Annual Program Report
2010-2011

Wildlife Diversity Program
Division of Wildlife Management
NC Wildlife Resources Commission

1751 Varsity Drive
Raleigh, NC 27606

CONTENTS

Final Performance Report

State: North Carolina **Grant Number:** T-12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Priority Species Data Management

Objective:

1). Efficiently collect, manage, and catalog data on sensitive species across the state in form that is readily accessible, scientifically sound, and useable in maintaining the Wildlife Action Plan.
2). Develop and maintain data management tools to assess Wildlife Action Plan progress and facilitate plan revision.

A. Activity

1. Purchased annual ESRI ArcGIS software maintenance fees for Wildlife Diversity staff. This grant period covered 2 fiscal years' (2010 and 2011) worth of costs. The software allows Diversity staff to continue to use GIS mapping applications to catalogue, store, and display NC Wildlife Action Plan priority species and habitat information for planning and reporting conservation actions.
2. Staff partnered with Defenders of Wildlife to complete the NC Wildlife Resources Commission portal on the Conservation Registry website (http://ncwrc.conservationregistry.org). This project is designed to allow conservation projects of NC Wildlife Action Plan partners to be searchable via map or text. Project activities are automatically tied back to specific goals identified in the NC Wildlife Action Plan. Currently, there are 1,268 partner projects listed on the website.
3. Provided GPS, GIS, and data support to Diversity Staff, including compiling Wildlife Action Plan data for newly hired WAP coordinator.
4. Developed GIS data and maps for the NC Wildlife Action Plan Climate Change conference.
5. Developed and deployed aquatic listed species database application to catalogue and make accessible mapping tools for aquatic priority species.
6. Coordinated staff development of NC Project Tracking Database. The Prototype database that links State Wildlife Grant project expenditures to specific performance indicators of Wildlife Action Plan achievements.

B. Target Dates for Achievement and Accomplishment

In addition to the activities listed, efforts were initiated to design and develop an all-encompassing species database (BIODE) that would store information for all species for which

NCWRC collects distribution data. While some species specific databases (e.g. box turtles, aquatics, colonial waterbirds) were adapted to the BIODE framework, we were only able to address a subset of species databases and logistical constraints upon staffing prevented completion of the overall BIODE database.

C. Significant Deviations

NC WRC staffing limitations reduced the amount of effort expended upon this project, particularly in the final 9 months of the project period. The project objectives were addressed and many tasks were accomplished, however there remains additional work to be done to fully integrate Priority species data and coordinate collection, storage, and retrieval in a GIS platform.

D. Remarks

None

E. Recommendations

It remains to be seen whether the TRACS system being developed by the Fish and Wildlife Service can integrate the NC Project Tracking database and Conservation Registry information from North Carolina. NCWRC staff should continue to be engaged with USFWS as the TRACS system is rolled out to ensure that NC Wildlife Action Plan achievements are catalogued as efficiently as possible.

F. Estimated Cost

$ 19,610

Prepared by: Scott Anderson
Division of Wildlife Management

Final Performance Report

State: North Carolina **Grant Number:** T-12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Monitoring Species in Early Successional Habitats

Objectives:

The objectives of this project were to

- Implement surveys and monitoring to improve understanding of distribution, relative abundance, and/or population trends of priority species and habitats, with an emphasis on early successional habitats
- Evaluate the response of priority early succession species and habitats to management and determine factors limiting populations
- Utilize bird watching groups to help fill information gaps, particularly for distribution and timing of migrating birds
- Communicate results to appropriate lay and scientific audiences
- Provide technical guidance on species and habitat management to land managers and land use decision makers
- Plan and coordinate with local, regional, and national organizations to optimize conservation efforts.

A. Activity

Activity in 2010-2011 included continuation of long term monitoring on Suggs Mill Pond, Sandhills, Caswell, and South Mountains Game Lands and Murphy Brown corporate farms. These properties are part of the Cooperative Upland habitat Restoration and Enhancement (CURE) program, an early successional habitat initiative started by the NC Wildlife Resources Commission in 2001. Long term monitoring surveys include breeding songbird point count surveys, targeted point count surveys for Bachman's sparrows and northern bobwhite, and a useable habitat evaluation for Bachman's sparrows and for quail. Data analysis continued on the Piedmont native warm season grass research project in collaboration with NC State University.

Emphasis was placed during this grant period on summarizing results from 10 years of surveys related to this project, and sharing results with land managers, biologists, and other stakeholders. This activity included presenting results at South Mountains, Caswell, Sandhills, and Suggs Mill Pond game lands and generating consensus recommendations for future habitat management strategies and tactics.

During this grant period we initiated planning and pilot studies for future bird surveys. These include distribution and status assessments for Bachman's sparrow and other longleaf-associated species and Swainson's warbler and other bottomland-associated species.

Methods

Breeding Bird Surveys- An index of songbird abundance on game lands was tracked using point count surveys (Hamel et al. 1996, Freemark and Rogers 1995). In 2002, we established 21-36 permanent survey points on each CURE Game Land. Control routes on Sandhills and Caswell Game Lands were initiated in 2004. Regional Breeding Bird Survey (BBS) routes were selected from nearby counties to serve as a reference for South Mountains and Suggs Mill Game Lands (USGS 2009). Five minute, unlimited distance point count surveys were conducted once per year on each area between May 18th and June 14th. To facilitate analyses, we grouped species together into guilds based on life history characteristics (Table 1). Simple linear regression was used to compare the slope of the trend line between CURE and reference routes.

Bachman's sparrow point counts. In 2006 we initiated surveys focused specifically on Bachman's sparrows to monitor populations of this priority species after observational data indicated an increase throughout CURE-managed areas. We originally established ~110 survey points on each of the CURE and control areas, and in 2011 we reduced the number of survey points to 40 on each of the CURE and control areas for long term monitoring. Survey points were located $\geq$0.4 miles apart using a modified gird system. Surveys were repeated 3 times in late April/early May and included 3 minutes of passive listening followed by 3 minutes of using territorial song playback to stimulate calling. Surveys began at first light and ended ~5 hours after sunrise on days with little wind and no precipitation.

Table 1. Songbird guild groupings for spring songbird point count analysis.

Grassland Nesters	Shrubland Nesters	Early Succession Foragers
Bachman's Sparrow	American Goldfinch	Barn Swallow
Aimophila aestivalis	*Carduelis tristis*	*Hirundo rustica*
Eastern Meadowlark	Blue Grosbeak	Brown-headed Cowbird
Sturnella magna	*Guiraca caerulea*	*Molothrus ater*
Grasshopper Sparrow	Brown Thrasher	Chipping Sparrow
Ammodramus savannarum	*Toxostoma rufum*	*Spizella passerina*
Northern Bobwhite	Common Yellowthroat	Eastern Bluebird
Colinus virginianus	*Geothlypis trichas*	*Sialia sialis*
Red-winged Blackbird	Eastern Towhee	Eastern Kingbird
Agelaius phoeniceus	*Pipilo erythrophthalmus*	*Tyrannus tyrannus*
	Field Sparrow	Eastern Phoebe
	Spizella pusilla	*Sayornis phoebe*
	Gray Catbird	Eastern Wood-Pewee
	Dumetella carolinensis	*Contopus sordidulus*
	Hooded warbler	Loggerhead Shrike
	Wilsonia citrine	*Lanius ludovicianus*
	Indigo Bunting	Orchard Oriole
	Passerina cyanea	*Icterus spurius*
	Prairie Warbler	Purple Martin
	Dendroica discolor	*Progne subis*
	Song Sparrow	Red-headed Woodpecker
	Melospiza melodia	*Melanerpes erythrocephalus*
	White-eyed Vireo	Wild Turkey
	Vireo griseus	*Meleagris gallopavo*
	Yellow-breasted Chat	Yellow-shafted Flicker
	Icteria virens	*Colaptes auratus*

Northern Bobwhite surveys. Point count surveys were conducted for breeding and fall quail. Please refer to previous annual reports for details of survey methodology.

Useable Habitat. To track the quantity of early successional habitat, we established useable habitat evaluations on each CURE area. Useable habitat was defined as any area with sufficient cover for quail to carry out life functions (breed, forage, roost, etc.) and is determined by a qualitative, "eyeball" assessment. We measured useable habitat available during both the breeding and non-breeding seasons. A stand was classified as useable for the non-breeding season if it was available in five of the seven months from October through April. A stand was classified as useable for the breeding season if it was useable in at least two of the five months of the breeding period from May through September. "Not useable" habitat was all areas without suitable cover for quail. On Sandhills Game Land, a separate evaluation of useable habitat for Bachman's sparrow was made on the CURE and control area based on conditions present at the time of point count surveys in late April.

Native Warm Season Grass Research project. A graduate research project with NC State University began in April 2009 to evaluate the wildlife benefits of grassland management techniques in the western Piedmont. Methods include songbird territory (spot) mapping, small

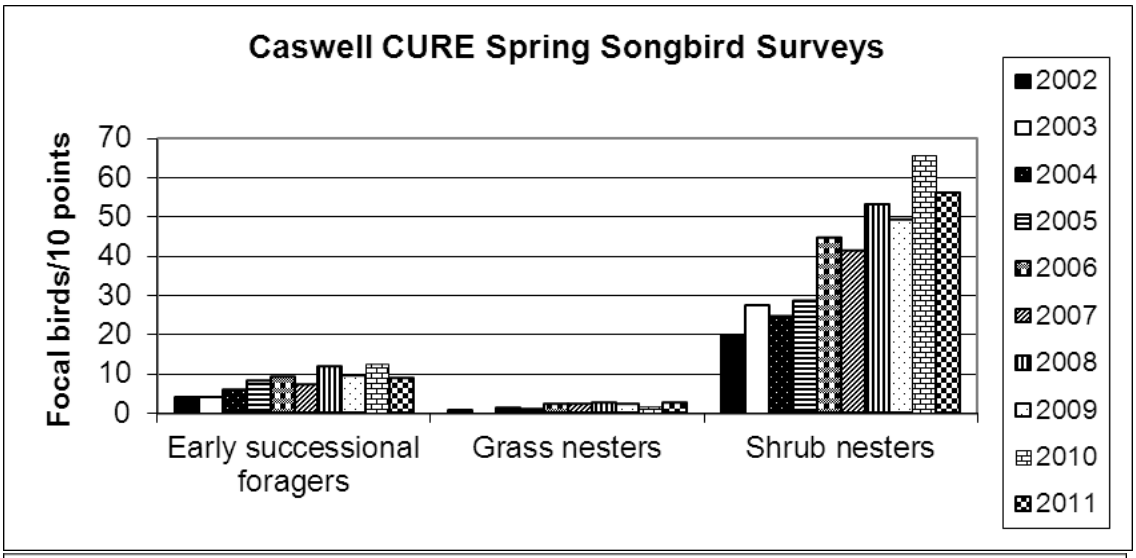
mammal trapping, and vegetation surveys. Objectives were to compare use and benefits to wildlife populations of native warm season grass (nwsg) fields under agricultural management, native warm season grass fields managed exclusively for wildlife ("wildlife fields"), and exotic cool season grass (ecsg) fields managed for agriculture. Songbird and small mammal surveys were conducted in 7 nwsg forage fields, 7 ecsg forage fields, and 4 "wildlife" fields that contained a mix of nwsg and forbs. In this reporting year most of the effort on this project was dedicated to data analysis.

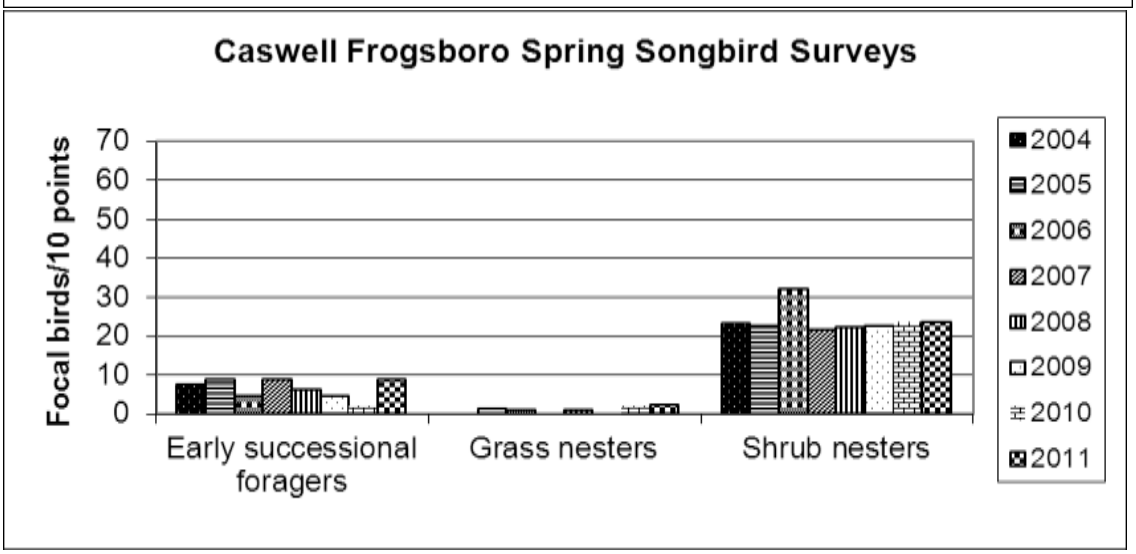
Results

Caswell Game Land

Breeding Songbirds. At Caswell Game Land shrubland nesters were the most abundant guild. Indigo bunting was by far the most common shrub nesting species detected on Caswell, followed by yellow-breasted chat and prairie warbler. The early successional forager group was dominated by chipping sparrows and brown-headed cowbird. The grassland nester group was entirely represented by northern bobwhite.

Since the initiation of CURE (2002-2011) there have been significant increases in early successional foragers (+0.76 birds/10 points per year, $P = 0.003$), grassland nesters (+0.22 birds/10 points per year, $P = 0.01$), and shrub nesters (+4.76 birds/10 points per year, $P = 0.00005$) on the CURE area. From 2004-2011 there has been no trend (all P values ≥ 0.13) in counts for any of these guilds on the Frogsboro route control (Fig 1 & 2).





Figures 1 and 2. Relative abundance (# focal birds per 10 survey points) of early succession songbird guilds on Caswell Game Land based on unlimited distance, five-minute counts. Habitat enhancements were initiated in the summer of 2003. Caswell Frogsboro (control) surveys were initiated in 2004.

Within the shrub nesting group, yellow breasted chat showed the greatest increase (13% increase per year, Fig 3) on the CURE area since the start of management. Field sparrow, eastern towhee, brown thrasher, indigo bunting, prairie warbler, white-eyed vireo and common yellowthroat also had statistically significant increases in counts on the CURE area from 2002-2011. From 2004-2011 there was a significant increase in counts of hooded warbler on the control area but no significant trend for any other species, suggesting that the increase in most of the shrub nesting species may be attributable to CURE management.

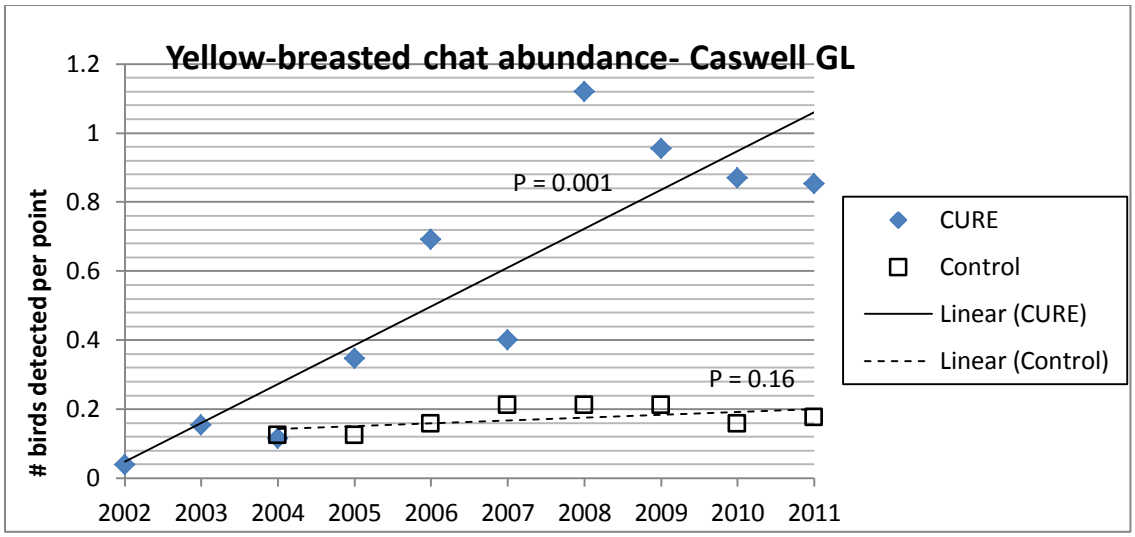


Figure 3. Yellow-breasted chat relative abundance from point count surveys, Caswell Game Land, 2002-2011. Lines represent linear regression trend and P values are from test if slope of line (trend) is equal to zero. The control route was started in 2004 and is located on Caswell Game Land but off the CURE area.

Within the early successional forager guild, brown-headed cowbird had the greatest increase in relative abundance on the CURE area since the initiation of management. There were significantly more eastern wood-peewees detected on the CURE area compared to the control.

While timber cutting in hardwood stands had negative effects on mature forest breeding species such as wood thrush and ovenbird at the scale of the stand (Marcus unpublished data), the count trend for these species across the entire CURE area is similar to the trend on the reference route (Fig 4), suggesting that the more intensive timber management is not negatively affecting populations of forest species at the scale of the CURE area.

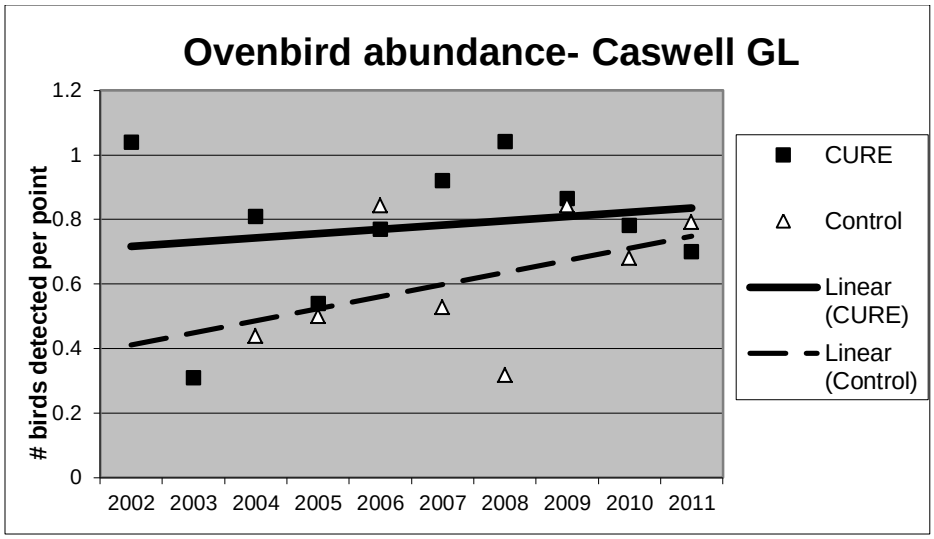


Figure 4. Ovenbird relative abundance from point count surveys, Caswell Game Land, 2002-2011. Lines represent linear regression trend. Control route is located on Caswell Game Land but off the CURE area.

Winter Songbirds. Results from winter songbird strip transect surveys from 2004-2009 were summarized. There were higher densities of wintering birds in fields, but greater diversity in forest stands. More species were detected in pine stands than hardwood stands. A higher density of early successional focal species (primarily sparrows & towhees) were detected in pine stands that had been thinned or clearcut than in unmanaged pine stands, while there was no difference in focal species between managed and unmanaged hardwood stands. There were relatively few species of conservation concern present in winter, and most of the Wildlife Action Plan priority species present in winter were year round residents (e.g. brown-headed nuthatch, hairy woodpecker).

Useable Habitat. There has been a steady increase in acres of useable quail habitat in both the breeding and non-breeding seasons since the inception of CURE (Fig 5). In 2002, only 10% of the Caswell CURE area provided breeding habitat and 11% of the landscape was useable in the winter. Patches of useable habitat were separated by large blocks of closed canopy forest which are not suitable for quail. In 2011, 37% of the CURE area provided useable habitat during the breeding season and 36% in the non-breeding season. The majority of the remaining non-useable habitat (~60% of the landscape) consists of mature, closed canopy hardwood-dominated stands. Caswell's CURE goal is to establish and maintain ~51% of the area in early successional habitat by 2012.

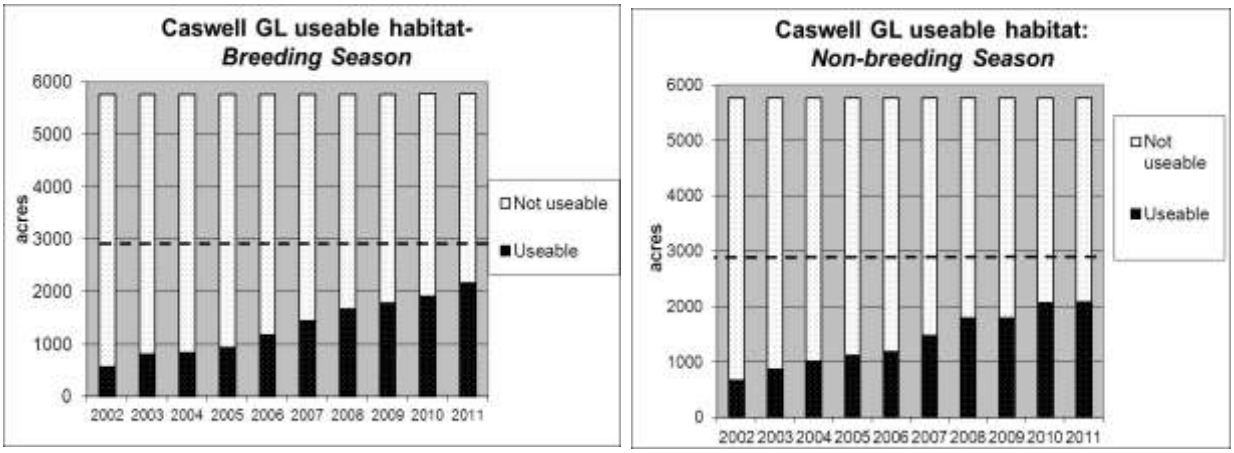


Figure 5. Acres of habitat suitable for quail use on Caswell Game Land CURE area, 2002-2011, during the breeding season (left graph) and the non-breeding season (right graph). (Note: Dashed line indicates early succession acreage goal stated in CURE area management plan.)

Northern Bobwhite. Counts of breeding northern bobwhite on the CURE area have not shown a significant linear trend since 2002, while no significant trend has been evident on the reference route either (Fig 6).

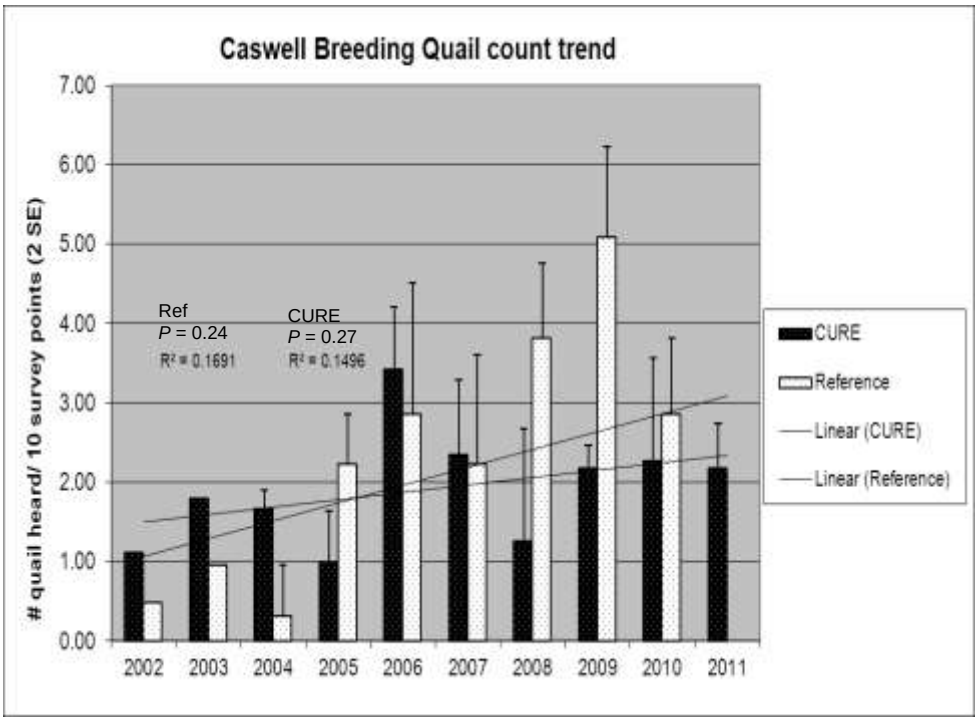


Figure 6. Counts of northern bobwhite on CURE area and reference (Rockingham County WRC quail route). Bars represent mean of 3 repeat surveys within a year, and error bars are 2 standard deviations above that mean.

Fall covey counts remain relatively low though counts were up in 2010 and 2011 (Fig. 7).

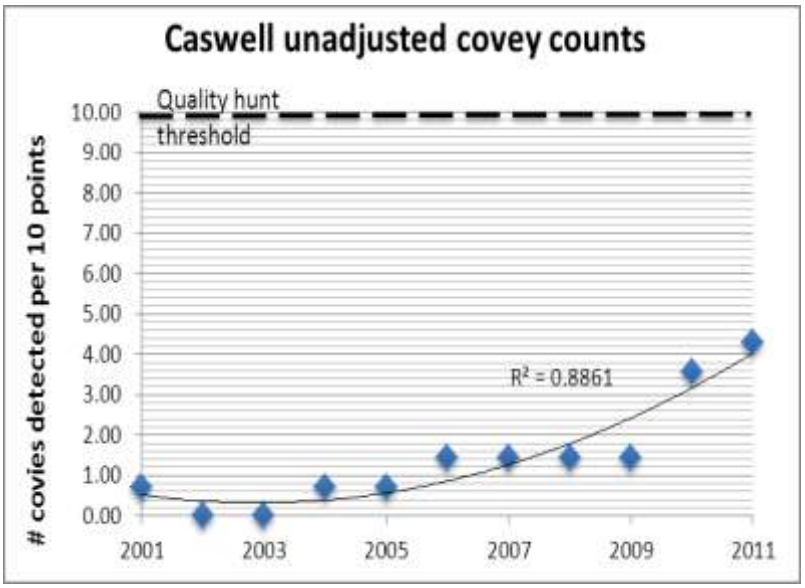
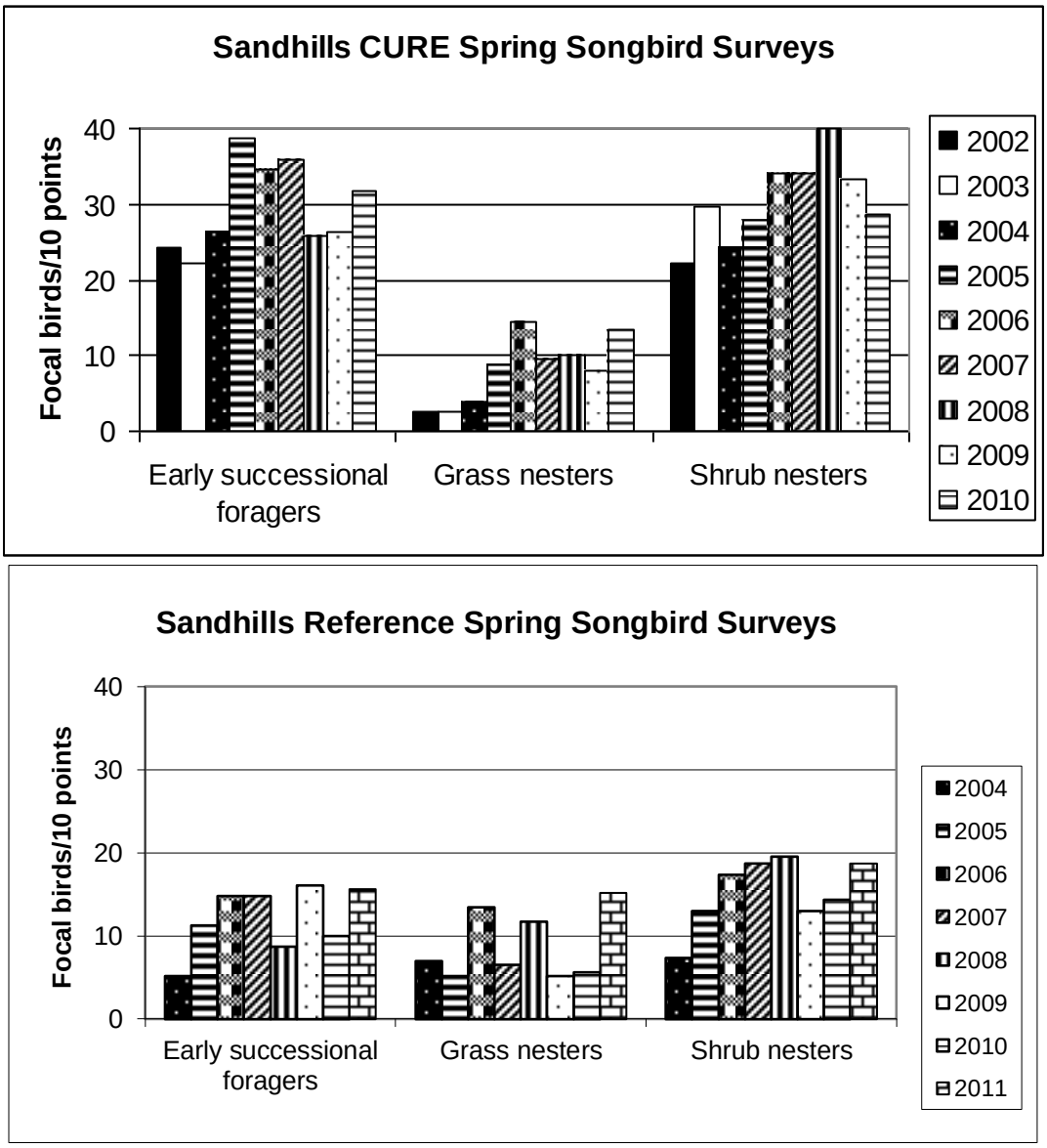


Figure 7. Fall covey counts on Caswell CURE area. Counts are not adjusted for detection probability because detection formula is unreliable at low densities. Dashed line represents quail density above which there may be enough birds for quality hunt opportunities.

Sandhills Game Land

Breeding Songbird. On the Sandhills CURE area there was a significant increase in grassland nesters (+1.22 birds/10 survey points per year, $P = 0.02$) and a marginally significant increase in shrub nesters (+1.26 birds/10 survey points per year, $P = 0.07$; Fig 8). There were no significant trends for guilds on the Block B control route (Fig 9). Within the early successional forager guild, eastern kingbird and orchard oriole showed the greatest increase on the CURE area. Within the grass nesting guild, both quail and Bachman's sparrows (Fig 10) increased significantly on CURE. Within the shrub nesting guild, field sparrow, blue grosbeak, prairie warbler and yellow-breasted chat had increasing trends on the CURE area while counts were unchanged on the control area.



Figures 8&9. Relative abundance (# focal birds per 10 survey points) of early succession habitat songbird guilds on Sandhills Game Land CURE and control areas based on unlimited distance,

five minute counts. Habitat enhancements were initiated in the summer of 2003. Surveys on reference area were initiated in 2004.

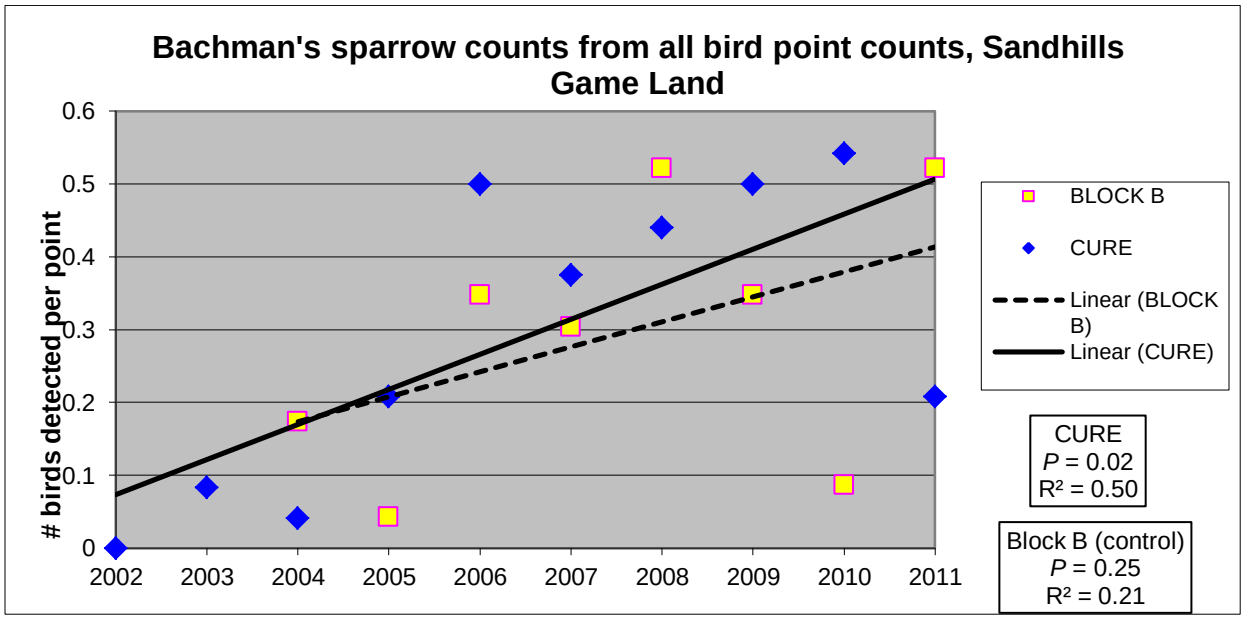


Figure 10. Bachman's sparrow relative abundance from point count surveys, Sandhills Game Land, 2002-2011. Lines represent linear regression trend line. The reference route is located on Sandhills Game Land but off the CURE area. Surveys on the reference route started in 2004.

Bachman's Sparrows. Since 2006, counts from the point count survey on the CURE area have been relatively stable and moderately decreasing on the control area. There is no significant difference (P = 0.68) in the average counts on the CURE area compared to the control area, 2007-2011 combined.

Analysis of point count data using program PRESENCE indicated that there was a similar probability of occupancy (at least one Bachman's sparrow detected within 161m of a survey point) on the CURE and control area. The variable that explained the most variation in the data was the percentage of Bachman's sparrow useable habitat within the count circle. The overall average occupancy probability was 36.7% which was correlated with an average of 44% useable habitat within a count circle. In order to get a 50% chance of encountering a Bachman's sparrow a point would need 80% useable habitat within the count circle (Fig 11). The average detection probability was 61%. The largest influence on detection probability was temperature, although the effect was modest. There was a high rate of year-to-year turnover in occupancy of a given point, likely due to the timing of controlled burns at a site.

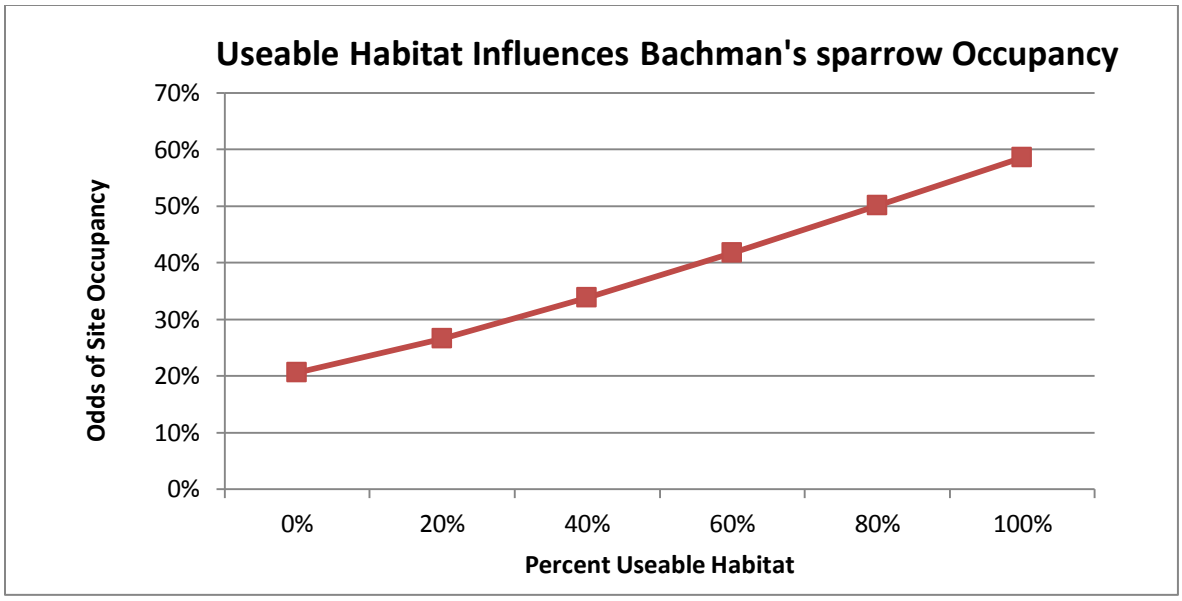


Figure 11. Relationship between Bachman's sparrow occupancy probability and percent useable habitat within a 161m count circle.

Winter birds. Results from winter songbird strip transect surveys from 2004-2009 were summarized. The highest densities of wintering birds were in fields and hedgerows. Closed canopy pine plantations raked for pine straw supported a lower density and diversity of wintering birds than plantations that were thinned and had groundcover restored. Closed canopy, dense drains (streamhead pocosin) supported lower density and diversity of wintering birds than drains which were thinned and burned. Several high priority species, including Bachman's sparrow and red-cockaded woodpecker, are present in the non-breeding season.

Useable Habitat. Useable habitat for quail continued to increase on Sandhills Game Land (Fig 12). At the initiation of CURE in 2002, only 11% of the CURE area was useable as breeding habitat and 20% non-breeding. In 2011, 66% of the CURE was useable breeding habitat and 46% of the landscape was suitable for quail in the non-breeding season. Most timber thinning and herbicide applications were completed in 2007, and habitat management has entered the "maintenance" phase, primarily with the use of prescribed fire. The location of useable habitat shifts from year to year, with nearly half the acres burned annually on the CURE area. The majority of the "not useable" acres (31% of area was not useable during either season) consisted of uplands with sparse wiregrass cover. Sandhills has nearly met its CURE goal to maintain 74.7% of the CURE area in early successional habitat.

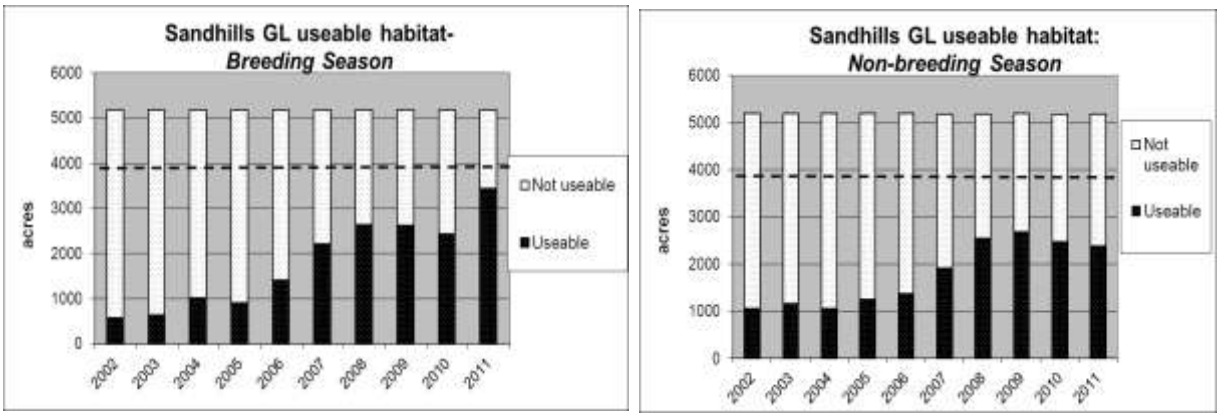


Figure 12. Acres of habitat suitable for quail use on Sandhills Game Land CURE area, 2002-2011, during the breeding season (left graph) and the non-breeding season (right graph). Note: Dashed line indicates early successional acreage goal as stated in CURE area management plan.

Northern Bobwhite. Counts of breeding quail increased in 2005 and 2006 and have subsequently come back down close to pre-treatment levels. The trend from fall covey counts on the CURE area is similar. However, the fall covey count may be greatly underestimating the true population. In 2011 we conducted covey counts at 16 points with passive listening per our standard protocol and detected 3 covies. We returned to the same points on a subsequent morning and broadcast a covey call using MP3 players at 25 minutes before sunrise and detected 19 covies. The detection probability (Wellendorf 2000) with passive listening was 29% while the detection probability with stimulation was 62%. Adjusting for detection probability we calculate that there were 27 covies present or an average of 1.7 covies per point, which is above the 1 covey per point threshold desired for hunting.

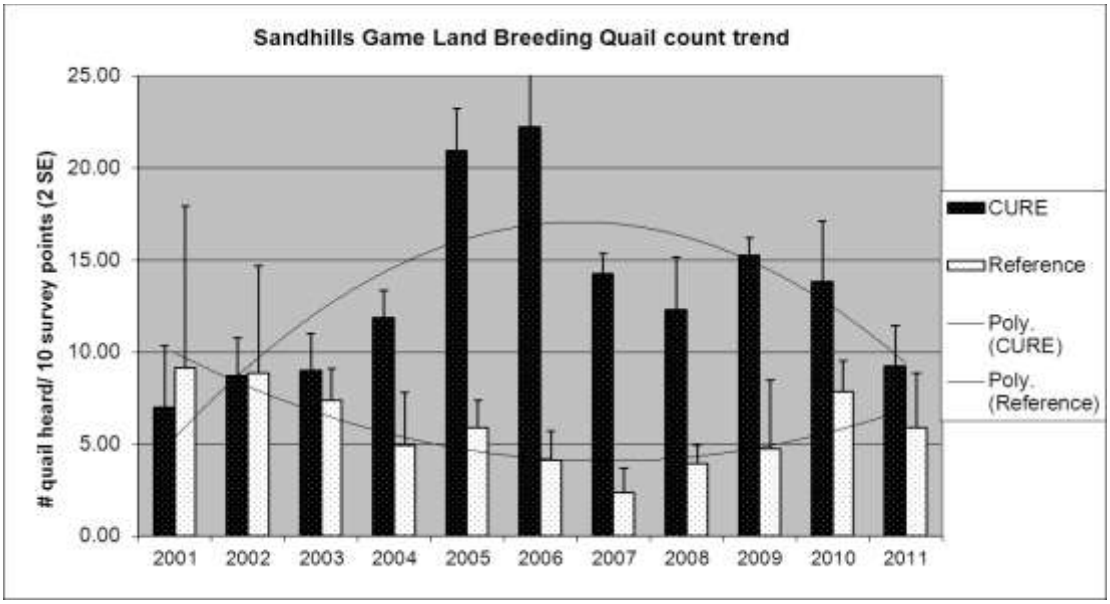
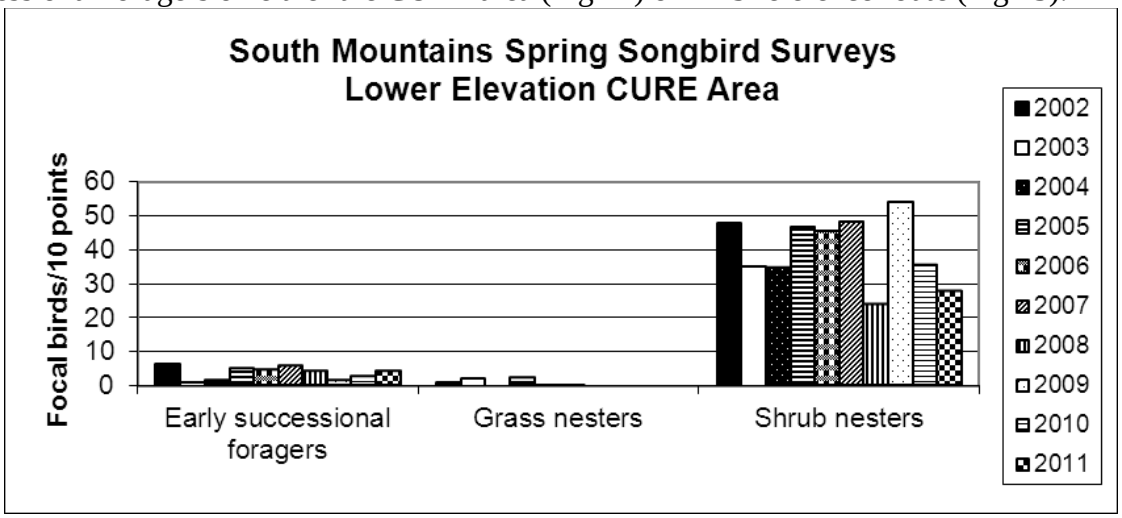


Figure 13. Counts of breeding northern bobwhite on CURE area and control route on Sandhills Game Land from point count surveys. Bars represent mean of 3 repeat surveys within a year, and error bars are 2 standard deviations above that mean.

South Mountains Game Land

Breeding Songbirds. On the South Mountains lower elevation CURE area shrub nesters were by far the most abundant guild. There were no significant trends in counts for shrub nesters or early successional foragers on either the CURE area (Fig 14) or BBS reference route (Fig 15).



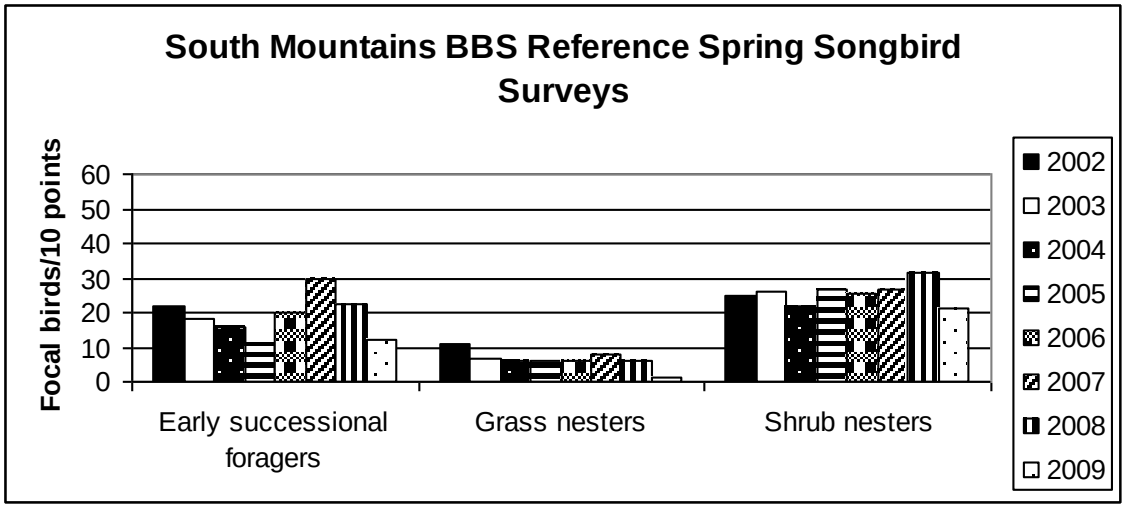


Figure 14 and 15. Relative abundance (# focal birds per 10 survey points) of early succession songbird guilds on South Mountains Game Land CURE area based on unlimited distance, five minute counts. BBS counts are based on unlimited distance, 3 minute counts. Habitat enhancements on CURE were initiated in the summer of 2003.

There was a significant decline in counts of some mature forest species such as red-eye vireo ($P = 0.001$), yellow-billed cuckoo ($P = 0.009$), and black-throated green warbler ($P = 0.038$, Fig 16), though other mature forest species such as scarlet tanager showed an increasing trend ($P = 0.011$).

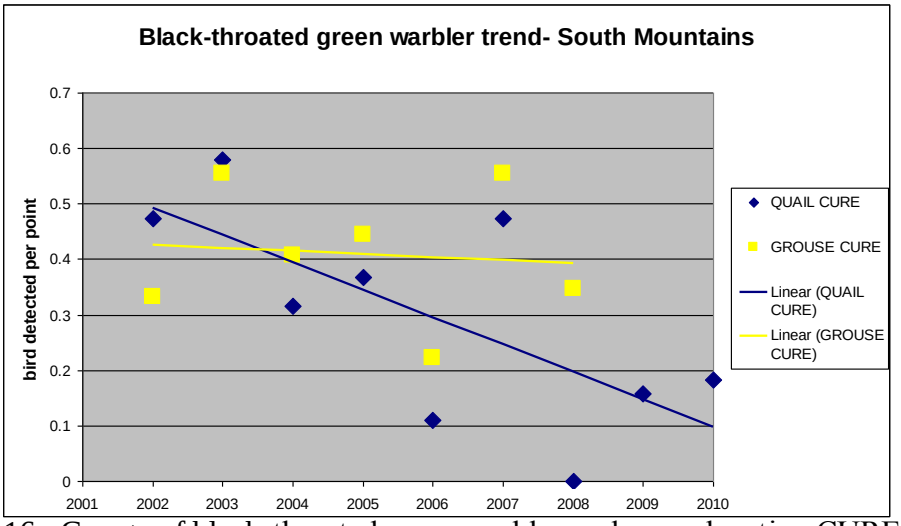


Figure 16. Counts of black-throated green warbler on lower elevation CURE area ("quail CURE", dark diamonds) and a higher elevation portion of South Mountains Game Land which was not managed as intensively ("Grouse" CURE, light squares)

Useable Habitat. There were modest increases in useable habitat for quail on South Mountains, though the majority of the CURE area remains not useable.

Northern Bobwhite. There is no significant trend in counts of breeding quail on South Mountains Game Land, while we have documented a significant, steep decline in counts on the nearby reference route (Fig 17). Counts of fall covies remain very low with no significant trend.

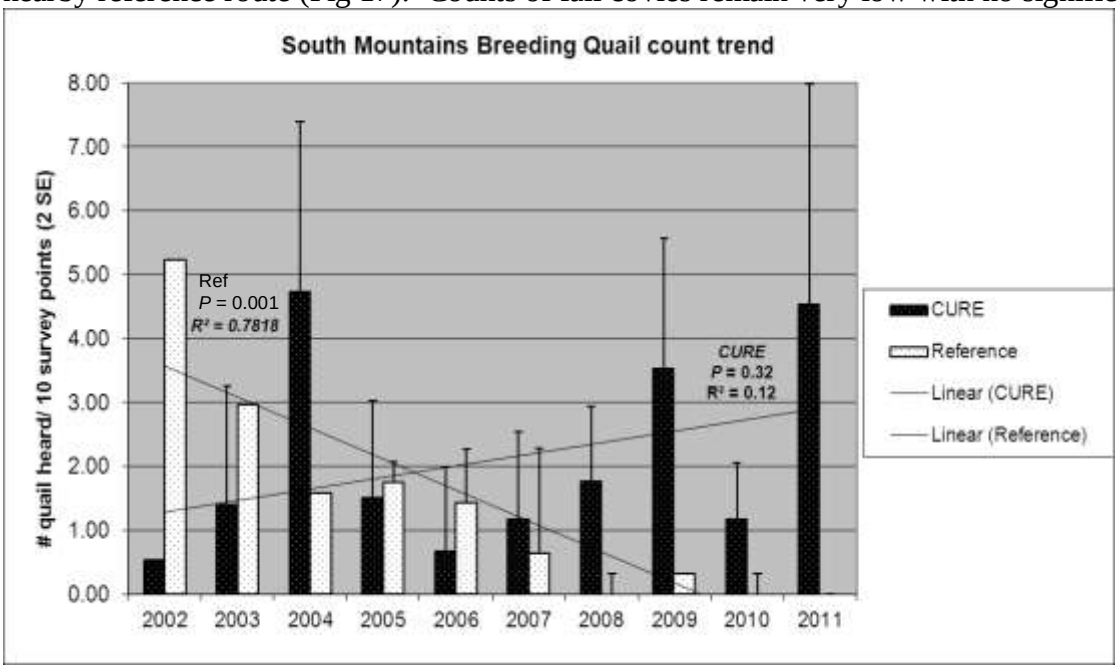
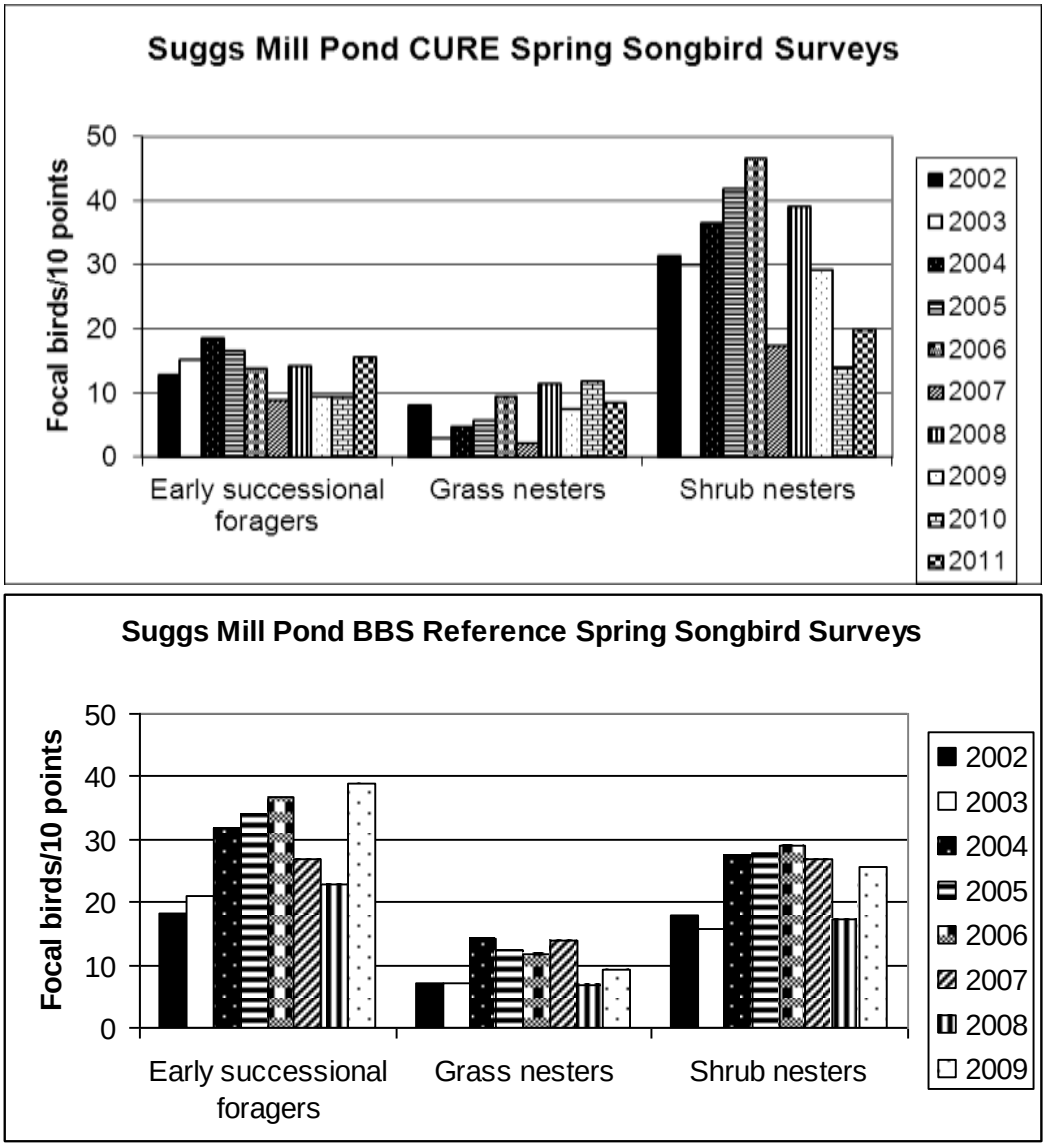


Figure 17. Counts of northern bobwhite on CURE area and reference (Rockingham County WRC quail route). Bars represent mean of 3 repeat surveys within a year, and error bars are 2 standard deviations above that mean.

Suggs Mill Pond Game Land

Breeding Songbirds. On Suggs Mill Pond Game Land CURE area shrub nesters were the most abundant guild. There were no significant trends in counts for any of the guilds or any individual species on either the CURE area or BBS reference route (Fig. 18 & 19). High observer turnover may have contributed to variability in long term data.



Figures 18 and 19. Relative abundance (# focal birds per 10 survey points) of early succession habitat songbird guilds on Suggs Mill Pond Game Land CURE area based on unlimited distance, five minute counts. Habitat enhancements were initiated in the summer of 2003. Comparisons between BBS and CURE should be made only for count trends.

Useable Habitat. There have been substantial gains in useable habitat on Suggs since the initiation of CURE. In 2002 only 4% of the total acreage (13% of the upland acreage) was useable breeding habitat for quail, and in 2011 16% of the total acreage (53% of upland acreage) was useable for quail. There was a large increase in the amount of non-breeding habitat reported, although this had more to do with the way large pocosins were classified than with any

habitat changes on the ground. The majority of the non-useable breeding habitat consists of mature loblolly/pond pine forest and pocosin with inadequate herbaceous understory. Suggs Mill Pond's CURE goal is to establish and maintain 2,492 acres in early successional habitat by 2014.

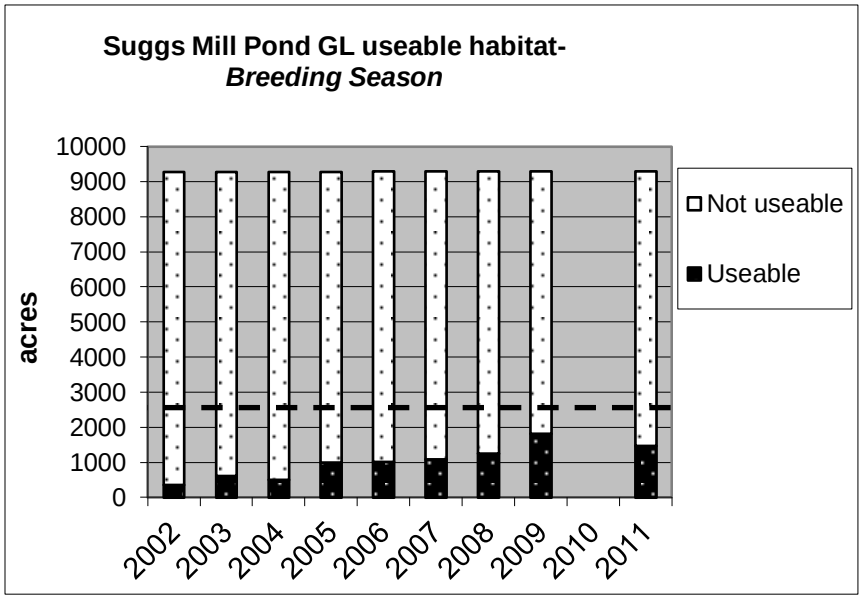


Figure 20. Acres of breeding habitat suitable for quail at Suggs Mill Pond Game Land, 2002-2011. Non-breeding season data is not presented because of inconsistencies in survey methodology. Dashed line indicates early succession acreage goal stated in CURE area management plan. Note that only ~2800 acres of Suggs Game Land is upland with potential for CURE management. Data were not collected in 2010.

Murphy Brown Corporate CURE

Breeding Songbirds. The Murphy Brown CURE area supported very high numbers of grassland nesters and shrub nesters. Relatively few early successional foragers were detected during point count surveys and this guild appeared to be relatively less abundant on the CURE area than on the BBS reference route. CURE management was initiated in 2006 and the 2003-2006 counts can be considered pre-treatment baseline conditions while 2007-2011 can be considered post treatment. Counts of several species were all significantly lower in the post-treatment years than the pre-treatment years, though this may be due in part to a change in point count observers between the pre and post treatment periods.

Winter Songbirds. The Ammon farm supports high numbers of several grassland birds in the winter, including eastern meadowlark, savannah sparrow, and northern harrier. Field borders and fallow fields support a higher density of sparrows than crop fields. We observed an increasing trend in early successional focal species in forest stands under CURE management.

Useable Habitat. Murphy Brown Corporate CURE started with a large percent of the landscape in suitable breeding habitat due to the large acreage of corn, soybean, and wheat crops. Habitat improvements have increased the % of the landscape with breeding habitat from 55% to 75%

(Fig 21). Increases in winter habitat have been more modest from 32% to 35%, though the habitat was strategically placed, with linear field borders facilitating movement out of the large crop fields after harvest and into larger blocks winter cover in the woods and pocosins.

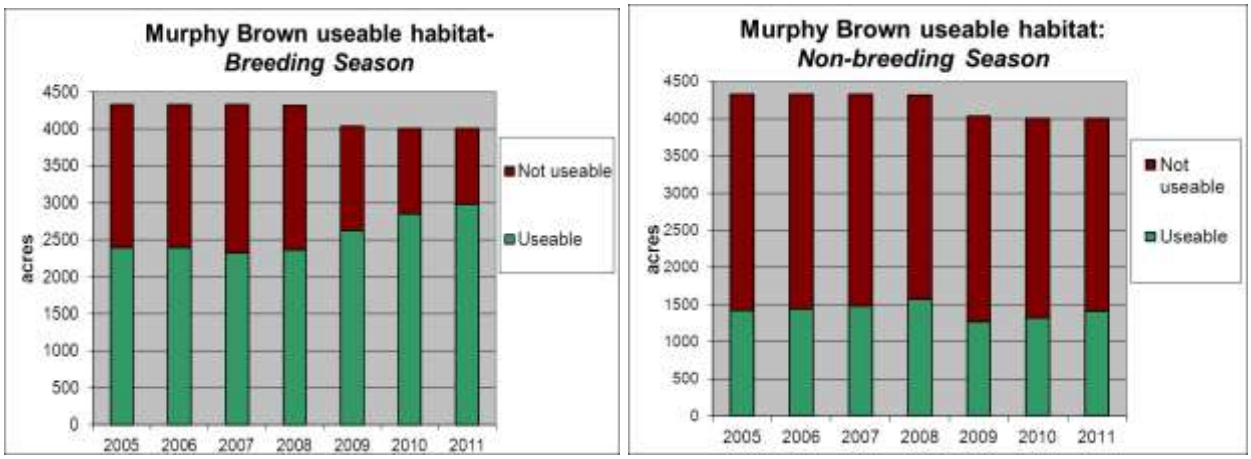


Figure 21. Acres of habitat suitable for quail use on Murphy Brown - Ammon CURE area, 2005-2011, during the breeding season (left graph) and the non-breeding season (right graph).

Northern Bobwhite. The Murphy Brown Ammon farm supported very high densities of quail under baseline conditions (~4 covies/point). We have not detected any change in counts from pre to post treatment periods during either the breeding season or fall.

Piedmont Native Warm Season Grass Study

Preliminary data analyses for this study have been completed. Copied below is the abstract from the draft thesis chapter on bird survey results (from report on contract WM-0181).

Native grasslands have declined across North America as a result of fire suppression, agricultural conversion, and replacement by exotic cool-season grass (ecsg) pastures for livestock grazing and hay production. Concurrently, birds dependent on fallow fields and native grass habitats have declined. Establishment of native warm-season (nwsg) fields has been proposed as a strategy to provide avian habitat and diversify forage production, yet monocultures of nwsg may offer poor quality wildlife habitat. We measured territory density and reproductive effort for eastern meadowlark (*Scurnella magna*), grasshopper sparrow (*Ammodramus savannarum*), field sparrow (*Spizella pusilla*), and indigo bunting (*Passerina cyanea*) in 7 nwsg forage fields (4 hayed and 3 grazed), 7 ecsg forage fields (4 hayed and 3 grazed), and 3 nwsg-forb fields managed for wildlife (i.e., reference condition) during May-August 2009 and 2010. Eastern meadowlark territory density was greater in ecsg grazed fields than in nwsg hayed, nwsg grazed, ecsg hayed, and reference fields and increased with field size. Grasshopper sparrow territory density did not differ among field types but did increase with field size. Field sparrow territory density was greater in reference fields than in all other field types, and indigo bunting territory density was greater in nwsg hayed and reference fields than in nwsg grazed, ecsg grazed, and ecsg hayed fields and increased with field size. Vegetation density near the ground (<0.5 m) generally was greater in reference fields and nwsg fields than in ecsg fields. Forb percent cover was greater in ecsg grazed and reference fields than in nwsg and ecsg hayed fields, and leaf litter

and thatch percent cover were greater in ecsg hayed and reference fields than in nwsg hayed fields. Native warm-season grass monocultures with high seeding rates and rigorous haying schedules did not provide suitable breeding habitat for grassland and shrubland songbirds. Reduced seeding rates and late-season low intensity grazing instead of haying may increase suitability of nwsg forage fields for songbirds.

Sharing Results and Offering Management Recommendations

Wildlife Diversity Staff presented the results of CURE surveys to 98 people including NC Wildlife Resources Commission staff from Game Lands, Research & Surveys, Private Lands, Wildlife Diversity, WRC administrators, NC Natural Heritage Program staff, and other interested parties. Presentations were held at South Mountains GL, Caswell GL, Sandhills GL, Suggs GL/Murphy Brown, and WRC headquarters in Raleigh. Following the presentations at each Game Land, field staff discussed recommendations for future management activities, considering the lessons learned to date. A summary of staff recommendations for each game land follows:

Suggs Mill Pond

- Continue managing uplands for longleaf pine savannah ecosystem including burning, groundcover restoration, and longleaf conversion
- Introduce fire into bays when feasible
- Start quail permit hunts in 2012

Sandhills

- Continue managing for longleaf ecosystem & lush herbaceous groundcover
- Continue to extend many management practices to rest of game land including
    - Growing season fire
    - Midstory control- though with modifications to make velpar herbicide applications more patchy and limit roller chopping in sensitive herp areas
    - Manage for herbaceous drains through mechanical means, herbicide, & fire
- No consensus on whether to thin remaining straw sale plantations
- Start quail permit hunt in 2012

Caswell

- Manage for early successional habitat as component of diverse landscape, but not attempt to create and maintain contiguous early successional habitat across entire CURE area
- Adjust burn goals which are not achievable with current manpower
- Maintain high value hardwood stands
- Continue to aggressively manage pine stands with thinning and burning; herbicide ~2 years after planting clearcut
- Thin heavily as soon as commercially viable
- No consensus on future quail hunting

South Mountains

- Manage for early successional habitat as component of diverse landscape, but not attempt to create and maintain contiguous early successional habitat across entire CURE area
- Allow clearcuts to grow rather than maintaining in early successional stage
- Fire will be the primary management tool
- Recommend removing restrictions on quail hunting and not implement permit hunt

Engaging birding groups to help fill information gaps

Volunteers contributed to pilot surveys for bottomland birds, eagle nest monitoring, and reporting observations of rare species. This effort can be expanded in future years.

Planning for Future Bird Surveys

During this grant period preliminary planning was initiated for future bird survey work. Future surveys may include a conservation status assessment of Bachman's sparrow and Swainson's warbler and establishment of long-term monitoring surveys for bottomland-associated birds and longleaf pine-associated birds.

B. Target Dates for Achievement and Accomplishment

Staffing limitations within NCWRC reduced the amount of effort that was planned for this project; however monitoring and analysis of longer-term data became more important than establishing additional survey efforts. Essential monitoring activities occurred according to plans and on schedule with the exception of delayed final report on the piedmont native warm season grass study. The final report on that study is expected in early 2012.

C. Significant Deviations

None

D. Remarks

None

E. Recommendations

Useable habitat evaluations and Bachman's sparrow, quail, and all bird point count surveys will be continued for the foreseeable future to provide long term monitoring data. Fall covey counts will be modified to use covey call stimulation. New status assessment surveys will be developed in the coming year.

F. Estimated Cost

$36,622 (including in-kind match and non-federal matching contributions)

G. Literature Cited

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United States Geological Survey (USGS). 2009. North American Breeding Bird Survey. Patuxent Wildlife Research Center. Available http://www.pwrc.usgs.gov/bbs [2009].

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Prepared By: Jeffrey Marcus, Piedmont Wildlife Diversity Supervisor
Wildlife Diversity Program, Division of Wildlife Management
NC Wildlife Resources Commission

Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Surveys of Priority Amphibians and Reptiles in the Piedmont and Coastal Plain of North Carolina

Objectives:

1. To coordinate and carry out surveys of selected reptile and amphibian populations listed as priorities by the North Carolina Wildlife Action Plan in order to clarify their status and distribution.
2. To determine the current status of priority species' habitat and restore habitats if necessary.
3. To monitor reptile and amphibian populations to determine population trends.
4. To conduct research on movements, habitat use, and relationship to land use to better elucidate factors which may be limiting populations.
5. To provide technical guidance to governmental agencies and private entities based on findings from surveys and research.
6. To conduct management activities to enhance reptile and amphibian habitats and populations.

A. Activity

Projects completed during FY 2010-2011 included 1) Restoration of an isolated wetland and surrounding uplands on Sandhills Game Land to enhance amphibian breeding habitat; 2) Monitoring of vegetation and amphibian response to isolated wetland restoration completed in previous years; 3) Neuse River Waterdog surveys and monitoring; 3) Pine Barrens Treefrog surveys and monitoring; 4) Gopher Frogs status surveys; and 5) Wetland enhancement and Gopher Frogs headstarting on Holly Shelter Game Land. Additional surveys of priority species and habitats were also conducted throughout the Piedmont, Sandhills, and Coast. A manuscript pertaining to Gopher Frogs movement and habitat use was completed and accepted for publication in the Journal of Herpetology (currently In Press).

Isolated Wetland Restoration and Enhancement

Isolated wetlands, or upland ephemeral ponds, support a wide array of amphibian species in North Carolina. Many species in the Sandhills and Coastal Plain (e.g., Gopher Frog, Ornate Chorus Frog, Tiger Salamander) require open-canopied, herbaceous ponds for successful reproduction. Because of historic fire exclusion, or problems with the timing of prescribed fire,

many isolated ponds that were once open-canopied have become forested. Dense canopy in these ponds reduces herbaceous vegetation needed for amphibian egg attachment, changes the pond's pH, and can drastically alter the hydroperiod such that ponds dry too early in the year for amphibian larval development to complete.

We are currently in the process of restoring degraded ponds by removing woody vegetation through various means. In consultation with botanists, the state Division of Water Quality, and other partners, we are developing the most effective ways to conduct restoration activities. We have now conducted restoration work on 4 wetlands on Sandhills Game Land (in collaboration with other Wildlife Resources Commission staff) and 5 wetlands on the Lower Coastal Plain (in collaboration with Croatan National Forest staff). Sites are being monitored for changes in hydrology, water chemistry, vegetation characteristics, and amphibian use.

One restoration site which had not supported any amphibians in recent history was used by a large number of Tiger Salamanders and Eastern Spadefoots during the first breeding season after restoration (winter 2009-10). The lack of any pond-breeding amphibian activity in the Sandhills during the winter/spring of 2010-11 due to drought conditions made amphibian monitoring impossible; however, we continued to monitor vegetation response using surveys and repeat photography. An example of the vegetation response at one of our isolated wetland restoration sites is shown below (Fig 1).

Active restoration management was begun on an additional, large isolated wetland ("Block T pond") on Sandhills Game Land during 2011. This site has developed a dense tree canopy over time because of lack of appropriate fire regimes. Monitoring for 3 years has shown that few amphibian species attempt to use the site for breeding, and successful reproduction of any species has not been noted due to the hydroperiod being too short. In collaboration with NC Wildlife Resources Commission (NCWRC) staff and other experts on vegetation and wildlife, canopy trees were removed in the vicinity of the wetland. The uplands surrounding the wetland, which consisted of dense Longleaf Pine stands used for pine straw raking, were mechanically thinned in order to provide greater and more diverse ground cover. We are currently in the process of seeding the uplands and areas around the wetland with native grasses and forbs to improve habitat and so that fire will carry through the wetland more easily, maintaining an open canopy pond. This site was surveyed for vegetation characteristics, hydrology, and amphibian use prior to management and post-treatment monitoring will continue for at least 5 years.

Figure 1. Progress of an isolated, ephemeral wetland restoration project on Sandhills Game Land in Scotland County, NC from 2008-2011. The final photograph shows the response of herbaceous vegetation from the wetland's seedbank after opening the canopy and re-introducing growing-season fire. Monitoring of vegetation and amphibian colonization is ongoing.

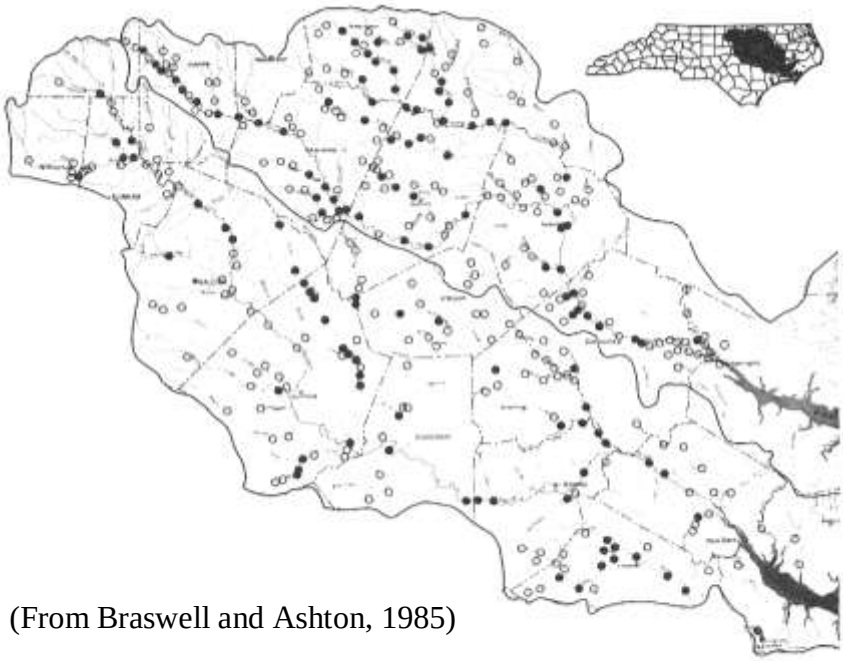
Neuse River Waterdog Surveys and Monitoring

Neuse River Waterdogs (*Necturus lewisi*) are large, permanently aquatic salamanders that only occur in the Tar and Neuse River drainages of central and eastern North Carolina. This species is state listed as a Species of Special Concern, mainly because little is known about its current status. Braswell and Ashton (1985) provided the most complete survey of *N. lewisi*, sampling waterdogs at 361 sites throughout both drainages from 1978-1980. Of the 361 sites sampled during their surveys, waterdogs were captured at 116 sites (Fig 2).

The surveys conducted in the late 1970s and 80s provide a sound baseline and excellent opportunity for monitoring of this species. We began an effort in 2011 to survey the same sites surveyed by Braswell and Ashton 30+ years later, using the same survey techniques, to determine the conservation status of Neuse River Waterdogs. We deployed 10 standard minnow traps with chicken liver as bait at previously sampled sites and checked traps at each site daily for 4 nights, or until at least one waterdog was captured. Dipnetting surveys were also conducted at each site. All waterdogs were measured for snout-vent length and total length, weighed, and released at the capture site. Incidental captures of other species were also recorded and provided to appropriate outlets.

During the winter of 2011, we surveyed 28 of the sites previously surveyed by Braswell and Ashton, and captured waterdogs at 8 of those sites. Twenty-nine waterdogs were captured during surveys, with a maximum of 13 captured at one site. Preliminary surveys found that waterdogs still occur in the Tar River and several tributaries near Greenville and the Trent River near New Bern, but surveys conducted in the upper Neuse River drainage resulted in waterdogs only being captured in the Little River (Wake County) and Swift Creek (Johnston County), despite considerable trapping effort in the main stem Neuse River and tributaries near Raleigh. Future surveys of additional sites are needed to better determine where this species still remains.

Surveys for Neuse River Waterdogs will continue for at least 2 additional seasons to re-visit all of the sites surveyed by Braswell and Ashton. We are also planning to conduct studies to address the capture probability of waterdogs in order to provide a more accurate assessment of this species' status based on standardized surveys.



(From Braswell and Ashton, 1985)

Fig 2 Sites sampled for *Necturus lewisi*, 1978 through 1981, Neuse and Tar River drainages. Solid dots are positive sites, hollow dots are negative sites. Inset shows location of Neuse and Tar River drainages in North Carolina.

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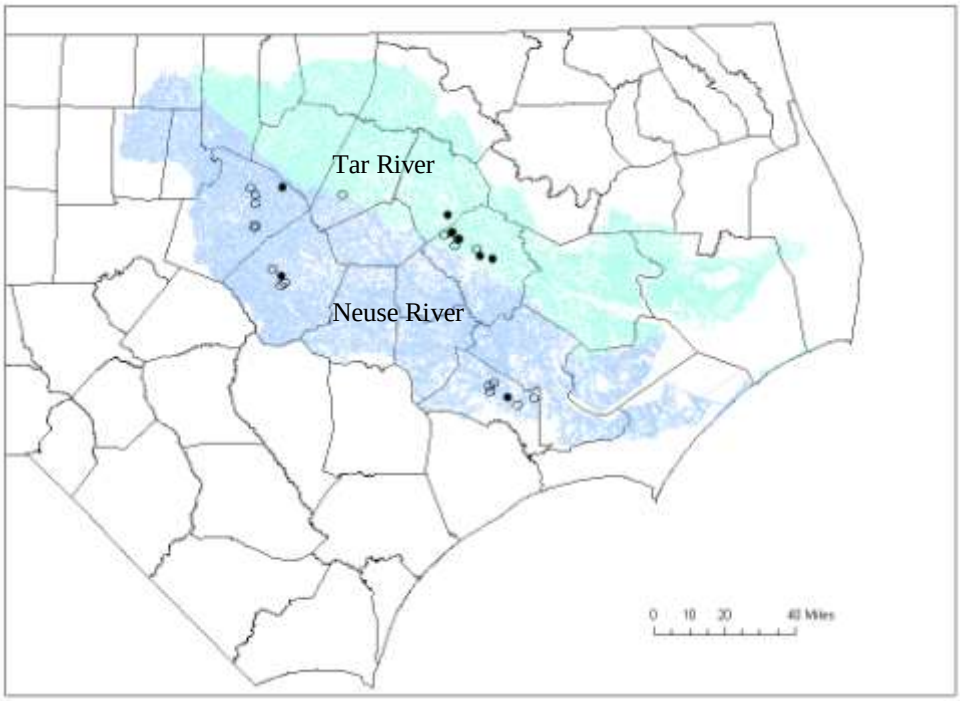


Fig. 3. Survey results for Neuse River Waterdogs (*Necturus lewisi*) conducted by NCWRC staff and collaborators in 2011. Solid circles are positive sites; open circles are negative sites.

Pine Barrens Treefrog Surveys and Monitoring

Surveys for previously undiscovered Pine Barrens Treefrog (*Hyla andersonii*) sites were conducted during the summer of 2011 on the Sandhills Game Land and adjacent land. Surveys were conducted by listening for calling males in streamhead seepage habitat at night, usually during rainy or wet nights in early and mid-summer. During 2011, 3 new sites with *H. andersonii* were discovered on the Sandhills Game Land. All of the sites consisted of only a few calling males.

A collaborative project between NCWRC and a doctoral student at Florida State University was started in 2011 to assess population sizes of Pine Barrens Treefrogs on Sandhills Game Land. Surveys were conducted at 5 sites where adult frogs were captured by hand at night. Each individual was marked by toe-clipping and released back to the site. A total of 54 individual frogs were captured and marked, with a maximum of 24 frogs marked at a single site/population. Subsequent surveys to determine recapture rates of individuals will provide information about population size and annual survival, as well as provide a baseline for monitoring and assessing habitat management implications.

Conservation of the Gopher Frogs (*Rana capito*) in North Carolina: Historical versus Current Range and Population Status – Year 2

In North Carolina, Gopher Frogs once occurred in 13 counties, from the Sandhills in the south-central part of the state, east throughout the Coastal Plain roughly to the Pamlico River in Beaufort County (Braswell 1993). Historically, there were 53 verified site locations from 29 different populations (populations are delineated as separated by 4 km or a major feature such as a river), based on museum records and reports by expert herpetologists.

We visited all historic sites where Braswell (1993) reported active or "unknown status" Gopher Frog populations in 2009-2010. We did not re-visit sites that Braswell reported as destroyed. In addition to historic sites, we visited numerous other ponds near historic sites or in areas where Gopher Frogs have never been documented. Surveys were conducted by egg mass counts and tadpole surveys. During the winter/spring of 2011, we sampled for Gopher Frogs at additional wetlands that had been identified during the previous year and re-sampled historic sites where Gopher Frogs had not been detected during previous surveys. We specifically targeted wetland clusters on Military Ocean Terminal at Sunny Point (Brunswick Co), Croatan National Forest (Carteret Co), and land recently acquired by The Nature Conservancy near Boiling Spring Lakes (Brunswick Co). We were unable to survey any sites in the Sandhills due to local drought conditions.

Gopher Frogs were detected at only 2 sites on the lower Coastal Plain during 2010-2011 surveys. One egg mass was discovered at a pond 1 km from a historically-known breeding pond on Croatan National Forest (Carteret Co). Five egg masses were found at a historically-known population on Holly Shelter Game Land (Pender Co). Despite surveying all historically-known populations and nearby wetlands on Military Ocean Terminal at Sunny Point, Gopher Frogs were not detected there during the most recent breeding season.

After year-2 of surveying for Gopher Frogs, this species still is known to occur as only 7 populations in NC, all on public land. The previously unknown breeding pond on Croatan National Forest that was discovered during 2011 is within a cluster where a small population was already known to occur. Drought conditions in the Sandhills and the apparently sporadic nature of breeding on the Coastal Plain suggests that surveys for Gopher Frogs should continue for at least another season. During the winter and spring of 2012, we plan to deploy audio recorders at historic sites and areas where appropriate breeding habitat occurs in an attempt to better document the status of Gopher Frogs. Automatic audio recorders may also offer some insight into the accuracy of our survey methods at detecting populations.

Monitoring Gopher Frogs and Headstarting on Holly Shelter Game Land

Gopher Frogs in Pender County, NC are currently only known to occur at a single breeding site – a borrow pit on Holly Shelter Game Land (Fig 4). During 2010, NCWRC staff began an effort to enhance the site so that successful reproduction of Gopher Frogs will be likely to occur more frequently. The main objectives for enhancement are to lengthen the hydroperiod of the pond so that tadpoles have a greater chance of transforming to juveniles in a given year, as well as to provide more herbaceous vegetation for egg deposition sites and to provide additional food resources for tadpoles. Enhancement efforts started in 2009 and continued into 2011. Deepening and re-shaping the borrow pit has resulted in a hydroperiod that now that should be appropriate for successful Gopher Frog and other amphibian species recruitment during most years. Heavy rains during the summer of 2011 negatively impacted our effort to increase herbaceous vegetation in the borrow pit; however, work will continue until our objectives are met.

During the 2011 breeding season, 5 Gopher Frog egg masses were discovered, indicating that the species still occurs at the site, but that the population of adults is likely very small. Additionally, successful recruitment (tadpoles surviving to the juvenile stage) has not been observed at this site for at least 3 years. Because of the suspected small population of breeding adults and lack of recent recruitment, we began a juvenile headstarting program to ensure at least one year where tadpoles survive to become juveniles while we continue to improve the quality of breeding habitat at this site.

In partnership with the North Carolina Aquarium at Fort Fisher, we collected a small percentage of the eggs from each of 5 egg masses found in the Holly Shelter borrow pit in early 2011. Eggs were hatched at the aquarium and tadpoles were raised in large tanks until they reached metamorphosis. In total, 275 juvenile frogs were raised and released into the uplands surrounding the borrow pit. Each individual was marked by injecting a small amount of fluorescent dye into the frog's leg and between the webbing of one foot. This will allow us to determine the success of this effort as we sample the population for breeding adults in the future.

Figure 4. The last known Gopher Frog breeding site in Pender County, NC occurs on Holly Shelter Game Land. NCWRC is in the process of enhancing this borrow pit in order to provide a longer hydroperiod and greater herbaceous vegetation cover in order for successful Gopher Frog reproduction to occur more frequently. The photos above show the breeding site in 2009 (left) and the site in late 2010 (right) after re-shaping the pond.

Other Activities

Piedmont Wildlife Diversity staff, along with other NCWRC staff, continued to work closely with biologists and managers from Croatan National Forest, Military Ocean Terminal at Sunny Point, and Camp Lejeune in order to survey for priority amphibian and reptile species and to conduct sound management of habitat. Surveys for priority amphibians on the Coastal Plain resulted in the continued failure to detect Ornate Chorus Frogs (*Pseudacris ornata*) at any sites. Targeted surveys of historic sites for this species should be a future priority. Finally, Diamondback Rattlesnakes (*Crotalus adamanteus*) were not detected at any sites outside of Camp Lejeune, where the species is still occasionally encountered by staff on base.

Results from surveys, research, and management projects were shared with various groups in order to inform conservation and management of priority habitats and species. During FY2010-2011, talks were presented at the following venues: Southeastern Partners in Amphibian and Reptile Conservation conference, C.U.R.E. update meeting at Suggs Mill Pond, NCWRC Commissioner's meeting, NCWRC Western Region Game Lands meeting, and Wake Audubon Society.

Major performance indicators achieved during FY2010-2011 included:

- At least 36 populations or meta-populations of priority amphibians monitored;
- Four technical guidance consultations on non-NCWRC projects, including species inventory and habitat management on Croatan National Forest, Camp Lejeune, and Military Ocean Terminal at Sunny Point
- Ten wetland sites managed (including collaborative wetland restoration and enhancement projects on partner-managed and dual-managed lands);
- At least 100 sites surveyed for priority species;
- Increased the knowledge score of Gopher Frogs, Pine Barrens Treefrogs, and Neuse River Waterdogs;
- One peer-reviewed publication in press.

B. Target Dates for Achievement and Accomplishment

Isolated wetland restoration and enhancement activities will continue over a number of years, and we will monitor the success of each project and adapt our management activities as needed. Surveys to determine the status of Neuse River Waterdogs will continue for two additional seasons or until all historic sites have been re-visited. Surveys for Pine Barrens Treefrogs and mark-recapture studies will continue for an additional season. At least one additional season is needed to determine the status of Gopher Frogs in the state, especially since weather conditions were suboptimal for conducting surveys during this reporting period. Surveys for priority amphibians and reptiles in the Piedmont will continue as appropriate.

C. Significant Deviations

None.

D. Remarks

The loss of a Coastal biologist position necessitated that Piedmont Wildlife Diversity staff work on projects in the Piedmont and Coastal Plain, and some projects that straddled both regions.

E. Recommendations

This project should continue as planned in order to meet long-term project objectives.

Wildlife Resources Commission biologists should continue collaborating with other agencies, academic researchers, volunteers, and the general public in conducting surveys, research, and land management activities. This would not only provide better data to our biologists, but also help to avoid overlap in survey and research activities. Habitat restoration and protection should be a continued focus for priority species. Additionally, status assessments of other amphibians that use upland pools and adjacent upland habitat on the lower Piedmont and Coastal Plain should continue.

F. Estimated Cost

$103,997 (including in-kind contributions)

G. References

Braswell, A.L. 1993. Status report on *Rana capito capito* Leconte, the Carolina Gopher Frogs in North Carolina. Report to North Carolina Wildlife Resources Commission. 53 pp.

Braswell, A.L. and R.E. Ashton, Jr. 1985. Distribution, ecology, and feeding habits of *Necturus lewisi* (Brimley). Brimleyana 10:13-35.

Prepared by: Jeff Humphries, Piedmont Wildlife Diversity Biologist
NC Wildlife Resources Commission

Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: July 1, 2010 - September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Piedmont Cooperative Land Conservation Project

Objectives:

To implement the Land Conservation and Private Lands Strategies of the NC Wildlife Action Plan collaboratively with conservation partners, particularly by working through the Greater Uwharrie Conservation Partnership (GUCP) and the NC Sandhills Conservation Partnership (NCSCP).

1) Coordinate and focus wildlife habitat protection efforts between land trusts, state agencies, federal agencies, private conservation buyers, industry and other entities through participation in and contributions to conservation partnerships.
2) Provide technical guidance to county and municipal governments, private landowners, and other stakeholders to develop land use and management plans that will protect important wildlife habitats and other natural resources alongside sustainable economic growth.
3) Plan and conduct biological surveys for Wildlife Action Plan priority species and habitats and update maps of priority natural resources.
4) Pursue land acquisition and other land conservation projects.

A. Activity

The Piedmont Cooperative Land Conservation Project has worked toward completing project objectives, in this 5th year of the project, with the following results between July, 2010 and September, 2011.

Coordinate and focus wildlife habitat protection efforts among conservation partners

The Piedmont Cooperative Land Conservation Project (PCLCP) helped to coordinate and support the Greater Uwharrie Conservation Partnership (GUCP) and participated in the NC Sandhills Conservation Partnership (NCSCP). Participation in these partnerships helped lead to results reported under objectives 2 -5. The Greater Uwharrie Conservation Partnership (GUCP) Forum and Steering Committee met once and working groups met 10 times on various projects. The Sandhills Conservation Partnership steering committee met 4 times and the working groups met 6 times. The GUCP expanded relationships with NC Division of Forest Resources and the Natural Resources Conservation Service (NRCS). The web page for the GUCP was improved this year. A basic wiggio.com file sharing website was developed and is being used by 5 partners. Active information exchange occurred on the GUCP and NCSCP email lists.

Promote better land use planning and development ordinances informed by biological data

Land use planning technical guidance was provided to local governments in the Uwharries and Sandhills through use of the Green Growth Toolbox (GGT), a technical assistance tool for sharing conservation data and planning recommendations with local governments. GGT implementation efforts were coordinated closely with the Urban Wildlife project, and full results for GGT efforts are included in the Urban Wildlife 2010 - 2011 report.

Provide technical guidance on priority wildlife habitat conservation.

- WRC staff continued serving on the Land Trust for Central NC (LTCNC) Land Protection and Stewardship Committees. WRC input has resulted in a greater emphasis on habitat stewardship and a change in LTCNC philosophy regarding the relative priority of stewardship. Habitat management and conservation considerations are being integrated in to LTCNC accreditation documents that guide their actions and criteria.
- 5 Landowner participants at last year's NC Tree Farm Workshop participated in fire training at Montgomery Community College.
- Technical guidance by WRC to a major local timber company led to improved habitat conservation planning for G1 and G2 (globally rare) ranked species. This timber company is also interested in training their staff on small wetlands buffers.
- A landowner of a GUCP priority area that WRC surveyed made plans to conserve and connect priority habitats after consultation between WRC and their forester.
- A survey was completed on 140 acres to assess the presence of priority habitats and landowner eligibility for the Wildlife Conservation Lands Program (WCLP). The landowner was also referred to the Land Trust for Central NC.
- A presentation at a NC Division of Forest Resources regional meeting resulted in Significant Natural Heritage Area data being available on the virtual workroom and accessible to consulting foresters working with private landowners to include in their forest management plans.
- The GUCP Stewardship committee completed a landowner technical assistance resources brochure to provide at events and send to landowners. WRC included the brochure in landowner reports for the Uwharrie Wildlife Inventory.
- 2 GUCP partner organizations were trained on how to conduct Uwharrie Wildlife Inventory and WCLP surveys.
- WRC and the GUCP provided technical guidance on bog habitat management to 3 private landowners (owning 15,000 acres) and the Uwharrie National Forest (UNF) during the Uwharrie Bogs Tour. Ten GUCP partner organizations participated in a field tour of bogs to form agreement on their status and management. Two landowners and the UNF are now actively managing bog habitat.
- WRC created a field guide for GUCP target herpetofauna identification for conservation partners to use in the field.

Land acquisition and other forms of habitat protection.

The NCWRC provided technical guidance, information, coordinated communications and planning assistance to our partners that contributed to conservation of priority NC WAP habitats including:

- The purchase of 180 acres of the King Mountain tract by WRC was completed.
- The purchase of 219 acres of the Harmon tract was completed by WRC and added to Sandhills Game Land.
- The purchase of 16.2 acre Carpenter tract was completed by The Nature Conservancy with transfer to WRC pending for inclusion in Sandhills Game Land.
- The Nature Conservancy purchased 805 acres in the Sandhills for Carver's Creek State Park.
- The Sandhills Area Land Trust conserved ~200 acres in northern Moore County for habitat conservation and to provide training lands for the military.
- At the close of this grant period the purchase of the 543ac Martin Marietta tract and the 42.5 acre Futrell tract were pending by The Nature Conservancy. Both these properties will be transferred to WRC for addition to Sandhills Game Land.
- In addition to projects mentioned above, WRC staff are currently working with LTCNC and The Nature Conservancy to pursue the purchase of up to approximately 1135 acres in 5 tracts in the Uwharries and Sandhills to add to Game Lands.
- The NC Zoo received a funding commitment to purchase 80 acres of the Arnett Branch (Nichols) old growth longleaf pine forest but funds are not currently available for disbursement due to state budget cuts. Alternative funding is being sought.
- WRC surveys and support assisted LTCNC in the purchase of 400 acres at the confluence of the Yadkin and South Yadkin Rivers. The tract contains early successional, wetland and mature hardwood forest and floodplain forest habitats.
- LTCNC are managing 195 new acres to maintain early successional and contiguous hardwood forest priority wildlife habitats.

Surveys, data collection and priorities assessment for wildlife species and habitats.

WRC continued to train and collaborate with conservation partners to collect data on priority species and habitat locations to identify priority conservation projects.

- WRC compiled and completed a database to document observations of GUCP target and NC Wildlife Action Plan priority species. The database was made available to the GUCP for partners to update with their records. The database is comprised of 1849 new records that will aid in conservation planning.
- Data is contributing to a WRC assessment of fox squirrel population status in the Uwharries.
- The GUCP participated in a winter survey for rusty blackbirds. None were observed.

Uwharrie Wildlife Inventory

WRC designed and conducted this project with the goal to inventory priority habitats, to assess habitat condition and document priority species occurrences primarily on private lands. Properties with high potential for occurrence of priority species, as identified by the GUCP

conservation target map, were contacted for permission to conduct surveys. Survey protocols included fixed effort surveys for birds, reptiles, and amphibians, in addition to habitat evaluations and recording incidental observations of all Wildlife Action Plan priority species. Landowner reports were drafted, but due to personnel changes have only been finalized and sent to 2 out of 24 landowners.

Wildlife surveys were conducted by a field technician with the aid of 3 GUCP partners on 24 privately-owned priority lands. In June a population of Swainson's warblers was documented on the Pee Dee River between Lake Tillery and Blewett Falls Lake during 2 river transect bird surveys. Thirty-two tin cover board arrays were surveyed once for reptiles and amphibians on two Land Trust properties, one private property and the Uwharrie National Forest and yielded only 1 new record for a marbled salamander. The landowner is collecting survey data for WRC, but no priority reptiles have been observed to date.

Road cruising herpetofauna surveys were conducted during September, October and February through May and covered 734 miles yielding 60 new records of priority species (3 timber rattlesnake, 1 corn snake, 2 mole king snake, 2 mole salamander, 47 spotted salamander, 5 marbled salamander).

Summary results from the Uwharrie Wildlife Inventory are as follows.

- 166 priority species records were documented including: 16 bird, 6 reptile, 3 amphibian, and 2 mammal species.
- One new population of mole salamanders was documented at a small wetland on private land.
- Strong relationships were formed with 4 new landowners and the Land Trust was connected with 3 landowners.

Measures of Success

NCWRC Measures of Success

- 4 key landowner relationships formed in GUCP priority areas.
- 817 acres of land permanently protected with WRC technical guidance.
- 1 Green Growth Toolbox workshop attended by 6 land use planners and GIS staff in Davidson County.
- 1 new local government downloaded Green Growth Toolbox GIS data.
- 1 local government received technical guidance and written recommendations in 3 technical guidance requests.
- County-wide zoning district document which included GGT recommendations was adopted by the Anson County Board of Commissioners.
- 3 new local government working relationships formed.
- Presentations on priority wildlife conservation given to over 40 consulting foresters and state foresters working with private landowners.
- 215 additional records added to the GUCP conservation target map database
- 24 new private land sites surveyed for priority species and habitats.

GUCP Partner Measures of Success (2009-2011)

- 2965 acres permanently protected that improve conservation for priority species.
- 798 acres of priority habitat enhancement on permanently protected land.
- 132 new landowner relationships.
- 13 strong working relationships with local government representatives.
- $3,330,000 of state, $873,000 of federal and $1,765,000 of local and private funding directed to land conservation in the region.
- 95 sites surveyed for GUCP conservation targets.

B. Target Dates for Achievement and Accomplishment

The scale and pace of achievements and accomplishment was less than anticipated, however targets have been achieved and will continue to be pursued.

C. Significant Deviations

NCWRC staffing changes and state-imposed hiring delays resulted in diminished capacity to focus upon this project in the latter half of the period. The results being that we spent less than originally anticipated upon staff time to coordinate, communicate, provide technical guidance, and conduct surveys for priority species and habitats. However, those capacity issues did not alter the course or content of the project in significant ways and overall the project was successful in meeting objectives.

D. Remarks

None

E. Recommendations

This project should be continued.

F. Estimated Cost

$47,290 (including in-kind contributions)

Prepared By:

Kacy Cook
Land Conservation Biologist
Wildlife Diversity Program, Division of Wildlife Management
NC Wildlife Resources Commission

Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: July 1, 2010 - September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Urban Wildlife Project

Objectives:

The main goal of the Urban Wildlife Project has been to help North Carolina's communities proactively conserve important species, habitats, and ecosystems alongside urban development. Project objectives include:

- To provide proactive technical guidance to local governments on how to plan for growth in a way that will conserve important species and habitats alongside development.
- To provide technical guidance to local governments on how to improve inventory, mapping, and management of priority species and habitats on parks and open space properties.
- To participate in partnership efforts to achieve conservation of species and habitats in urbanizing areas.
- To provide technical guidance to developers on how to create wildlife-friendly development projects.

A. Activity

Proactive Technical Guidance to Local Governments

The Urban Wildlife Project has continued to provide proactive technical guidance to local governments. During the reporting period, staff provided technical guidance on the following projects:

- Anson County Zoning Districts.
- A Green Infrastructure Plan by the Piedmont Authority for Regional Transportation and the Piedmont Triad Council of Governments for the entire northern NC Piedmont.
- The Davidson County Lower Abbots Creek Watershed Plan.
- An effort of the NC Wildlife Resources Commission (NCWRC), the NC Natural Heritage Program, US Army Corps of Engineers and the Conservation Trust for NC to coordinate recommendations among agencies and to coordinate between local governments with jurisdiction along Jordan and Falls Lakes Game Lands. The goal is for state and federal agencies with jurisdiction in Jordan and Falls Lake Game Lands to support each other's conservation recommendations and to inform local governments of

priority conservation areas adjacent to Game Lands that will lead to more proactive conservation-based policies in these priority areas.
- Continued input on the Horseshoe Farm Park planning effort with the City of Raleigh.

Short and long-term outcomes from project efforts are being noted where possible. On-the-ground outcomes often take years to become apparent. However, we are beginning to see long-term results and the following outcomes have emerged in this reporting year:

- The Anson County Zoning Districts incorporated GGT recommendations for conservation of priority habitats and were adopted by the County Board of Commissioners. The Districts include a Conservation Overlay of priority wildlife habitats, a Resource Conservation District and a Floodplain Protection Overlay. These policies and the design of other zoning districts encourage most growth to occur near town centers, discourage major development in the floodplain and conservation overlay areas and encourage wildlife corridors.
- Comments on the Aydan Court project in Orange County, subsequent communication with the Chapel Hill Planning Department and public pressure resulted in denial of the rezoning request for this land adjacent to Jordan Game Lands. Impacts to the waterfowl impoundments were cited among the reasons for the decision. Granting the rezoning would have set a precedent of allowing intense development in areas zoned for low density development adjacent to the Game Lands.
- The Raleigh City Council approved a park concept that will conserve 146 acres as early successional and floodplain forest priority wildlife habitat in Horseshoe Farm Park. NCWRC staff began providing recommendations on this project in 2005.
- The Wake County Board of Commissioners unanimously approved purchase and transferred easements on 211 acres of the Vick tract with funds from the Trust for Public Land. NCWRC staff is working through the Wake Nature Preserves Partnership to provide guidance on priority habitat management.
- NCWRC is working with Davidson County to plan a Watershed Summit for the county.

Participation in conservation partnership efforts

The Land Conservation Biologist continued to participate in and support regional conservation partnership efforts. During this reporting year, the Urban Wildlife Project:

- Participated in meetings of the Chatham Conservation Partnership
- Obtained a signed Memorandum of Understanding between NC Wildlife Resources Commission and the Wake Nature Preserves Partnership (WNPP) and participated in activities of the WNPP.
- Our participation in these conservation partnerships has resulted in successful trust building and training of partnership member organizations on priority habitat conservation.

Outcomes from these partnership efforts include:

- The first countywide Comprehensive Conservation Plan in North Carolina was completed by the Chatham County Conservation Partnership. The County has yet to officially adopt the plan.

- Completion and public release of new GIS data layers mapping the location of Wildlife Action Plan priority habitats in Chatham County. This GIS data is updated by Natural Heritage Program staff.
- Wake Nature Preserves Partnership led the official dedication of the first "Nature Preserve" (Turnipseed Nature Preserve) City Park by the City of Raleigh.
- WNPP completed a habitat management plan for 1,000 acres of protected open space along Marks Creek in eastern Wake County. The goal is for the "Marks Creek project" to serve as a pilot through which a process will be refined to inventory and develop habitat management plans for other parks and open spaces across Wake County.

Implementation of the Green Growth Toolbox (GGT)

One of the Urban Wildlife Project's focal efforts during the period has been coordinating implementation of the Green Growth Toolbox. The Green Growth Toolbox is a technical assistance tool designed to help local governments plan for growth in a way that will minimize impacts of development on priority habitats and species. During the past year, the Urban Wildlife Project:

- Administered and completed a $200,000 grant to 3 Non-profit organizations from the Wildlife Conservation Society's Wildlife Action Opportunities Fund to expand implementation of the Green Growth Toolbox across the state of North Carolina over 2 years.
- Provided additional training and support to staff with the NC Coastal Land Trust, Land of Sky Regional Council, and Sustainable Sandhills to complete and release regional GGT datasets and appendices, provide regional GGT training workshops, and deliver GGT technical guidance in their regions.
- NCWRC lead Green Growth Toolbox workshops in Davidson County and at Elon University and assisted external partners with workshops in the Southern Appalachians, Harnett County, and Brunswick and Columbus Counties and their major municipalities.
- Prepared a joint panel presentation on economic benefits of conservation-based planning to the NC Association of the American Planning Institute annual meeting with Land of Sky Regional Council, Fort Bragg Regional Alliance, Sustainable Sandhills and NC Department of Environment and Natural Resources.
- Delivered presentations on the Green Growth Toolbox to approximately 270 stakeholders (planners, elected officials, developers, resource professionals) around the state during NC Wildlife Action Plan Stakeholder meetings and at a quarterly meeting of the state's Rural (transportation) Planning Organizations hosted by the NC Department of Transportation.
- Defenders of Wildlife reviewed and provided suggestions for updates to the GGT that would focus on incorporating climate change. NCWRC conducted literature reviews for updates to the GGT handbook and website.
- Responded to inquiries and communicated with various stakeholders about the project.

Outcomes from the activities listed above include:

- Staff from three partner organizations (NC Coastal Land Trust, Land of Sky Regional Council – LOSRC, and Sustainable Sandhills) delivered 14 workshops to 45 local governments and trained 162 land use planners, GIS staff and elected officials and 15

non-governmental and state or federal government staff on how to conserve priority wildlife habitats through land use planning. We have now trained or reached 13 of the 16 Councils of Government in the state.

- Green Growth Toolbox technical guidance is being provided by partners and NCWRC to 21 local governments on 30 GIS mapping, land use plan, ordinance and development projects.
- The Green Growth Toolbox forms a basis of the Fort Bragg Regional Sustainable Growth Management Strategy and we are collaborating with LOSRC to encourage the Western NC Councils of Government to pursue Green Infrastructure plans.
- The Green Growth Toolbox partners that were funded under the Wildlife Conservation Society grant are continuing to collaborate to implement the GGT after completion of the grant. Sustainable Sandhills and Land of Sky Regional Council have secured their own funding sources to continue GGT implementation.
- Over 4,000 unique visitors used and explored the Green Growth Toolbox website.

Technical guidance to developers

While the Urban Wildlife Project's main focus has been on providing technical guidance to local governments, guidance has been provided to developers where requested. This past year, technical guidance included:

- The Urban Wildlife Project contributed to the development of the Wildlife Friendly Development certification program.
- NCWRC commented on a proposed 1,800 acre golf course development and rezoning in West End, NC that would take place in a mature longleaf pine forest.
- NCWRC conducted a wildlife inventory in partnership with the Natural Heritage Program for a 350 acre Spring Hill tract south of Lexington in Davidson County and provided the landowner, who may develop the tract, with conservation recommendations and habitat maps.

Results from technical guidance on development projects that occurred during this reporting period —

- The University of North Carolina agreed not to develop the Rizzo Center on a Significant Natural Heritage Area (SNHA) adjacent to Jordan Game Lands citing impacts to the SNHA and the Game Lands.
- A verbal commitment from the Spring Hill landowner to consider a conservation easement and a wildlife friendly development at the appropriate time.

Terrestrial Habitat Conservation Recommendations project (THCR)

During the project period, final edits, graphics and a statement of intent for the THCR document were completed. The document is under review for endorsement by the NCWRC Commissioners. The draft document was shared with some NCWRC biologists and conservation partners for use on their habitat conservation projects.

Model Wildlife Habitat Protection Ordinance Project

NCWRC and the Duke Nicholas Institute are collaborating to create a model wildlife habitat protection ordinance. NCWRC provided technical guidance to the Senior Attorney of the Duke Nicholas Institute on the draft model ordinance this year. A draft of the Model Wildlife Habitat Protection Ordinance was completed and shared with over 30 land use planners, the UNC School of Government, NCWRC staff and conservation partner organizations for comment. A key to success of the model ordinance is that it meets the needs of local governments that wish to adopt language or that wish to adopt their own habitat protection ordinances. We are consulting with the Town of Navassa near Wilmington and are also providing technical guidance to them in creating their own wildlife habitat protection ordinance. The next phase of the model ordinance project will be to incorporate comments from reviewers and to update the ordinance based on what we learn from research conducted for the Navassa ordinance.

B. Target Dates for Achievement and Accomplishment

Green Growth Toolbox implementation and related initiatives have met benchmarks for achievement and the project remains on schedule. Within the next year we intend to have more information on the effectiveness of this approach to land conservation, and the entire project will be evaluated over the next 2 years to determine future directions, to ensure the most effective and efficient use of resources

C. Significant Deviations

None

D. Remarks

None

E. Recommendations

We recommend that this project be continued for the coming year.

F. Estimated Cost:

$260,368 (including in-kind contributions)

Prepared By:

Kacy Cook
Land Conservation Biologist
Wildlife Diversity Program, Division of Wildlife Management
NC Wildlife Resources Commission

Final Performance Report

State: North Carolina **Grant Number:** T – 12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Coastal Region Landbird Investigations

Objectives:

1. Conduct surveys, monitoring, management, and research for priority landbird species occurring in the Coastal Plain ecoregion of North Carolina.

2. Provide technical assistance to government agencies and private entities regarding status, conservation, and management of priority landbird species in the coastal plain ecoregion and to participate in regional conservation partnerships and planning efforts.

A. Activity

During the reporting period, the NCWRC wildlife biologist continued landbird monitoring in the Coastal Plain, which consisted of several species-specific surveys (Bachman's Sparrow, Cerulean Warbler, Henslow's Sparrow), as well as more broad-based and regional efforts (early successional bird surveys, Breeding Bird Survey, Monitoring Avian Productivity and Survivorship Program, Nightjar Survey Network, and fall migration banding). In addition, a new southeastern Red-cockaded Woodpecker (RCW) working group was established, and several RCW Safe Harbor Agreements have been drafted for new properties.

Landbird monitoring

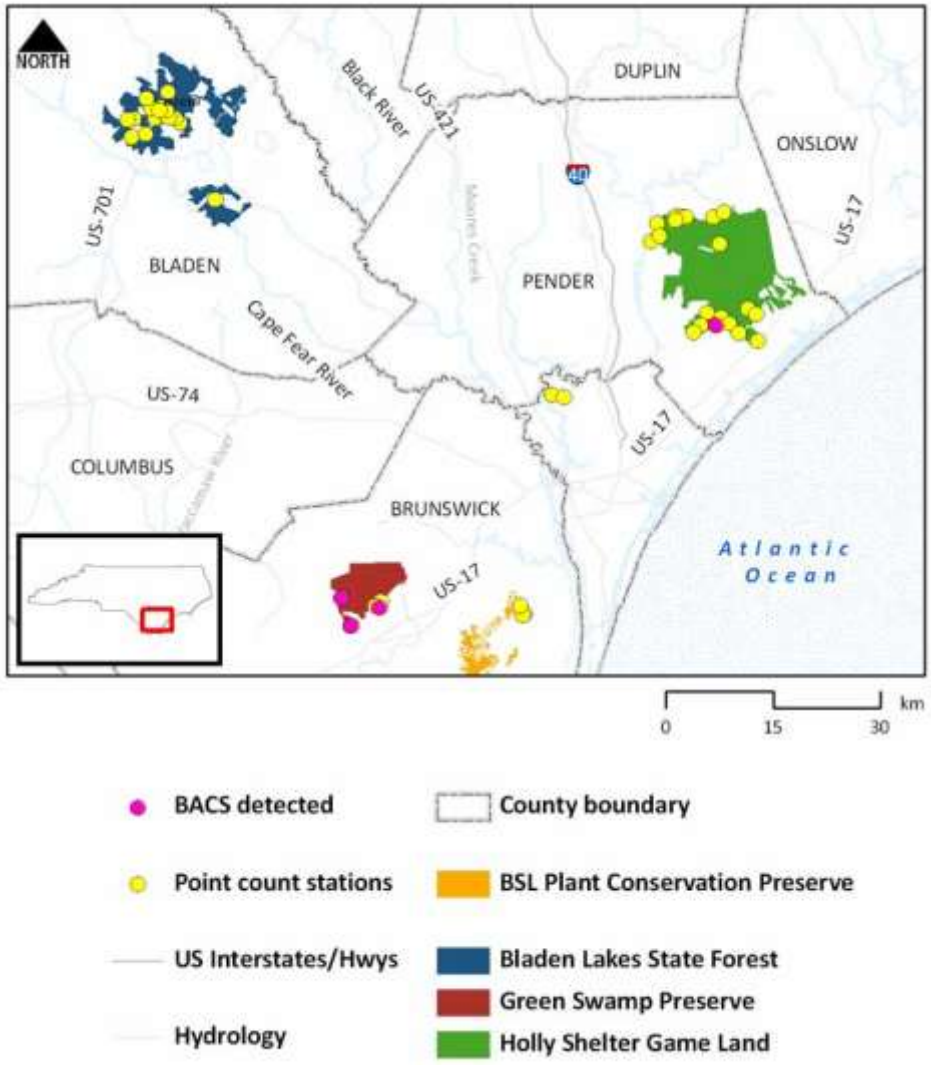
Bachman's Sparrow

Bachman's Sparrows (*Peucaea aestivalis*) were once considered common in many areas of the southeastern US but are now a species of management concern throughout most of its present day range (Dunning 2006). During the 2011 breeding season, surveys for Bachman's Sparrows were performed on both private and public property in four southeastern NC counties: Bladen, Brunswick, New Hanover, and Pender. Surveys were carried out on private lands enrolled in the RCW Safe Harbor Program and preserves owned by The Nature Conservancy (Green Swamp Ecological Preserve and Boiling Spring Lakes Plant Conservation Preserve), and on public lands in Bladen Lakes State Forest and Holly Shelter Game Land (HSGL).

To increase detectability in the field and help guide future sampling efforts, suitable Bachman Sparrow habitat (Haggerty 1998, Tucker et al. 2006) was modeled with the Mahalanobis distance (D^2) statistic using ArcMap 9.3 and the Land Facet Corridor extension (ESRI 2009, Jenness et al.

2010). Locations of Bachman's Sparrows detected during surveys from the 2010 breeding season and macro-habitat variables derived from the 30-m^2 Southeast GAP land cover data set (USGS 2008) and 6-m^2 footprint Light Detection and Ranging (LiDAR) data (Newcomb and Mitasova 2009) were the basis of the analysis. Only variables not highly correlated ($r < 0.75$) were accepted for modeling and included: distance to nearest upland longleaf pine (*Pinus palustris*) pixel, percent longleaf pine, habitat patch size > 6 acres, percent canopy cover, variety of landcover types, maximum canopy height, and canopy height standard deviation.

Fig. 1. Locations of point count stations used in Bachman's Sparrow (BACS) surveys, May-June, 2011. BACS were encountered only at the Green Swamp (n = 6) and Holly Shelter (n = 1).



The resulting grid was reclassified to retain only those cells with values ≤ one standard deviation of the mean D^2 of Bachman Sparrow locations from 2010 and clipped to areas managed with prescribed fire and/or basal area thinning. Secondary and tertiary roads were digitized from 2010 1-m^2 National Agriculture Imagery Program (NAIP) imagery in ArcGIS 9.3, and 50 points

were randomly stratified along this network ensuring that each of the aforementioned properties were sampled from.

Counts did not extend beyond 9:30 am and were divided into two three-minute periods followed by three minutes of *P. aestivalis* playback, which alternated between 30 second intervals of broadcast and passive listening. Distance and bearing to Bachman's Sparrows recorded during counts were later used to estimate basal area in approximate locations of bird use.

A total of 48 point count stations were visited once from May 24 to June 24, 2011 (Fig 1). Bachman's Sparrows were encountered only in HSGL (n = 1) and Green Swamp Ecological Preserve (n = 6). Of the seven detections, three males were detected during the first three minute period, while the remaining four individuals (three males and one juvenile) were detected during playback. The mean basal area for used habitat was 46.25 ft^2/acre.

The number of Bachman's Sparrows detected at Holly Shelter in 2011 was strikingly fewer than the eighteen encountered in 2010. There were fewer surveys performed at the game land in 2011 (n = 20) as in 2010 (n = 80). Furthermore, Bachman's Sparrows appear to be restricted to the southern 1/3 of the game land where only ten surveys were conducted in 2011 versus 26 in 2010. Although the use of GIS to identify *P. aestivalis* habitat *a priori* was beneficial by eliminating some field reconnaissance, the models were certainly affected by the reliance on antiquated spatial data layers, which must be updated for future use.

Cerulean Warbler

The NCWRC, in collaboration with the US Fish and Wildlife Service (USFWS), organized a survey for Cerulean Warblers (*Dendroica cerulea*) along the Roanoke River in May 2011. This species has been inadequately monitored in the Coastal Plain's Roanoke River Basin since territorial males were discovered there in 1972 (Lynch 1973). Recent range-wide estimates suggest that the already troubled Cerulean Warbler's situation has worsened with a 4.6% decline per year from 2003-2008 and 8.9% decline from 2007-2008 (Ziolkowski et al. 2010). Because of this, as well as our lack of knoweldge regarding the Cerulean population's present state along the Roanoke, the objectives were to: (1) estimate the Cerulean Warbler's current population size and distribution along the river by surveying for singing males, and (2) evaluate changes in land cover in the Roanoke River Basin to help explain trends in their abundance and distribution.

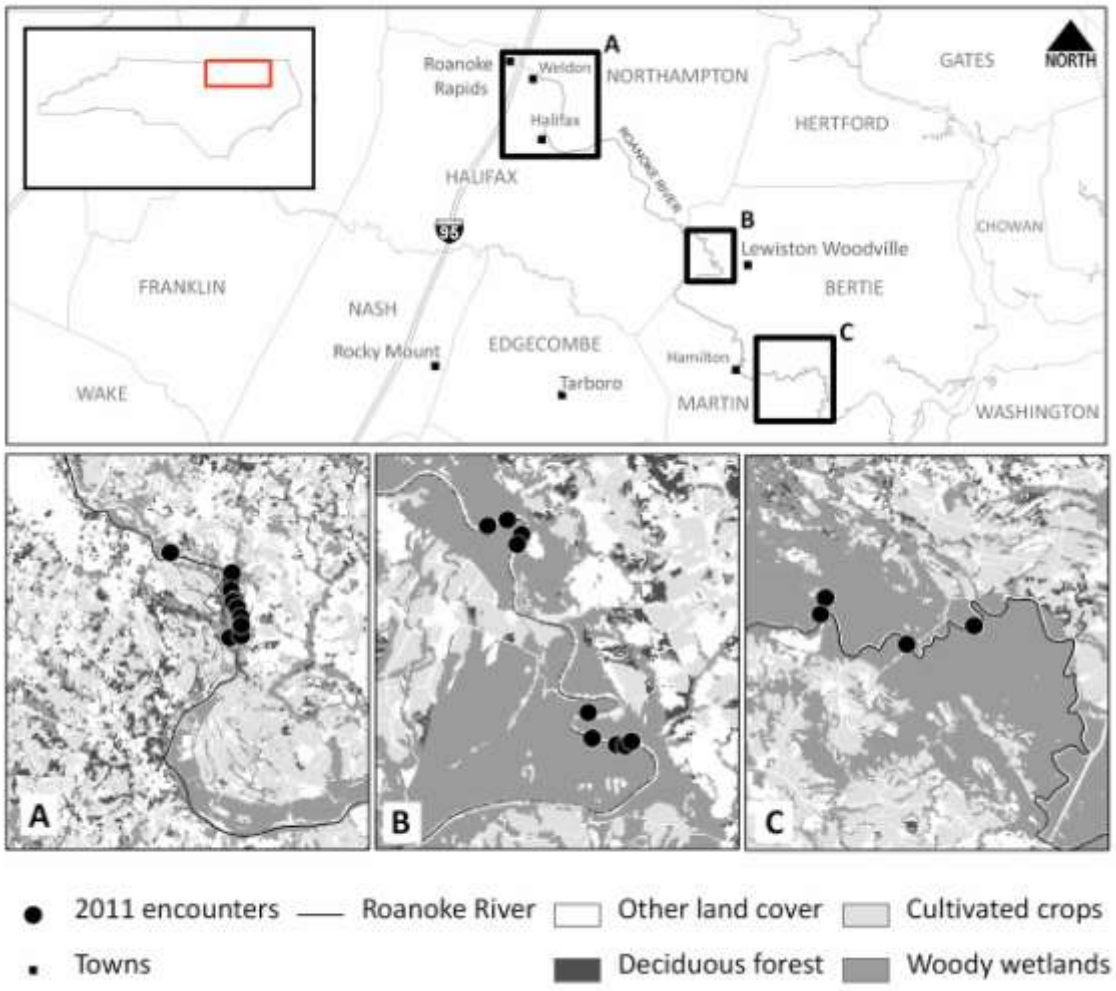
Our efforts were concentrated along roughly 100 miles of the Roanoke River from Weldon to the outlet of Conine Creek east of Williamston in northeast North Carolina. This area corresponds to that portion of the river surveyed during the most recent and comprehensive censuses to date (Lynch 1981, J. Richter, USFWS, unpublished report). NCWRC staff, along with eight volunteers, surveyed for singing Cerulean Warbler males from May 14-15 and May 28-29 in 2011. Surveys were conducted primarily by boat; however, several areas inaccessible by boat adjacent to the river were also investigated on foot.

Observations began at sunrise and ended at approximately 11:00 am. We recorded all species seen or heard as well as the total number of Brown-headed Cowbirds detected during encounters with Cerulean Warblers. Playback of a conspecific *D. cerulea* song was periodically used to

elicit the response of males on most but not all routes. We revisited Cerulean hotspots during the second survey weekend and considered encounters independent if the nearest Cerulean neighbor was >100 m away (Robbins et al. 2010). Recreational grade Global Positioning System (GPS) units were used to record approximate locations of Cerulean males.

ArcGIS version 9.3 was used to evaluate land cover change from 2001-2006 for a portion of the Roanoke River Basin. Change was examined at both small and large scales using a 10000 km^2 area centered on the mean geographic distribution of the entire Cerulean Warbler population (36.23° N, -77.37° W) as well 100 km^2 areas centered on clusters of Cerulean encounters. The basis for our analysis was the 30 m^2 National Land Cover Database (NLCD) from 2001 to 2006.

Fig. 2. Locations of Cerulean Warbler males detected on survey along the Roanoke River, May 2011. Land cover from National Land Cover Dataset 2006.



Change Index (USGS EROS 2011). We focused our analysis on loss of deciduous forest and woody wetlands because of the Cerulean Warbler's preference for these habitats (Lynch 1981).

We detected a total of 24 Cerulean Warbler males (19 on May 14-15, and five on May 28-29) and tallied a total of 99 species (Fig. 2, Table 1). This was at least 32.4% fewer Cerulean Warbler males than detected during a similar study performed in 2001 (J. Richter, USFWS, unpublished data). Cerulean Warblers were found in three distinct, spatially clustered groups along the Roanoke River, and most were found in areas associated with levee forests dominated by green ash (*F. pennsylvanicus*), sweetgum (*L. styraciflua*), sycamore (*Platanus occidentalis*), and red and silver maples (*Acer rubrum* and *A. saccharinum*).

Both deciduous forest and woody wetland habitat were lost between the years 2001 and 2006 (Fig. 3). The most common and abundant conversion was to cultivated crops, which increased by 6490 ha within 10000 km^2 surrounding the entire cerulean population, and by a total of 148 ha within three 100 km^2 centered on Cerulean Warbler clusters. Very little habitat was replaced with developed land at either scale.

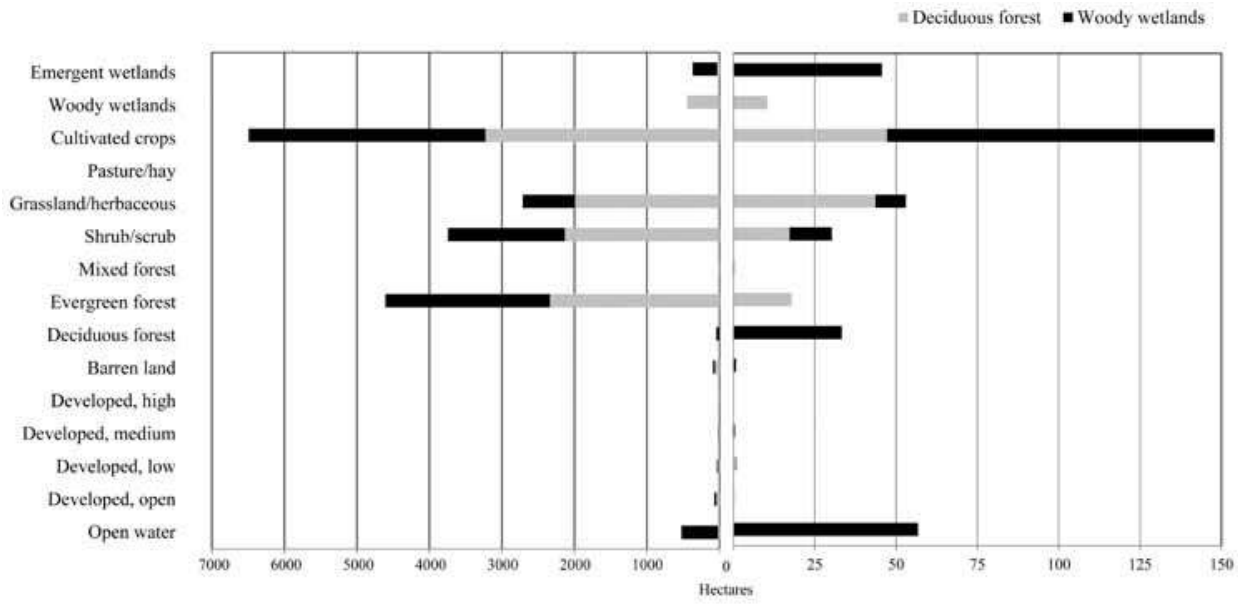
Several regions on the periphery of the Cerulean Warbler's core range have reported recent declines, including Ontario (Environment Canada 2011), Alabama (J.P.C. pers. obs.), Maryland (P. Stengo, Maryland Department of Natual Resources, pers. comm.), Delaware (*Breeding Bird Atlas Explorer* 2011), Connecticut (G. Krukar, Connecticut Department of Energy and Environmental Protection, pers. comm.) and Oklahoma (Cavalieri et al. 2011). More research is needed along the Roanoke River to confirm that the apparent decline there is growing.

Table 1. Bird species and percentage of routes (n = 11) detected during surveys along the Roanoke River, from May 14-15 and May 28-29 2011. Bold type indicates priority species.

Common name	% of routes	Common name	% of routes
Acadian Flycatcher	100.0	House Wren	9.1
American Crow	100.0	Indigo Bunting	90.9
American Goldfinch	45.5	**Kentucky Warbler**	45.5
American Redstart	81.8	Killdeer	9.1
American Robin	27.3	Least Sandpiper	18.2
Anhinga	18.2	Louisiana Waterthrush	36.4
Bald Eagle	45.5	Mallard	9.1
Barn Swallow	45.5	**Mississippi Kite**	45.5
Barred Owl	45.5	Mourning Dove	81.8
Belted Kingfisher	36.4	Nashville Warbler	9.1
Black Vulture	45.5	**Northern Bobwhite**	27.3
Black-and-white Warbler	9.1	Northern Cardinal	90.9
Black-crowned Night-Heron	9.1	**Northern Flicker**	36.4
Blackpoll Warbler	18.2	Northern Mockingbird	9.1

Black-throated Blue Warbler	18.2	Northern Parula	81.8
Blue Grosbeak	90.9	N. Rough-winged Swallow	45.5
Blue Jay	72.7	Northern Waterthrush	9.1
Blue-gray Gnatcatcher	100.0	**Orchard Oriole**	45.5
Blue-winged Teal	9.1	Osprey	36.4
Boat-tailed Grackle	9.1	Ovenbird	45.5
Brown Thrasher	36.4	Pileated Woodpecker	72.7
Brown-headed Cowbird	81.8	Pine Warbler	45.5
Canada Goose	45.5	**Prairie Warbler**	27.3
Canada Warbler	9.1	Prothonotary Warbler	100.0
Carolina Chickadee	100.0	Red-bellied Woodpecker	100.0
Carolina Wren	100.0	Red-eyed Vireo	100.0
Cattle Egret	9.1	Red-shouldered Hawk	72.7
Cedar Waxwing	9.1	Red-tailed Hawk	27.3
Cerulean Warbler	45.5	Red-winged Blackbird	9.1
Chimney Swift	72.7	Rock Pigeon	9.1
Chipping Sparrow	36.4	Ruby-throated Hummingbird	54.5
Common Grackle	72.7	Scarlet Tanager	45.5
Common Yellowthroat	63.6	Spotted Sandpiper	36.4
Double-crested Cormorant	45.5	Summer Tanager	100.0
Downy Woodpecker	100.0	**Swainson's Warbler**	72.7
Eastern Bluebird	27.3	Tree Swallow	9.1
Eastern Kingbird	36.4	Tufted Titmouse	100.0
Eastern Phoebe	9.1	Turkey Vulture	72.7
Eastern Towhee	27.3	Warbling Vireo	9.1
Eastern Wood-Pewee	90.9	White-breasted Nuthatch	63.6
European Starling	18.2	White-eyed Vireo	100.0
Field Sparrow	9.1	Wild Turkey	54.5
Fish Crow	54.5	Wood Duck	36.4
Gray Catbird	18.2	**Wood Thrush**	72.7
Great Blue Heron	54.5	**Yellow-billed Cuckoo**	81.8
Great Crested Flycatcher	81.8	Yellow-breasted Chat	36.4
Great Egret	36.4	Yellow-crowned Night-Heron	18.2
Green Heron	27.3	Yellow-throated Vireo	54.5
Hairy Woodpecker	36.4	Yellow-throated Warbler	63.6
Hooded Warbler	90.9		

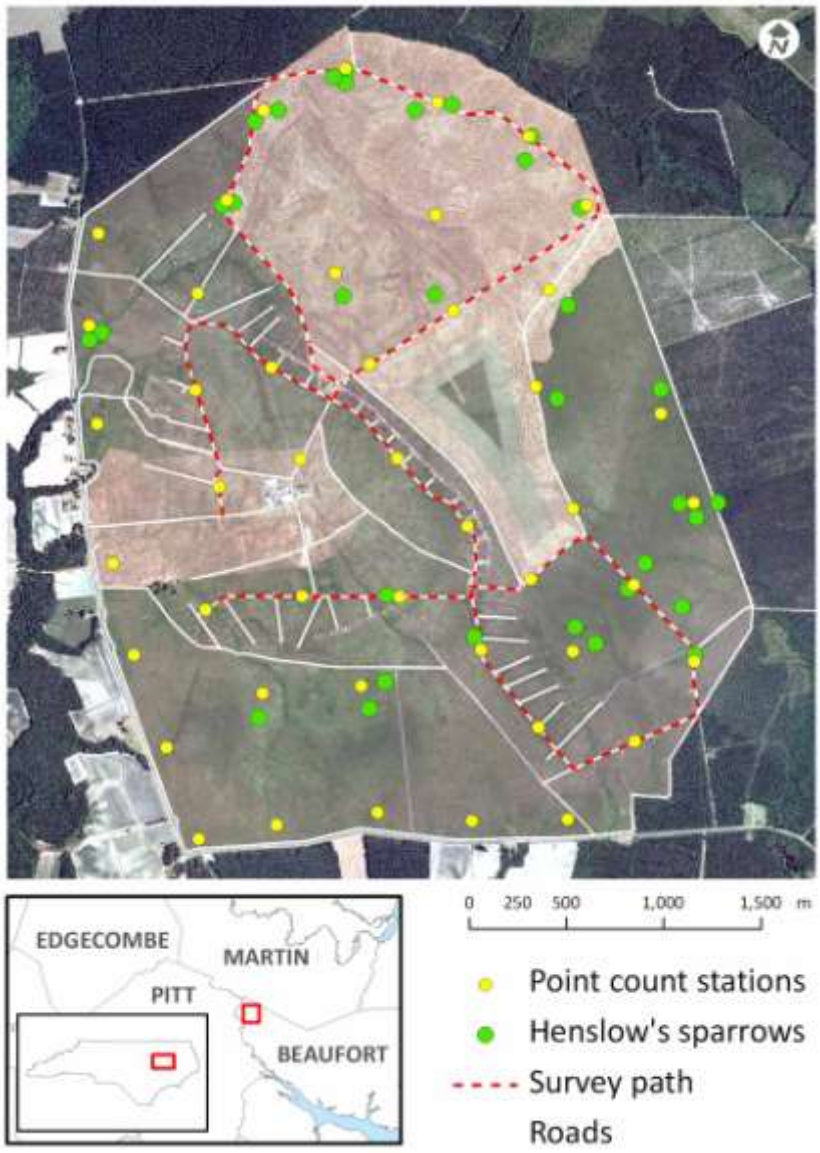
Fig. 3. Total hectares of land converted from deciduous forest or woody wetlands to other land cover types in the lower Roanoke River Basin, 2001-2006. Analyses confined to a single 10000 km^2 area centered on the entire Cerulean Warbler population (left) and three 100 km^2 areas centered on Cerulean Warbler clusters (right).



Henslow's Sparrow

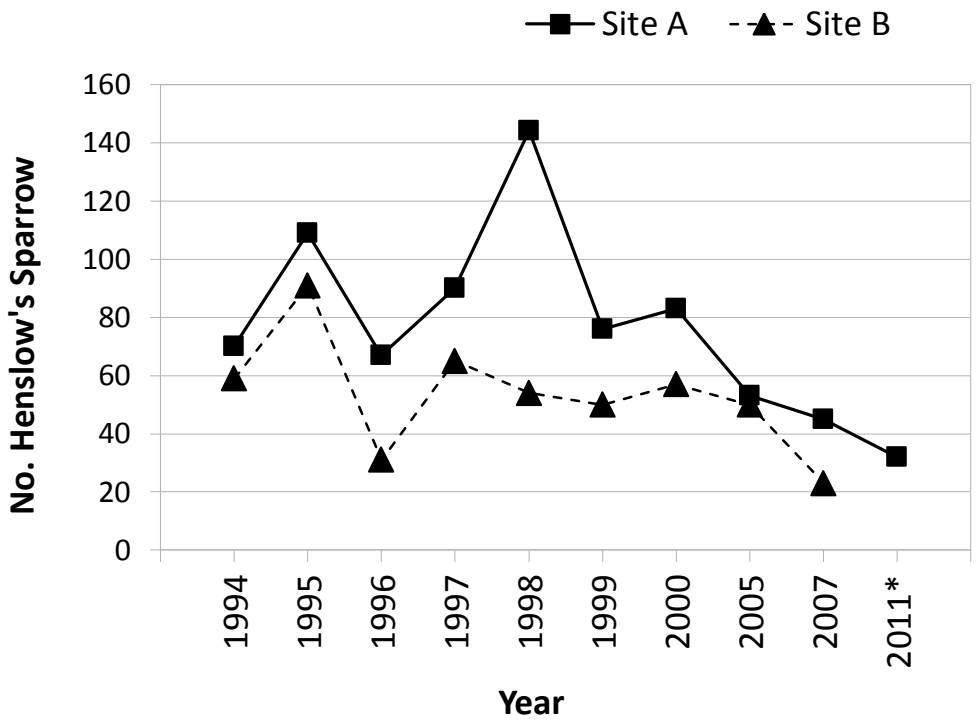
The Henslow's Sparrow (*Ammodramus henslowii*) occupies an extremely restricted breeding range in North Carolina with only two known breeding populations, both of which occur at Voice of America (VOA) broadcasting sites A and B in Beaufort and Pitt Counties, respectively (Lynch and LeGrand 1985). These areas represent two of the largest, contiguous, early successional grassland habitats in North Carolina and are considered Significant Natural Heritage Areas by the NC Natural Heritage Program (NCDENR 2009). Breeding Henslow's Sparrows are seldom encountered elsewhere in North Carolina because they require grassland-like habitat patches greater than 100 hectares with heterogeneously structured vegetation (Herkert 1994, Pruitt 1996). Open, herbaceous land cover is extremely scarce in North Carolina and represented only 2.9% of the landscape in 2001 (USGS 2008).

Fig. 4. Locations of Henslow's Sparrows detected (n = 33) during point counts conducted at Voice of America site A in Beaufort County, NC, May 2011. Survey path used to inventory plants and invertebrates only.



USFWS records suggest that the VOA sites support the largest breeding Henslow's Sparrow populations in the southeastern United States (USFWS 2009). According to censuses conducted at both sites by J. S. Wright from 1994-2000, 2005 and 2007, an average of 135 singing males were encountered, which fluctuated from 98 to 200 detections (J. S. Wright, unpublished data).

Fig. 5. Total number of Henslow's sparrows detected at Voice of America broadcasting sites A and B near Greenville, NC. Asterisk (*) denotes different survey technique.



Due to the absence of any formal survey of Henslow's since 2007, NCWRC staff and three volunteers inventoried the plant and animal communities of VOA site A (35.699° N, -77.148° W) from May 16-18, 2011. We documented all plants and animals encountered but placed emphasis on estimating the population size of Henslow's Sparrow. Point count stations were placed a minimum of 500 m apart along tertiary roads and fire lines within the property; however, several stations were also placed within the interior of the complex to increase detectability away from such corridors (Fig. 4). Nine-minute counts were divided into three equal intervals and did not extend beyond 9:30 am. Distance and bearing to all encountered Henslow's Sparrow males were estimated with a laser range finder and compass. Observers also tallied all other species encountered using the property during counts.

A total of 104 plant (trees/shrubs, vines, and herbs) and 58 animal (birds [Table 2], amphibians, and invertebrates) species was documented within the VOA site A property boundary. We performed 45 point counts and detected 33 Henslow's Sparrow males including one singing from an adjacent, regenerating pine clear-cut. This estimate is markedly lower than previous surveys (Fig. 5) and warrants further investigation of this population.

Table 2. Bird species and percentage of counts (n = 45) detected on during surveys on Voice of America site A, May 2011. Bold type indicates priority species.

Common name	% of counts	Common name	% of counts
American Crow	33.3	**Grasshopper Sparrow**	24.4
American Goldfinch	2.2	**Henslow's Sparrow**	46.7
Bald Eagle	2.2	Indigo Bunting	2.2
Barn Swallow	6.7	Killdeer	11.1
Brown-headed Cowbird	4.4	Mourning Dove	66.7
Blue Grosbeak	22.2	**Northern Bobwhite**	44.4
Brown Thrasher	2.2	Northern Cardinal	2.2
Chimney Swift	20.0	**Northern Harrier**	2.2
Common Grackle	20.0	Northern Mockingbird	2.2
Common Nighthawk	6.7	Purple Martin	13.3
Common Yellowthroat	11.1	Red-bellied Woodpecker	2.2
Eastern Bluebird	15.6	Rock Pigeon	2.2
Eastern Kingbird	6.7	Red-tailed Hawk	4.4
Eastern Meadowlark	88.9	Ruby-throated Hummingbird	4.4
Eastern Towhee	4.4	Red-winged Blackbird	37.8
European Starling	33.3	Turkey Vulture	4.4
Fish Crow	20.0	Yellow-breasted Chat	2.2

Monitoring Avian Productivity and Survivorship (MAPS)

The MAPS program is a continent-wide network of constant-effort mist netting stations operated cooperatively by public agencies, private organizations, and independent banders (DeSante et al. 2010). The resulting banding data provides critical information relating to the ecology, conservation, and management of North American landbird populations.

Due to a low number of captures in 2010, a new banding station was established in the Green Swamp Ecological Preserve approximately 5 km north of last year's station. The new site is characterized by longleaf pine savanna bordered by pocosin and a 2-hectare man-made pond. Eight standard size (12 m x 3 m) mist nets were operated once every ten days from May 20-August 4, 2011 with periodic assistance from volunteers. Banding effort at the Green Swamp yielded 95 new captures of 21 bird species, six of which were NCWAP priority species (Table 3). This was a 143.6% increase in new captures from 2010.

Table 3. Birds captured at Monitoring Avian Productivity and Survivorship (MAPS) banding station at Green Swamp Ecological Preserve, May–August 2011. Bold type indicates priority species.

Common name	New captures	Re-captures	Un-banded	Total	% Total	% Recaps
Bachman's Sparrow	1	1	0	2	1.1	10.0
Brown-headed Nuthatch	2	0	0	2	2.1	0.0
Blue Grosbeak	1	0	0	1	1.1	0.0
Brown Thrasher	3	1	0	4	3.2	10.0
Carolina Wren	5	0	0	5	5.3	0.0
Common Grackle	0	0	2	2	0.0	0.0
Common Yellowthroat	27	5	0	32	28.4	50.0
Eastern Bluebird	2	1	0	3	2.1	10.0
Eastern Towhee	4	0	1	5	4.2	0.0
Indigo Bunting	3	0	0	3	3.2	0.0
Louisiana Waterthrush	1	0	0	1	1.1	0.0
Mourning Dove	0	0	1	1	0.0	0.0
Northern Cardinal	3	2	0	5	3.2	20.0
Orchard Oriole	1	0	0	1	1.1	0.0
Pine Warbler	21	0	0	21	22.1	0.0
Prairie warbler	12	0	0	12	12.6	0.0
Red-bellied Woodpecker	1	0	0	1	1.1	0.0
Red-headed Woodpecker	4	0	1	5	4.2	0.0
Ruby-throated Hummingbird	0	0	1	1	0.0	0.0
Worm-eating warbler	2	0	0	2	2.1	0.0
Yellow-breasted chat	2	0	0	2	2.1	0.0
	95	10	6	111		

Early successional bird monitoring

The NCWRC's Wildlife Diversity and Private Lands Programs partnered through a North Carolina Department of Justice Environmental Enhancement Grant as part of the WRC's current Cooperative Upland habitat Restoration and Enhancement (CURE) program. One of its objectives is to continue and expand inventory of early successional bird species on corporate agricultural and swine farm operations.

In 2011, an additional 23 point count stations were surveyed with an emphasis on NCWAP priority landbirds, specifically: Northern Bobwhite (*Colinus virginianus*), Field Sparrow (*Spizella pusilla*), Eastern Meadowlark (*Sturnella magna*), Eastern Kingbird (*Tyrannus tyrannus*), Grasshopper Sparrow (*Ammodramus savannarum*), Prairie Warbler (*Dendroica discolor*), and Loggerhead Shrike (*Lanius ludovicianus*).

Surveys were performed once at 23 stations (Fig. 6) in mid-June and consisted of five-minute counts segmented into 0-3 min. and 4-5 min. periods. Distance (<25 m, 25-50 m, 50-100 m, 100-250 m, 250-500 m, and >500 m) and bearing to individual priority species, including Brown-headed Cowbirds, were recorded, as well as presence of all other species heard or seen. Counts did not extend beyond 9:45 am.

A total of 44 species were detected, including four priority species (Table 4). These results are preliminary and surveys are scheduled to continue in winter, spring, and summer of 2012.

Fig. 6. Locations of point count stations used for early succesional bird surveys in Duplin and Sampson Counties, June, 2011.

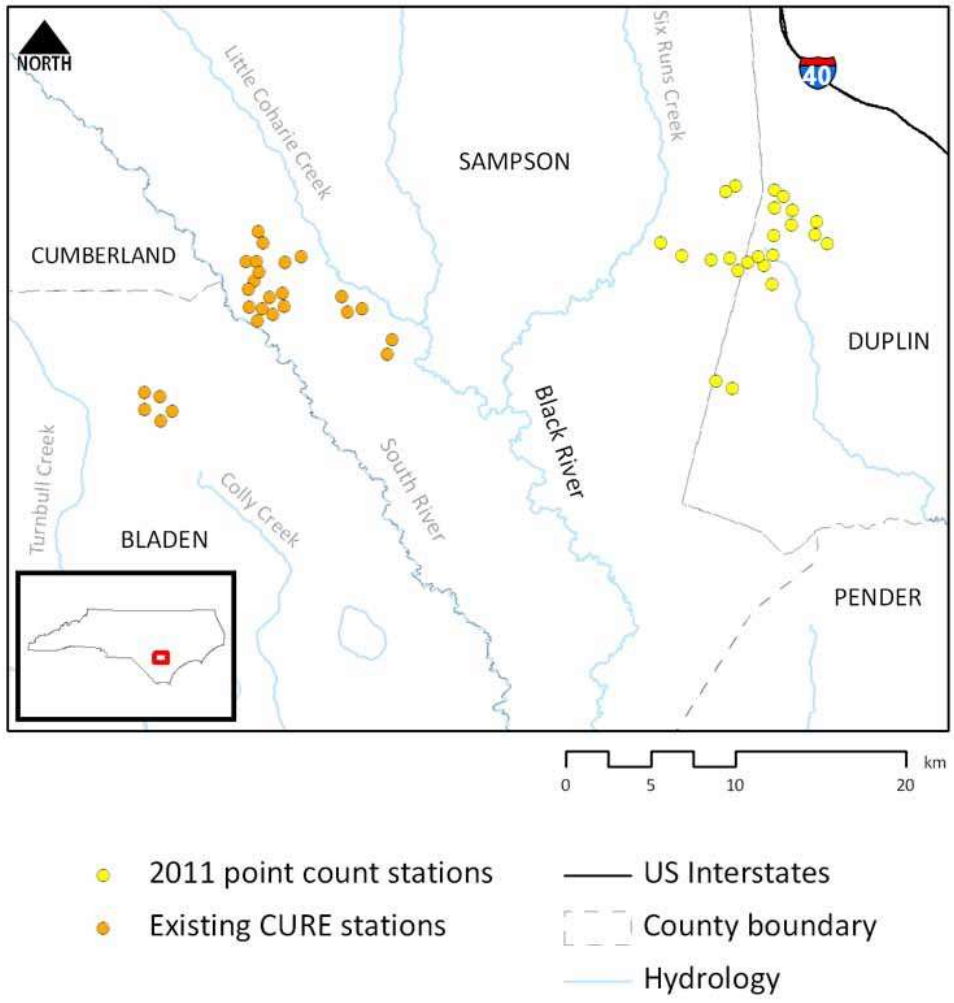


Table 4. Bird species, total detections (priority species only), and percentage of counts (n = 23) detected during surveys of early successional habitats in Sampson and Duplin Counties, June 2011. Bold type indicates priority species.

Common name	Total detected	% of counts	Common name	Total detected	% of counts
American Crow	N/A	69.6	**Grasshopper Sparrow**	7	30.4
Barn Swallow	N/A	13.0	Indigo Bunting	N/A	82.6
Brown-headed Cowbird	12	47.8	Killdeer	N/A	13.0
Brown-headed Nuthatch	1	4.3	Mourning Dove	N/A	26.1
Blue Grosbeak	N/A	30.4	**Northern Bobwhite**	5	17.4
Blue Jay	N/A	21.7	Northern Cardinal	N/A	56.5
Brown Thrasher	N/A	4.3	Northern Rough-winged Swallow	N/A	4.3
Carolina Chickadee	N/A	26.1	**Orchard Oriole**	1	4.3
Carolina Wren	N/A	52.2	Pine Warbler	N/A	8.7
Chipping Sparrow	N/A	4.3	**Prairie Warbler**	1	4.3
Common Grackle	N/A	4.3	Prothonotary Warbler	N/A	13.0
Common Yellowthroat	N/A	4.3	Red-bellied Woodpecker	N/A	13.0
Downy Woodpecker	N/A	13.0	Red-eyed Vireo	N/A	17.4
Eastern Bluebird	N/A	13.0	Red-shouldered Hawk	N/A	4.3
Eastern Kingbird	6	26.1	Red-tailed Hawk	N/A	8.7
Eastern Meadowlark	12	30.4	Red-winged Blackbird	N/A	8.7
Eastern Towhee	N/A	34.8	Summer Tanager	N/A	8.7
Eastern Wood-Peewee	N/A	13.0	Tufted Titmouse	N/A	26.1
European Starling	N/A	4.3	Turkey Vulture	N/A	13.0
Field Sparrow	N/A	4.3	White-eyed Vireo	N/A	4.3
Great Blue Heron	N/A	4.3	Yellow-breasted Chat	N/A	21.7

Fall migration monitoring

Migratory stopover sites play an important role in the life cycle of many landbird species (Moore et al. 2005). In collaboration with the NC Division of Parks and Recreation and Bald Head Island Conservancy, monitoring of migrating landbirds was initiated at Lake Waccamaw State Park and Bald Head Island from September through October 2010. This data may be used to evaluate species composition and relative abundance, clarify peak migration dates, stopover duration, and habitat use.

Ten standard size mist nets were operated five times at Lake Waccamaw, which yielded 101 new captures, 11 recaptures, and one unbanded bird. A total of 23 species were banded: 13 Neotropical migrant species (including seven non-NC Coastal Plain breeders), four temperate migrant species, and six resident species (Table 5). Black-throated Blue Warbler was the most abundant species caught (n = 18, or 17.8%) and recaptured (n = 4, or 36.4%). One juvenile

Black-throated Blue Warbler was recaptured twice and stayed at Lake Waccamaw for at least 28 days. Banding has continued in fall 2011.

Five nets were operated on Bald Head, but only twice due to inclement weather, which resulted in 23 new captures, one recapture, and two unbanded birds. A total of ten species were banded: five Neotropical migratory species (including two non-NC Coastal Plain breeders) and five resident species (Table 6). Northern Cardinal was the most abundant species caught (n = 7, or 30.4%). Logistical issues have prevented banding on Bald Head Island in 2011; however, a new station has been established in maritime forest habitat on NC Aquarium property at Ft. Fisher.

Table 5. Birds captured at Lake Waccamaw State Park fall migration banding station, fall 2010.

Common name	New captures	Re-captures	Un-banded	Total	% Total	% Recaps
American Redstart	12	0	0	12	11.9	0.0
Baltimore Oriole	1	0	0	1	1.0	0.0
Black-&-White Warbler	1	0	0	1	1.0	0.0
Black-throated Blue Warbler	18	4	0	22	17.8	36.4
Carolina Chickadee	4	0	0	4	4.0	0.0
Carolina Wren	7	3	0	10	6.9	27.3
Gray-checked Thrush	1	0	0	1	1.0	0.0
Gray Catbird	7	0	0	7	6.9	0.0
Hooded Warbler	3	0	0	3	3.0	0.0
Magnolia Warbler	2	0	0	2	2.0	0.0
Northern Cardinal	11	2	1	14	10.9	18.2
Northern Parula	2	0	0	2	2.0	0.0
Northern Waterthrush	4	0	0	4	4.0	0.0
Ovenbird	2	0	0	2	2.0	0.0
Ruby-crowned Kinglet	1	0	0	1	1.0	0.0
Red-eyed Vireo	1	0	0	1	1.0	0.0
Swamp Sparrow	1	0	0	1	1.0	0.0
Swainson's Thrush	4	0	0	4	4.0	0.0
Swainson's Warbler	1	0	0	1	1.0	0.0
Tufted Titmouse	6	2	0	8	5.9	18.2
Veery	1	0	0	1	1.0	0.0
White-eyed Vireo	8	0	0	8	7.9	0.0
White-throated Sparrow	3	0	0	3	3.0	0.0
Total	101	11	1	113		

Table 6. Birds captured at Bald Head Island fall migration banding station, September–October 2010.

Common name	New captures	Re-captures	Un-banded	Total	% Total	% Recaps
American Redstart	2	0	0	2	8.7	0.0
Blackpoll Warbler	1	0	0	1	4.3	0.0
Brown Thrasher	1	0	0	1	4.3	0.0
Carolina Wren	4	0	0	4	17.4	0.0
Common Grackle	0	0	2	2	0.0	0.0
Common Yellowthroat	2	0	0	2	8.7	0.0
Gray Catbird	1	0	0	1	4.3	0.0
Magnolia Warbler	1	0	0	1	4.3	0.0
Northern Cardinal	7	0	0	7	30.4	0.0
Painted Bunting	2	1	0	3	8.7	100.0
Red-eyed Vireo	2	0	0	2	8.7	0.0
	23	1	2	26		

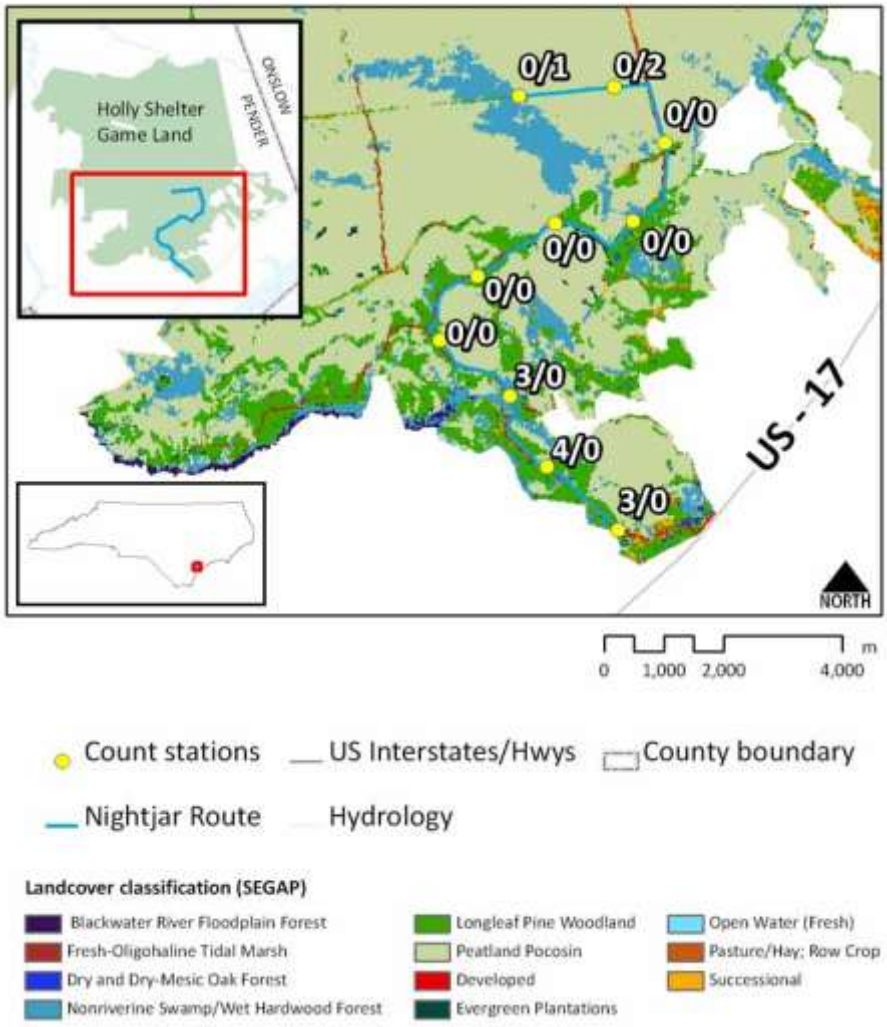
Breeding Bird Survey (BBS) & Nightjar Survey Network Survey

The BBS is a long-term, large-scale, international avian monitoring program initiated to track the status and trends of North American bird populations. Two BBS routes were completed in Craven/Pamlico/Beaufort Counties and Jones/Onslow, NC in May and June 2011, respectively. Data has been submitted to the USGS Patuxent Wildlife Research Center.

The Nightjar Survey Network is an annual monitoring program, coordinated by **The College of William & Mary's Center for Conservation Biology**, to collect information on population distribution and trends of Nightjars throughout 38 US states. Nightjars are nocturnal and therefore BBS data are unreliable. Surveys are performed at night and consist of standardized six-minute counts along 10 roadside stops spaced 1-mile apart.

A single survey was conducted on HSGL on June 14, 2011. Chuck-will's-widow (*Caprimulgus carolinensis*, $n = 10$) were encountered only in the southern portion of the route among longleaf savanna, whereas Whip-poor-wills (*Caprimulgus vociferous*, $n = 3$) were detected only at the northern most stops within a pocosin and non-riverine swamp/wet hardwood forest dominated landscape (Fig. 7).

Fig. 7. Total nightjars (Chuck-wills-widow/Whip-poor-will) detected on Nightjar Network survey route, Holly Shelter Game Land, June 2011.



Red-cockaded Woodpecker (RCW) management and Safe Harbor program

The NC wildlife diversity biologist assisted with the annual HSGL and Sandhills Game Land's RCW cavity tree status surveys, as well as artificial cavity insertion and pre-burning cavity maintenance at HSGL.

Safe Harbor Agreements have been drafted for three new properties: 62 acres in Brunswick County near Winnabow, NC, 32 acres in Bladen County near Bladen Lakes State Forest, and 76 acres in Craven County near Croatan National Forest. The latter two properties are situated in areas that may provide refuge for existing RCW clusters on nearby public lands. Furthermore, a RCW working group was formed in February 2011 to promote RCW conservation in southeastern NC (see below).

Currently, NCWRC does not band RCWs on Safe Harbor properties, thus limiting our ability to track the status of active clusters and document the success of the program. As a result, the NCWRC is in the process of seeking permission from the USFWS to color band RCW adults and juveniles nesting on Safe Harbor properties. NCWRC will coordinate color band combinations with other organizations and agencies working with RCWs in NC.

Regional conservation partnerships and planning efforts

The Cape Fear Arch (CFA) Conservation Collaborative is a multi-agency partnership committed to protecting the ecologically rich plant and animal diversity of North Carolina's coastal plain. The NCWRC wildlife diversity biologist attended two Cape Fear Arch committee workshops and organized a CFA RCW sub-committee. To date, the RCW group has convened four times and, using a geographic information system (GIS), identified several parcels exhibiting characteristics (e.g., dominant evergreen canopy, proximity to existing RCWs, mature canopy heights) that would more easily transition into suitable RCW habitat and enhance connectivity of active clusters in the region. Information highlighting the benefits of the Safe Harbor Program has been mailed to these private landowners and the NCWRC wildlife diversity biologist will pursue their enrollment in the Safe Harbor Program.

The wildlife diversity biologist also delivered a presentation of priority NC landbird species at The Nature Conservancy's (TNC) Fire in the Lakes Festival in Boiling Spring Lakes and assisted TNC with prescribed burns at two of their properties in Columbus and Pender Counties.

B. Target Dates for Achievement and Accomplishment

Species-specific surveys will continue until sufficient baseline data are acquired. Participation in regional efforts (BBS, MAPS, and Nightjar Network), as well as RCW monitoring and administration of the Safe Harbor Program, will continue indefinitely. Early successional bird monitoring will be completed in 2012. Fall migration banding will resume but most likely only at Ft. Fisher Recreation Area and supplemented with ancillary field surveys.

C. Significant Deviations

None

D. Remarks

None

E. Recommendations

More thorough surveys of Henslow's and Bachman's Sparrows and Cerulean Warblers are needed and will be initiated in 2012 to produce reliable baseline data. The current status of these species and our lack of knowledge regarding their population trends warrants continued monitoring.

- Surveys for Bachman's Sparrow should commence earlier in the breeding season (i.e., mid-April).

- Characteristics of the Cerulean Warbler's micro-habitat requirements need to be identified, and more systematic foot surveys are needed for population estimates.

- The persistence of many of the species we documented at the VOA is dependent on the control of woody vegetation throughout the property. Site A is now in the process of being decommissioned and the grounds are no longer being maintained by the federal government. We are in a position now to closely monitor this species' response to vegetative regeneration due to a lack of annual mowing, and therefore, begin the process of identifying its tolerance to these forces. However, it is highly recommended that management of the property resume within 2-3 years, and that the NCWRC remain persistent in pursuing acquisition of this property to carry out this task.

- The fire on Holly Shelter Game Land that began on June 19, 2011 and burned over 12000 ha provides a unique opportunity to monitor avian responses to a catastrophic perturbation. Revisiting point count stations sampled in 2010 and 2011 would be worthwhile.

F. Estimated Cost

$99,726 (including in-kind and other non-federal match)

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Final Performance Report

State: North Carolina **Grant Number:** T – 12

Period Covered: July 1, 2010 - September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Waterbird Investigations and Management

Objectives:

1. Survey breeding and non-breeding shorebirds and colonial-nesting waterbirds to clarify their status and distribution (NCWRC 2005, pp. 181, 194, 245, 249, 261, 269, 274).
2. Manage shorebird and colonial waterbird nesting sites to reduce human disturbance and increase productivity (NCWRC 2005, pp. 270, 275).
3. Provide technical guidance to other agencies and individuals, and coordinate with existing and new partners to stabilize declining populations of breeding and non-breeding shorebirds and colonial-nesting waterbirds, and protect their habitats (NCWRC 2005, pp. 270, 271, 276).

A. Activities

Surveys & Monitoring

International Piping Plover Winter Census

Every 5 years, the U.S. Fish and Wildlife Service (USFWS) works with its partners to complete a census of Piping Plovers (*Charadrius melodus*) during winter, and we conducted this census in North Carolina from January 27 – February 7, 2011. The 2011 International Piping Plover Census in North Carolina was largely complete with most known sites and suitable habitats surveyed (Table 1, Fig. 1). Thirty people covered almost all suitable habitats and slightly more habitat than in 2006. The 2011 count of 43 birds was lower than the number of Piping Plovers counted in 1996, 2001, and 2006 (Table 2), but higher than the 1991 count. We surveyed a greater length of shoreline (approximately 407 km) in 2011 and had more participants than during previous Winter Censuses.

There were several days with high winds, rain, and snow during the census window; however, we surveyed all but two sites within the time frame. Winter storms and snow reduce the number of plovers in North Carolina and these weather events may have brought about the lower number of plovers in 2011. We tried to avoid counting during high winds and rain, but a couple of sites were surveyed during these conditions so it is possible that birds were not detected at those sites. Browns Island, a small barrier island just north of Onslow Beach, was not surveyed during the census window because the Marine Corps Base would not grant access to the restricted area.

During the census for Piping Plovers, we also recorded all Wilson's (*C. wilsonia*) and Snowy (*C. nivosus*) Plovers detected. Only two Wilson's Plovers were detected (Table 2), and both of them

were on the east end of Ocean Isle Beach (Shallotte Inlet). No Snowy Plovers were detected. The North Carolina coast is not a common wintering area for either of these plover species.

Piping Plover Breeding Season Census

We worked with our cooperators to detect all nesting pairs of Piping Plovers in North Carolina from 1-9 June, the census window for the USFWS, and the entire nesting season (May–July; Table 3). Nests were monitored to determine success (≥1 egg in a clutch hatched) or failure (no eggs hatched, eggs were preyed upon, etc.). If ≥1 egg hatched, chicks were monitored to determine if they lived to the fledgling stage. The nesting success of Piping Plovers has increased in North Carolina during the last few years, perhaps due to predator management, increased management of recreational activity, and favorable environmental conditions (Figs. 2-3).

Colonial Waterbird Survey: history & background

Dr. James Parnell, University of North Carolina at Wilmington, conducted the first coast-wide survey of colonial waterbird nests in North Carolina in 1977 (Parnell and Soots 1979). A second coast-wide survey of colonial waterbird nests was led by Parnell in 1983 (Parnell and McCrimmon 1984). Monitoring of North Carolina's colonial-nesting waterbirds has continued since these initial surveys, and is supported by numerous cooperating agencies.

The North Carolina Wildlife Resources Commission's (NCWRC's) efforts to manage the state's colonial waterbird resources began in the early 1980s when the first draft of a waterbird management plan was presented at the first annual N.C. Colonial Waterbird Management Workshop by Parnell in May 1985. In 1990, Parnell and Shields published *Management of North Carolina's Colonial Waterbirds*. This publication serves as the basis for management efforts in North Carolina, as well as a model for other states.

In 1988, a Cooperative Agreement was signed by the NCWRC, Cape Hatteras National Seashore (CHNS), Cape Lookout NS (CLNS), National Audubon Society, National Marine Fisheries Service, N.C. Division of Coastal Management, N.C. Division of Marine Fisheries, N.C. Division of Parks and Recreation, The Nature Conservancy–N.C., U.S. Army Corps of Engineers (USACE), and USFWS. The NCWRC is the lead agency that insures agencies that signed the Agreement manage and protect colonial-nesting waterbirds to the extent of their jurisdiction. Hence, NCWRC coordinates activities related to the Agreement such as the Colonial Waterbird Survey and management of nesting habitats. Additional agencies have signed the Cooperative Agreement and annual Colonial Waterbird Committee meetings are held to update individuals on research and management issues in the state and to facilitate coordination among the agencies.

Census data going back to 1972 are housed in The North Carolina Colonial Waterbird Database, first developed by Parnell, and now maintained by NCWRC's Wildlife Diversity Program. The online database contains information on all known nesting sites of colonial waterbirds in North Carolina. This database has been updated continually with the help of USACE funding since 1989. Additional information available from the database includes site descriptions, specific nesting habitat characteristics, survey history, landowner information, and managing agency.

Colonial Waterbird Survey: justification & objectives

The need to monitor and manage colonial waterbirds was acknowledged in the *Management of North Carolina's Colonial Waterbirds* (Parnell and Shields 1990). The *North American Waterbird Conservation Plan* (Kushlan et al. 2002) was developed to provide a continental-scale framework for the conservation and management of waterbirds and it emphasizes the importance of regular monitoring to help determine conservation status, population trends, and effects of environmental changes and management prescriptions on waterbird populations. Waterbird conservation was put into a regional context with the publication of the *Southeast United States Regional Waterbird Conservation Plan* (Hunter et al. 2006). The NCWRC uses these plans as guidelines for Waterbird activities.

The objective of North Carolina's coast-wide Colonial Waterbird Survey is to provide data for trend, distribution, and habitat-selection analyses, as well as critical data on endangered species (Wood Stork [*Mycteria americana*]), threatened species (Gull-billed Tern [*Gelochelidon nilotica*]), and species of special concern (Black Skimmer [*Rynchops niger*], Common Tern [*Sterna hirundo*], Least Tern [*Sternula antillarum*], Glossy Ibis [*Plegadis falcinellu*s], Little Blue Heron [*Egretta caerulea*], Snowy Egret [*E. thula*], Tricolored Heron [*E. tricolor*]) that nest on barrier, estuarine, and dredged-material islands along North Carolina's coast. These data are used for technical guidance, education, management, research, and outreach purposes.

The NCWRC provides frequent technical guidance to the USACE regarding impacts of USACE-permitted activities that might affect colonial waterbirds. The islands created from dredged sand-shell material provide nesting habitat for many colonial waterbirds, and are a beneficial use of this material. Maintenance of these sites as nesting habitat is well-coordinated between the NCWRC and USACE.

Twenty-five species of colonial waterbirds nest in North Carolina, each selecting different types of nesting habitat. Herons, egrets, ibis, gulls, the Anhinga (*Anhinga anhinga*), the Brown Pelican (*Pelecanus occidentalis*), and the Wood Stork nest in undisturbed areas with grasses, shrubs, and trees. The Black Skimmer and most terns nest on bare or nearly bare sand–shell material. The Forster's Tern (*Sterna forsteri*) nests on wrack on coastal marsh islands. Because Anhingas and Great Blue Herons (*Ardea herodias*) nest almost exclusively in swamp forests and other inland wetlands, surveys of coastal islands do not obtain accurate counts of their nests; thus, data for these species are not reported in overall colonial waterbird survey results. The Wood Stork nests at one site in North Carolina and data from that colony are reported separately. Yellow-crowned Night-Herons (*Nyctanassa violacea*), Cattle Egrets (*Bubulcus ibis*), Snowy Egrets, and Green Herons (*Butorides virescens*) nest on coastal islands and at inland sites in great numbers, so data from coastal surveys will not provide accurate estimates of numbers of their nests. The primary focus of the Coastal Waterbird Survey is to estimate the number of nests of species that nest exclusively within coastal habitats.

Colonial Waterbird Survey: methods

Coast-wide surveys have been conducted every 2-4 years since 1993. The last complete survey was done in 2007. We began the 2011 survey in early May and continued through mid-July to

detect as many nesting colonies of these birds as possible and count all active nests. Cooperators from the CHNS, CLNS, USFWS, U.S. Marine Corps, USACE, National Audubon Society – North Carolina, UNC – Wilmington, N.C. State University, N.C. Division of Parks and Recreation, and many private volunteers worked with the NCWRC to complete these surveys.

Surveys were conducted using methods described by Parnell and Soots (1979) and Parnell and McCrimmon (1984). Nests were counted by 1–15 people (depending on colony size), spaced about 3–15 m apart. Counters walked transects through colonies and identified and tallied active nests (those with ≥1 egg or chick). Ground counts were preferred, but if chicks were fairly mobile, colonies were counted from the perimeter or the number of breeding pairs was estimated from adult counts. For herons and egrets with similarly-small blue eggs, nests with small blue eggs were counted, then a count of adults provided the proportion of each species, and this proportion was applied to the count of nests with small blue eggs to obtain a count of nests by species. We visited all colonies during peak incubation. Because we are only able to visit most sites once, counts of active nests likely underestimate the breeding population, but they provide an index of the number of nesting pairs that can be compared over time and among locations.

In June 2011, we conducted an aerial survey of the coast to detect colonies that may have been missed by ground surveys. We flew over the entire coast in 2 days, except military lands that were closed air space, primarily areas over Onslow Beach and Browns Island.

Colonial Waterbird Survey: results & discussion

We detected 71,036 nests of colonial waterbirds along North Carolina's coast in 2011 (Table 4). These nests were from 24 species distributed among 134 nesting sites. Species with the greatest numbers of nests were White Ibis, Laughing Gulls (*Leucophaeus atricilla*), Royal Terns (*Thalasseus maximus*), and Brown Pelicans (Table 4). We did not detect new coastal colonies during the aerial survey.

While some species' totals fluctuate annually but are stable over the long-term, the percentage change between 2011 estimates and the long-term (n = 11 coast-wide, colonial waterbird surveys) average for Caspian Terns (*Hydroprogne caspia*; -95%), Common Terns (-59%), Glossy Ibis (-26%), and Royal Terns (-11%) are noteworthy (Table 4). Further, the number of nests recorded for each of these species is less than the population goal for them (Table 5). Population and habitat goals were approved by the North Carolina Colonial Waterbird Committee at the 2001 Colonial Waterbird Committee Meeting, based on recommendations in *Management of North Carolina's Colonial Waterbirds* (Parnell and Shields 1990) and other waterbird conservation plans (Kushlan et al. 2002, Hunter et al. 2006).

Caspian Terns nest in small numbers (long-term average, 19 nests, Table 4) at only 1-2 sites in North Carolina. Most Caspian Terns nest in the Great Lakes and Northwest regions of the United States. Several adults were present on the dredged-material island where the one nest was found, but no additional nests were detected during several follow-up surveys. The only other colonial-nesting waterbirds nesting on this island were Herring (*Larus argentatus*) and Great Black-backed Gulls (*Larus marinus*). The number of nests of Great Black-backed Gulls in 2011 was 114% greater than the long-term average (Table 4). Nesting by this species (254 nests in

2011) has increased significantly since the late 1970s and 1980s (mean = 4 nests, *n* = 3 survey years). Possibly, the large, aggressive gull species is precluding Caspian Terns, and perhaps other species, from nesting sites and/or reducing their nesting success rates.

The Common Tern is a species of Special Concern in North Carolina, but it is not listed federally as a Candidate, Threatened, or Endangered Species. Although the number of nests recorded in 2011 was greater than in 2 previous coast-wide surveys (2004 and 2007), there is a negative long-term trend for this species (Table 4). The last time numbers of its nests were near the Population Goal of the Colonial Waterbird Committee (Table 5) was in 1993. There were 15 Common Tern nesting colonies in 2011, and most were on islands in the Back, Core, and Pamlico Sounds. Sites varied from dredged-material and natural estuarine islands to barrier island beaches. All nests were on sand-shell material. Greater protection of these nest sites may be warranted to address an immediate concern, but a study should be conducted to identify factors affecting nesting Common Terns so management will be most effective over a long term.

Numbers of Glossy Ibis nests (263) declined in 2011 relative to the long-term average (354; *n* = 11 survey-years), and its number of nests was lower than the Population Goal (500 nests; Table 5). This species is listed by North Carolina as a Species of Special Concern whose numbers of nests have only met its Population Goal during 2 of 11 coast-wide Colonial Waterbird Surveys (1993, 2001; Table 4). The number of nests detected during surveys appears to vary; thus, a decline detected in 2011 may not be of concern. Further study of the population may be warranted if numbers of nests are low again during the next Colonial Waterbird Survey.

The number of Royal Tern nests (11,049) reported in 2011 was 11% lower than the long-term average (12,453; *n* = 11 survey-years), and lower than the Population Goal (15,000 nests). The Population Goal for Royal Terns has been met during 1 of 11 Colonial Waterbird Surveys. The number of sites at which Royal Terns nested (*n* = 6) met the Habitat Goal. Five colonies were on islands – 4 dredge-material islands and 1 natural estuarine island. A new colony was found on CLNS, a barrier island beach habitat. Sandwich Terns (*Thalasseus sandvicensis*) nest in colonies of Royal Terns, and the number of their nests was 13% greater than the long-term average.

The Gull-billed Tern is a Threatened species in North Carolina whose Population Goal was set at 300 nests. During 2011, we recorded 183 nests, substantially below the Population Goal. However, the Population Goal has not been met during 11 Colonial Waterbird Surveys, and the 2011 estimate is about equal to the long-term average for this species (181 nests; *n* = 11 survey-years). Thus, this species is remaining stable, but not meeting its Population Goals.

The Black Skimmer is a Species of Special Concern in North Carolina, and its number of nests (702) in 2011 is below the Population Goal (1000 nests), but near the long-term average (740 nests; *n* = 11 survey-years), and the greatest number of nests recorded since the 1995 Colonial Waterbird Survey. With continued protection from human and other disturbances, this number may remain high and increase. Colonies of Black Skimmers were scattered among 9 sites, with 3 additional sites each with only 1 nest. Sites were barrier island beach, dredge-material island, and natural estuarine island habitats.

Forster's Terns are unique among the terns because they nest almost exclusively on wrack in marshes. The number of nests detected in 2011 (981) was lower than the long-term average (1031 nests; *n* = 11 survey-years; 5% decline) and lower than the Population Goal (1100 nests). We found many empty nests that were not counted as active nests, and several dead chicks. Because we found a dead rat and signs of rat activity at a few colonies, we suspect that the Marsh Rice Rat (*Oryzomys palustris*) may be a predator affecting nesting success of Forster's Terns (Brunjes and Webster 2003). The Marsh Rice Rat is a native species with which Forster's Terns must contend. It is likely that the number of dispersed colonies of Forster's Terns and their ability to re-nest after loss of an early nest lets them withstand some losses to rats.

There were no significant spring storms on the North Carolina coast during the survey; thus, nesting birds were not greatly affected by adverse environmental conditions. Of the wading bird species that nest almost exclusively on the coast, numbers of nests of White Ibis (*Eudocimus albus*), Black-crowned Night-herons (*Nycticorax nycticorax*), Great Egrets (*Ardea alba*), Snowy Egrets, and Little Blue Herons exceeded their respective long-term averages (Table 4). The Tricolored Heron, however, had fewer nests than the long-term average and did not meet its Population Goal. The number of sites at which it nested was greater than its Habitat Goal.

The Least Tern is a Species of Concern in North Carolina that has benefited from its plastic behavior, accepting various types of nesting sites. Numbers of nests of Least Terns (2916) were 50% greater than the long-term average (1939 nests; *n* = 11 survey-years; Table 4) and were greater than the Population Goal for the species (2000 nests; Table 5). Further, it nested at 47 sites, exceeding the Habitat Goal of 25 sites. Most sites on which it nested were dredge-material islands, barrier island beaches, and natural estuarine islands. Only 5 roof top sites were used in 2011. Several large (>100 nests) colonies were on sand-shell material near inlets. Use of fewer roof top sites and increased numbers of nests suggest that less disturbance from people, pets, and predators.

The number of Brown Pelican nests (5150) in 2011 was 52% greater than the long-time average (3394 nests; *n* = 11 survey-years), and one of the largest numbers counted during the 11 coast-wide surveys (second only to the count of 5173 nests in 2004). The 2011 nest count was greater than the Population Goal for Brown Pelicans (4000), and the number of nesting sites in 2011 (11 sites) exceeded the Habitat Goal of 5 sites. Although some islands on which it nests are eroding (e.g., Beacon Island), pelicans are doing well within the state.

Three species of gulls nest in North Carolina – the Laughing Gull, Herring Gull, and Great Black-backed Gull. Since 1977, gull numbers have increased. Herring Gulls and Great Black-backed Gulls did not nest in North Carolina in significant numbers before the 1970s, but both have been expanding their range southward. Range expansion and population increases of these species are assisted by their ability to benefit from human refuse. Gulls, unlike many other colonial waterbirds, adapt to and benefit from human-altered environments. Increases in gull populations can cause problems for other species of colonial-nesting waterbirds because gulls compete for nesting sites and prey on eggs and chicks of other species.

In 2011, Great Black-backed Gulls nested at fewer sites than in 2007, but the number of nests increased to 254, the greatest number yet (Table 4). Numbers of Herring Gull nests increased

slightly and they used 2 fewer sites than in 2007. Both Great Black-backed and Herring Gulls have expanded their range from islands in Pamlico Sound to islands in the Cape Fear River area. Laughing Gulls are native to North Carolina and have also been increasing due to their propensity for eating trash. Numbers of Laughing Gull nests in 2011 were 44% greater than the long-term average.

Colonies of nesting birds were distributed from Currituck Sound in the northern region of North Carolina's coast, to the east end of Ocean Isle Beach at Shallotte Inlet, near the border with South Carolina. Hence, the entire coast of North Carolina provides sites for these birds to nest on its barrier, estuarine, and dredged-material islands. Although some islands are eroding, some ends of islands near inlets are growing. Colonial waterbirds are adapted to ephemeral habitats and move to sites that provide habitat criteria specific to their nesting needs and habits. However, most of these species do not react quickly to sudden disturbances from recreationists, predators, or engineered construction; thus, these factors reduce availability of nesting sites along North Carolina's coast. In 2011, the NCWRC was given permission to post signs about nesting birds around potential nesting habitat on 4 private beaches in Brunswick County. These sites were at Tubbs Inlet, Shallotte Inlet, and Lockwood Folly Inlet. North Carolina Audubon and UNC-W monitored birds and habitat at Masonboro Inlet, Mason Inlet, Rich Inlet, and New Topsail Inlet. With these efforts, more colonies were successful in 2011 than in 2007 on natural beach inlet sites. Undoubtedly, continued success will require constant outreach to recreationists in these areas, but increased numbers of interested, conservation-minded citizens groups are providing assistance.

The colony sites at which birds nested were natural or dredged material, and in some rare instances, gravel roof tops. Most nests (about 68%) were on natural material (sand–shell beach, marsh wrack, shrubs, trees), about 32% of nests were on dredged material, and <1% were on gravel roof tops (Least Terns, only). Most colonies on natural sites were within CHNS, CLNS, and USFWS (Pea Island and Swanquarter NWRs). Species either listed as Threatened (Gull-billed Tern) or Species of Special Concern differed in their selection of dredged-material or natural sites; but the Least Tern was the only species that nested on roof tops (Figure 4). These results demonstrate the importance of both natural sites and man-made dredged-material islands, and the need for management and conservation of them for nesting birds. Gravel roofs have been important to Least Terns, and sometimes Black Skimmers, so they should be monitored and the owners encouraged to allow bird use during the few months of the nesting season.

A Wood Stork nesting colony was discovered in 2005 at Lays Lake. This lake is privately-owned and is within the Waccamaw River basin and coastal plain. Counts of active nests have been conducted from the periphery of the colony from a canoe due to the inability to walk through the swamp-island on which the colony exists. In May 2011, we detected 96 active Wood Stork nests (Figure 5). The number of active nests in 2011 is lower than that in all years except 2005. The population of Wood Storks within the southeastern region is growing, so rather than a population decline, the 2011 data may indicate movement of storks to other sites.

Colonial Waterbird Survey: conclusions & recommendation

Colonial-nesting waterbirds did well during 2011, with several species increasing the number of nests and/or sites used for nesting. The number of nests of a few species declined, especially the Common Tern.

An increased number of small colonies were on privately-owned land, and increased public interest and conservation concern should be nurtured so these sites persist and colony sizes increase. Most colonies are on islands that are under the management of conservation agencies (CHNS, CLNS, USFWS, or NCWRC) or on sites with restricted access (Cat, Raccoon, Brown Islands; Onslow Beach overwash) due to USMC activities; thus, should receive continued, and where necessary, increased management actions. Management may include reducing disturbance to nesting birds from recreationists or reducing the number of predators.

Islands composed of dredged sand-shell material continue to be important to colonial-nesting waterbirds and should receive continued attention. Management may be needed on several of these islands to reduce erosion and create the vegetative structure needed by a variety of bird species. The USACE and NCWRC should continue to coordinate when permitted actions may affect waterbirds, and when dredged material may be used beneficially to maintain and create bird nesting islands. The importance of these man-made islands will increase as sea-level rise models predict many natural areas will be inundated and lost.

The assistance from members of the Colonial Waterbird Committee and other interested groups is critical to achieving Population and Habitat Goals. The Annual Meeting of these agencies and individuals is critical to the exchange of information and planning for forthcoming conservation, management, or research actions.

Inland heronry surveys

Herons and egrets are surveyed regularly in North Carolina's coastal estuaries, but complete surveys for inland heronries are lacking. The last inland survey was conducted in 1996 and covered only portions of the coastal plain (Allen 1996). Because heronries are important biological resources and indicative of healthy wetland systems, surveying and monitoring them are listed as priorities in the NC Wildlife Action Plan (NCWRC 2005). Unfortunately, heronries are increasingly vulnerable to land development and human disturbance. Keeping the state's waterbird database of locations and numbers of heronries up-to-date will allow assessment of population status and of possible impacts from proposed land use projects.

Recent aerial surveys for inland heronries began in 2008. During May and June 2008, 2009, and 2010, NCWRC biologists surveyed portions of North Carolina's Coastal Plain and Piedmont.

In April and May 2011, NCWRC biologists continued surveys of inland areas of the Coastal Plain region for known and new heronries. Thirty-nine (39) heronries were detected, including 30 new heronries (Figure 6). Heronries were composed of Great Blue Herons (*Ardea herodias*) and Great Egrets. Surveys of the lower Neuse and Tar River basins were completed and portions of the Roanoke, Chowan, and Pasquotank basins remain to be surveyed in 2012.

A complete summary and assessment of survey data will be completed when the remaining sites within the Coastal Plain are surveyed and all data are obtained. We expect to assess our survey protocol and refine it to develop a monitoring plan for the southeastern region including Virginia, North Carolina, South Carolina, Georgia, and Florida. A meeting of southeastern waterbird biologists to discuss these plans will be held during the Waterbird Society meetings in November 2011.

Management of Shorebird and Waterbird Nesting Sites

Before the 2011 nesting season (March–April), Wildlife Diversity personnel and volunteers posted the perimeter of nesting sites that included 20 state-owned islands in or near Oregon Inlet, Pamlico Sound, Hatteras Inlet, Ocracoke Inlet, Core Sound, and New River Inlet. We obtained permission to post 4 privately-owned barrier and estuarine sites. Nesting sites are posted with informative signs for the public about sensitive nesting species and legal statutes that authorize such protection. Law enforcement officers have the authority to enforce temporary closures (1 April – 31 August) of state property to the general public during the nesting season. Our partners within the Colonial Waterbird Committee (USMC, USFWS, NPS, NC Audubon, NC State Parks [Hammocks Beach State Park, Ft. Fisher State Park]) post property under their jurisdiction with signs that are the same as or similar to those used on NCWRC properties.

An interactive map was created within Google Earth software to identify property managed by NCWRC, NPS, USFWS, USMC, and others for wildlife conservation, human recreation, research and education, or other purposes. This map identifies each location and provides the site name, land management agency, latitude and longitude, management activity, and bird species that frequently use the site.

Technical Guidance and Coordination

Reviews of Permits.— The Wilmington District Corps of Engineers continues to coordinate its activities with the Wildlife Diversity Program, incorporating moratoriums on activities during the nesting season for shorebirds and colonial-nesting waterbirds. We reviewed projects that involved dredging, placement of dredged material for beach nourishment or bird island maintenance, and renovations of structures such as jetties and bridges. We provide technical guidance to long-term studies of the Currituck and Pamlico-Albemarle Sounds.

We reviewed several permits for work with migratory and listed waterbird species for research, surveys, or management by those outside the NCWRC. The permitees were individuals or with agencies and universities.

State Waterbird Meeting.—On 10 March, the NCWRC hosted a meeting for members of the Colonial Waterbird Committee and other interested individuals. This meeting had not been held since 2009 due to the waterbird biologist position vacancy. Thirty-eight people attended the meeting and 8 presentations were given. Informative signs were given to those who wanted to post nesting areas under their jurisdiction. The meeting provided an opportunity to discuss

ongoing activities related to waterbird management, conservation, and protection, and to determine opportunities to collaborate.

Seabird Die-offs.— From November through December 2010, and during April 2011, the Wildlife Diversity Program responded to numerous calls about dead and seriously injured Brown Pelicans. A sample of dead pelicans was sent to the diagnostic lab of the Southeastern Cooperative Wildlife Disease Study, Athens, Georgia. Although thorough diagnostic exams were conducted, a clear cause of death was not determined. A result of this problem was greater organization among biologists, rehabilitation centers, and the public; thus, thorough data should be collected quickly if future die-off events are detected. Further, the USFWS, NCWRC, and Tufts University have begun enlisting the assistance of volunteers to collect data along North Carolina's coast for the Seabird Ecological Assessment Network (SEANET) program. A workshop on this program was held at UNC-Wilmington during early September 2011, and several volunteers have begun to get involved with data collection for the SEANET program.

B. Target Dates for Achievement and Accomplishment

All planned posting, technical guidance, and survey activities are on schedule. Portions of the Roanoke, Chowan, and Pasquotank Basins remain to be surveyed for inland heronries in 2012.

C. Significant Deviation

No significant deviation occurred.

D. Remarks

None

E. Recommendations

Continue working with landowners to post barrier island, beach-nesting sites before April; continue to work with interested citizen groups and volunteers; continue surveys and mapping of sites with most frequent use by shorebird and colonial-nesting waterbirds; continue enhancement and protection of nesting habitat. Propose research to address questions and problems associated with increased numbers of large gulls nesting along the coast, and with the continued decline of nesting Common Terns.

F. Estimated Cost

$ 162,368 (including in-kind and other non-federal match)

G. Literature Cited

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Table 1. Locations where censuses for Piping Plovers were conducted in North Carolina from 27 January to 7 February 2011 for the International Piping Plover Winter Census. Numbers of adult Piping Plovers, site descriptions, and previous census activity are provided.

County	Site name	Number on map[1]	Date	Total adults	Km	Previous censuses 1991	1996	2001	2006	Owner-ship[2]
Brunswick	Bald Head Island	31	2/3	0	19.4	Yes	Yes	Yes	Yes	s/p
Brunswick	Ft. Fisher State Park	31	2/3	0	8.0	Yes	Yes	Yes	Yes	s/p
Brunswick	Oak Island: East end & Fort Caswell Beach	32	2/3	0	3.0	Yes	Yes	Yes	Yes	p
Brunswick	Oak Island: Long Beach & west end to inlet	33	2/3	0	3.2	Yes	Yes	Yes	Yes	p
Brunswick	Holden Beach: E end to Lockwood Folly's Inlet	34	2/3	0	1.6	Yes	Yes	Yes	Yes	p
Brunswick	Holden Beach: W end to Shallotte Inlet	35	2/3	0	4.8	Yes	Yes	Yes	Yes	p
Brunswick	Ocean Isle Beach: E end	36	2/3	1	4.4	Yes	Yes	Yes	Yes	p
Brunswick	Ocean Isle Beach: W end	37	2/3	0	4.4	Yes	Yes	Yes	Yes	p
Brunswick	Sunset Beach: W end and Bird Island	39	2/6	0	3.2	Yes	Yes	Yes	Yes	s/p
Brunswick	Sunset Beach: E end to Tubbs Inlet	38	2/6	0	3.2	Yes	Yes	Yes	Yes	p
Carteret	Bogue Banks: W end of beach to inlet	18	2/3	0	1.6	Yes	Yes	Yes	Yes	s/m
Carteret	Bogue Inlet isl's & shoals (Dudley Is., Onslow Co)	19	2/3	0	5.2	No	No	Yes	Yes	s/p
Carteret	Cape Lookout N.S.: Morgan & Sand Bag[3] Islands	13	2/1	0	4.0	No	Yes	Yes	Yes	f
Carteret	Cape Lookout N.S.: N. Core Banks (includes Middle Core Banks & Ophelia Island as merged island)	10, 12	1/28	6	37.0	Yes	Yes	Yes	Yes	f
Carteret	Cape Lookout N.S.: S. Core Banks	14	1/24	2	37.0	Yes	Yes	Yes	Yes	f
Carteret	Cedar Island Ferry Terminal	11	1/24	0	2.5	Yes	Yes	Yes	Yes	f/p
Carteret	Dump & New Dump Islands	12	2/1	0	3.5					s
Carteret	Fort Macon State Park	17	1/24	0	1.6	Yes	Yes	Yes	Yes	s(p)
Carteret	Rachel Carson Estuarine Res. Reserve (Bird Shoal)	16	1/24	3	2.6	Yes	Yes	Yes	Yes	s(p)
Carteret	Cape Lookout N.S.: Shackleford Banks	15	1/24	7	14.4	Yes	Yes	Yes	Yes	f
Currituck	Currituck National Wildlife Refuge	1	1/24	0	17.6	Yes	Yes	Yes	Yes	f
Dare	Cape Hatteras N.S.: Rodanthe to Buxton	5	1/27	0	37.0	No	No	No	Yes	f
Dare	Cape Hatteras N.S.: Buxton to Hatteras Inlet	5	1/27	0	27.2	No	No	No	Yes	f
Dare	Clam Shoal	6	1/27	3	5.0	No	Yes	Yes	Yes	f
Dare	Cape Hatteras N.S.: Cape Point to Hatteras Inlet	7	1/27	0	25.8	Yes	Yes	Yes	Yes	f
Dare/Hyde	DOT, Ferry Channel, & Cora June[1] Islands	8	1/27	0	13	Yes	Yes	Yes	Yes	s(p)
Dare	Cape Hatteras N.S.: Bodie Island	2	1/27	0	9.2	Yes	Yes	Yes	Yes	f
Dare	Oregon Inlet & multiple dredged-material islands	3	1/28	1	4.8	No	No	Yes	Yes	s/p
Dare	Pea Island National Wildlife Refuge	4	1/27	0	19.3	Yes	Yes	Yes	Yes	f

Table 1. Continued.

County	Site name	Number on map[1]	Date	Total adults	Km	Previous censuses 1991	1996	2001	2006	Owner-ship[2]
Hyde	Cape Hatteras N.S.: Ocracoke Island	9	1/28	6	27.4	Yes	Yes	Yes	Yes	f
Hyde	Ocracoke Inlet: Bigfoot Island		1/27	0	1.6	No	No	No	No	p
New Hanover	Carolina Beach State Park	30	2/6	0	2.4	Yes	Yes	Yes	Yes	p
New Hanover	Figure Eight Island	28	2/3	0	3.2	No	Yes	Yes	Yes	p
New Hanover	Wrightsville Beach	28	2/3	0	1.6	No	Yes	Yes	Yes	M
New Hanover	Masonboro Island & Inlet Shoals	29	2/9	0	11.8	Yes	Yes	Yes	Yes	f
Onslow	Brown's Island, Camp Lejeune (U.S. MCB)	21	-	-	-	No	Yes	No	Yes	f
Onslow	Hammocks Beach State Park, Bear Island	20	2/4	0	7.2	Yes	Yes	Yes	Yes	s(p)
Onslow	Bear Island: East end to Bogue Inlet	20	2/3	2	3.2	Yes	Yes	Yes	Yes	s(p)
Onslow	N. Topsail Beach to New River Inlet	23	2/6	1	0.8	Yes	Yes	Yes	Yes	s/m
Onslow	Onslow Beach, Camp Lejeune (U.S. MCB)	22	2/4	0	12.9	No	No	Yes	Yes	f
Pender	Hutaff Island	26	2/7	0	3.3	No	Yes	Yes	Yes	p
Pender	Lea Island	25	2/3	0	2.4	No	Yes	Yes	Yes	s/p
Pender	Rich Inlet Shoals	27	2/7	0	3.3	No	No	No	Yes	s(p)
Pender	S. Topsail Beach to New Topsail Inlet	24	2/3	11	2.4	Yes	Yes	Yes	Yes	s(p)
Pender	S. Topsail Beach to New Topsail Inlet	24	2/6	0		Yes	Yes	Yes	Yes	s(p)
Total				**43**	**407**					

[1]See Figure 1for map of Piping Plover locations.
[2]Ownership: f (federal), s (state), p (private); m (municipality); some sites are partially state and private ownership.
[3]Island was not surveyed in 2006 or previous years.

Table 2. Numbers of plovers counted during each of five international winter censuses along North Carolina's coast.

	Census year				
Species	1991	1996	2001	2006	2011
Piping Plover	21	50	87	84	43
Snowy Plover	n.a.	n.a.	n.a.	n.a.	0
Wilson's Plover	n.r.	n.r.	n.r.	1	2

Table 3. Numbers of nesting pairs of Piping Plovers and individual Piping Plovers counted during the annual "window" survey (1-9 June 2011) along the coast of North Carolina. If individuals were counted, they were assumed to be single, non-nesting adults. Best estimates pertain to the entire nesting season, and the estimate of productivity was obtained by dividing the number of young fledged by the best estimate of number of nesting pairs. Most Piping Plovers nest within Cape Hatteras and Cape Lookout National Seashores within the Outer Banks of North Carolina.

Location (north to south)	Number of pairs (1-9 Jun window survey)	Number of individuals (1-9 Jun window survey)	No. pairs – best estimate (over entire season)	No. individuals – best estimate (over entire season)	No. young fledged	Estimate of productivity
Currituck National Wildlife Refuge	0	0	0	0	na[1]	na
Cape Hatteras N.S.	13	1	15	0[2]	10	0.67
Pea Island National Wildlife Refuge	1	0	1	1	1	1.00
Cape Lookout N.S.	41	1	41	1	37	0.90
Rachel Carson Reserve (Bird Shoals)	0	0	0	0	na	na
Ft. Macon State Park	0	0	0	0	na	na
Bogue Inlet, Dudley Isl., & W end of Bogue Banks	0	0	0	0	na	na
Hammocks Beach State Park (Bear Island)	1	0	1	0	0	0
Camp Lejeune, Onslow Beach	0	0	1	4	0	0
North Topsail Beach @ New River Inlet	0	0	0	0	na	na
South Topsail Beach	1	0	1	0	0	0
Lea-Hutaff Island	2	5	2	5	0	0
Figure Eight Island	0	0	0	0	na	na
Wrightsville Beach	0	0	0	0	na	na
Masonboro Island	0	0	0	0	na	na
Ft. Fisher State Recr. Area	0	0	0	0	na	na
Bald Head Island	0	0	0	0	na	na
Oak Island, Caswell Beach, & West end of Long Beach	0	0	0	0	na	na
Holden Bch, E & W ends	0	0	0	0	na	na
Ocean Isle, E & W ends	0	0	0	0	na	na
Sunset Beach & Bird Isl.	0	0	0	0	na	na
TOTAL	59	7	62	11	48	0.77

[1]na = not applicable because there were no nests.

[2]The single individual present during the census window found a mate later; therefore, after the census window, there were no single individuals present.

Table 4. Numbers of nests of colonial-nesting waterbirds counted within North Carolina's coastal region during coast-wide surveys. Changes in numbers and percentage-change from the long-term average are provided.

	Number of nests												Change	
Species	**1977**	**1983**	**1988**	**1993**	**1995**	**1997**	**1999**	**2001**	**2004**	**2007**	**2011**	**Average**	**#**	**%**
White Ibis	1939	3825	6332	10,455	9571	9446	8711	17,043	14,392	16,962	11,178	9987	1191	12
Glossy Ibis	404	291	84	526	279	482	229	600	377	356	263	354	-91	-26
Brown Pelican	82	1586	2637	3327	3290	4145	4350	4137	5173	3452	5150	3394	1756	52
Green Heron[1]	42	24	64	8	8	4	15	30	47	117	2	33	-31	-94
Black-crowned Night-heron	237	269	207	251	204	233	193	262	297	177	244	234	10	4
Yellow-crowned Night-heron[1]	2	9	12	18	10	21	12	10	2	14	1	10	-9	-90
Great Egret[2]	494	832	682	1945	1901	3551	1230	1901	1879	1697	2055	1652	403	24
Cattle Egret[1]	1137	1754	1919	2271	1517	908	3049	342	547	479	737	1333	-596	-45
Snowy Egret[2]	1034	716	497	904	672	676	271	349	446	386	664	601	63	10
Tricolored Heron	1479	1436	869	1938	1716	1241	701	1219	1702	979	1232	1319	-87	-7
Little Blue Heron[2]	802	1178	538	1727	1407	679	1025	1349	1354	1090	1307	1132	175	15
Least Tern	1925	1653	1528	2188	1993	882	1271	1742	2408	2827	2916	1939	977	50
Forster's Tern	1138	936	933	1610	1117	867	812	1086	828	1034	981	1031	-50	-5
Royal Tern	9755	17,029	11,793	14,611	14,150	10,991	12,519	10,877	13,524	10,689	11,049	12,453	-1404	-11
Sandwich Tern	1190	1850	1199	2700	2905	2766	3041	2487	2635	2786	2710	2388	322	13
Caspian Tern	10	6	11	33	37	26	32	22	16	15	1	19	-18	-95
Common Tern	2761	2247	2618	2122	1699	952	888	1131	570	498	604	1463	-859	-59
Gull-billed Tern	268	233	161	155	249	137	154	258	99	90	183	181	2	1
Black Skimmer	976	797	743	1084	819	570	681	594	623	555	702	740	-38	-5
Laughing Gull	9369	22,903	17,478	17,970	23,567	11,325	17,960	31,749	14,922	19,964	28,121	19,575	8546	44
Herring Gull	433	440	353	960	516	687	746	881	663	630	682	636	46	7
Great Black-backed Gull	9	0	3	47	92	177	201	181	176	164	254	119	135	114
Totals	**35,486**	**60,014**	**50,661**	**66,853**	**67,719**	**50,768**	**58,091**	**78,252**	**62,680**	**64,961**	**71,036**	**60,593**		

[1]This species nests primarily inland so this coastal survey did not detect the total number of nests in North Carolina in 2011

[2]This species nests both in coastal and inland regions, so these data do not reflect total numbers of nests in 2011.

Table 5. From May through mid-July 2011, the N.C. Wildlife Resources Commission worked with cooperators from The National Audubon Society–North Carolina, Cape Hatteras and Cape Lookout National Seashores, U.S. Fish and Wildlife Service, U.S. Marine Corps, North Carolina State Parks, Bald Head Island Foundation, North Carolina's National Estuarine Research Reserves, UNC–Wilmington, North Carolina State University, and individual volunteers to survey the entire coastal region for colonial-nesting waterbirds. New and known sites were visited and all active nests were counted. An aerial survey was conducted in June to detect colonies that may have been missed on the ground. Nests of 24 species were counted and 135 sites were surveyed. The U.S. Corps of Engineers helps fund this coast-wide survey every 3-4 years. Population and habitat goals were established by the NCWRC in 2001 in consultation with its cooperators.

Species	Nests[1]	Goal - nests	Sites	Goal - sites
White Ibis	11,178	8000	10	6
Glossy Ibis	263	500	9	7
Brown Pelican	5150	4000	11	5
Black-crowned Night Heron	244	250	20	10
Great Egret[3]	2055	2500	21	30
Cattle Egret[2]	737	No management need; No goal set; State will continue to monitor		
Snowy Egret[3]	664	800	13	15
Tricolored Heron	1232	1500	17	15
Little Blue Heron[3]	1307	1200	9	15
Least Tern	2916	2000	47	25
Forster's Tern	981	1100	14	15
Royal Tern	11,049	15,000	6	6
Sandwich Tern	2710	2700	5	6
Caspian Tern	1	25	1	1
Common Tern	604	2500	15	20
Gull-billed Tern	183	300	9	6
Black Skimmer	702	1000	12	15
Laughing Gull	28,121	No management need, but ≥10,000		
Herring Gull	682	No management need, but ≤1000		
Great Black-backed Gull[4]	254	No management need[4], but ≤200		

[1]Numbers of nests and nesting sites in red are below the Waterbird Program goal.
[2]This species nests primarily inland so this coastal survey did not detect the true number of its nests in North Carolina in 2011.
[3]This species nests both in coastal and inland regions, so these data do not reflect total numbers of nests for it in 2011.
[4]The number of Great Black-backed Gull nests has increased above the Waterbird Program goal, so management of the nesting population will be considered.

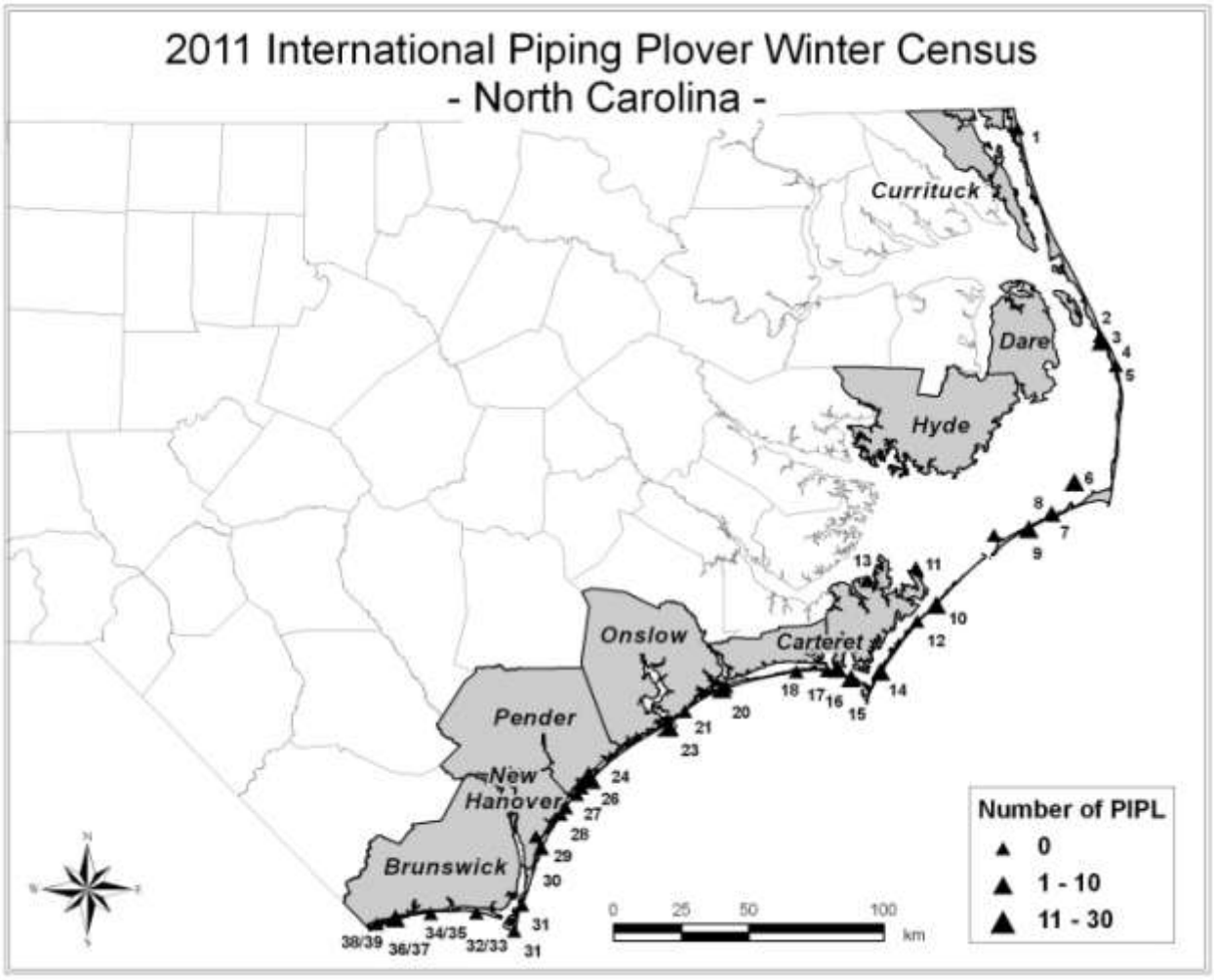

Figure 1. Locations where censuses for Piping Plovers were conducted along the coast of North Carolina from 27 January to 7 February 2011 for the International Winter Census of Piping Plovers. Numbers correlate with data in Table 1.

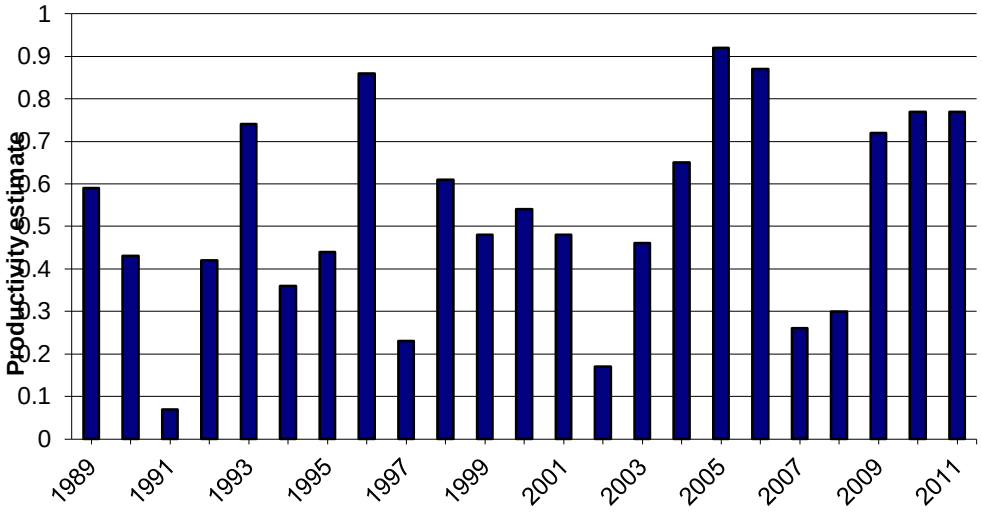

Figure 2. Estimated productivity for Piping Plovers nesting along the North Carolina coast from 1989 to 2011. Overall productivity of Piping Plovers within North Carolina has been >0.70 for the last 3 years. In 2011, the estimated productivity of Piping Plovers nesting within Cape Hatteras National Seashore was 0.67 fledged young per pair, and 0.90 fledged young per pair within Cape Lookout National Seashore. Elsewhere, except Pea Island NWR where one nest fledged one chick, either no chicks hatched successfully or chicks did not survive to fledgling stage.

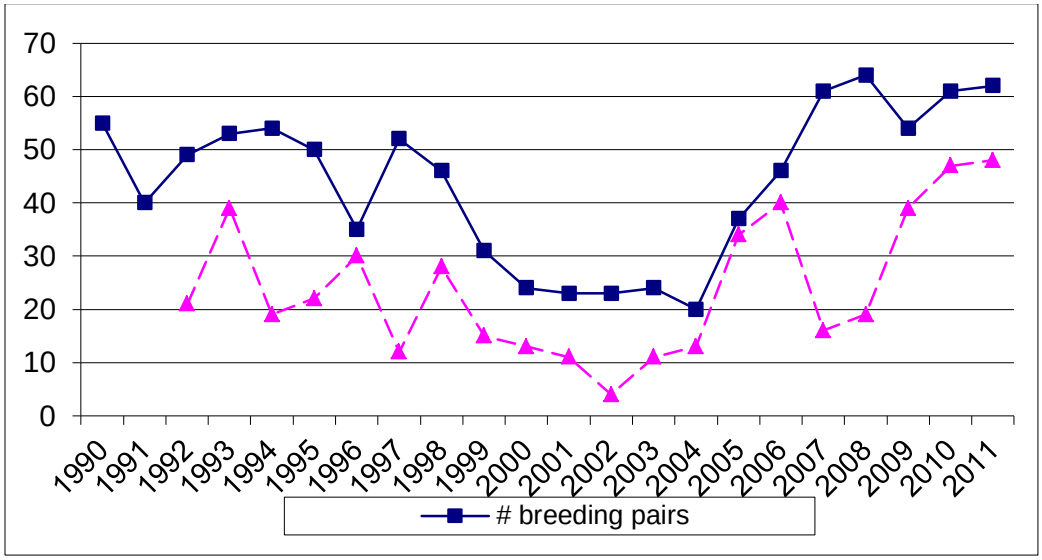

Figure 3. Numbers of Piping Plover breeding pairs and fledged chicks in North Carolina from 1990 to 2011.

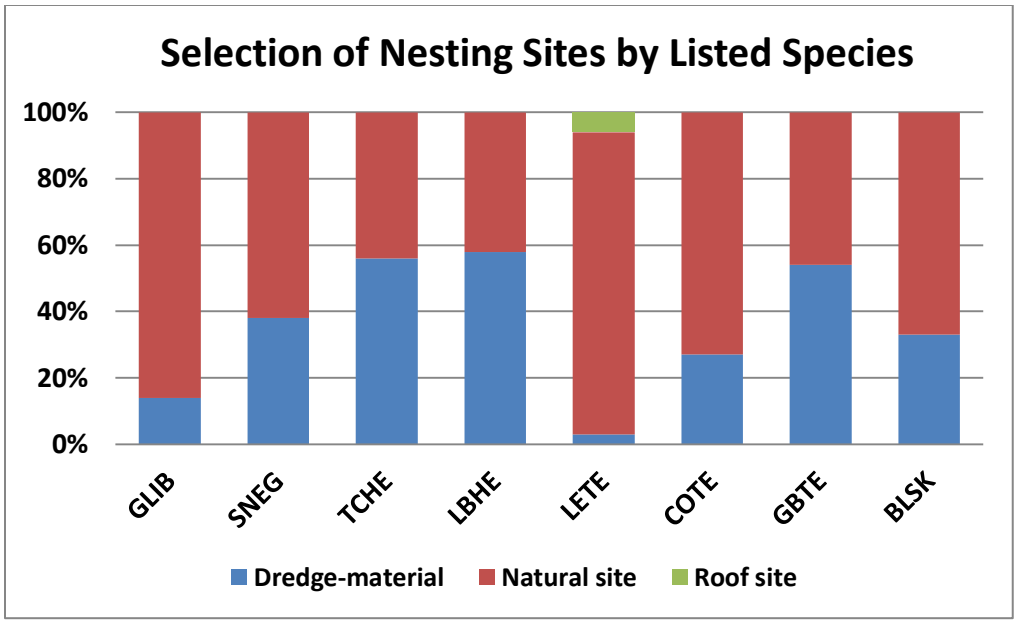

Figure 4. Selection of nesting sites by species listed as Threatened (Gull-billed Tern) or Species of Special Concern in North Carolina, 2011. Dredged-material sites are islands created when channels are dredged for maintenance and sand-shell material can be used to maintain or create bird nesting sites. Natural sites include barrier beaches, mostly at inlets; marsh islands; and sand-shell shoal islands. Roofs used by Least Terns are flat and covered with small gravel or stones. No other species nested on roofs although Black Skimmers have done so in the past. Abbreviations are: GLIB (Glossy Ibis), SNEG (Snowy Egret), TCHE (Tricolored Heron), LBHE (Little Blue Heron), LETE (Least Tern), COTE (Common Tern), GBTE (Gull-billed Tern), BLSK (Black Skimmer).

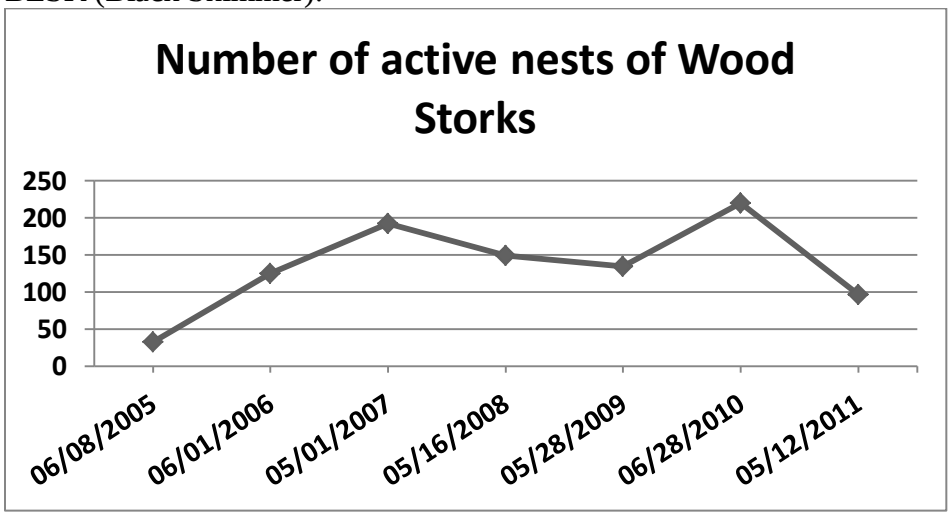

Figure 5. Wood Storks nest only at Lays Lake, North Carolina, and this colony was discovered in 2005. The number of nests has been counted via a periphery count from a canoe each year since the colony was discovered. The number of active nests in 2011 was lower than previous years (n = 96).

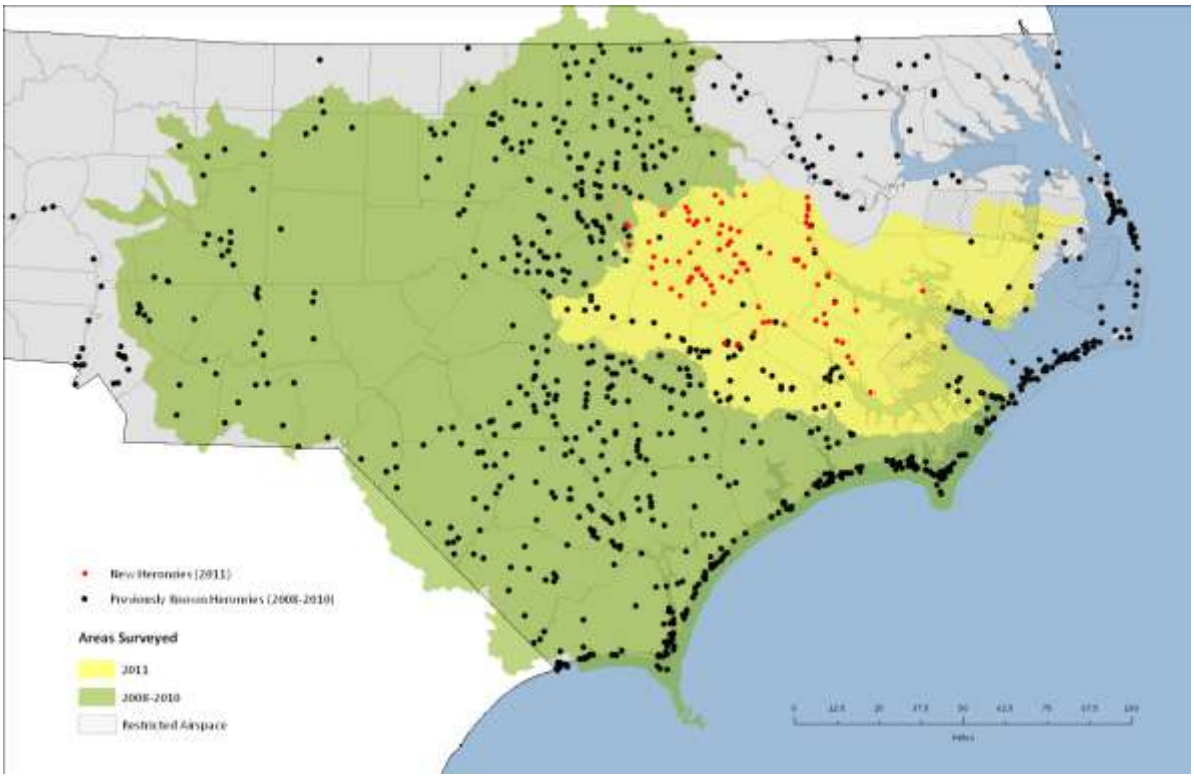

Figure 6. Areas surveyed and heronries detected during 2008 through 2011 flights by NC Wildlife Resources Commission biologists.

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Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Western Region Amphibian Conservation

Objectives:

Given the need to study the distribution and status of numerous species, this project has the following five primary objectives, as discussed in the NC Wildlife Action Plan (2005):

1. Compile existing, available information from all sources (e.g., state, federal, universities, and private individuals) regarding the current status of amphibian species in western North Carolina (pgs. 457-458, 461-462)
2. Conduct baseline inventories to locate and assess populations of target species (pgs. 457-458)
3. Conduct long-term monitoring and applied research studies of target species communities and their habitats (pgs.457-460)
4. Survey for common, though poorly documented amphibians, to assess their populations and trends (pgs. 457-458)
5. Provide technical guidance regarding the status and distribution of amphibians and habitat conservation, management, creation, and/or restoration priorities and techniques to state and federal agencies and other project partners (pgs. 459-463).

A. Activity

The western region amphibian species list is currently composed of 50 salamander species and 15 frog species (NC Natural Heritage Program 2010). Twenty-one salamander and 1 frog species are currently designated priority species in the NC Wildlife Action Plan (2005) (Table 1).

Data compilation and management are integral to successfully meeting the objectives of this project. Reviews of permit applications and reports provide important data and a means to control data acquisition and impacts of collection on local populations. Technical guidance and volunteer opportunities offered to past and current researchers, collectors, and other stakeholders continue to be an invaluable source of data and partnerships supporting the project. Results of those activities have led to collaborative projects, volunteer contributions, and increased efficiency in achieving project objectives.

Project sampling methods included visual encounter surveys of specific habitats like rock outcrops, timed and area-constrained day searches of natural and artificial cover objects in

terrestrial and aquatic habitats, nighttime searches of surface-active salamanders, egg mass counts and nest searches, and auditory surveys (Heyer et al. 1994; Dodd 2010).

Table 1. North Carolina Wildlife Action Plan (2005) priority amphibian species of western North Carolina.

SCIENTIFIC NAME	COMMON NAME	FED STATUS	STATE STATUS
Ambystoma maculatum	Spotted Salamander		
Ambystoma opacum	Marbled Salamander		
Ambystoma talpoideum	Mole Salamander		SC
Aneides aeneus	Green Salamander	FSC	E
Cryptobranchus a. alleganiensis	Eastern Hellbender	FSC	SC
Desmognathus aeneus	Seepage Salamander	FSC	SR
Desmognathus marmoratus	Shovelnose Salamander		
Desmognathus wrighti	Southern Pigmy Salamander	FSC	SR
Eurycea guttolineata	Three-lined Salamander		
Eurycea junaluska	Junaluska Salamander	FSC	T
Eurycea longicauda	Longtail Salamander		SC
Hemidactylium scutatum	Four-toed Salamander		SC
Necturus maculosus	Mudpuppy		SC
Plethodon aureolus	Tellico Salamander		SR
Plethodon chattahoochee	Chattahoochee Slimy Salamander		SR
Plethodon glutinosus	Northern Slimy Salamander		W
Plethodon richmondi	Southern Ravine Salamander		W
Plethodon ventralis	Southern Zigzag Salamander		SC
Plethodon wehrlei	Wehrle's Salamander		T
Plethodon welleri	Weller's Salamander		SC
Plethodon yonahlossee pop. 1	Crevice Salamander		SC
Pseudacris brachyphona	Mountain Chorus Frog		SC

FSC = Federal Species of Concern
SC = Special Concern Species
SR = Significantly Rare Species
E = Endangered Species
T = Threatened Species
W = Watch List Species

Aquatic Salamanders

During this reporting period, staff, volunteers, and project partners conducted at least 58 aquatic surveys, documenting one new site and county record (Macon) for Mudpuppy and records for Eastern Hellbender at 35 sites (including 12 new sites) in 23 individual streams in 11 counties. Despite intensive survey efforts, no hellbenders were found at 8 sites where they occurred historically, including one of the best known populations in the South Toe River (Yancey County). Captures were heavily skewed toward adults; juveniles and/or larvae were detected at only 7 sites. Staff and partners documented a nest of ~350 eggs at one site on the Cane River (Yancey County). This observation was particularly significant because of recent increased sedimentation and pollution events in that watershed.

Reports of incidental hellbender sightings by the public and incidental captures by fisheries staff and partners continue to be a valuable source of information. These reports provided 5 new records (including from 3 new streams that had never been confirmed for hellbenders).

Additionally, project partners with the NC Division of Parks and Recreation provided 10 capture records from a week of surveys in the South Fork New River (Ashe and Alleghany Counties).

High-Elevation Salamanders

Staff continued to inventory and monitor salamander communities in high-elevation forests. Two priority salamander species occurring in this habitat type are Weller's Salamander and Pigmy Salamander. During this reporting period, staff and volunteers conducted surveys in 4 counties along the Blue Ridge Parkway, Pisgah National Forest, Three Top Game Land, Pond Mountain Game Land, and Roan Mountain. Staff, partners, and citizen volunteers documented new occurrences for Pigmy Salamander in all locations surveyed with the exception of Three Top Game Land and Roan Mountain; the Pigmy Salamanders found in the Courthouse Analysis Area of Pisgah National Forest, Transylvania County, updated a 40 year-old historical record for the species in that county. Staff documented new occurrences for Weller's Salamander at Pond Mountain and Three Top Game Lands. The surveys at Three Top Game Land occurred prior to a scheduled prescribed burn in 2011; staff will conduct post-burn surveys in 2012 and beyond to monitor Weller's Salamander relative abundance. Surveys at Roan Mountain were unsuccessful for either of the target species.

Rock Outcrop Salamanders

Two priority salamander species dwell in suitable rock outcrop habitats in the Hickory Nut Gorge of northwestern Rutherford and northeastern Henderson Counties: Green Salamander and Crevice Salamander (also known as the "Bat Cave variant" of Yonahlossee Salamander). During the reporting period, staff and volunteers documented 23 new sites for Crevice Salamander and 5 new sites for Green Salamander in the Hickory Nut Gorge.

Green Salamanders also occur in the Southern Blue Ridge area of Henderson, Transylvania, Jackson, and Macon Counties; the population of Green Salamanders in this area is disjunct from that in the Hickory Nut Gorge. Staff, volunteers, and partners documented approximately 370 new locations in the Southern Blue Ridge during this reporting period.

Ongoing applied research with Green Salamanders examines the effects of prescribed fire on their habitats (including microclimate) and populations. The project consists of studying 80 randomly-chosen Green Salamander sites (40 burn, 40 control), on 11 management units totaling ~880 acres (Henderson and Transylvania Counties). Multiple surveys at the study sites occur October-November each year to assess seasonal occupancy rate and detection probability (Thompson 2004; MacKenzie et al. 2006). Sites are searched once in August to detect nests. Salamanders that can easily and safely be extracted from rock crevices are processed and photographed (Dodd 2010). Habitat, weather, and site microclimate data are collected pre and post-burn. These sites will be monitored post-burn for several years, along with population metrics, to examine effects of prescribed fire on this species and its habitat.

In spring of 2011, 8 study sites were burned, allowing for the first year of post-burn data collection at those sites; staff and volunteers recorded another year of pre-burn data for the

remaining study sites. No nests were found at any site that was burned; 8 nests were found at 6 of the other sites, and staff and volunteers observed hatchlings at all of those sites.

Staff and volunteers monitored15 other Green Salamander nests, not associated with the burn study, in Henderson and Transylvania Counties. At least 4 of these nests appeared to fail in 2011.

Staff continued a study that began in spring 2010 to track nighttime movements of Green Salamanders within and among patch habitats using a harmless, fluorescent powder and a UV lamp ("black light") (Graeter et al. 2008; Dodd 2010). In May 2011, the afternoon before a predicted evening rain event, three adult male Green Salamanders were safely extracted from three different rock outcrops, powdered, and replaced immediately. Nighttime (10 pm and later) and pre-dawn (6 am and earlier) observations were made for three consecutive days, after the initial rain event on the first night. All salamanders moved the first night, covering ½ to ¾ of their home rocks, making lateral movements around the rocks and transverse movements over the top of rocks. All salamanders made stops in less suitable crevices, and all climbed adjacent mature trees. One of the salamanders appeared to walk on the ground over two feet to climb the nearest tree, while the other two salamanders made use of trees touching their home rocks and thus avoided any on-ground movements to find arboreal habitat.

Other Priority Salamanders

Volunteers documented two new locations for Southern Zigzag Salamander, one near the Buncombe/Madison County line and one in Madison County within riparian habitat on the north side of the French Broad River (the first record of its kind). Other volunteers documented 3 new locations for Spotted Salamander and 1 new location for Three-lined Salamander (Henderson and Transylvania Counties). Staff and volunteers monitored Mole Salamander breeding activity at the new site documented in 2010 in Transylvania County.

Frogs

As a Special Concern and priority species, Mountain Chorus Frog continues to require further study. Historically, from 1949 to 2007 only a few locations in North Carolina were known, all in Cherokee County. In spring 2011, using auditory survey methods, staff documented 16 new breeding habitats for this species, including 6 locations in adjacent Clay County, a new county distribution record. Project partners with the NC Natural Heritage Program and a private contractor for the USFS documented an additional 15 new breeding sites in 2011. Since 2008, staff and partners have confirmed close to 80 new Mountain Chorus Frog records in the state; the vast majority occurs on private property or in areas highly vulnerable to disturbance (e.g., roadside ditches) (Figure 1).

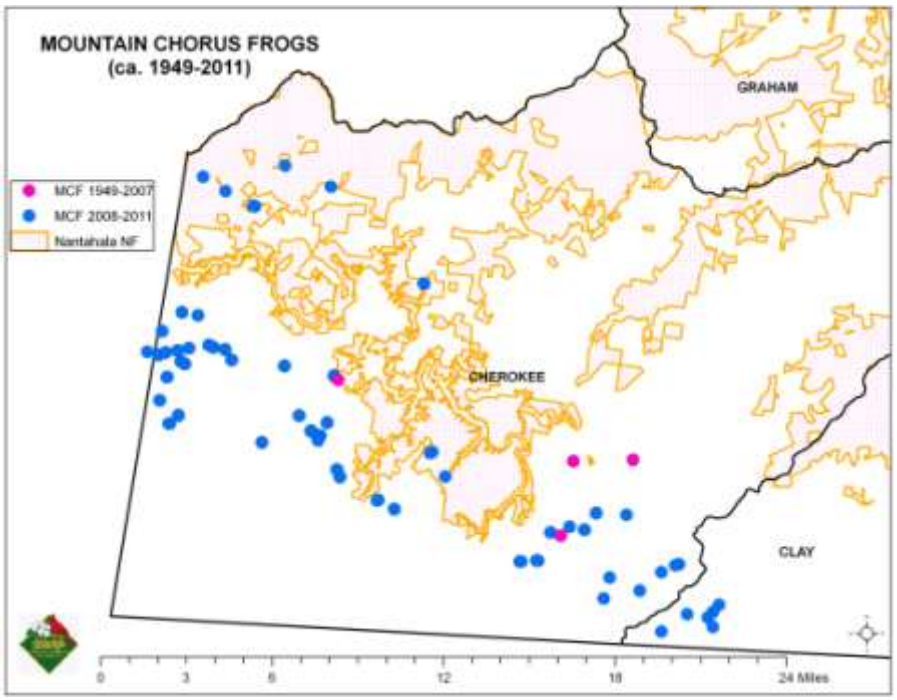

Figure 1. Historical (pre-2007) and recently documented occurrences (2008-2011) for Mountain Chorus Frog (*Pseudacris brachyphona*) in Cherokee County and Clay County, North Carolina.

B. Target Dates for Achievement and Accomplishment

On schedule

C. Significant Deviations

None

D. Remarks

Of increasing importance is access to private lands, particularly areas that have never been surveyed. Many new salamander records were documented during this reporting period simply by having access to private land and conducting baseline inventories. New partnerships within local communities and NGOs also resulted in new connections and relationships and ultimately new records for priority species. The Wildlife Conservation Lands Program (WCLP) continues to provide new opportunities on private land that may have previously been off-limits to biologists.

E. Recommendations

The inherently low detection probability of salamanders (especially rare species) will always provide logistical challenges to overcome in pursuit of project objectives. Since many sampling iterations may be required to document the presence of some of our target species, staff should

continue to seek collaboration, coordination, and data sharing among researchers and other conservation partners if we hope to meet long-term project goals and objectives.

As time and resources permit, staff will seek more opportunities to partner with other agencies and other programs within the NC Wildlife Resources Commission to conduct baseline inventories on Game Lands and monitor effects of land management activities such as prescribed fire and/or silviculture on amphibian communities and habitats. Future collaborative efforts will also include creating and/or restoring wetland habitats and ephemeral pools on Game Lands to benefit amphibians and other priority species. These habitats will become much more important (and possibly rare) across the landscape as natural habitats continue to be fragmented, developed, and destroyed. Also, predicted effects of climate change could mean more intense and frequent droughts and/or floods which could alter habitats and impact populations permanently.

University partnerships are mutually beneficial, not only as a source for volunteer help in the field, but also as a means of collaboration for data analysis and ultimately, for publishing peer-reviewed manuscripts. Several university collaborations are already underway (e.g., Green Salamander, Eastern Hellbender) or are being planned for the near future (e.g., Mountain Chorus Frog, high-elevation and climate change sensitive salamander species).

Salamander taxonomy continues to change. Staff will continue to learn about current research being done in the mountain region and investigate published results regarding taxonomic changes. Target species and locations could change in the future as researchers continue to revise salamander taxonomy.

F. Estimated Cost

$ 111,803 (including in-kind contributions)

G. References

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Final Performance Report

State: North Carolina **Grant Number:** T-12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grant 08- Wildlife Management

Project Title: Western Region Reptile Conservation

Objectives:

1. To survey for state listed and high priority reptiles throughout western North Carolina (Table 1), including new sites and "re-discovery" of historic sites (NCWAP, p. 109, 114, 119, 124, 129, 132, 140, 145, 149)
2. To assess (when possible) the relative abundance as well as the requirements and availability of habitat for rare or poorly known reptiles throughout western NC (NCWAP, p. 114, 124, 125, 130, 132, 140, 145, 149)
3. To implement long-term population monitoring studies to monitor trends and to examine the effects of habitat management on certain species to inform conservation and management decisions (NCWAP, p.124, 130, 132, 140, 145, 149)
4. Provide information regarding the status and distribution of reptiles (technical guidance) to state and federal agencies and other organizations/individuals that will further the goals of the North Carolina Wildlife Action Plan (NCWAP, p. 6-7, 486-488)
5. To maintain, restore, and protect important habitat for reptiles, with special attention to bog turtle habitat (NCWAP, p. 115, 120, 125, 130, 133, 141, 145, 146, 150)

A. Activity

Activities included continued efforts on the bog turtle project, coordination of the statewide mark-recapture box turtle study (i.e., the Box Turtle Connection), continued efforts to learn more about the aquatic turtle assemblages in western North Carolina, and recording of incidental observations of priority reptile species. More information about each of these projects is outlined below. Technical guidance was also provided to conservation partners and the public.

Staff participated in several important meetings with volunteers, non-governmental organizations, and other state and federal agencies and gave several presentations about priority reptiles. Data compilation and management are integral to successfully meeting the objectives of this project. Communication efforts directed towards researchers, wildlife enthusiasts, and other stakeholders continue to be an invaluable source of data. Results of these activities led to collaborative projects, volunteer contributions, and increased efficiency in achieving project objectives.

Bog Turtles

We continued to collect data in cooperation with a very active group of volunteers, Project Bog Turtle. We entered data into and managed the Microsoft Access database that serves as the permanent storage medium for all bog turtle data generated in North Carolina. We also began a major effort to request and collect data from partners that were missing from the database. In conjunction with this, we began making a plan for improving our data collection methodology and outlining the steps necessary to create a new and improved bog turtle database in the near future. We also continued to communicate and foster working relationships with project collaborators including private groups, non-governmental organizations, federal agencies, and citizen volunteers. Other activities this year included meeting with landowners to discuss options for protecting their land, providing technical guidance to partners and citizens, and presenting an update on survey activities, results, and habitat management projects at Project Bog Turtle's Annual Meeting. Traps were set at one site with a total of 870 trap nights, but no bog turtles were captured during this trapping event (Table 1).

Table 1. Number of new and recaptured bog turtles at the site trapped for bog turtles in 2011.

Site	County	Trap nights	New turtles	Recap Turtles
Glady Fork	Transylvania	870	0	0

During this time period, surveys were conducted in fall 2010, spring 2011, and fall 2011 for bog turtles, with extensive efforts from volunteers and inter-agency collaborators. One hundred and sixty-four (164) bog turtles (including 50 new individuals) were captured during 36 site visits (Table 2). In the past few years, we have visited a small number of sites frequently as part of an effort to collect more detailed information on a set of sites (Figure 1).

Table 2. Summary by NC County of reported survey visits from September 1, 2010 – September 30, 2011 to known and potential bog turtle (*Glyptemys muhlenbergii*) sites, the number of new sites with bog turtles discovered, and the number of new and recaptured bog turtles found. Note that some sites were visited multiple times.

NC County	Known Sites	Potential Sites	Total Visits	New Turtles	Recaptured Turtles	Total Captures
Alleghany	2	1	3	0	1	1
Ashe	2	0	2	2	7	9
Surry	2	0	3	0	0	0
Transylvania	0	1	1	0	0	0
Watauga	2	0	6	2	5	7
Wilkes	8	0	21	46	101	147
TOTAL	**14**	**2**	**36**	**50**	**114**	**164**

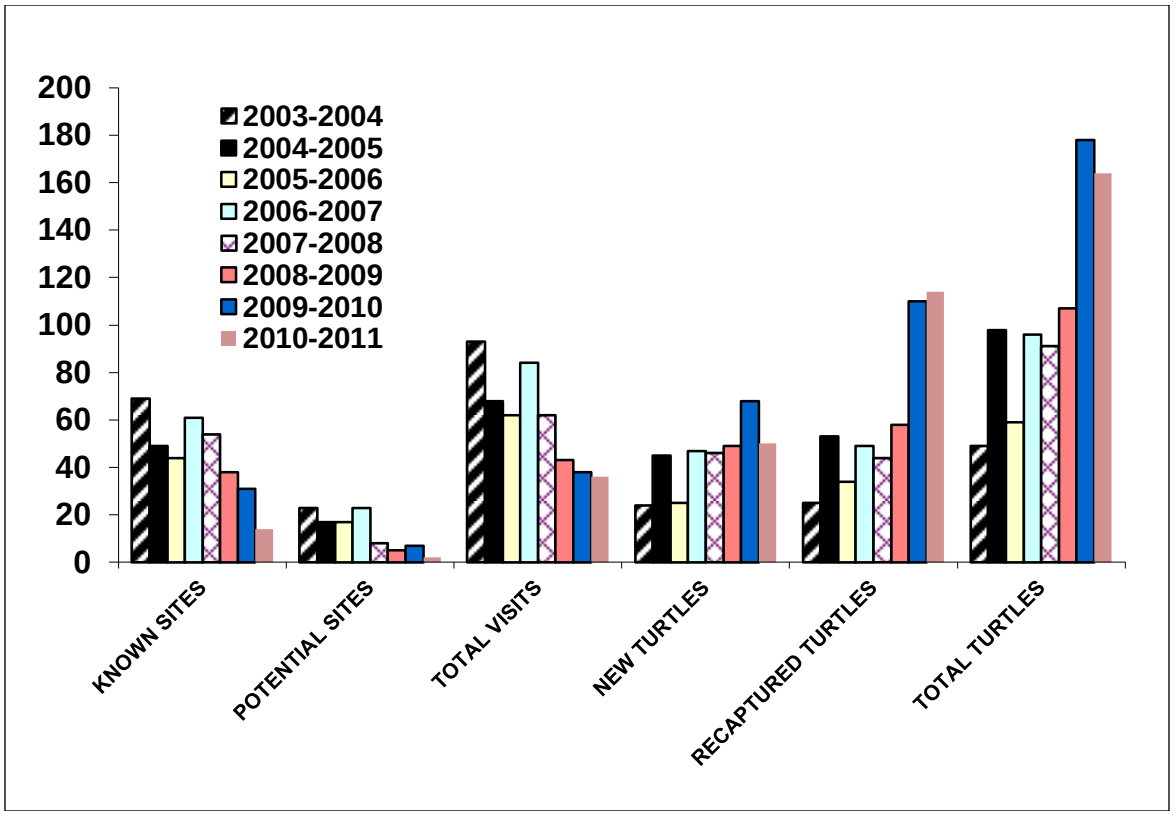

Figure 1. NC Wildlife Resources Commission bog turtle site visits and survey results shown for every year beginning with the 2003-2004 fiscal year and up to the 2010-2011 fiscal year.

Box Turtles

We continue to encourage the public to submit basic locality information of box turtles to the NC Partners in Amphibian and Reptile Conservation website (www.ncparc.org) via the Carolina Herp Atlas (www.carolinaherpatlas.org). This information will be useful in expanding our knowledge of the box turtle's distribution in North Carolina and in alerting us to particular problem areas for box turtles (e.g., roadways, railroad tracks), so that we can ameliorate the problem if possible. The box turtle is the most highly reported species on the Carolina Herp Atlas; a total of 1392 box turtles have been reported thus far (as of November 23, 2011). Note that this total includes both North and South Carolina records, though the vast majority were from North Carolina. These data will be compiled and summarized in the future.

In an effort to better understand the box turtle's status and presumed declines, a collaborative box turtle research group, called "Box Turtle Connection" (BTC) was formed in 2007 to begin planning a state-wide mark-recapture study on box turtles. Representatives of this group include staff from NC Wildlife Resources Commission, NC State Parks, UNC-Greensboro, Duke University, NC Museum of Natural Sciences, NC Zoo, and Davidson College. The main research objectives of this group are to gather baseline data, as well as information about activity levels, health status, landscape level influences, and to compare among ecosystem types across the state. There are currently 35 study sites across North Carolina, located in 27 counties, with

each project leader running their own mark-recapture study. A list of the number of Box Turtle Connection sites per county that have reported capture data is shown in Table 3.

Table 3. Number of BTC study sites/county that have already reported capture data for 2011 and the number of turtles captured for those sites

County	# Sites	# Box Turtles Captured
Camden	1	2
Durham	1	42
Gates	1	35
Guilford	2	6
McDowell/Burke	1	13
Orange	1	1
Orange/Durham	1	3
Robeson	1	7
Transylvania	1	4
Wake	3	26
Total	**13**	**139**

Regular management of the online data entry website and communication with the project leaders has been necessary throughout the year. The online data entry system has vastly streamlined the data entry process and provides a more secure method for storing data (data are regularly backed up on the server). As of August 2011, there had been a total of 1386 captures in the BTC project (see Table 4). The first year that data were collected on this project was 2008. However, some sites were recording box turtle captures before the project officially started; this explains why there are captures shown in Table 4 in the years preceding 2008. Some BTC sites have not submitted their data for 2010 and 2011 yet, so the number of captures for those two years should be somewhat higher than what we are able to report here (Table 4). The BTC project founders are planning to meet in December 2011 to discuss data analysis and evaluate the project.

Table 4. Number of captures by year in the Box Turtle Connection mark-recapture study

Year	# Turtles Captured
2002	5
2003	13
2004	25
2005	31
2006	9
2007	18
2008	265
2009	565
2010	316
2011	139
Total	**1386**

*Not all 2010 or 2011 data have been entered.

Aquatic Turtles

The focus this year with aquatic turtles has been on stripeneck musk turtles (*Sternotherus minor peltifer*) and eastern spiny softshell turtles (*Apalone spinifera spinifera*), both of which are state listed Special Concern species in the mountain region of North Carolina. In addition, we have been gathering data on several other species (or subspecies) that were not previously known to North Carolina, such as the Cumberland slider (*Trachemys scripta troosti*) and the common map turtle (*Graptemys geographica*), and species that are found outside their known range, such as the river cooter (*Pseudemys concinna*). As very little is known about their biology, habitat use, and distribution and status in western North Carolina, our main objective has been to learn more about these species' distributions in this area and obtain basic information about their habitat use.

In the last year, we conducted a single trapping event at a location that has been trapped several times previously (Table 5). Turtle hoop traps of various sizes were set for three trap nights. All turtles captured were measured and marked before released. A total of three target species were captured in these efforts, including three stripeneck musk turtles, one eastern spiny softshell turtles, and one river cooter (see Table 5). Other species captured include the snapping turtle (*Chelydra serpentina serpentina*) and the common musk turtle (*Sternotherus odoratus*).

Table 5. Trapping events, number of trap nights, and captures for priority aquatic turtle species between September 1, 2010 and September 30, 2011.

Trapping Site	County	Month/Year	Total # of Trap Nights	Target Species (# captured)
French Broad River at Huff Island	Madison	September 2011	84	*Apalone spinifera spinifera* (1) *Sternotherus m. peltifer* (3) *Pseudemys concinna* (1)

Priority Reptiles

Visual encounter surveys and road cruising surveys, as well as reported records from other biologists yielded locality information for several other priority reptile species (Table 6). Most reptile observations have been incidental in nature, such as snakes found alive or dead on the road, reptiles captured while conducting other surveys, or observations reported by other biologists. Because of limited staffing, we were unable to survey the 10 artificial cover study sites that were set up in 2007-2008 (Table 7).

Table 6. Target reptile species documented in western North Carolina from September 1, 2010 to September 30, 2011.

Scientific Name	Common Name	County	# Observed	Observation/Method
Lampropeltis g. getula	Eastern Kingsnake	Wilkes	1	visual encounter survey
Lampropeltis t. triangulum	Eastern Milksnake	McDowell	1	visual encounter survey
Apalone s. spinifera	Eastern Spiny Softshell	Madison	1	visual encounter survey
Ophisaurus attenuates	Slender Glass Lizard	Cherokee	1	visual encounter survey
Elaphe g. guttata	Corn Snake	Madison	1	visual encounter survey
Crotalus horridus	Timber Rattlesnake	Henderson (3), Macon (1)	4	visual encounter survey, road cruising

Table 7. Sites in western North Carolina set up with artificial cover (tin) for a snake and lizard study. GL = Gameland; SP = State Park; NF=National Forest.

Site	County	Property owner
North Mills River	Henderson	USFS - Pisgah NF
Sandy Bottoms	Buncombe	UNC-Asheville
Pilot Mountain SP	Yadkin	NC State Parks
Chimney Rock SP	Rutherford	NC State Parks
John's River GL	Burke	NC WRC
Nantahala GL	Cherokee	USFS - Cherokee NF
Sandy Mush GL	Buncombe	NC WRC
South Mountains GL	Rutherford	NC WRC
Table Rock Fish Hatchery	Burke	NC WRC
Talula bog	Graham	NC DOT/EEP

B. Target Dates for Achievement and Accomplishment

On schedule

C. Significant Deviations

None

D. Remarks

In summary, one hundred and sixty-four (164) bog turtles (including 50 new individuals and 114 recaptures) were captured during 36 site visits. Several sites were visited multiple times this year as part of the continued effort to collect quality mark-recapture data on a few specific bog turtle populations. The ultimate goal of this focused survey methodology is to obtain information on age class, sex ratio, survival and mortality rates, recruitment into the adult population, and population size estimates. From this information, we should be better able to determine the viability of individual populations and/or meta-populations.

The state-wide mark-recapture box turtle study, the Box Turtle Connection, was continued in 2010-2011 at 35 study sites across North Carolina. Collaboration with many partners throughout the state and the hard work of each site's project leader are essential components to the longevity of this project. The total number of box turtle captures (1386 total) in this project is indicative of the high level of dedication that some of the project leaders have shown. This project has the potential to answer some of the most important questions about the status of box turtles in North Carolina. A meeting of project coordinators is planned for winter 2011 to discuss data analysis, additional training of project leaders, and the future direction of the project.

In the aquatic turtle project, we captured several priority species, including three stripe-neck musk turtles and one eastern spiny softshell turtle. An additional softshell turtle was spotted basking in a new location on the French Broad River in Madison County. We also documented another river cooter in the lower part of the French Broad River, an area where they were not known to exist until one was found last year. Through these trapping efforts, we have learned of additional subspecies and species that were not known within North Carolina or within particular areas of NC, thereby gaining a better understanding of the species assemblages and distribution of aquatic turtles in western North Carolina.

Records submitted by the public and partner agencies and organizations have proven invaluable for gaining new locality records for priority reptiles in the mountain region. For example, a slender glass lizard was found and reported by a Cherokee County resident. Many of the records of priority reptile species were sent in by NC Wildlife Resources Commission staff and employees of other governmental entities that we frequently partner with on conservation efforts.

E. Recommendations

Reptiles, like many amphibians, are often very difficult to find and even the best available techniques are limited for many species. Thus, in order to provide the basic distribution and status information needed to work toward goals established in the North Carolina Wildlife Action Plan (NC Wildlife Resources Commission, 2005), it is essential to conduct multiple surveys over multiple years.

As time and resources allow in the upcoming years, we should continue to improve our knowledge of bog turtle distribution in North Carolina, monitor bog turtle populations, learn more about the effects of different types of habitat management of bogs, take action to better manage and protect priority habitats, gather data on priority reptile species, learn more about the

distribution, status, and habitat use of aquatic turtles, and continue to improve upon the Box Turtle Connection project. In addition, of immediate importance is to invest time in updating, organizing, and managing the reptile databases, especially the bog turtle database, in order to better answer key questions pertaining to the long term persistence of these reptile species in North Carolina. The functionality and quality of the data in the bog turtle database must be improved so that we can prioritize our efforts and resources and make more informed conservation decisions regarding bog turtles. Data sharing, collaboration, and coordination of survey and monitoring efforts must continue with academic researchers, other state and federal agencies, NGOs, and private individuals. Finally, we must find ways to continue to recruit interns and volunteers in order to maximize resources, the area covered by surveys, and the probability of detecting all target species.

F. Estimated Cost

$ 152,549 (including in-kind contributions)

G. References

North Carolina Natural Heritage Program. 2006. Natural Heritage Program list of the rare animal species of North Carolina. Raleigh, North Carolina.

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Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08 – Wildlife Management

Project Title: Western Region Bird Conservation

Objectives:

1) To improve our understanding of avian diversity and priority species in western North Carolina, thereby enhancing our ability to make conservation or management decisions via adaptive management.
2) To provide technical guidance to partners (government agencies and private entities) based on findings from surveys and research.
3) To plan and coordinate bird conservation efforts with partners across the state and country.

A. Activity

Game Land Surveys

Inventory surveys continued at Pond Mountain Game Land, documenting 47 species, including 10 Wildlife Action Plan priority species and one NC Special Concern species (Table 1). All points at Cold Mountain Game Land and a subset of points at Green River Game Land representing actively managed areas (timber harvest, burning) documented 11 Wildlife Action Plan priority species and one NC Special Concern species (Table 2). Five barn owl nest boxes were posted on Sandy Mush Game Land. Eggs were found in one box in June, but the nesting attempt failed. Sixteen American kestrel nest boxes at Sandy Mush Game Land were checked and one nest produced five fledglings. Mountain staff hosted three bird refresher trips, providing training in general bird identification and standardized survey techniques (e.g., point counts, Golden-winged Warbler Atlas Project survey) for agency staff and partners.

Table 1. Breeding season species list for Pond Mountain Game Land (Ashe County, NC).

Common name	2011	2010	Status	Common name	2011	2010	Status
Alder flycatcher	X		SR, WAP	Hairy woodpecker	X		WAP
American crow	X	X		Hermit thrush	X		
American goldfinch	X	X		House wren	X		
American robin	X	X		Indigo bunting	X	X	
American woodcock	X		WAP	Least flycatcher	X	X	Watch List
Barn swallow	X	X		Mourning dove	X	X	
Black and white warbler	X	X		Northern bobwhite		X	WAP
Black-throated blue warbler	X	X		Ovenbird	X	X	
Black-throated green warbler		X		Pileated woodpecker		X	
Blue jay	X	X		Red-breasted nuthatch		X	
Blue-headed vireo	X	X		Red-eyed vireo	X	X	
Brown-headed cowbird	X			Red-tailed hawk	X	X	
Brown thrasher	X	X		Rose-breasted grosbeak	X	X	WAP
Canada warbler	X	X	WAP	Ruffed grouse	X	X	
Carolina chickadee	X	X		Scarlet tanager	X	X	
Carolina wren	X			Slate-colored junco	X	X	
Cedar waxwing	X	X		Song sparrow	X	X	
Chestnut-sided warbler	X	X	WAP	Turkey vulture	X	X	
Chimney swift		X	WAP	Veery	X	X	
Chipping sparrow		X		Vesper sparrow	X	X	SC, WAP
Common yellowthroat	X	X		White-breasted nuthatch	X		
Downy woodpecker	X			Wild turkey	X	X	
Eastern towhee	X	X		Winter wren	X	X	
Eastern wood pewee	X	X	WAP	Wood duck	X		
Field sparrow	X	X	WAP	Yellow-bellied sapsucker		X	WAP
Golden-crowned kinglet	X			Yellow-shafted flicker	X	X	WAP
Gray catbird	X	X		Total species 2010-11: 53			

[1] NC Wildlife Action Plan priority species, [2] NC Special Concern species, [3] NC Significantly Rare species

Table 2. Wildlife Action Plan priority species documented during *partial* monitoring of Green River and Cold Mountain Game Lands, 2011.

Species	Green River	Cold Mountain
Brown creeper[1]		X
Chestnut-sided warbler	X	X
Chimney swift		X
Eastern wood pewee	X	X
Field sparrow	X	
Hairy woodpecker	X	
Hooded warbler	X	X
Prairie warbler	X	
Swainson's warbler[2]	X	
Wood thrush		X
Yellow-billed cuckoo	X	X

[1] NC Special Concern, [2] Watch List

Nightjar Survey

Following U.S. Nightjar Survey Network protocol, surveys were conducted once within a 15 day window around the May 17th or June 16th, 2011 full moons. Twenty-four routes were surveyed this year in 18 counties in the Mountains, Foothills, and western Piedmont. Whip-poor-will detections per route were higher on the Foothills and western Piedmont routes than Mountain routes (Table 3). Chuck-will's widows were encountered on four routes in three counties (Burke, Polk, and Catawba) in the Foothills and western Piedmont. Both species were detected on the Worry Crossroads and Valdese routes in Burke County.

Table 3. Mountain, Foothills, and western Piedmont regions summary of western NC nightjar survey results for 2011. WPWI = whip-poor-will. CWWI = chuck will's widow.

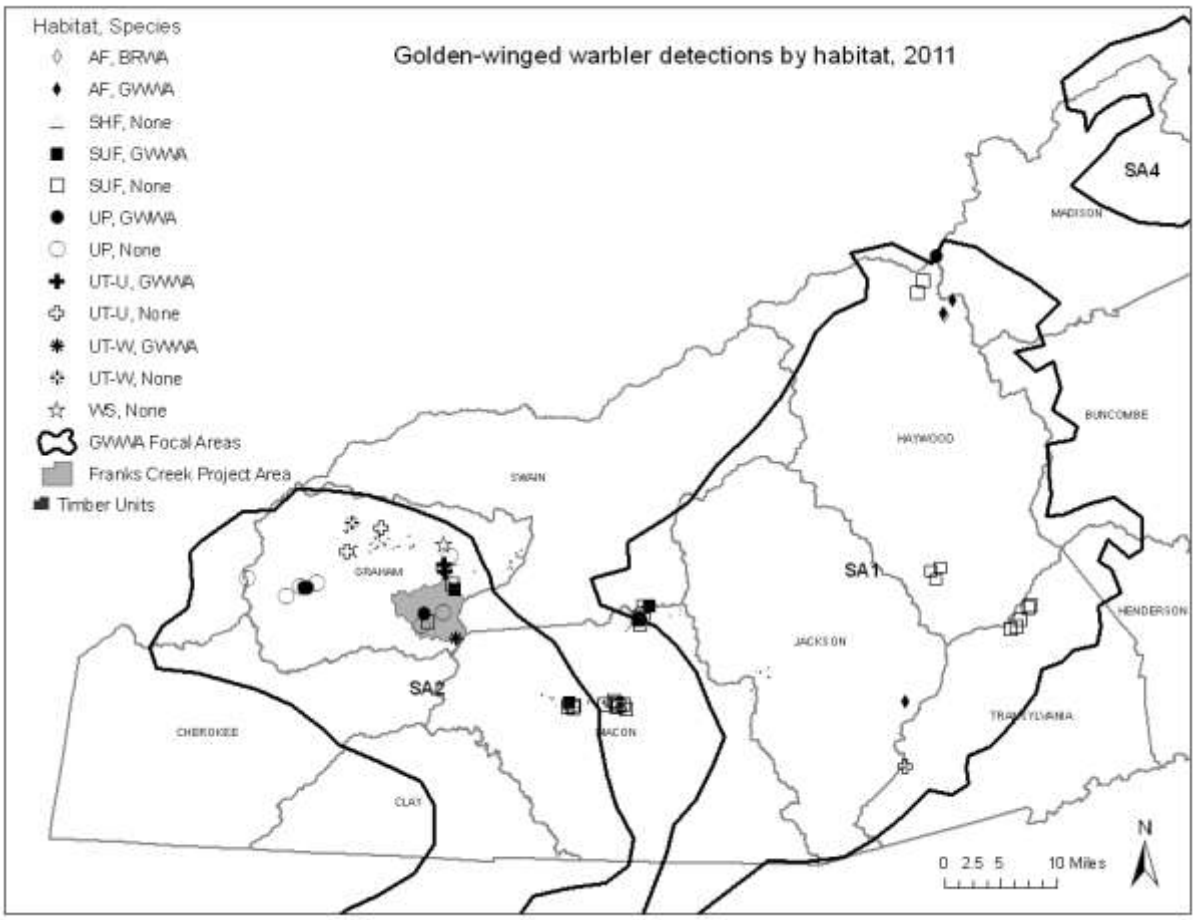
	Mountains	**Foothills and Western Piedmont**
# routes surveyed	14	10
# routes with WPWI	10 of 14	8 of 10
Total # WPWI	28	53
# WPWI per route (S.E.)	2.00 (0.47)	5.3 (1.65)
# WPWI per route with WPWI (S.E.)[1]	2.8 (0.44)	6.6 (1.76)
# routes with CWWI	0 of 14	4 of 10
# CWWI	0	17

[1] Total number of WPWI divided by number of routes where WPWI were detected.

Golden-winged warbler

Golden-winged warbler (GWWA) conservation efforts included (1) monitoring of official Golden-Winged Warbler Atlas Project (GOWAP) sites (2) surveys of timber harvest units on the Nantahala and Pisgah National Forest Game Lands, (3) meeting of the NC GWWA Working Group, (4) development of draft Best Management Practices for NC, (5) integration of GWWA BMPs in the Franks Creek Timber Sale (Nantahala National Forest) as part of the U.S. Forest Service Restoration initiative, (6) submission of data to U.S. Fish and Wildlife Service for Status Review, and (7) habitat assessment of scorched prescribed burn units ("hot burn units"). Timber unit surveys were conducted at: Stecoah, Trimont, Ray Branch, County Line, Case Camp, and Hurricane Ridge on the National Forest, plus Cold Mountain Game Land. Hot burn units were generally unsuitable for GWWA, requiring additional burning or other form of vegetation management to achieve the desired habitat structure. Combining all projects, 54 surveys were conducted and staff observed 20 golden-winged warblers and one Brewster's warbler (at 3700ft elevation) (Figure 1).

Figure 1. Golden-winged warbler[1] detections by habitat[2] within Southern Appalachian Focal Areas, 2011.



[1] Species codes: GWWA= golden-winged warbler, BRWA= Brewster's warbler.

[2] Habitat codes: AF= agricultural field, SHF= upland shrubby field, SUF= upland successional forest, UP= other upland habitat, UT-U= upland utility right-of-way, UT-W= wetland utility right-of-way, WS= shrub wetland.

Peregrine Falcon Monitoring

Surveyed sites include those with previous peregrine nesting activity, sites with suitable habitat, and those with reported peregrine sightings. Efforts focused on territories surveyed in 2010 (NCWRC 2010) with a combined effort of 178.25 observer hours. Pairs were present at eight of the 15 sites, and three produced fledglings (Table 4). Once again, it was unclear if a pair was present at the historical eyrie on Shortoff Mountain. Victory Wall was usurped by nesting Common ravens. Looking Glass Rock experienced late cycle nest failure. Falcons returned to an eyrie on the west side of Whiteside Mountain, after nesting on the east side in 2010, prompting adjustment of the closure order. A second year female was on territory at Dunn's Rock and a second year male harassed the resident pair at NC Wall.

Table 4. Summary of peregrine falcon territory occupancy (pair), nest success, and productivity at eyries in western North Carolina, 1987-2011.

SITE[1]	# years surveyed (1st year)[2]	# years occupied by a pair (percent)	# years successful (percent)	total # fledglings	# fledglings/ years surveyed	# fledglings/ years occupied	# fledglings 2011
Big Lost Cove	15 (1997)	14 (93%)	6 (43%)	9	0.60	0.64	0
Hickory Nut Gorge[2]	23 (1989)	21 (91%)	3 (14%)	5	0.22	0.24	0
Devil's Courthouse	13 (1999)	12 (92%)	8 (66%)	14	1.07	1.17	0
Grandfather Mountain	22 (1990)	14 (64%)	4 (29%)	9	0.41	0.64	0
Hanging Rock	12 (2000)	7 (58%)	2 (29%)	2	0.17	0.29	0
Shortoff Mountain	14 (1998)	11 (79%)	10 (91%)	24	1.71	2.18	0
NC Wall	18 (1987)	16 (89%)	3 (19%)	5	0.28	0.31	0
Looking Glass	24 (1988)	24 (100%)	13 (54%)	34	1.42	1.42	0
Panthertail Mountain	19 (1993)	19 (100%)	12 (63%)	29	1.53	1.53	0
Pigeon River Gorge	8 (2004)	6 (75%)	3 (50%)	10	1.25	1.67	0
White Rock Cliff	24 (1988)	21 (87%)	9 (43%)	17	0.71	0.81	2
Whiteside Mountain	24 (1988)	24(100%)	19 (79%)	47	1.96	1.96	2
Dunn's Rock	5 (2007)	4 (80%)	1 (25%)	2	0.40	0.50	0
Table Rock	6 (2006)	2 (33%)	1 (50%)	3	0.50	1.50	0
Victory Wall	2 (2010)	1 (50%)	1 (100%)	2	1.00	2.00	0
Pickens Nose	2 (2010)	2 (100%)	2 (100%)	4	1.00	1.00	2
(Laurel Top)	1 (2010)	1 (100%)	1 (100%)	2	2.00	2.00	-
Total	-	-	-	218			6
Mean (SE)	-	-	-		0.95 (0.15)	1.17 (0.16)	

[1] 2011 occupancy codes: Bold font = territory occupied by a pair. Italics = unoccupied territory. Parentheses = not surveyed. The remaining sites had one unpaired falcon on territory.
[2] Not all sites were surveyed annually. Percentage adjusted for number of years surveyed.

Technical Guidance

Assistance for bird related issues included responding to requests from the public such as guidance for Hospital Fields early successional habitat management.

B. Target Dates for Achievement and Accomplishment

On schedule

C. Significant Deviations

None

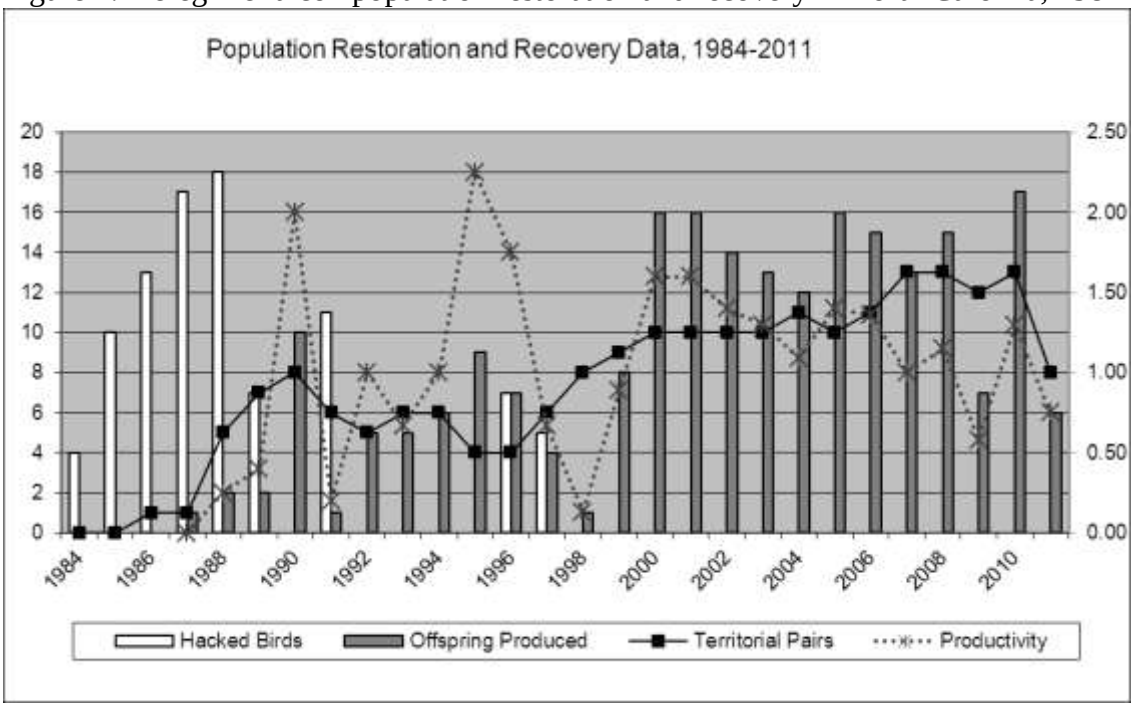
D. Remarks

New priority species documented at Pond Mountain Game Land included alder flycatcher (SR), American woodcock, and hairy woodpecker. The number of whip-poor wills per route remained steady in the Foothills and western Piedmont but dropped 34% in the Mountains from last year. Nest success and the number of territories occupied by breeding pairs of peregrine falcons dropped dramatically this year and were much lower than the 2006 National Average (Table 5, Figure 2).

Table 5. North Carolina Wildlife Resources Commission peregrine falcon population health indices; western North Carolina 2011 – vs. – national average (2006).

	TERRITORY OCCUPANCY	NEST SUCCESS	PRODUCTIVITY
North Carolina (2011)	53% (8 of 15 sites)	37% (3 confirmed of 8 pairs)	0.75 (6 young/8 nesting pairs)
National Average (recent years)	84%	71%	1.24 – 2.2

Figure 2. Peregrine falcon population restoration and recovery in North Carolina, 1984-2011.



E. Recommendations

Western region bird projects will integrate the top five priorities of the Appalachian Mountains Joint Venture's three year operational plan (AMJV 2011). As such, staff efforts will focus on priority species (e.g., GWWA, cerulean warbler, barn owl, nightjars, and peregrine falcon) and ecosystems (e.g., high elevations and early successional habitat). With fewer resources to carry out full game land surveys, other options to maintain some level of inventory and monitoring on

game lands are being considered, including bird blitzes using volunteers (birders). Also, existing bird data from several game lands on the NC Birding Trail will be used to develop birding checklists and game land management plans per the NCWRC Division of Wildlife Management Strategic Plan (NCWRC 2009). A management plan for Pond Mountain Game Land, including spruce restoration and early successional habitat management is in the early stages of development. Bird refresher workshops/field trips will be needed to provide training on standardized survey techniques and identification of priority species and habitat in order to best implement coordinated bird monitoring and habitat conservation.

Nightjars- Now in its fifth year, the western NC nightjar survey should establish routes in the remaining western counties, summarize observations of the last five years, and continue to integrate with the U.S. Nightjar Survey Network for opportunities to analyze regional datasets.

Golden-winged warbler- The forthcoming GWWA range wide Conservation Plan will be integrated into North Carolina efforts to guide future monitoring and improve NC BMPs. The NC and Southern Appalachian GWWA Working Groups will step-down objectives of the range wide conservation plan and AMJV. The function of these working groups will be to provide technical expertise to member partners and landowners, communicate conservation needs of GWWAs (e.g., through feature articles, response to public comments, etc.), and collaborate and compete for funding for habitat management projects.

Peregrine falcon- Greater coverage of North Carolina eyries is planned for 2012. An aerial survey of Linville Gorge may be needed to locate the Shortoff Mountain pair.

F. Estimated Cost

$ 52,650 (including in-kind contributions)

G. References

AMJV. 2011. Appalachian Mountains Joint Venture 3-Year Operational Plan October 2011 Draft. 15pp.

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Green, M.G., S. Willey, T. Swem, R. Mesta, P. Delphey, R. Currie, and M. Amaral. 2008. 2006 Monitoring results for breeding American Peregrine Falcon (*Falco peregrinus anatum*). U.S. Department of Interior, Fish and Wildlife Service. Region 1, Portland, OR.

Prepared By: Chris Kelly
Division of Wildlife Management

Final Performance Report

State: North Carolina **Grant Number:** T – 12

Period Covered: July 1, 2010 – September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Mammal Inventory and Monitoring

Objectives:

1. To collect information on distribution, relative abundance, and/or site occupancy of priority mammal species identified in the NC Wildlife Action Plan for North Carolina (NCWAP, pp. 97, 103, 109, 114, 124, 129, 132, 135,140, 145, 152, 165, 171, 180, 197, 202, 208, 214, 220, 227, 233, 239, 245, 253, 261, 265, 269)
2. To survey all existing geographic recovery areas and other areas of suitable habitat for the presence of Carolina northern flying squirrel (NCWAP, pp. 97, 103);
3. To assess population status of priority mammal species through regular survey and long-term monitoring efforts (NCWAP, pp. 97, 103, 130, 132, 135, 153, 158 , 165, 171, 180, 181, 197, 198, 203, 208, 214, 220, 228, 240, 245, 246, 254)
4. To implement conservation actions that improve health and/or protection of bat populations (e.g., bat gates at cave/mine entrances,) (NCWAP, p. 136,)
5. To provide technical guidance about priority mammal populations, their habitats, and the threats they face to partners and stakeholders and during the revision of the NC Wildlife Action Plan (NCWAP, pp 75, 78, 80, 81, 464)
6. To implement conservation actions that improve high elevation habitat (NCWAP, pp. 97-98, 104).

A. Activity

A large portion of the project focused resources on Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*) inventory and monitoring, including investigating new techniques. The remaining funds were directed toward bat technical guidance and planning and conducting the 2011 Southeastern Bat Diversity Network Bat Blitz in Pisgah National Forest.

Surveys and Monitoring

The Carolina northern flying squirrel (CNFS) portion of the project consisted of winter nest box surveys, acoustic surveys, and live-trapping, data analysis, and technical guidance. The long term nest box monitoring database was updated and shared with Virginia Tech for analysis using mark-recapture models. The majority of field work addressed objectives 1 and 2. Objective 1: Productive nest box lines in the Great Balsams, Black-Craggy Mountains, Unicoi Mountains, and Grandfather Mountain were surveyed in winter 2011. Captured animals were weighed, measured, ear-tagged, and released. Acoustic surveys were conducted in previously un-surveyed areas of the Unicoi Mountains, Great Balsams, and Roan Mountain to fill in distribution and

elevation range gaps. Objective 2: Secondary sites (areas of suitable habitat outside of designated Geographic Recovery Areas) were also surveyed, including nest box checks at Beech Creek bog and Alarka Laurel, acoustic surveys at Big Bald, Pond Mountain, Wine Spring Bald, Unaka Mountain, Beech Creek bog, and Sugar Mountain bog, and live trapping and cameras at Big Bald and Pond Mountain. Nest boxes were posted at Pond Mountain.

Technical Guidance

Using the North Carolina Wildlife Resources Commission (NCWRC) nest box data, the U.S. Fish and Wildlife Service helped build a draft CNFS model. NCWRC provided technical guidance to the U.S. Forest Service on take of CNFS habitat on a trail project in the Black Mountains and on spruce restoration plans in the Unicoi Mountains. A brief habitat evaluation was conducted at a spruce bog along Highway 105 with NC Department of Transportation (NDOT) biologists. Staff met with the Superintendent of Grandfather Mountain State Park to coordinate survey efforts on the newly established state park. Technical guidance was given to citizens regarding proper eviction and exclusion methods for bats. Technical guidance was also provided to NCDOT regarding Virginia big-eared bat (*Corynorhinus townsendii virginianus*) surveys Highway 105 widening project. Technical documents were assembled and provided to the USFWS for three bat species native to North Carolina.

Results

Objective 1- Between January and early April, staff conducted checks of boxes in the Unicois, Great Balsams, Black and Craggy Mountains, Plott Balsams, and Grandfather Mountain. Altogether, 58 CNFSs were detected including 11 previously tagged individuals (Table 1). Forty-three of these 58 animals were fitted with ear tags for the first time. Four of the 58 squirrels were either seen leaving the box or escaped before the observer could determine whether or not the animal had an ear tag. Active nests can provide some insight, albeit limited, into the squirrel's presence in an area. In total, 211 boxes contained CNFS nests, although just 26 of the 211 were occupied by CNFSs. Overall, across the five Geographic Recovery Areas (GRAs), 37% of boxes were found to contain nest material identified as CNFS nests (Table 2). However, only 13% of those nests and just 5% of all boxes we checked were occupied by CNFSs. No CNFS were documented in boxes at Alarka spruce bog and Beech Creek bog, although surveys at Beech Creek were conducted outside of the established survey window.

Table 1. NCWRC Carolina northern flying squirrel capture summary, 2011.

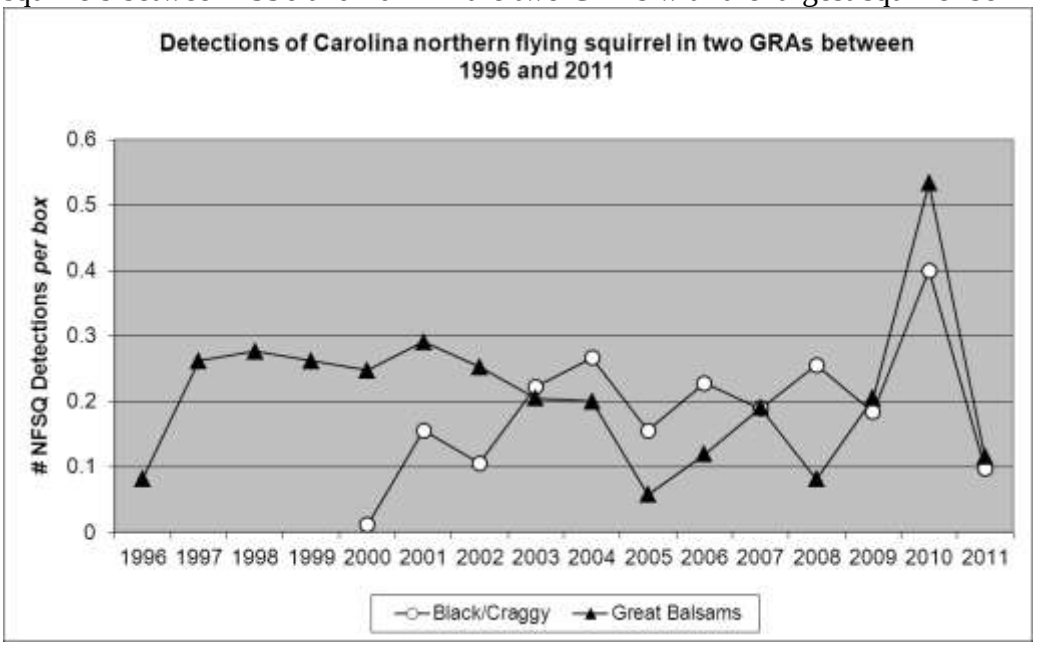
Mountain Range/GRA	# Boxes Checked[1]	# CNFS Detected	# Recaptures	# CNFS Newly Tagged
Black & Craggy Mtns	154	**15**	3	11
Great Balsams	156	**18**	6	12
Unicoi Mountains	80	**7**	1	6
Grandfather Mountain	76	**3**	1	1
Plott Balsams	48	**15**	0	13
Beech Creek Bog SNA	11	**0**	0	0
Alarka Spruce Bog	7	**0**	0	0
Totals	**537**	**58**	**11**	**43**

[1] Detections defined as new captures, recaptures, and escapees.

Table 2. NCWRC Carolina northern flying squirrel nest summary, 2011.

Mountain Range/GRA	Number Boxes Checked	Number CNFS Nests (occupied and unoccupied)	% Boxes with Nests	% Boxes occupied by CNFSs	% Nests occupied by CNFSs
Black & Craggy Mtns	154	67	43 %	5 %	12 %
Great Balsams	156	57	36 %	5 %	14 %
Unicoi Mountains	80	19	24 %	2.5 %	10 %
Grandfather Mountain	76	37	66 %	2.6 %	5 %
Plott Balsams	48	17	35 %	13 %	4 %
Beech Creek Bog SNA	11	0	0 %	0 %	0 %
Alarka Spruce Bog	7	0	0	0 %	0
Totals:BC,GB,UN,GF, PB	**514**	**197**	**38 %**	**5 %**	**13 %**

Figure 1. North Carolina Wildlife Resources Commission detections of Carolina northern flying squirrels between 1996 and 2011 in the two GRAs with the largest squirrel box networks.



Using acoustics, CNFS were documented in a previously un-surveyed area of suitable habitat in the Great Balsams being evaluated for a spruce restoration project (Table 3, Figure 2). Similarly, suitable habitat in the Unicoi Mountains was surveyed, resulting in a new low elevation record (3,680ft) along Johns Branch. Habitat was dominated by yellow birch, Eastern hemlock, boulders, and riparian vegetation. One night of surveys on the north end of the Unicois resulted in no detections of CNFS and one recording of a southern flying squirrel (SFSQ) in transitional high elevation red oak-northern hardwood forest. A new high elevation record of 6,190ft was documented in pure Fraser fir forest along the Appalachian Trail at Roan Mountain. CNFS was also documented in northern hardwood forest along Powers Branch at Roan Mountain.

Table 3. Acoustic survey effort (trap nights) and detections of Carolina northern flying squirrel in three Geographic Recovery Areas.

Site	Acoustic Trap Nights[a]	Acoustic Detections[b]	Significance
Great Balsams (Black Balsam)	12	5 recorders	Fills in distribution gap in the Great Balsams.
Roan – N.Hardwoods (Powers Branch)	5	1 recorder	Never before documented via nest boxes.
Roan – Fraser fir (AT and Cloudland)	8	6 recorders	New high elevation record.
Unicois (Johns Branch)	7	1 recorder	New low elevation record.
Unicois (north end)	4	0 recorders	SFSQ documented at one site.

[a] "Trap" nights refer to the number of recording units operating overnight.
[b] "Detections" refer to the number of recording units that recorded vocalizations. This may consist of one or many files of CNFS vocalizations.

Objective 2- While a separate Section 6 grant closely examined performance of the acoustic survey technique in sites known to be occupied by CNFS (Kelly 2011), the current study addressed objective 2, above, employing acoustics and other techniques to survey suitable habitat in areas outside of the Geographic Recovery Areas. A total of 105 "trap" nights resulted in 17 "captures" of CNFS (i.e., detection based on recording of a vocalization) (Table 4, Figure 2). Live-trapping and camera monitoring were used, albeit unsuccessfully, to attempt to validate acoustic surveys at two sites.

Table 4. Survey effort and detections of flying squirrels outside of known CNFS range using acoustic recording and live-trapping.

Site	Acoustic Trap Nights[a]	Acoustic Detections[b]	Tomahawk Trap Nights	Tomahawk Captures
Big Bald	24	CNFS: 4 recorders SFSQ: 3 recorders	10	0
Pond Mountain	36	CNFS: 7 recorders SFSQ: 0 or 1 recorder	80	0
Wine Spring Bald	18	CNFS: 2 recorders SFSQ: 5 recorders	-	-
Unaka Mountain	7	CNFS: 4 recorders SFSQ: 0 recorders	-	-
Beech Creek Bog	16	0	-	-
Sugar Mtn Bog	4	SFSQ: 1 recorder	-	-

[a] "Trap" nights refer to the number of recording units operating overnight.
[b] "Detections" refer to the number of recording units that recorded vocalizations. This may consist of one or many files of squirrel vocalizations. CNFS = Carolina northern flying squirrel. SFSQ = southern flying squirrel.

The 2011 Bat Blitz provided an inventory of public lands within one hour drive from Crossnore, NC. Thirty one sites were netted with a total 446 captures of nine species (Table 5). Establishment of these sites provided important relative abundance data and the potential for long-term monitoring at sites in under-sampled portions of the western region.

Table 5. Bat species captured during the 2011 Bat Blitz.

Bat Species	# Captured
Corynorhinus rafinesquii rafinesquii	1
Eptesicus fuscus	138
Lasiurus borealis	90
Lasiurus cinereus	2
Lasiurus seminolus	1
Myotis leibii	17
Myotis lucifugus	81
Myotis septentrionalis	78
Perimyotis subflavus	19
Myotis species	6
Unknown	13
Total	**447**

B. Target Dates for Achievement and Accomplishment

On schedule

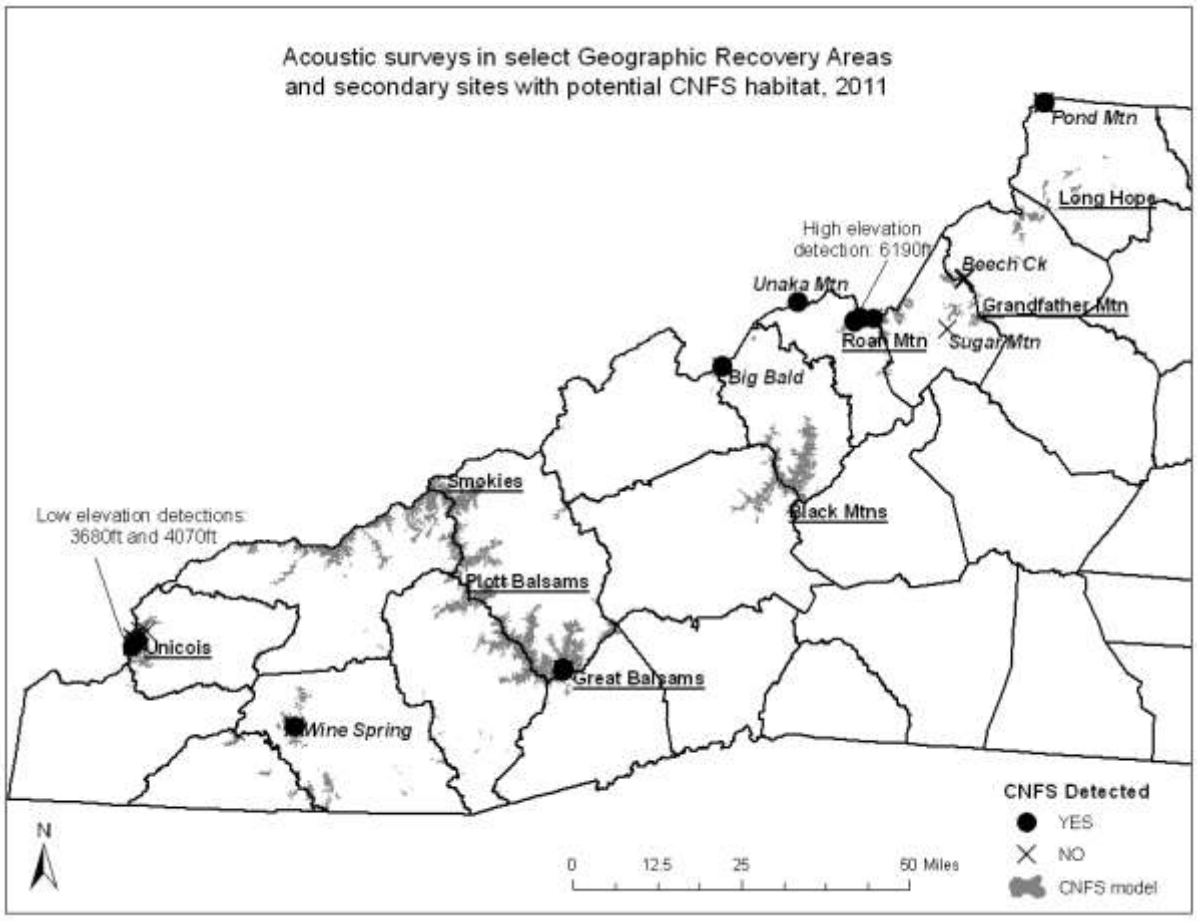
C. Significant Deviations

None.

D. Remarks

Nest box captures and occupancy were lower this year. Acoustic survey results demonstrated acoustic's value as a rapid survey technique. Acoustic surveys filled in distribution gaps in three recovery areas, and documented new record high and low elevation occurrences of CNFS. NCWRC's nest box network generally spans the elevation range 4,500 to 6,000 feet, and under-samples Fraser fir forest and low elevation hardwoods. The Johns Branch record in the Unicois is 1.16 miles from a new record low elevation (4,070ft) from a nest box capture in February 2011. Prior to acoustics, nest boxes along Powers Branch remained empty of squirrels and nests, providing no insight to the presence of CNFS. Further testing is needed to develop acoustic survey protocol in order to determine how many nights of surveys are needed to determine presence/absence of CNFS in previously un-surveyed areas, for example, the north end of the Unicoi Mountains. Detections of CNFS at Big Bald, Pond Mountain, Wine Spring Bald, and Unaka Mountain expand the known range of CNFS outside of the existing nine GRAs (Figure 2). While habitat at Unaka Mountain is high quality (red spruce-northern hardwood), habitat in the other three areas is of lower quality, consisting of northern hardwood forest, high elevation red oak forest, and scattered, planted conifers. All are areas of overlap with SFSQ.

Figure 2. Acoustic surveys in select Geographic Recovery Areas and secondary sites with potential CNFS habitat, 2011.



Geographic Recovery Areas underlined; Secondary Sites in italics.

E. Recommendations

The highest priorities now are to (1) continue developing acoustic survey protocols, (2) run finer-grained occupancy analysis of nest box data (with Virginia Tech), (3) run mark-recapture analysis (with Virginia Tech), (4) compare occupancy and detection from nest box surveys versus acoustic surveys, (5) survey "new" sites using acoustic monitoring equipment, and (6) validate occupancy at "new" sites. Because acoustics is a new survey technique, validation is needed via nest box capture, live-trapping, camera footage, tracking, or hair sample in at least one of the four newly discovered locations. These efforts will culminate in development of a long-term monitoring plan for CNFS. High elevation conservation efforts of the Appalachian Mountains Joint Venture will complement and guide spruce restoration efforts for CNFS. Manuscripts of NCWRC's CNFS studies to date are in preparation. The U.S. Fish and Wildlife Service draft habitat model should be updated with new distribution information.

F. Estimated Cost

$ 57,546 (including in-kind contributions)

G. References

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US Fish and Wildlife Service. 1990. Appalachian northern flying squirrels (*Glaucomys sabrinus fuscus* and *Glaucomys sabrinus coloratus*) recovery plan. Newton Corner, MA. 53pp.

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Prepared By: Chris Kelly
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Final Performance Report

State: North Carolina **Grant Number:** T – 12

Period Covered: July 1, 2010 - September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: NC Partners in Amphibian and Reptile Conservation

Objectives:

The North Carolina Partners in Amphibian and Reptile Conservation (NCPARC) program will:

- Continue to develop and coordinate a North Carolina chapter of PARC to cooperatively promote conservation and assist with conservation planning.
- Continue to develop and reinforce partnerships that will benefit reptile and amphibian conservation in the state and region through increased communication, cooperation and collaboration.
- Provide technical assistance to local, state and federal agencies, private business, conservation groups and private citizens on matters related to reptile and amphibian conservation.
- Coordinate the North Carolina Calling Amphibian Survey Program (CASP) and assist with other monitoring and research programs.
- Coordinate and facilitate the exchange of information about the status and needs of reptiles and amphibians for citizens and natural resource professionals through NCPARC working groups.
- Continue to provide facilitation of and cooperative participation in planning statewide projects to address herpetological needs as determined by the WRC in conjunction with the NCPARC research, inventory, monitoring and management technical working group.
- Train natural resource professionals and volunteers to help survey reptile and amphibian populations, and assist agencies, non-governmental organizations and private entities to implement herpetofaunal monitoring, research, and habitat management programs.

A. Activity

The principle objective of this project is to coordinate a North Carolina chapter of Partners in Amphibian and Reptile Conservation (NCPARC) to promote herpetological conservation and assist with planning herpetological research initiatives. The NCPARC program has involved: 1) continued NCPARC coordination; 2) cooperative planning, development and initiation of citizen participation projects as recommended by NCPARC technical working groups; 3) facilitation of and cooperative participation in planning statewide projects to continue to address herpetological needs as determined by the WRC and the NCPARC research, inventory, monitoring and management technical working group; and 4) coordination of the NC Calling Amphibian Survey Program (CASP).

Coordination and Communication

Maintaining close coordination and communication among NCPARC members involved providing technical guidance and facilitation of meetings of the three technical working groups, the steering committee, and an annual meeting of the entire NCPARC membership. Website pages were updated routinely and emails distributed to the NCPARC membership to keep the NCPARC body informed of ongoing research, initiatives and activities. The NCPARC Coordinator also provided technical guidance on matters related to planning, research, monitoring, conservation and management of reptiles and amphibians to agencies, private conservation organizations and citizens.

NCPARC Research/Monitoring Programs and Partnerships

The North Carolina Calling Amphibian Survey Program (CASP)

In the fall of 2010, all data from the 2010 field season was entered into the online North American Amphibian Monitoring Program (NAAMP) database. All NAAMP data is available online: http://www.pwrc.usgs.gov/naamp/. In 2010, forty-eight volunteers collected data on fifty-two CASP routes. Twenty-four of NC's thirty native anuran species were detected on these routes. Of these twenty-four, four are priority species listed in the North Carolina Wildlife Action Plan (*Hyla gratiosa*, *Pseudacris brimleyi*, *Pseudacris nigrita*, *Pseudacris ornata*). Data collection continued for the 2011 field season. Although data from the 2011 season has not yet been entered or reviewed, seventy-five observers were assigned to seventy-eight routes. Data entry by observers began in July and August along with review by the coordinator. All data will be entered and reviewed by November 1, 2011.

The Carolina Herp Atlas (CHA)

The CHA was officially launched in March 2007. Prior to the launch, the Davidson College Herpetology Lab imported approximately 3900 records, primarily from Mecklenburg, Iredell, and Cabarrus counties in the western Piedmont of North Carolina. From March 2007 through January 1 2011, the CHA totaled 845 registered users. The CHA received 11,991 reptile and amphibian records from North Carolina. Of these 11,589 records, 5091 were accompanied by voucher photograph and/or given a status of 10 (high confidence). A total of 143 North Carolina reptile and amphibian species have at least 1 record in the CHA.

Thus far, the CHA has collected species-level, distribution data on 143 species of amphibians and reptiles, including the occurrence of 30 anurans, 48 salamanders, 36 snakes, 11 lizards, 17 turtles, and the American alligator. The most commonly reported species include eastern box turtle (*Terrapene carolina*; 1222 records), painted turtle (*Chrysemys picta*; 790 records), rat snake (*Elaphe obsoleta*; 601 records), black racer (*Coluber constrictor*; 560 records) and slider (*Trachemys scripta*; 364 records)

Amphibians listed special concern, threatened, or endangered by the state of North Carolina for which records have been submitted include green salamander (*Aneides aeneus*; 14 records), tiger salamander (*Ambystoma tigrinum*; 17 records), mole salamander (*Ambystoma talpoideum*; 6 records), eastern hellbender (*Cryptobranchus alleganiensis*; 6 records), dwarf salamander

(*Eurycea quadridigitata*; 7 records), four-toed salamander (*Hemidactylium scutatum*; 5 records), Pine Barrens Treefrog (*Hyla andersonii*; 2 records), Eastern zigzag salamander (*Plethodon ventralis*; 1 record), Wehrle's salamander (*Plethodon wehrlei*; 2 records), mountain chorus frog (*Pseudacris brachyphona*; 12 records) and Carolina gopher frog (*Rana capito*; 3 records).

Reptiles listed special concern, threatened or endangered by the state of North Carolina for which records have been submitted to the CHA include American alligator (*Alligator mississippiensis*; 19 records), eastern diamondback rattlesnake (*Crotalus adamanteus*; 5 records), loggerhead sea turtle (*Caretta caretta*; 6 records), timber rattlesnake (*Crotalus horridus*; 176 records), coal skink (*Eumeces anthracinus*; 2 records) bog turtle (*Glyptemys muhlenbergii*; 7 records), diamondback terrapin (*Malaclemys terrapin*; 5 records), southern hognose snake (*Heterodon simus*; 18 records), northern pine snake (*Pituophis melanoleucus*; 18 records) and pigmy rattlesnake (*Sistrurus miliarius*; 59 records).

The CHA has thus far been a highly successful, citizen-science based project to document the distribution of reptiles and amphibians in North Carolina. The collection of 11,991 reptile and amphibian observational records from North Carolina (16,991 total from North and South Carolina) during the first 3.5 years suggests that the CHA has the potential to surpass many other citizen-science based herpetological atlas projects. For example, the Georgia Herp Atlas collected a total of 7452 records during five years of operation. The CHA also continues to receive a high number of submissions each year (Figure 1) although the number of registered participants peaked during the first year of operation (i.e., 2007, Figure 2). Thus far, the CHA represents a significant step towards development of a better understanding the distributions of reptiles and amphibians in the Carolinas.

An over-arching goal of the CHA is to promote conservation and understanding of reptiles and amphibians in North Carolina. The interactive nature of the CHA appears to appeal to a wide variety of people, including school teachers, professional herpetologists, and those generally interested in wildlife. Efforts are currently underway to secure additional funding to ensure the continuation of the Carolina Herp Atlas.

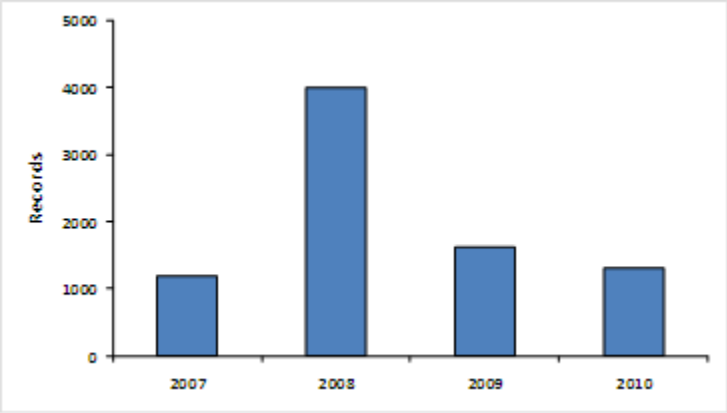

Figure 1. The number of records submitted annually from 2007 through 2010. Although the number of records peaked during 2008, over 1,000 records have been submitted each year.

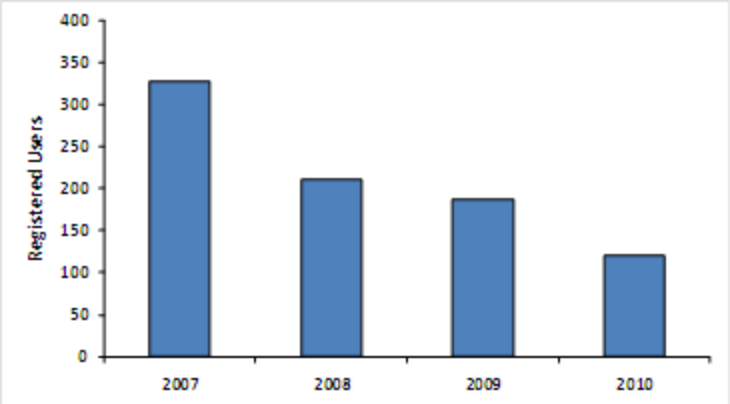

Figure 2. The number of registered users annually from 2007 through 2010.

*Population status, distribution, and phylogeography of the seepage salamander (*Desmognathus aeneus*) in North Carolina. Report Submitted in fulfillment of contract WM -0190 by Trip Lamb and David Beamer:*

ABSTRACT

The seepage salamander, *Desmognathus aeneus*, is a species listed as Significantly Rare in North Carolina. To provide an update on its distribution and status, we 1) compiled/consolidated all existing locality records for North Carolina; 2) executed an ecological-niche modeling analysis to identify suitable habitat; 3) conducted a field survey (visiting historical localities and seeking new ones); and 4) examined genetic variation among North Carolina populations. We compiled and georeferenced 55 existing localities for the state, and during field surveys over the spring and summer of 2010, we discovered 10 new state localities, all within the known range of the species. We sequenced a 1200 base-pair segment of the mitochondrial genome (containing the genes *Nd2* and *Co1*) for individuals representing 17 North Carolina populations. A Bayesian analysis of these sequences and others throughout the species' range identified three major lineages in *D. aeneus*. All North Carolina samples fall in the Northeastern lineage, but phylogeographic structure is apparent within the state. One clade within the Northeastern lineage comprises two subclades: one in the vicinity of Peachtree (type locality) and the second in the Nantahala Mountains, extending into northeast Georgia. The second clade, differing by 4.28%, is distributed across the Great Smoky and Unicoi mountains, extending west into Tennessee.

INTRODUCTION

The seepage salamander, *Desmognathus aeneus*, is a small lungless salamander (family Plethodontidae) described in 1947 from western North Carolina. Compared to many other species in the genus *Desmognathus* (dusky salamanders), relatively little information concerning the distribution or status of *D. aeneus* in North Carolina has been published since. As a result, it ranks as one of the state's more poorly known salamander species. One reason may relate to its exceptionally small size; at 57 mm total length, *D. aeneus* is among the tiniest salamanders in North America. As such, specimens can often go overlooked or may be misidentified as juveniles of other dusky species. Moreover, the common name, seepage salamander, has probably minimized

search effort in other suitable habitats. With its limited North Carolina range, in conjunction with the 'seepage' habitat perception, *D. aeneus* is a species state listed as "Significantly Rare," with a concern for population trends (LeGrand and Hall 1999).

Species overview. In this section, we summarize literature pertinent to the status of the seepage salamander in North Carolina (and other areas of its range). We emphasize those papers addressing taxonomy, distribution, and population genetics, which collectively come to bear on the conservation management of this species. Additional aspects of its biology (e.g., diet, reproduction, etc.) have been adequately compiled by Harrison (1992, 2005).

Taxonomy.—Brown and Bishop (1947) described *Desmognathus aeneus* based on 12 specimens collected "near a small seepage branch 100 feet north of Peachtree Creek, ½ mile S.S.E. of Peachtree, Cherokee County, North Carolina." A second, similar form, *Desmognathus chermocki,* was described from Alabama soon thereafter (Brown and Valentine 1950). However, its taxonomic validity was short-lived, being relegated to subspecific status (*D. aeneus chermocki*) just two years later (Chermock 1952) and then subsumed completely to the synonymy of *D. aeneus*. No other subspecific designations are currently recognized.

Distribution.—Accounts on *D. aeneus* (e.g., Mount 1975, Harrison 2005) generally note the salamander's spotty distribution (though local abundance) across its geographic range, which runs from extreme western North Carolina and southeastern Tennessee southwest through northern Georgia and into east-central Alabama—largely along the Blue Ridge (Petranka 1998). Geographically disjunct populations (formerly *D. chermocki*) inhabit the Fall Line Hills region of west-central Alabama, approximately 80 km west of the Blue Ridge terminus (Mount 1975). Some notable range extensions have been reported, including northeast Georgia (Camp and Payne 1996) as well as the first record for South Carolina (Livingston et al. 1995). Dodd (2003, 2004) reversed a long-held view that *D. aeneus* does not occur north of the Little Tennessee River, based on three populations discovered in Great Smoky Mountains National Park. With this exception, there are no published reports for North Carolina populations with regard to updated distribution records or the status of populations at documented localities.

The common name, seepage salamander—coupled with early habitat descriptions emphasizing this ecological connection—is something of a misnomer. These salamanders are terrestrial, occupying the interface between the leaf/leaf mold layer and underlying soil or occurring beneath moss mats on boulders in heavily shaded hardwood or mixed forests (Jones 1981; Bruce, 1991, Harrison 1992, 2005, Beamer, pers. obs.). Though typically found in vicinity of seepages or small streams, the species is by no means restricted to seepages. We believe the salamander's spotty distribution and reputed ties to seeps may be major reasons why it is generally considered uncommon to rare.

Population genetics.—Range-wide population genetic surveys of salamanders, even those with small but disjunct ranges like that of the seepage salamander, often reveal significant genetic divergence if not pronounced phylogeographic structure (Crespi *et al.* 2003, Timpe *et al.* 2009). Indeed, the phylogeographic survey of pigmy salamanders (*Desmognathus wrighti*) led to a subsequent taxonomic revision and description of the new species *Desmognathus organi* (Crespi et al. 2010). No phylogeographic survey of *D. aeneus* has been attempted and, as a result, we have no

idea whether this species may be composed of distinct evolutionary lineages.

Project goals. To assess the current status and distribution of *D. aeneus* in North Carolina, we carried out the following steps.

- Assembled a complete locality database, consolidating all known North Carolina locations.
- Geo-referenced these locality data by uploading them in a geographic information system (GIS) to generate a state distribution map.
- Employed ecological-niche modeling methods to identify suitable habitat.
- Visited several historical localities (or vicinities) to determine whether seepage salamander populations remain extant, and surveyed areas of suitable habitat (identified via GIS/ecological niche modeling) to establish new population records.
- Sequenced a 1200 base-pair fragment of the mitochondrial genome for representatives from each population surveyed.
- Analyzed these North Carolina samples in conjunction with other populations to examine extent and degree of phylogeographic structure across the species range.

METHODS

Georeferenced database assembly. Our update of locality data for *D. aeneus* in North Carolina involved consolidating North Carolina records through searches of museum collections, literature accounts, and appropriate online databases. Many state localities correspond with specimens housed in the North Carolina State Museum, but we accessed several other databases, including, preferentially, HerpNET (www. Herpnet.org). HerpNET, a website of herpetological collections data, represents a worldwide collaborative effort among some 55 institutions. HerpNET museums/institutions containing North Carolina specimens of *D. aeneus* in their collections include: Auburn University Natural History Museum, California Academy of Sciences (San Francisco), Field Museum of Natural History (Chicago), Museum of Comparative Zoology (Harvard University), Museum of Vertebrate Zoology (UC Berkeley), and Smithsonian National Museum of Natural History. We also contacted several regional institutions not yet affiliated (fully) with HerpNET to request possible records for *D. aeneus*, e.g., the Charleston Museum, Georgia Museum of Natural History. Our search of the literature provided localities not listed elsewhere (Harrison 1967), and we sought unpublished records from herpetologists familiar with this species and its general geographic region. Combining these disparate data, we uploaded localities (for which there were no lat./long. data) in a geographic information system (GIS) and collated them with all existing georeferenced localities to generate a state distribution map using ArcView V 3.0 (ESRI).

Ecological-niche modeling. To evaluate the potential range extent and to guide our searches for new populations, we constructed climate based suitability models using a maximum entropy algorithm as implemented in the software package MaxEnt (Phillips et al. 2006). We started with 19 climate variables (e.g., maximum temperature, rainfall in driest quarter, etc.) and used a jackknife procedure to select those variables most important in influencing the range extent of *D. aeneus*. We used all historical localities

as inputs of positive occurrence to produce our maximum entropy model of climate suitability.

DNA sequence procurement and phylogenetic analysis. We sequenced a segment of the mitochondrial genome containing portions of two protein-coding genes—NADH dehydrogenase subunit 2 (*Nd2*) and cytochrome oxidase subunit c (*Co1*)—and a series adjacent transfer RNAs. These genes have proved informative at both intraspecific and interspecific levels in previous dusky salamander surveys (Kozak et al. 2005, Beamer and Lamb 2008).

Genomic DNA was extracted from salamander tail tips using Qiagen's DNeasy kit. Genes were amplified via PCR using primer sets and cycling conditions detailed in Kozak et al. (2005) for *Nd2* and Beamer and Lamb (2008) for *Co1*. Amplification products were cleaned using exoSAP-IT (USB Corp.) and sequenced on an Applied Biosystems 3130 capillary sequencer. Sequences were aligned using CLUSTAL X 1.81 (Thompson *et al.* 1997), after which protein-coding sequences were translated to ensure an appropriate reading frame.

We analyzed the sequence dataset using Bayesian inference. DNA substitution models for each gene were identified by partitioning protein-coding genes by codon position and assessing gene/codon partitions using MrModelTest 2.0 (Nylander 2004). Bayesian analyses, implemented in MrBayes 3.1.2 (Huelsenbeck and Ronquist 2001, Ronquist and Huelsenbeck 2003), comprised two concurrent runs of four simultaneous Markov Chain Monte Carlo (MCMC) chains for ten million generations with a sample frequency of 1,000. Topologies in the first 25% of the posterior distribution were discarded as burn-in following inspection in the program Tracer ver. 1.3 (Rambaut and Drummond 2009). The remaining trees were summarized as a majority consensus and rooted with *Desmognathus wrighti* as an outgroup taxon, based on recent molecular phylogenetic relationships reported for the genus (Chippindale et al. 2004, Kozak et al. 2005).

RESULTS AND DISCUSSION

Georeferenced database assembly. We compiled a total of 55 existing locality records for *Desmognathus aeneus* in North Carolina. A map depicting these georeferenced sites is shown in Fig. 1. Certain localities, e.g., the type locality, are represented across institutions. Collectively, the existing locality data support the view that the distribution of *D. aeneus* in North Carolina is confined to the extreme western portion of the state, with records being restricted to Cherokee, Clay, Graham, Macon, and Swain counties.

Ecological-niche modeling. The maximum entropy climate suitability model was largely congruent with the known range extent (Fig. 2). It identified some high elevation areas in the Unicoi Mountains as having climatic conditions of low suitability despite three collections made in a small area near one of the highest peaks in this mountain range. Likewise, higher elevations in the Nantahala and Tusquitee mountains are also modeled as having low probabilities of occurrence (red-orange, Fig. 2).

Generally areas of moderate elevation were identified as being most suitable. Some of these areas in the vicinity of Andrews and Murphy have been highly modified by man, and it is likely that populations existed in pre-settlement times. Most populations in these areas were probably destroyed before *D. aeneus* was described, which may explain the paucity of records in these areas that were otherwise identified as having suitable climate.

Our maximum entropy climate models identified suitable climatic conditions in the headwaters of portions of the Chatooga River and adjacent areas where the species has not been documented. Richard Bruce (pers. comm.) positively identified a photograph of *D. aeneus* purported to have been collected in that area, but searches by Bruce and during this survey failed to produce specimens. Further downstream the species is known from both Georgia and South Carolina. Continued searches of this area may well close this distributional hiatus.

Field survey and range locality update. We sampled some 30 sites throughout (and beyond) the state's known geographic range for *D. aeneus*—sites selected in part on the basis of optimal habitat identified from our suitability model. Salamanders (n = 80) were collected at 17 localities (Fig. 3, Appendix 2).

Nine of the 30 sites we visited were historical localities, and we confirmed continued presence of salamander populations at eight of these nine. We discovered ten new localities, securing voucher specimens for nine of them. An eleventh population, recorded just across the state line in Tennessee (and just outside the Great Smoky Mountain National Park) provides another population record north of the Little Tennessee River. Despite our survey efforts of optimal habitat in two counties (Jackson, Transylvania) east of the species' known geographic range, we did not find any seepage salamanders there. All the new populations we discovered fall within the species' recognized range extent (sensu Harrison 2005); nonetheless, our survey efforts increased the number of state localities for *D. aeneus* by ~30% (Fig. 4).

Population genetics and phylogeographic structure. For our population genetic analysis, we examined 17 populations collected in North Carolina, sequencing two individuals per population for all localities with n>1. We identified 17 *Co1-Nd2* haplotypes for the North Carolina samples, one for each population surveyed. These sequence data were compared to sequences for other populations collected throughout the species' range for an assessment of genetic divergence and phylogeographic structure. Our Bayesian analysis identified three distinct lineages among the range-wide samples of *D. aeneus*. All the North Carolina samples, in conjunction with populations from northeast Georgia and eastern Tennessee, form a Northeastern Lineage, which is sister to a second, Central Lineage comprising populations from west-central Georgia and east-central Alabama. These two lineages are, in turn, sister to populations representing the disjunct portion of the species' range in west central Alabama (formerly *D. chermocki*), which we refer to here as the Western Lineage. A Bayesian consensus tree depicting these relationships is shown in Figure 5. Note that Central and Western lineages are represented by a single haplotype, providing focus on the relationships among North Carolina samples and additional members of the Northeastern lineage. Levels of genetic divergence between the Northeastern and Central lineages average 6.12%; mean level of divergence between these two lineages and the disjunct

populations of the Western Lineage are comparable, at 5.76%. Despite rather limited geographic distances, phylogeographic structure is present among populations in the Northeastern lineage, reflected in two clades that differ genetically by a mean of 4.28%. Both clades are represented in the North Carolina. One clade (red-numbered localities) is distributed across in the Great Smoky and Unicoi mountains, extending west into Tennessee. The second clade is composed of two subclades, one in the vicinity of Peachtree, the type locality (green-numbered localities), and the second in the Nantahala Mountains, extending into northeast Georgia (blue-numbered localities, see Fig. 5).

ACKNOWLEDGMENTS

We extend our gratitude to Matthew Beamer, Thomas Bridgers, and Sean Graham for their assistance in the field.

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Figures

Fig. 1. Known localities for *D. aeneus* in North Carolina. Black circle depicts the type locality. Certain circles depicted in Macon County represent two localities of very close proximity.

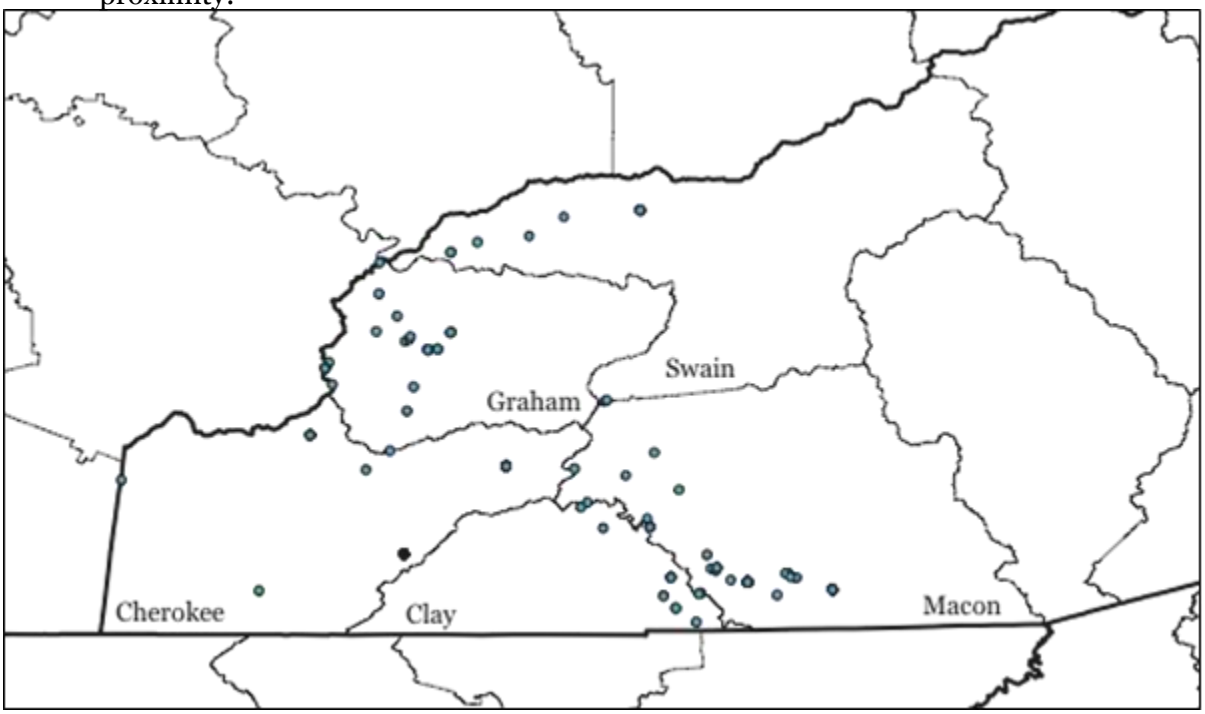


Fig. 2. Occurrence probabilities for *D. aeneus* derived from climate-based suitability models. Optimal habitat/conditions are depicted in blue, followed by purple, red, and so on to yellow for low suitability.

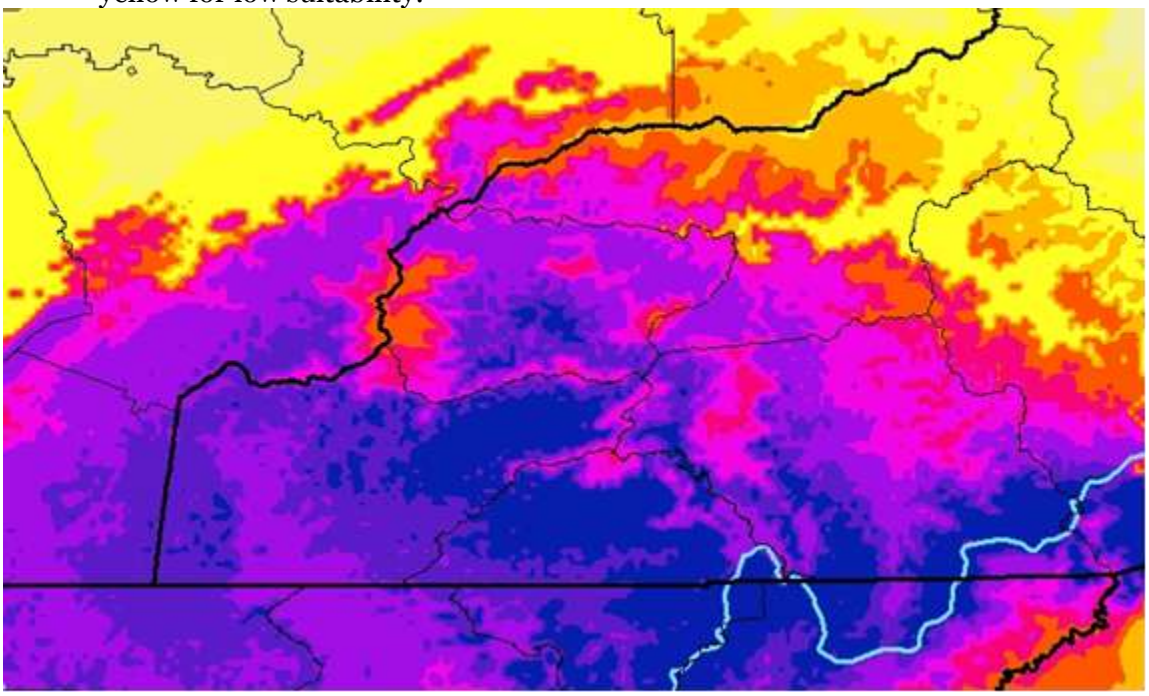


Fig. 3. Collecting effort for 2010, depicted as georeferenced localities.

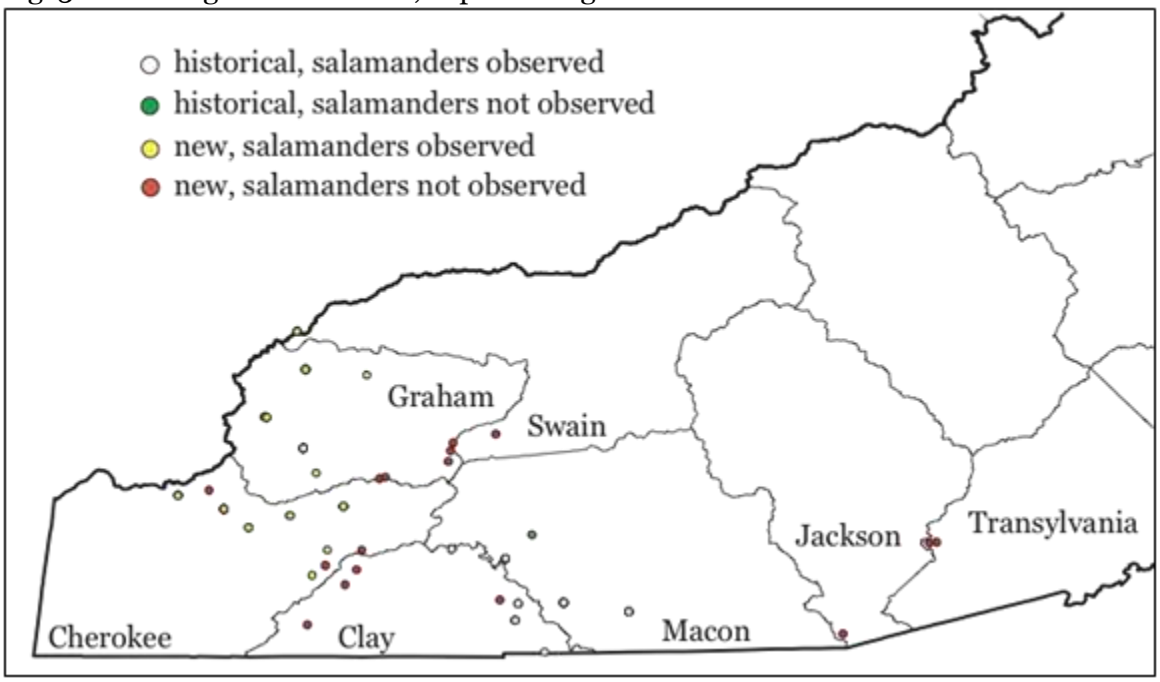


Fig. 4. Updated locality map for *D. aeneus* in North Carolina. Blue circles = historical localities; black circle = type locality; yellow squares = new localities.

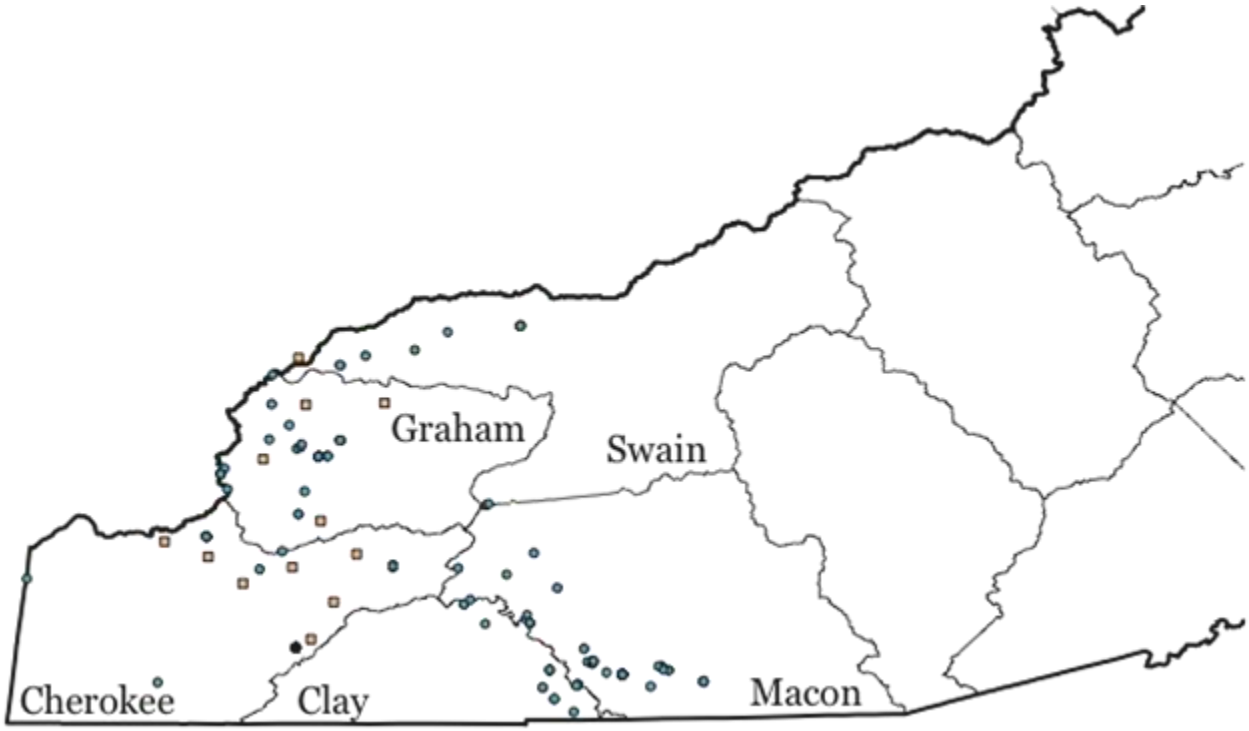
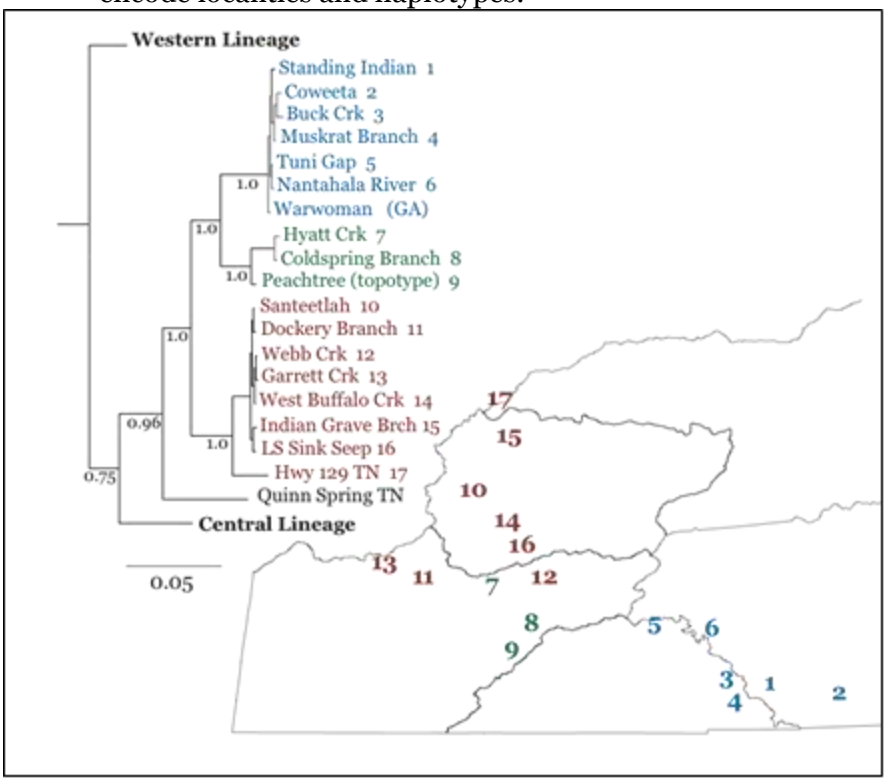


Fig. 5. Bayesian phylogram depicting relationships among populations of *D. aeneus*, emphasizing phylogeographic structure within the Northeastern lineage. Numbers encode localities and haplotypes.



B. **<u>Target Dates for Achievement and Accomplishment</u>**
On schedule

C. **<u>Significant Deviations</u>**
None

D. **<u>Remarks</u>**
None

E. **<u>Recommendations</u>**
None

F. **<u>Estimated Cost</u>**

$ 157,434 (including in-kind contributions and non-federal match)

Prepared By: Jeff Hall
Partners in Amphibian and Reptile Conservation Biologist
Division of Wildlife Management

Final Performance Report

State: North Carolina **Grant Number:** T – 12

Period Covered: July 1, 2010 - September 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: Wildlife Diversity Coordination

Objectives:

To establish and maintain management control systems adequate to meet requirements for administration of Federal-Assistance Programs and integrate them with non-federally funded projects into a comprehensive Wildlife Diversity Program to achieve NC Wildlife Action Plan goals.

A. Activity

Maintaining eligibility for participation in federal assistance programs

The Wildlife Diversity Coordinator worked with appropriate administrators to monitor the status of State laws necessary to participate in the Federal-Aid programs aimed at nongame species. No problems were encountered with regard to modification of existing laws that might jeopardize Program funding. Submission of active grants and documentation satisfied the requirement for "notice of desire to participate" in the Federal-Aid Programs.

Assuring that grant proposals submitted met program standards and consistency with state Wildlife Action Plan goals.

The Wildlife Diversity Coordinator worked with senior staff to develop projects (section 6 ESA, and SWG, primarily) that met eligibility standards to be submitted for Federal-Aid. Projects were chosen that met the basic criteria for character and design and that utilized accepted wildlife conservation principles and practices. Projects that would yield benefits pertinent to the stated need and that could be accomplished within reasonable funding limits were proposed, submitted, and monitored.

Assuring that documentation was consistent with program standards.

The coordinator and senior staff reviewed, edited, and compiled all documents that were submitted to the Regional Office, including interim and final reports, and new grant applications. This review assured that all documents were submitted within FWS deadlines with appropriate forms and other associated documents. The coordinator corresponded regularly with Federal Assistance Personnel and Ecological Services (FWS) personnel, and compiled and reviewed in-kind match documentation to assure consistency with program standards.

Assuring that work funded was accomplished in an effective and efficient manner.

The coordinator supervised all senior staff directly and all other staff indirectly thereby facilitating the effort to assure that work was accomplished in an effective and efficient manner. Almost daily contact with senior staff and subsequent contact between field supervisors with their staff through the use phone calls and emails and numerous face-to-face meetings facilitated efficiency. Frequent communications and meetings among WRC personnel occurred with various program personnel to review progress, discuss issues, and coordinate the work on federal assistance projects throughout the year.

Assuring that adequate financial and property records were maintained.

The coordinator and senior staff monitored the general program for financial accountability with program supervisors, administrators, and accountants on a regular and frequent basis. Inventories of property were maintained and checked by the coordinator and field supervisors. No problems were encountered. Program expenditures were monitored by the coordinator and regional supervisors to ensure compliance with the various federal assistance grant requirements and standards, and to ensure that expenditures were within grant limits.

To coordinate the federal assistance program with other state activities and those of other agencies or organizations to eliminate duplication, avoid conflicts, maximize complementarity, and build partnerships.

The coordinator, program manager, and regional supervisors coordinated with other regulatory agencies, both state and Federal, to assure that duplication of efforts and conflicting activities were prevented. No conflicts with or violations of state or Federal law were discerned during numerous review opportunities. Numerous coordination meetings with other agencies, organizations, and individuals provided opportunities to share information, facilitate cooperation, and avoid duplication of effort in the Wildlife Diversity Program's work. These included a Wildlife Diversity Program Manager's meeting, 4 Joint Venture and 2 Atlantic Flyway meetings, 2 Landscape Conservation Collaborative meetings, and numerous WRC coordination meetings. Regular review of federal assistance grants, projects, and plans ensured that the variety of federal assistance grants, and other funding source grants complement each other in pursuit of the NC Wildlife Action Plan goals.

To initiate integration of Climate Change impact planning into all program areas.

This task included internal and external planning and coordination, document review and other communications. It also included initial steps to identify and assess changes in biological or ecological communities, prioritize threats, or otherwise assess vulnerability of priority species and habitats to all of the impacts associated with climate change or its causes. Numerous communications and meetings with Defenders of Wildlife and the NC Natural Heritage Program to assess climate change impacts on NC wildlife and initial planning for coordinated vulnerability assessment were the primary tasks.

B. Target Dates for Achievement and Accomplishment
On schedule

C. Significant Deviations
None

D. Estimated Cost

$131,403

Prepared By: Chris McGrath
Wildlife Diversity Program Coordinator
Division of Wildlife Management

Final Performance Report

State: North Carolina **Grant Number:** T - 12

Period Covered: September 16, 2010 – Sept 30, 2011

Grant Title: State Wildlife Grants 08-Wildlife Management

Project Title: North Carolina Partners in Flight (NCPIF)

Objectives:

1. Develop and participate in partnerships that will benefit bird conservation in the state and region through increased communication, coordination, and collaboration.
2. Provide technical assistance to local, state and federal agencies, private business, conservation groups and private citizens on matters related to bird conservation.
3. Facilitate communication throughout the bird conservation community in North Carolina.
4. Coordinate the development and dissemination of informational materials to help create and improve awareness about the status and needs of migratory birds for citizens and natural resource professionals.
5. Foster participation amongst natural resource professionals, volunteers, agencies, non-governmental organizations, academia and private industries to implement bird survey, monitoring, research, and conservation programs.

A. Activity

A major goal of the NC Partners in Flight (NC PIF) Program is to help maintain or increase populations of migratory birds throughout the state and region through increased communication, cooperation, and collaboration via voluntary, creative partnerships. The NC PIF Biologist is charged with coordinating all Partners in Flight activities in the state for the Wildlife Resources Commission.

After having been vacant for 2 years, a new NC PIF Biologist was hired to re-start this initiative in September 2010. Much of the grant period was spent developing resources to facilitate communication, re-forging connections with the bird conservation community and coordinating meetings designed to bring conservation professionals together.

Beginning in June 2011, the NC PIF Biologist implemented a monthly newsletter designed to disseminate information among the current 173 subscribers representing 2 private companies, 4 local land trusts, 17 universities, 7 non-governmental organizations, and 16 local state and federal government agencies (3). NC PIF participants are encouraged to submit material for inclusion. During the grant period, 5 newsletters were distributed containing a total of 51

articles. Examples of articles include recent and relevant peer-reviewed papers, upcoming bird-related meetings and events, and new tools for bird conservation.

To further enhance the amount and accessibility of information (3), a new NCPIF website was developed (http://www.ncpartnersinflight.org). The website is designed to not only disseminate information and recommendations for bird conservation, but also provide an easy way to relate this information to the 2005 NC Wildlife Action Plan. The website displays all information the terrestrial habitat sections of the Plan connecting priority bird species accounts, priority habitats, and research priorities. These data are linked to organizations, individual researchers, and current research projects, creating clear connections between the current state of knowledge and bird conservation practitioners. While many species accounts contain information generated from previous NC PIF efforts, they are also augmented with images, ecology and life history, management recommendations, and conservation status from other sources of information (NatureServe, Encyclopedia of Life, and the Integrated Taxonomic Information System). As new projects and individual researchers are added, we hope to enhance awareness and coordination of research projects occurring in the state and their relationship to the priorities identified in the Wildlife Action Plan.

In March 2011, the NC PIF Biologist attended the Annual Southeast Partners in Flight (SE PIF) Meeting in Lexington, Kentucky as a representative on the SE PIF steering committee. SE PIF is a focal point for bird conservation in the region from Kentucky to Texas. In addition to reporting back results to the NC bird conservation community, it was decided the upcoming 2012 SE PIF meeting will be held in Raleigh, NC. During this grant period, the NC PIF Biologist and other staff spent a significant amount of time planning for the 2012 meeting, to take place February 6-9. Focused on "Conserving Birds in a Changing Environment", the meeting will bring together researchers working on issues related to urbanization, alternative/renewable energy, and fire suppression and provide an opportunity to highlight North Carolina bird conservation efforts to the regional community.

On March 30, 2011, the first NC PIF meeting in 3 years was held at Umstead State Park and attended by over 30 professionals representing a diverse set of agencies and organizations (1,3,5). Attendees watched presentations on topics such as: the NC Heritage Program species guild designations for biodiversity protection, introduction to the South Atlantic Landscape Conservation Cooperative, an update on the NC Wildlife Action Plan revision, and the effects of lead shot at mourning dove hunting locations. Future biannual meetings such as this are scheduled at different locations across the state to encourage greater participation.

The NC PIF effort has a long and successful history with the Forest Landbird Legacy Program (FLLP). This partnership between the US Fish & Wildlife Service, National Resources Conservation Service, and the NC Wildlife Resources Commission provided cost-share funds to landowners for habitat management focused on mature forest habitat. The FLLP ended September 30, 2011. The NC PIF Biologist assisted other staff in performing final review visits to the properties of two recent program participants during the grant period. The NC PIF Biologist worked with US Fish & Wildlife Service Partners for Fish and Wildlife staff to wrap up FLLP program funds by installing camera-enabled Eastern Bluebird nest boxes at certain sites across the state; a project designed to increase awareness of migratory bird natural history (2,4).

The NC PIF Biologist and other staff reviewed the final re-evaluation of endangered, threatened, and special concern status listings for birds in North Carolina from the Scientific Council on Birds. Staff input will be evaluated by the Commission when making recommendations for status changes for bird species.

During the grant period, the assisted with bird banding for 3 days at Prairie Ridge Ecostation in cooperation with the NC Museum of Natural Sciences, and for 2 days at Sandy Ridge State Natural Area in cooperation with NC State Parks. Staff also participated in the nationally-organized bird survey projects Breeding Bird Survey and US Nightjar Survey.

In support of bird conservation partnerships, the NC PIF Biologist facilitated 6 North Carolina Birding Trail (NCBT) Steering Committee meetings during the grant period (1,3). In addition, he provided logistical assistance to the committee on several initiatives including soliciting nominations to expand the number of sites on the NCBT and development of a project to evaluate attendance of bird enthusiasts at NCBT sites.

B. Target Dates for Achievement and Accomplishment

Implementation of this State Wildlife Grant project will continue to facilitate coordination, collaboration, and cooperation within the bird conservation community, all of which are on schedule and on track. In the future, the NC PIF biologist will focus on more technical guidance opportunities.

C. Significant Deviations

None

D. Remarks

None

E. Recommendations

Partners in Flight coordination and communication should continue to be nurtured amongst the numerous bird conservation organizations across North Carolina.

F. Estimated Cost

$39,004 (including in-kind contributions)

G. References

North Carolina Wildlife Resources Commission. 2005. *North Carolina Wildlife Action Plan*. Raleigh, NC.

Prepared By: Scott Anderson, Bird Conservation Biologist
Division of Wildlife Management

Annual Performance Report

State: North Carolina **Grant Number:** T-13-L

Period Covered: October 1, 2010 – September 30, 2011

Grant Title: North Carolina State Wildlife Grants 2009

Project Title: NC Wildlife Action Plan Land Conservation

Objective:

The primary objective will be to acquire Wildlife Action Plan (NCWAP) priority habitat tracts identified by conservation partners that contain NCWAP priority habitats and associated species of greatest conservation need. Specifically this project will:

1. Contribute funding towards acquisitions and/or easements on high Priority Wildlife Action Plan tracts approved by USFWS (including acquisition and other costs of protection activities).
2. Leverage grant funding in support of these activities.

A. Activity

The staff of the North Carolina Wildlife Resources Commission began to develop a list of potential properties for consideration under this grant in October 2011. Initial discussions involved personnel in both the Wildlife Management and Inland Fisheries Divisions who were familiar with the NC Wildlife Action Plan land acquisition priorities as well as the constraints of this grant. The initial list included roughly 20 properties with which Commission staff were familiar that possessed requisite characteristics. Subsequently, the list has been modified numerous times based upon new information about those properties and other properties of which we have been made aware through various means. The potential properties list now contains 28 properties.

Beginning in the spring of 2011, we began a series of meetings and other communications with our conservation partners including the North Carolina Natural Heritage Program (NHP) staff, and the staffs of numerous land trusts across North Carolina. In those meetings and discussions, our aim was to solicit input on those and other high priority NC WAP properties and explore with them the potential for leveraging resources in pursuit of acquisitions. To date we have received input from 7 land trusts, NHP, and several other organizations. The result of all of the internal and external communications is a dynamic, yet prioritized list that we now have to begin the various processes towards acquisition.

The land acquisition process for North Carolina state government agencies is complex and protracted. It requires multiple approvals from multiple agencies as well as branches of

government. The initial step that is required by the North Carolina Wildlife Resources Commission (Commission) is a formal approval by that board to initiate discussions with a landowner that may or may not lead to state acquisition. We have secured permission from the Commission to begin discussion and development of project proposals for 5 of the top priorities on the T-13 potential properties list and 4 others are awaiting Commission action in the near future. That means that staff members have been assigned to begin drafting project proposals for those 5-9 properties with expected drafts in January 2012. As soon as the draft proposals are prepared they will be submitted for consideration by the Service under the terms of this grant.

B. Target Dates for Achievement and Accomplishment

The North Carolina budget and political considerations have delayed progress on this grant. For several months, all land acquisition activities were suspended and the Commission would not consider granting approval to pursue properties. We have seen a very slow turnaround in that situation and as 2011 draws to a close we anticipate more flexibility to return to the process.

C. Significant Deviations

The only deviation within the grant is the slow progress that we've made getting to the point of authorization to pursue acquisitions. Development of the priority list and communications with our partners regarding potential properties proceeded according to schedule and we do have a prioritized list of properties to pursue as the next year of the grant unfolds.

D. Remarks

We anticipate submission of several project proposals early in 2012 for the Service's review. Our land trust and other partners stand ready to proceed with development of all necessary proposal documentation, and despite the slow pace thus far, we continue to be optimistic that we can fulfill the project goals within the grant period.

E. Recommendations

None at this time.

F. Estimated Cost

As yet there have been no acquisition costs associated with this grant.

Prepared by: Chris McGrath
Division of Wildlife Management

Interim Performance Report

State: North Carolina **Project No:** U2-1-R

Period Covered: July 1, 2010 – June 30, 2011

Grant Title: A coordinated response to a deadly, emerging threat: White Nose Syndrome in bats

Project Title: Competitive SWG – WNS and North Carolina Bats

Objective:

1. To coordinate, implement, and revise the NC White Nose Syndrome Surveillance and Response Plan.
2. To participate in White Nose Syndrome (WNS) related meetings in order to share and gather the most recent information.
3. To conduct surveillance for WNS throughout the year in North Carolina.
4. To assess population status of common and priority bat species, both pre-WNS and post-WNS through year-round monitoring efforts.
5. To provide technical guidance and communicate information to partners, stakeholders, and the public about bats, their habitats, and WNS.
6. To assist in collection of samples and data for WNS research projects.

A. Activity:

We conducted bat hibernacula surveys and surveillance for White Nose Syndrome (WNS) at 12 caves and/or mines in 6 counties in western North Carolina. We also visited an additional 12 sites in 5 counties in late winter/early spring to do WNS Surveillance. By the end of winter/spring 2011, 4 counties in NC had been determined positive for WNS (Avery, Yancey, McDowell, Transylvania), with an additional county considered "suspect" (Buncombe). Programmatic procedures were developed to properly respond to reports of WNS from the public. Staff consulted with the State Laboratory of Veterinary Health to coordinate WNS testing of bats submitted for rabies testing.

As of June 30, 2011, surveys had been conducted at 4 mist-net monitoring sites in 3 counties, resulting in the capture of 7 species (*Myotis septentrionalis, Myotis lucifugus, Eptesicus fuscus, Lasiurus borealis, Lasiurus cinereus*, *Myotis leibii*, and *Perimyotis subflavus*) with a total of 145 bats captured. A contractor was hired to conduct mist-net monitoring at an additional 10 sites with results pending. We acquired tissue samples for research purposes whenever possible during mist-netting.

From May-June 2011, the North Carolina Bat Acoustic Monitoring Program (NCBAMP) was coordinated utilizing Competitive SWG funds. In conjunction with NCBAMP partners, we hosted a training session for all volunteers involved in NCBAMP. At this training, volunteers were briefed on the program objectives, the specific protocols for running routes, the protocol for checking out equipment, as well as how to operate the Anabat equipment. Twenty-five routes

were each run twice during the June 1 – July 15 period. A preliminary general analysis of the 2011 data from NCBAMP yielded a total of 15,233 Anabat sound files, with 3,100 of those being actual bat call files. Of those 3,100 bat call files, 1,169 of those were identified to a tree bat species and 1,221 were identified to a cave hibernating species of bat. An additional 710 call files were categorized as "unknown species."

We began revising North Carolina's White Nose Syndrome Surveillance and Response Plan, attended professional meetings (e.g. WNS Symposium) and helped coordinate the Southeastern Bat Diversity Network (SBDN) bat blitz in NC, provided information for press releases, communicated with partners about WNS, and provided technical guidance regarding bats, WNS, and regulations pertaining to bats.

B. Target Dates for Achievement:

On schedule.

C. Significant Deviations:

Coordination and participation in the SBDN bat blitz cost a considerable amount in equipment, supplies, and labor due to compliance with protocols in the WNS Surveillance and Response Plan.

D. Remarks:

None.

E. Recommendations:

Monitoring efforts need to be evaluated in order to streamline bat monitoring.

F. Estimated Cost:

$65,191 (including in-kind volunteer time)

Prepared By: Gabrielle J. Graeter
Wildlife Diversity Biologist
NC Wildlife Resources Commission

Annual Performance Report

State: North Carolina **Project Number:** E-16HM-4

Period Covered: July 9, 2010 - June 30, 2011

Grant Title: North Carolina Terrestrial Endangered Species

Project Title: Sea Turtle Nest Surveys, Status, Management and Protection in North Carolina

Objectives:

1. To conduct sea turtle nesting surveys and to carry out sea turtle and nest protection measures in compliance with the Endangered Species Act.

A. Activity

Coordination:
The Coastal Wildlife Diversity Supervisor for the North Carolina Wildlife Resources Commission supervises and assists the Sea Turtle Project Biologist in managing the State's Sea Turtle Protection Program. The Biologist is responsible for overseeing statewide sea turtle nest monitoring projects, training agency staff and volunteers on nest management techniques, coordinating rehabilitation and release of sick or injured sea turtles in North Carolina, collecting nesting data from beach project coordinators, and serving as Coordinator for the North Carolina Sea Turtle Stranding and Salvage Network (NCSTSSN). Coordination of activities associated with nesting is directed toward standardizing management techniques and data collection (including training in field-based techniques), compiling nesting data and reporting results. Additionally, activities associated with sand management and beach reconstruction activities during and outside the nesting season require coordination with sea turtle volunteers, beachfront property owners, town officials, NC Division of Coastal Management, NC Division of Parks and Recreation, US Army Corps of Engineers, US National Park Service and US Fish & Wildlife Service to ensure that these activities do not result in the take of viable nests or hatchlings. The Sea Turtle Project Biologist spends a considerable amount of time addressing environmental concerns as they relate to sea turtles, including reviewing Endangered Species Permit applications and a growing number of environmental impact documents.

Nest Surveys and Protection:
In 2010, 22 sea turtle nest monitoring and protection projects were active in North Carolina (Table 1). These projects varied in intensity from simply counting turtle crawls to full-scale night-time monitoring and management.

B. Target Dates for Achievement and Accomplishment

All planned activities are on schedule.

C. Significant Deviations

There were no significant deviations.

D. Remarks

Coordination:
The Wildlife Resources Commission is responsible for issuing Endangered Species Permits to other agencies and volunteers involved with the State Sea Turtle Protection Program. In 2010, 86 sea turtle permits were issued to volunteer coordinators, cooperators and researchers for the collection of sea turtle nesting and stranding data, as well as for obtaining or receiving biological samples for research purposes. Also, more than 600 additional individuals who operated under umbrella beach project permits contributed significantly to sea turtle management efforts.

Nest Surveys and Protection:
During the 2010 nesting season, there were 1615 sea turtle crawls observed on ocean-facing beaches in North Carolina. Of these, 881 were sea turtle nests (847 laid by loggerheads, 18 laid by green turtles, two laid by leatherbacks, two laid by Kemp's ridley turtles, and 12 laid by an unidentified species – see Table 1), and the remainder were non-nesting emergences (also referred to as "false crawls"). It is likely that some nests and false crawls were not observed by volunteers or collaborators patrolling the beaches, although the actual number is impossible to quantify. The observed nesting total of 847 loggerhead nests is higher than the state average (718 nests/yr), based on the previous 15 years, but annual fluctuation in reproductive activity of sea turtles is common (Figure 1). Note that areas on Brown's Island in Camp Lejuene Marine Corps Base and the southern half of Masonboro Island were not regularly monitored for nesting activity, although the total beach length of these areas is <10 miles (or <3% of the entire ocean coastline of NC). Similarly, Lea-Hutaff Island (~4 miles) is not monitored daily, although there is regular observer effort several times a week during the nesting season.

A primary objective of the Sea Turtle Project is to allow as many nests as possible to incubate successfully *in situ*. On occasion it is necessary to relocate nests that are laid in areas prone to erosion. In 2010, 249 loggerhead nests (29.4%), 3 green turtle nests (16.7%), 1 leatherback nest (50%) and 1 Kemp's ridley nest (50%) were judged to have been laid in a threatened area and were relocated to a more secure location on the same beach. For loggerheads, the mean hatchling emergence success rates of relocated nests (70.0% ±30.3SD, n=249) and *in situ* nests (56.6% ±37.9 SD, n=581) were significantly different ($p<0.02$, two-tailed Mann Whitney non-parametric test, data transformed using the arcsin function). The lower emergence success of *in-situ* nests was likely related to the passage of Hurricane Earl near North Carolina in August 2010, which created heavy surf that inundated or eroded incubating clutches of eggs, in addition to mammalian predation associated with islands such as Masonboro and Lea-Hutaff, where nearly all nests remain *in situ*. Emergence success for green turtle nests was 23.5% ±35.0 SD (n=18), for leatherback nests was 84.6% (n=2), and for Kemp's ridleys was 38.6% (n=2). Total hatchlings produced in sea turtle nests in North Carolina in 2010 was 63,856. Mean clutch size for nests was based on relocated nests only, with no prior egg predation. Mean clutch size for loggerhead nests was 110 eggs (range: 19-181); for green turtles, mean clutch size was 111 eggs (range: 74-153); for leatherbacks, clutch size was 70; for Kemp's ridley turtles, clutch size was 105 eggs.

Supplementary research:
Post-Nesting Telemetry: The nest monitoring project infrastructure and volunteer network facilitated the deployment of six satellite tags on nesting female loggerhead turtles on Bogue Banks, Bear Island, and Topsail Island during the 2010 nesting season. The most striking

observation from this project was of one female that migrated south, around Peninsular Florida and settled in her foraging area near Tampa Bay. This was the first time that a post-nesting female loggerhead from North Carolina was observed migrating into the Gulf of Mexico. Full maps of the migratory routes and foraging areas of the turtles are available at: http://www.seaturtle.org/tracking/index.shtml?project_id=517.

Genetic Mark Recapture: The nearly complete daily monitoring for freshly laid nests by the project volunteers and collaborators facilitated the collection of fresh eggshell samples for an ongoing genetic mark-recapture research project in collaboration with the projects in Georgia and South Carolina. Although all samples from 2010 have not been fully analyzed, preliminary results reveal that there were 256 different female loggerheads nesting in NC in 2010, the mean clutch frequency per female was 3.1 (maximum = 6 clutches laid by one female), and that there was variation in nesting beach fidelity, with some females nesting repeatedly on the same island for the whole season, while others placed clutches on different island, even in different states, during 2010. More information on this project can be found here: http://www.seaturtle.org/nestdb/genetics.shtml?program=1.

E. Recommendations

Monitoring and protection of sea turtle nests in North Carolina is vital to sea turtle conservation efforts in the SE USA, and annual nesting data are needed for comparison with the recovery criteria of the 2009 US Recovery Plan for the Loggerhead Turtles in the NW Atlantic. It is recommended that nest monitoring and protection continue indefinitely in North Carolina. In 2010, great efforts were made to meet the challenges of ensuring standardized management and data recording techniques employed by the diverse number of volunteers and participants in the Sea Turtle Project. The reduced rate of nest relocation, relative to historic levels, is an indication of consistency of management approach across the state. A major concern continues to be the ongoing human development of the coast. As more ocean-front areas are developed, the amount of suitable sea turtle nesting habitat concomitantly decreases. As such, it is imperative that coastal communities take a greater role in ameliorating the negative impacts that beach nourishment, artificial lighting, sand fencing, beach bull-dozing and other human activities commonly associated with developed beaches may have on sea turtle reproductive success. In order to achieve this goal, the project biologist must be able to work year round with the communities, as well as with other state and federal regulatory agencies, to facilitate the protection of turtle nests and nesting habitat on all ocean beaches. Lastly, it is important to fill the vacant position of the Assistant Sea Turtle Project Biologist in order to continue our coordination efforts with other organizations and agencies, and to better manage our sea turtle resources.

F. Estimated Cost

$192,604 (including in-kind contributions)

Prepared By: Matthew H. Godfrey - Sea Turtle Project Biologist

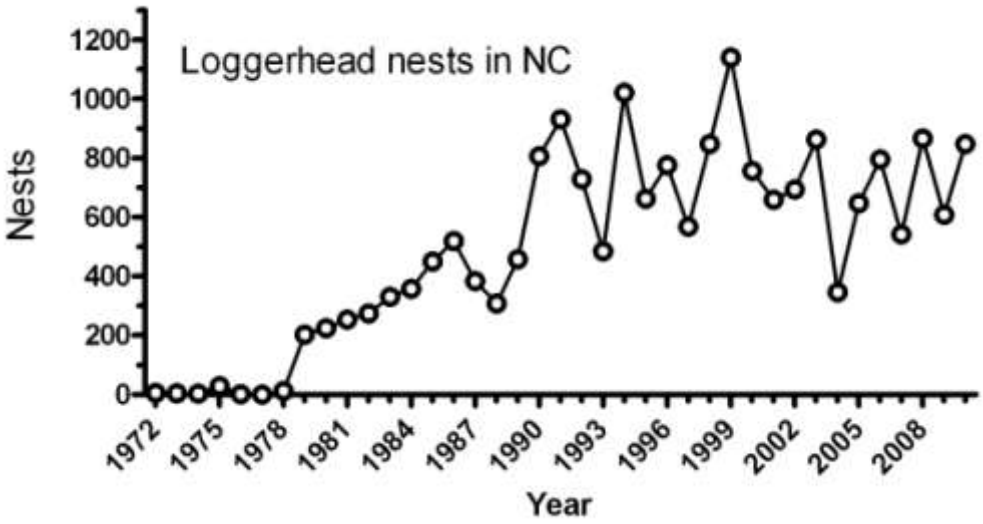


Figure 1: Annual loggerhead nests laid in North Carolina, 1972-2010. Statewide standardized monitoring for sea turtle nesting was established in the mid-1990s.

PROJECT	Loggerhead	Green	Leatherback	Kemp's ridley	UNK
NORTH OF NAGS HEAD	8	0	0	1	0
PEA ISLAND NWR	11	2	0	0	0
CAPE HATTERAS NS	147	6	0	0	0
CAPE LOOKOUT NS	153	4	0	0	0
FORT MACON SP	5	0	0	0	0
BOGUE BANKS	47	2	0	0	0
HAMMOCKS BEACH SP	18	1	0	0	0
CAMP LEJEUNE MCB	47	0	0	0	0
TOPSAIL ISLAND	104	0	0	0	0
LEA-HUTAFF ISLANDS	10	0	0	0	1
FIGURE 8 ISLAND	13	0	0	1	0
WRIGHTSVILLE BEACH	1	0	0	0	0
MASONBORO ISLAND	17	0	0	0	9
CAROLINA BEACH	1	0	0	0	0
KURE BEACH	11	0	0	0	0
FORT FISHER SRA	28	0	0	0	0
BALD HEAD ISLAND	72	2	1	0	0
CASWELL BEACH	47	0	0	0	2
OAK ISLAND	57	0	0	0	0
HOLDEN BEACH	27	1	1	0	0
OCEAN ISLE BEACH	17	0	0	0	0
SUNSET BEACH	6	0	0	0	0
TOTAL	**847**	**18**	**2**	**2**	**12**

Table 1. Observed sea turtle nests laid on beaches in North Carolina, May-October 2010.

Annual Performance Report

State: North Carolina **Project Number:** E-16-HM-4

Period Covered: July 9, 2010 – June 30, 2011

Grant Title: North Carolina Terrestrial Endangered Species

Project Title: Landscape and Conservation Genetics of the Northern Flying Squirrel

Objectives:

The objective of this project is to determine levels of genetic variability for the northern flying squirrel (*Glaucomys sabrinus*). It will assess how the genetic variability is distributed across the landscape. Between 5 and 8 nuclear loci will be analyzed using microsatellites.

A. Activity

The staff of the North Carolina Wildlife Resources Commission (NCWRC) collaborated with Brian Arbogast and Katelyn Shumaker of the University of North Carolina-Wilmington (UNC-W). NCWRC collected blood samples from northern flying squirrels in western North Carolina, using State Wildlife Grant funding. Samples were analyzed at UNC-W.

B. Target Dates for Achievement and Accomplishment

Initiation of contract negotiations between NCWRC and UNC-W were significantly delayed. An agreement with UNC-W was pursued but not completed within the time frame of the grant. Samples were collected and provided to UNC-W; however, the results of the analysis have not been completed or yet supplied.

C. Significant Deviations

Because of late initiation of contract arrangements for genetic analysis, we do not currently have results. However, we understand that the analyses will be completed even in the absence of the specific contract. We anticipate learning the results of samples analyzed thus far through publication of reports/theses within a year.

D. Remarks

Genetics samples are being processed by UNC-W under other funding sources, and we anticipate learning the results in the near future.

E. Estimated Cost $266

Prepared By: Chris Kelly, Mountain Wildlife Diversity Biologist
North Carolina Wildlife Resources Commission

Annual Performance Report

State: North Carolina **Project Number:** E-16HM-4

Period Covered: July 9, 2010 – June 30, 2011

Grant Title: North Carolina Terrestrial Endangered Species

Project Title: Northern Flying Squirrel Acoustic Survey

Objectives:

The main goal of this project is to evaluate the usefulness of bat detectors as a survey technique for Carolina northern flying squirrels (CNFS). Objectives to accomplish this goal included:

- Obtaining audio recordings in the field for analysis.
- Determining an effective "trap" array of acoustic equipment for detecting flying squirrel vocalizations.
- Compare the acoustic survey results with other methods, such as concurrent nest box checks or other means.

A. Activity

This year's activities consisted of acquiring and field-testing acoustic equipment. Equipment purchased included two Pettersson D240X ultrasound detectors, two iRiver IFP mp3 line-in recorders, one iRiver E100 mp3 line-in recorder, audio cables, batteries, SonoBat™ 2.9.5 Suite software license, GoldWave® Digital Audio Editor v5.58 software license, an external hard drive for storing audio files, and materials for constructing rainproof containers for housing audio equipment in the field. Borrowed equipment consisted of four Pettersson D240X ultrasound detectors, two iRiver IFP mp3 line-in recorders, and one H2 Zoom mp3 recorder. Recorders were strapped onto or near potential den trees in habitat with relatively open mid-stories to enhance audio recordings. Sites were sampled for one to three nights. Field recordings were processed with GoldWave® Digital Audio Editor v5.58 and all ".mp3" files having calls were saved as ".wav" files for analyzing with SonoBat™ 2.9.5 Suite.

Flying squirrel vocalizations were recorded in the field in order to add to the collection of "wild calls", compare those to Auburn University's captive call library, test trap arrays, and compare survey methods. As such, surveys were conducted under the following two scenarios to address the objectives, with the ensuing results:

Scenario1. Sample in areas where CNFS is known to occur (based on nest boxes) or not known to occur.

Sampling took place in two Geographic Recovery Areas (GRAs) (Black-Craggies and Great Balsams). NCWRC's nest box database was queried to establish *a priori* knowledge of the flying squirrel species occupying potential acoustic sampling sites. Thirty-eight sampling sites

were in areas where CNFS were known to occur at the exact sampling location or within ½ mile, and seven sampling sites were in areas where CNFS occurrence was unknown (Black Balsam parking area). A total of 54 "trap" nights resulted in 27 "captures" of CNFS (i.e., presence confirmed by recording of a vocalization), comprised of 125 audio (.mp3) files of vocalizations (Table 1). Southern flying squirrels (SFSQ) were recorded in areas of overlap.

Nest boxes were checked for occupancy at several sampling sites on the eve of actual acoustic recording. Unfortunately, this did not provide much insight, since all but one of the boxes checked were unoccupied. The time frame for acoustic sampling (Spring-Fall) corresponds with the seasons when nest box use by CNFS is lowest.

Table 1. Survey effort (trap nights) and captures (audio recordings) of two flying squirrel species in western NC.

	"Trap" Nights[a]	**"Captures"[b]**	**# Files with squirrel calls[c]**
CNFS	54	27	125
SFSQ	10	6	220

[a] "Trap" nights refer to the number of recording units operating overnight.
[b] "Captures" refer to the number of recoding nights that resulted in recording of a confirmed CNFS (or SFSQ) vocalization. This may consist of one or many files of squirrel vocalizations (next column).
[c] # Files refers to the number of 17-second long ".mp3" files per recorder. Only one file with a recording of a squirrel vocalization was required to establish presence; however, multiple files were recorded in many cases.

Scenario 2. Sample using different arrays of survey equipment.

Recorders were set up at nest boxes of known occupancy history (ten years of sampling in the Black-Craggy Mountains and 14 years of sampling in the Great Balsams). Direct comparisons between acoustics and concurrent nest box checks could not be made, given low occupancy of boxes during acoustic sampling (as noted in 2, above). However, knowledge of a nest box's occupancy history since the initiation of the nest box program afforded an opportunity for indirect comparisons with acoustics, by comparing the proportion of visits (annual checks) when a box was occupied versus the proportion of trap nights at the same location that resulted in successful recording of CNFS vocalization(s). Acoustic sampling confirmed presence better than nest box surveys at boxes with a history of captures and even documented CNFS at boxes where CNFS have never been captured but habitat appeared to be high quality (Table 2).

Occupancy was confirmed in a single night of acoustic sampling at 47% of sampling sites where CNFS were known to occur. Some locations were surveyed repeatedly (for two nights, not necessarily consecutive), generating preliminary detection histories for acoustic equipment (Table 3). 88% of repeated surveys in known CNFS-occupied areas detected CNFS within two trap nights.

Given limited sets of equipment, greater effort was directed into obtaining as many wild calls from individual squirrels as possible (by spacing recorders widely), with less effort put into testing equipment arrays (e.g., side by side recorders, distance bands between recorders, etc). Five types of calls that correspond to common calls in the Auburn University call library were documented and analyzed, including "short call", "long call", "upsweep call", "juvenile song",

and “trill”. In addition, three types of calls not well represented in the CNFS call library were recorded at sites occupied exclusively by CNFS. These calls included “hoot/roar”, “bugle”, and “bark”. Several files contained a series of multiple short calls, short and upsweep calls, or counter-calling between two or more individuals. The “short call” was the most common vocalization for CNFS (n=83 short calls); the “descending call” was the most common for SFSQ.

Midway through the project, wrist watches, programmed to beep on the hour, were placed in each box with recorders in order to establish approximate time of vocalizations. CNFS were most vocal in the middle of the night, between 11PM and 3AM.

Table 2. Mean proportion of visits confirming CNFS presence for two survey methods, nest boxes and acoustics.

	At box with history of captures[b] n=18 sites		**At box with no history of captures[c] n=9 sites**	
	Nest box annual check	Acoustic trap night	Nest box annual check	Acoustic trap night
Proportion of visits[a] CNFS confirmed	X=0.218 (SE=0.03)	X=0.639 (SE=0.10)	X=0.00 (SE=0.00)	X=0.667 (SE=0.14)

[a] Visits = annual nest box check over the past 10 or 14 years, or acoustic trap night over 1-2 nights in 2010-2011.
[b] Boxes with CNFS captured at least once in ten years (Black-Craggies) or fourteen years (Great Balsams).
[c] Boxes with zero CNFS captured in ten years (Black-Craggies) or fourteen years (Great Balsams).

Table 3. Capture histories at sites surveyed repeatedly (two nights) with acoustics.

Location	**Capture History[a]**
Bearpen Gap Service Road box 2	0,0
Bearpen Gap Service Road box 6	0,1
Bearpen Gap Service Road box 8	0,1
Bald Knob box 1	0,1
Bald Knob box 4	0,1
Bald Knob box 7	0,1
Buncombe Horse box 6	1,1
Buncombe Horse box 10	0,1

[a] 0 = no CNFS detected, 1= CNFS detected. “,” separates visits (trap nights)

B. Target Dates for Achievement and Accomplishment

On schedule.

C. Significant Deviations

None.

D. Remarks

Acoustic sampling shows promise as a rapid survey technique, with preliminary surveys confirming CNFS presence in an average of two nights of surveys (i.e., two trap nights). In comparison, Weigl et al (1992) reported that live-trapping with Tomahawk traps resulted in an average of 80 trap nights per capture in western North Carolina and nest boxes have entailed several years of annual checks to initially confirm presence. In terms of capture or detection success, acoustics (47%) greatly outperformed live-trapping (~2% for Weigl) and nest box checks (~8-11% in recent years). Furthermore, acoustics succeeded in documenting presence in locations with no prior history of captures from nest boxes, despite high quality habitat. CNFS vocalizations were confirmed at 63% of occupied spruce/fir-northern hardwood sites and 66% of occupied northern hardwood sites, where habitat was classified visually. In comparison, nest box surveys in the Black Mountains confirmed CNFS presence at 73% of predicted spruce sites and 66% of predicted northern hardwood sites (McGrath 2003).

A large part of this year's effort was directed at fine-tuning acoustic survey equipment. Side by side comparisons of three different models of recorders, each paired with a D240X, demonstrated greater success in obtaining recordings using the iRiver IFP and iRiver E100 mp3 recorders than the H2 Zoom mp3 recorder, which often missed calls. This may be correctable by adjusting the unit's settings. Post-processing of audio files was significantly more efficient with the iRiver IFP's 17-second-long individual files than the H2 Zoom or iRiver E100's continuous 5+ hour ".mp3" file. However, the iRiver IFP is no longer manufactured.

E. Recommendations

- Track and record radio-transmittered squirrels (i.e., known individuals). Obtain greater documentation of unfamiliar calls.
- Conduct more repeat sampling and side by side recorder sampling to fine tune detection rates and trap arrays.
- Compare Pettersson with Anabat and further fine-tune acoustic survey equipment, including mp3 recorder needs.
- With guidance from upcoming collaborative studies with university partners, develop a survey protocol for acoustics and a long-term monitoring plan (acoustics and/or nest boxes).

F. Estimated Cost

$ 4,582 (Including In-Kind contributions)

G. References

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Prepared By: Chris Kelly, Mountain Wildlife Diversity Biologist
Division of Wildlife Management

Annual Performance Report

State: North Carolina **Project Number:** E-16HM-4

Period Covered: July 9, 2010 – June 30, 2011

Grant Title: North Carolina Terrestrial Endangered Species

Project Title: Northern Saw-whet Owl Breeding in Northern Hardwood Forests

Objectives:

- Determine the number of NSWO territories on Big Bald Mountain and measure the habitat characteristics
- Determine number of breeding NSWO using Big Bald Mountain habitat
- Locate active nesting sites of NSWO through radio tracking and habitat searches
- Determine number, age and sex of NSWO using the site during autumn post-breeding dispersal and migration

A. Activity

Southern Appalachian Raptor Research conducted a multi-method study of NSWO's use of northern hardwood forest on Big Bald, using live-capture, banding, radio-telemetry, audio lures/listening surveys, and nest boxes. Due to the secretive nature of the owl and general lack of information on the specie's dispersal habits, surveys were conducted year-round to determine arrival on these potential breeding grounds and post-breeding season dispersal. A complete report of activities and accomplishments is attached as Appendix A. Funds were used to purchase needed equipment, including: mist nets, banding tool, spring scale, radio transmitters, audio lure components, and head lamps.

B. Target Dates for Achievement and Accomplishment

On schedule.

C. Significant Deviations

None

D. Remarks

Thus far, radio tracking, captures of banded individuals, and listening surveys have provided information on roost sites, migration, and dispersal, but not nest locations. Population status remains undetermined, since no *active* nests have been located. However, despite lower captures, this year's efforts mount further evidence of possible breeding in the Big Bald area.

It is worth noting that mere days (July 4, 2011) after the grant cycle closed another adult female with a brood patch and three fledglings were captured, banded, and transmittered. SARR will continue to track these four individuals to learn more about post-breeding dispersal and site fidelity and provide NCWRC with the information necessary to improve technical guidance.

E. Recommendations

SARR is now outfitted with equipment needed to continue this study with more listening surveys, live trapping, banding, telemetry, nest searching, habitat assessments, and nest box checks.

F. Estimated Cost

$5,406 (including in-kind contributions).

Prepared By: Chris Kelly
Mountain Wildlife Diversity Biologist
North Carolina Wildlife Resources Commission

Appendix A

Northern Saw-whet Owl Monitoring at Big Bald Mountain, Cherokee National Forest, Unicoi County, Tennessee and Pisgah National Forest, Yancey County, North Carolina

Report for North Carolina Wildlife Resources Commission for the period July 9 – June 30, 2011

Southern Appalachian Raptor Research
PO Box 305, Mars Hill, NC 28754
www.bigbaldbanding.org

Introduction

This report for the period July 9, 2010 – June 30, 2011, includes the sixth autumn that systematic Northern Saw-whet Owl trapping has been conducted at Big Bald Banding Station (BBBS). Northern Saw-whet Owl (NSWO) has been documented at Big Bald through aural surveys since 2001 and by incidental diurnal capture in passerine mist nets since the autumn of 2003. Data gathered at BBBS in 2005 prompted the Cherokee National Forest to install owl nest boxes on the northern flanks of Big Bald Mountain in 2006. In 2010, NSWO monitoring effort expanded to include playback surveys during spring and summer, nocturnal trapping samples during summer and autumn, and the application of radio telemetry for tracking NSWO using the Big Bald Mountain habitat.

Location

Big Bald Banding Station (BBBS) is located high on Little Bald Mountain at 5390 feet above sea level (1643 m), inside the Appalachian Trail corridor in Cherokee National Forest, Unicoi County, Tennessee and Pisgah National Forest, Yancey County, North Carolina. The habitat is an edge ecotone mix of exotic and native grasses surrounded by northern hardwood forest, dominated by American beech (Fagus grandifolia), sugar maple (Acer saccharum), hawthorne (Crataegus spp.), northern red oak (Quercus rubra) and native shrub thickets.

Monitoring Methods

Trapping of NSWO is conducted during appropriate weather windows from sundown to a variable end time during the night. The BBBS passerine banding station, consisting of 16 mist nets in permanent locations, are most often used as traps for migrating owls. During the summer and late autumn, NSWO trapping was conducted in Big Stamp Gap, located 1 kilometer from BBBS. All trapping is done following protocols set by the US Bird Banding Lab and the North American Banding Council. Captured owls are processed in the established manner for small raptors, with age determined from flight feather observations (Pyle, 1997). Gender is determined using the wing-mass data chart developed by David F. Brinker (Project Owlnet, 2005).

Playback call surveys of the NSWO are broadcast as audio lures using a boom-box with MP3 recordings. NSWO calls are broadcast for 2.5 minutes, after which, surveyors listen for response for another 2.5 minutes. The sequence is repeated two times at each of six listening positions within a 3 km area trail around the Big Bald habitat.

Nest box checks are conducted by climbing a ladder to a position that allows safe observation of the box contents. Nest boxes are secured to a tree approximately 7 meters above the forest floor.

Radio transmitters and a radio receiver were procured in 2010 to monitor NSWO movements and evaluate the extent of Big Bald Mountain habitat use by NSWO.

Results

Trapping

Trapping for NSWO was attempted on 21 days during the period July 9, 2010 – June 30, 2011, totaling 295 net hours of effort (Table 1). Ten new NSWO were trapped and banded and three NSWO were recaptured during this period. The recaptures were all banded during the same reporting period at the Big Bald location.

Table 1. Trapping dates, effort and capture results for Northern Saw-whet Owls from July 9, 2010 – June 30, 2011. Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

MONTH	DATE	OPEN	CLOSE	TRAP HOURS	NET HOURS	NEW	RECAP	RETURN
JUL	23	2200	2300	1.5	3.0	0	0	0
JUL	27	2200	0030	2.5	3.75	0	0	0
JUL	30	2130	2230	1.0	3.0	0	0	0
AUG	7	2130	2245	1.25	1.25	0	0	0
AUG	8	2145	2345	2.0	4.0	0	0	0
AUG	10	2130	2300	1.5	3.0	0	0	0
SEP	14	2100	2330	2.5	25.0	3	0	0
SEP	20	2100	2300	2.0	20.0	2	2	0
OCT	18	2030	2200	1.5	25.0	0	1	0
OCT	22	2100	2300	2.0	36.0	1	0	0
NOV	01	0445	0730	2.75	27.5	1	0	0
NOV	29	1800	2000	2.0	8.0	0	0	0
DEC	02	1800	2200	4.0	16.0	0	0	0
DEC	06	1800	2200	4.0	16.0	0	0	0
APR	24	2200	0030	2.5	5.0	0	0	0
MAY	05	2130	0030	3.0	6.0	0	0	0
MAY	09	2100	2400	3.0	12.0	1	0	0
MAY	28	2115	2315	2.0	10.0	0	0	0
MAY	29	2115	2345	2.5	12.5	0	0	0
MAY	30	2130	0500	8.5	42.5	1	0	0
JUN	07	2230	0030	2.0	8.0	1	0	0

NSWO Capture Data

Ten NSWO were trapped during the period July 9, 2010 – June 30, 2011. No NSWO return captures (owls banded in past years) were trapped during this period. Three of the ten new captures were aged as immature (hatch-year) and seven owls were determined to be adults (after hatch-year). The 2010-2011 reporting period is the first in six years of trapping at BBBS that adult NSWO captures outnumber immature NSWO captures. Of the seven adult owls captured, three are male and four are female. Two immature owls were male and the gender of one immature owl was unknown (Table 2).

Table 2. Descriptive banding measurements of Northern Saw-whet Owls for the period July 9, 2010 – June 30, 2011. Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

YEAR	MONTH	DATE	SPP	AGE	SEX	WT	TAIL	HAL	WING	CUL	STATUS
2010	SEP	14	NSWO	HY	M	77	67	7.8	130	15.1	NEW
2010	SEP	14	NSWO	AHY	M	81	68	8.0	130	12.4	NEW
2010	SEP	14	NSWO	AHY	F	105	71	8.6	139	13.5	NEW
2010	SEP	20	NSWO	AHY	F	98	74	8.6	142	14.4	NEW
2010	SEP	20	NSWO	HY	M	80	67	8.2	130	11.8	NEW
2010	OCT	22	NSWO	HY	U	86	68	8.0	131		NEW
2010	NOV	01	NSWO	AHY	F	101	65	8.9	136	12.8	NEW
2011	MAY	09	NSWO	SY	F	105		9.5	139	11.7	NEW
2011	MAY	30	NSWO	AHY	M	79		9.1	129	13.0	NEW
2011	JUN	07	NSWO	AHY	M	75		7.6	127	10.5	NEW

HY=hatch year, AHY=after hatch year, SY=second year, F=female, M=male, U=undetermined, HAL=halux, CUL=culmen

Telemetry

The small sample of NSWO trapped during the period July 9, 2010 – June 30, 2011, provided limited opportunity to gather preliminary data on NSWO movement and territory via radio transmitters. Radio transmitters were deployed on two adult female NSWO trapped on 01-November, 2010 and 09-May, 2011 (Figure 1). The November NSWO roosted in a large rhododendron thicket after release, approximately 2 meters off the forest floor and 75 meters from BBBS on the east side of Little Bald Mountain. The next evening she was located with a distant signal, moving to the west. No other signal was detected despite repeated searches. The May NSWO was tracked after release to a day roost in a rhododendron thicket, within a high-elevation acidic cove forest type approximately 2km distant and ~300 meters lower in elevation than the BBBS trapping location. Searches for her location in the following weeks were unsuccessful. A general location to the east of BBBS was determined following a *Southwings* reconnaissance flight on 08-June, 2011. An exact roost location has not been determined at the time of this report. Minimal data on roost and habitat use have been gathered from these encounters, and valuable experience using our telemetry monitoring equipment has been accrued.

Figure 1. Adult female Northern Saw-whet Owl with radio transmitter attached. November 1st, 2010. Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

Owl Nest Boxes

Eighteen nest boxes on the northern flanks of Little Bald, approximately 1 km from the Big Bald Banding Station, were checked four times during the 2010-2011 reporting period NSWO activity (Table 3). An additional 12 boxes were hung in the Little Bald northern hardwood habitat area in early April and May, 2011. New boxes were constructed and donated by *Mountain Wild*, a local not for profit wildlife organization. New boxes were checked once since their initial placement. No evidence of NSWO nest box use was detected during the period of July 9, 2010 – June 30, 2011. Evidence of nest box use by NSWO has been gathered from two boxes (2008 and 2009) since box distribution in 2006.

Table 3. Northern Saw-whet Owl nest box check dates for July 9, 2010 – June 30, 2011. Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

YEAR	MONTH	DATE	NEST BOX CHECK	NUMBER OF BOXES
2010	JUL	22	NO USE	18
2010	AUG	15	NO USE	18
2011	APR	29	NO USE	18
2011	MAY	30	NO USE	28

Audio surveys

Playback surveys were conducted seven times, during the 2010-2011 reporting period. NSWO were detected by call response two times from February into early May, 2011 (Table 4).

Table 4. Northern Saw-whet Owl Audio Playback survey dates and results for July 9, 2010 – June 30, 2011. Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

YEAR	MONTH	DATE	AUDIO SURVEY	NUMBER OF NSWO
2010	JUL	22	NO RESPONSE	0
2011	FEB	23	NO RESPONSE	0
2011	MAR	17	NO RESPONSE	0
2011	APR	7	NO RESPONSE	0
2011	APR	18	NO RESPONSE	0
2011	MAY	02	RESPONSE	1
2011	MAY	23	RESPONSE	1

Discussion

Thus far, listening surveys, captures of banded individuals, and radio tracking have provided information on habitat use, migration routes and habitat use, and roost sites, but not nest locations. Playback call surveys and trapping conducted in 2010-2011 confirm the presence of NSWO in the Big Bald habitat for ten months (February – November). The capture of six 'return' NSWO, originally banded at Big Bald in previous years, and then recaptured in 2006, 2008 and 2009 respectively, demonstrates site fidelity (Table 5). Return captures also indicate that adult birds remain on territory during the winter months, or return in late spring to use the northern hardwood forest habitat at Big Bald. The capture of immature birds in late summer with a small amount of retained juvenile feathering supports the possibility of resident NSWO nesting in the Big Bald habitat. Probable NSWO eggs, collected post breeding season at two boxes in 2008 and 2009 respectively, also supports the possibility of resident NSWO nesting in the Big Bald northern hardwood forest habitat. An adult female NSWO with an active brood patch was captured on 9 May 2011 and radio-tracked to a lower elevation acidic cove forest location, supporting the use of the bald/hardwood forest habitat by breeding NSWO. Breeding population status remains undetermined, since no *active* nests have been located, warranting more study over the 2012 breeding season.

Table 5. Age and Gender of Northern Saw-whet Owl trapped at Big Bald Banding Station, Cherokee National Forest, Unicoi County, TN and Pisgah National Forest, Yancey County, NC.

YEAR	HY-M	HY-F	HY-U	AHY-U	AHY-M	AHY-F	TOTALS NEW	RETURNS	SY-M	SY-F
2005	5	2	5				12			
2006	1	1	3			3	8	2	2	
2007	3	11	8		1		23			
2008	4	4	3	1	1	1	14	2	1	1
2009	1	4	5	1		1	10	2		2
2010	2		1		1	3	7			
2011*					2	1	3			
TOTALS	**16**	**22**	**25**	**2**	**5**	**9**	**77**	**6**	**3**	**3**

HY=hatch year, AHY=after hatch year, SY=second year, F=female, M=male, U=undetermined, TOTALS NEW=birds banded for the first time, RETURNS= recaptured birds banded in previous years at BBBS
***2011=January to June**

Efforts and Recommendations for the 2011-2012 reporting period:

- Continue to monitor for adult NSWO presence or absence during the early nesting season
- Monitor USFS nest boxes regularly for nesting activity through the breeding season
- Trap spring and summer residents and use radio-tracking to determine habitat use and nesting locations
- Complete habitat parameter measurements
- Continue trapping and banding during the autumn migration season
- Radio track early autumn hatch-year captures to determine dispersal and survivorship
- Develop education materials for the public to raise awareness of the NSWO habitat

Acknowledgments

Northern Saw-whet Owl trapping and monitoring is supported by generous private donations to Southern Appalachian Raptor Research (SARR), a non-profit 501(c)(3). SARR is especially grateful of financial support for the NSWO project from the Tennessee Ornithological Society, the Appalachian Trail Conservancy and the North Carolina Wildlife Resources Commission. Thanks to Lynn Brandon, Kathryn Gunther, Joe McGuiness, Tom McKeig, Tedi McManus, Mark Hopey and other volunteers that assist with owl trapping and monitoring.

The Big Bald Banding Station operates with the cooperation and permission of the US Forest Service and the US Bird Banding Lab. SARR also receives support from the Tennessee Wildlife Resources Agency.

References

Project Owlnet. http://www.projectowlnet.org/df.htm

Pyle, P. 1997. Identification Guide to North American Birds. Part 1. Columbidae to Ploceidae. Slate River Press, Bolinas, CA.

Final Performance Report

State: North Carolina **Grant Number:** E-17-R

Period Covered: July 1, 2010 – June 30, 2011

Grant Title: WNS Grants to States

Project Title: Acoustic Bat Monitoring in North Carolina

Objectives:

1. Set up acoustic survey routes during the non-hibernation period to determine baseline summer bat activity levels and help identify additional important monitoring sites
2. Facilitate development of additional data sets to measure impacts of White Nose Syndrome upon bat populations.
3. Coordinate both within North Carolina and with other national partners to establish a national network of monitoring sites.
4. Solicit and train volunteers to conduct and submit data from acoustic survey routes

A. Activity

The North Carolina Bat Acoustic Monitoring Program (NCBAMP) was successfully launched in western North Carolina in 2011. NCBAMP is a statewide program that monitors bat populations using acoustic bat detectors. North Carolina's program is part of a national effort to monitor the effects of white-nose syndrome and other threats on bat populations. The program is a collaborative effort between the North Carolina Wildlife Resources Commission, U.S. Fish and Wildlife Service (Asheville Office), U.S. Forest Service (Nantahala National Forest and Pisgah National Forest), Bureau of Indian Affairs (Eastern Band of Cherokee Indians), and the National Park Service (Blue Ridge Parkway and the Great Smoky Mountains National Park).

Two Anabat units were purchased in December 2010. A total of 32 acoustic routes were set up in the mountain region of western North Carolina in spring 2011 (Table 1; Figure 1). Each route is 20 miles long and goes through different habitat types and elevations. The start points and the cardinal direction that each route runs were randomly selected. The survey season is from June 1st to July 15th and each route is run twice during that time period. Surveying a route starts one half hour after sunset. Route packets were produced that include maps, driving directions, and proper permits. A volunteer instruction manual was also created to assist volunteers.

Table 1. NCBAMP routes and the counties they cover in western North Carolina (highlighted routes were run twice in 2011. An "*" indicates route was run 3 times)

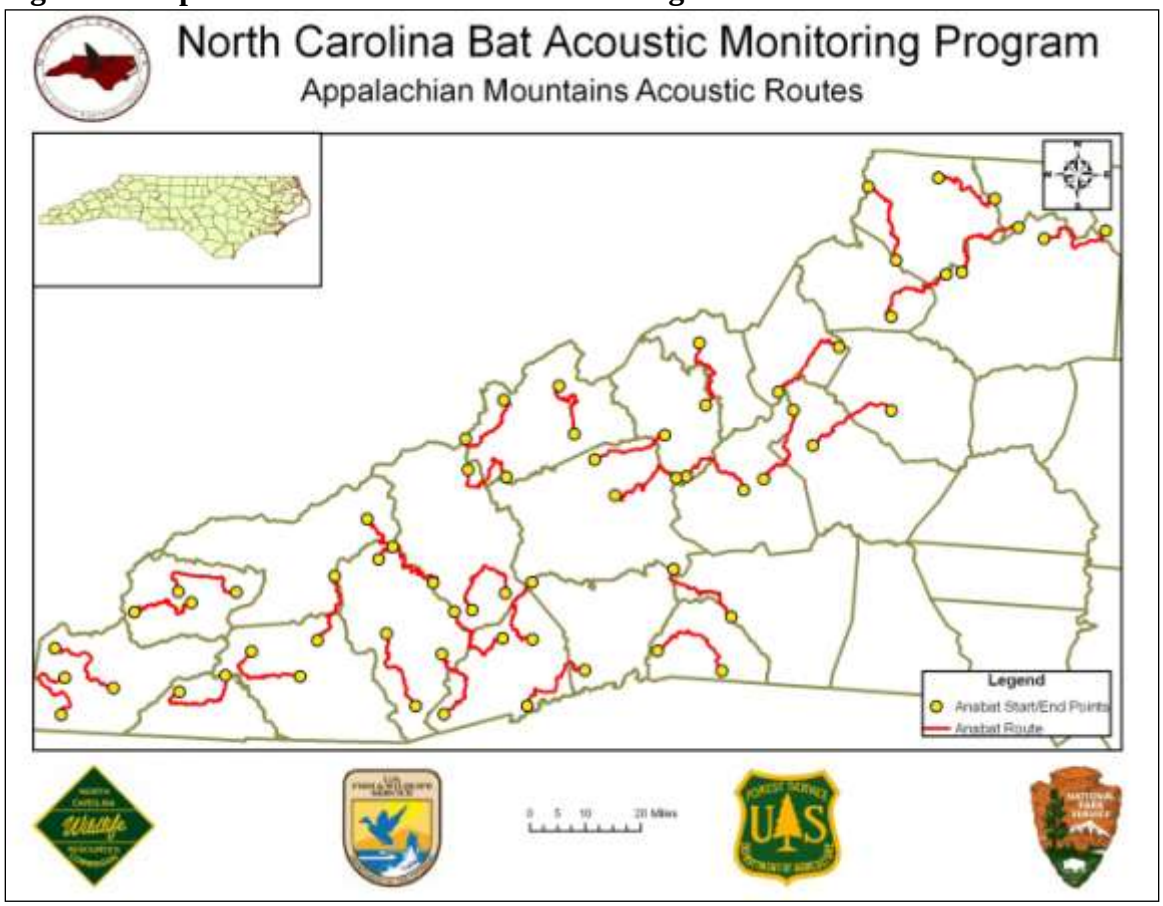
Route Name	County
Abington	Caldwell/Burke
Alarka	Macon/Swain/Jackson
Balsam Mountains *	Transylvania/Haywood/Jackson
Barnardsville	Buncombe/Yancey
Beans Creek	Mitchell/Yancey
Big Laurel	Madison
Cheoah	Graham
Craggy Mountains*	Yancey/Buncombe
Cross Mountain	Wilkes/Ashe/Alleghany
Cullowhee Mountain	Jackson/Macon
Fires Creek*	Cherokee/Clay
Gragg*	Avery/Burke/McDowell
Grandfather	McDowell/Burke
Green River	Polk
Lake Lure	Rutherford/Polk/Henderson/Buncombe
Mabe Dairy*	Alleghany/Ashe
Max Patch	Haywood/Madison
Pisgah	Transylvania/Haywood/Henderson/Buncombe
Plott Balsam	Jackson/Haywood
Sampsons	Ashe/Watauga
Shining Rock	Haywood
Sky Valley	Henderson/Transylvania
South Toe River	Yancey/McDowell
Stone Mountain	Surry/Wilkes/Alleghany
Sunny Point	Cherokee
Three Top Mountain	Watauga/Caldwell
Tuskeegee	Swain/Graham
Tusquitee	Cherokee
Wayah	Macon
Wesley Creek	Haywood/Madison
Whitewater	Transylvania/Jackson
EBCI	Jackson

In addition to setting up the NCBAMP, Wildlife Diversity staff attended a multi-day Anabat training workshop run by Titley Scientific staff (inventor of Anabat). This training proved to be extremely helpful in designing and organizing NCBAMP. The course also trained Wildlife Diversity staff to understand and effectively manage the data.

WNS Grant funds were expended by May 1, 2011. Utilizing a Competitive State Wildlife Grant (SWG), the North Carolina Wildlife Resources Commission, in conjunction with NCBAMP partners, hosted a training session for all volunteers involved in NCBAMP. At this training, volunteers were briefed on the program objectives, the specific protocols for running routes, the protocol for checking out equipment, as well as how to operate the Anabat equipment.

Twenty-five routes were each run twice during the June 1 – July 15 period (Table 1; Figure 1). Five of those 25 routes were also run a third time later in the summer. Seven of the 32 routes were not surveyed because of problems with the equipment that U.S. Forest Service personnel had for their routes.

Figure 1. Map of western North Carolina showing the locations of the 32 NCBAMP routes.



A preliminary general analysis of the 2011 data from NCBAMP yielded a total of 15,233 Anabat sound files, with 3,100 of those being actual bat call files. Of those 3,100 bat call files, 1,169 of those were identified to a tree bat species and 1,221 were identified to a cave hibernating species of bat. An additional 710 call files were categorized as "unknown species." A much more in depth analysis of the call files will be conducted at a later date.

Volunteers were an integral part of the success of this first year of NCBAMP. They surveyed a total of 1,060 miles as part of this program. The future success of this program will depend on Wildlife Diversity staff's ability to retain and train quality dedicated volunteers.

B. Target Dates for Achievement and Accomplishment

On schedule.

C. Significant Deviations

None

D. Remarks

Many methods regularly used to monitor bats have limitations (e.g., low or selective capture rates with mist netting). Thus, there is room for improvement in our ability to detect and monitor bat populations. One way to address this is through the use of a variety of techniques. Research shows that detection and accuracy are often improved when multiple techniques are employed (Robbins et al. 2008). Thus, by launching an acoustic monitoring program for bats we have strengthened our ability to monitor the response of bat populations to WNS and other threats.

The Anabat units may prove to be useful for several other applications. Thus far we have used them to obtain additional data during mist-netting surveys. We are also considering the utility of using it for monitoring winter activity at the entrances of caves and mines. The bat call data have yet to be analyzed from the mist netting sites, but the hope is that this data will supplement the information gathered from mist-netting.

E. Recommendations

We should continue to gather acoustic data that will improve our understanding of bat populations in North Carolina. The NC Bat Acoustic Monitoring Program (NC BAMP) has been successfully incorporated as one of several methods for monitoring bats in western North Carolina, but when feasible, this program should be expanded to the rest of the state. When the computer program that Eric Britzke has designed for automatically identifying bat calls is available, all data collected as part of NC BAMP should be analyzed and the data added to our bat database.

F. Estimated Cost

$23,478

Prepared By: Gabrielle Graeter, Wildlife Diversity Biologist
North Carolina Wildlife Resources Commission

Semi-Annual Progress Report
North Carolina Sea Turtle Stranding and Salvage Network
1 July 2010 – 31 December 2010

A. Grant Number: NA08NMF4720513
B. Amount of Grant: $50,000.00
C. Project Title: North Carolina Sea Turtle Stranding and Salvage Network (STSSN)
D. Grantee: North Carolina Wildlife Resources Commission (NCWRC)
E. Award Period: 1 July 2008 – 30 June 2011
F. Summary of Progress:

Job 1 Title: STSSN Recruitment, Training, and Improved Data Collection and Coverage

1. To enhance and strengthen the overall sea turtle stranding network in North Carolina, the Coordinator and Assistant Coordinator worked towards recruiting more participants and building capacity with respect to post-mortem examinations and sample collection. New recruits in the North Carolina STSSN include employees of various state and federal agencies, students and staff of universities, local town employees, and members of the public.

2. During this reporting period, identification/stranding workshops for volunteers and cooperators were held on Pleasure Island, Swansboro, Pine Knoll Shores, Beaufort and Cape Hatteras. One-on-one training of volunteers was conducted when the opportunity arose.

3. During this reporting period, calipers, measuring tapes, GPS units, digital cameras, PIT tag scanners, towels, gloves and other supplies were distributed to permitted volunteer members of the North Carolina STSSN.

Job 2 Title: Stranding Data Reporting

1. The North Carolina stranding database was updated regularly throughout this reporting period and originals of completed stranding reports were proofed, photocopied and forwarded to the NMFS Southeast Fisheries Science Center. Additionally, copies of stranding reports for turtles found with tags and tagging reports for live stranded turtles that were tagged prior to release were mailed to the Cooperative Marine Turtle Tagging Program office at the ACCSTR of the University of Florida. Lastly, stranding reports of turtles from which biological samples were collected were photocopied for submission to recipients of the samples.

2. Weekly stranding reports for statistical zones 33 – 36 were submitted electronically to the National STSSN Coordinator, NMFS Southeast Regional

Office (SERO), NMFS Beaufort Laboratory, NMFS Law Enforcement, NCDMF and North Carolina Fisheries Association.

3. There was no take of sea turtles by employees or agents of the NCWRC during this period.

4. There was a concentrated cold-stunning event in the estuarine waters of Core/Pamlico Sounds in December 2010. One hundred and seventy five observed stranded sea turtles (27 loggerheads, 103 green turtles, and 45 Kemp's ridleys) were determined to be associated with cold stunning. Of these turtles, 83 turtles were alive when encountered although nine subsequently died overnight. The remaining 74 turtles were placed in rehabilitation centers or aquariums for treatment. All live cold-stunned turtles were recovered by National Parks Service personnel or volunteers at Cape Hatteras and Cape Lookout National Seashores.

Job 3 Title: Post-Mortem Examinations and Collection of Biological Samples

1. During the reporting period, there were 471 stranded turtles observed by the STSSN: 98 loggerheads, 267 green turtles, 104 Kemp's ridleys, and 2 unidentified species. Of these, 221 carcasses (29 loggerheads, 136 green turtles, and 56 Kemp's ridleys were necropsied by NCWRC staff and permitted volunteers. These examinations revealed 111 females, 63 males, and 47 turtles with unclassifiable gonads. Additionally, 6 adult sized stranded loggerhead turtles were assigned sex according to the length of their tails. The majority of the turtles necropsied had no remarkable findings. One green turtle was found to have a piece of plastic and a piece of latex balloon blocking the lower intestine. Four turtles showed evidence of shark bites. Thirteen carcasses had evidence of entanglement in unidentified fishing gear. Twenty four turtles had signs of impacts from propellers or boat hulls. Three turtle carcasses had signs of knife cuts to flippers.

2. Several necropsy workshops were held during this reporting period including workshops at Duke University Marine Laboratory, Center for Marine Studies (NCSU), College of Veterinary Medicine (NCSU), Cape Hatteras National Seashore, and Holden Beach.

3. Sampling supplies were issued to the STSSN on an as-needed basis throughout this reporting period.

4. During the reporting period a variety of samples were collected for research purposes. Humeri and/or eyes were collected from 30 loggerheads and 139 green turtles for skeletochronology work. Muscle tissue was collected on an opportunistic basis from green turtles for DNA analysis. Front flippers were collected from 58 Kemp's ridleys that stranded dead for coded wire tag scanning

and ageing. Samples for skeletochronology were transferred to the NOAA-Beaufort Laboratory for later analyses. Thirteen fresh dead carcasses were collected and frozen for future necropsy workshops with students and/or volunteers. Additional samples taken from strandings include epibiota, fat, liver, heart, lung, kidney, gastro-intestinal tract, and brain tissue.

Job 4 Title: Facilitate the Recovery and Release of Live Stranded Sea Turtles

1. The STSSN recovered 96 live-stranded sea turtles during the reporting period: 23 loggerheads, 57 green turtles, and 16 Kemp's ridleys. Six loggerheads, six green turtles, and one Kemp's ridley died shortly after rescue. These turtles had succumbed to boat strike injuries, cold stunning, or severe emaciation. There were 74 live sea turtles found cold-stunned that were placed in the NC Aquariums, Karen Beasley Sea Turtle Rescue and Rehabilitation Center, South Carolina Aquarium, and the Georgia Sea Turtle Center. Thirty four green turtles and two loggerheads that were cold-stunned were subsequently released; the remaining animals require more time for rehabilitation.

2. Three releases of rehabilitated turtles occurred during the reporting period. Nine Kemp's ridleys and one green turtle were released in the surf in July and September on Topsail Island. In late December, two loggerheads and 35 green turtles (most recovered as cold-stunned turtles in early December) were released next to the Gulf Stream with the help of the US Coast Guard.

3. During this reporting period, the Topsail Sea Turtle Hospital and the sea turtle rehabilitation facility at the North Carolina Aquarium on Roanoke Island were provided support in terms of medical/husbandry supplies and transport as needed.

Semi-Annual Progress Report
North Carolina Sea Turtle Stranding and Salvage Network
1 January 2011 – 30 June 2011

A. Grant Number: NA08NMF4720513
B. Amount of Grant: $50,000.00/yr.
C. Project Title: North Carolina Sea Turtle Stranding and Salvage Network (STSSN)
D. Grantee: North Carolina Wildlife Resources Commission (NCWRC)
E. Award Period: 1 July 2008 – 30 June 2012
F. Summary of Progress:

Job 1 Title: STSSN Recruitment, Training, and Improved Data Collection and Coverage

1. To enhance and strengthen the overall sea turtle stranding network in North Carolina, NCWRC biologists worked towards recruiting more participants and building capacity with respect to post-mortem examinations and sample collection. New recruits in the North Carolina STSSN include employees of various state and federal agencies, students and staff of universities, local town employees, and members of the public.

2. During this reporting period, identification/stranding workshops for volunteers and cooperators were held in various areas including Ocean Isle Beach, Bald Head Island, Carolina Beach, Wrightsville Beach, Swansboro, Emerald Isle, Morehead City, Cape Hatteras, and Corolla. One-on-one training of volunteers was conducted when the opportunity arose.

3. During this reporting period, calipers, measuring tapes, GPS units, digital cameras, PIT tag scanners, towels, gloves and other supplies were distributed to permitted volunteer members of the North Carolina STSSN.

Job 2 Title: Stranding Data Reporting

1. The North Carolina stranding database was updated regularly throughout this reporting period and originals of completed stranding reports were proofed, photocopied and forwarded to the NMFS Southeast Fisheries Science Center. Additionally, copies of stranding reports for turtles found with tags and tagging reports for live stranded turtles that were tagged prior to release were mailed to the Cooperative Marine Turtle Tagging Program office at the ACCSTR of the University of Florida. Lastly, stranding reports of turtles from which biological samples were collected were photocopied for submission to recipients of the samples.

2. Weekly stranding reports for statistical zones 33 – 36 were submitted electronically to the National STSSN Coordinator, NMFS Southeast Regional Office (SERO), NMFS Beaufort Laboratory, NMFS Law Enforcement, NCDMF and North Carolina Fisheries Association.

3. There was no take of sea turtles by employees or agents of the NCWRC during this period.

4. There were no mass stranding events during the reporting period.

Job 3 Title: Post-Mortem Examinations and Collection of Biological Samples

1. During the reporting period, there were 245 stranded turtles observed by the STSSN: 93 loggerheads, 77 green turtles, 70 Kemp's ridleys, 1 leatherback, and 4 unidentified species. Of these, 70 carcasses (29 loggerheads, 15 green turtles, and 26 Kemp's ridleys) were necropsied by NCWRC staff and permitted volunteers. These examinations revealed 42 females, 13 males, and 15 turtles with unclassifiable gonads. The female-biased sex ratio in stranded turtles in NC during the reported period is consistent with findings in previous reporting periods. Additionally, 2 adult sized stranded loggerhead turtles were classified as males because of their extended tails, and one leatherback (155 cm curved carapace length) was classified as female by its short tail length. The majority of the turtles necropsied had no remarkable findings. Most necropsied animals had prey items in the digestive track. Three carcasses had evidence of entanglement in fishing gear: two had pieces of gillnet wrapped around one or two flippers, and one turtle was entangled in a discarded dip-net. Twenty turtles had signs of impacts from propellers or boat hulls.

2. Several necropsy workshops were held during this reporting period including workshops at Duke University Marine Laboratory, Center for Marine Studies (NCSU), College of Veterinary Medicine (NCSU), Cape Hatteras National Seashore, Hammocks Beach State Park, and Bald Head Island.

3. Sampling supplies were issued to the STSSN on an as-needed basis throughout this reporting period.

4. During the reporting period a variety of samples were collected for research purposes. Humeri and/or eyes were collected from 37 loggerheads and 26 green turtles for skeletochronology work. Muscle tissue was collected on an opportunistic basis from green turtles for DNA analysis. Front flippers were collected from 39 Kemp's ridleys that stranded dead for coded wire tag scanning and ageing. All flipper samples were transferred to the NOAA-Beaufort Laboratory for later analyses. Twelve fresh dead carcasses were collected and frozen for future necropsy workshops with students and/or volunteers. Additional samples taken from strandings include epibiota, fat, liver, heart, lung, kidney,

gastro-intestinal tract, and brain tissue, in association with ongoing monitoring of sea turtle health in North Carolina, in collaboration with the College of Veterinary Medicine at NCSU.

Job 4 Title: Facilitate the Recovery and Release of Live Stranded Sea Turtles

1. The STSSN recovered 34 live-stranded sea turtles during the reporting period: 9 loggerheads, 14 green turtles, and 11 Kemp's ridleys. Three loggerheads, four green turtles, and four Kemp's ridleys died shortly after rescue. These turtles had succumbed to boat strike injuries, cold stunning, or severe emaciation. Of the remaining live stranded turtles entered into rehabilitation, two loggerheads and four green turtles were subsequently released after being cleared by collaborating veterinarians. The remaining live animals require more time for rehabilitation before they can be released.

2. Four releases of rehabilitated turtles occurred during the reporting period: Four loggerhead turtles, six Kemp's ridleys and one green turtle were released next to the Gulf Stream with the help of the US Coast Guard in February and March. In June, 15 green turtles, 10 Kemp's ridleys and five loggerheads were released from the beach in Buxton and Topsail Island.

3. During this reporting period, the Topsail Sea Turtle Hospital and the sea turtle rehabilitation facility at the North Carolina Aquarium on Roanoke Island were provided support in terms of medical/husbandry supplies and transport, and as needed.

WCS Wildlife Action Opportunities Fund
Grantee Progress Reporting Form
North Carolina Wildlife Resources Commission

The Wildlife Conservation Society is pleased to have made a grant to your organization. As part of our grant agreement, semi-annual and final reports are required on the progress of your project. This reporting structure is established as a means to better follow the success of your project, track the impact of individual grants that we make, as well as our overall effectiveness as a philanthropic program. Key to this assessment is our commitment to being a learning partner alongside our grantees. We are providing a list of general questions to ignite concise feedback on various aspects of the projects.

Succinct answers will best serve our purposes in analysis and implementation. We would also appreciate any photos or maps you might include to better illustrate your important work. Also, please attach copies of any publications created for this project or any media coverage of the work.

With the exception of the budget summary, which should be given to-date, please report on changes and progress only since your previous progress report. Your final report should be a comprehensive assessment of the entire project.

Please respond to the following questions:

Section I - Outcomes

1. What is the overall status of your project? Please list the goals and outcomes that were outlined in your proposal and briefly describe your progress on each.

Outcome 1: Three partner organizations will be trained on how to implement the Green Growth Toolbox (GGT).

- Partner organizations took a GGT "train the trainer" workshop from NC Wildlife Resources Commission (NCWRC) in December 2009.
- Partners were assisted in preparation and presentation of 4 GGT workshops in the Sandhills and Coast and participation in 2 GGT workshops in the Mountains. NCWRC assisted Sandhills and Coastal partners in their first 2 major technical guidance interactions with local governments.
- We have had 3 coordination meetings and bi-monthly individual interactions among project partners.

Outcome 2: Regional appendices and datasets are available in all eco-regions of the state.

- Regional appendices are available in the Piedmont (Uwharries and Triangle), Coast, Sandhills and Mountains and have been updated once.

- The Mountains region dataset and appendix are specific to the Land of Sky Regional Council (LOSRC) area of Buncombe, Henderson, Madison, & Transylvania Counties. The dataset and appendix were developed in conjunction with the LOSRC Linking Lands and Communities (LLC) project available at: http://www.linkinglands.org.

Outcome 3: Staff from 20 communities across the state's 4 eco-regions will receive Green Growth Toolbox training by September 2011.

- Forty-five local governments (counties and municipalities) received Green Growth Toolbox training during this project at 11 workshops which targeted jurisdictions that are experiencing or will experience significant priority habitat conversion to development.
- The following cities and large municipalities were trained in the Mountains: Asheville, Hendersonville, Waynesville; Piedmont: Albemarle, Wadesboro, Chapel Hill, Carrboro, Hillsborough; Sandhills: Lillington, Southern Pines and its surrounding towns; and Coast: Wilmington and its suburb towns and Morehead City. The following counties (including many of their small and mid-sized municipalities) were trained in the Mountains: Buncombe, Haywood, Henderson, Madison, Transylvania; Piedmont: Anson, Stanly, Davidson, Orange; Sandhills: Moore, Harnett; and Coast: Carteret, Craven, Onslow, Pender, Brunswick, Columbus and New Hanover.

Outcome 4: Staff from 20 jurisdictions across the state's 4 eco-regions receives follow up technical guidance using the Green Growth Toolbox.

- Twenty one local governments have received technical guidance on 31 land use planning projects.
- These projects include 14 land use plans, 5 ordinances, 5 developments, 3 local government-led mapping projects to identify conservation priorities, 1 storm water project and 3 local government led land acquisition projects.

Awards

- The Green Growth Toolbox received the Southeastern Section of the Wildlife Society's 2010 Award for Excellence in Wildlife Management.
- The Linking Lands and Communities Project and the Land of Sky Regional Council received a Regional Center of Excellence Award from the National Association of Regional Councils and a 2011 Innovation Award from the National Association of Development Organization.

Communication

In addition to these outcomes we have promoted the Green Growth Toolbox to planners, community leaders, landowners, land trusts and other potential external partners with the following results.

Features on the GGT can be found on websites and in publications by the following organizations: Pender County Planning Department, Gaston County Planning Department, the Wake County Soil and Water Conservation District, Federal Highway Administration, Green Infrastructure Models in the USFS Southeast Region (attached), NC Sea Grant, the NC Conservation Network, NC Department of Environment and Natural Resources NC Conservation Planning Tool, Albemarle Pamlico National Estuary Program, NC Wildlife Society, NC Academy of Sciences, NC State University Watershed Education for Community Officials, The Swamp School, City of Charleston SC Green Connection, Greensboro News and

Record Green Notes, Fort Bragg Regional Land Use Advisory Commission, Triangle Land Conservancy, Division of Water Quality Planning Tools, Go Green Triad and the Biltmore Forest School Woodland Steward Series.

- NCWRC, Sustainable Sandhills and the Coastal Land Trust focused on targeted promotion to statewide and regional agencies and organizations that provide technical guidance to local governments. This has led to the following communication results.
    - Over 4,000 unique visitors per year to the GGT web site with 50% visitation of multiple pages.
    - Presentations to over 700 individuals at: the Cape Fear Arch Conservation Collaborative, the North Carolina Association of Soil & Water Districts annual meeting, 2nd Annual North Carolina Urban Forestry Conference, 5 statewide Wildlife Action Plan stakeholder meetings, the quarterly meeting of NC Rural (transportation) Planning Organizations, SE Lake Management Society, the Fort Bragg Regional Land Use Advisory Commission, Fort Bragg Alliance, the NC Department of Commerce Division of Community Assistance, local conservation group meetings and 8 Planning Board and Board of Commissioner meetings.
    - We have reached 13 of the 16 Councils of Government (CoGs) in the state and received requests for workshops from 8 CoGs with offers to help organize these workshops.
    - NC Department of Transportation Long Range Planning Division now actively promotes the GGT to the Federal Highways Administration and local government Rural and Metropolitan (transportation) Planning Organizations.
    - 15 news articles have reached audiences in Wilmington, Fayetteville, Moore County, Richmond County, Greensboro, Brevard, Wake Forest, Manteo, the Roanoke – Chowan Region, Greene County, Pender County, Duplin County, Onslow County, Montgomery County and Wilkes County.

- The Mountains region Linking Lands and Communities project has reached over 500 individuals, including at the following venues.
    - City of Brevard and Transylvania County Joint Planning Board meeting
    - Buncombe County Land Conservation Advisory Board
    - Asheville Sustainability Advisory Committee on Energy and the Environment
    - Western NC Regional Forum on Growth and Development
    - Asheville Land Development Conference
    - National Green Infrastructure Conference in Shepherdstown, WV
    - National Association of Regional Councils Annual Conference in San Diego
    - National Association of Development Organizations-sponsored webinar
    - Blue Ridge Parkway Anniversary
    - The Southern Man and Biosphere Conference on Climate Change: Science to Action

<u>Future Green Growth Work and Promotions</u>

All partners will likely be independently funded over the following year to 3 years to continue their Green Growth programs. The NC Coastal Land Trust and Sustainable Sandhills and the Cape Fear Council of Government (with NCWRC assistance) are planning GGT workshops for this November and early next year. All project partners will be continuing to fulfill technical guidance requests and requests for assistance in developing wildlife habitat protection ordinances with assistance from the NCWRC and Duke University model wildlife habitat protection ordinance project. LOSRC, NCWRC, Sustainable Sandhills, NC Department of Environment and Natural Resources and the Fort Bragg Regional Alliance

will be presenting a joint panel on conservation-based land use planning case studies, techniques and economic benefits at the NC American Planners Association Annual Conference in October, 2011. The GGT project will also be featured in an upcoming article of the Wildlife in North Carolina Magazine.

2. We understand that variance from original plans occurs often. Has your project varied from the initial goals and objectives that were outlined in your grant proposal? If so, please briefly describe any changes in your plans.

- We were not able to rehire the Piedmont Land Conservation Biologist position with NCWRC, so staff capacity was reduced and we were not able to complete as much promotion, or as many workshops or technical guidance interactions as we would have liked.
- We originally thought that we would be able to have more local governments provide the GGT conservation data on their websites. However due to planning department time constraints this has happened in only a few places, including Chatham (pre-WCS) and Buncombe counties. The Green Growth Toolbox data is also available online for all Sandhills Counties via the Sandhills GIS Association web viewer, which is a regional partnership administered by the NC Department of Commerce.
- The downturn in the economy and changes from recent elections have led to a somewhat less favorable political climate for regulations in some communities, causing communities to progress toward passage of new land use policies at a slower pace. During a time period when few developments are being constructed it is harder for elected officials to fund the development of green growth policies (though these conditions create the opportunity to get out ahead of future growth).
- We did not see the need for as much communication and promotion materials as we originally anticipated due to the targeted nature of our audience and the need to put time into demand for presentations, workshops and technical guidance.

3. What have been the key factors to your success thus far?

The biggest key to success has been the relationships built over time with local leaders, land use planners, community groups, land trusts and other conservation partners, especially in the case of less 'progressive' communities. Planners that already have an understanding of the importance of conservation have been quicker to use and promote the GGT, requiring less support from us.

The quality of the information and data in the GGT and Linking Land and Communities project and the quality of workshops have been a key factor in success. GGT workshop evaluations revealed that 85% of respondents (120 planners, and planning related staff or board members) understood how green growth practices can be incorporated in plans, ordinances and development designs after completing a workshop.

The Sandhills Conservation Partnership (SCP) has contributed significantly to the success of Sustainable Sandhills Green Growth Program. Through the SCP/ US Army ORISE Fellowship, the SCP created and updates the regional GGT map layers and the Sandhills GGT Appendix.

A relatively large amount of positive and wide spread press and promotion communications have likely led to a positive regard for this project. The partnership of NCWRC, Coastal Land Trust, Sustainable Sandhills, and Land of Sky Regional Council has been productive, with each organization contributing unique resources, credibility, and local contacts. Resources have been further leveraged by collaborating with regional conservation partnerships.

4. Please describe any unanticipated benefits you have encountered during your work on this project.

- Several counties and their major municipalities had never had a joint meeting of current planning staff. Inter-jurisdictional planning meetings and projects, which are essential to green growth, were identified as a priority by these workshop participants.
- External organizations, including Councils of Governments, are beginning to align their work with the GGT and we have seen increased publication about the GGT and requests for GGT presentations and workshops without a large time commitment by NCWRC. A few key sportsman news web sites and blogs have promoted the GGT and see it as a positive step for the Commission.
- NC Department of Transportation is actively promoting the GGT (without prompting) because they want to avoid placing roads in priority wildlife habitats and proactively reduce permitting burdens.

5. What conservation impact do you believe that the project has made thus far and/or how has this work furthered implementation of your State Wildlife Action Plan(s) or any other strategic conservation plans? What good conservation stories does your project have to tell?

This project was designed to address a top threat to priority wildlife identified in the NC Wildlife Action Plan: development that occurs without regard for priority wildlife habitats. Across North Carolina, the Green Growth project has provided needed land use planning resources that, with continued acceptance and use, will help to conserve and connect priority habitats and minimize negative impacts from development. We have reached communities that want to do the right thing and were missing the data, guidance, training and assistance they needed to support wildlife habitat conservation in their land use plans, policies and developments. The words of Navassa town planner Sean Ryan capture the wildlife conservation and community needs we are addressing: "One of the things we value here most is our natural areas and we would like to do what is best to preserve them while also being open to more economic development for our people."

Below we highlight four conservation stories that illuminate the effects that the green growth project has had and that we expect to continue in priority regions of our state.

<u>Boiling Spring Lakes: From a Worst Case Scenario to an Emerging Leader in Green Growth</u>

The City of Boiling Spring Lakes in Brunswick County in the Southeast NC Coastal Plain is at the center of a "biodiversity hotspot" in an area of extensive but fragmented longleaf pine forest with populations of many rare species and natural communities. In 2006 the city's growth began to encroach on thousands of acres of endangered Red Cockaded Woodpecker habitat, in part due to lack of access to and use of habitat data in land use planning. Development activities threatened the woodpecker population while enforcement of the Endangered Species Act threatened to impact the plans of the town, landowners, and developers. Tensions were high. The Boiling Spring Lakes Preserve was purchased for conservation within the town boundary and is fragmented among lots in developments. This created a further challenge for balancing the needs of the City and the Preserve, especially since most of the habitats supporting rare species rely on periodic fires to maintain suitable conditions.

The NC Coastal Land Trust helped the town continue with and improve their plans for a Conservation Overlay District, a district that the City of Boiling Spring Lakes hopes will reduce conflict and make landowners of Preserve inholdings aware of sensitive natural resources and potential restrictions if endangered species are present. The Conservation Overlay will not eliminate all development, but will limit development to very low intensity uses. The Conservation Overlay will encourage pro-active thinking and planning about future development, and may encourage further conservation of private parcels to be incorporated into the Boiling Spring Lakes Preserve. Also because

fire is a necessary management tool for the habitats in the Preserve, the Conservation Overlay may discourage development directly adjacent to the Preserve and may encourage private landowners outside of the preserve to consider using controlled burning to manage their lands. It is hoped that these actions will lead to increased protection of priority wildlife and reduced conflict (Appendix Exhibit A).

Regional and Local Sustainable Growth Strategies help the North Carolina Sandhills Embrace Green Growth

The NC Sandhills are one of the most unique and endangered ecosystems in the US and contain some of the most contiguous Sandhills longleaf pine forest remaining outside of South Carolina and Florida. The region's population is expected to grow by 36% in less than ten years due to transfer of military personnel to Fort Bragg from closing military bases. Two US Army-supported regional partnerships, the Fort Bragg Regional Alliance (FBRA) and the Regional Land Use Advisory Commission (RLUAC), have officially expressed support for Sustainable Sandhills' Green Growth Program and the GGT. The GGT data form the basis of the FBRA's Regional Sustainable Growth Management Strategy Green Infrastructure Map, which covers the entirety of the Sandhills Region. Upon completion, this Strategy is expected to become a resource for local government and regional planning initiatives.

In addition to these regional initiatives, Sustainable Sandhills has educated and trained local governments within the Sandhills Region, building support and capacity for implementation of the GGT. Moore County is known around the world as the "Home of American Golf." The county's 40+ golf courses are the region's biggest tourism attraction, and Moore County is also a very popular retirement location. The GGT workshop in Moore County was well received and Sustainable Sandhills was invited to give input on the County's Unified Development Ordinance revision by the Planning Department and Planning Board. This process will be completed in 2012. GGT recommendations will likely be incorporated into the Unified Development Ordinance by amending regulations regarding the Planned Unit Development and Subdivision Regulation articles. Examples of recommended changes include requirements to show GGT map features on site plan checklists, requirements for natural buffers on all waterways, and increasing the connectivity and percent of open space set-aside required for development. In the future, the recommendations and data from the Green Growth Toolbox will likely also inform the revision of the Moore County Land Use Plan.

Several Moore County municipalities were also represented at the GGT workshop and have received technical guidance or independently incorporated GGT recommendations into their planning processes. The Town of Aberdeen has signed a Resolution of Support for the GGT and will incorporate recommendations into development designs. The Town of Southern Pines incorporated GGT conservation data in the evaluation of development designs without the need for input from Sustainable Sandhills. The Town of Whispering Pines is planning to incorporate Green Growth Toolbox recommendations and maps into an Open Space Master Plan for Recreation and Conservation.

On the northern edge of the Sandhills, Harnett County is growing significantly due to its proximity to Raleigh and the Fort Bragg Military Base. Since their GGT workshop, they have welcomed Sustainable Sandhills input to the update of the Unified Development Ordinance and are interested in creating a wildlife habitat protection overlay amendment once the UDO is adopted. Harnett County incorporated language regarding potential impacts of prescribed fire into their Unified Development Ordinance Section 13.0 Military Corridor Overlay District; a five mile buffer surrounding Fort Bragg. The language, taken from the Green Growth Toolbox, explains the reasons for and potential impacts of prescribed burning on Fort Bragg. The ordinance also requires that all plats for multifamily residential and all subdivision types state that lots within the Military Corridor Overlay District may be periodically subject to potential adverse effects from prescribed fire, which will ensure less conflict with homeowners (Appendix Figure 1).

Local Governments in the Rural South Central Piedmont Take the First Steps to Planning Ahead for Natural Resources and Wildlife Conservation

The Uwharrie Mountain region of the south central Piedmont is within a one hour drive of 5 million people living in the urban areas from Raleigh to Charlotte, NC. The region is mostly rural and is economically depressed from the loss of textile mills leading to a pro-development growth political climate. Urban and rural sprawl are spreading in the region due to traditional land use policies. With the exception of Randolph County which has been using conservation data for the last decade, the other counties and municipalities were unaware of the need or resources to plan ahead for ecosystem and wildlife habitat conservation. This has changed in Stanly, Anson, Montgomery and Davidson Counties. The Anson, Stanly and Montgomery County Land Use Plans have incorporated at least half of the GGT recommendations for land use planning and vision making. Anson County adopted a Resource Conservation District and Overlay that incorporate almost all of the GGT data. They will not allow major development in the floodplain and have aligned their residential districts, in the first district to be zoned, to minimize infringement on sensitive wildlife habitats and corridors. Montgomery County has formed an advisory board to update their zoning ordinance that includes local conservation partners who understand the GGT. Davidson County does not feel that it is the right time to promote the GGT to their Board of Commissioners but will use the GGT to negotiate for open space within developments and have invited NCWRC to advise their Planning Board. Stanly County has requested input on plans to develop a 600 acre site and will be incorporating GGT recommendations when they update their subdivision ordinance. In Cabarrus County the Soil and Water Conservation District has provided input based on their GGT training to county and town land use plan updates (Appendix Figure 2).

Linking Lands and Communities: Empowering Citizens with Data and Maps for Informed Decision-Making

The first time Kristin Peppel from Land of Sky met Steve Schmeiser, they were at a NC Wildlife Resources Commission meeting in March 2009. Near the end of the meeting, Steve addressed the group with his concerns about mountain-side development that was threatening to severely impact a number of rare and fragile habitats in the Southwest Mountains. He was in search of data or other documented information that could prove what he knew to be true through his time spent on the mountain near his home.

Steve became active in the Linking Lands and Communities Project and in April, 2010, a situation arose which would call on the knowledge he gained. Steve became aware of a proposed zoning change that would allow commercial development on two very large tracts of forested land at Minehole Gap.

Steve's concerns were amplified when he reviewed the wildlife corridors identified in the LLC project to find that this stretch of forest was in one of only two significant wildlife corridors in the region. Steve decided to send a letter to each Buncombe County Commissioner prior to the hearing so they'd have adequate time to consider his key points. He wrote, "These parcels form the center of a long stretch of residential parcels (R-1 and R-LD) on both sides of the highway, which consists of mature forest cover, and which serves as the primary wildlife corridor between Swannanoa Mountain and Chestnut Mountain. There are four Natural Heritage Sites on Swannanoa Mountain and two are immediately north of this area. The current zoning of low density residential preserves existing mountain woodland habitat on both sides of the highway, and still allows development consistent with neighboring parcels." Steve was able to cite the LLC project results as evidence that the change would be harmful to our county's commitment to preserve areas of high natural resource value.

The Commissioners voted to deny the proposed zoning change by a vote of 4 – 1. A few days after the hearing, Steve received a letter from the Chairman the Board thanking him for his involvement

in the process, for articulating what they intuitively knew to be true and for helping them to make a more objective and defensible decision.

Steve's story reminds us that it's often the private citizens – land owners, home owners, grassroots organizations, and others in the community – who play a key role in local decision-making. Efforts like the LLC and GGT support citizens by providing them with maps and data, boosting their confidence that they can make a difference when they are empowered with conservation data and an understanding of land use planning laws.

In addition to this case of citizen empowerment, Buncombe County revised their steep slope development regulations in October, 2010. They adopted a new Steep Slope/High Elevation Overlay District (Sec. 78.645) which applies to any development activity that occurs above 2,500 feet in elevation. The revisions included increasing the minimum lot sizes on slopes, with lot sizes determined by the average steepness of the slopes. They also included limitations on the amount of land that can be disturbed and the amount of impervious surfaces. The Green Growth Toolbox was referenced and was useful in providing information on development options, especially regarding conservation-based planning. In addition, Henderson County is currently developing small area plans and using the Linking Lands and Communities maps and data and information from the Green Growth Toolbox to talk to communities about planning and planning policies. Transylvania Co is going through a similar process as they prepare to update their county comprehensive plan (Appendix Figure 3).

Section II – Funding & Budget Report

5. Other than fundraising, what have been the largest impediments to your project's success? What were your stumbling blocks and how did you overcome them?

A challenge for this effort is that land use policies and decisions are made by local governments and the Green Growth Toolbox is a voluntary program, so we are not able to directly influence land use. Ironically, due to the current virtual standstill in development in many areas almost no major developments have been designed or approved during the last year of the project when partners would have been available for technical guidance. As a result, by the end of this grant period, we could not fully assess the short-term willingness of local governments, planning departments or developers to fully implement GGT recommendations. However, NCWRC and our partners have been called on to provide input on a few major development designs. Even in tough economic times, two rezoning requests that would have led to significant negative habitat impacts were denied due to environmental concerns after NCWRC and local citizens empowered by conservation data provided invited comments. Due to the recent change in the political climate, which is now focused on less regulation in many communities, we have worked directly with planning departments and educated citizen groups to build public awareness. Additionally land use plan and ordinance updates take more time to complete than the grant period allowed in all cases except for those communities that took early NCWRC GGT workshops.

A barrier faced by the LLC is the perception that it was not as useful in urban contexts, due to the scale of the map units (30 meter pixels) and the regional study area. The LLC now have an online mapping tool that was developed and is hosted by Buncombe County on which users can zoom into aerial photos of their city and view the resources that exist in the jurisdictions.

6. How is fundraising for your project progressing and how have existing funds been used?

a. Provide a list of additional funding sources for the project. Indicate the status of these sources – received, committed or pending.

- State Wildlife Grant to NCWRC ($52,015)— received
- In-kind match Anson County Planning Department and Central Park NC to NCWRC($7,720) - received

- Z. Smith Reynolds Foundation grant to NC Coastal Land Trust ($25,426)— received
- Wal-Mart Foundation grant to NC Coastal Land Trust ($11,865) – received
- NC Coastal Land Trust in-kind match ($15,000)—received
- Sustainable Sandhills funds ($43,835)—received.
- Federal Highway Administration Eco-Logical grant to Land of Sky Regional Council ($23,473)—received
- Land of Sky Regional Council (31,507) - received
- Z. Smith Reynolds Foundation grant to Land of Sky Regional Council ($21,188) – received

Post WCS GGT Project Continuation Funds

- SS - 2011 – 2014 US Army funded fellowship for the Green Growth Planner – received and committed
- NCCLT - - Sustainable Forestry Initiative grant partly to continue their Green Growth project - received
- NCWRC - State Wildlife Grants ($57,000) – received
- NCWRC - State Wildlife Grants ($26,000) - committed
- LOSRC – Partial funds from a Sustainable Communities Initiative Regional Planning Grant - received
- LOSRC – Blue Ridge National Heritage Area - received

b. Did this grant assist your organization in obtaining funds from other sources? If so, how?

Land-of-Sky Regional Council was awarded a Sustainable Communities Initiative Regional Planning Grant that started in February 2011. Sustainable Sandhills received a contract through the US Army to incorporate the GGT map layers into the Fort Bragg Regional Sustainable Growth Strategy project. This WCS grant was used by WRC to leverage State Wildlife Grant funds to support Green Growth Toolbox efforts. The Coastal Land Trust used the WCS funding to match their Sustainable Forestry Grant and other grants.

c. Provide a list of project expenditures to date on this grant. Please match line items to the budget in your grant agreement. Many grantees find a budget table useful here.

Project Expenditures

1. Program staff salaries, wages, and benefits Title of Position	Number of People	% Time on Project	Total	Wildlife Conservation Society (WCS) Share	All non-WCS Funds
Urban Wildlife Biologist, NCWRC	1 for 1 year	42% to 7/2010	$14,670.35	$7,335.18	$7,335.18
Piedmont Land Conservation Biologist, NCWRC	1 for 1 year	38% to 11/14/10	$11,841.57	$5,920.79	$5,920.79
Land Conservation Biologist, NCWRC	1 for 1 year	80% from 11/15/10	$39,210.95	$18,117.63	$21,093.33
Piedmont Wildlife Diversity Supervisor, NCWRC	1	20%	$20,429.60	$10,214.80	$10,214.80
Cape Fear Arch Coordinator, NC Coastal Land Trust	1	50%	$76,282.00	$38,400.00	$37,882.00

Executive Director, Sustainable Sandhills	1	10%	$19,750.00	$10,750.00	$9,000.00
Green Growth Planner, Sustainable Sandhills	1	50%	$60,000.00	$30,000.00	$30,000.00
Regional Planner, Land of Sky Regional Council	1	50%	$89,461.00	$31,194.00	$58,267.00
GIS Planner, Land of Sky Regional Council	1	3%	$4,417.00	$0.00	$4,417.00
Benefits			$35,540.98	$13,348.08	$22,192.90
Total salaries, wages, and benefits	7.5	38%	$371,603.45	$165,280.46	$206,322.99

2. Contract services Type of consultant or contractor	Number of days on project	Daily rate fee basis			
	2	$544.76	$1,089.52	$1,089.52	$0.00
Total contract services			$1,089.52	$1,089.52	$0.00

Other Expenses				
3. Travel		$18,165.13	$3,921.02	$14,244.11
4. Communications		$2,132.59	$1,537.59	$595.00
5. Capital expenses (supplies/materials/ equipment)		$14,769.14	$10,237.51	$4,531.63
6. Other (Specify line items)		$0.00	$0.00	$0.00
7. Overhead/Indirect Costs (WCS share is max 10% of request amount)		$24,269.06	$17,933.90	$6,335
Total project expenses		$432,028.89	$200,000.00	$232,028.89

Section III – Partnerships for implementation

8. Tell us about any interaction you have had with both your public agency and private NGO partners on this project, either positive or negative.

As described above, extensive collaboration between public and private partners has been integral to this project. NCWRC leadership has expressed support for integrating implementation of the GGT in the position responsibilities of some other NCWRC Wildlife Biologists.

9. Are any of these partnerships new as a result of this grant or this project?

NCWRC had worked indirectly with all of the NGO partners in the past. However, the strength and content of the partnerships formed through this grant are new and are likely to result in improved future collaboration between our organizations. Besides NCWRC, the partners had not all worked with each other before so new relationships were built between them.

10. How have those new partners contributed to or supported your work?

Our partnerships are now stronger and Green Growth is integrated into the work that our partner organizations consider part of their mission. Our partners have ensured that local governments across the state are aware of the need and resources for Green Growth and those governments have begun to incorporate GGT recommendations into land use plans, policies and developments.

Please include any inserts or attachments: photos, maps, publications, and media pieces. Thank you!

Please see the Appendix to this report and also supporting materials submitted with previous reports.

Appendix to Final Report 9/30/2011

WCS Wildlife Action Opportunities Fund
Grantee Progress Reporting Form
North Carolina Wildlife Resources Commission

Green Growth Toolbox Workshop Images
Sustainable Sandhills and the Sandhills Conservation Partnership
Moore County Workshop 8/25/10

Green Growth Toolbox Workshop sections cover “what is Green Growth?”, using conservation data in land use planning and achieving Green Growth through plans, policies and development designs.

Workshop presentations are interactive. Here land use planners are learning about each conservation data map layer such as Significant Natural Heritage Areas and other documented wildlife habitats.

Participants complete a hands-on exercise during each Green Growth Toolbox Workshop that demonstrates how to incorporate priority wildlife habitat into land use plans or development designs.

Green Growth Toolbox Workshop Images
Moore County Workshop 8/25/10

A full day Green Growth Toolbox Workshop includes a field trip to a nearby wildlife habitat. Here a NC Wildlife Resources Commission Biologist is pointing to a tree containing a Red- Cockaded Woodpecker nesting cavity and teaching land use planners and planning board members about the longleaf pine forest ecosystem.

Green Growth Toolbox Workshop participants debrief after a development design hands-on exercise to share ideas and learn about wildlife habitat conservation thresholds and recommendations.

Green Growth Toolbox Workshop Images
NC Wildlife Resources Commission Anson County Workshop 3/14/10

Land use planners, public works officials and elected officials work through a development design exercise at a Green Growth Toolbox Workshop in Anson County.

Land use planners, public works officials and elected officials learn about vernal pools, priority salamander species ecology and other priority wildlife habitats in Anson County during a Green Growth Toolbox Workshop field Trip.

Green Growth Toolbox Workshop Images
NC Coastal Land Trust Southern NC Coastal Plain Workshop 6/24/11

Land use planners from counties and Councils of Government in the southern NC Coastal Plain learn about the conservation data and complete Green Growth Toolbox Workshop land use plan hands on exercise.

Land use planners from counties and Councils of Government in the southern NC Coastal Plain learn about Carolina bays and other priority wildlife habitats from rangers at Lake Waccamaw State Park during a Green Growth Toolbox Workshop.

Green Growth Toolbox Workshop Images
Land of Sky Regional Council Linking Lands and Communities Project

The Linking Lands and Communities Project is an award winning Green Infrastructure resource for communities in the Southern Appalachians of North Carolina. Land use planners, GIS specialists, land trusts and citizen's groups learn about Green Infrastructure, Green Growth and conservation mapping data through Linking Lands and Communities trainings, handbooks and follow-up technical assistance. The Green Growth component of this project provides a guide to how to incorporate priority wildlife habitats into land use plans, policies and development designs.

Figure 1. Sandhills GIS Website for Regional and Jurisdiction Land Use Planning Incorporates the Sandhills Green Growth Toolbox Regional GIS Dataset.

https://edis.commerce.state.nc.us/sandhills_gis/index.jsp

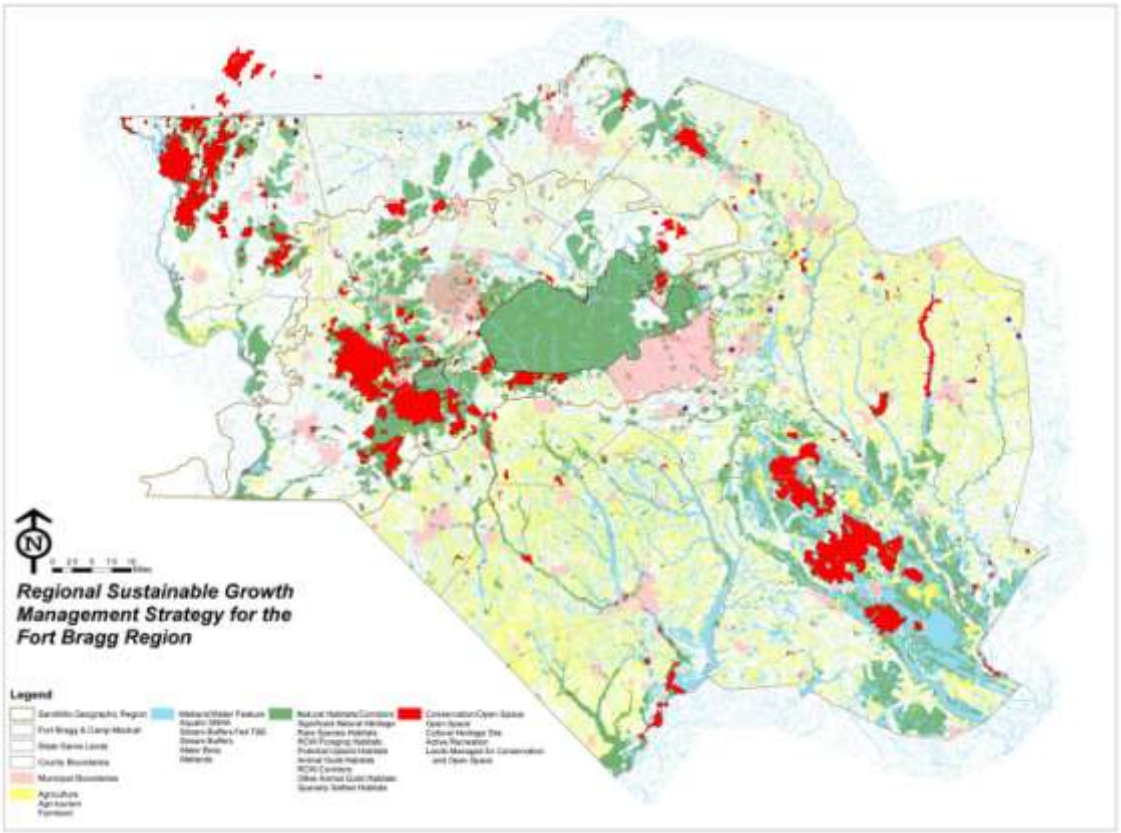


Figure 2. Anson County Zoning Map for the first district to be zoned under the new Anson County Zoning Ordinance. The Updated General Zoning Ordinance and Map can be viewed at: http://www.co.anson.nc.us/content/index.php?id=54,0,0,1,0,0. The Conservation Overlay includes the priority wildlife habitats of the district including small wetlands, natural mature forest over 50 acres and floodplain forest. Other Zoning Districts are designed to protect the floodplain and wildlife habitat connectivity.

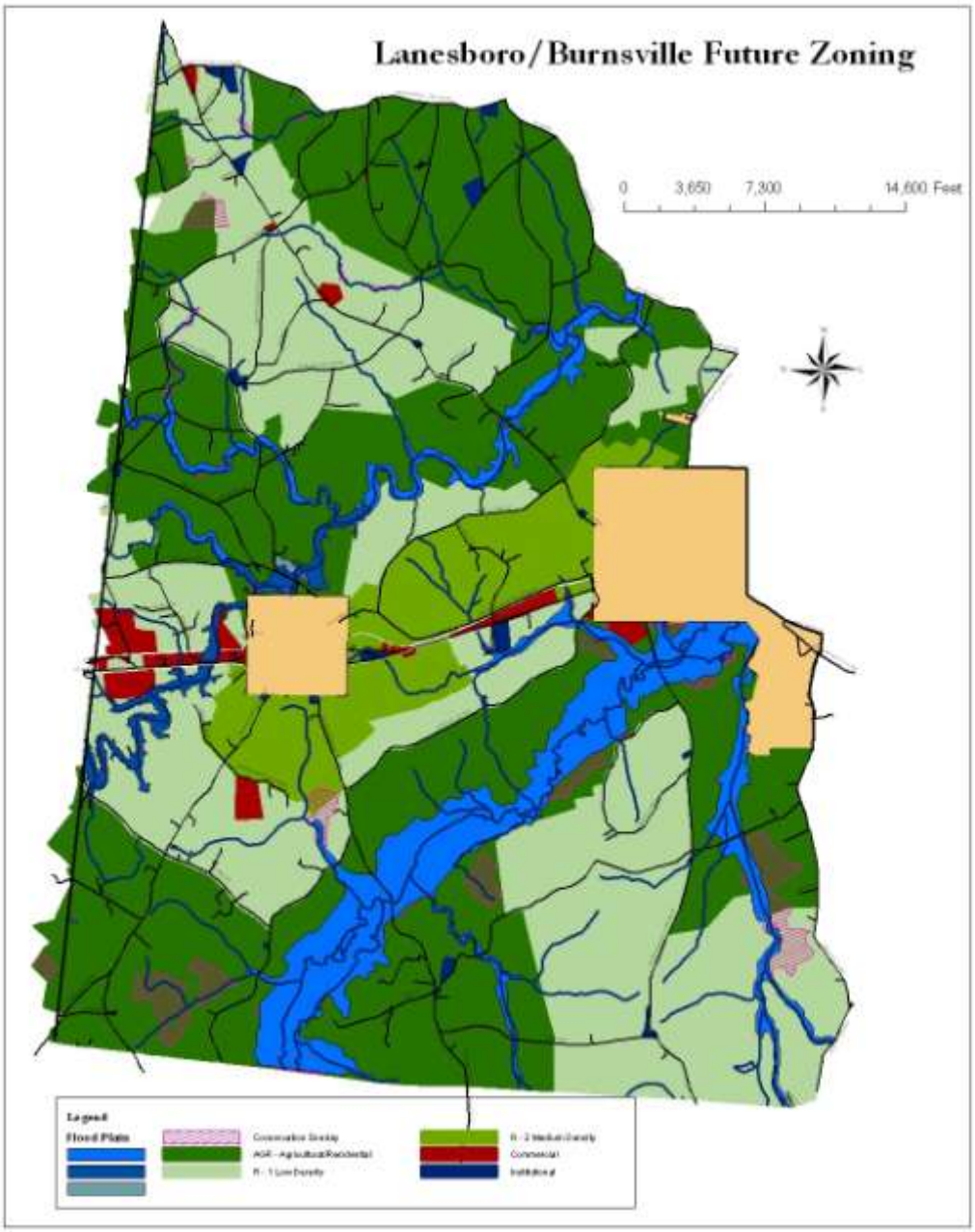
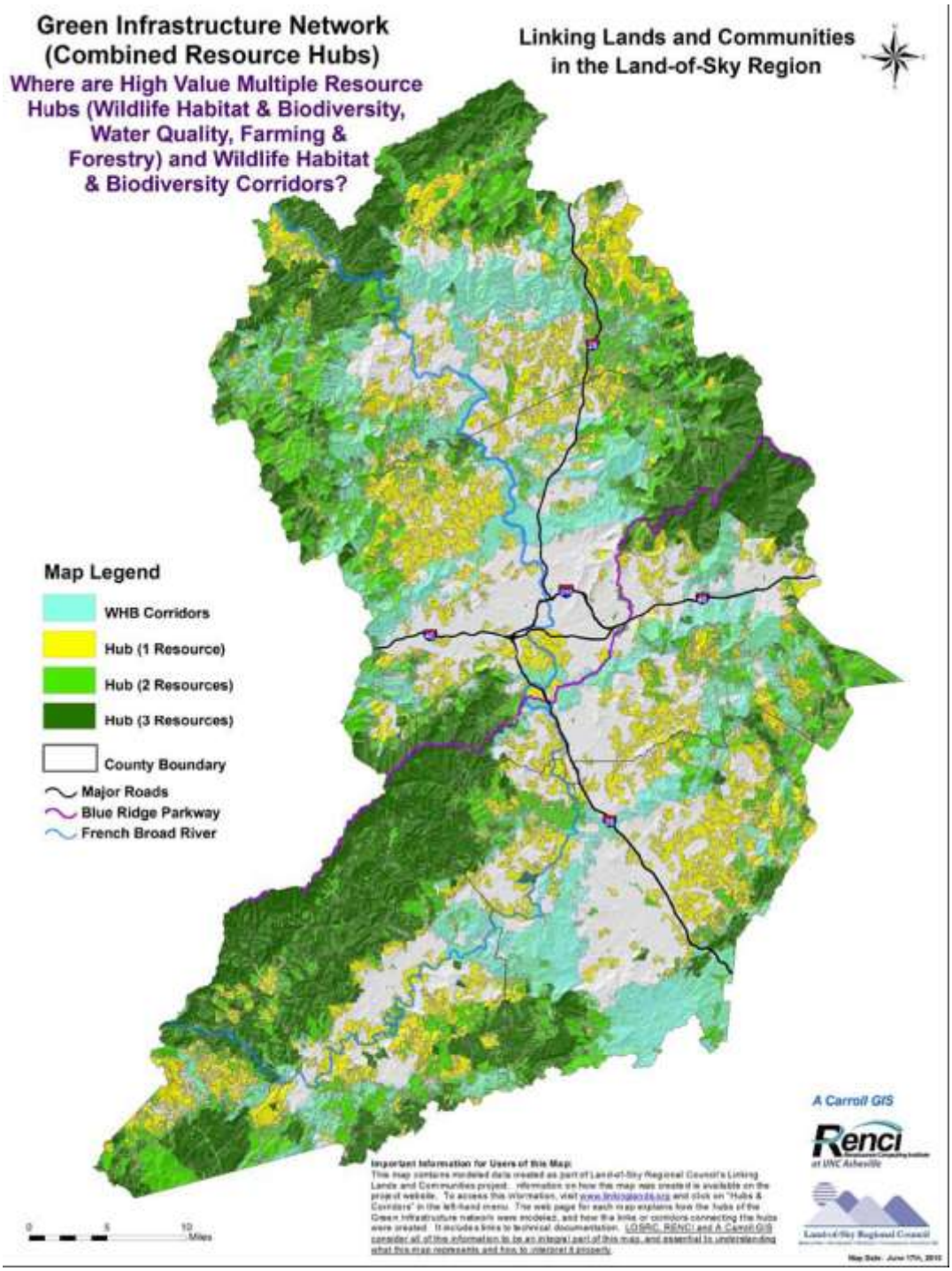


Figure 3. Land of Sky Regional Council Linking Lands and Communities Green Infrastructure Network Resource for Land use Planning. The Green Growth Toolbox is an Addition to the LLC Tool that provides specific guidance and recommendations on achieving green growth through land use plans, ordinances and development designs.



Appendix A.

Supplemental Conditions
Conservation District (CON)

6.xxxxx CON –Conservation

A. Intent

The Conservation District is intended to be used for the permanent protection and preservation of environmentally sensitive lands. Activities within the CON district are limited to very low intensity uses, open space, natural habitat preservation and very limited resicential uses. Construction and land disturbing activities shall be limited in nature and scope and shall have a very low impact on the environment and surrounding area.

B. Permitted Uses

Only uses specifically listed in the Table of Uses, Section 5.5, as a permitted use with suppmental regulations (PS) shall be allowed in a conservation district.

C. Standards

1. Applicability

a) The following standards shall apply to all development within the CON district.
b) In addition to the standards contained in this Section al other provisions in this Ordinance and all other applicable state and federal laws shall apply.

2. Dimensional Standards

Parcels existing at the time of adoption of this ordinance shall not be subdivided into smaller parcels. Parcels may be increased in size.

3. Development Standards

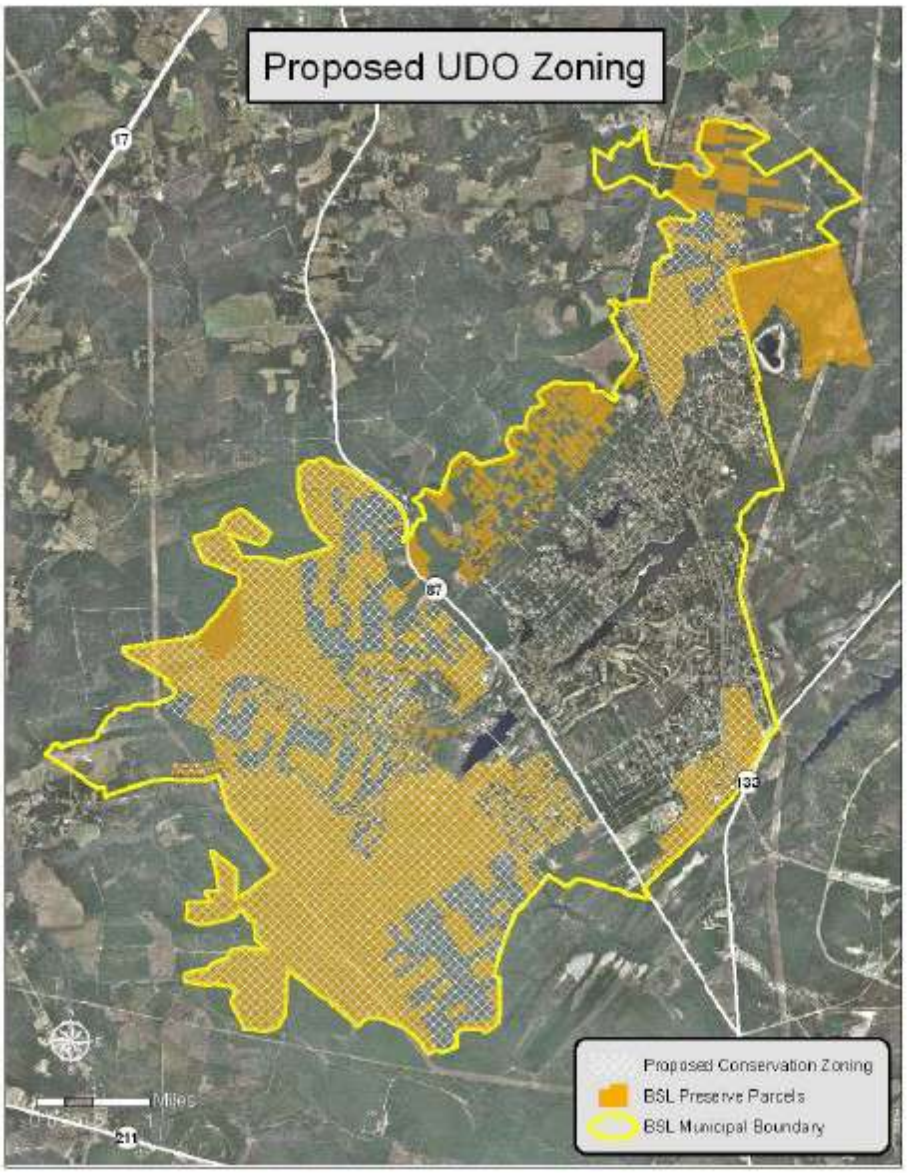
In order to reduce the impact of development on the existing natural environment the following standards shall apply to all land disturbing activities within the CON district:

a) A site plan shall be required that identifies all trees, state of federally protected flora and wetlands prior to any development or land disturbing activity. The site plan shall be submitted to the city for review as required.
b) Endangered flora shall be relocated to state or city owned land as directed.
c) Removal of trees shall be approved by the city and any other state or federal agency necessary prior to removal. All remaining trees shall be protected from damage during construction or land development activities.
d) Fill material shall not be placed on any property without city, county or state approval as required.
e) Fencing shall be discouraged and if allowed should be designed for easy movement of wildlife. Impervious fencing should be limited to small areas around the main structure or garden areas.
f) Only one (1) primary structure shall be allowed per parcel.

Possible uses for Conservation District:

Forestry Service – Public
Hunting preserves/Hunt clubs (nor facilities)
Nature Trails – State/City controlled

Parks and Playgrounds (limited areas)
Residences (individual)



Year-round Study of American Oystercatchers at Selected Sites in North Carolina

Numbers of American Oystercatchers within Back Sound during 2011

N.C. Wildlife Resources Commission

Sara H. Schweitzer, Wildlife Diversity Biologist, Coastal Waterbirds

We counted numbers of American Oystercatchers roosting on sand shoals, sand beaches, and oystershell mounds (shell rakes) during high tide within Back Sound. Sites surveyed were identified as roosts for large numbers of American Oystercatchers during a winter 2002 aerial survey (Brown et al. 2005). These roost sites were on Phillips Island (privately-owned dredged-material island) in the Newport River; Bird Shoal, smaller shoals, Horse Pen island, Carrot Island, and marshes of the Rachel Carson National Estuary Research Reserve bordered by Taylor's Creek and Beaufort Channel; Bottle Run Point shell rakes and marsh edges in Back Sound; and shell rakes in Davis Bay. All sites are in Carteret County, near Beaufort, North Carolina, and are accessible only by boat (Fig. 1).

Each roost site was visited during rising or high tide as frequently as possible. Surveys were not conducted during rain, thunderstorms, high winds (>10 mph), or in low light conditions (dawn, dusk, night). At each site, when possible, we counted numbers of adults and young (hatch-year or subadult with dark bill and non-definitive eye coloration), and, if present, we recorded band color and alpha-numeric code. Generally, oystercatchers were roosting at high tide; thus, their aggregation at roost sites increased the probability that counts were of most birds in the area. Often, however, oystercatchers tucked their bills and laid down while roosting. In such cases, some birds were not identified by bill color and the presence or complete code of a band was not seen. If encouraged to stand, oystercatchers frequently flushed and left the site entirely, so we did not disturb the oystercatchers unnecessarily to get them to stand and walk at roost sites.

Counts were conducted with binoculars and spotting scopes. The boat was anchored and observers walked or waded to get as close to the roosting birds as possible.

2011 Results

Late breeding season (July 2011).— We conducted 2 surveys in July and detected 30 and 70 oystercatchers, respectively (average = 50, SE = 20; Table 1).

Fall migration (August–October 2011).— We conducted 5 surveys during fall migration and detected an average of 106 oystercatchers (SE = 9) in the Back Sound area, of which, an average of 7 were juveniles. The greatest number of oystercatchers detected was 134 of which, 5 were juveniles.

Winter (November – December 2011).—Two surveys were conducted during winter months during which we detected 119 and 194 oystercatchers, respectively. Thirteen juveniles were

detected during the November survey, but windy conditions and behavior of oystercatchers precluded counting numbers of juveniles on 13 December.

Financial statements for grant.— Expenditures by NCWRC personnel on this project were related to work hours, travel, and boat use (Tables 2-4).

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Table 1. Numbers of American Oystercatchers detected at roost sites during high tide in Back Sound near Beaufort, North Carolina. Data include surveys conducted before the collaborative project began in 2009.

Year	Season	Month	Dates	Total number	mean	SE	n	Greatest count
2004	winter	Dec	14, 16	265				
2006	winter	Jan	16	259				
2007	winter	Jan	7	151				
2007	winter	Dec	13	197				
2008	winter	Dec	4	163				
2008	winter	Dec	17	183				
2009	winter	Feb	11	220	205	17	7	265
2009	fall migr	Aug	4	75				
2009	fall migr	Aug	10	76				
2009	fall migr	Aug	21	101				
2009	fall migr	Sept	4	199				
2009	fall migr	Sept	21	123				
2009	fall migr	Oct	2	145				
2009	fall migr	Oct	20	164				
2009	fall migr	Oct	30	176	132	16	8	199
2009	winter	Nov	9	233				
2009	winter	Dec	4	164				
2010	winter	Jan	5	195				
2010	winter	Jan	6	206				
2010	winter	Jan	7	198				
2010	winter	Feb	19	212	201	9	6	233
2010	sprg migr	Mar	8	104				
2010	sprg migr	Apr	1	59	82	23	2	104
2010	fall migr	Aug	3	83				
2010	fall migr	Aug	11	54				
2010	fall migr	Aug	17	106				
2010	fall migr	Aug	27	156				
2010	fall migr	Sept	1	169				
2010	fall migr	Sept	8	87				
2010	fall migr	Sept	13	248				
2010	fall migr	Sept	23	82				
2010	fall migr	Oct	11	123				
2010	fall migr	Oct	22	189	130	19	10	248
2010	winter	Nov	5	193				
2010	winter	Nov	10	242				
2010	winter	Nov	19	155				
2011	winter	Feb	9	137				

Year	Season	Month	Dates	Total number	mean	SE	n	Greatest count
2011	winter	Feb	23	141	174	20	5	242
2011	breeding	Jul	5	30				
2011	breeding	Jul	18	70	50	20	2	70
2011	fall migr	Aug	2	83				
2011	fall migr	Aug	8	95				
2011	fall migr	Sept	14-15	120				
2011	fall migr	Sept	20, 22	98				
2011	fall migr	Sept	30	134	106	9	5	134
2011	winter	Nov	19-20	119				
2011	winter	Dec	12-13	194	157	38	2	194

Table 2. Expenditures related to the American Oystercatcher surveys in Back Sound, North Carolina, incurred by the N.C. Wildlife Resources Commission from 1 January through 31 August 2010 (NCWRC Invoice 716 dated 28 September 2010).

Category	Expense
Personnel & Benefits (hrs on project by NCWRC biologists)	$7,036.97
Travel (mileage on vehicles, ferry, lodging, subsistence)	$1526.99
Boat Use (@ $30/hour)	$1080.00
Total:	$9,643.96

Table 3. Expenditures related to the American Oystercatcher surveys in Back Sound, North Carolina, incurred by the N.C. Wildlife Resources Commission from 1 September 2010 through 30 June 2011 (NCWRC Invoice 962 dated 5 July 2011).

Category	Expense
Personnel & Benefits (hrs on project by NCWRC biologists)	$4,511.01
Travel (mileage on vehicles, ferry, lodging, subsistence)	$751.08
Boat Use (@ $30/hour)	$750.00
Total:	$6,012.09
Grant funds available:	$9,644.00
Balance:	$3,631.91

Table 4. Expenditures related to the American Oystercatcher surveys in Back Sound, North Carolina, incurred by the N.C. Wildlife Resources Commission from 1 July through 31 December 2011.

Category	Expense
Personnel & Benefits (portion of hrs on project by NCWRC biologists)	$2,833.16
Travel (portion of mileage on vehicles, ferry, lodging, subsistence)	$748.02
Boat Use (@ $30/hour)	$50.00
Total:	$3,631.18
Grant funds available(year 3):	$3,631.91
Balance:	$0.73

Figure 1. Roost sites visited during rising and high tides during each survey. Sites are in Back Sound near Beaufort, Carteret County, North Carolina.

2011 Survey of Nesting Colonial Waterbirds in Coastal North Carolina and an Update of the Colonial Waterbird Database

Final Report to the U.S. Army Corps of Engineers,
Wilmington District

Sara H. Schweitzer, Waterbird Biologist
David H. Allen, Coastal Wildlife Diversity Supervisor
North Carolina Wildlife Resources Commission
Wildlife Diversity Program

Introduction

Twenty-five species of colonial waterbirds nest in North Carolina, including species of terns, gulls, and skimmers (Order Charadriiformes); herons, egrets, and ibis (Order Ciconiiformes); and pelicans, cormorants, and anhingas (Order Pelicaniformes). These birds are long- and short-distance migratory species; hence, they often cross state boundaries and are protected by the Migratory Bird Treaty Act. Seven of these species are state-listed as Special Concern, one is threatened, and one is endangered (at state and federal levels).

These species rely on diverse habitats for nesting. Herons, egrets, ibis, and pelicans typically nest in grasses, shrubs, and trees. Terns and skimmers are ground nesters with many species preferentially selecting bare sand or shell with little or no vegetation near the nest. Anhingas, double-crested cormorants, and great blue herons nest almost exclusively in forested swamps and other inland wetlands and will not be considered further in this report. Yellow-crowned night herons, cattle egrets, snowy egrets, and green herons nest at estuarine sites and can be found nesting in significant numbers at inland sites. All other species nest primarily along the coast. This report will focus on species that nest within North Carolina's estuaries, including coastal beaches, marshes, forested islands, peninsulas, and riverine edges.

Dr. James Parnell of the University of North Carolina at Wilmington conducted the first survey of colonial waterbirds along North Carolina's coast in 1977 to estimate breeding population sizes (Parnell and Soots 1979), especially relative to concerns about pesticides used in previous decades. This 1977 survey was followed by a second coast-wide survey led by Dr. Parnell in 1983 (Parnell and McCrimmon 1984). These surveys and specific research (Parnell and Soots 1975, Soots and Parnell 1975) revealed the importance of dredged-material islands to nesting colonial waterbirds in North Carolina. Monitoring of North Carolina's colonial-nesting waterbirds is listed as a priority in the North Carolina Wildlife Action Plan (NCWRC 2005); hence, such coast-wide monitoring is conducted each 3-4 years. Funding support for coast-wide surveys is provided by the U.S. Army Corps of Engineers (USACOE), and other agencies, organizations, and individuals contribute significant in-kind support.

NCWRC's efforts to manage the state's colonial waterbird resources began in the early 1980s when a contract to develop a management plan was awarded to Dr. Parnell. The first draft of the plan was presented at the first annual Colonial Waterbird Management Workshop in May 1985. The culmination of this effort came in 1990 when *Management of North Carolina's Colonial Waterbirds* by Parnell and Shields was published. This publication now serves as the basis for management efforts in the state, as well as a model for other states. Actual management for colonial waterbirds began in 1989 with the formation of a Cooperative Agreement signed by 11 agencies that implemented a program for the protection and management of colonial waterbirds nesting in North Carolina. The agreement includes virtually all agencies that have land management or permit review responsibilities in the coastal zone. Today, additional agencies have signed the Cooperative Agreement and annual Colonial Waterbird Committee meetings are held to update individuals on research and management issues in the state and to facilitate coordination among the different agencies. NCWRC works closely with USACOE and other agencies to direct the placement of dredged material on nesting islands and to ensure that projects along the coast minimize impacts to colonial nesting waterbirds. In addition, NCWRC

and partnering agencies post informative signs around the perimeter of known nesting sites before the breeding season to reduce disturbance to nesting birds.

Census data going back to 1972 are housed in The North Carolina Colonial Waterbird Database, developed by Dr. Parnell and now held and maintained by NCWRC's Wildlife Diversity Program. It contains a history of all known nesting sites of colonial waterbirds in North Carolina. This database is updated continually with the help of USACOE funding since 1989. Information can be compiled and extracted easily and quickly in table or report form by year, site, or species. Reports or tables can be converted to Word, Excel, or PDF documents to be printed or manipulated. Additional information available includes site descriptions, specific nesting habitat characteristics, survey history, landowner information, and managing agency.

Justification

The need to monitor and manage colonial waterbirds was acknowledged in the *Management of North Carolina's Colonial Waterbirds* by Parnell and Shields (1990). The *North American Waterbird Conservation Plan* (Kushlan et al. 2002) was developed to provide a continental-scale framework for the conservation and management of waterbirds and points to the importance of regular monitoring to help determine conservation status, detect population trends, and indicate whether environmental changes and management prescriptions are affecting waterbirds. Waterbird conservation was put into a regional context with the publication of the *Southeast United States Regional Waterbird Conservation Plan* (Hunter et al. 2006). NCWRC uses all of these plans as a basis for the Waterbird Program and coast-wide nesting surveys are conducted as part of this program. In addition to tracking population trends, documenting locations of nesting colonies, and recording the condition of habitat, survey data provide critical information for decision-making. Hence, these data ensure management actions, conservation decisions, and research projects are based on scientific evidence. NCWRC, USACOE, and other agencies use coast-wide nesting survey data when planning and reviewing coastal projects.

Coast-wide surveys include regular monitoring of colonial waterbirds on dredged material islands, an increasingly important resource for nesting waterbirds. Development of roads, homes, and businesses on North Carolina's barrier islands has replaced much natural beach and shrub-scrub (maritime forest) habitat traditionally used by nesting colonial waterbirds. The increased number of people on barrier islands increases disturbance to colonial waterbirds from vehicles, boats, pedestrians, and unrestrained pets. Several mammal and avian species benefit from human structures and uncontained refuse; hence, increasing numbers of raccoons, foxes, feral cats, fish and American crows, common grackles, laughing gulls, herring gulls, and great black-backed gulls are present. Most of these species prey readily on colonial waterbird eggs and chicks. Dredged-material islands provide nesting sites that are relatively free of human disturbance and predators. USACOE has been involved in colonial waterbird management in North Carolina since the 1970s, and works with NCWRC and Audubon North Carolina to direct the placement of dredged material on waterbird islands to benefit nesting birds.

Objectives

The objective of coast-wide colonial waterbird surveys is to provide updated information on the status of waterbird nesting colonies on North Carolina's barrier islands, within its estuaries, and within coastal swamps. To achieve this objective, surveys are designed to locate all nesting colonies, determine the number of nests of colonial-nesting waterbirds at each colony, and update the statewide colonial waterbird database. This information is necessary to achieve the goals of North Carolina's Waterbird Program: to maintain breeding populations at or near 1977-1983 levels, to discourage problem species, to encourage a dispersed breeding population over that portion of the coastal area traditionally occupied by each species, to provide special attention to state and federally listed species, and to develop management techniques to help meet these goals. Population and habitat goals (Table 2) were approved by the North Carolina Colonial Waterbird Committee at the 2001 Colonial Waterbird Committee Meeting, based on recommendations in *Management of North Carolina's Colonial Waterbirds* (Parnell and Shields 1990) and other waterbird conservation plans (Kushlan et al. 2002, Hunter et al. 2006).

Methods

Coast-wide surveys are conducted every 3-4 years. The last complete survey was done from early May through June 2007. The 2011 survey began in early May and concluded in early July. Surveys were conducted on barrier islands, natural and dredged-material estuarine islands, and coastal swamps. Known nesting sites and potential nesting sites were visited and surveyed. Information was collected on the number of nests, stage of development, nest substrate, colony vegetation, and site disturbance factors. Surveys were coordinated by the NCWRC Waterbird Biologist and conducted with help from many staff members from NCWRC, the National Park Service (Cape Lookout [CALO] and Cape Hatteras [CAHA] National Seashores), Audubon North Carolina, Camp Lejeune Marine Corps Base (USMC), U.S. Fish and Wildlife Service (USFWS), North Carolina Division of Coastal Management, North Carolina Division of State Parks, University of North Carolina at Wilmington (UNCW), and NC State University (NCSU). Many unaffiliated volunteers helped with surveys also.

Surveys were conducted using methods described by Parnell and Soots (1979) and Parnell and McCrimmon (1984). Nests were counted by 1–15 people (depending on colony size), spaced about 3–15 m apart. Counters walked transects through colonies and identified and tallied active nests (those with ≥1 egg or chick). Complete ground counts were preferred, but if chicks were fairly mobile, colonies were counted from the perimeter, or the number of breeding pairs was estimated from adult counts. For herons and egrets with similarly-small blue eggs, nests with small blue eggs were counted, then a count of adults provided the proportion of each species, and this proportion was applied to the count of nests with small blue eggs to obtain a count of nests by species. Likewise, for herons with small white chicks, nests with small white chicks were counted, and then a count of adults provided the proportion of these nests. We attempted to visit all tern and skimmer colonies during peak incubation and we tried to visit all heronries and pelican colonies early in the nestling stage. Because we were only able to visit most sites once, counts of active nests likely underestimated the breeding population, but they provide an index of the number of nesting pairs that can be compared over time and among locations.

In June 2011, we conducted an aerial survey of the coast to detect colonies that may have been missed by ground surveys. We flew over the entire coast in 2 days, except military lands that were closed air space, primarily areas over Onslow Beach and Browns Island.

Results and Discussion

We detected 71,483 nests of colonial waterbirds along North Carolina's coast in 2011 (Table 1). These nests were from 22 species distributed among 134 nesting sites. Species with the greatest numbers of nests were White Ibis, Laughing Gulls (*Leucophaeus atricilla*), Royal Terns (*Thalasseus maximus*), and Brown Pelicans (Table 2). We did not detect any new coastal colonies during the aerial survey.

While some species' totals fluctuate annually but are stable over the long-term, the percentage change between 2011 estimates and the long-term (n = 11 coast-wide, colonial waterbird surveys) average for Caspian Terns (*Hydroprogne caspia*; -95%), Common Terns (-59%), Glossy Ibis (-26%), and Royal Terns (-11%) are noteworthy (Table 1). Further, the number of nests recorded for each of these species is less than the population goal for them (Table 2).

Caspian Terns nest in small numbers (long-term average, 19 nests, Table 1) at only 1-2 sites in North Carolina. Most Caspian Terns nest in the Great Lakes and Northwest regions of the United States. Several adults were present on the dredged-material island where the one nest was found, but no additional nests were detected during several follow-up surveys. The only other colonial-nesting waterbirds nesting on this island were Herring (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*). The number of nests of Great Black-backed Gulls in 2011 was 114% greater than the long-term average (Table 1). Nesting by this species (254 nests in 2011) has increased significantly since the late 1970s and 1980s (mean = 4 nests, n = 3 survey years). Possibly, the large, aggressive gull species is precluding Caspian Terns, and perhaps other species, from nesting sites and/or reducing their nesting success rates.

The Common Tern is a species of Special Concern in North Carolina, but it is not listed federally as a Candidate, Threatened, or Endangered Species. Although the number of nests recorded in 2011 was greater than that in 2 previous coast-wide surveys (2004 and 2007), there is a negative long-term trend for this species (Table 1). The last time numbers of its nests were near the Population Goal of the Colonial Waterbird Committee (Table 2) was in 1993. There were 15 Common Tern nesting colonies in 2011, and most were on islands in the Back, Core, and Pamlico Sounds. Sites varied from dredged-material and natural estuarine islands to barrier island beaches. All nests were on sand-shell material. Greater protection of these nest sites may be warranted to address an immediate concern, but a study should be conducted to identify factors affecting nesting Common Terns so management will be most effective over a long term.

Numbers of Glossy Ibis nests (263) declined in 2011 relative to the long-term average (354; n = 11 survey-years), and its number of nests was lower than the Population Goal (500 nests; Table 2). This species is listed by North Carolina as a Species of Special Concern whose numbers of nests have only met its Population Goal during 2 of 11 coast-wide Colonial Waterbird Surveys (1993, 2001; Table 1). The number of nests detected during surveys appears to vary; thus, a

decline detected in 2011 may not be of concern. Further study of the population may be warranted if numbers of nests are low again during the next Colonial Waterbird Survey.

The number of Royal Tern nests (11,049) reported in 2011 was 11% lower than the long-term average (12,453; *n* = 11 survey-years) and lower than the Population Goal (15,000 nests). The Population Goal for Royal Terns has been met during 1 of 11 Colonial Waterbird Surveys. The number of sites at which Royal Terns nested (*n* = 6) met the Habitat Goal. Five colonies were on islands – 4 are dredged-material islands and 1is a natural estuarine island. A new colony was found on CLNS, a barrier island beach habitat. Sandwich Terns (*Thalasseus sandvicensis*) nest in colonies of Royal Terns, and the number of their nests was 13% greater than the long-time average.

The Gull-billed Tern is a Threatened species in North Carolina whose Population Goal was set at 300 nests. During 2011, we recorded 183 nests, substantially below the Population Goal. However, the Population Goal has not been met during 11 Colonial Waterbird Surveys, and the 2011 estimate is about equal to the long-term average for this species (181 nests; *n* = 11 survey-years). Thus, this species is remaining stable, but not meeting its Population Goals.

The Black Skimmer is a Species of Special Concern in North Carolina, and its number of nests (728) in 2011 is below the Population Goal (1000 nests), but near the long-term average (740 nests; *n* = 11 survey-years), and the greatest number of nests recorded since the 1995 Colonial Waterbird Survey. With continued protection from human and other disturbances, this number may remain high and increase. Colonies of Black Skimmers were scattered among 11 sites, with 3 additional sites each with only 1 nest. Sites were barrier island beach, dredged-material islands, and natural estuarine island habitats.

Forster's Terns are unique among the terns because they nest almost exclusively on wrack in marshes. The number of nests detected in 2011 (981) was lower than the long-term average (1031 nests; *n* = 11 survey-years; 5% decline) and lower than the Population Goal (1100 nests). We found many empty nests that were not counted as active nests, and several dead chicks. Because we found a dead rat and signs of rat activity at a few colonies, we suspect that the Marsh Rice Rat (*Oryzomys palustris*) may be a predator affecting nesting success of Forster's Terns (Brunjes and Webster 2003). The Marsh Rice Rat is a native species with which Forster's Terns must contend. It is likely that the number of dispersed colonies of Forster's Terns and their ability to re-nest after loss of an early nest lets them withstand some losses to rats.

There were no significant spring storms on the North Carolina coast during the survey; thus, nesting birds were not greatly affected by adverse environmental conditions. Of the wading bird species that nest almost exclusively on the coast, numbers of nests of White Ibis (*Eudocimus albus*), Black-crowned Night-herons (*Nycticorax nycticorax*), Great Egrets (*Ardea alba*), Snowy Egrets, and Little Blue Herons exceeded their respective long-term averages (Table 1). The Tricolored Heron, however, had fewer nests than the long-term average and did not meet its Population Goal. The number of sites at which it nested was greater than its Habitat Goal.

The Least Tern is a Species of Concern in North Carolina that has benefited from its plastic behavior, accepting various types of nesting sites. Numbers of nests of Least Terns (3363) were

70% greater than the long-term average (1980 nests; n = 11 survey-years; Table 1) and were greater than the Population Goal for the species (2000 nests; Table 2). Further, it nested at 47 sites, exceeding the Habitat Goal of 25 sites. Most sites on which it nested were dredged-material islands, barrier island beaches, and natural estuarine islands. Only 5 roof top sites were used in 2011. Several large (>100 nests) colonies were on sand-shell material near inlets. Use of fewer roof top sites and increased numbers of nests suggest that less disturbance from people, pets, and predators is present.

The number of Brown Pelican nests (5150) in 2011 was 52% greater than the long-time average (3394 nests; n = 11 survey-years), and one of the largest numbers counted during the 11 coast-wide surveys (second only to the count of 5173 nests in 2004). The 2011 nest count was greater than the Population Goal for Brown Pelicans (4000), and the number of nesting sites in 2011 (11 sites) exceeded the Habitat Goal of 5 sites. Although some islands on which it nests are eroding (e.g., Beacon Island), pelicans are doing well within the state.

Three species of gulls nest in North Carolina – the Laughing Gull, Herring Gull, and Great Black-backed Gull. Since 1977, gull numbers have increased. Herring Gulls and Great Black-backed Gulls did not nest in North Carolina in significant numbers before the 1970s, but both have been expanding their range southward. Range expansion and population increases of these species are assisted by their ability to benefit from human refuse. Gulls, unlike many other colonial waterbirds, adapt to and benefit from human-altered environments. These great increases in gull populations can cause problems for other species of colonial-nesting waterbirds because gulls compete for nesting sites and prey on eggs and chicks of other species.

In 2011, Great Black-backed Gulls nested at fewer sites than in 2007, but the number of nests increased to 254, the greatest number yet (Table 1). Numbers of Herring Gull nests increased slightly and they used 2 fewer sites than in 2007. Both Great Black-backed and Herring Gulls have expanded their range from islands in Pamlico Sound to islands in the Cape Fear River area. Laughing Gulls are native to North Carolina and have also been increasing due to their propensity for eating trash. Numbers of Laughing Gull nests in 2011 were 44% greater than the long-time average.

Colonies of nesting birds were distributed from Currituck Sound in the northern region of North Carolina's coast, to the east end of Ocean Isle Beach at Shallotte Inlet, near the border with South Carolina. Hence, the entire coast of North Carolina provides sites for these birds to nest on its barrier, estuarine, and dredged-material islands. Although some islands are eroding, some ends of islands near inlets are growing. Colonial waterbirds are adapted to ephemeral habitats and move to sites that provide habitat criteria specific to their nesting needs and habits. However, most of these species do not react quickly to sudden disturbances from recreationists, predators, or engineered construction; thus, these factors reduce availability of nesting sites along North Carolina's coast. In 2011, the NCWRC was given permission to post signs about nesting birds around potential nesting habitat on 4 private beaches. These sites were south of Tubbs Inlet (Sunset Beach, east end), south of Shallotte Inlet (Ocean Isle, east end), north of Shallotte Inlet (Holden Beach, west end), and south of New River Inlet (Topsail Beach, north end). North Carolina Audubon and UNC-W monitored birds and habitat at Masonboro Inlet, Mason Inlet, Rich Inlet, and New Topsail Inlet. With these efforts, and those of CAHA and CALO National

Seashores, more colonies were successful in 2011 than in 2007 on natural beach inlet sites. Undoubtedly, continued success will require constant outreach to recreationists in these areas, but increased numbers of interested, conservation-minded citizen groups are providing assistance.

The colony sites at which birds nested were natural or dredged material, and in some rare instances, gravel roof tops. Most nests (about 68%) were on natural material (sand–shell beach, marsh wrack, shrubs, trees), about 32% of nests were on dredged material, and <1% were on gravel roof tops (Least Terns, only). Most colonies on natural sites were within CHNS, CLNS, and USFWS (Pea Island and Swanquarter NWRs). Species either listed as Threatened (Gull-billed Tern) or Species of Special Concern differed in their selection of dredged-material or natural sites; but the Least Tern was the only species that nested on roof tops (Figure 1). These results demonstrate the importance of both natural sites and man-made dredged-material islands, and the need for management and conservation of them for nesting birds. Gravel roofs have been important to Least Terns, and sometimes Black Skimmers, so they should be monitored and the owners encouraged to allow the birds continued use of them during the few months of the nesting season.

Conclusions and Recommendations

Colonial-nesting waterbirds did well during 2011, with several species increasing the number of nests and/or sites used for nesting. The number of nests of a few species declined, especially the Common Tern.

An increased number of small colonies were on privately-owned land, and increased public interest and conservation concern should be nurtured so these sites persist and colony sizes increase. Most colonies are on islands that are under the management of conservation agencies (CHNS, CLNS, USFWS, or NCWRC) or on sites with restricted access (Cat, Raccoon, Brown Islands; Onslow Beach overwash) due to USMC activities; thus, these sites should receive continued, and where necessary, increased management actions. Management may include reducing disturbance to nesting birds from recreationists or reducing the number of predators.

Islands composed of dredged sand-shell material continue to be important to colonial-nesting waterbirds and should receive continued attention. Management may be needed on several of these islands to reduce erosion and create the vegetative structure needed by a variety of bird species. The USACE and NCWRC should continue to coordinate when permitted actions may affect waterbirds, and when dredged material may be used beneficially to maintain and create bird nesting islands. The importance of these man-made islands will increase as sea-level rise models predict many natural areas will be inundated and lost. Examples of specific islands needing new sand-shell material include Sandbag Island, DOT Island, and the Unnamed Island in Stumpy Point Bay.

The assistance from members of the Colonial Waterbird Committee and other interested groups is critical to achieving Population and Habitat Goals agreed to during a meeting in 2001. The Annual Meeting of these agencies and individuals is critical to the exchange of information and planning for forthcoming conservation, management, or research actions. These new data from

the 2011 Colonial Waterbird Survey will aid decision-making and guide management actions that will further enhance North Carolina's waterbird populations.

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Table 1. Numbers of nests of colonial-nesting waterbirds counted within North Carolina's coastal region during coast-wide surveys. Changes in numbers and percentage-change from the long-term average are provided.

	Number of nests											Change		
Species	**1977**	**1983**	**1988**	**1993**	**1995**	**1997**	**1999**	**2001**	**2004**	**2007**	**2011**	**Average**	**#**	**%**
White Ibis	1939	3825	6332	10,455	9571	9446	8711	17,043	14,392	16,962	11,178	9987	1191	12
Glossy Ibis	404	291	84	526	279	482	229	600	377	356	263	354	-91	-26
Brown Pelican	82	1586	2637	3327	3290	4145	4350	4137	5173	3452	5150	3394	1756	52
Green Heron[1]	42	24	64	8	8	4	15	30	47	117	2	33	-31	-94
Black-crowned Night-heron	237	269	207	251	204	233	193	262	297	177	244	234	10	4
Yellow-crowned Night-heron[1]	2	9	12	18	10	21	12	10	2	14	1	10	-9	-90
Great Egret[2]	494	832	682	1945	1901	3551	1230	1901	1879	1697	2055	1652	403	24
Cattle Egret[1]	1137	1754	1919	2271	1517	908	3049	342	547	479	737	1333	-596	-45
Snowy Egret[2]	1034	716	497	904	672	676	271	349	446	386	664	601	63	10
Tricolored Heron	1479	1436	869	1938	1716	1241	701	1219	1702	979	1232	1319	-87	-7
Little Blue Heron[2]	802	1178	538	1727	1407	679	1025	1349	1354	1090	1307	1132	175	15
Least Tern	1925	1653	1528	2188	1993	882	1271	1742	2408	2827	3363	1980	1383	70
Forster's Tern	1138	936	933	1610	1117	867	812	1086	828	1034	981	1031	-50	-5
Royal Tern	9755	17,029	11,793	14,611	14,150	10,991	12,519	10,877	13,524	10,689	11,049	12,453	-1404	-11
Sandwich Tern	1190	1850	1199	2700	2905	2766	3041	2487	2635	2786	2710	2388	322	13
Caspian Tern	10	6	11	33	37	26	32	22	16	15	1	19	-18	-95
Common Tern	2761	2247	2618	2122	1699	952	888	1131	570	498	604	1463	-859	-59
Gull-billed Tern	268	233	161	155	249	137	154	258	99	90	183	181	2	1
Black Skimmer	976	797	743	1084	819	570	681	594	623	555	702	740	-38	-5
Laughing Gull	9369	22,903	17,478	17,970	23,567	11,325	17,960	31,749	14,922	19,964	28,121	19,575	8546	44
Herring Gull	433	440	353	960	516	687	746	881	663	630	682	636	46	7
Great Black-backed Gull	9	0	3	47	92	177	201	181	176	164	254	119	135	114
Totals	**35,486**	**60,014**	**50,661**	**66,853**	**67,719**	**50,768**	**58,091**	**78,252**	**62,680**	**64,961**	**71,483**	**60,633**		

[1]This species nests primarily inland so this coastal survey did not detect the true number of its nests in North Carolina in 2011.

[2]This species nests both in coastal and inland regions, so these data do not reflect total numbers of nests for it in 2011.

Table 2. Colonial waterbird nests and nest sites detected throughout North Carolina's estuaries in 2011 compared to goals set for each species based on baseline surveys conducted in 1977 and 1983.

Species	Nests[1]	Goal - # nests	Sites	Goal - # sites
White Ibis	11,178	8000	10	6
Glossy Ibis	263	500	9	7
Brown Pelican	5150	4000	11	5
Black-crowned Night Heron	244	250	20	10
Great Egret[3]	2055	2500	21	30
Cattle Egret[2]	737	No management need; No goal set; State will continue to monitor		
Snowy Egret[3]	664	800	13	15
Tricolored Heron	1232	1500	17	15
Little Blue Heron[3]	1307	1200	9	15
Least Tern	3363	2000	47	25
Forster's Tern	981	1100	14	15
Royal Tern	11,049	15,000	6	6
Sandwich Tern	2710	2700	5	6
Caspian Tern	1	25	1	1
Common Tern	604	2500	15	20
Gull-billed Tern	183	300	9	6
Black Skimmer	702	1000	12	15
Laughing Gull	28,121	No management need, but ≥10,000		
Herring Gull	682	No management need, but ≤1000		
Great Black-backed Gull[4]	254	No management need[4], but ≤200		

[1]Numbers of nests and nesting sites in red are below the Waterbird program goal.
[2]This species nests primarily inland so this coastal survey did not detect the total number of its nests in North Carolina in 2011.
[3]This species nests both in coastal and inland regions, so these data do not reflect total numbers of nests for it in 2011.
[4]The number of Great Black-backed Gull nests has increased above the Waterbird Program goal, so management of the nesting population will be considered.

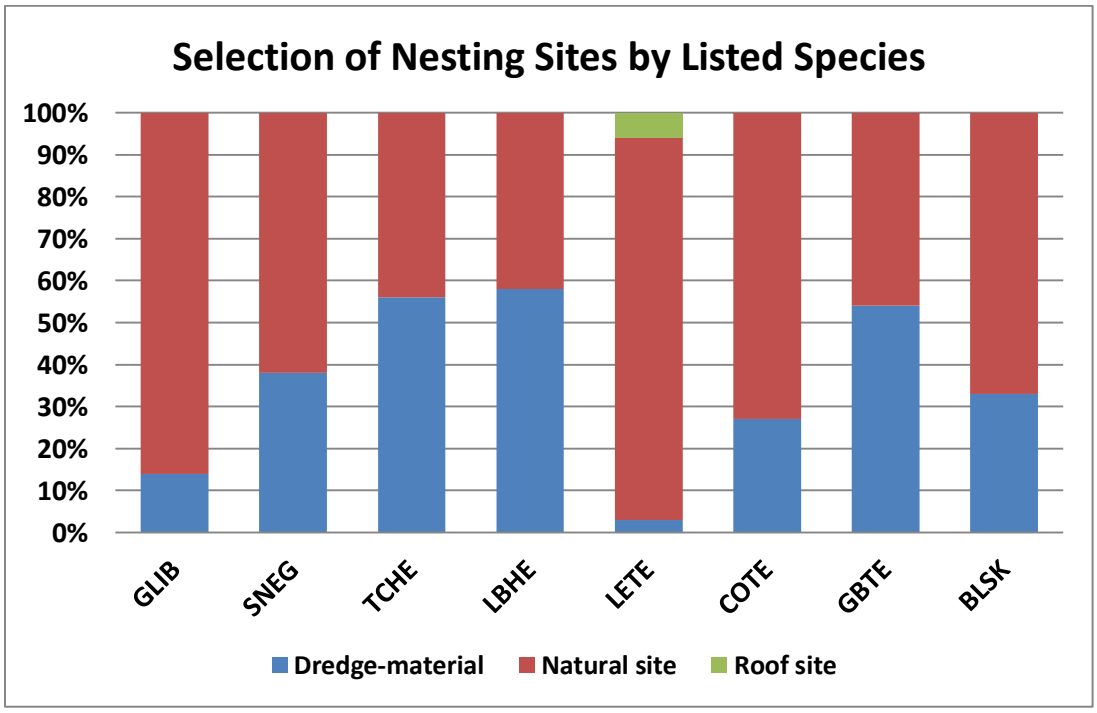


Figure 1. Selection of nesting sites by species listed as Threatened (Gull-billed Tern) or Species of Special Concern in North Carolina, 2011. Dredged-material sites are islands created when channels are dredged for maintenance and sand-shell material can be used to maintain or create bird nesting sites. Natural sites include barrier beaches, mostly at inlets; marsh islands; and sand-shell shoal islands. Roofs used by Least Terns are flat and covered with small gravel or stones. No other species nested on roofs although Black Skimmers have done so in the past. Abbreviations are: GLIB (Glossy Ibis), SNEG (Snowy Egret), TCHE (Tricolored Heron), LBHE (Little Blue Heron), LETE (Least Tern), COTE (Common Tern), GBTE (Gull-billed Tern), BLSK (Black Skimmer).

Final Project Report

Partners for Fish and Wildlife Grant # 40181-03-G202

January 2003 – September 2011

Introduction

This final report covers the many accomplishments made through the $101,000 Partners for Fish and Wildlife (PFW) grant that was awarded to the NC Wildlife Resources Commission (NCWRC) which began in 2003 and was active through September 2011. In addition to the narrative summary below, each landowner project that was completed under the grant program is summarized in appendix A. A few projects are featured in more detailed summaries which are also attached in appendix B. The purpose of this detailed report is twofold; to share the successes resulting from the grant and to provide a record of grant/program activities. With the information in this record projects can be visited and monitored in the future, allowing biologists to continue to learn for our work. In addition, the Forest Landbird Legacy Program (FLLP), which is the name of the program developed under this grant, can be evaluated for effectiveness and consideration of the viability of the approach.

History

On January 30, 2003 a meeting was held at the U.S. Fish & Wildlife Service (USFWS) office in Raleigh, N.C. related to the potential for a program addressing the conservation of forest landbirds with private landowners. The purpose of the meeting was to explore a new program that would initially be funded at $25,000 by the USFWS's PFW Program in cooperation with the NCWRC that would develop and implement stronger partnerships with state agencies and other partners. More specifically, the funding would be used for on-the-ground restoration and habitat improvement practices on private lands. The PFW staff wanted to use the money for practices that would benefit forest-dependent migratory birds, particularly species or suites of species of a high conservation priority. Initial partners present at this meeting included representatives of the USFWS, NCWRC and Natural Resources Conservation Service (NRCS).

At the preliminary meeting, the group was supportive of launching a new program with the goal of conservation of biodiversity in mature forests for the benefit of forest-dependent landbirds. The group discussed the conditions of certain existing habitat types and how those habitats might best be improved. In particular, the group felt that mature forests were top priority for forest-dependent land birds. The consensus was that the age of the dominant trees was not as critical as the structure that is present (midstory, vine diversity, dead wood (downed and standing), and gaps). The group also decided that perhaps this complex structure could be achieved in younger forests through a variety of management actions. Riparian zones were another priority habitat that the group felt should be targeted, and acknowledged the lack of understory and midstory vegetation in many forest stands. In addition to habitat management practices, the group determined that developing a certification and signage component that would recognize private landowners would be a valuable tool for educating and recruiting additional private landowners to participate.

The PFW Program hoped to contribute $25,000 to the grant agreement each year for 5 years. The grant began with a $25,000 contribution in 2003. In 2004, $26,000 was added. In 2005, $25,000 was added. And finally, in 2006, $25,000 was added for a grant total of $101,000. The NCWRC representatives were never in a position to commit funding, but expressed support and interest in accepting, promoting, and carrying out the program and ended up devoting many hours to the program.

With the premise that mature forests and riparian areas should be a priority focus, the partners determined eligible practices that benefit forest landbirds. Those included: developing a harvest management strategy, creating gaps, burning, thinning, exotic plant control, use exclusion, understory planting, reforestation, offsetting the cost of planting hardwoods vs. pines, and removing timber of no commercial value to reforest. Other programs address some of these practices, but not necessarily from a mature forest or forest landbird perspective. In some cases the recommended practices existed in Forest Stewardship Plans or modified plans with added focus on forest dependent birds. The partners agreed that the program would be opportunity driven and that there would be no 'cookbook formulas' for achieving the goals. Each project would have to be handled on a case by case basis.

The partners agreed to limit participation in the program to private landowners, land trusts, universities, etc. Partners agreed that they could or should provide only technical assistance for backyard-type or small-scale management and focus funding on larger tracts. Although the group ultimately favored a 50/50 rule in which 50 acres and a forest 50 years old would be the minimum requirement for participation, it was not adopted as an absolute requirement.

The group decided to develop several projects, review and rank them according to criteria discussed, and move forward on implementation rather than perform a general call for proposals since the partners were already engaged with numerous private landowners interested in wildlife conservation and followed similar procedures with other Programs like the NC Partners Program in which partners from the USFWS, NCWRC, NRCS, and Ducks Unlimited all bring projects forward to benefit waterfowl and shorebirds on private lands.

Partners agreed that there could be agencies or organizations involved in soliciting projects, providing technical assistance, or reviewing projects, but that the USFWS, NCWRC, and NRCS would likely be the only financial contributors and would be the decision-makers.

<u>Defining Forest Landbird Legacy Program</u>

Prior to visiting potential landowner sites the partners decided to name the newly developed program the Forest Landbird Legacy Program (FLLP). The partners representing the program made up the FLLP committee. A logo was developed for use on signs (Certified Forest Landbird Habitat) to denote certification and participation in FLLP. NCWRC would use the grant funds from the USFWS primarily to reimburse landowners. A cooperative agreement between each landowner and NCWRC would be developed, reviewed by the FLLP committee, and signed by Brad Gunn (NCWRC) serving as Project Administrator. Through 2008 Mark Johns of the NCWRC was the Project Officer and handled program organization and grant reports, with assistance from other partners as needed. Since 2008 Chris McGrath has served as the Project Officer.

In 2004 FLLP signs (50) for posting on sites involved in the program were ordered at a cost of $717.50. The North Carolina Chapter of the Wildlife Society contributed $500.00 toward the cost of the signs and the remaining balance was paid with grant funds. Later, plaques and certificates for landowner participants were developed and purchased.

Training/Outreach

A FLLP Fact Sheet was developed in August 2004 and approved by the FLLP committee. The purpose of the color one-page fact sheet was to provide information to landowners with potential FLLP sites about what the FLLP is, who they should contact for information about FLLP, and issues related to cost-share funding. FLLP contacts for each region of the state were provided and this fact sheet was distributed throughout the state. The fact sheet (appendix C) was updated annually to reflect changes in the Forest Landbird Legacy Committee members and their contact information, but the framework of the program remained the same.

A Letter was distributed to land trusts throughout the state with information about the FLLP in September of 2004.

A training workshop was held on October 26, 2005 by the FLLP committee to promote the program and inform natural resource managers, consulting foresters, and land trusts about how to participate in FLLP. This workshop was developed and conducted via a partnership with the NC State University Forestry Education and Outreach Program and the FLLP committee. The NC Forest Service also participated in the workshop in Johnston County.

A second FLLP training workshop was held in Johnston County on October 3, 2007 conducted by Mark Johns and Danny Ray of NCWRC, FLLP certified consulting forester David Halley, and Chris Moorman of NC State University to promote FLLP to natural resource managers, consulting foresters and land trusts, and to train consulting foresters. This workshop was a partnership with the NC State University Forestry Education and Outreach Program and the FLLP committee. Several consulting foresters who participated in the workshop oversaw FLLP landowner agreements or were involved in potential FLLP site visits.

Feature articles on FLLP were included in the fall 2007 NC Partners in Flight newsletter and the winter 2008 NCWRC Upland Gazette newsletter on the successful Hosley FLLP project.

Successes

FLLP evolved into a well-defined program in which private landowners received both advice and financial support for enhancement and restoration work in their mature upland forest stands to improve habitat for forest dwelling songbirds. FLLP representatives visited over 37 sites; many on multiple occasions. FLLP agreements were not pursued on twelve of the sites that were visited. However, technical assistance was provided. Twenty-five cooperative agreements were developed between landowners and the NCWRC and 23 projects were actually completed. Two were cancelled because they did not go forward with the planned practices. One project of the 23 ended up being completed without using the funds offered in the agreement.

The full grant of $101,000 was expended on the work of this program. The on-the-ground projects that were accomplished provided $89,411 (89%) in reimbursement payments directly to landowners for the work that they did on their lands (appendix A). Approximately $5,000 (5%) was used to make direct purchases for specific projects on the ground. The remaining approximately $6,500 (6%) was used to pay for signs, plaques, publications, printing, postage, other materials and supplies, and 9 hours of staff time by NCWRC. Each of the 23 completed cooperative agreements with landowners included at least a 25% match of their own funds ($38,531, appendix A). The FLLP partner agencies provided hundreds of hours of staff time participating in the committee meetings, visiting sites, developing and providing oversight to cooperative agreements, producing materials, and processing payments to landowners.

Landowners agreed to keep the restored or enhanced property in its improved condition for a period of 10 years after the project work was completed. Over 1,245 acres were improved under Forest Landbird Legacy cooperative agreements. FLLP projects occurred in 17 counties across the state (see map- Appendix D) and covered a variety of habitat types including mountain hardwoods, mixed hardwoods, longleaf pine, shortleaf pine, bottomland hardwoods, cypress and tupelo swamp, and oak-hickory uplands.

How FLLP Worked/Activities of the FLLP Committee

Once FLLP was set up, committee members were made aware of potential new projects and were invited to visit the site and evaluate it. These on-site visits with landowners often served as educational experiences for the entire committee as well as the landowners. Taking a mature forest and fine tuning it to benefit birds is not an easy task and there was often healthy debate on how to undertake the project. After the initial site visit a proposal was developed and reviewed by the committee. An agreement between the NCWRC and the landowner was developed and approved by the committee. Once the agreement was signed, the project could begin. The lead for each project often visited the site more than once to guide the habitat improvement work. When the project was completed the project lead verified the work before NCWRC reimbursed the landowner. The FLLP committee was invited to come back to the site to see the results and to recognize the landowner.

Program Coordination

Coordination was achieved among the FLLP committee largely via e-mail. Further communication developed on site visits. Well attended annual FLLP meetings were held for the FLLP committee members from 2005 through 2009. Attendees reviewed procedures, discussed projects, ironed out any issues, shared ideas, and charted a path forward. Presentations and new research were shared and field trips were taken.

Challenges

The development and implementation of FLLP was not without challenges. The program was very slow to start because of the time involved establishing criteria and procedures as well as engaging landowners. It took time for FLLP to build momentum. Consequently, it took a while before grant funds were being expended with regularity.

The next major challenge was the time it took for landowners to implement the recommended practices to improve their habitat. One of the most common practices recommended was

prescribed burning. Very often conditions were not favorable and burning opportunities were missed. Even the most diligent landowners fell behind on their habitat improvement work because of limited burning opportunities. One year there as a burning ban due to severe drought. Other work such as gap creation required coordination and availability of loggers and was often not easy to accomplish quickly.

Some landowners lacked continuous motivation. In three cases, landowners signed an agreement, but then never pursued it, despite repeated encouragement from their FLLP committee member. This had the unfortunate consequence of tying up funds that others could have been using while also not accomplishing improvements.

The time commitment of the FLLP committee members varied over the years. Some were rarely involved while others spent many hours on FLLP projects. In 2009 a survey was conducted of the committee to help determine how to most efficiently use the remaining grant funds and what level of interest they had in continuing FLLP. Most respondents were willing to continue to serve as an FLLP representative. However, only 5 people were willing to put in 2-5 days/month.

The last noteworthy challenge was the administration of FLLP. One person served as a coordinator which required as much as 5 days/month at times. That job included overseeing the project agreements, ensuring consistency, tracking projects, sending reminders, planning annual meetings, and keeping track of expenditures and remaining funds. A second person within NCWRC had to process the requests for reimbursements to the landowners, and the program did not contain funding for staffing to carry out the functions FLLP.

Impacts on Forest-Dwelling Birds/ Surveys

The FLLP committee wanted baseline inventories performed on potential FLLP sites to document existing birds present whenever possible, and to compare baseline bird communities present prior to FLLP management activities with bird guilds that are present after FLLP management activities over time. However, since there was no funding for a monitoring component, only a few projects were informally surveyed while most were not. However, the birds identified as beneficiaries of the completed projects include many high priority birds of conservation concern for Partners In Flight.

The Role of Forest Stewardship

The FLLP committee held and still holds the desire that forest dwelling birds be considered in all Forest Stewardship Plans. Further, we are hopeful that the lessons learned from the many projects undertaken with FLLP will provide useful information for practical suggestions to include in Forest Stewardship Plans. We learned that many landowners will apply practices that benefit forest dwelling birds such as prescribed burning, canopy gap creations, and snag development even without cost share funding. However, they are not likely to do these things if they are not detailed in their Forest Stewardship Plan.

Educational Component

To round off the FLLP, agreements were established with 8 North Carolina Parent Teacher Associations (PTA) to use a bluebird nesting box with a wireless camera provided by FLLP on their elementary school campus to educate their students about birds and bird conservation. The FLLP committee recognized the importance of connecting children with nature and specifically the importance of bringing the life of birds to their fingertips via nest box cameras. Each PTA has agreed to maintain the wireless box camera set up and to use it for educational purposes. Children will learn about bluebirds, but they will also be able to write about them, count the days until they hatch, tell stories about the birds, and experience the development of the nestlings. Development of an educational curriculum to accompany the boxes is underway by FLLP partners.

FLLP Landowner Recognition

An FLLP Recognition and Certification procedure was defined and documented for all members to use. Recognition/Certification was available for landowners receiving financial assistance from FLLP as well as landowners who managed their land well for birds without financial assistance from FLLP. Recognition/Certification in the way of a letter, a sign, and a plaque has been presented to 11 landowners to date. Eight of those received funds from FLLP and 3 did not. It is anticipated that recognition and certification for landowners who are managing their land to benefit forest dwelling birds will continue even though they are not receiving financial assistance. This positive reinforcement for landowners has been very well received.

Partnerships

The USFWS's PFW program provided these grant funds with the specific objective and guidance to develop unique and mutually beneficial partnerships with their state wildlife counterparts and private landowners in the process of restoring and enhancing bird habitats. These grant funds to NCWRC have accomplished that goal. USFWS PFW and NCWRC biologists have worked very closely over the last 8 years to develop, refine, and implement FLLP. NCWRC biologists throughout the agency worked collaboratively to develop and implement the FLLP for the benefit of forest birds. The administration of the program also required close interactions between the two agencies which strengthened the already positive working relationship. The two agencies will continue to work together with mutual respect to recognize landowners and share restoration and management techniques to benefit forest dwelling birds.

Appendix A

Agreement Number	Project Cooperator	Dates of Agreement	Life of Agreement	County	FLLP Payment	Landowner Contribution-estimate	Total Project Cost - estimate	Habitat Type	Priority Birds	Practices	Acres	Recognition/ Certification	Lead	Forest Steward-ship Plan
WM-0152/ 0156	NC CLT - DuPont	9/15/04-4/15/09	10yrs 2017	Bladen	$2,556.65	$1,832	$4,389	Longleaf Pine	BASP, BHNH, NOBO, SUTA	Thin, Burn, Exotic Plant Treatment	174	Sept. 2005	David Allen, JA Shearer	Yes
WM-0157	Henry&Sharon Hosley	7/1/04-8/3/06	10yrs 2016	Buncombe/ Henderson	$2,700	$900	$3,600	Mt. Hardwoods	HOWA, SWWA, WOTH	Exotic Plant Treatment	8	Dec. 2006	Kelly Hughes	Yes
WM-0110	William Jenkins/Rufus Brown	11/1/06-5/15/11	10yrs 2018	Granville	$1,768	$1,270	$3,038	mixed pine hardwoods	WOTH, YTWA, HOWA, NOPA,	Firelines, Burn, Gaps, Snags	96	May. 2008	Danny Ray, Kelly Douglass	Yes
WM-0124	Frank Bragg	2/1/07-2/1/11	10yrs 2021	Mecklenburg	$3,750	$1,500	$5,250	shortleaf/mixed hardwoods	SUTA, WOTH, OVBI, YBCU,	Exotic Plant Treatment	5	Feb. 2008	Laura Fogo, Danny Ray	Yes
WM-0154	Longleaf Pine Farms - Snowden	1/20/08-4/15/10	10yrs 2020	Scotland	$3,790	$1,375	$5,165	Longleaf Pine	BASP, BHNH, NOBO,	Firelines, Burn	90		Susan Miller	Yes
WM-0162	SALT River Oaks	2/15/08-4/1/11	10yrs 2020	Cumberland	$5,040.75	$2,585	$7,626	Mesic Mixed Forest	SWWA, HOWA, POWA, NOPA WOTH	Burn, Timber Stand Improvement, Exotic Plant Treatment	87		JA Shearer	Other Plan
WM-0160	Boy Scouts of America Cherokee Reservation	4/1/08-4/1/09	10yrs 2019	Caswell	$8,142	$2,714	$10,856	shortleaf pine	NOBO, SUTA, WPWI, NOFL,	Site Prep, Plant	76		Danny Ray	Yes
WM-0174	John & Linda Sigmon	10/1/08-4/1/11	10yrs 2020	Granville	$2,613.25	$1,076	$3,690	hardwood	WOTH, YTWA, HOWA, NOPA,	Firelines, Burn	78	Sept. 9, 2011	Danny Ray, Kelly Douglass	Yes
WM-0187	Hogan	4/1/09-4/1/11	10yrs 2021	Richmond	$7,636	$3,323	$10,959	Longleaf Pine	BASP, BHNH, NOBO, SUTA, RCWO	Marking timber, site prep, understory control, thinning, plant, exotic plant treatment	93		JA Shearer, John Isenhour	Yes
WM-0199	Ricks White Oak Alley	3/1/10-3/1/11	10yrs 2021	North Hampton	$3,832	$1,278	$5,110	Hardwoods/ Oaks	WOTH, YTWA, HOWA, NOPA,	Gap creation, firelines, burning	118	July. 8, 2011	Danny Ray, Kelly Douglass	Yes

Appendix A

Agreement Number	Project Cooperator	Dates of Agreement	Life of Agreement	County	FLLP Payment	Landowner Contribution-estimate	Total Project Cost - estimate	Habitat Type	Priority Birds	Practices	Acres	Recognition/ Certification	Lead	Forest Steward-ship Plan
WM-0160b	Boy Scouts of America Cherokee Reservation	2/1/10-2/1/11	10yrs 2021	Caswell	$7,020	$2,340	$9,360	Hardwoods/ Oaks	WOTH, YTWA, HOWA, NOPA,	understory control	72		Danny Ray, JA Shearer	Yes
WM-0209	TNC-Clark II	7/10/10-4/1/11	10yrs 2021	Cumberland	$12,938	$4,312	$17,250	Longleaf Pine	BASP, BHNH, NOBO, SUTA,	midstory control	30		JA Shearer, Susan Miller, Kelly Douglass	other plan
WM-0156b	NC CLT - DuPont - G Track	7/1/10-4/1/11	10yrs 2021	Bladen	$4,950	2,175	$7,125	Longleaf Pine	BASP, BHNH, NOBO, SUTA	site prep (herbicide and burn), firelines, plant	25		David Allen, JA Shearer	Yes
WM-0156c	DuPont Fayetteville Works	7/1/10-4/1/11	10yrs 2021	Cumberland	$6,093.75	$2,000	$8,094	Longleaf Pine	BASP, BHNH, NOBO, SUTA	site prep (herbicide and burn), firelines, plant	30		David Allen, JA Shearer	Yes
WM-0210	Wildwood Heritage LLC	10/1/10-4/1/11	10yrs 2021	Caswell	$3,825	$1,275	$5,100	Hardwoods/ Oaks	WOTH, YTWA, HOWA, NOPA, SCTA	understory control	34		Kelly Douglass, JA Shearer	Yes
WM-0213	Jackson Park	11/1/10-4/1/11	10yrs 2021	Henderson	$4,150	$1,382	$5,527	Hardwoods	WOTH, YTWA, HOWA, NOPA, SCTA	Exotic Plant Treatment	25	Jan. 24, 2011	Kelly Hughes	
WM-0216	Hairston Family LLC - Cooleemee	11/19/10-4/1/11	10yrs 2021	Davie	$1,241	$500	$1,741	Hardwoods/ Oaks	WOTH, YTWA, HOWA, NOPA, SCTA	firelines, burning	37	July. 26, 2011	Laura Fogo, John Isenhour	
WM-0220	NCCLT- Hewett	3/10/11-4/10/11	10yrs 2021	Brunswick	$2,400	$800	$3,200	Longleaf Pine	BASP, BHNH, NOBO, SUTA	removal of encroaching loblolly pine in young longleaf stand	25		JA Shearer, David Allen	Yes
WM-0218	Transylvania Parks and Recreation	3/15/11-4/15/11	10yrs 2021	Transylvania	$2,625	$875	$3,500	mixed pine hardwoods	HOWA, KEWA, WOTH, YTVI	Exotic Plant Treatment	6		Kelly Hughes	

Appendix A

Agreement Number	Project Cooperator	Dates of Agreement	Life of Agreement	County	FLLP Payment	Landowner Contribution-estimate	Total Project Cost - estimate	Habitat Type	Priority Birds	Practices	Acres	Recognition/ Certification	Lead	Forest Steward-ship Plan
WM-0222	Blue Farm	3/27/11-4/15/11	10yrs 2021	Hoke	$2,340	$585	$2,925	Longleaf Pine	BASP, BHNH, NOBO, SUTA, RCWO	removal of encroaching loblolly pine in young longleaf stand	18		JA Shearer, Kelly Douglass	yes
					$89,411.89	$34,097	$123,505							
NO CASH TO LANDOWNER AGREEMENTS														
WM-0148	Waynesborough Historical Village	11/1/07-8/15/10	10yrs 2018	Wayne	landowner followed agreement without reimbursement	$2,500	$2,500	bottomland hardwoods	GCFL, PFWA, HOWA, WOTH, VTVI	exotic plant treatment, snag creation	68	Dec. 2010	Joe Folta	other plan
WM-0223	DENR - Office of Conservation	3/18/11-6/18/11	10yrs 2021	Franklin/ Warren	$1000 paid for herbicides directly by WRC	$334	$1,334	mixed pine hardwoods/ riparian	SWWA, HOWA, POWA, NOPA, WOTH	exotic plant treatment	50		JA Shearer, David Allen	other plan
	8 Elementary School PTAs	7/1/11-9/31/11		multiple	$3,500 paid directly to Spy On A Bird	$1,600	$5,100		EBLB	Educational - Bluebird boxes with cameras			JA Shearer, David Allen	
					$93,912	$38,531	$132,439				1,245			
Other expenses														
	Mailing/shipping				$9.80									
	Printing				$1,924.00									
	Materials and supplies				$1,834.03									
	Placques/certificates				$266.69									
	Misc. staff time				$242.94									
					$4,277.46									
Overall Totals					$98,489.35	$38,531.00	$137,020.35							
		Does NOT include staff time to conduct meetings, site visits, write plans, review plans, inspect completed projects												

North Carolina Coastal Land Trust's DuPont Property

Background and Plan

The North Carolina Coastal Land Trust (NCCLT) acquired several tracts of land adjacent to the DuPont Corporation lands in Brunswick County and became interested in working with the Forest Landbird Legacy Program (FLLP) in the fall of 2004. After inspecting several tracts, the FLLP formulated a plan to focus on two of the tracts totaling 174 acres. We first completed a rudimentary timber survey to determine the amount of pine versus hardwood and the percentage of longleaf pine on the tracts. After substantial discussions we devised a plan that was fully supported by the NCCLT: (1) thin two stands of mixed pine hardwood (down to 50 BA or 30 BA around existing longleaf pines) removing a majority of the hardwoods and favoring any existing longleaf pines; (2) institute a prescribed burning program immediately after timber thinning to remove competing loblolly pines and hardwoods; (3) plant longleaf seedlings in areas where longleaf overstory wasn't sufficient to reestablish the stand, and (4) eradicate non-native bamboo and wisteria in a 4-acre area on Tract E. These activities were intended to improve habitat for forest landbirds and in particular priority forest landbirds. Bird surveys began in an attempt to quantify birds within the stands both before and after the treatments.

Accomplishments

Timber was marked by a team from the FLLP, a registered forester, and representatives from the NCCLT. Thinning was conducted in 2007 and 2008. In addition 4 acres of bamboo and wisteria were cut and the stumps were treated with 41% glysophate at an 8% mix rate with dye to help identify which stumps had been treated. After one growing season the same 4 acres were mulched and treated again with herbicide. This time a 4% glysophate, 1% arsenal and 0.5% surfactant mixture was used at about 20 gallons/ac. Additional mop-up treatments were also applied on 3 different occasions within the next 2 years. Both stands have also been burned after they were thinned, then under-planted with longleaf pine seedlings where the overstory was not primarily longleaf pine. In areas where the overstory was primarily longleaf, there were no seedlings planted since the seed source from the overstory should be sufficient to seed in any gaps.

Breeding season bird point counts were conducted in June from 2005 through 2011 with the exception of 2010. This provided at least 30 points of bird data both before and after treatment. Some additional point count data was not used since it was collected soon after treatment. Bird activity had been disrupted and ground cover had not yet recovered during this time.

Site D in 2010 after habitat improvement.

Results

Basal area (BA) measurements after thinning indicated the remaining stand to be 20-50 square feet of BA. Some of these areas were primarily longleaf pine, while others were a mixture of longleaf, shortleaf, and loblolly pines with some large hardwoods (primarily oaks) mixed within. Survival of longleaf pine seedlings was good, but patchy. Some natural longleaf pine regeneration was noted and wiregrass looked healthy in patches. Competition from vines and

saplings is significant, but the NCCLT has plans to continue burning efforts which should release the seedlings and promote further wiregrass expansion. After at least 5 herbicide treatments on the bamboo and wisteria, these exotic species seem to be eradicated. No live stems of these two species have been noted during the past two growing seasons.

The Forest Landbird Legacy committee recognizes the NC Coastal Land Trust.

Twelve priority bird species were identified during point count surveys over six years of effort (see Table 1). Nine of these bird species were found both before and after treatment. Three bird species were only found before the treatment and four were only found after treatment. Two of these priority birds (wood thrush and hooded warbler) declin significantly after treatment, while two (easte wood-pewee and brown-headed nuthatc increase significantly after treatment. No oth significant differences were found for t priority bird species.

These data would seem to indicate that althou the treatment certainly changed the habitat a the birds that are found on these two stan during the breeding season, the treatment d not necessarily improve the sites for priori forest dwelling birds in the short term. It do however seem that much of the benefits to fore landbirds will be in the future, because of fore maturation and fire regime benefits to come.

Perhaps the largest benefit of the project was encourage the DuPont Corporation to bett manage hundreds of acres of remaining habi around and between the NCCLT propertie After seeing the management done on t NCCLT property and after working with t FLLP, DuPont has initiated a significa burning program and has already burned seve stands at least once. They have also thinn several stands that were very dense a provided much better habitat for birds and oth species. In addition, both the NCCLT and t DuPont Corporation have site prepared a planted additional acreage into longleaf pine.

Table 1. Priority Bird Species found on the North Carolina Coastal Land Trust's DuPont Property (Tracts D and E) through Point Count Data, Before and After Treatment.

	Before Treatment				After Treatment				
Bird Species	2005	2006	2007	Total	2008	2009	2011	Total	T test
wood thrush	13	18	7	38	2	1	0	3	Significantly fewer
eastern wood-pewee	5	3	2	10	6	11	9	26	Significantly more
hairy woodpecker	1	0	0	1	0	0	0	0	No significant difference
hooded warbler	4	4	0	8	0	0	0	0	Significantly fewer
yellow-billed cuckoo	3	4	0	7	4	2	0	6	No significant difference
northern bobwhite	2	4	1	7	0	1	5	6	No significant difference
chuck-wills widow	0	0	2	2	0	0	0	0	No significant difference
brown-headed nuthatch	0	0	0	0	2	6	3	11	Significantly more
prairie warbler	0	0	0	0	0	1	0	1	No significant difference
red-headed woodpecker	0	0	0	0	0	4	2	6	No significant difference
field sparrow	0	0	0	0	0	1	2	3	No significant difference
common nighthawk	0	0	0	0	0	0	1	1	No significant difference

Habitat Restoration at Jackson Park

The bottomland swamp forest at Jackson Park in Hendersonville, NC is infested with invasive exotic plants. Privet and multiflora rose have spread to form an almost impenetrable thicket in the midstory and understory. Heavy infestations of honeysuckle and bittersweet are also present. Trails were bordered with privet, 6 to 10 feet tall, allowing limited views into any of the swamp forest understory.

Jackson Park is heavily used by birders. For the past few years, efforts to involve birders in work days to control invasives on the trails were met with minimal interest. In 2009, one birder assisted with clipping back privet and opening up viewing windows for improved birding opportunity. Little progress was made with hand tools; undesirable vegetation rapidly grew back the next year.

In April of 2010, the park was invited to participate in the Forest Landbird Legacy Program, and cost share funding was offered to control the invasives. Initial control work began in November 2010. Invasives were removed from the Warbler Trail and an area along the Nature Trail using the cut stem method. Undesirables were cut off at ground level and a 50% solution of 53.8% glyphosate and a colorant was applied to the cut surface. Crews with North Carolina Wildlife Resources Commission and park maintenance staff removed the cut slash as the contract crew worked along both sides of the Warbler Trail in November.

Habitat Restoration at Jackson Park

Since the initial effort, habitat work has been ongoing as time and weather conditions allow. During December, cut stem work began along the other side of the Nature Trail and in the swamp forest between the Bottomland Trail and the marsh on Highway 64.

Work is only conducted on days when temps are above 40 degrees and rain is not predicted for at least 24 hours. A lightweight Stihl pruning saw was purchased by the park in December and is used to cut off the stems at ground level. A hand-held spray bottle is used to immediately apply herbicide to all cut stems surfaces. Work was usually conducted in 3 hour blocks, typically within the 1pm to 5pm range. The herbicide application was observed to dry on the cut stem surface within a few minutes of application. In fact, the herbicide appeared to be rapidly absorbed into the cut stem.

Literature suggests that cut stem work in December and January may be less effective than at other times of the year. The ongoing control work will be evaluated during the growing season 2011 to determine the effectiveness of these dormant season applications. Impact to park users is one of the main considerations for this timing since visitor use is low during the winter compared to others seasons when birders frequent these areas. No birders were observed during these winter work days. Dog walkers, joggers, and bikers are seen on the trails.

Mature Ailanthus trees along the Warbler Trail were girdled and sprayed during the December treatments. Literature suggests that glyphosate is not as effective on Ailanthus as triclopyr, but previous control work done under FLLP contract provided evidence to the contrary. If the girdling and herbicide application only kills the trees from the girdle up, then once the tops fall, the short trunks can be cut off at ground level and glyphosate applied to the cut surface to control re-sprouting.

During January 2011, cut stem work was conducted in the Bottomland Trail swamp forest. The FLLP certified habitat sign was erected and the FLLP plaque and accompanying letter was presented to the park director.

Efforts to assuage concerns generated by the changes in appearance to the area include meetings and calls with bird club members to explain the benefits of the work, educational materials made available at the park office, and signage on the trails to inform users regarding the girdled trees and the changes along the Warbler Trail. Articles for various newsletters (Henderson County newsletter, NC Birding Trail newsletter, Henderson County Bird Club newsletter, Forest Stewardship newsletter) and the Henderson County newspaper are in preparation.

Forest Landbird Legacy and the William Jenkins Tract

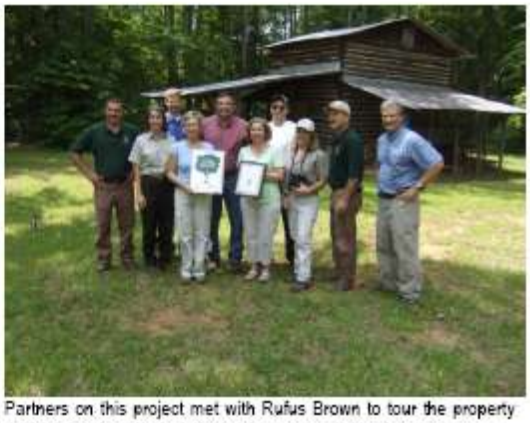
Imagine taking a large mature forest and fine tuning it to benefit forest dwelling songbirds. It's a challenge alright, but exactly the challenge for which the Forest Landbird Legacy Program was designed. And speaking of challenges, no one likes to take them on better than Rufus Brown, son-in-law of William Jenkins and caretaker of the Jenkins family property. Put these two together and you have a success story on 117 acres of mixed hardwood and pine forest in the southeast corner of Granville County.

After walking over the property and discussing land management practices with wildlife biologists and foresters, the family's consulting forester developed a Forest Stewardship Plan. With the collaborative plan in place, Rufus Brown requested funds from the Forest Landbird Legacy Program to help accomplish some of the plan's goals.

Then the fun stuff... Over the next two years Brown worked diligently to establish firebreaks along property boundaries and around each burn block and followed up by conducting a prescribed burn. He'll continue to conduct prescribed burns on a regular basis.

In addition to containing prescribed burns, firebreaks make great hiking and access trails, good shooting lanes for deer hunting, and perfect places to be planted as food plots for turkey.

Prescribed fires enhance the wildlife habitat along the forest floor, particularly in pine stands. Fire improves the growth and composition of the understory vegetation and benefits many species of forest dwelling birds including brown-headed nuthatches and black and white warblers that search for insects nestled in the tree bark.



Partners on this project met with Rufus Brown to tour the property and present the Jenkins family with a recognition sign and plaque.

He also created half acre forest canopy gaps every 3 to 4 acres by simply harvesting the trees in a few small areas and allowing sunlight to reach the forest floor. Soon vegetation filled in the gaps, adding to the diversity of the forest and making feeding places for such birds as scarlet tanagers and hooded warblers.

The summer tanager is one type of songbird that needs relatively open space within the forest to forage on insects. Using its tweezer-like beak, the scarlet tanager flies through the open air to grab flying insects. It also will hover over the ground in search of insects and earthworms.

Simultaneously he had the density of the pine forest reduced to a basal area between 50 and 70 square feet. A reduction in basal

area relieves the crowded conditions in the forest. The released trees usually grow larger crowns which produce more mast and provide greater habitat potential for canopy dwelling birds.

One bold strategy of Brown's forest and songbird management plan was the creation of snags. Snags are standing dead trees that woodpeckers, owls, and other cavity-nesting birds use. Insects burrow into the trees, simultaneously helping with the breakdown of tree fibers and serving as a source of prey for woodpeckers, nuthatches and other animals. Many other critters, such as raccoons and possums, use snags to find shelter and food. To create snags, Brown girdled four trees within each five acre block.

Snags and den trees are a vital component of all forests, providing a significant microhabitat within the forest. To some wildlife species, a snag is more usable than a living tree.

In addition to benefitting so many high priority bird species, the family's opportunities for outdoor recreation, including turkey and deer hunting improved with the management actions they chose to take.

Another strong desire of this family was to protect it from development. Today, the entire Jenkins tract is protected with a working forest conservation easement held by the Tar River Land Conservancy. The family will continue to conduct prescribed burns, harvest timber, hunt, and hike there, and take comfort knowing the land will remain intact in a natural condition…forever.

Forest gaps were created to provide diversity in the forest.

The Partners for Fish and Wildlife Program in North Carolina collaborated with the North Carolina Wildlife Resources Commission and the Natural Resources Conservation Service to establish the Forest Landbird Legacy Program in 2003. This voluntary program that promotes the conservation of forest-dependent migratory birds on non-industrial private forest lands is available to interested landowners. See http://www.fws.gov/raleigh/pdfs/partners/FLLPFact_Sheet.pdf for more information.

Forest Landbird Legacy Program

The Forest Landbird Legacy Program (FLLP) is a voluntary wildlife conservation program for private non-industrial forest landowners in all parts of North Carolina who want to manage their mature forests to benefit forest dwelling landbirds. The focus of the FLLP is migratory "birds of conservation concern" identified by the Partners In Flight assessment for North Carolina. The FLLP will build appreciation for songbirds and their forest habitats, provide recognition to landowners that conserve forest landbirds, promote forest management to sustain migratory bird populations, and provide expert planning and financial assistance for restoration and enhancement practices.


Swainson's Warbler


Northern Parula


Hooded Warbler

Why should I participate? FLLP participants receive assistance from professional wildlife biologists and foresters to develop a landbird management plan. Reimbursement for a portion of costs incurred implementing a forest landbird conservation plan is also available. Each participating landowner can receive a Forest Landbird Legacy sign and certificate recognizing their participation in the program and their commitment to bird conservation.

Who can participate in the FLLP? Cost sharing is available to any non-industrial forest landowners including private owners, partnerships, corporations, not-for-profits, local governments, and Indian tribes. Federal agencies, state agencies, and commercial forest industries cannot receive cost sharing. However, planning assistance and program recognition may still be given to participants that are not eligible for cost share. Land eligibility is determined by "the 50/50 rule" that calls for forests to be a minimum of 50 years old and 50 acres in size. The forested or wooded land must have management potential and must contribute to a larger landscape affect that benefits forest landbirds. Exceptions may be made to the 50/50 rule if surrounding landscape contributes to the goals of the program. The program is available statewide.

How long do I have to participate in order to receive funding? FLLP participants will be asked to sign an agreement to implement and maintain their habitat conservation plan over a span of at least 10 years. Each participant will also be asked to demonstrate their commitment to the FLLP goals by sharing part of the cost to implement the conservation plan using their own resources which may include agreed-to materials, labor, or money.


Summer Tanager


Prothonotary Warbler

Forest Landbird Legacy Program

Black-throated Blue Warbler

Wood Thrush

Kentucky Warbler

What type of conservation work will be done on my land?
Forest landbird conservation plans will be considerate of the participant's goals, values, concerns, and abilities. Conservation plans may include prescriptions for a variety of treatments such as snag creation, prescribed burning, control of exotic invasive plants, tree-release cutting, creation of gaps in the canopy, habitat improvement plantings, and in some cases simply maintaining the status quo.

How much work or money will I have to contribute? FLLP will contribute up to 75% of the cost of recommended actions. Project costs will be calculated based on the average state-wide cost of a practice as indicated on the FLLP cost rate list. Payments will be made to participants by the NC Wildlife Resources Commission (NCWRC). The participants are asked to provide a contribution of materials, labor, or money totaling at least 25% of the project cost.

When will I receive assistance and/or funding? Participants receive cost reimbursement after the project is completed and approved by the NCWRC. Treatments will be scheduled for completion within 24 months of signing the FLLP agreement. Each participant may only receive one cost-sharing agreement per year. Participants may reapply in subsequent years. No participant may receive more than $10,000 reimbursement from FLLP.

How will others know I am participating in this program? Participants having existing habitat that already demonstrates conservation of biodiversity in mature forests for the benefit of forest-dependent landbirds may be certified as Forest Landbird Legacy Habitat participants and receive the FLLP sign and certificate. Certified sites demonstrate the goal of the FLLP and serve to educate the public and recognize landowners who participate in the program.

How do I apply to become part of this program? Contact a FLLP representative in your area to discuss your interest and schedule a site visit. Applications will be reviewed and ranked by the FLLP partnership. Those selected will be offered a participation agreement and cost-sharing if appropriate.

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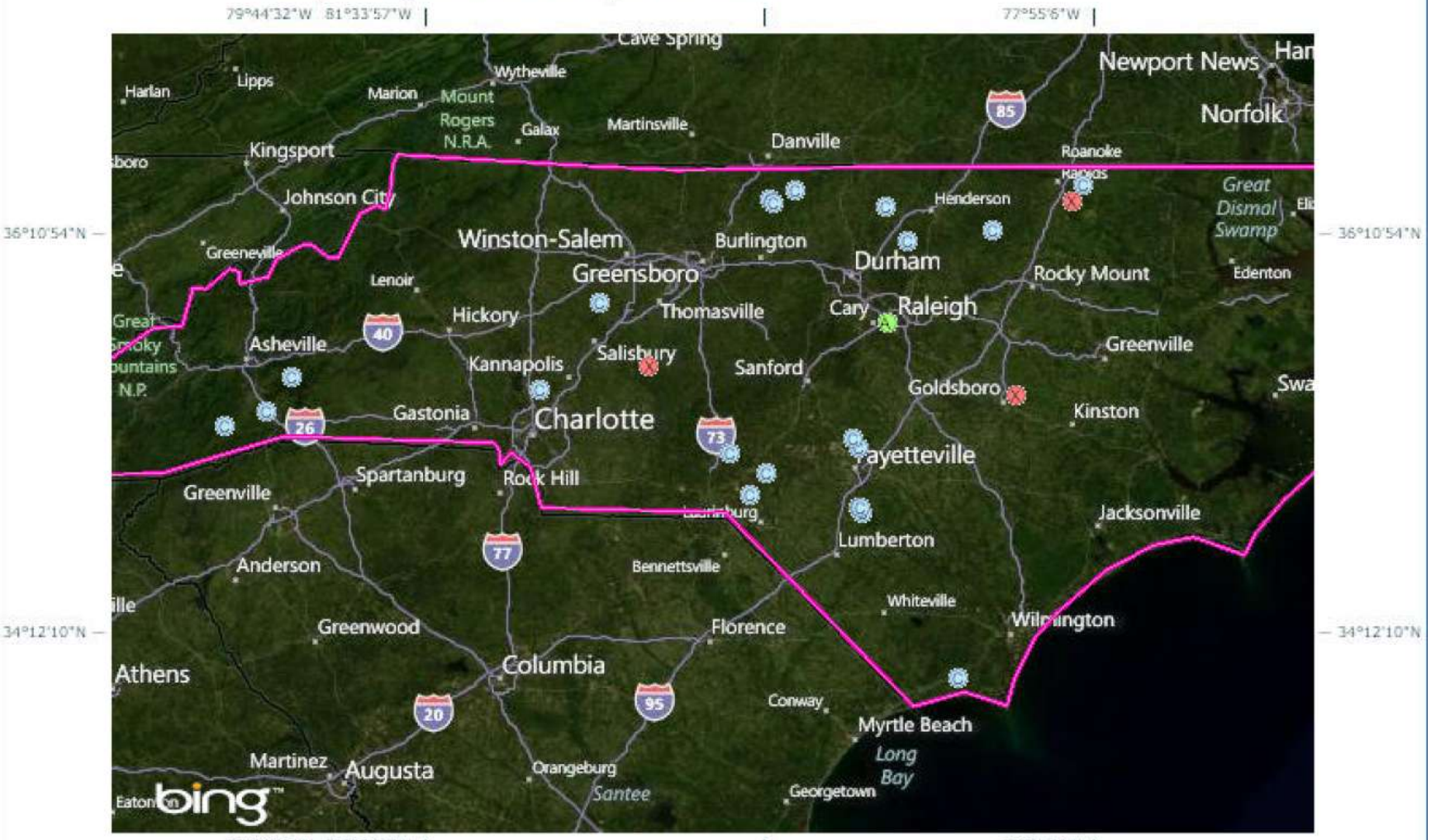
Chris Kelly, NCWRC (828) 299-7441

U.S. Fish and Wildlife Service

Forest Landbird Legacy Projects

C=Completed Projects, X=Cancelled Projects, A=NCWRC



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ORGANIZATION: 42420 - RALEIGH ESFO

MAP DATE: Tue Nov 15 2011

BASEMAP: Bing Aerial Maps (with labels)

50 mi

100 km

N W E S