



# Summary of Amphibian Community Monitoring at Fort Sumter National Monument, 2010

Natural Resource Data Series NPS/SECN/NRDS—2011/140



**ON THE COVER**

*Scaphiopus holbrookii* (eastern spadefoot toad)

Photograph by Allan Cressler

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February 2011

U.S. Department of the Interior  
National Park Service  
Natural Resource Program Center  
Fort Collins, Colorado

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data were collected and analyzed using established methods based on peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Please cite this publication as:

Byrne, M.W., B.D. Smrekar, M.N. Moore, C.S. Harris, and B.A. Blankley. 2011. Summary of amphibian community monitoring at Fort Sumter National Monument. Natural Resource Data Series NPS/SECN/NRDS—2011/140. National Park Service, Fort Collins, Colorado.

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## Executive Summary

This report summarizes data collected with the Draft SECN Amphibian Community Monitoring Protocol (Byrne et al., *in preparation*) at Fort Sumter National Monument in 2010.

1. Data were collected at four spatially-balanced random locations at the Monument with two techniques: automated recording devices and visual-encounter surveys.
2. Sampling activities occurred at the Monument from 4/8/2010 to 4/22/2010 and again from 6/10/2010 to 6/11/2010.
3. We detected 16 amphibians of two species and three reptiles of two species. Almost half of the species known to occur at the park were detected as part of this sampling effort.
4. One reptile species, eastern glass lizard (*Ophisaurus ventralis*), was the first recorded occurrence at the Monument and an addition to the species list.
5. No non-native species were detected.
6. All but one of the individuals detected occurred in only one sampling location.
7. This monitoring protocol will be implemented again at the Monument in 2013. Because the sample collected only represented two of the four amphibian species known to occur at FOSU, sample-size adequacy will be evaluated prior to resampling.
8. The full dataset, and associated metadata, can be acquired from the data store at <http://science.nature.nps.gov/nrdata/>

# Introduction

## Overview

Amphibian populations have exhibited declines in North America and many other areas around the world. Several factors are attributable to population declines and localized extinctions. Among these factors are disease and anthropogenic stressors such as habitat loss and degradation, non-native predators, acid precipitation, altered hydrology and hydroperiod, ultraviolet radiation, and chemical contaminants (Collins and Storfer 2003). Although diseases and parasites naturally occur in amphibian populations, the effects of these influences can be exacerbated when combined with other anthropogenic stressors.

Amphibians have complex life cycles, where the immature phase often consists of an aquatic larval stage, followed by a post-metamorphic adult terrestrial stage. Slight alterations in the aquatic or terrestrial communities upon which amphibians are dependent can have substantial impacts on the survival, reproduction, and persistence of a species. Given their habitat requirements, anatomy, and physiology, amphibians are considered good indicators of ecological condition.

The southeastern U.S. is host to one of the most diverse amphibian communities in the world. With an estimated 140 amphibian species, more than half of which are salamanders, the Southeast accounts for about half of the total number of amphibians in the U.S (Echternacht & Harris 1993, Petranka 1998). The Southeast Coast Network (SECN) has 61 known amphibian species; 26 in Caudata (salamanders, newts, amphiumas, sirens), and 35 in Anura (frogs and toads).

Given their known population declines, sensitivity to anthropogenic stressors, and the diversity of amphibians in the southeastern U.S., amphibian communities are a priority for SECN monitoring efforts.

The National Park Service Omnibus Management Act of 1998, and other reinforcing policies and regulations, require park managers “to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources” (Title II, Sec. 204). The amphibian-community monitoring data summarized herein is a tool to assist park managers in fulfilling this mandate.

This report summarizes data collected under the draft SECN Amphibian Community Monitoring Protocol (Byrne et al., *in preparation*).

## Objective

- Determine trends in occupancy, distribution, diversity, and community composition in amphibian species of SECN parks.



## Methods

### Study Area

Fort Sumter National Monument (FOSU) is in Charleston, South Carolina (Figure 1). The Monument occurs at the mouth of the Charleston Harbor and on the southern tip of Sullivan's Island. The Monument is co-administered with Charles Pinckney National Historic Site (CHPI), although CHPI was not included as part of this monitoring effort. The Monument is 81-ha (200 ac), of which approximately 50 ha (122 ac) is submerged in the Harbor. Although the Monument is primarily managed as an important cultural site (i.e., it was the site of the first engagement of the Civil War), it also contains natural resources that provide important stop-over sites for migratory birds. Additionally, an accreted area adjacent to the fort and the beachfront areas on Sullivan's Island provide foraging habitat for shorebirds year-round.

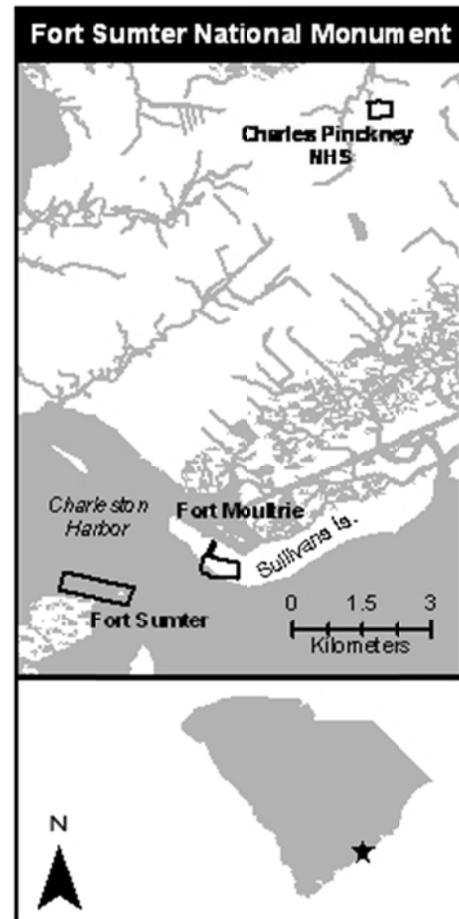
Vegetation is sparse around the fort itself, and consists primarily of early-successional tidal forbs (e.g., *Batis maritima*). The vegetation communities in the unit on Sullivan's Island are somewhat more complex, although impacted from strong anthropogenic use, and consist of primary dune, beach, and maritime hammock communities, and manicured lawn areas. The primary dune is characterized by sea oats (*Uniola paniculata*), while the maritime hammock is dominated by Virginia live oak (*Quercus virginiana*).

Dredging activities within the Harbor pose a potential threat to the source of sand, and other material, for the accreted area adjacent to the fort; although dredging activities are closely monitored by park managers.

FOSU has four known amphibian species and five known reptiles (Appendix A); which includes one reptile added to the Park's species list as a result of these 2010 monitoring efforts summarized herein. The amphibians consist of four species in Anura (frogs and toads) and the reptiles consist of five species in Squamata (e.g. lizards, snakes, geckos, and skinks).

### Sampling Design

A detailed explanation of the sampling design and site selection can be found in the SECN Draft Amphibian Monitoring Protocol (Byrne et al., *in preparation*) and sample site selection SOP (Byrne 2009). In summary, to allow for park-wide inference, the Monument's administrative boundary was used as the sampling frame. The sampling frame was divided into a systematic 0.5-ha grid; the center point of each grid cell served as the potential sampling site. A spatially-balanced sample was drawn from this grid using the Reversed Randomized Quadrant-Recursive Raster (RRQRR) algorithm (Theobald et al. 2007). Alternate points were used when selection



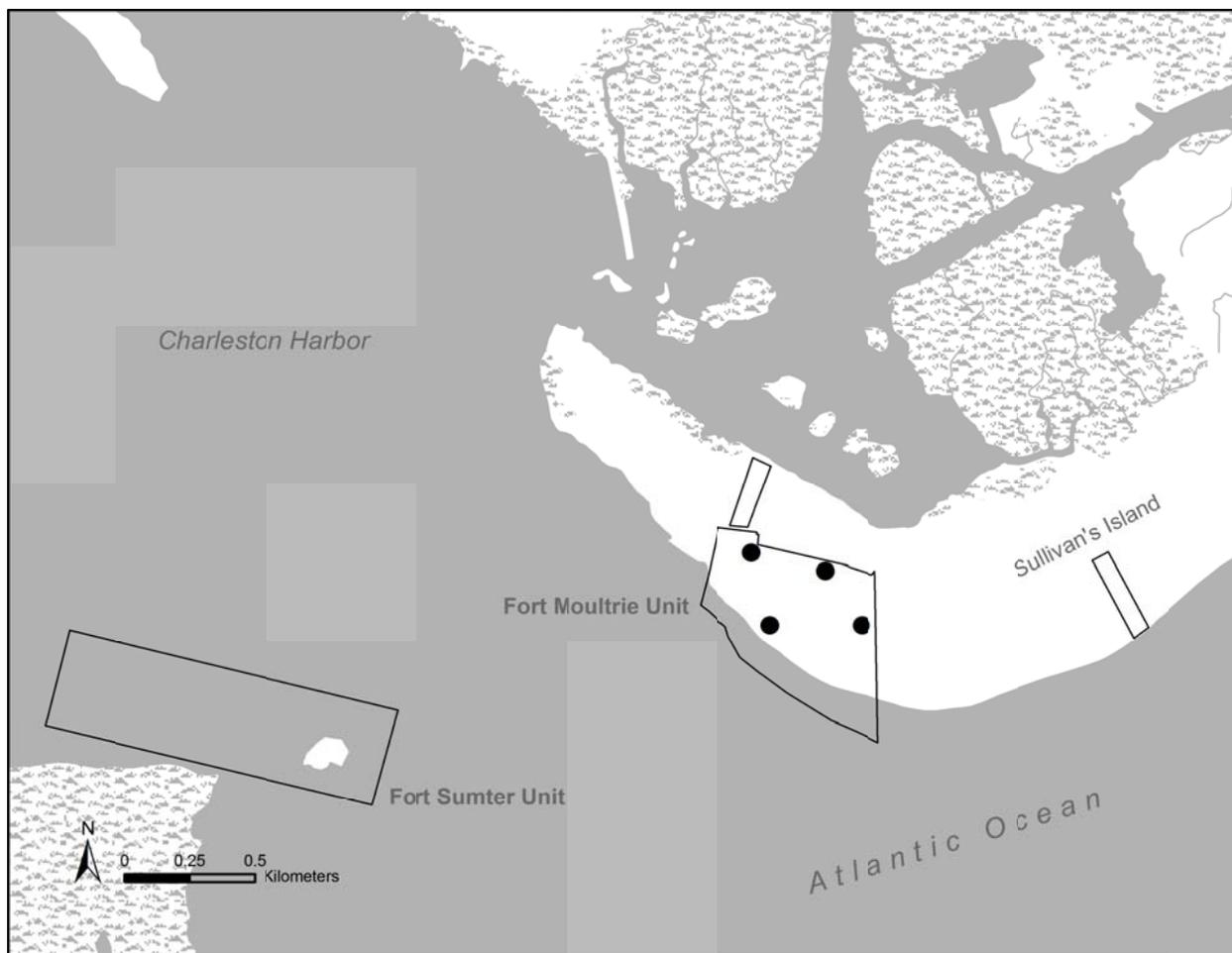
**Figure 1.** Location of Fort Sumter National Monument.

criteria (i.e., including safety and access issues) were not met. Areas not considered amphibian habitat (e.g., saline tidal marshes) were also excluded from the suite of sampling locations. A sample size of four was chosen after consideration of the Monument's size, hypothesized variability, and logistical issues regarding travel time and conducting monitoring activities in five to six park units per year. Sampling locations are presented in Figure 2.

### **Sampling Methodology**

Two sampling techniques are used as part of SECN amphibian monitoring; a combination of active and passive sampling techniques. The active technique is a time- and area-constrained medium-intensity visual encounter survey (VES) that incorporates dip-net techniques in sampling locations with aquatic communities. All species or species sign detected by sight or sound are recorded as part of the VESs. The passive technique is an automated-recording device (ARD) programmed to record one minute every ten minutes from dusk to dawn once every three days. Use of multiple techniques, as a "toolbox" approach (Olson et al. 1997), is generally agreed to be the most effective means to monitor amphibian communities (Hutchens and DePerno 2009). These sampling techniques are described in detail in Byrne (2007a) and Byrne (2007b).

ARD's were deployed from 4/8/2010 to 4/22/2010. A total of 1,680 minutes were recorded by all of the devices deployed the Monument. VESs were conducted from 6/10/2010 to 6/11/2010.



**Figure 2.** Spatially-balanced random sampling locations at FOSU, 2010.

### **Data Analysis**

Because this is the first year of this protocol’s implementation at the Monument, only the status of the elements presented in the aforementioned monitoring objective are presented; except occupancy. The data in this report are summarized and presented in three general categories: diversity, composition, and distribution. Sampling locations are presented in Figure 2, labeled locations are presented in Appendix B, and species detected at each location are presented in Appendix C.

Despite a well-trained and dedicated field crew, complete identification of all individuals encountered was not always possible due to the quick and evasive nature of many species. Species were, however, identified to the most refined taxonomic level possible. For example, while the surveyors are approaching a small pool surrounded by dense vegetation, they catch brief glimpses of and hear several frogs dive into the pool prior to completing a full visual inspection of the individuals necessary for identification. Although the majority of these species could most likely be identified to the genus or family level (i.e., Unknown *Rana* or Ranidae in this instance) based upon knowledge of the site and the local fauna, a conservative estimation is used and these species are identified to Order as “Unknown Anuran”.

Although the primary purpose for implementing the aforementioned monitoring techniques as part of SECN monitoring efforts was to detect amphibians, reptiles were also encountered. It is important to note that VESs and ARDs are not effective tools to survey for many reptile species, nor was the intent of VES implementation to target reptiles, but all reptile, and reptile sign detections are presented.

### ***Diversity***

For this report, diversity indices were not estimated due to the small number of amphibians detected. While the methods used are effective in characterizing amphibian diversity (Byrne et al. 2009a, b, c, d, e), it remains unknown if the low number of amphibians detected is an effect of sample size or if the park does not host a high number of amphibians due to the habitat types available. If more amphibians are encountered in the future, several metrics of alpha diversity will be calculated similar to methods outlined in Byrne et al. (*in preparation*) and as reported for parks where sufficient diversity allowed (see Byrne et al. 2010a, b, c, d, and e).

### ***Composition***

Measures of community composition are often good indicators of abiotic variability, disturbance, or other stressors. Summaries related to sample composition include the total number of individuals and species detected, and proportional abundances of each species in the overall sample. Frequency of occurrence estimates were calculated for each species detected by dividing the number of points where at least one individual was found by the total number of points sampled. Counts were also pooled across non-native species to generate frequency of occurrence estimates for all non-natives. Ratios of the individual counts of native to non-native species are also presented. Summaries of composition are presented for all amphibians, reptiles, and reptile sign (e.g., snake skin) detected.

### ***Distribution***

The distribution of species on park lands is integral to informed management. Further, changes in species distributions over time provide useful information regarding possible unseen influences that alter wildlife-habitat use and may be indicative of other issues. This section presents maps of all sampling locations where each amphibian, reptile, and reptile sign was detected.

# Results

## Composition

### ***Amphibians***

We detected 16 amphibians across two species: 12 eastern spadefoot, three southern toad, and one unknown *Bufo* sp. All amphibian detections occurred in the same sampling location, #1. Consequently, frequency of occurrence for these species was 0.25 (Table 1). Frequency of occurrence provides insight into the abundance of detected species across the park and whether a species is commonly or uncommonly encountered; however, this is strongly influenced by a species' detectability as more-easily detected species may be more frequently encountered (and vice versa). No non-native species were detected. The sample collected represented one-half of the amphibian species known to occur at FOSU.

### ***Reptiles***

We detected three reptiles of two species: two six-lined racerunners (locations #1 and #A2) and one eastern glass lizard (location #1). The detection of the eastern glass lizard was the first recorded occurrence of this species and an addition to the Monument's species list. Six-lined racerunner occurred in half of the locations sampled (Table 1).

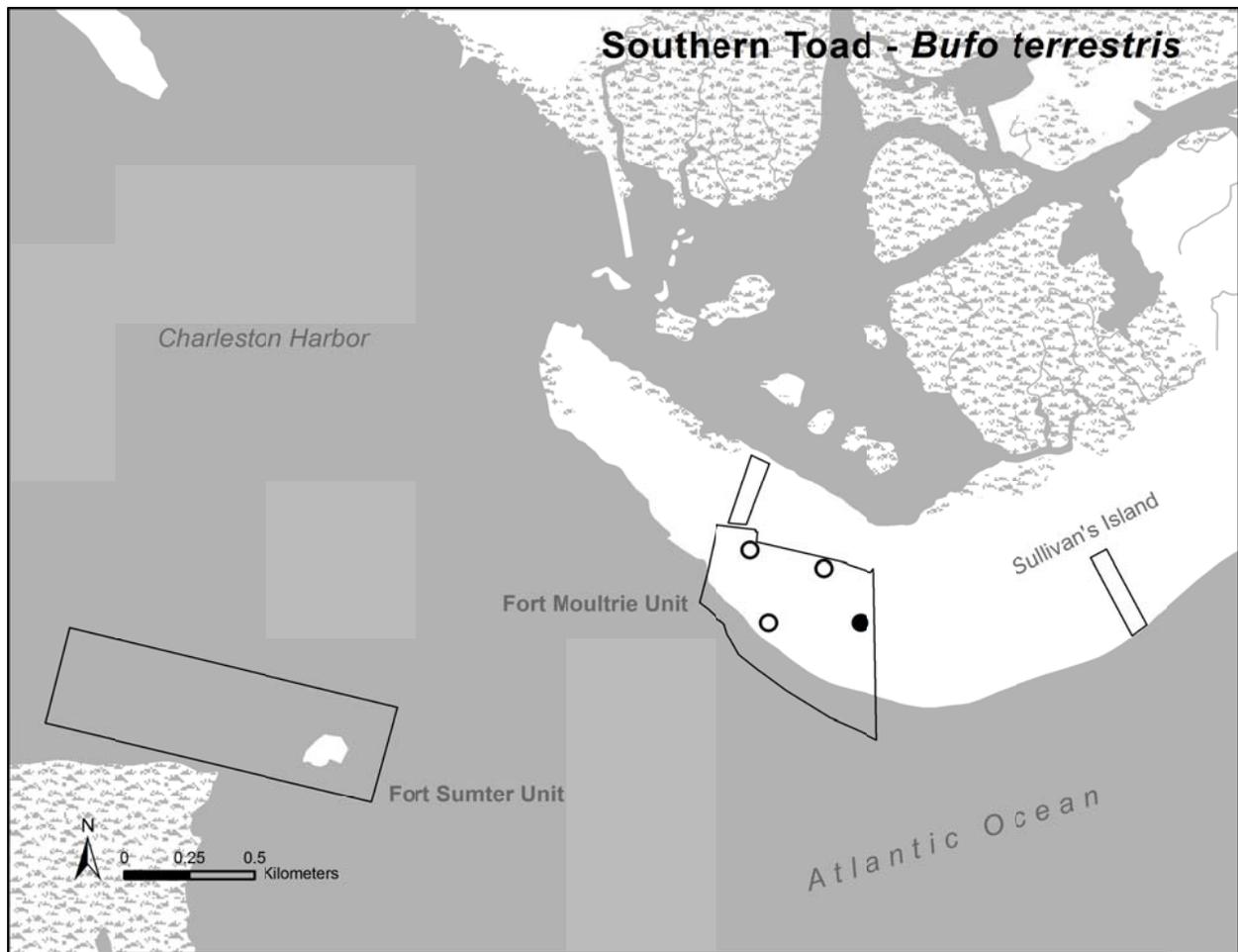
**Table 1.** Frequency of occurrence of amphibians and reptiles at FOSU, 2010.

<b>Common Name</b>	<b>Frequency of Occurrence</b>
southern toad	0.25
eastern spadefoot	0.25
six-lined racerunner	0.50
eastern glass lizard	0.25

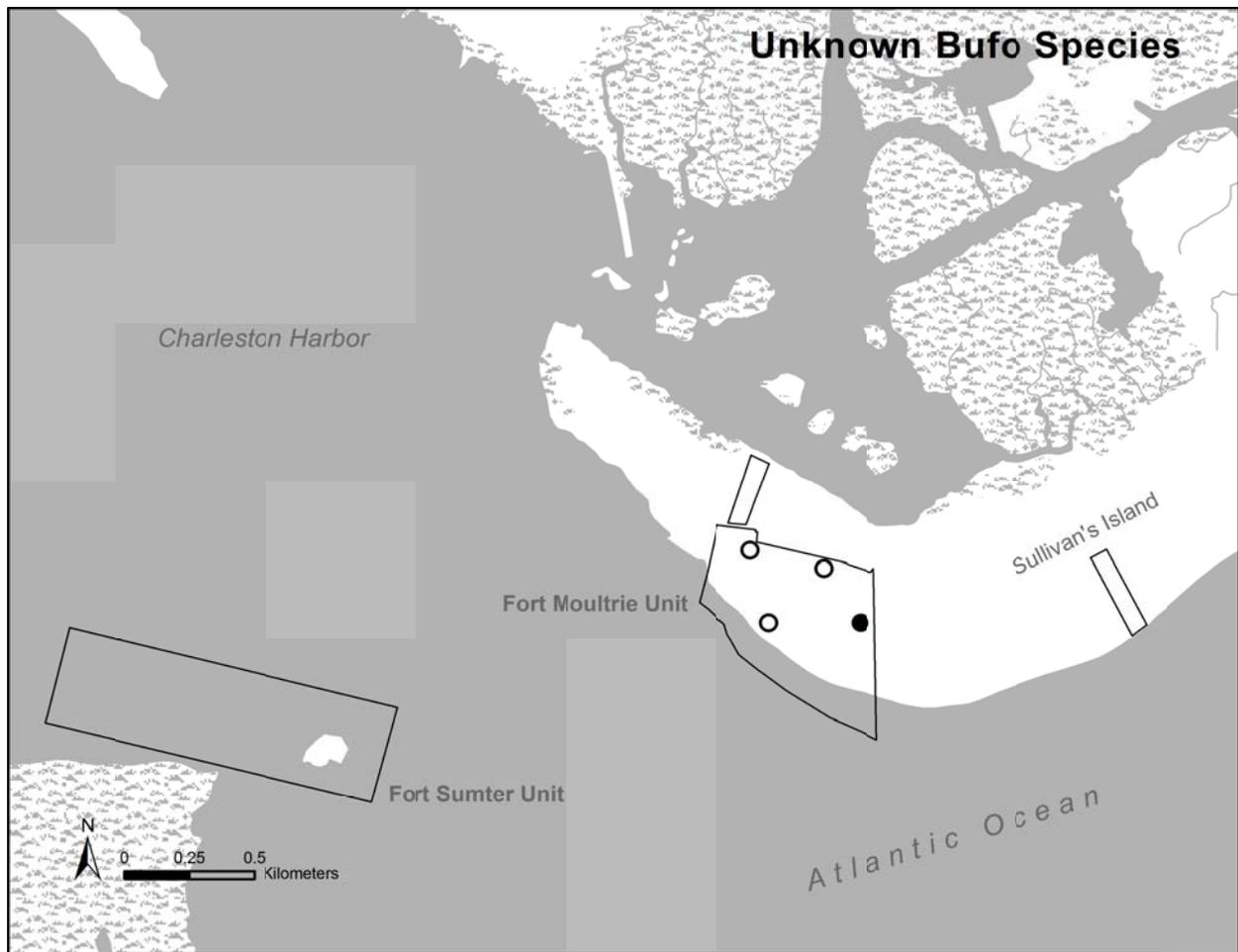
## Distribution

### ***Amphibians and Reptiles***

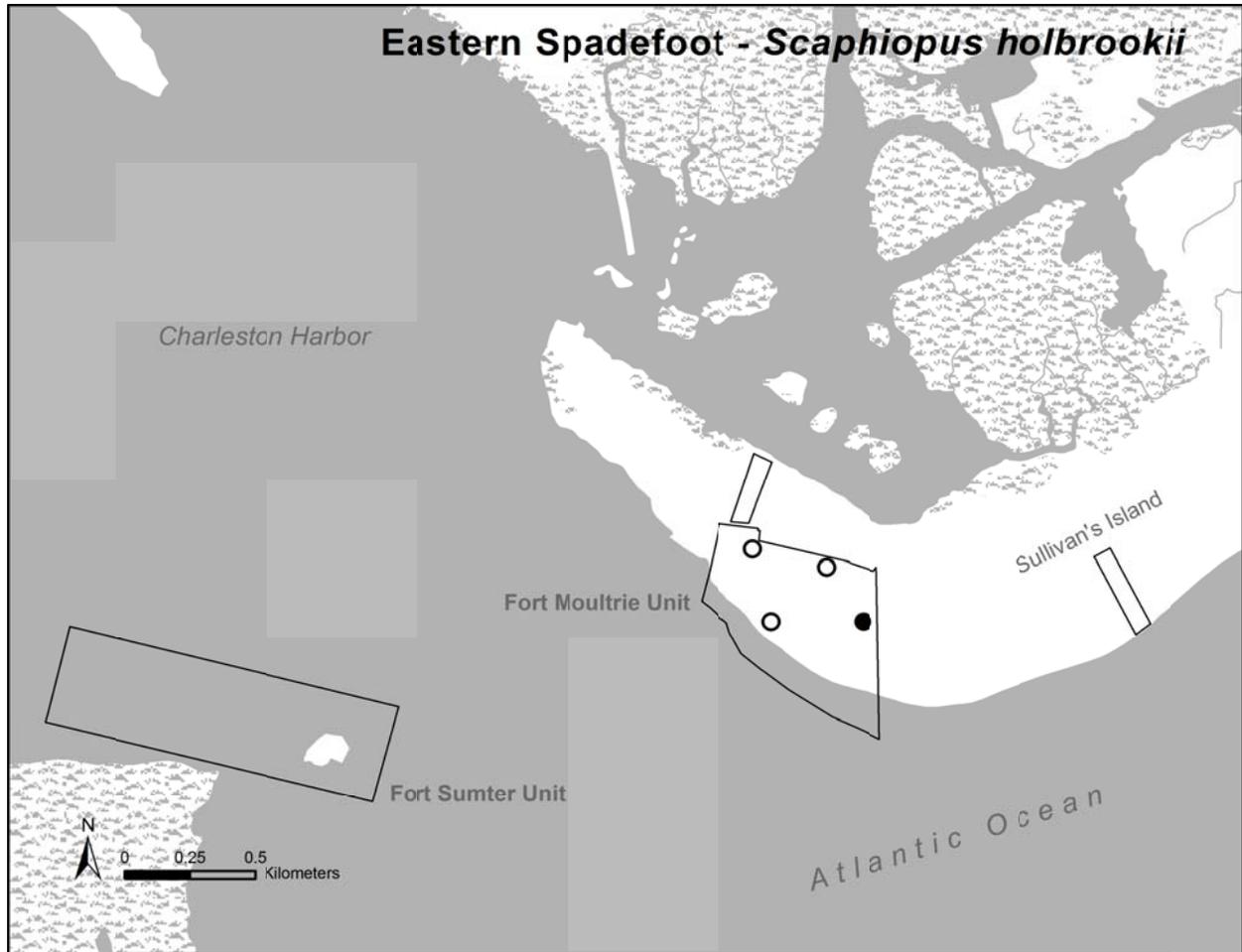
All of the species detected occurred in sampling location #1, except for six-lined racerunner which also occurred in sampling location #A2 (Figures 3–7). A species-by-sampling location matrix is presented in Appendix C.



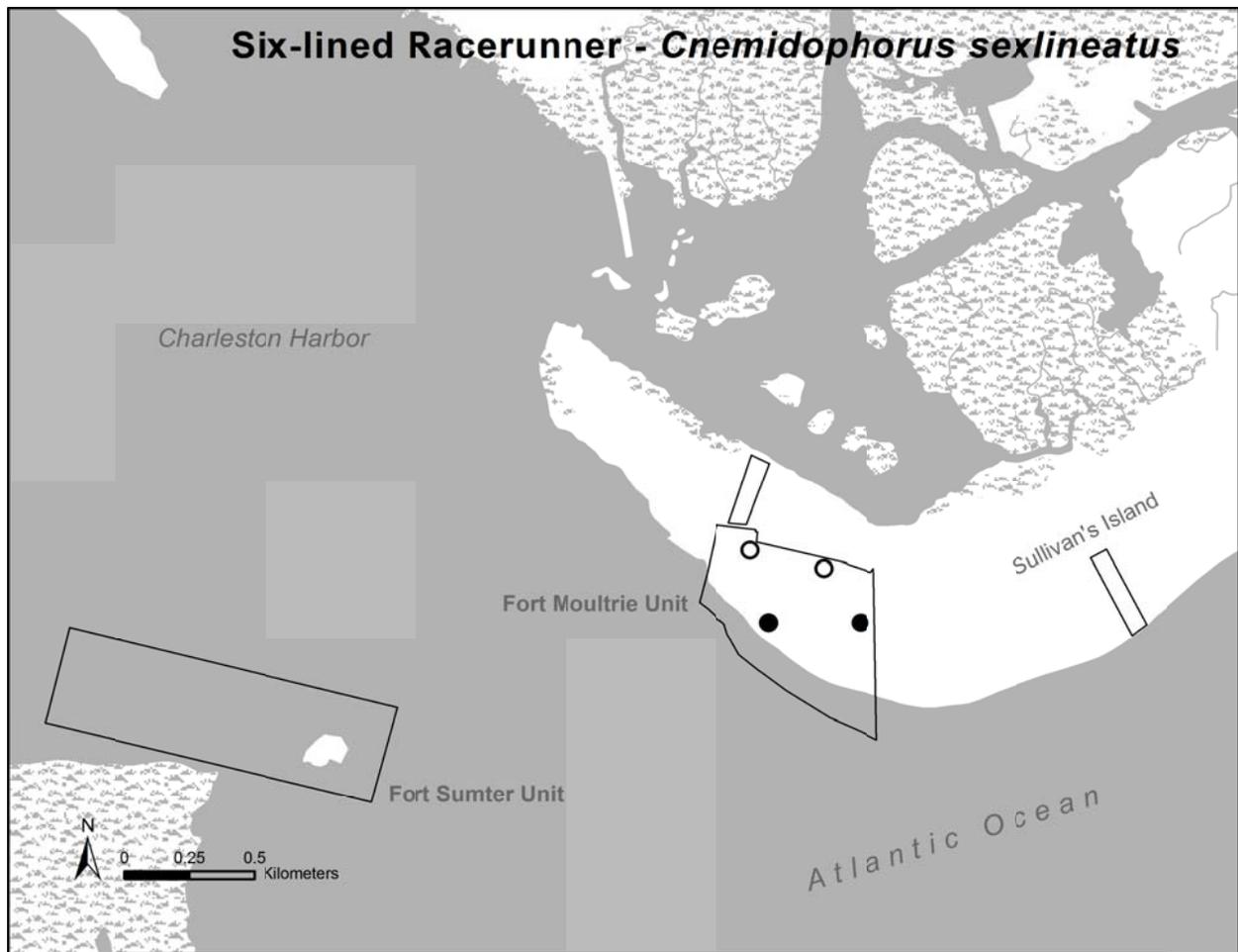
**Figure 3.** Sampling locations where southern toad (*Bufo terrestris*) was detected at FOSU, 2010. ● = detected, ○ = not detected.



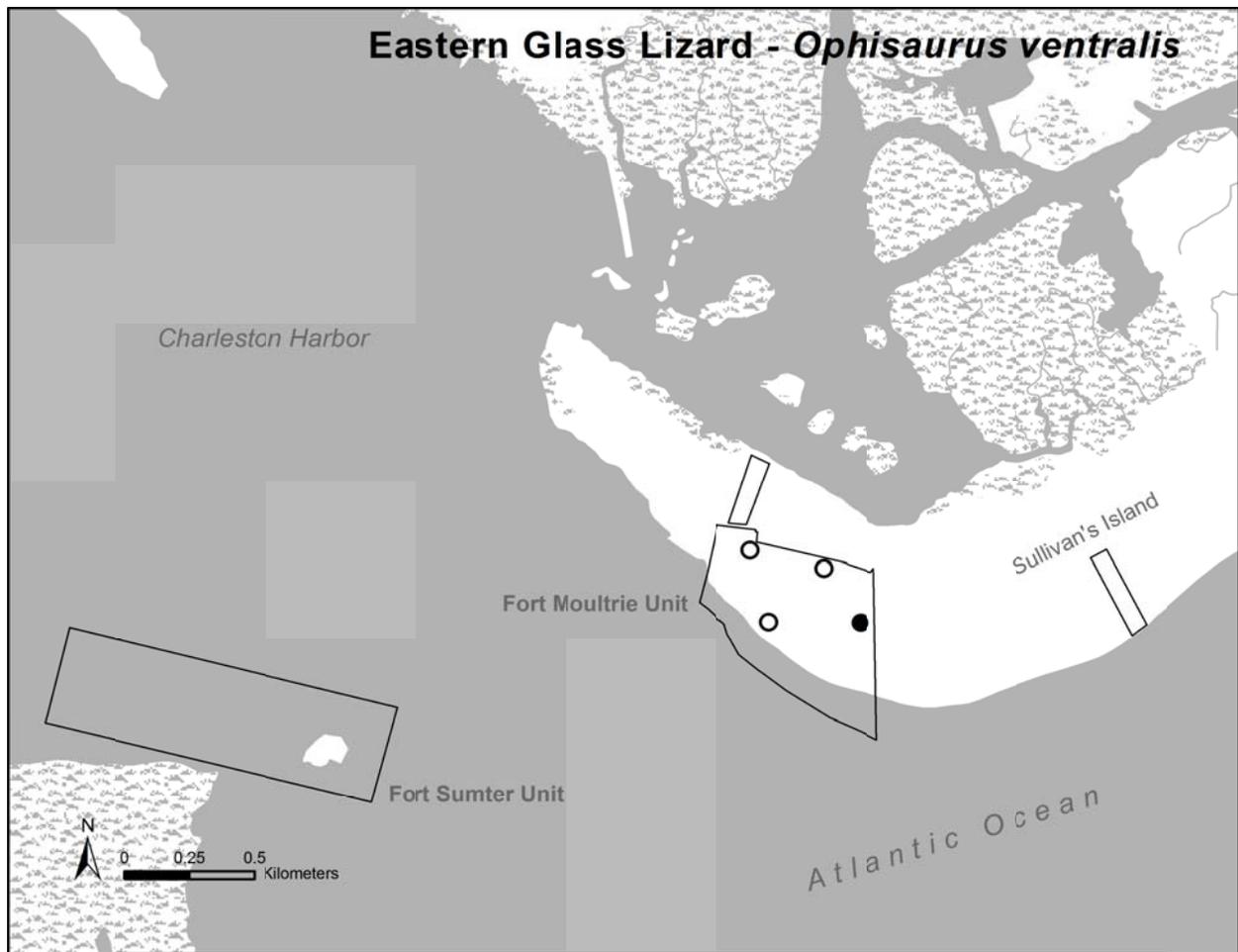
**Figure 4.** Sampling locations where *Bufo* sp. was detected at FOSU, 2010. ● = detected, ○ = not detected.



**Figure 5.** Sampling locations where eastern spadefoot toad (*Scaphiopus holbrookii*) was detected at FOSU, 2010. ● = detected, ○ = not detected.



**Figure 6.** Sampling locations where six-lined racerunner (*Cnemidophorus sexlineatus*) was detected at FOSU, 2010. ● = detected, ○ = not detected.



**Figure 7.** Sampling locations where eastern glass lizard (*Ophisaurus ventralis*) was detected at FOSU, 2010. ● = detected, ○ = not detected.

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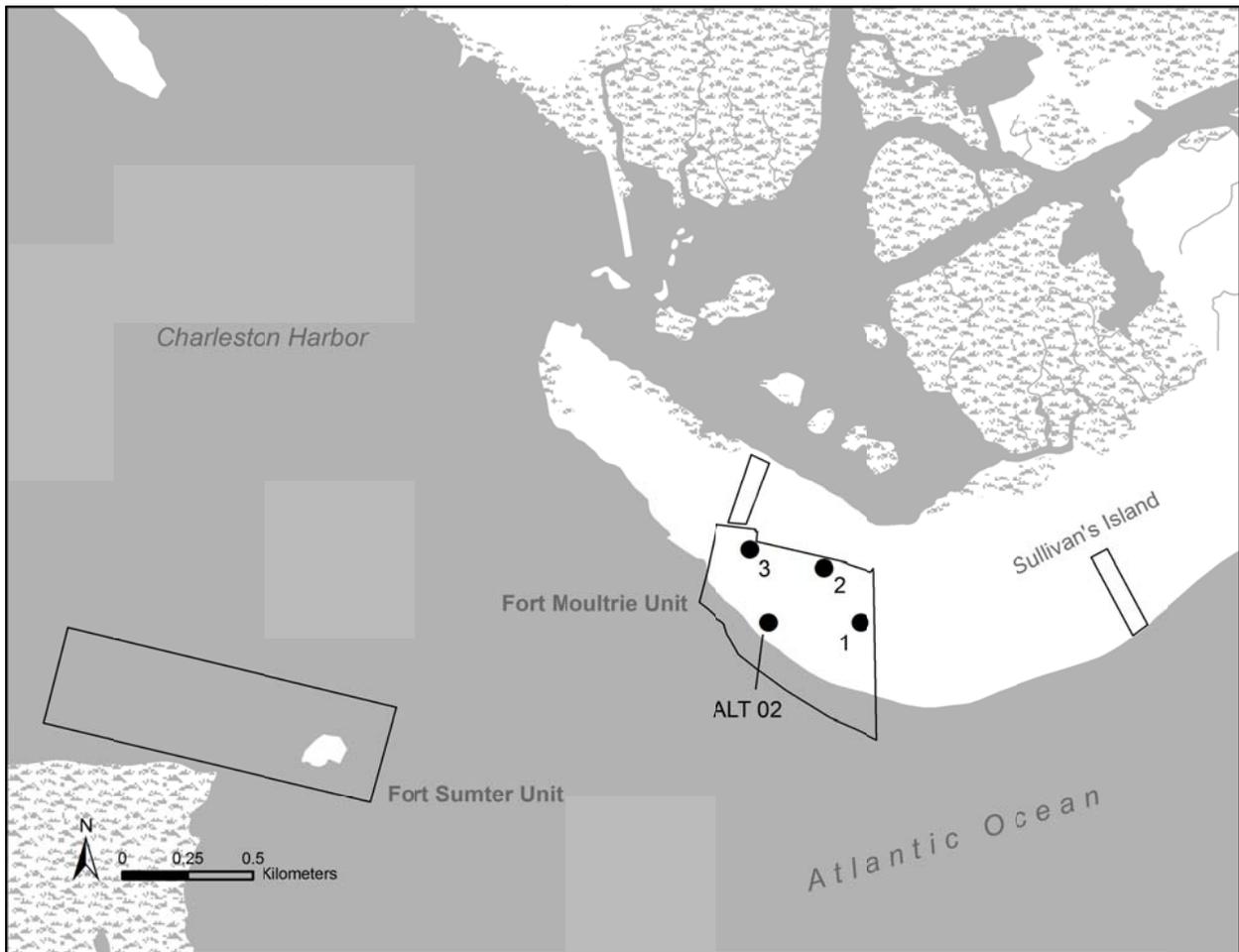
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**Appendix A. Amphibians and reptiles known to occur at FOSU.**

**Table A-1.** Amphibians and reptiles known to occur at FOSU based upon records in NPSpecies (2010) or from current monitoring efforts presented herein.

Order	Family	Scientific Name	Common Name	NPSpecies	ARD	VES
Anura	Bufo	<i>Bufo terrestris</i>	southern toad	X		X
Anura	Hyla	<i>Hyla cinerea</i>	green treefrog	X		
Anura	Microhylidae	<i>Gastrophryne carolinensis</i>	eastern narrow-mouthed toad	X		
Anura	Scaphiopodidae	<i>Scaphiopus holbrookii</i>	eastern spadefoot	X		X
Squamata	Anguillidae	<i>Ophisaurus ventralis</i>	eastern glass lizard			X
Squamata	Colubridae	<i>Coluber constrictor</i>	racer	X		
Squamata	Colubridae	<i>Elaphe obsoleta</i>	common rat snake	X		
Squamata	Polychrotidae	<i>Anolis carolinensis</i>	green anole	X		
Squamata	Teiidae	<i>Cnemidophorus sexlineatus</i>	six-lined racerunner	X		X

## Appendix B. Map of sampling locations with point labels.



**Figure B-1.** Spatially-balanced random sampling locations at FOSU with labels, 2010.



## Appendix C. Species detections by sampling location.

Table C-1. Species or species sign detected at each sampling location at FOSU, 2010. Refer to Appendix B for labeled sampling-locations.

Common Name	1	2	3	A2
southern toad	X			
eastern spadefoot	X			
unknown Bufo sp.	X			
eastern glass lizard	X			
six-lined racerunner	X			X