distributions are not well understood.

Introduction

- Texas Parks and Wildlife currently sample 20 gobble count routes in East Texas to obtain an estimate of Eastern Wild Turkey distribution.
- Original gobble count routes were located in areas where populations were known to exist in association with federal and state lands as well as areas where prior restocking efforts were concentrated.
- Original East Texas gobble count surveys were not sampled on an annual basis leading to inconsistent data collection and reporting.

Introduction

- Gobble counts generally provide three types of information:

  Phenology of Gobbling
  Population Abundance
  Population Distribution

- Advantages: Gobble counts are particularly useful for detecting the presence and distribution of low density populations.

- Disadvantages: Large day-to-day variation, weather, observer bias, route placement

Justification

- Because of the long history of reintroductions in the region, hypotheses have been formulated that populations are disjunct and variable in their permanence and habitat use.

- Because of rapid habitat changes due to intensively managed commercial timber operations throughout the region, habitat suitability for wild turkeys likely changes on annual or semi-annual basis.

- Improvements to aspects of gobble count sampling design and route placement should allow for more accurate surveys and estimates of distribution patterns throughout East Texas.

Objectives

- Conduct surveys along current gobble count routes, in order to verify turkey use of currently sampled habitat.

- Capture and radio mark wild turkeys to:
  - Evaluate habitat use during the period of peak gobbling activity.
  - Evaluate habitat use throughout the annual cycle.

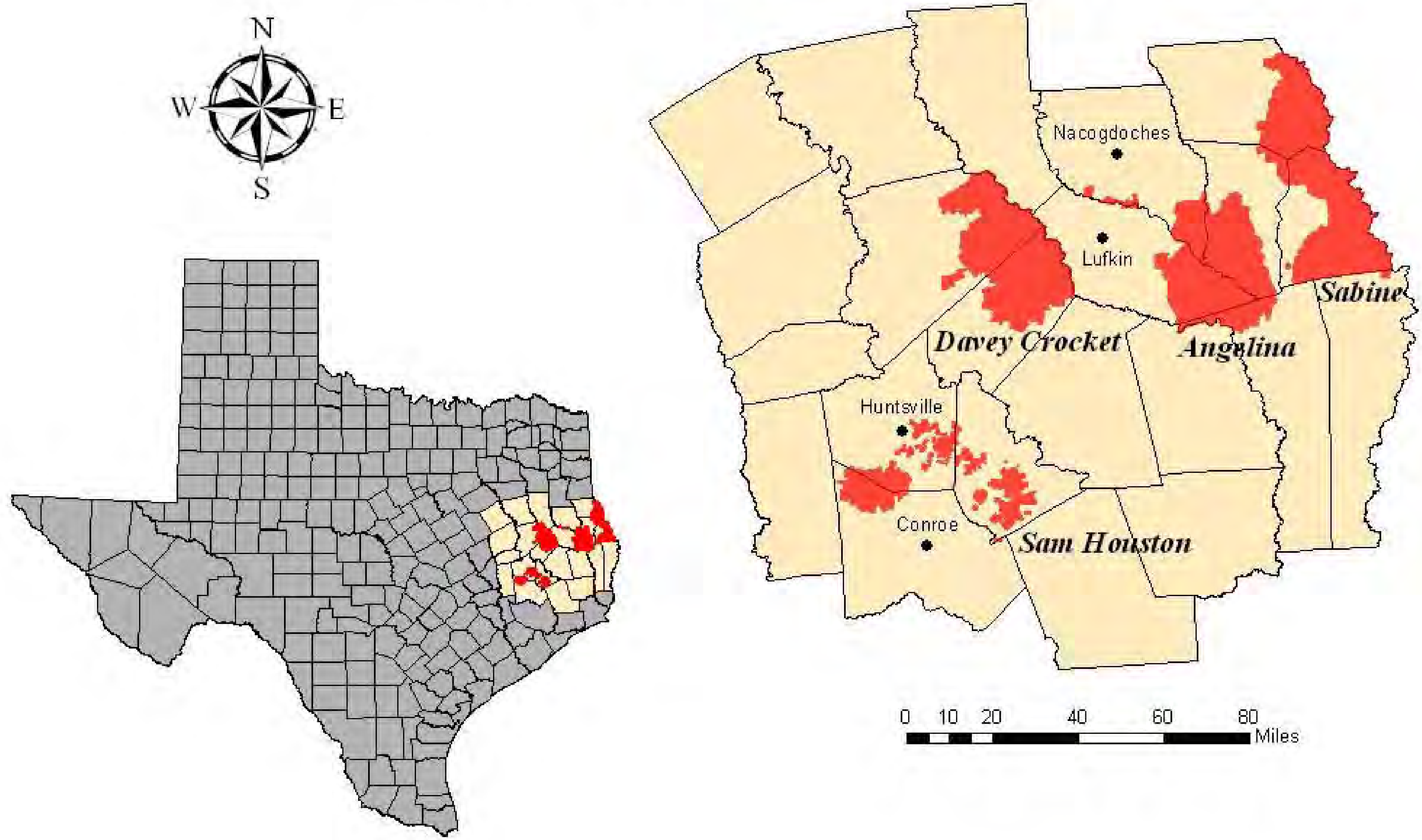
- Incorporate field generated data into a Geographic Information System (GIS) to:

  - Develop a predictive model to identify core areas of use during the period of peak gobbling activity.

  - Identify optimal route placement throughout East Texas based upon model generated data.

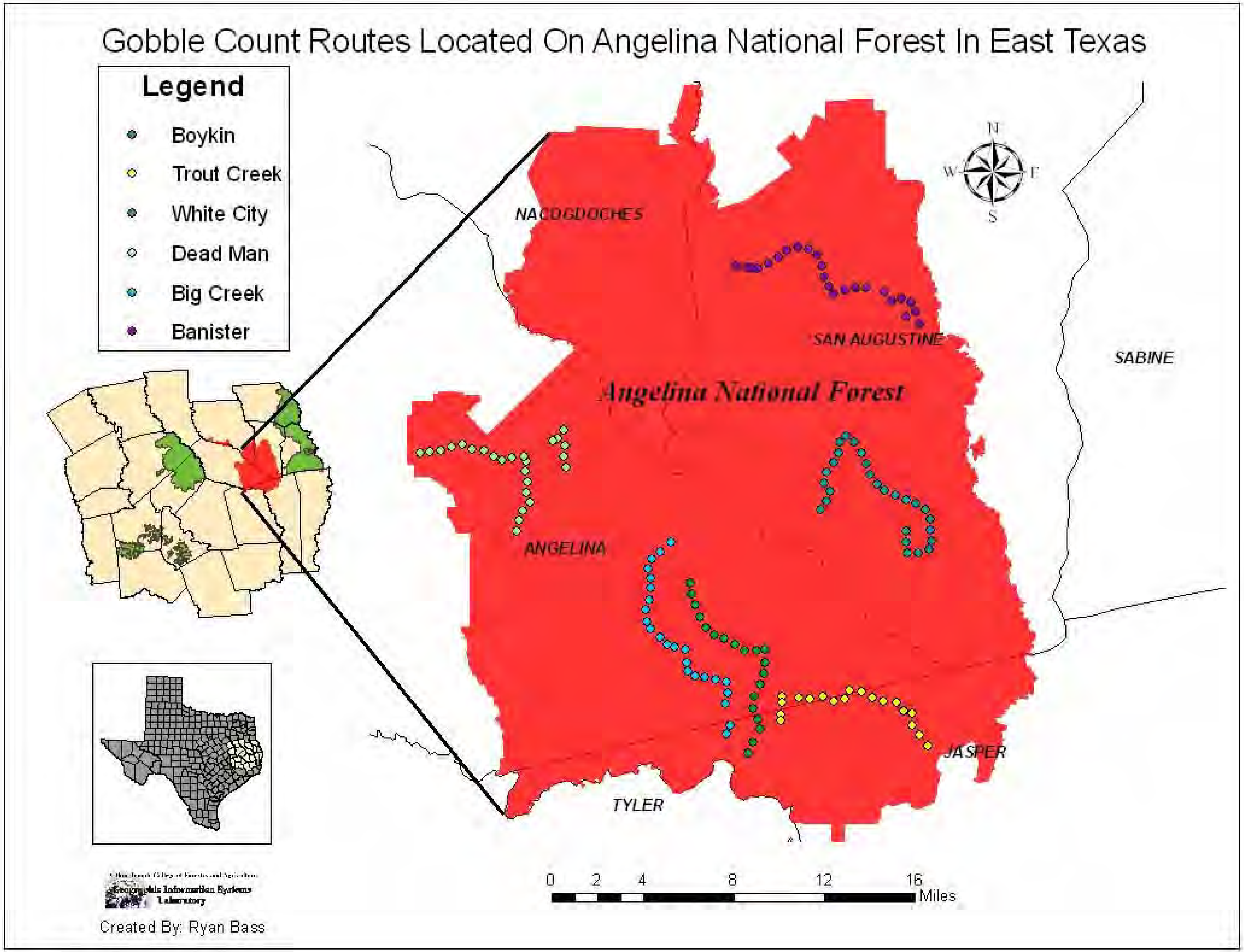
- Conduct gobble counts along newly established routes and utilize digital field recorders to help collect presence/absence data.

National Forest Locations In East Texas



Arthur Temple College of Forestry and Agriculture
Geographic Information Systems Laboratory

Created By: Ryan Bass



Gobble Count Routes Located On Angelina National Forest In East Texas
Legend
Boykin
Trout Creek
White City
Dead Man
Big Creek
Banister
NACOGDOCHES
SAN AUGUSTINE
SABINE
Angelina National Forest
ANGELINA
JASPER
TYLER
N
S
W
E
0 2 4 8 12 16
Miles
Created By: Ryan Bass

Methods: Gobble Counts

- Gobble count surveys are annually conducted along established transects during late March into early April.
- Sample points are spaced 0.8 km apart along routes that are approximately 14 - 19 km long. Fixed sampling points are marked with a fluorescent green blaze on trees along each route.
- Routes are not to be sampled during periods of inclement weather or if winds are gusting > 8 mph.

Methods: Gobble Counts

- At each stop during a 2 minute listening period the observer records number of gobbles, number of individuals heard, bearing and estimated distance to gobble and any noise interference.

- Each route is sampled 4 times (twice weekly) in opposite directions starting 30 minuets before sunrise.

- In order to enhance detection probabilities, attempts were made to elicit vocalizations prior to the 2007 survey.

- Gobble count protocol in East Texas was established by John Burk

Methods: Capture and Handling

- With assistance from TPWD and USFS biologist, areas on the southern portion of Angelina National Forest were identified as potential trapping sites.

- Bait sites were checked daily at mid-day for evidence of turkey activity. In 2007 Cuddeback® Expert digital cameras were used to monitor sites.

Methods:Capture and Handling

- Baiting was initiated in late January 2006/2007. Baiting ceased March 14th for both years.

- 9 x 18 m skirted nets with 3 Win-Star, Inc. rockets launched from ground level ramps were used for trapping.

Methods: Capture and Handling

- Captured males were fitted with an Advanced Telemetry System (ATS) backpack transmitter and TPWD leg band. Age, spur length and beard length were recorded. Blood samples were collected via the brachial artery.

- Captured females were aged, received a TPWD leg band and had a blood sample collected. Females captured in 2007 were fitted with ATS backpack transmitters.

Methods: Hunting Club Surveys

- To expand our trapping efforts onto private lands, Temple Inland Corp. hunting clubs were asked to participate in a survey during the 2005-2006 deer season allowing us to identify areas that would provide trapping opportunities.
- A secondary objective of the survey was an attempt to estimate average winter flock size and sex ratio.
- Hunters were provided with an identification card to reduce bias from gender misidentification.

Methods: Radio Telemetry

- An attempt was made to locate radioed individuals daily from time of capture through May of each year to estimate habitat use and home range throughout the period of peak gobbling activity.

- Locations were obtained weekly throughout the remainder of the year.
- Three bearings recorded < 6 minutes apart were taken for each bird.
- To aid in telemetry data collection, 66 fixed stations consisting of 3 points spaced100m apart were established across the study area. All points were marked with sub-meter accuracy.

Methods: Route Habitat Evaluation

- Habitat for each gobble count route in the study area was evaluated for species composition and density.

- Four 1/25th ha plots with 1/300th ha sub plots were measured at each listening station.

- Plots were located perpendicular to the road at 50 m and 100 m.

- At each plot basal area using a 10 BAF prism, quantity and diameter of all trees > 15.25 cm and height and species of dominant tree was recorded. Sub-plots measured species >2.54 cm and < 15.25 cm

Methods: Habitat Evaluation at Estimated Locations

- All estimated locations for each radioed individual were displayed in Arc GIS 9.2
- The nearest neighbor feature in Hawth's tools extension of GIS was used to select all locations > 50 m apart.
- Selected points were transferred into a Trimble Geo XH GPS with external antennae. Navigation to estimated locations was possible to < 1m.
- Habitat sampling methods at estimated locations were identical to that of gobble count routes.

Methods: Home Range Kernel Analysis

- Kernel home range tool from the home range extension of Arc GIS 9.2 was used to evaluate annual and spring home ranges per individual.
- In addition to calculating home range estimates the kernel estimator identifies areas of concentrated use which will aid future GIS habitat modeling.
- Volume contours created by the kernel method connect regions with an equal probability of occurrence. All reported home range sizes are 90% probability polygons.

Results: Gobble Count Data 2003-2007

Table1. Cummulative Eastern Wild Turkey Gobble Count Survey Results in East Texas 2003 - 2007

Year	National Forest	Number of Routes Sampled	Number of Routes With Gobbles Detected	Individuals Detected
2003	Angelina	12	7	30
2003	Davey Crocket	0	0	0
2003	Sabine	0	0	0
2003	Sam Houston	0	0	0
Totals		***12***	***7***	***30***
2004	Angelina	16	9	59
2004	Davey Crocket	0	0	0
2004	Sabine	0	0	0
2004	Sam Houston	0	0	0
Totals		***16***	***9***	***59***
2005	Angelina	16	9	35
2005	Davey Crocket	3	0	0
2005	Sabine	0	0	0
2005	Sam Houston	0	0	0
Totals		***19***	***9***	***35***
2006	Angelina	13	6	11
2006	Davey Crocket	4	0	0
2006	Sabine	0	0	0
2006	Sam Houston	0	0	0
Totals		***17***	***6***	***11***
2007	Angelina	20	6	8
2007	Davey Crocket	4	0	0
2007	Sabine	16	4	7
2007	Sam Houston	32	0	0
Totals		***72***	***10***	***15***

Results: 2006 Capture Summary

Table 2. 2006 Eastern Wild Turkey Capture/Release Data For The Southern Angelina National Forest

Frequency	Band I.D.	Sex Age	Spur Length (cm)	Beard Length (cm)	Capture Date	Status	Last Location	Cause of Mortality
150.145	45451	M (AD)	2.2 - 2.3	24.0	02/23/2006	Dead	05/25/2006	Unknown*
151.377	45452	M (AD)	2.5 - 2.6	27.0	02/23/2006	Lost	01/24/2007	Lost
151.086	45453	M (AD)	2.2 - 2.5	25.5	02/23/2006	Dead	04/26/2007	Harvest
151.344	45454	M (AD)	2.1- 2.3	26.0	02/23/2006	Alive	06/21/2007	
150.096	45455	M (AD)	2.4 - 2.6	26.0	02/26/2006	Dead	02/19/2007	Unknown
151.325	45456	M (AD)	2.4 - 2.5	25.0	02/28/2006	Dead	12/21/2006	Unknown
150.116	45457	M (AD)	2.2 - 2.1	25.0	02/28/2006	Dead	04/25/2006	Crippled
150.405	45458	M (AD)	2.8 - 2.8	26.0	03/03/2006	Dead	04/25/2006	Crippled
150.396	45459	M (AD)	1.9 - 1.6	24.0	03/03/2006	Lost	05/04/2006	Lost*
151.063	45460	M (JV)	1.0 - 0.7	10.1	03/07/2006	Dead	04/13/2007	Harvest*
South Carolina Release					**Release Date**			
150.416	A-408	M (JV)	0.6 - 0.4	11.9	03/10/2006	Dead	08/09/2006	Unknown
150.626	A-409	M (JV)	0.8 - 0.2	6.5	03/10/2006	Alive	06/22/2007	
151.336	A-410	M (JV)	0.4 - 0.3	3.9	03/10/2006	Dead	04/02/2007	Harvest
150.614	A-411	M (JV)	0.3 - 0.4	7.2	03/10/2006	Dead	04/02/2007	Harvest
150.067	45461	M (JV)	0.5 - 0.4	10.0	03/11/2006	Dead	04/01/2007	Harvest
150.126	45462	M (JV)	0.8 - 0.5	9.8	03/11/2006	Dead	03/31/2007	Unknown
150.405	A-407	M (JV)	0.8 - 0.7	12.0	03/11/2006	Dead	03/13/2006	Trap Related

* indicates transmitter failure

Results: 2007 Capture Summary

Table 3. 2007 Eastern Wild Turkey Capture Data For The Southern Angelina National Forest

Frequency	Band I.D.	Sex Age	Spur Length (cm)	Beard Length (cm)	Capture Date	Status	Last Location Date	Cause of Mortality
150.574	2534	M (AD)	R 1.8, L 1.8	22.2	01/30/2007	Alive	09/01/2007	
150.533	2533	M (AD)	R 2.1, L 2.3	22.2	01/30/2007	Dead	04/26/2007	Harvested
150.473	2545	M (AD)	R 2.2, L 2.5	22.8	01/30/2007	Alive	10/06/2007	
150.773	t2546	M (JV)	R 0.6, L 0.6	7.0	01/31/2007	Alive	10/06/2007	
150.054	t2537	M (JV)	R 0.5, L 0.4	8.9	01/31/2007	Alive	10/06/2007	
150.193	t2538	M (JV)	R 0.4, L 0.4	7.6	01/31/2007	Alive	09/21/2007	
150.654	A461	M (JV)	R 0.4, L 0.4	6.3	02/14/2007	Alive	09/21/2007	
150.253	A462	M (JV)	R 0.4, L 0.5	7.6	02/14/2007	Alive	10/06/2007	
150.012	45216	M (AD)	R 2.4, L 2.8	26.1	02/15/2007	Dead	07/20/2007	Unknown
150.333	45215	M (AD)	R 2.6, L 2.7	20.4	02/15/2007	Dead	04/22/2007	Harvested
150.694	45214	M (AD)	R 2.7, L 2.7	28.7	02/15/2007	Alive	09/21/2007	
150.731	A-460	M (AD)	R 2.1, L 2.6	25.5	02/23/2007	Dead	04/04/2007	Harvested

Results: 2006-2007 Radio Telemetry Summary

Table 4. 2006-2007 Eastern Wild Turkey Radio Telemetry Summary For The Angelina National Forest

Year	Spring		Annual		Bearings	Locations
	Bearings	Locations	Bearings	Locations	Total	Total
2006	867	289	747	249	1614	538
2007	2078	693	246	82	2324	775
Total	**2945**	**982**	**993**	**331**	**3938**	**1313**

- Locate III freeware software was used to calculate estimated locations for all radio telemetry data

Results: Annual Home Range Estimates

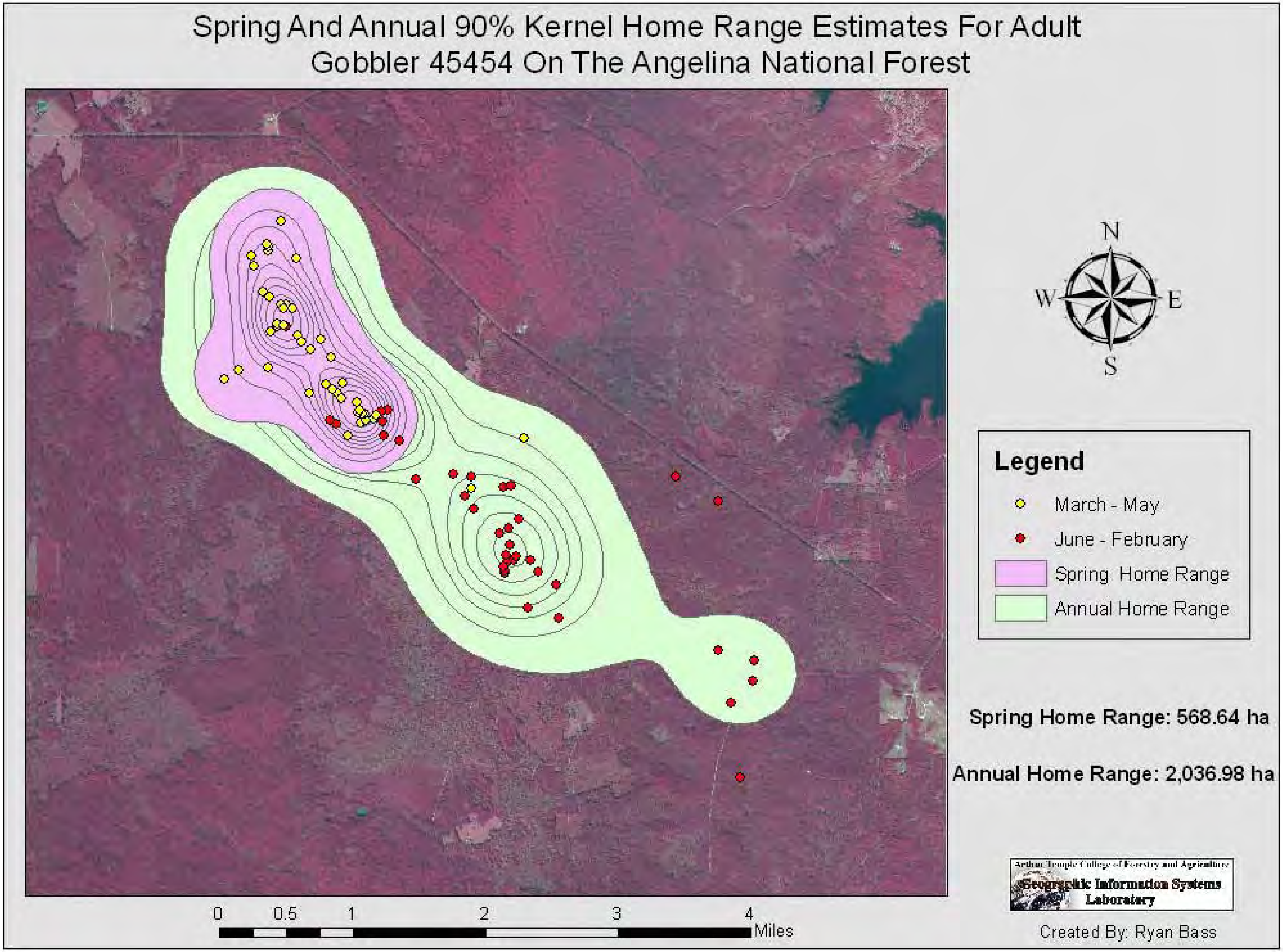
Table 5. Annual Kernel Home Range Estimates For Wild Trapped and Released Eastern Wild Turkeys on Angelina National Forest

Wild Trapped Adults			Wild Trapped Juveniles			Released Juveniles		
Frequency	Hectares	n	Frequency	Hectares	n	Frequency	Hectares	n
150.086	2555.61	61	150.773	1014.84	74	150.067	1288.94	52
150.377	1400.57	43	151.063	973.77	41	150.126	1070.25	47
150.096	409.02	56	150.054	1211.45	77	150.614	1577.37	27
151.325	797.59	49	150.193	1344.18	64	150.626	1383.88	88
151.344	2036.98	82	150.654	2049.57	62	151.336	2218.36	29
150.116	884.55	18	150.253	1031.19	72	***mean***	***1507.76***	***48.6***
150.405	777.82	22	***mean***	***1270.83***	***65***	***max***	***2218.36***	***52***
150.396	1892.19	38	***max***	***2049.57***	***41***	***min***	***1070.25***	***27***
150.574	1564.70	60	***min***	***973.77***	***74***			
150.533	594.40	27						
150.473	1632.27	62						
150.012	576.05	62						
150.333	1213.82	25						
150.694	1331.00	58						
mean	***1261.90***	***47***						
max	***2555.61***	***82***						
min	***409.02***	***18***						

Results: Spring Home Range Estimates

Table 6. Spring Kernel Home Range Estimates For Wild Trapped and Released Eastern Wild Turkeys on Angelina National Forest

Wild Trapped Adults			Wild Trapped Juveniles			Released Juveniles		
Frequency	Hectares	n	Frequency	Hectares	n	Frequency	Hectares	n
150.012	720.03	47	150.054	1512.66	50	150.067	1290.65	28
150.086	2402.77	41	150.193	1165.59	43	150.126	568.91	26
150.096	299.77	29	150.253	951.82	52	150.614	502.84	11
150.116	1007.79	18	150.654	2256.98	44	150.626	1275.13	48
150.333	1393.41	25	150.773	1072.28	50	151.336	1872.63	13
150.377	1016.21	22	151.063	1093.06	27	***Mean***	***1102.03***	***25***
150.396	1357.22	18	***Mean***	***1342.065***	***44***	***Max***	***1872.63***	***48***
150.405	878.55	22	***Max***	***2256.98***	***52***	***Min***	***502.84***	***11***
150.473	1036.50	45	***Min***	***951.82***	***27***			
150.533	655.86	27						
150.574	1685.54	42						
150.694	1214.83	39						
151.325	922.90	22						
151.344	568.64	44						
Mean	***1082.86***	***32***						
Max	***2402.77***	***47***						
Min	***299.77***	***18***						



Spring And Annual 90% Kernel Home Range Estimates For Adult
Gobbler 45454 On The Angelina National Forest
N
W
E
S
Legend
March - May
June - February
Spring Home Range
Annual Home Range
Spring Home Range: 568.64 ha
Annual Home Range: 2,036.98 ha
0
0.5
1
2
3
4
Miles
Arthur Temple College of Forestry and Agriculture
Geographic Information Systems Laboratory
Created By: Ryan Bass

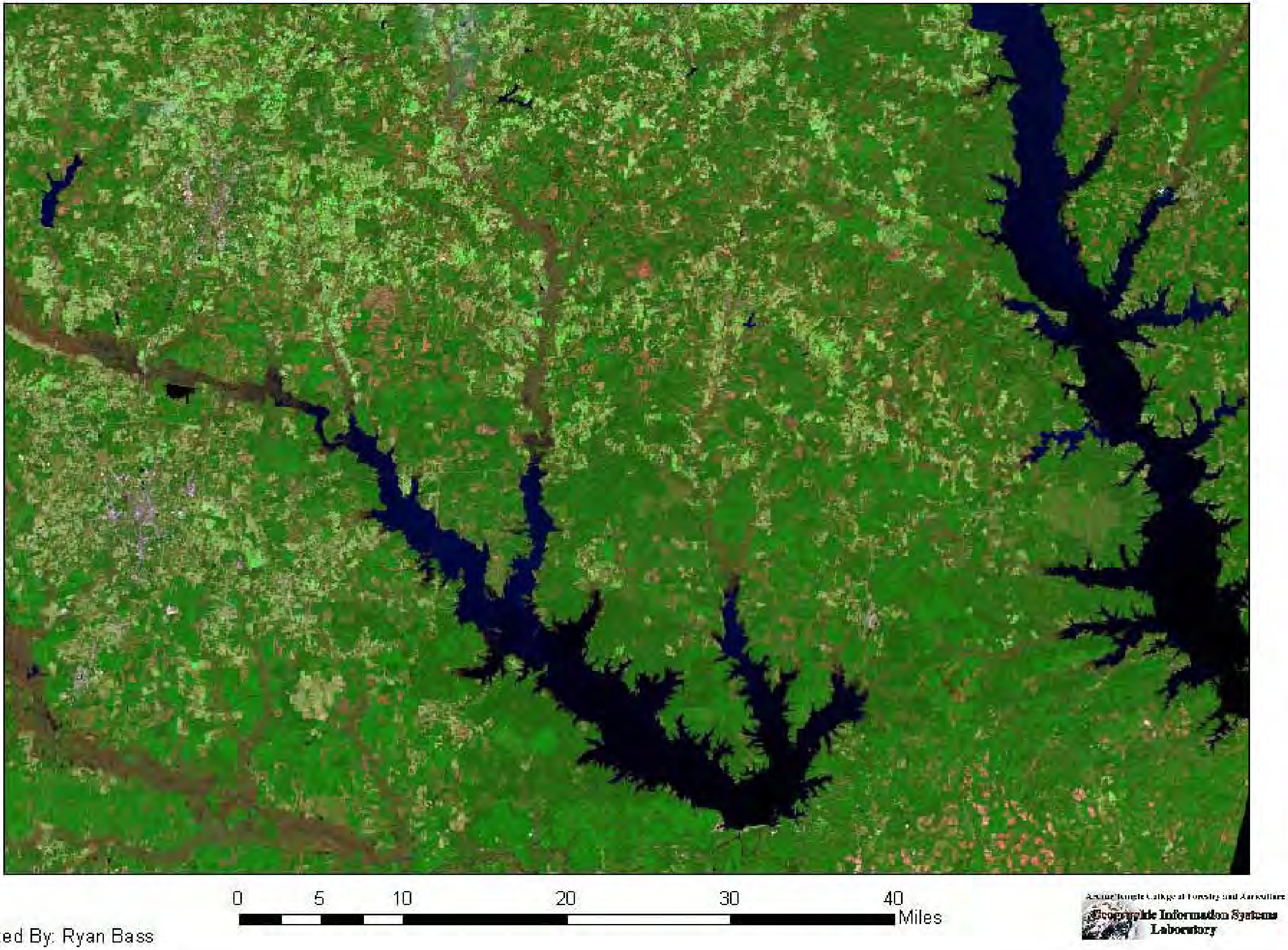
Landsat Enhanced Thematic Mapper Image Of Angelina N.F.
WIth Overlay Of Kernel Home Range Polygons

0 1 2 4 6 8 Miles

Created By: Ryan Bass

Geographic Information Systems Laboratory

Landsat Enhanced Thematic Mapper Image Of Sam Rayburn And Toledo Bend Reservoirs in East Texas



Created By: Ryan Bass

Discussion

- Analysis of habitat sampling data is still in preliminary stages.
- Upon completion this data will be used for field verification of our spatial analysis.
- Field work in Spring 2008 will be focused on sampling of newly established routes and analyzing data from digital recorders.

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- Arthur Temple College of Forestry

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Eastern Wild Turkey Research in East Texas:
Genesis and Approaches to Addressing Turkey Population Management Issues in the Region

A Collaborative Effort Among Partners from

Texas Parks and Wildlife Department

National Wild Turkey Federation

Private Landowners

U.S. Forest Service

Texas A&M University

Stephen F. Austin State University

Eastern wild turkeys in Texas

- Historically, Eastern wild turkeys (*Meleagris gallopavo silvestris*) were found throughout the southeastern United States
- Localized overharvesting and alterations in land use practices negatively impacted turkeys throughout its range
  - resulted in unsuitable turkey habitat
  - forced remaining populations to become concentrated in remaining habitats
- In East Texas, the eastern subspecies (*M. g. silvestris*) was the endemic turkey
- In 1941, turkey season closed in the Pineywoods Ecoregion
  - by 1942, < 100 turkeys were estimated to exist within the region

From Newman (1945)

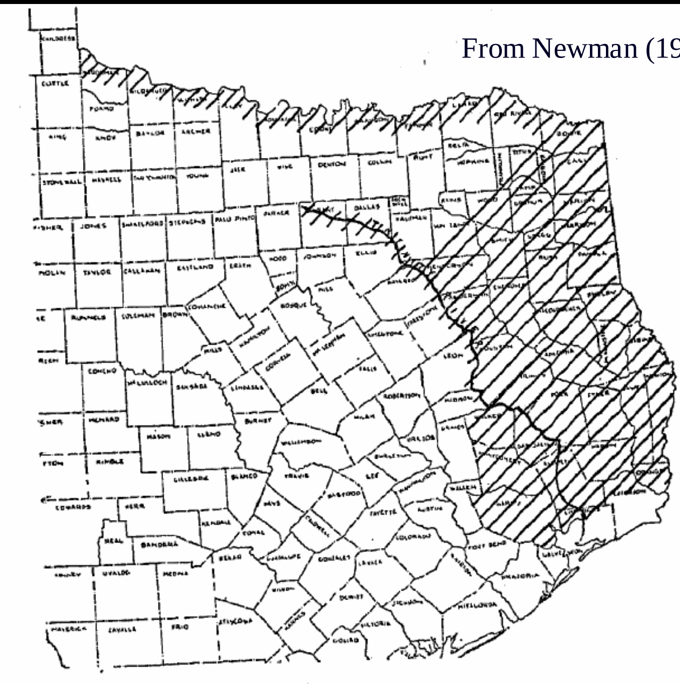
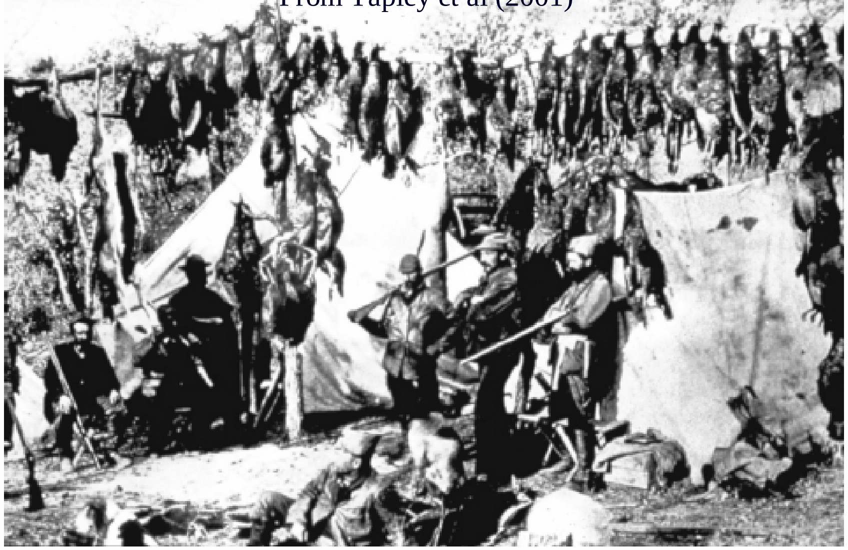


Fig. 1.—Original distribution of Eastern Wild Turkey in Texas (////).

From Tapley et al (2001)



Subsistence hunting was a major factor causing the decline of wild turkeys.

Eastern wild turkeys in Texas: low point

TABLE 1.—LATEST KNOWN RECORDS OF NATIVE EASTERN TURKEY IN SOME TEXAS COUNTIES.

County	Place	Year	Authority
Angelina	Angelina River Bottom, Attoyac	1932	C. P. Stewart
Bowie	Red and Sulphur rivers	1910	Hugh Ashford
Camp	Cypress Creek	1910	J. D. Bass
Cass	Sulphur River	1913	R. W. McCoy
Chambers	Old River Bayou	1904	H. Harman
Cherokee	17 mi. n. of Jacksonville	1919	Arthur Sharp
Fannin	Red River Bottom	1888	Mr. Coleman
Franklin	Sulphur River	1919	Wildlife Planning Board
Hardin	Beech Creek at Village Creek	1930	D. W. Lay
Henderson	Flat Creek	1910	A. P. Perry
Houston	5 mi. e. of Crockett	1921	R. R. Stockton
Hunt	Cado Creek	1923	Bill Arnold
Jasper	Boat Lake	1937	Roy Blake
Jefferson	Common sw. of Beaumont; probable kills after 1886	1886	H. C. Hillebrandt
Kaufman	Trinity River, East Fork	1893	A. W. Lewis
Lamar		1883	Gus Cothran
Liberty	Luces Bayou	1932	G. C. Gardner
Marion	Big Cypress	1939	John Markos
Montgomery	10 mi. se. Conroe	1939	W. E. McKay
Newton	Nr. Devil's Pocket	1936	Jim Hicks
Panola		1912	
Polk	Piney Creek, Pate pasture; caught in steel trap	1937	Ed. Proone
Rains	Sabine River	1908	County Wildlife Planning Board
Rusk	Turkeys trapped out	1897	H. W. Watson
Sabine	10 mi. se. Hemphill	1939	Art Scilling
San Augustine	Mouth of Attoyac River	1938	Fischer Osburn
Smith	Nw. part of county	1908	J. H. Mosley
Titus	Sulphur River, Jones Crossing	1913	J. D. Bass
Trinity	Kickapoo Creek	1930	R. R. Stockton
Tyler	Neches River, Wolf Creek	1940	John Knight
Upshur	Big Woods	1918	J. D. Bass
Van Zandt	Koon Creek	1910	Bob Wisdom
Wood	"Big Woods"	1917	Arch Moore

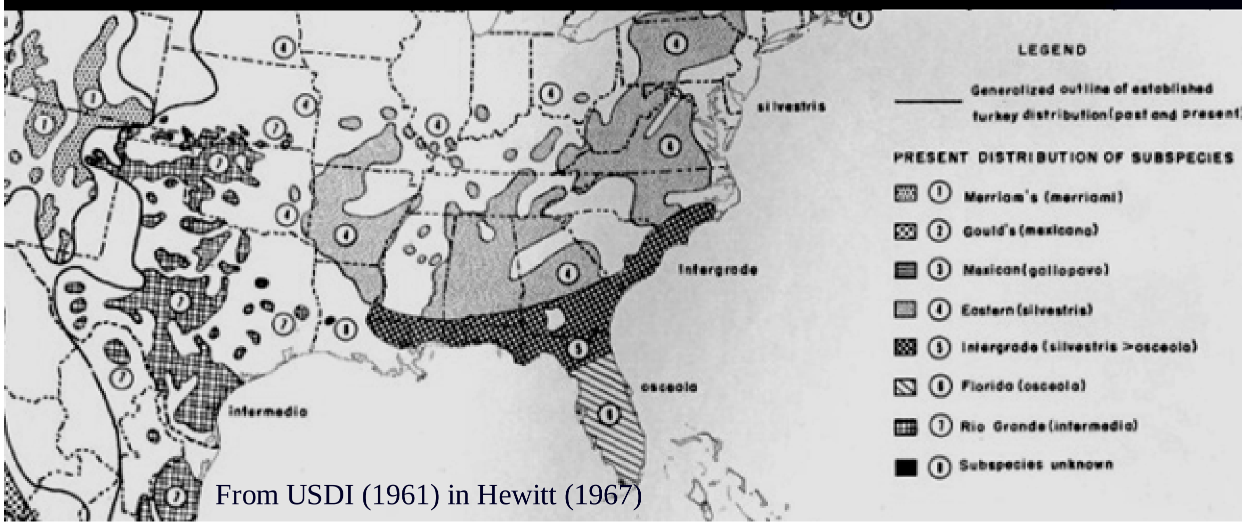
(from Newman 1945)

Eastern wild turkeys in Texas: changes in habitat

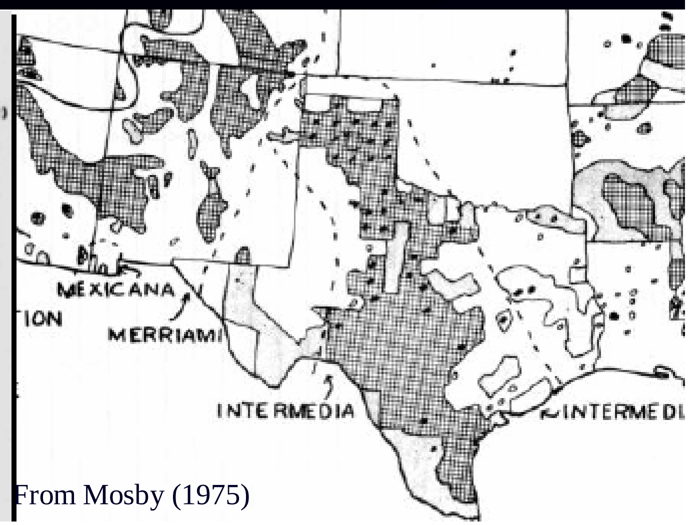
- Prior to removal of virgin forests, the Pineywoods Ecoregion was dominated by longleaf pine (*Pinus palustris*) savannas, other (pine) forests, and bottomland hardwood forests
  - 1936 estimates in East Texas (Newman 1945)
  - Longleaf pine savanna: approx. 1 million acres
  - Bottomland hardwoods: approx. 1.8 million acres
  - Other forest types: approx. 8 million acres (2001, approx. 6 million acres total)
- Much of the region was cultivated for annual food and fiber crops
  - over time provided edge habitats near fields and in young, regenerating forests
- Reports from the 1930s and 1940s noted the obvious absence of Eastern wild turkeys in the region
- However, for several decades following World War II, East Texas contained a diversity of row crop agricultural lands, interspersed with forested habitats
  - in which *Northern bobwhite* were abundant (Lay 1965)
- Even as early as the 1950s and 1960s, there were concerns about even age pine and hardwood forest harvest management impacts upon turkeys in the southeast

Eastern wild turkeys in Texas: changes in habitat

- Many of the same concerns regarding declines in *Northern bobwhite* in East Texas also apply to issues with *Eastern wild turkeys* regionally as well
  - emphasis upon timber and fiber production
  - conversion of pine forests to loblolly pine plantations
  - proliferation of even-aged pine plantation management
  - degradation, harvest, and even-aged management of bottomland hardwood forests
  - removal/alteration of fire regimes in forested ecosystems
  - CRP in the form of more even-aged pine plantations, rather than grass or forb cover as found on CRP lands throughout Texas and the mid-west



From USDI (1961) in Hewitt (1967)



From Mosby (1975)

Eastern wild turkeys in Texas: restoration (1924-1941)

- To address population concerns regionally, turkeys were released in East Texas as early as 1924
- Florida, Rio Grande, & pen reared Eastern wild turkeys were released in some early attempts
  - Limited success
- *18/19 Rio attempts failed*
  - *(Notice numbers)*

From Newman (1945)

TABLE 2.—TURKEY RESTOCKING TRIALS WITH RIO GRANDE TURKEYS IN EASTERN TEXAS.

Date	County	Place	Number	Results
1924	Harrison	Sabine River near Easton	5	Disappeared by 1933
1927	Walker	Thompson Game Pasture	6	Disappeared by 1935
1932	Panola	Sabine River n. of Carthage	10	Disappeared soon
1933	San Augustine	Mouth Attoyac	—	Disappeared
1933	Harrison	Caddo Lake	36	Disappeared
1934	Angelina	Pine Island Pasture Neches River	14	Disappeared within 3 years
1934	Trinity	Southern Pine Pasture	12	Disappeared within a year or so
1934	Walker	Weiser Bottom	6	Disappeared soon after
1934	San Jacinto	Durden Bend	6	Killed by poachers
1934	Hopkins	Delta-Hopkins Ranch	3	Disappeared soon
1935	Walker	Gibbs Ranch, Trinity River	6	Disappeared
1936	Nacogdoches	Cousins Ranch	5	Immediately killed by poachers
1937	Jefferson	Gilbert Ranch, Fannett	16	No evidence birds remain
1938	Jefferson	Gilbert Ranch, Fannett	24	Dallas hatchery birds, no increase
1937	Walker	Gibbs Ranch, Trinity River	10	Disappeared
1939	Angelina	Perry Club, Neches River	20	Some increase in 1939, none in 1940
1939	Fannin	S.C.S. project	48	Released in pen; practically gone by 1942
1940	Red River	18 mi. n. Annona	68	Still on the increase
1941	Trinity	Southern Pine	45	Never reproduced, some released in pen

- soft-releases from field-pens were thought to have some promise
- Several issues working with birds in pens in the field

Restocking efforts (1924-1941)

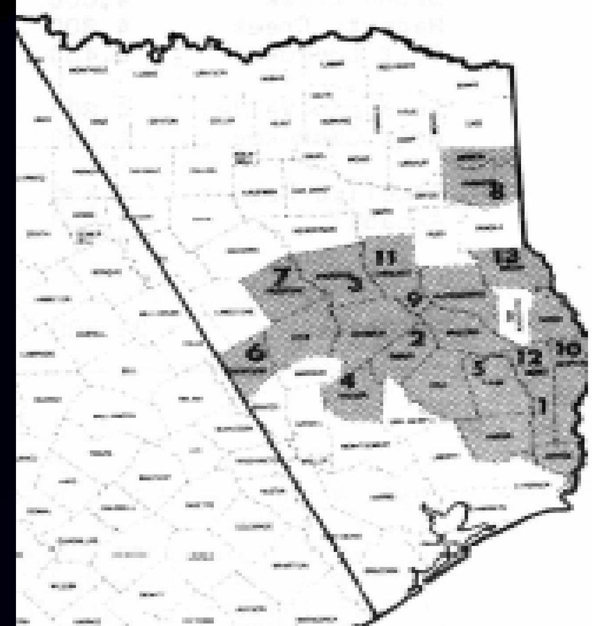
Eastern wild turkeys in Texas: restoration (1959-1974)

- Next phase of reintroductions used several different techniques
- Bird captured from East Texas, Florida, South Carolina, and Georgia
  - Again, success was variable
  - Again, notice numbers
- Boyd and Oglesby (1975): estimated 1000 turkeys in the region
- Initiated another phase during the late 1970s through 1980s

Table 1. Wild turkey releases in east Texas, 1959 through 1974.

Release Areas	Size	Time	Gobblers	Hens	Source of Turkeys
	Ha.	Yr.	No.	No.	
Lower Neches	35,000	1959-62	14	17	Florida
			3	11	West Texas
Alabama Creek	5,500	1959-62	10	19	S. Carolina & Georgia.
Engeling	4,400	1960	21	25	West Texas
Nelson Creek	4,800	1963	2	13	Florida
Caney-Russell Creek	6,000	1964	5	20	Florida
Red Oak	4,800	1966-67	10	18	Lower Neches
Brown Creek	4,000	1966-67	6	13	Lower Neches
Hagerty Creek	4,800	1969-71	8	13	Lower Neches
East Cherokee	6,400	1969-71	9	3	Lower Neches
			0	12	West Texas
Scrappin Valley	4,800	1969-71	5	9	Lower Neches
West Cherokee	4,000	1973	0	15	West Texas
			3	0	Magnolia Game Farm
Angelina-Neches	4,800	1973	2	7	Lower Neches & Florida
Arcadia	4,000	1974	3	4	Caney-Russel Creek
			10	20	M & R Station, Tyler
			8	18	M & R Station, Tyler
Totals	93,300		119	237	

1. Lower Neches
2. Alabama Creek
3. Engeling
4. Nelson Creek
5. Caney-Russell
6. Red Oak
7. Brown Creek
8. Hagerty Creek
9. Cherokee
10. Scrapping Valley
11. West Cherokee
12. Angelina-Neches
13. Arcadia



From Boyd and Oglesby (1975)

Eastern wild turkeys in Texas: restoration (1978-2004)

- Between 1978 and 2004, 7,155 Eastern wild turkeys were stocked at > 300 sites in 58 East Texas counties
- Sources of birds included Louisiana, Mississippi, Georgia, Iowa, South Carolina, and Tennessee
- Again, long term survival appeared to be compromised

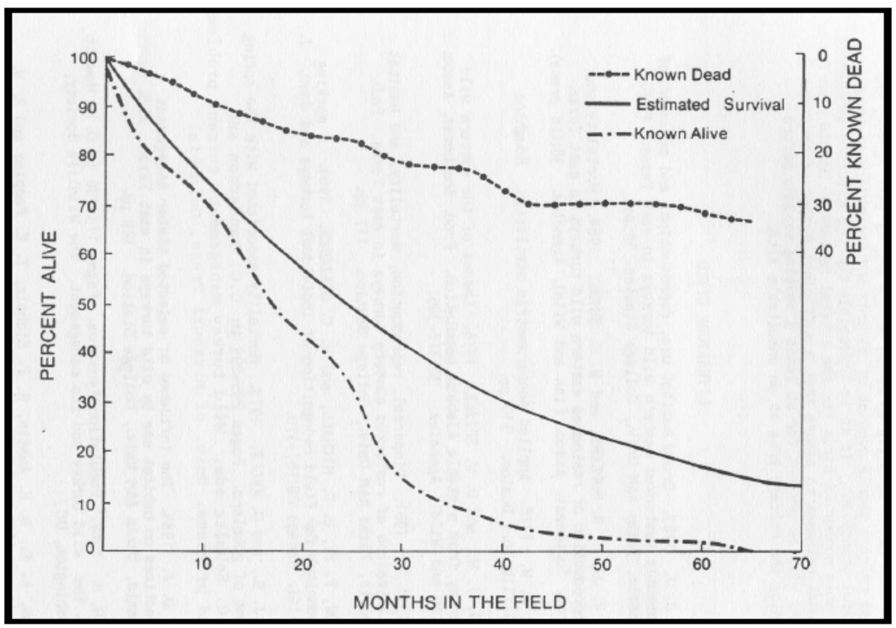


Fig. 1. Known mortality and survival and estimated survival following release for 74 transmitter-equipped wild turkeys in east Texas.

From Swank et al. (1985)

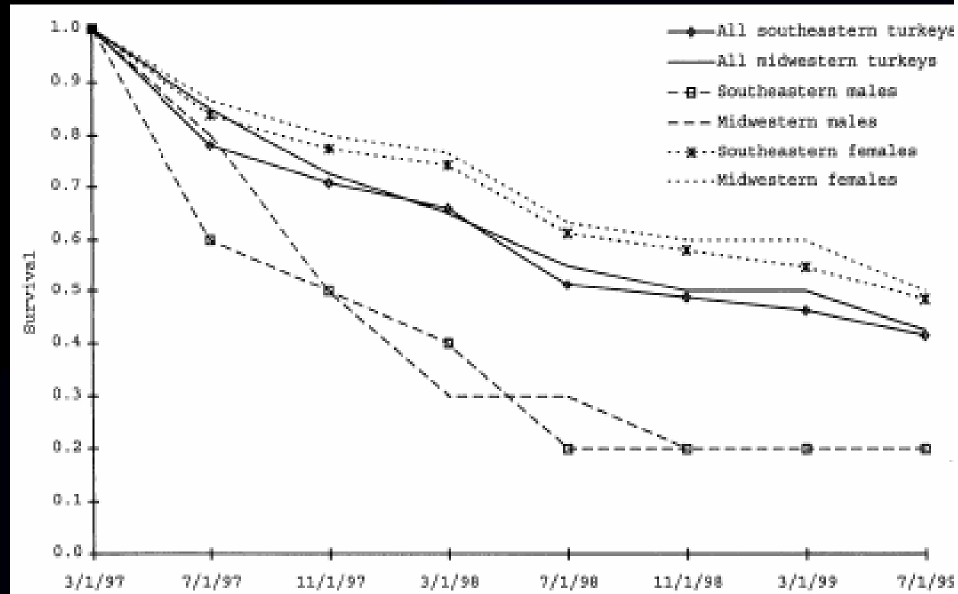


Figure 3. Survival by broodstock source of turkeys supplementally stocked in Tyler County, Texas. The birds were released in January and February 1997 and radio tracked until 30 June 1999.

From Kelly (2001)

Eastern wild turkeys in Texas: restoration evaluation

- Several cooperative research projects between TPWD, Texas A&M University (TAMU), and Stephen F. Austin State University (SFASU) were conducted in the mid-late 1990s
  - survival and production were generally poor, but there were slight differences in survival among birds from different states
- Although efforts in the 1980s and 1990s were initially hailed as a successful
  - restoration program has experienced many difficulties associated with maintaining viable turkey populations throughout the region
  - some local populations established during the restoration efforts have failed to expand or have undergone localized extinctions
- For example:
  - 1994 and 1999 estimates of approximately 5,000 Eastern wild turkeys in East Texas (Kennamer and Kennamer 1996, Tapley et al 2001)
  - 2005 population estimates by TPWD field staff suggest a total Eastern wild turkey population of < 10,000
- *Represents little change from the number of birds originally stocked, and East Texas turkey density remains significantly below that of other southern states*

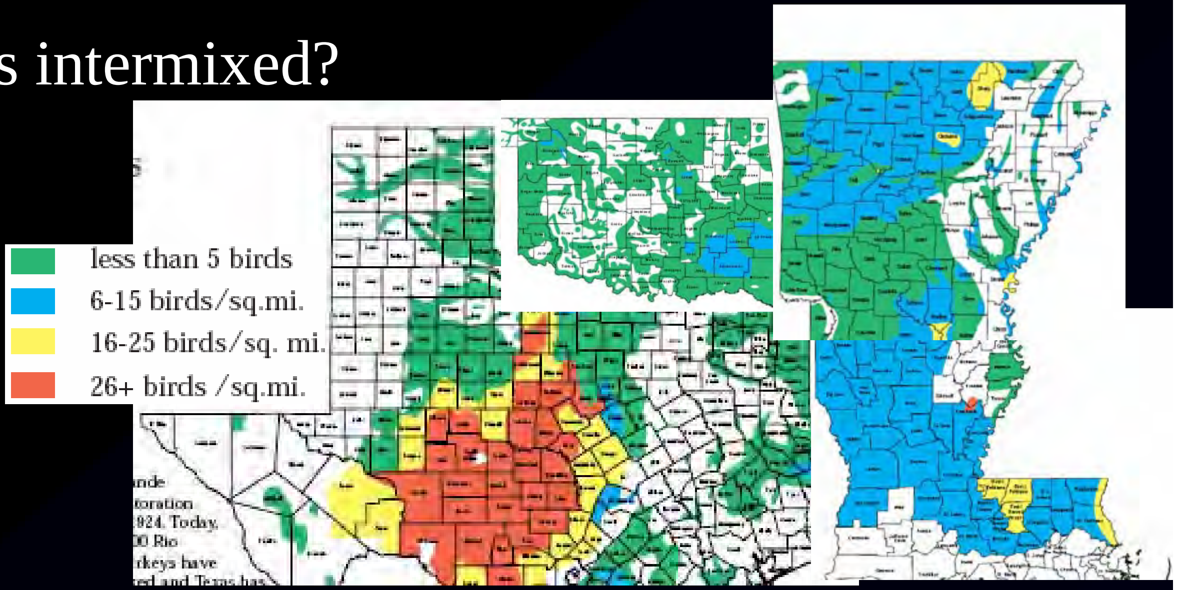
Eastern wild turkeys in Texas: genesis of current research

- Currently, metapopulation dynamics of Eastern wild turkeys in East Texas remain an enigma
- *Unlike other regions, where successful reintroductions have been a highlight of modern wildlife management, similar success has not been observed in East Texas*
- Highlighting this management issue is that accurate sub- or metapopulation estimates do not exist, nor are the specific mechanisms driving local persistence or extinction of subpopulations known
  - making long-term landscape scale assessment of the reintroductions difficult
- It is suspected, despite several decades of reintroductions, turkeys in the region
  - (1) remain in disjunct, fragmented subpopulations
  - (2) apparently do not disperse into or colonize vacant, potentially suitable habitat
  - (3) are susceptible to localized extinction
- Moreover, how do turkeys respond to rapid habitat modification from
  - intensive commercial timber operations regionally?
  - changes in landscape habitat suitability on annual or semi-annual bases?
  - changes in land ownership patterns?

Eastern wild turkeys in Texas: genesis of current research

Driving these projects are several basic questions:

- Why have not Eastern wild turkeys recovered in East Texas as they have in other regions?
- What are limiting factors for Eastern wild turkeys in East Texas?
- How many turkeys exist in the region?
- Is there a genetic/molecular basis for success?
- Have remnant populations intermixed?
  - Are they isolated?
- *Many unknowns!*



NWTF (1999)

Eastern wild turkeys in Texas: current research

Gobble Count Research Project: Ryan Bass, MS student, SFA

- Status, distribution, and population size is unclear
  - In absence of any other monitoring program
    - gobble count surveys provide critical data for managers to develop habitat and harvest management plans and recommendations
  - In East Texas, several routes performed each year throughout East Texas
    - provide a general idea of distribution
- *Generalized questions:*
  - Do gobble counts provide relevant information about turkey distribution, abundance, or habitat use during spring?
  - Are routes placed in appropriate habitats?
  - Are routes performed to coincide with gobbling activity?
- *Goals: through use of radioed gobblers, GIS & field habitat data:*
  - provide a geospatially explicit, habitat based model of gobbler habitat use during spring, so as to refine gobble count route placement
  - develop occupancy model of turkeys in East Texas

Eastern wild turkeys in Texas: current research

Landscape-level turkey population dynamics

- In response to the aforementioned information gaps regarding metapopulation dynamics
  - Research was initiated as a long-term (5 year study) to address several concurrent lines of research
- The overall goal is of this research is to simultaneously link:
  - subpopulation vital rates with landscape scale geospatial habitat analyses
  - to develop predictive and interactive metapopulation dynamics models for strategic guidance of conservation and management plans for wild turkeys in East Texas
- Through cooperation with TPWD, TAMU, NWTF, and SFASU
  - Have initiated this research during 2007
  - Will continue through 2011

Eastern wild turkeys in Texas: current research

Landscape-level turkey population dynamics

- Currently divided into three graduate projects:
- Jason Isabelle, MS student SFA
  - Examining nesting ecology and nest site selection
  - Quantifying vital rates of wild turkeys as related to productivity and nest success
- Sabrina Seidel, MS student SFA
  - Starting January 2008
  - Examining genetic structure of wild captured/harvested turkeys throughout East Texas
- Haemish , Ph.D. student TAMU
  - Starting January 2008
  - Examining predator ecology as related to turkey nesting success, hen/poult survival, and habitat manipulations

Eastern wild turkeys in Texas: current research

Evaluation of superstocking translocated turkeys

- Use translocated birds to make direct comparisons between wild captured birds and translocated birds:
  - Nesting ecology
  - Survival
  - Habitat use
  - Movements
  - Home range

- The effort in 2007 represents the largest on record for East Texas
  - With approximately 80 birds translocated to three private properties in Texas
  - Birds from South Carolina and Tennessee
  - Tremendous cooperative effort among TPWD, NWTF, SFA, and personnel in South Carolina and Tennessee
- No other study has been able to combine wild captured and translocated birds into the same study for >1 year
- Absolutely unique opportunity to directly compare established turkey ecology with translocated turkey ecology

Eastern wild turkeys in Texas: current research

Evaluation of superstocking translocated turkeys

- Secondarily, address Lopez et al. (2000) call for an evaluation of "superstocking" in East Texas
- Suggested from models that biologists attempting to restore wild turkeys in east Texas should use higher stocking rates
  - Supplemental stocking appears to be relatively ineffective
- Superstocking efforts appear to have the highest survival in best, average, and worst case scenarios, particularly if in proper age/sex class arrangements
- However, success is really determined in years 2, 3, and thereafter

Table 2
Fifteen stocking strategies (five stock
restoration model[a]

Stocking rate	ACS1[b]
	Male
1	3
2	5
3	20
4	5/5/5
5	10/10/10

[a] Numbers separated with a slash (
[b] ACS1 = all males and females rele
and a half of females released were j

Table 3
Stocking strategy effectiveness (measured by the percentage population increase (R^a)) by stocking rate, age-class, and survival

	Best-case[b] (high survival)	Average-case[b] (average survival)	Worst-case[b] (low survival)
Stocking rate 1	1.691A	1.282A	0.930A
Stocking rate 2	1.589A	1.380A	1.183B
Stocking rate 3	1.609A	1.399A	1.180B
Stocking rate 4	0.833B	0.720B	0.620C
Stocking rate 5	0.835B	0.708B	0.624C
Juvenile[c]	1.656A	1.362A	1.147A
Juvenile/adult	1.589A	1.333A	1.103A
Adult	0.988B	0.897B	0.772B

[a] R = total number of birds remaining at the end of 4 years/total number of birds released. Means with the same letter are not significantly different.
[b] Fifteen scenarios simulated under three different survival curves: (1) best-case, (2) average, and (3) worst-case scenarios.
[c] Mean R determined from all stocking strategies.

- To date: approximately 35 EWT have been captured on public lands, radio marked, and are currently being tracked
  - *Study sites are expanding in 2008-2010 onto private lands to capture more wild birds*
- To date: nearly 240 EWT were translocated to three private ranches in 2007
- To date: nearly 40 nests have been initiated from wild and translocated birds
- These efforts would not be possible without the cooperation and collaboration among many entities
- We believe we are embarking on new, relevant, and largely uncharted territory in terms of turkey research in East Texas

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Chapman and Graff Ranches