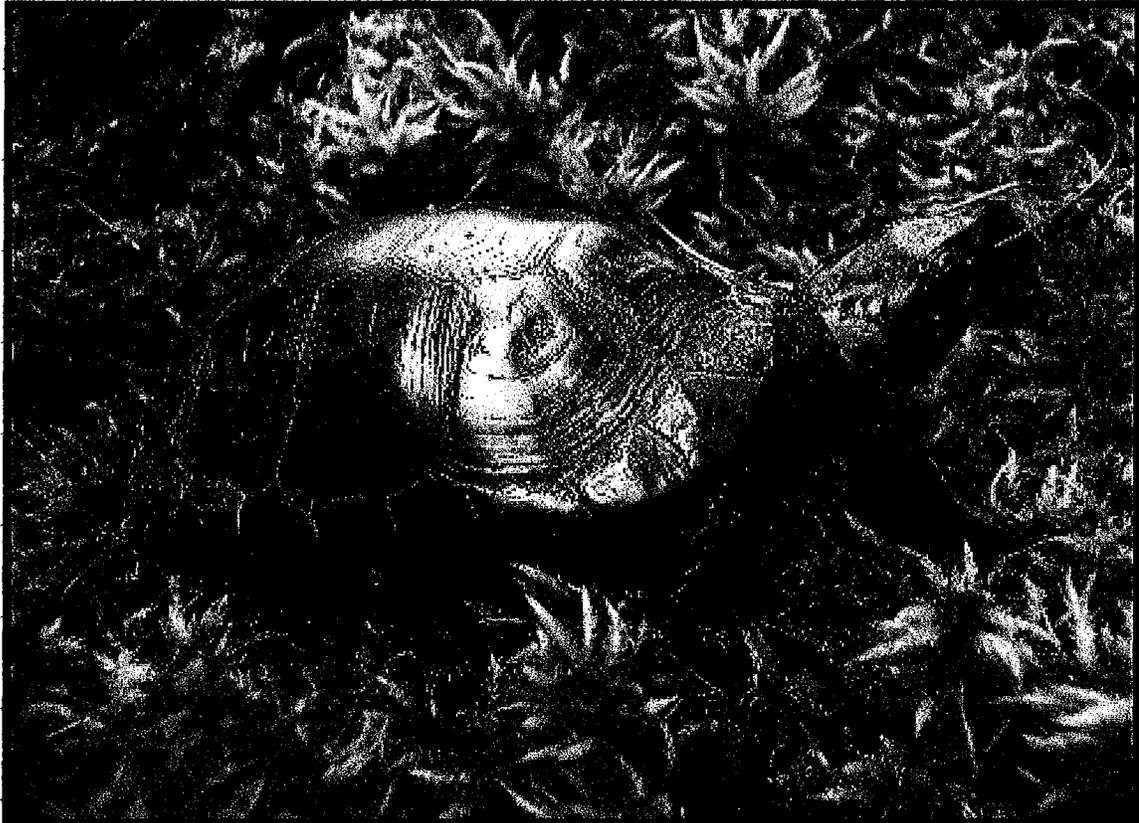


**Bog Turtle Population Assessment at the Franklin Bog,  
Henderson County, North Carolina  
May 24-28 & June 7-11, 2004**

**Bog Turtle Population Survey Conducted for  
Earth Tech, 701 Corporate Center Drive, Suite 475, Raleigh, NC 27607**



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# CONTENTS

<b>Introduction</b> .....	1
<b>Purpose of the Population Survey</b> .....	2
<b>Materials and Methods</b> .....	2
Bog Turtle Search Methods .....	3
Bog Turtle Collection Data .....	3
<b>Results</b> .....	3
Turtle Data .....	4
Capture Data .....	4
Trapping Data .....	4
Capture Methods .....	4
Age Structure .....	5
<b>Discussion</b> .....	5
<b>Management Recommendations</b> .....	7
A. Habitat Management & Livestock Grazing .....	7
B. Captive Breeding & Release Program .....	8
C. Impediment or Control of Illegal Turtle Collecting .....	9
<b>Conclusion</b> .....	10
<b>Acknowledgments</b> .....	11
<b>Literature Cited</b> .....	12
<b><u>Appendices</u></b>	
<b>Appendix A: Map of Franklin Bog Indicating the Trap &amp; Bog Turtle Capture Point Locations – May 24-28, 2004</b> .....	13
<b>Appendix B: Map of Franklin Bog Indicating the Trap &amp; Bog Turtle Capture Point Locations – June 7-11, 2004</b> .....	15
<b>Appendix C: Franklin Bog Plants &amp; Animals</b> .....	17
1. Franklin Bog Plant List .....	18
2. Franklin Bog Animal List .....	20

**Cover Photo:** Female bog turtle (T46), found in the Phase 2 section of the Franklin Bog on 7 June 2004. Photograph by Dennis W. Herman

**Bog Turtle Population Assessment at the Franklin Bog, Henderson County, NC**  
**May 24-28 & June 7-11, 2004**

**Introduction**

Robert T. Zappalorti and Dave Collins first discovered the Franklin Bog on June 19, 1975 (Zappalorti and Johnson 1981). The wetlands observed from the road by Zappalorti and Collins reminded them of bog turtle sites they were familiar with in Pennsylvania. This initial investigation yielded seven bog turtles, and an additional fifteen were found during the next two days. These wetlands were located on both sides of Blythe Mill Creek and Turnpike Road (presently Old Turnpike Rd.) in a semi-rural area of Henderson County approximately 2 miles northwest of Etowah. The wetland on the east side of Turnpike Road became known as the "main bog" (Phase I, in the present study) and was the first area searched by Zappalorti and Collins. The smaller wetland patch to the west of the road was referred to as the "Triangle Campground bog" (Phase II) because of the campground of the same name owned and managed by Mr. Emerson Franklin. This wetland was later called the "pasture bog" by Herman and his associates because it was the only grazed area of the two.

When discovered in 1975 the "main bog" was formerly grazed and had an open canopy dominated by peat moss, sedges, and rushes, and it graded into a larger red maple swamp-forest bog complex. The "pasture bog" was an open wet meadow dominated by peat moss, sedges, and rushes and was grazed by three horses. Active management by Mr. Franklin by hand clearing trees and shrubs maintained the site as open pasture. Mr. Franklin had installed a shallow hand-dug ditch to drain water from a portion of the site. This water originated from a spring that flowed from the toe of the slope above the wetland. Two ponds were constructed during 1975-1976 to provide fishing and recreation for campers. Bog turtles were found in both wetlands by during Zappalorti's visits in 1975, but the majority were found in the "main bog", and that became the trend throughout the site's history.

Robert T. Zappalorti (a curator with the Staten Island [NY] Zoo), under a National Audubon Society grant, was commissioned by the Highlands Biological Station to conduct a bog turtle survey in southwestern North Carolina. Dr. Dan Pittillo (Western Carolina University botanist) had discovered the first bog turtle known from Henderson County while conducting rare plant surveys in May 1975. Mr. Zappalorti took this information and searched the area of Pittillo's discovery and found the Franklin Bog and a smaller, less quality site downstream that he called the Costa Bog.

Mr. Zappalorti invited this investigator to assist him in the survey and I made my first visit to the Franklin Bog on July 16, 1976. I was given all of Zappalorti's field data after the 1977 field season with encouragement to continue the survey work in North Carolina. The Franklin Bog became a very important study site until 1992, and during a period covering 1975 to 1992 at least 130 individual turtles were found and nearly 100 were marked.

The Franklin Bog became a registered Natural Heritage Area in 1982. The N.C. Natural Heritage Program assumed that the entire site was under registry, but only the Franklin's portion was. On April 7, 1984 this investigator discovered that a large portion of the "main bog" had been filled with stumps and debris in an attempt to build a road across the wetland to access property on the south side of Blythe Mill Creek. The NCNHP was informed of this discovery, and after a brief investigation it became evident that Mr. Franklin did not own this parcel. The NCNHP was shocked to find out that two developers actually owned several acres of the "main bog". The U.S. Army Corps of Engineers cited the two owners and they were given a 'cease and desist' order and told to remove the debris fill. These owners fought the order in court and received an after-the-fact permit two years later. The landowners refused all access to their portion of the site, so the total area of the bog turtle study decreased

significantly. The “pasture bog” and the present Phase I area became the main study areas from 1985 to 1992.

The Franklin Bog had become known to turtle collectors sometime during the late 1970s, but the source of this knowledge can only be speculated. Collectors from Columbus, Ohio spent nearly a week at the Franklin Bog in May 1989 (Memorial Day holiday week), and visited the nearby McClure Bog, too, according to landowners at both sites. These individuals collected an unknown number of bog turtles, including an unknown number of marked turtles. Bern Tryon (Knoxville Zoo) contacted the herpetology curator at the Columbus Zoo to report this incident. The curator reported back that, after an investigation by his staff, a large number of bog turtles had appeared in the Columbus area, and that many of the turtles bore shell notches. We can only speculate how many turtles were taken from the Franklin Bog by these collectors, but as many as 30-40 would be a conservative number, depending on the expertise of the collectors. This major removal of turtles by the Ohio individuals occurred less than two months prior to North Carolina giving the bog turtle protection as a “threatened species.” Other turtles were taken, under state permit, by several institutions from the Franklin Bog for scientific and research purposes over the years after its discovery.

The Franklin Bog became less important as a study site by this investigator because the turtle project expanded into other regions of North Carolina and other southern states. Visits to the Franklin Bog by this investigator became rare after 1992, although the majority of visits resulted in turtle captures.

The N.C. Department of Transportation purchased a 2.1-acre parcel east of the road in 2001 (“main bog”) and a 7.1-acre parcel west of the road in December 2003 (“pasture bog”). A conservation bank of these parcels was proposed by the NCDOT for the protection of the bog turtles and the conservation of bog turtle habitat.

### **Purpose of the Population Survey**

An assessment of the bog turtle population was imperative before a management plan could be completed. Bog turtles had not been found by, or reported to this investigator since 1992. Two turtles were found by Chris McGrath (NCWRC) and Ed Hajnos (NCDOT) on May 6, 2003. Both of these turtles were recaptures of formerly marked individuals found in the early 1990s.

We knew from capture data recorded by Zappalorti and myself that the Franklin bog was the largest turtle population known in North Carolina and, possibly, in the entire Southeast. How had the past disturbances and the natural succession that had taken place since 1984 affected the turtle population? What is site’s current population status? These questions were the driving force behind the current study to determine the present status of the bog turtle at the Franklin Bog.

### **Materials and Methods**

The population assessment was conducted over a two week period from May 24 to May 28, 2004 and June 7 to June 11, 2004 at the Franklin Bog in both Phase I and Phase II parcels. These two weeks were selected because they fall within the peak capture season (and spring activity period) based on past capture results from the Franklin Bog and other southern bog turtle study sites, also, maximum vegetation growth is usually reached by the second week of June.

## Bog Turtle Search Methods:

Random visual searches were conducted by walking through the wetland and carefully looking for active or inactive turtles. These searches were conducted multiple times daily from May 24-28 and June 7-11. Active turtles are those observed walking or running along a mucky rivulet or through rodent tunnels and trails, digging into the mud, foraging for food, and while eating, mating, or fighting. Inactive turtles are those found as they bask in shallow, muddy water, or on top of sedge tussocks or mossy mounds, and as they rest in or under vegetation or other cover. Long wooden sticks (broom handles or hiking sticks) were used to move sedges, rushes, and other vegetation aside and to probe into muddy pockets and holes at the base of tussocks of vegetation or shrubs in search of hidden turtles. Physical signs of bog turtles were determined by observing turtle footprints in the mud, nests with eggs, hatched egg shells, and dead turtles' remains.

Wire traps (N=20) were used in conjunction with the above search methods to aid in locating active turtles while the investigator was away from the site during the early morning and night time hours. The traps were placed in the site on the by 10:30 a.m. on May 24 and June 7 and removed by 10:30 a.m. on May 28 and June 11. The traps used were a modified version of those developed and used by Fahey (1992, 1998) and constructed of 1" X 1" welded wire. The traps had openings at both ends that measured 3½ - 4" square, were 12 - 14" long, and had free falling trapdoors attached to the inside of each opening. The traps were placed in muddy runs or nestled into rodent tunnels under cascading vegetation. All traps were covered to shade any capture turtles and checked a minimum of twice daily. Most often the traps were checked multiple times daily as part of the random search method. GPS coordinates were recorded for the trap placement positions.

## Bog Turtle Collection Data:

Turtles captured during the survey were assigned identification numbers and were marked by filing notches in the marginal scutes. The notching code system used was similar to that of Cagle (1939) and Ernst et al. (1974), or a modification of those systems. Every turtle was weighed and measurements of the carapace, plastron, nuchal (cervical) scute, and shell height were taken and recorded in a field notebook. The turtles were closely examined and the shell condition, shell anomalies, or injuries (fresh and healed) were noted and recorded, along with a drawing indicating their location on the carapace or plastron. The age of each turtle was determined or estimated by counting the growth annuli on the right abdominal scute and other plastral or carapacial scute, if necessary. Turtles that possessed smooth shells with few or no visible annuli were recorded as 20+ years old based on observations of shell wear history over the years. Ages of recaptured turtles were determined by adding the years between captures to the estimated age at last capture.

The time of capture and the GPS coordinates were recorded for each turtle, along with any observed behaviors or activities. Recaptured turtles were weighed to see if any change had occurred between captures during the study. All of the turtles were implanted with passive integrated transponders (PIT-tags) for positive identification and then released at their capture points.

## Results

The results reported, herein, are as complete as possible and include the following: number of individual turtles, number of recaptured turtles, number of recaptured turtles (previously marked), total turtle captures (new and recaptures), number of search days, number of search hours (manhours), turtles per unit effort (turtles/search hour), and trapping data (number of traphours, number of trapdays, turtles/traphours, and turtles/trapday).

### Turtle Data:

Individual turtles captured:	N = 8	(2 males and 6 females)
New (unmarked turtles):	N = 3	(0 males and 3 females)
Recaptured turtles (previously marked):	N = 5	(2 males and 3 females)
Total turtle captures:	N = 14	(7 males and 7 females)

### Capture Data:

Total search days:	N = 8.2	
Total search hours (manhours):	N = 83	
Turtle captures/day:	N = 0.98	
Turtle captures/search hour:	N = 0.10	
Turtle captures found by probing:	N = 8	(5 males and 3 females)
Turtle captures by trapping:	N = 6	(2 males and 4 females)

### Trapping Data:

Total number of traps placed:	N = 20	
No. traps in Phase I: (May 24-28)	N = 4	
No. traps in Phase I: (June 7-11)	N = 0	
No. traps in Phase II: (May 24-28)	N = 16	
No. traps in Phase II: (June 7-11)	N = 20	
Total days trapping:	N = 8	
Total trap days: (May 24-28 & June 7-11)	N = 160	
Trap hours for May 24-28:	N = 1852	
Trap hours for June 7-11:	N = 1920	
Total trap hours:	N = 3772	
Total turtles trapped:	N = 6	
Turtles/days trapping:	N = 0.75	
Turtles/trap days:	N = 0.375	(1 turtle capture/26.7 trap days)
Turtles/trap hours:	N = 0.0016	(1 turtle capture/628.7 trap hours)

### Capture Methods:

Two females (T14 & T90) were found by probing only; 3 females (T34, T46, & T47) were trapped only; 1 female (T40) was trapped initially and found by probing once; 1 male (T411) was trapped initially & found by probing twice; and 1 male (T024) was found by probing initially, trapped once, and found by probing two additional times.

Male turtle (T024) was captured four times (27.7% of captures), male (T411) was captured three times (21.4% of captures), female (T40) was captured twice (14.3% of captures), and females (T14, T34, T46, T47, and T90) were captured once (7.1% of captures each) during the survey.

Bog turtles were found at various times on any given day. In the following table the exact capture time is known for the turtles found by probing, but the actual time of capture is unknown for the trapped turtles, only the actual time of observing a turtle in a trap is known, as indicated:

Time Range                      Capture or Observation Mode & Actual or Observed Time

0800 – 0859 hr	3 found in same trap at 0838 hr
0900 – 0959 hr	1 found in trap at 0915 hr
1000 – 1059 hr	3 probed at 1030, 1049, & 1051 hr
1100 – 1159 hr	1 probed at 1103 hr
1200 – 1259 hr	1 probed at 1240 hr & 1 found in trap at 1243 hr
1300 – 1359 hr	0
1400 – 1459 hr	0
1500 – 1559 hr	1 found in trap at 1546 hr
1600 – 1659 hr	2 probed at 1604 & 1615 hr
1700 – 1759 hr	1 probed at 1749 hr

Age Structure:

The bog turtles found ranged in age from 3 years old to over 30 years of age. The age structure of the turtles found during the study is as follows:

<u>Estimated Age</u>	<u>Number (Sex - estimated age)</u>
Hatchling (<1 year)	N=0
Juvenile (1 – 4 years)	N=1 (F - 3 years)
Subadult (5 – 8 years)	N=0
Adult (9 – 20 years)	N=2 (F - 10+ and F - 11 years)
Old Adult (20+ years)	N=5 (M - 20+, F - 20+, M - 29+, F - 29+, and F - 33+ years)

**Discussion**

The Franklin Bog has had an interesting history in the 29+ years since its discovery. Ecologists and botanists never considered the Franklin Bog a high quality natural community, particularly those associated with the N.C. Natural Heritage Program, due to its grazing history. Plant surveys during the 1970s and early 1980s failed to locate any significantly rare species (Gaddy 1981; NCNHP reports). This site was noted more for its viable bog turtle population than for its plant community. In addition to the bog turtle, the four-toed salamander (*Hemidactylium scutatum*), a state listed “special concern” species, was initially discovered at the Franklin Bog in 1975-1976 (R. Bruce, pers. comm.). The N.C. Natural Heritage Program registered the site based on its important herpetological community in 1982. The poor plant diversity hindered efforts to gain more permanent protection, and the debris-fill episode in 1984 destroyed any chance for lasting protection of the original site.

Grazing was stopped in the “main bog” (Phase 1) section prior to its discovery by Zappalorti and Collins because Mr. Franklin had to continually pull cattle out of the deep mud (E. Franklin, pers. comm.). The “main bog” began to transition rapidly from the open pasture to an alder shrub bog by the late 1970s, but the habitat remained ideal for the bog turtle. The debris-fill episode (1984) caused a rapid increase in the successional processes in the “main bog” and today most of this portion is now climax forest with a closed canopy for the most part. It was during this time period that poison sumac (*Toxicodendron vernix*) was first observed at the site by this investigator, a species characteristic of high quality wetlands. Grazing and vegetation removal continued in the “pasture bog” (Phase 2) throughout the 1980s until the early 1990s when the owner’s advanced age and health prevented him from keeping the site open. The open pasture quickly transitioned to a red maple and alder shrub bog, but open sunny

areas dominated by graminoids persisted that benefited bog turtles. The crested shield fern (*Dryopteris cristata*), a state “watch list” species, was discovered for the first time at the Franklin Bog on May 24, 2004 during the present survey. Evidently, the successional stages that the Franklin Bog underwent over the years were beneficial to the plant diversity of the site, but potentially detrimental to the bog turtle population (See Appendix X for flora and fauna species lists).

Analyses of the bog turtle capture data provided by Robert T. Zappalorti (1975-1977), Dennis W. Herman (1978-1992), Chris McGrath (2003), and the present survey (2004) indicate that 133 individual bog turtles were captured from 1975-2004 for 182 total captures (initial captures + recaptures). Nearly 100 individual turtles were notched for identification. A decline in the bog turtle population at the Franklin Bog is, also, evident from analysis of these data.

There were 131 bog turtle captures (48 males, 69 females, 14 unknown sex) made in the Phase 1 section (“main bog”) based on the 1975-1992 capture data, and 51 captures (23 males, 23 females, 5 unknown sex) made in the Phase 2 section (“pasture bog”) from 1975 through 2004. During the present study 14 total captures (100%) of 8 individual turtles were found in the Phase 2 section, and no turtles were found in Phase 1 compared with 131 captures (72%) in Phase 1 and 51 captures (28%) in Phase 2 from the above analysis. A breakdown of monthly captures by sex (1975-2004) is presented in the following table”:

Month	Males	Females	Unknown Sex	TOTAL	% of Monthly Captures
April	15	12	2	29	16.0%
May	30	31	5	66	36.0%
June	15	28	9	52	29.0%
July	11	17	2	30	16.4%
August	2	0	1	3	1.6%
September	0	2	0	2	1.0%
<b>Total</b>	<b>73</b>	<b>90</b>	<b>19</b>	<b>182</b>	<b>100%</b>

The monthly captures recorded at the Franklin Bog reflect the norm for all other bog turtle sites in North Carolina where most turtle captures occur from April through July. The months of May and June (65% of captures) correspond to the main capture period for bog turtles when reproduction, nesting, and egg deposition occur. I refer to May and June as the main capture period and not activity period because the turtles remain active from April until they return to their hibernacula in September and October. The turtles are more readily observed during May and June because they remain near their home bog during this time, with occasional forays into adjacent meadows to forage for food and vegetation, and vegetation density is low compared to summer and fall months. Sometime in late June and July bog turtles disperse into nearby seepage areas, ditches, and wetlands as far as .5 mile or more from their home bog, where they remain until they return to hibernate. Some individuals may make long distance treks (2.5 miles +) from their initial capture point moving over slopes and ridges into adjacent drainages (Herman 2003) as part of the natural gene flow to keep populations viable.

The capture data recorded during this survey indicate that the turtle population has declined tremendously over the years. Several factors are responsible for this decline. The first factor is the habitat loss due to the debris-fill episode that physically destroyed >1 acre of prime wetland habitat and impacted several springs causing pooling and disruption of groundwater flow into the “main bog.” Also part of the first factor was the rapid succession from open pasture to shrub-bog habitat to climax forest in <20 years in Phase 1 and Phase 2. The second factor is the loss of turtles from the site either by legitimate or unethical reasons. At least 17 individual turtles (5 males, 10 females, 2 unknown sex) are known to no longer exist in the population because of natural mortality and the removal for state-permitted captive breeding programs during the late 1970s and 1980s. In addition to these turtles there is the unknown number of turtles that were removed from the Franklin Bog by the unethical collecting

of the Ohio collectors and others, and the unknown number of turtles that were killed by the debris-fill episode during the winter of 1983-1984.

The known turtles (N=17) that were found dead or removed for breeding projects constitute a 13% decline of the known population (N=130 turtles) prior to 1990. If we assume that 40 turtles were collected illegally by collectors prior to 1990 (Ohio collectors and others) then the population decline increases to 44% (N=57 turtles). Herman and Tryon (1997) and Herman (2003) estimate that an acre of quality habitat supported 15 to 20 turtles. If we factor in an additional 15 turtles removed from the Franklin bog population that were killed during the debris-fill episode (>1 acre destroyed) then the total population decline would be 55.4%. Other than the known group removed from the population these declines are speculative, but knowledge based. No turtle population can withstand this rate of decline, much less the added pressure of the >70% loss of the quality habitat to factor one above.

A comparison of the capture data recorded during the present study (2004) with data recorded for corresponding days and weeks from 1982-1990 is presented in the following chart:

#### 1982-1990

May 21-29	9 days	30 captures	3.33 captures/day
June 6-15	3 days	12 captures	4.0 captures/day

#### 2004

May 21-29	5 days	8 captures	1.6 captures/day
June 5-14	5 days	5 captures	1.0 captures/day

The rapid assessment method and probing with a stick were the methods used to make the captures from 1982-1990, and the captures made during this study (2004) included the above methods in addition to the use of wire traps. The number of captures from 1982-1990 would have been significantly higher if wire traps had been used as a capture method. Even without the use of traps the ratios of capture between the two time periods above were 3:1 and 4:1. This comparison indicates that there has been a tremendous decline in the bog turtle population at the Franklin Bog.

### **Management Recommendations to Enhance the Bog Turtle's Population and Habitat**

The Franklin Bog's declining bog turtle population may be increased using the following recommendations or a combination thereof: a vegetation removal and control program, a livestock grazing regime, a captive breeding and release program, and control turtle collecting.

#### **A. Habitat Management & Livestock Grazing**

Natural succession has made a major negative impact on the habitat quality for the bog turtle at the Franklin Bog. A regime of cutting, removal, and control of woody species and invasive nonnative species is recommended to enhance the turtle habitat. Vegetation removal and control should follow the recommendations presented by Somers et al. (2000).

Phase 1: This parcel is in the most need of habitat management. The forest canopy presently shades 75-80% of the parcel. Ideally, the amount of open sunny area to shade area should be 3:1. Removal of the majority of trees is needed to achieve the desired ratio. The large area of the escaped ornamental

multiflora rose (*Rosa multiflora*) in the vicinity of Blythe Mill Creek and other sections of Phase 1 should be removed.

Employment of a grazing regime in Phase 1 using cattle or goats would be an effective plant control method after the vegetation removal and installation of fencing. Goats may be the best option because they will readily forage on multiflora rose keeping this invasive under control. Light to moderate grazing practices on a seasonal schedule was recommended by Herman (1999), Somers et al. (2000), Ehrenfeld (2001), and Tesauro (2001) as the most effective method to maintain bog turtle habitat and control invasive species.

Phase 2: Some excellent bog turtle habitat remains in this parcel that supports the current turtle population. There are several fully-charged springs originating from the toe of the slope that enrich Phase 2 ("pasture bog") providing the ideal super saturated mucky conditions favored by bog turtles. As stated in the Introduction, this section was once open wet pasture and no trees or shrubs were visible from Turnpike Road. The small red barn and lower pond were, also, visible from the road. Trees now block the view from the road and the barn and pond are no longer visible. Today a large red maple and alder patch occurs in the south central portion of the old "pasture bog." The ratio of open sunny area to shade area is close to 3:1, but the site would benefit from thinning the red maples and alders. This woody patch continues to encroach on the best known nesting and nursery portions of the site. It is imperative that this red maple-alder patch is managed to prevent shading of the known nesting areas.

The thick multiflora rose patches along Blythe Mill Creek should be removed and either let trees become established naturally along the creek or plant native species there, i.e. river birch. A good growth of trees along the creek will stabilize the bank and help prevent flooding of the wetland.

The blue flag (*Iris virginica*) is a native wetland species found commonly in Phase 2. This iris was observed in two small areas of the "pasture bog" in 1976, each area covering <100 ft<sup>2</sup>. These two patches have spread over the ensuing years and now cover nearly 25% of the wetland. The largest patch of iris on the western side has created a solidification of the substrate and may pose a problem if the species continues to spread. Thinning of the irises is recommended to reduce the threat of soil compaction caused by the root masses.

A grazing regime similar to the one recommended for Phase 1 is recommended for the wetland portion of Phase 2. A fence would have to be installed along Old Turnpike Road, the northern property line, the base of the large hill, and the western side of the wetland. A fence along both sides of Blythe Mill Creek would be necessary, with one creek crossing access point to protect the riparian border. The various mosaics of open wet pasture and shrub patches would provide adequate prime habitat for the continued viability of the turtle population.

## B. Captive Breeding and Release Program

A captive breeding and release program, although a controversial subject by some (Fraser 1992; Jacobson 1993), could greatly enhance the bog turtle population at the Franklin Bog. Removal of gravid females prior to egg deposition, incubating and hatching the eggs, and release of the neonates would be an effective conservation practice to increase the turtle population. The neonates could be released shortly after egg emergence or "head-started" under captive conditions and then released into the Franklin Bog after a period of growth determined by the N.C. Wildlife Commission. A captive breeding program would require that a group of male and female turtles be removed from the Franklin Bog, or nearby colonies, held in captivity under natural conditions, and allowed to reproduce. Neonates would then be released into the Franklin Bog (or nearby sites) as mentioned previously. A combination of these two enhancement programs would help increase the Franklin Bog's turtle population, but the small

population currently existing there may prevent capture of enough founder specimens. The investigator has expertise (25+ years) in captive breeding and management of bog turtles and would like to participate in these programs, as well as assisting the establishment of the guidelines and protocols.

### C. Impediment or Control of Illegal Turtle Collecting

Illegal take of bog turtles is a major concern throughout the species' range (Pritchard 1992). The turtle collecting from the Franklin Bog has been well documented and the continued illegal removal of turtles would have devastating consequences to the population.

Phase 1: This parcel would benefit from the construction of a fence around it to provide some protection from trespassing, as well as keeping livestock in the site. Placement of signs, similar to those at the Sparta Bog, would indicate that it is a protected area and trespassing is prohibited. Trees should be removed along Old Turnpike Road to provide visibility of the wetland to law enforcement personnel.

Phase 2: The construction of a sturdy fence along Old Turnpike Road and the placement of a heavy gate south of the creek where the old unpaved road is located are recommended. The removal of the trees along Old Turnpike Road, at least those not along the creek bank, should be removed to provide visibility of the wetland to law enforcement personnel. It is recommended that trees be removed within the sight-line from the Franklin's home to the wetland to provide some oversight of the wetland by reliable neighbors. Placement of NCDOT (NCWRC) signs around the property is necessary to deter trespassing and turtle collecting.

The implantation of passive integrated transponders (PIT-tags) into turtles should be continued to provide permanent identification of each specimen. This practice provides positive turtle identification to law enforcement personnel in the case of illegal take and sale of bog turtles. In the event a turtle (or turtles) is suspected of being illegally collected law enforcement personnel can use a reader to scan the turtle for the tag number, check the database, and identify the turtle to the site it was removed from. This is an effective deterrent to would be collectors.

### D. Additional Conservation Recommendations

Buford Snoddy, the landowner of the property adjacent to Phase 1, approached Lori Williams (NCWRC) and the investigator on May 25 as we crossed Old Turnpike Road on our way to Phase 1. Mr. Snoddy informed us that he was the individual who filled in the acre of wetland in 1984. He was surprised to find out the NCDOT had purchased the wetland to protect the turtle and restore it, and told us that he would be willing to sell his property. He gave us his business card and drove away.

It is recommended that the NCDOT purchase the Snoddy tract to increase the acreage of the mitigation site. This tract would provide the most restoration credits of the entire project. The original debris-fill has collapsed over the 20 years since it was initially made, and it has become forested with mature river birches (*Betula nigra*) and other trees. The restoration of this parcel would entail finding adequate access to it for large equipment to remove the trees and old debris.

The Franklin Bog is in close proximity to the McClure Bog owned and managed by the N.C. Chapter of The Nature Conservancy. The McClure Bog has one of the largest populations of the federally endangered mountain sweet pitcherplant (*Sarracenia jonesii*) known in N.C., in addition to a small population of the federally threatened swamp pink (*Helonias bullata*). Both of these species may have been present in the Franklin Bog prior to the extensive farming and grazing practices that ended two decades ago. The discovery of the crested shield fern in the Franklin Bog during the survey would indicate that a seed bank of important plants exists at the site. The potential to expand the range in the Etowah area (the type locality of *S. jonesii*) using transplants of both federally protected species would

enhance the plant diversity at the Franklin Bog. In return this would increase the site's value as a conservation site for NCDOT. A project in conjunction with the U.S. Fish & Wildlife Service and the Atlanta Botanical Garden to place McClure Bog genetic stock plants in the Franklin Bog should be pursued.

### **Conclusion**

The Franklin Bog has had a long (29+ years) documented history of bog turtles, habitat loss and degradation due to natural succession and human related causes, and illegal turtle collecting. This site, once the largest bog turtle population in the Southeast, is still very important in providing habitat for the federally threatened (due to similarity of appearance) species, as well as potential for rare plant species.

The bog turtle population survey reported herein documented a tremendous decline in the turtle population at the Franklin Bog and discussed the reasons for this decline. Recommendations for the enhancement of the bog turtle population and the turtle's habitat at the Franklin Bog include:

- a) habitat management and a grazing regime
- b) a captive breeding and release program
- c) control of illegal turtle collecting
- d) expanding the mitigation site by purchase of adjacent properties
- e) transplanting the federally protected mountain sweet pitcherplant and the swamp pink to increase the site's plant diversity.

These recommendations are only as good as their timely implementation. Natural succession is a continuing process and needs to be controlled as soon as possible. It will take full cooperation of the NCDOT and the regulatory agencies to accomplish the goals to enhance and increase the turtle population and the available habitat to support the population.

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## Literature Cited

- Cagle, F.R. 1939. A system for marking turtles for future identification. *Copeia* 1939:170-172.
- Ehrenfeld, D. 2001. The turtle and the dairy cow. Orion. Spring, 2001:9-11.
- Ernst, C.H., R.W. Barbour, and M.F. Hershey. 1974. A new coding system for hard shelled turtles. *Trans. Kentucky Acad. Sci.* 35:27-28.
- Fahey, K.M. 1992. Habitat survey and census of bog turtles, *Clemmys muhlenbergii* Schoepff, populations in Georgia – final report for 1991-1992. Unpubl. Report Fish & Game Div., GA DNR. 14 pp.
- Fahey, K.M. 1998. Habitat survey and census of bog turtles, *Clemmys muhlenbergii* Schoepff, populations in Georgia with conservation and management suggestions. Unpubl. Report (1994-1996) Fish & Game Div., GA DNR. 38 pp.
- Frazer, N.B. 1992. Sea turtle conservation and halfway technology. *Conserv. Biol.* 6(2):179-184.
- Gaddy, L.L. 1981. The bogs of the southwestern mountains of North Carolina. N.C. Natural Heritage Program report.
- Herman, D.W. 1999. The impacts of livestock grazing on bog turtle habitat in the Piedmont and mountains of the Southeast. Report to U.S. Nat. Resources Conserv. Ser., Wetlands Science Institute, Raleigh, NC.
- Herman, D.W. 2003. Status of the bog turtle, *Clemmys muhlenbergii* Schoepff, in the southeastern United States. Unpubl. Final report USFWS Grant Agreement #1448-0004-96-9126. 150 pp.
- Herman, D.W. and B.W. Tryon. 1997. Land use, development, and natural succession and their effects on bog turtle habitat in the southeastern United States. pp. 364-371. In: J. Van Abbema (ed.), *Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles-An International Conference*. N.Y. Turtle and Tortoise Soc., New York.
- Jacobson, E.R. 1993. Implications of infectious diseases for captive propagation and introduction programs of threatened/endangered reptiles. *J. Zoo Wildl. Medicine* 24(3):245-255.
- Pritchard, P.C.H. 1992. Time out for turtles. *Wildl. Conserv.* 95(4):68-73.
- Somers, A.B., K.A. Bridle, D.W. Herman, and A.B. Nelson. 2000. The restoration and management of small wetlands of the mountains and Piedmont in the Southeast: a manual emphasizing endangered and threatened species habitat with a focus on bog turtles. Joint Publ. Watershed Sci. and Wetlands Inst. Of the Nat. Resources Conserv. Serv., Univ. North Carolina at Greensboro, and Pilot View Conserv. And Develop., Inc. 152 pp.
- Tesauro, J. 2001. Restoring wetland habitats with cows and other livestock. *Conserv. Biol. in Practice* 2(2):26-30.
- Zappalorti, R.T. and E.W. Johnson. 1981. The ecology of the bog turtle, *Clemmys muhlenbergii* (Schoepff), (Reptilia, Testudines, Emydidae) in western North Carolina. Highlands Biological Station report. Univ. North Carolina. 24 pp.

# APPENDIX A

**Map of the Franklin Bog Indicating the  
Trap & Bog Turtle Capture Point Locations  
May 24-28, 2004**

# APPENDIX B

## **Map of the Franklin Bog Indicating the Trap & Bog Turtle Capture Point Locations June 7-11, 2004**

# APPENDIX C

## **Franklin Bog Plants & Animals**

- 1. Plant List**
- 2. Animal List**

## 1. Franklin Bog Plant List

### I. Nonvascular Plants

#### A. Mosses and Liverworts

\*hooked peatmoss *Sphagnum recurvum*

### II. A. Ferns & Fern Allies

\*southern lady fern *Athyrium asplenoides*  
\*crested shield fern *Dryopteris cristata*  
\*cinnamon fern *Osmunda cinnamomea*  
\*New York fern *Thelypteris noveboracensis*

#### B. Trees & Shrubs

\*red maple *Acer rubrum*  
\*tag alder *Alnus serrulata*  
\*river birch *Betula nigra*  
\*silky dogwood *Cornus amomum*  
\*mountain laurel *Kalmia latifolia*  
\*great laurel or rosebay *Rhododendron maximum*  
\*common elderberry *Sambucus canadensis*  
\*silky willow *Salix sericea*  
\*poison sumac *Toxicodendron vernix*  
\*Canada hemlock *Tsuga canadensis*  
\*smooth highbush blueberry *Vaccinium corymbosum*  
\*northern wild raisin *Viburnum cassinoides*  
\*southern wild raisin *Viburnum nudum*

#### C. Sedges & Rushes

\*prickly bog sedge *Carex atlantica*  
\*a sedge *Carex incomperta*  
\*a sedge *Carex intumescens var. intumescens*  
\*a sedge *Carex leptalea*  
\*a sedge *Carex lurida*  
\*a sedge *Carex scoparia*  
\*tussock sedge *Carex stricta*  
\*flatsedge *Cyperus flavescens*  
flatsedge *Cyperus strigosus*  
\*flatsedge *Cyperus tenuifolius*  
\*obtuse spikerush *Eleocharis obtusa*  
\*fimbry *Fimbristylis autumnalis*  
\*common rush *Juncus effusus var. solutus*  
\*seep rush *Juncus gymnocarpus*  
\*bluntscale bulrush *Schoenoplectus purshianus*  
\*woolgrass bulrush *Scirpus cyperinus*  
\*woodland bulrush *Scirpus expansus*  
\*brownish beaksedge *Rhynchospora capitellata*

#### D. Orchids

\*pink ladyslipper *Cypripedium acaule*

## E. Grasses, Herbs, Vines, & Other Flora

*narrowleaf willow herb	<i>Epilobium leptophyllum</i>
*hollow stem Joe-Pye-weed	<i>Eupatorium fistulosum</i>
*boneset	<i>Eupatorium perfoliatum</i> var. <i>perfoliatum</i>
Appalachian bluet	<i>Houstonia serpyllifolia</i>
*American water pennywort	<i>Hydrocotyle americana</i>
*Canada St. John's-wort	<i>Hypericum canadense</i>
*common dwarf St. John's-wort	<i>Hypericum mutilum</i> var. <i>mutilum</i>
*spotted jewelweed	<i>Impatiens capensis</i>
*blue flag	<i>Iris virginica</i>
*rice cutgrass	<i>Leersia oryzoides</i>
*common water purslane	<i>Ludwigia palustris</i>
*Virginia bugleweed	<i>Lycopus virginicus</i>
maleberry	<i>Lyonia ligustrina</i> var. <i>ligustrina</i>
*whorled loosestrife	<i>Lysimachia quadrifolia</i>
*green arrow arum	<i>Peltandra virginica</i>
*arrowleaf tearthumb	<i>Polygonum sagittatum</i>
*swamp rose	<i>Rosa palustris</i>
*multiflora rose	<i>Rosa multiflora</i>
*American bur reed	<i>Sparganium americanum</i>
*hardhack	<i>Spirea tomentosa</i>
*poison ivy	<i>Toxicodendron radicans</i>
*blue marsh violet	<i>Viola cucullata</i>

\*observed during the survey

## References

Radford, A.E., H.E. Ahles, and C.R. Bell. 1976. Manual of the Vascular Flora of the Carolinas. Fifth Printing. The Univ. North Carolina Press, Chapel Hill. 1183 pp.

## 2. Franklin Bog Animal List

### I. Mammals

\*Virginia opossum  
\*meadow vole  
least weasel  
mink  
golden mouse  
\*white-tailed deer  
muskrat  
\*raccoon  
eastern mole  
masked shrew  
\*eastern cottontail  
gray fox

*Didelphis virginiana*  
*Microtus pennsylvanicus*  
*Mustela nivalis*  
*Mustela vison*  
*Ochrotomys nuttalli*  
*Oedocoileus virginianus*  
*Ondatra zibethicus*  
*Procyon lotor*  
*Scalopus aquaticus*  
*Sorex cinereus*  
*Sylvilagus floridanus*  
*Urocyon cinereoargenteus*

### II. Birds

\*redwing blackbird  
\*ruby-throated hummingbird  
\*tufted titmouse  
\*green heron  
\*northern flicker  
\*northern cardinal  
\*American goldfinch  
turkey vulture  
\*marsh wren  
\*black vulture  
\*American crow  
\*blue jay  
\*gray catbird  
\*common yellowthroat  
\*barn swallow  
\*swamp sparrow  
\*song sparrow  
\*mockingbird  
American woodcock  
\*Eastern towhee  
\*Carolina chickadee  
\*American robin

*Agelaius phoeniceus*  
*Archilochus colubris*  
*Baeolophus bicolor*  
*Butorides virescens*  
*Calaptes auratus*  
*Cardinalis cardinalis*  
*Carduelis tristis*  
*Cathartes aura*  
*Cistothorus palustris*  
*Coragyps atratus*  
*Corvus brachyrhynchos*  
*Cyanocitta cristata*  
*Dumetella carolinensis*  
*Geothlypis trichas*  
*Hirundo rustica*  
*Melospiza georgiana*  
*Melospiza melodia*  
*Mimus polyglottos*  
*Pilohela minor*  
*Pipilo erythrophthalmus*  
*Poecile carolinensis*  
*Turdus migratorius*

### III. Reptiles

northern copperhead  
\*eastern wormsnake  
\*common snapping turtle  
\*bog turtle  
northern black racer  
\*eastern painted turtle  
\*northern ringneck snake  
black rat snake  
five-lined skink  
eastern kingsnake  
\*northern watersnake  
\*queen snake  
\*eastern box turtle  
\*eastern gartersnake

*Agkistrodon contortrix mokesan*  
*Carphophis amoenus amoenus*  
*Chelydra serpentina*  
*Glyptemys muhlenbergii*  
*Coluber constrictor constrictor*  
*Chrysemys picta picta*  
*Diadophis punctatus edwardsi*  
*Elaphe obsoleta obsoleta*  
*Eumeces fasciata*  
*Lampropeltis getula getula*  
*Nerodia sipedon sipedon*  
*Regina septemvittata*  
*Terrepene carolina carolina*  
*Thamnophis sirtalis sirtalis*

#### IV. Amphibians

American toad	<i>Bufo americanus</i>
Fowler's toad	<i>Bufo woodhousii fowleri</i>
*Northern dusky salamander	<i>Desmognathus fuscus</i>
*southern two-lined salamander	<i>Eurycea cirrigera</i>
four-toed salamander	<i>Hemidactylium scutatum</i>
*Cope's gray treefrog	<i>Hyla chrysoscelis</i>
*red-spotted newt	<i>Notophthalmus viridescens viridescens</i>
white-spotted slimy salamander	<i>Plethodon cylindraceus</i>
black-chinned red salamander	<i>Pseudotriton ruber schencki</i>
northern spring peeper	<i>Pseudacris crucifer crucifer</i>
*bullfrog	<i>Rana catesbeiana</i>
*green frog	<i>Rana clamitans melanota</i>
*pickerel frog	<i>Rana palustris</i>

\*observed specimens, tracks, and scat, or heard songs and calls

#### References

##### Mammals

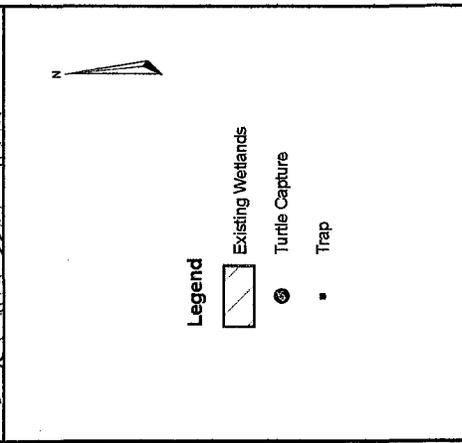
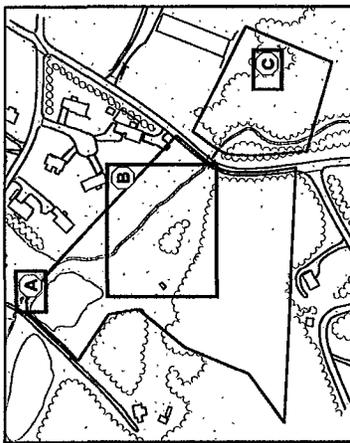
Whitaker, J.O. 1980. The Audubon Society Field Guide to North American Mammals. Alfred A. Knopf, N.Y. 743 pp.

##### Birds

Sibley, D.A. 2000. The Sibley Guide to Birds. National Audubon Society. Alfred A. Knopf, N.Y. 545 pp.

##### Reptiles & Amphibians

Conant R. and J.T. Collins. 1998. Reptiles and Amphibians of Eastern and Central North America. Third Edition, Expanded. Houghton Mifflin Co., Boston. 616 pp.



North Carolina - Department of Transportation  
 Division of Highways  
 Project Development and  
 Environmental Analysis Branch

**TURTLE AND TRAP LOCATIONS**  
 Franklin Bog Conservation Bank  
 Henderson County, North Carolina

