

**Vocal Anuran Community Monitoring  
with Automatic Recording Devices  
*at*  
Swanquarter National Wildlife Refuge**

**Summary Report  
2014**



**Photograph: Spring peeper (*Pseudacris crucifer*) by Wendy Stanton, USFWS.**

**Prepared by: Wendy Stanton**



## U.S. Fish and Wildlife Service

### Southeast Region Inventory and Monitoring Branch

### Final Report

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#### ***Abstract:***

During 2014, the Southeast Region Inventory and Monitoring Branch conducted the first vocal anuran monitoring at Swanquarter National Wildlife Refuge. The methodology and data analysis were conducted in accordance with the National Park Service Southeast Coast Network Inventory and Monitoring Branch's protocol for monitoring vocal anuran communities. Ten Wildlife Acoustic SM2+ automatic recording devices were deployed from March 24 – June 16. Eight species were detected with the ARDs. The southern leopard frog had the highest frequency of occurrence and relative abundance followed by green treefrog and squirrel treefrog. The lowest frequency of occurrence rates and relative abundance were the spring peeper and carpenter frog. However, this may be an underestimate due to a lapse in recording time in several of the ARDS because of battery malfunction early in the season. Amphibians have been recognized as important indicators for environmental health. Many refuges in the South Atlantic ecoregion lack baseline data for amphibians. This monitoring will provide baseline data for vocal anurans on the refuge.

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## **INTRODUCTION**

There is a growing concern about the worldwide decline of amphibian populations and in particular localized extinctions. Globally, some of the most diverse amphibian communities occur in the Southeast. Due to their specialized life histories, dependence on various habitats and sensitivity to environmental stressors, amphibian communities are recognized as good indicators of ecosystem health and change. Most national wildlife refuges located within the South Atlantic Landscape Conservation Cooperative (SALCC) geography lack baseline data on amphibian species composition.

In 2012, the National Park Service Southeast Coast Network Inventory and Monitoring Program (NPS-SECN) completed the draft protocol for Methods for Monitoring Amphibian Communities in SECN Parks. Between 2008 -2012, NPS-SECN implemented these techniques in 17 SENC parks as part of their vital signs monitoring program. In spring 2013, an interagency agreement was formalized between NPS SECN I&M and the USFWS Southeast Region I&M Branch (I&M Branch) to pilot the 2012 draft protocol at Roanoke River National Wildlife Refuge (RRNWR) and evaluate the feasibility of this protocol (Byrne et al. 2012) for use on other National Wildlife Refuges in the Southeast Region (R4). While this pilot was ongoing, the NPS-SECN completed

an evaluation of the SECN Parks data and numerous methodologies implemented between 2008-2012 and released the 2013 Protocol for Monitoring Vocal Anuran Communities SECN Parks ([Byrne et. al. 2013](#)). The significant change was to monitor only post metamorphic vocal anurans with automatic recording devices. The evaluation determined that the automated recording device methodology was considered the safest, most cost efficient, met logistical challenges of working in a variety of habitat conditions in the SECN parks and provided an effective, standardized technique to monitor amphibians across all amphibian habitat types. At the end of the pilot at Ronaoke River NWR and considering these changes to the NPS-SECN protocol, two USFWS I&M Branch reports were completed. First, a project template documenting the pilot and second, a two page report providing recommendations based on refuge objectives to use the 2013 NPS-SECN protocol to monitor vocal anurans on refuges (Stanton 2015a, Stanton 2015b).

In 2014, the I&M Branch piloted the 2013 NPS-SECN Protocol for Monitoring Vocal Anuran Communities at Swanquarter NWR. The objectives of this monitoring include:

1. Document the presence or absence of vocal anurans species, distribution, species richness, and composition at selected sites.
2. Establish a baseline inventory of vocalization phenology (based on one year) of anuran species.

## **STUDY AREA**

Swanquarter NWR is administered from the Mattamuskeet NWR complex and is located in Hyde County in northeastern North Carolina (Figure 1). The main habitat types (USFWS 2014) of this 16,411 acre refuge include brackish marsh (13,000 acres), mixed pine hardwoods (1300 acres), high pocosin (750 acres), estuarine fringe loblolly pine forest (500 acres), nonriverine swamp forest (400 acres), pond pine pocosin (300 acres). The brackish marsh is strongly dominated by black needle rush (*Juncus roemerianus*), rice cutgrass (*Leersia oryzoides*) smooth cordgrass (*Spartina alterniflora*), salt grass (*Distichlis spicata*) and giant cordgrass (*Spartina cynosuroides*). The estuarine fringe loblolly pine (*Pinus taeda*) forest (“Maritime Pine Savannas”) are grasslands that support cordgrass species and salt grass with a sparse loblolly pine (*Pinus taeda*) forest overstory or small islands of pine forests (loblolly or pond pine (*Pinus serotina*)) interspersed with the grasslands.



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Location of Swanquarter NWR in Southeast Region

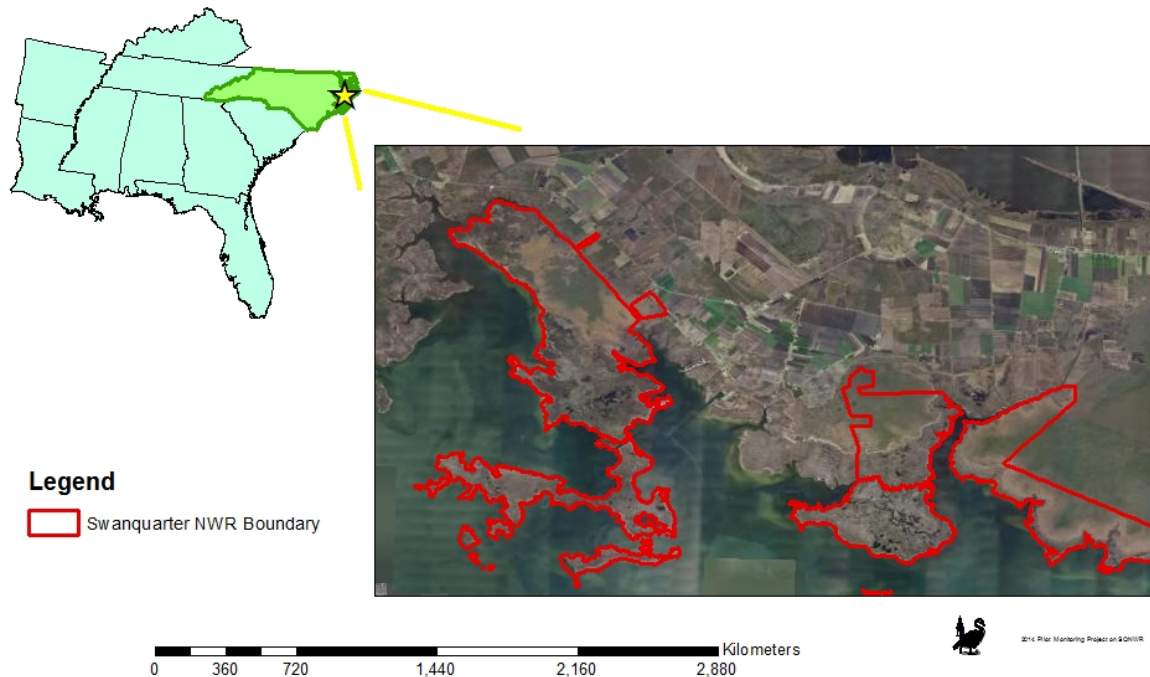


Figure 1. Swanquarter NWR is located in Northeastern North Carolina in Hyde County along the Pamlico Sound.

## METHODS

The 2013 NPS-SECN Monitoring Vocal Anuran Communities protocol and standard operating procedures for using Wildlife Acoustics SM2+ Automatic Recoding Devices (ARD) (Byrne et. al. 2013) were used to monitor vocal anurans on the refuge. The ARDs were programed to record every fourth night for 30 seconds per 10-minute interval from 18:00 – 06:50. This totals approximately 20 sampling nights at each sampling location, over an approximately 77 day period.

The sampling universe was stratified random to address access issues in the Swanquarter NWR. The NPS SECN SOP for *Generating Spatially-balanced Sampling Points with ArcGIS 10* (Asper. 2012) was used to select half hectare plots. The ARDs were placed in the center of half hectare plots along the edge of brackish marsh, estuarine fringe loblolly pine forest and mixed pine hardwoods. A half hectare was chosen for the size of the sampling location (i.e., plot)



because this is the minimum mapping unit for the SECN vegetation mapping inventory. Vegetation is one of the NPS-SECN's four vital signs selected to monitor for ecosystem health on the SECN National Parks. The other three vital signs include abiotic factors, landbirds and vocal anuran communities. Also, under calm weather conditions, a half hectare plot provides an area to accurately detect and identify of most vocal anuran species with the SM2+ ARDs and analysis with the *Wildlife Acoustics Song Scope* program.

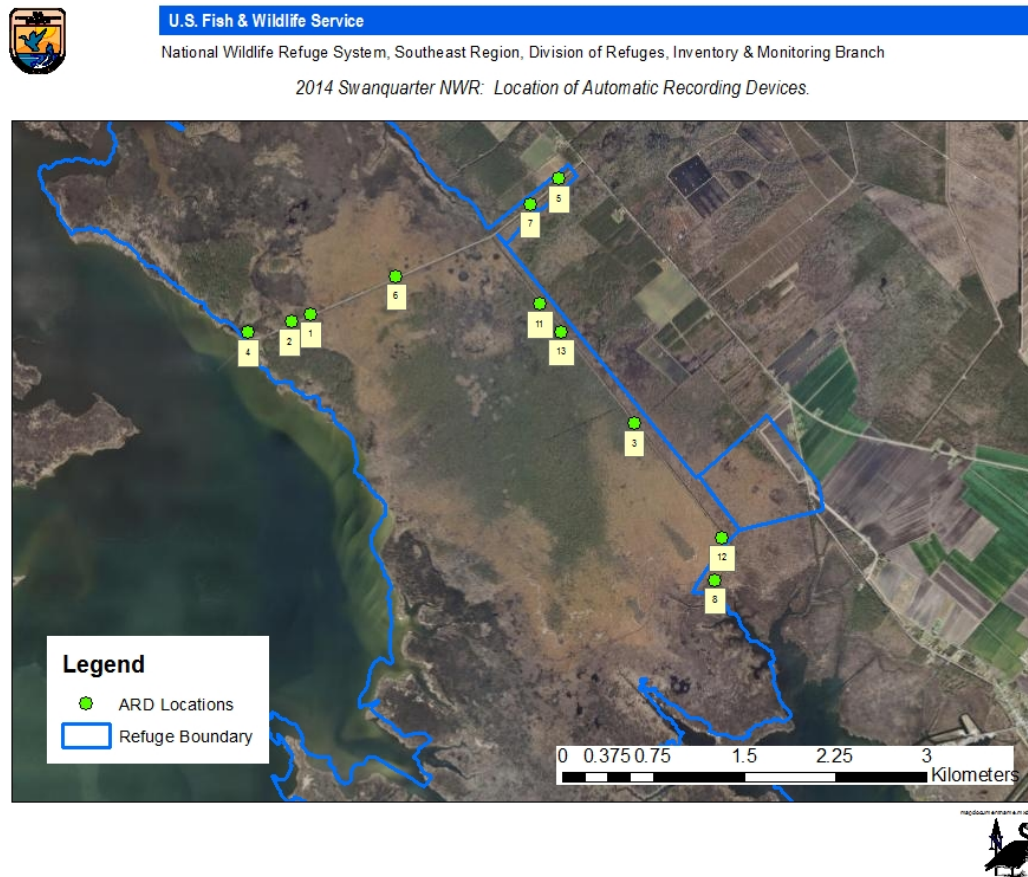


Figure 2. Location of Automatic Recording Devices (ARDs) on Swanquarter NWR.

Between March 24 through March 31, 2014, 11 ARDs were deployed on Swanquarter NWR. During a battery check on April 4, 2014, six ARDs had battery failures. A large portion of the batteries were donated and failed to carry a charge past 10 days. These batteries were replaced on April 16, 2014. One ARD was damaged by an animal, probably a raccoon and malfunctioned. This ARD was removed for repairs and not included in the data set. The 10 ARDs (Figure 2) were collected on June 16, 2014. The recorded data were analyzed using *Wildlife Acoustics Song Scope* program version 3.4. All QAQC were conducted in accordance with the NPS SECN I&M protocol and SOPs.



**Photograph of a deployed Wildlife Acoustics SM2+ automatic recording device used to record vocalizations of anuran species. Note the small predator guards used to protect the microphones from animal damage.**

The NPS SECN I&M vocal anuran communities protocol collects detections / non-detection data. These data can be interpreted as presence / absence data. However, ARDs cannot provide absolute abundance (i.e., population size). Each vocalization by species recorded on an ARD is associated with one individual and one individual may vocalize many times during the survey period.

The data analysis measures community composition which includes species richness, naïve occupancy, relative abundance and relative detection frequency. Species richness is the total number of native species detected. Naïve occupancy also referred to as frequency of occurrence is the percent of the sampling locations (ARD sites) where a species was detected without adjusting for detectability. Relative abundance is the percent of sampling sites where a particular species was detected divided by the total number of species detected. Relative detectability is unknown for this site because this is the first year data were collected at this refuge.

The vocalizations of some species of similar anurans or interbreeding species cannot be accurately differentiated. These species are identified to the genus level. For this survey, due to similarity of vocalizations, the northern cricket frog (*Acris crepitans*) and the southern cricket frog (*Acris gryllus*) were identified to *Acris* species. Although according to range maps, these frogs were probably southern cricket frogs. Both the Fowler's toad (*Bufo fowleri*) and the southern toad (*Bufo terrestris*) are known to occur in Hyde County, North Carolina and interbreed. Hybrid individuals often have a vocalization that extends longer than the typical

Fowler's toad's four second call but shorter than the up to 30 seconds trill call of the southern toad. Due to similarity of these vocalizations and potential hybrids, these vocalizations were identified as *Bufo* species.

## RESULTS AND DISCUSSION

During the 2014 vocal anuran monitoring, the 10 ARDs recorded 12,599 events (6,299.5 minutes). Eight species (Table 1) of anurans were identified. Southern leopard frog (*Lithobates sphenocphalus*) was detected at 100% of the sampling locations and had the highest frequency of occurrence rates (naïve occupancy) and relative abundance (Figures 3 and 4). Green treefrog (*Hyla cinerea*) and squirrel treefrog (*Hyla squirrela*) were detected at 90% of the sampling locations and tied for the second highest frequency of occurrence rates and relative abundance (Figures 3 and 4). Cricket frog (*Acris* spp) had the third highest frequency of occurrence rates and relative abundances followed by bullfrog (*Rana catesbeiana*) and toad species (*Bufo* spp). The carpenter frog (*Rana virgatipes*) and spring peeper (*Psuedacris crucifer*) were detected at one location and tied with the lowest frequency of occurrence rates and relative abundances (Figures 3 and 4). The detections of earlier calling species (e.g., spring peeper) may have been underestimated because of the lapse in recording times during March 31-April 16 due to battery failures in some of the ARDs. Distribution maps of detected anuran species (Naïve occupancy) by sampling site are included in Appendix A.

Table 1. This table shows detections by species at each sampling location (ARD). \*Note; A single or multiple vocalizations of the same species at a sampling location is considered to be one individual or naïve occupancy for that species at that sampling location. This assumes that one individual frog can make a single or multiple vocalizations across many nights. There were a total of 52 “individuals” or naïve occupancies detected at the sampling locations.

Sampling Location (ARD #)	Bufo Species	Cricket frog	Green Treefrog	Squirrel Treefrog	Spring Peeper	Bullfrog	Southern Leopard Frog	Carpenter Frog	Comments
1	x	x	x	x		x	x		new batteries 4/16/2014
2		x	x	x			x		new batteries 4/16/2015
3		x	x	x	x	x	x	x	
4	x	x	x	x		x	x		new batteries 4/16/2015
5	x		x	x		x	x		
6	x	x	x	x		x	x		new batteries 4/16/2015
7	x	x	x	x		x	x		
8		x	x	x		x	x		new batteries 4/16/2015
11							x		new batteries 4/16/2015
12	x	x	x	x		x	x		new batteries 4/16/2014
Total sampling locations detected	6	8	9	9	1	7	10	1	52 Total # naïve occupancies



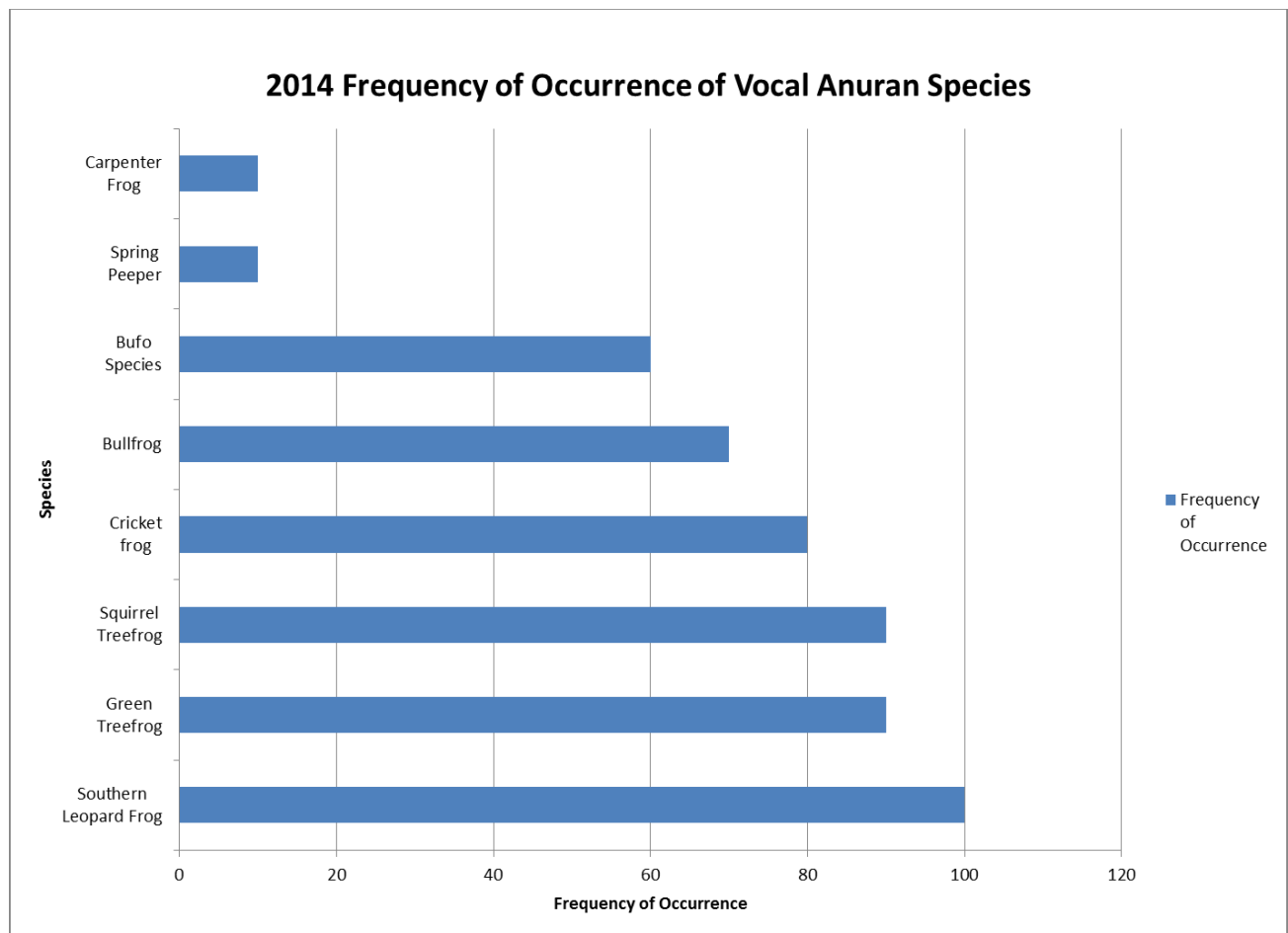


Figure 3. Frequency of occurrence (naïve occupancy) of vocal anuran species at Swanquarter NWR. Naïve occupancy is the percent of the sampling locations (ARD sites) (n=10) where a species was detected without adjusting for detectability.

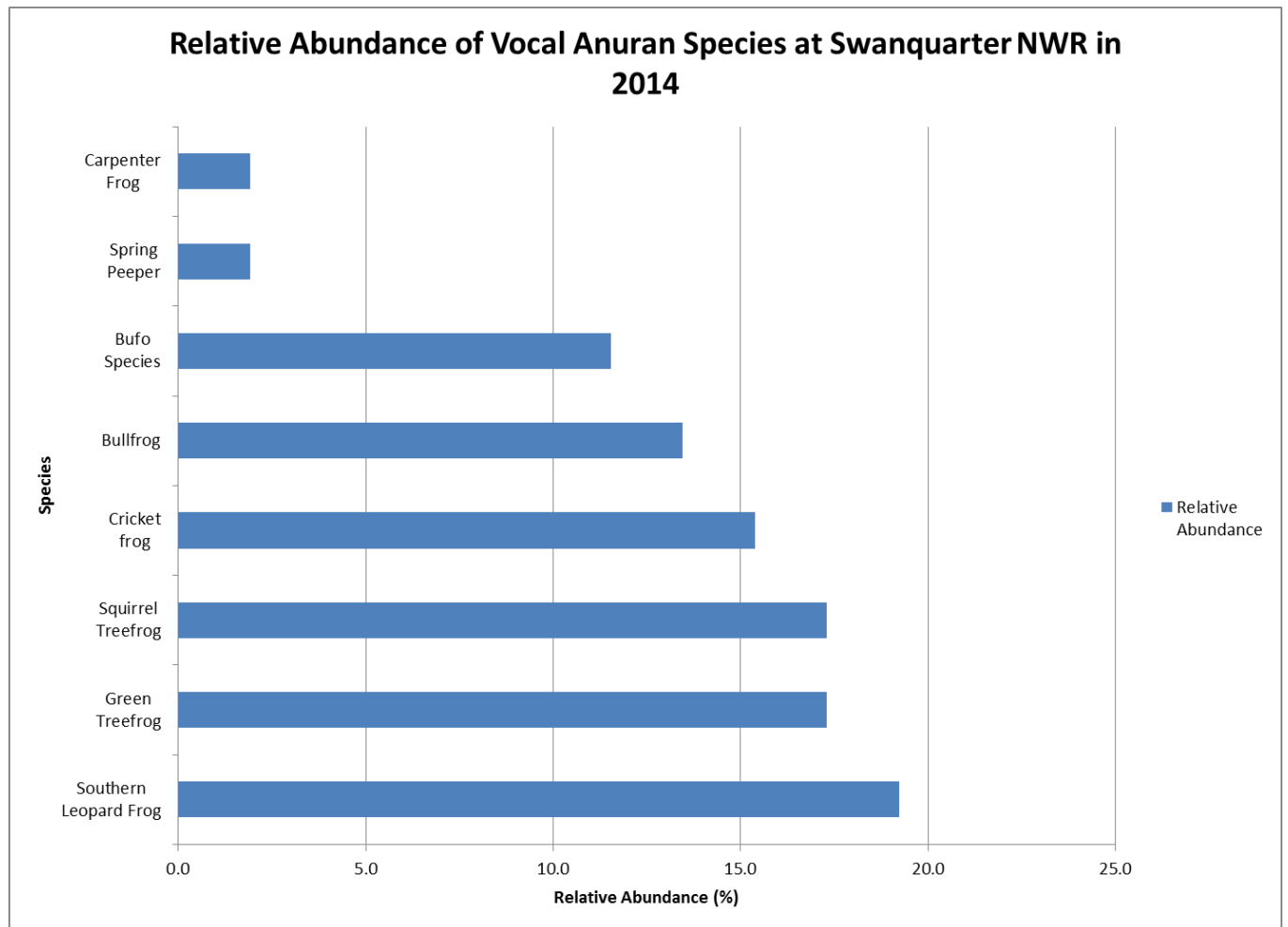


Figure 4. The relative abundance of detected vocal anuran species at Swanquarter NWR during the 2014 season. Relative abundance is represented as a percentage of the number of individuals of a particular species by the total number of species in the sample. The sample size ( $n = 52$ ) is the total number of species counted at all sampling locations at the refuge.

Table 2. Vocalization phenology for species detected using automated recording device (ARDs) at Swanquarter National Wildlife Refuge, from 24 March to 16 June 2014. \*Note, spring peepers and other early calling anuran species were likely underestimated due to battery failures during March and early April that limited the early season recording times.

	March			April			May			June		
Bufo Species												
American Toad or Fowler's Toad				x	x	x	x		x		x	
Cricket Frog				x	x	x	x	x	x			
Green Treefrog						x	x	x	x	x		
Squirrel Treefrog				x		x	x	x	x	x	x	
Spring Peeper*							x					
Bullfrog			x	x		x	x	x	x	x	x	
Green Frog								x		x		
Southern Leopard Frog			x	x		x	x	x	x	x	x	
Carpenter frog									x			
*Spring Peeper - batteries in majority of ARDs failed and were replaced on >>>>												

Certain Hylidae species have been identified to monitor changes in phenology of anuran vocalizations over time (Byrne et al 2013). For this survey, a table describing timing of vocalizations by species at sampling locations is included (Table 2). Due to the battery failures at the beginning of the season, some of the expected early vocalizing species were not detected at many of the sites. The earliest vocalizations detected with ARDs included southern leopard frog and bullfrog in late March. The latest vocalizations detected were in June and included toad species, squirrel treefrog, bullfrog and southern leopard frog. The only detection for spring peeper was at one sampling location in early May.

Table B.1 in Appendix B shows a comparison of the 2014 ARD vocal anuran detections to species range maps for Hyde County, North Carolina documented in the field guides *Amphibians & Reptiles of the Carolinas and Virginia* (Beane et al 2010) and *Frogs and Toads of the Southeast* (Dorcas and Gibbons 2006). The two field guides document 18 species of anuran species occur in Hyde County, North Carolina.

## Acknowledgments

We would like to thank Refuge Manager Pete Campbell for allowing this pilot to be conducted at this refuge. We would also like to acknowledge the hard work of the following interns and volunteers who provided invaluable assistance in the field:

Mary Kester, College Intern, University of Kentucky

Kathryn Nesbitt, College Intern, Texas A&M University

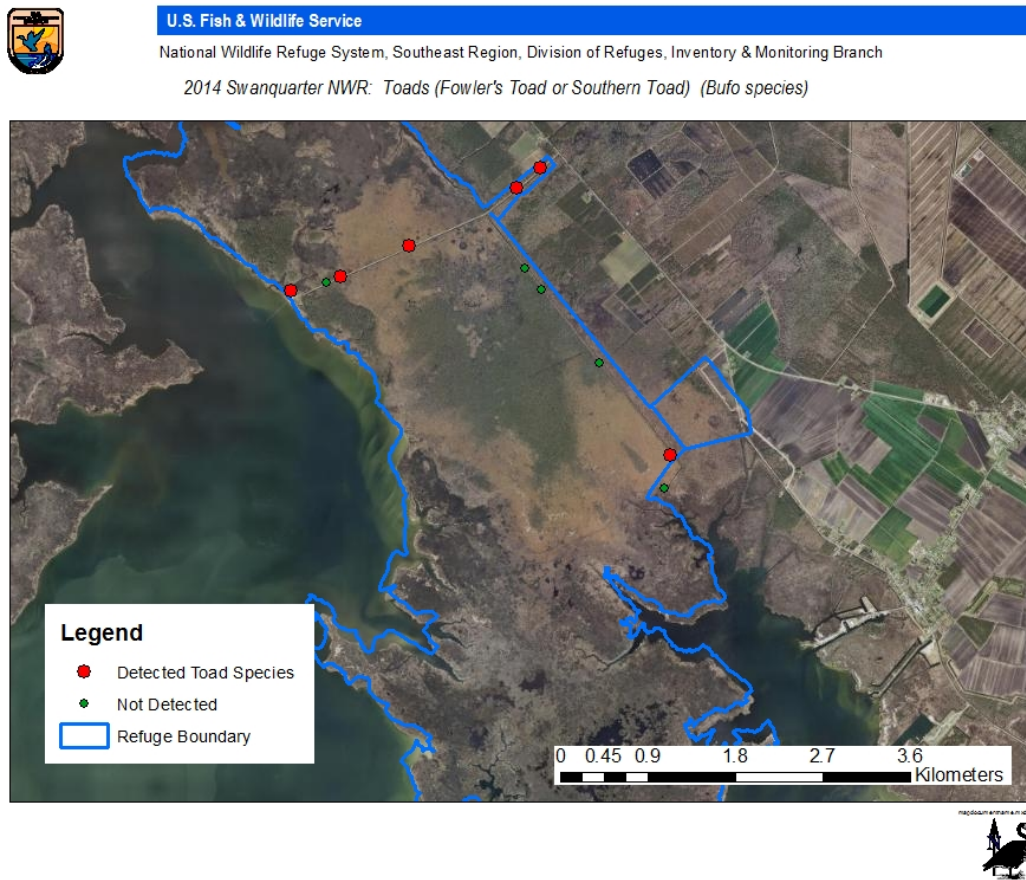
John Stanton, High School Volunteer, Columbia High School, Columbia, NC

Daniel Stanton, High School Volunteer, Columbia High School, Columbia, NC

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## APPENDIX A. Distribution Maps for Vocal Anuran Species Detected at Swanquarter NWR in 2014.



**Figure A-1.** Sampling locations where toad (*Bufo* spp.) was detected at Swanquarter National Wildlife Refuge, 2014.

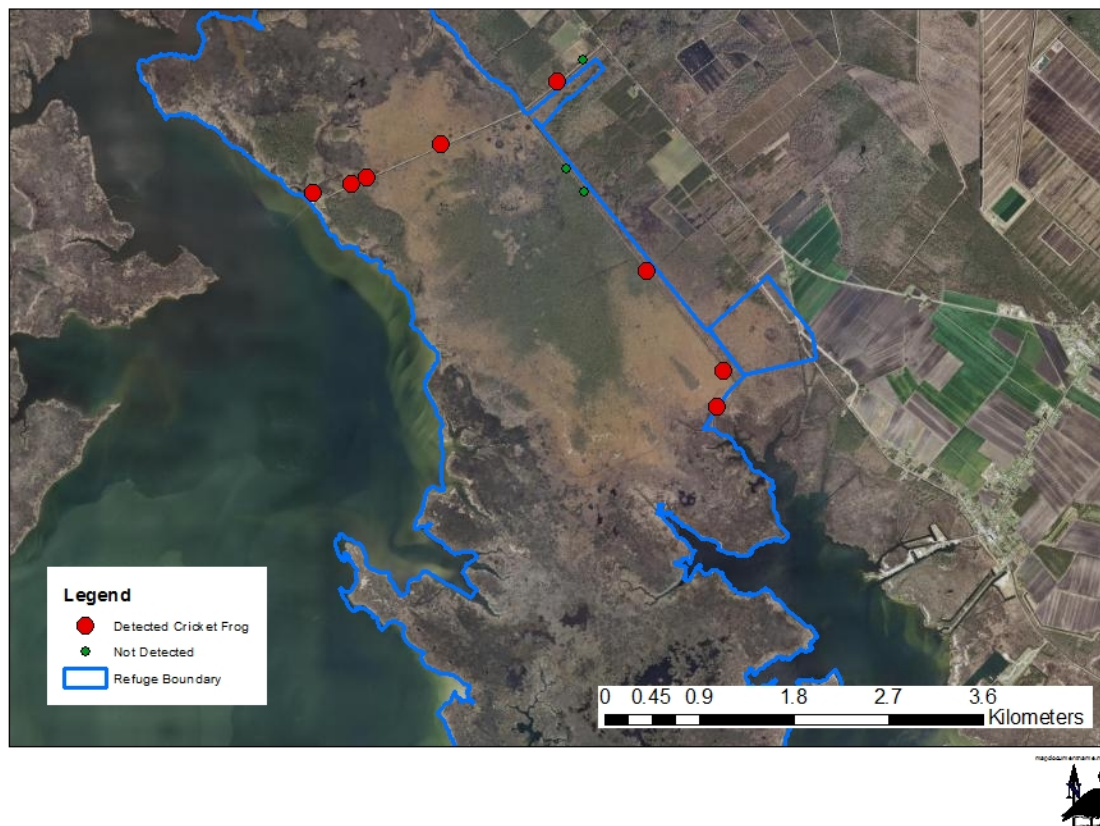




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2014 Swanquarter NWR: Cricket Frog (*Acris* spp.)



**Figure A-2.** Sampling locations where cricket frog (*Acris* spp.) was detected at Swanquarter National Wildlife Refuge, 2014.



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2014 Swanquarter NWR: Green Treefrog (*Hyla cinerea*)



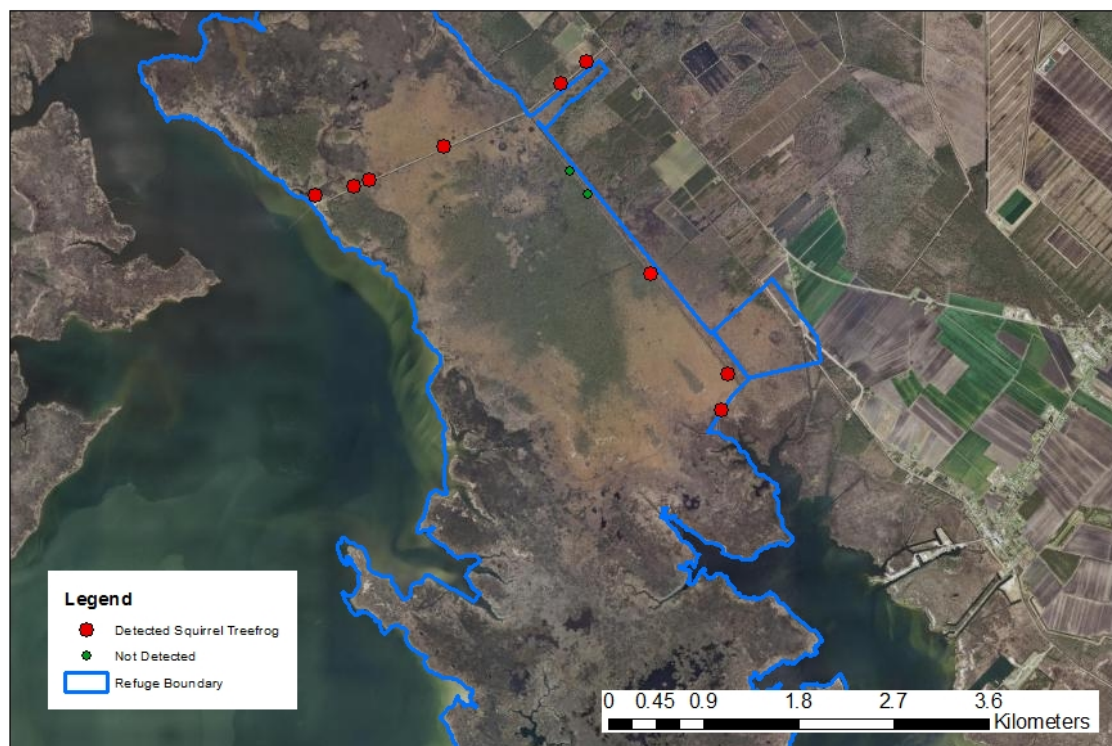
**Figure A-3.** Sampling locations where green treefrog (*Hyla cinerea*) was detected at Swanquarter National Wildlife Refuge, 2014.



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2014 Swanquarter NWR: Squirrel Treefrog (*Hyla squirrellella*)



**Figure A-4.** Sampling locations where squirrel treefrog (*Hyla squirrellella*) was detected at Swanquarter National Wildlife Refuge, 2014.





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2014 Swanquarter NWR: Spring Peeper (*Psuedacris crucifer*)



**Figure A-5.** Sampling locations where spring peeper (*Psuedacris crucifer*) was detected at Swanquarter National Wildlife Refuge, 2014.



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2014 Swanquarter NWR: Bullfrog (*Lithobates catesbeiana*)



**Figure A-6.** Sampling locations where bullfrog (*Lithobates catesbeianus*) was detected at Swanquarter National Wildlife Refuge, 2014.





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2014 Swanquarter NWR: Southern Leopard Frog (*Lithobates sphenoccephala*)



**Figure A-7.** Sampling locations where southern leopard frog (*Lithobates sphenoccephala*) was detected at Swanquarter National Wildlife Refuge, 2014.



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2014 Swanquarter NWR: Carpenter Frog (*Lithobates virgatipes*)



**Figure A-8.** Sampling locations where carpenter frog (*Lithobates virgatipes*) was detected at Swanquarter National Wildlife Refuge, 2014.

## APPENDIX B. Comparison of 2014 ARD Vocal Anuran Detections to Field Guide.

**Table B-1.** Comparison of the confirmed 2014 ARD detections and species range maps for Hyde County, North Carolina documented in the field guide *Amphibians & Reptiles of the Carolinas and Virginia* (Beane et al 2010) and *Frogs and Toads of the Southeast* (Dorcas and Gibbons 2006).

Scientific Name	Common Name	Beane et al 2010	Dorcas & Gibbons 2006	2014 ARD	Notes
<i>Scaphiopus holbrookii</i>	Eastern spadefoot	X	X		
<i>Bufo fowleri</i>	Fowler's toad	X	X	X	Identified as <i>Bufo</i> spp
<i>Bufo quericus</i>	Oak toad	X	X		
<i>Bufo terrestris</i>	Southern toad	X	X	X	Identified as <i>Bufo</i> spp
<i>Acris gryllus</i>	Southern cricket frog	X	X	X	Identified as <i>Acris</i> spp
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	X	X		
<i>Hyla cinerea</i>	Green treefrog	X	X	X	
<i>Hyla femoralis</i>	Pine woods treefrog	X	X		
<i>Hyla squirella</i>	Squirrel treefrog	X	X	X	
<i>Pseudacris brimleyi</i>	Brimley's chorus frog	X	X		
<i>Pseudacris crucifer</i>	Spring peeper	X	X	X	
<i>Pseudacris ocularis</i>	Little grass frog	X	X		
<i>Gastrophyrne carolinensis</i>	Eastern narrow-mouthed toad	X	X		
<i>Lithobates catesbeianus</i>	American bullfrog	X	X	X	
<i>Lithobates clamitans</i>	Green frog	X	X		
<i>Lithobates sphenoccephala</i>	Southern leopard frog	X	X	X	
<i>Lithobates sylvatica</i>	Wood frog	X			Relict populations in Hyde County (Beane et al 2010)
<i>Lithobates virgatipes</i>	Carpenter frog	X	X	X	