



Summary of Amphibian Community Monitoring at Fort Pulaski National Monument, 2010

Natural Resource Data Series NPS/SECN/NRDS—2011/139



ON THE COVER

Bufo terrestris (southern toad)

Photograph by Southeast Coast Network Staff

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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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Executive Summary

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

1. Data were collected at five spatially-balanced random locations at the Monument with two techniques: automated recording devices and visual-encounter surveys.
2. Sampling activities occurred at the Monument 4/7/2010 to 4/22/2010 and again from 6/9/2010 to 6/10/2010.
3. We only detected one amphibian of one species and four reptiles of one species.
4. No non-native species were detected.
5. All individuals detected occurred in one sampling location.
6. This monitoring protocol will be implemented again at the Monument in 2013. Because the effort resulted in the collection of only one of the seven amphibian species known to occur at FOPU, sample-size adequacy will be evaluated prior to resampling.
7. 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, Petranks 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 Pulaski National Monument (FOPU) is outside Savannah, Georgia along the Savannah River only a few miles from its junction with the Atlantic Ocean (Figure 1). The Monument's goal is to interpret technological advances in artillery and brick forts during the Civil War, although the Monument contains significant natural resources. The 2,276-ha (5,623 ac) Monument consists of two islands: Cockspur Island and McQueens Island. Both islands have been anthropogenically altered since the area was identified as a good defensive position in the 1700s and the Fort's construction began in the late 1820s. Of the two islands, Cockspur Island experienced much more impact by the installation of drainage ditches and the use of the island to deposit dredge spoil. Cockspur Island likely supported some variation of coastal maritime hammock historically, and currently hosts primarily a sabal palm (*Sabal palmetto*) dominated community. The larger of the two islands, McQueens Island (1,983 ha, 4,900 ac), appears less impacted from its history of use and consists primarily of a salt marsh cordgrass (*Spartina alterniflora*) community, which is likely similar to its original condition. Both islands provide important habitat for migratory birds and a variety of marine species.

Since the Monument is situated at the mouth of the Savannah River, the direct and indirect effects of contaminants accrued throughout the watershed are known to impact water quality and might also affect the plant and wildlife communities at the Monument, although the extent to which this occurs remains unknown. Further, shipping traffic and dredging are contributing to increased shoreline erosion along the north shore of Cockspur Island.

FOPU has seven known amphibian species and 16 known reptiles (Appendix A). The amphibians consist of seven species in Anura (frogs and toads) and the reptiles consist of one species of Crocodilia, 13 species in Squamata (e.g., lizards, snakes, geckos, and skinks), and two species in Testudines (turtles and tortoises).

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

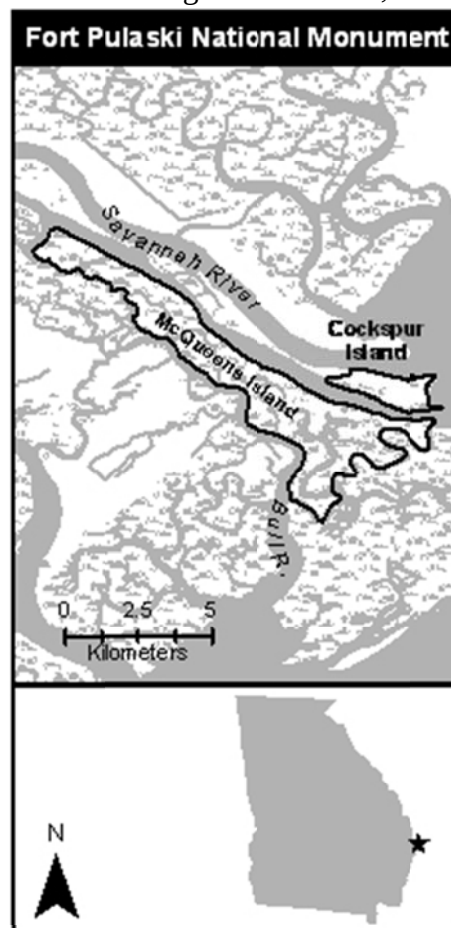


Figure 1. Location of Fort Pulaski National Monument.

Raster (RRQRR) algorithm (Theobald et al. 2007). Alternate points were used when selection 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 five 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 4/7/2010 to 4/22/2010. A total of 1,512 minutes were recorded by all of the devices deployed at the Monument. One device malfunctioned and did not record two of the planned four nights. VESs were conducted from 6/9/2010 to 6/10/2010.

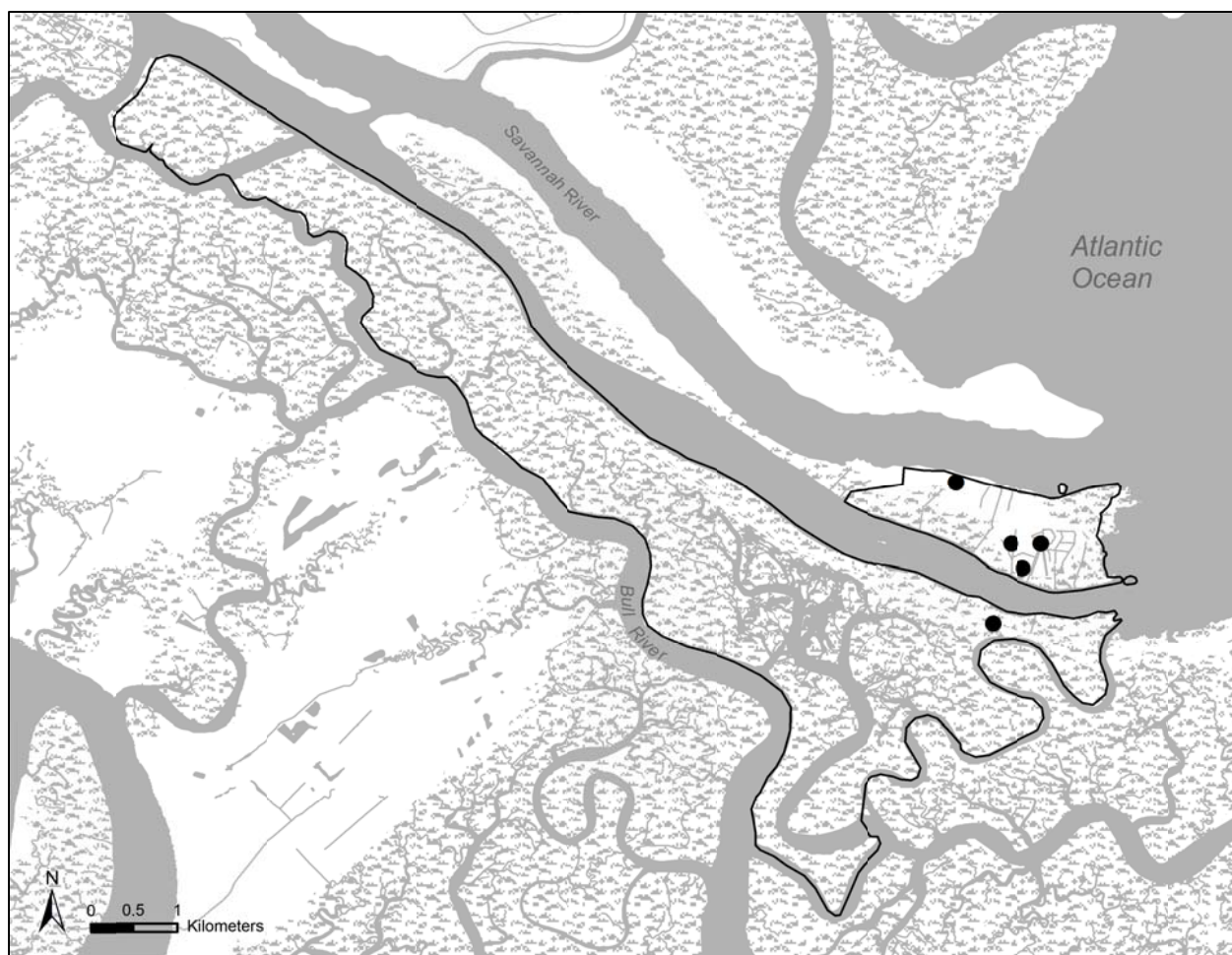


Figure 2. Spatially-balanced random sampling locations at FOPU, 2010.

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. For all species detected, a naïve estimate of occupancy is calculated as the proportion of sites where the species was detected at least once and unadjusted for probability of detection. All non-native species detections were pooled to calculate the proportion of sites where at least one non-native species was detected. Future data analyses will include estimates of occupancy adjusted for probability of detection (MacKenzie et al. 2002) and taking into account environmental covariates known to influence the probability of detection of amphibians (e.g., rainfall and temperature). 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 and Reptiles

We detected one individual of one amphibian species (southern toad) and four individuals of one reptile species (green anole). Both of these species were detected in the same sampling location (Figure 3; Figure 4), so frequency of occurrence was the same for both species (Table 1). Occupancy 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 (which will be accounted for in future analyses) as more-easily detected species may be more frequently encountered (and vice versa). No non-native species were detected.

Because the effort resulted in the collection of only one of the seven amphibian species known to occur at FOPU, sample-size adequacy and other factors that play a role in the occurrence and detection of amphibians will be evaluated prior to resampling the Monument in 2013.

Table 1. Naïve occupancy estimates (proportion of sites where the species was detected) for amphibians and reptiles at FOPU, 2010.

Common Name	Frequency of Occurrence
southern toad	0.20
green anole	0.20

Distribution

Amphibians and Reptiles

The two species detected during the sampling event both occurred in the same sampling location (Figure 3; Figure 4), Alternate 1. A species-by-sampling location matrix is presented in Appendix C.

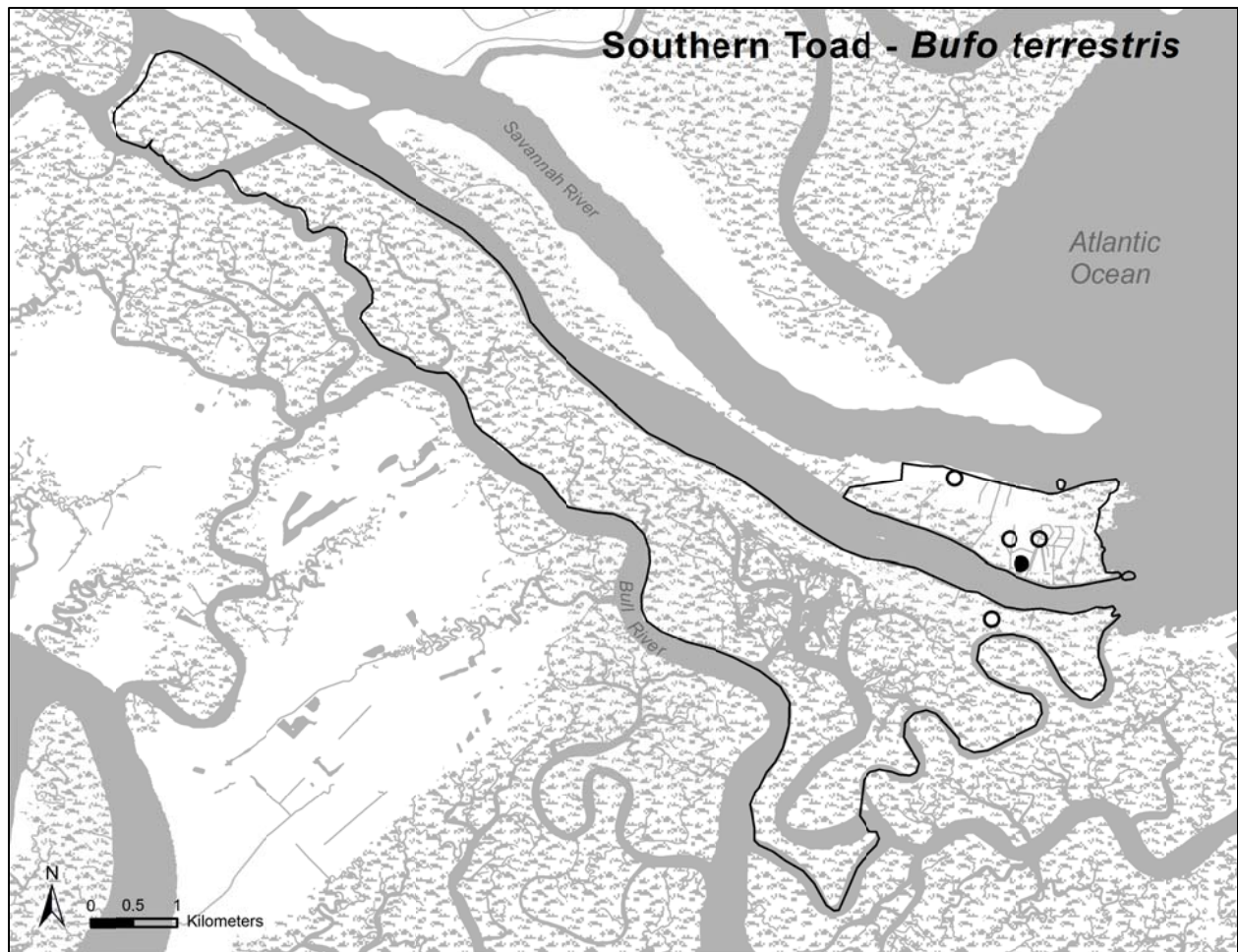


Figure 3. Sampling locations where southern toad (*Bufo terrestris*) was detected at FOPU, 2010. ● = detected, ○ = not detected.

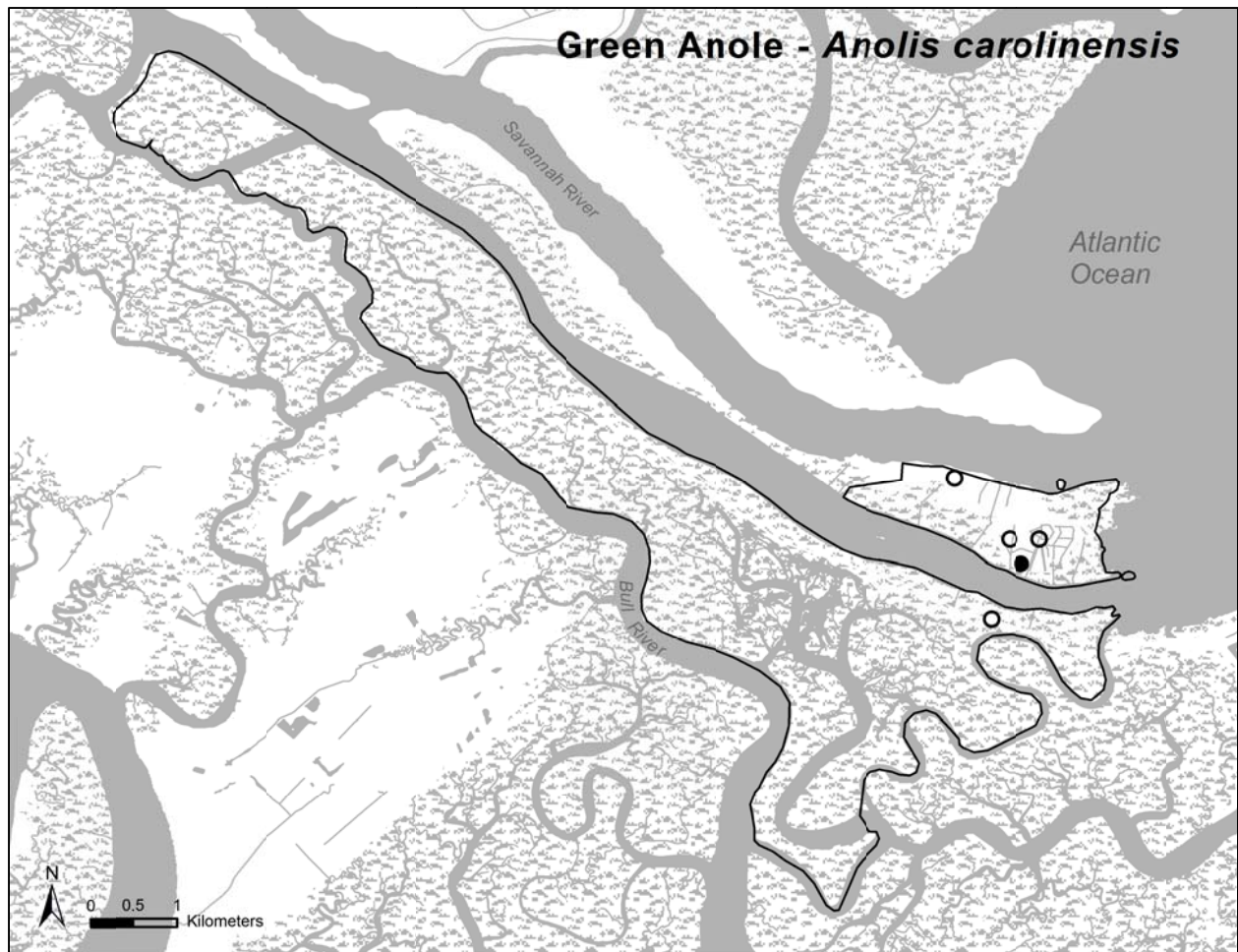


Figure 4. Sampling locations where green anole (*Anolis carolinensis*) was detected at FOPU, 2010. ● = detected, ○ = not detected.

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Appendix A. Amphibians and reptiles known to occur at FOPU.

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

Order	Family	Scientific Name	Common Name	NPSpecies	ARD	VES
Anura	Bufonidae	<i>Bufo terrestris</i>	southern toad	X		X
Anura	Hylidae	<i>Acris gryllus</i>	southern cricket frog	X		
Anura	Hylidae	<i>Hyla cinerea</i>	green treefrog	X		
Anura	Hylidae	<i>Hyla squirella</i>	squirrel treefrog	X		
Anura	Hylidae	<i>Pseudacris ocularis</i>	little grass frog	X		
Anura	Microhylidae	<i>Gastrophryne carolinensis</i>	eastern narrow-mouthed toad	X		
Anura	Ranidae	<i>Rana sphenoccephala</i>	southern leopard frog	X		
Crocodylia	Alligatoridae	<i>Alligator mississippiensis</i>	alligator	X		
Squamata	Anguidae	<i>Ophisaurus ventralis</i>	eastern glass lizard	X		
Squamata	Colubridae	<i>Coluber constrictor</i>	racer	X		
Squamata	Colubridae	<i>Elaphe guttata</i>	corn snake, red rat snake	X		
Squamata	Colubridae	<i>Elaphe obsoleta</i>	common rat snake	X		
Squamata	Colubridae	<i>Lampropeltis getula</i>	common kingsnake	X		
Squamata	Colubridae	<i>Nerodia fasciata</i>	southern water snake	X		
Squamata	Colubridae	<i>Opheodrys aestivus</i>	rough green snake	X		
Squamata	Polychrotidae	<i>Anolis carolinensis</i>	green anole	X		X
Squamata	Polychrotidae	<i>Norops sagrei</i>	brown anole	X		
Squamata	Scincidae	<i>Eumeces inexpectatus</i>	southeastern five-lined skink	X		
Squamata	Scincidae	<i>Scincella lateralis</i>	ground skink	X		
Squamata	Viperidae	<i>Agkistrodon piscivorus</i>	cottonmouth	X		
Squamata	Viperidae	<i>Crotalus adamanteus</i>	eastern diamondback rattlesnake	X		
Testudines	Emydidae	<i>Terrapene carolina</i>	eastern box turtle	X		
Testudines	Emydidae	<i>Trachemys scripta</i>	common slider	X		

Appendix B. Map of sampling locations with point labels.

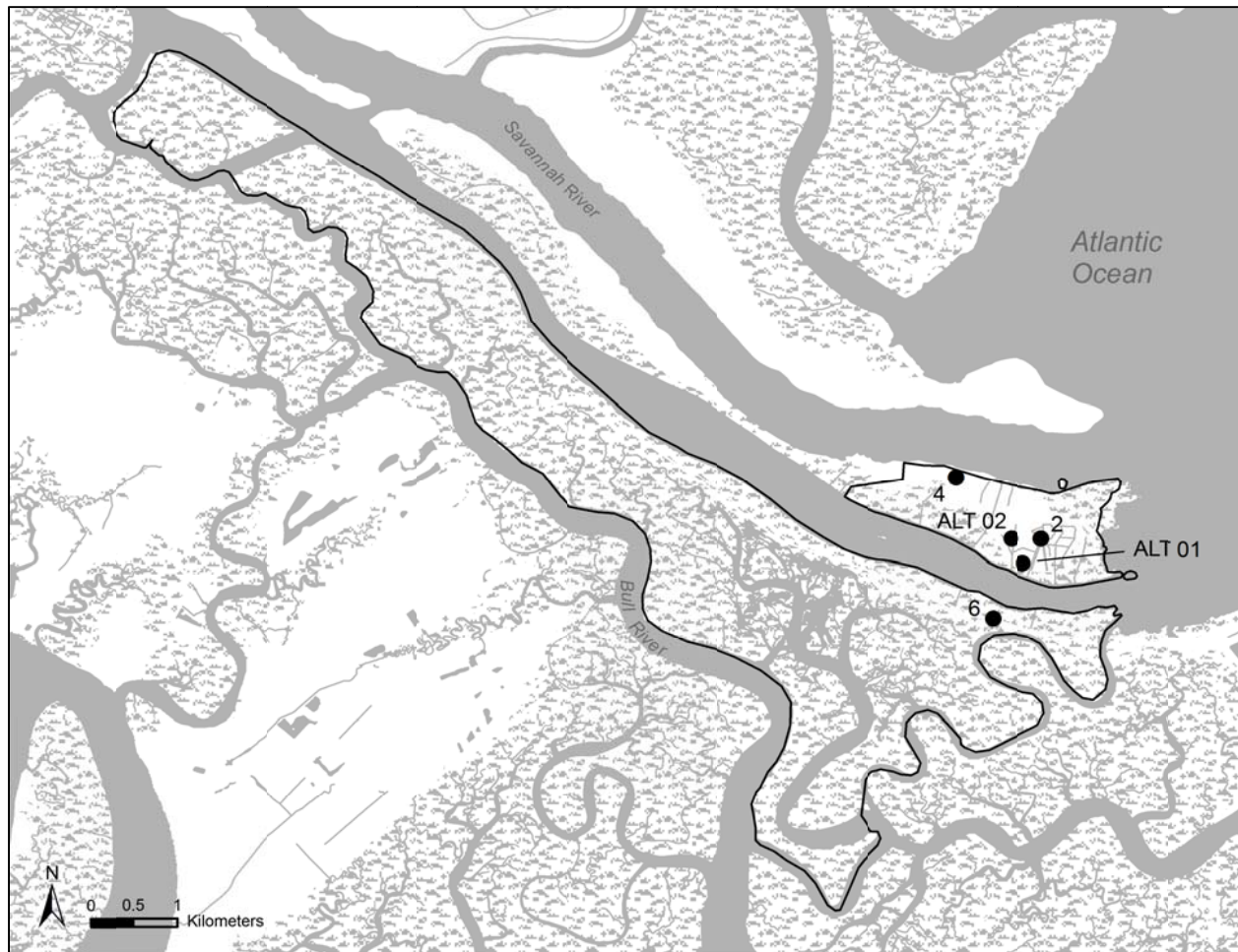


Figure B-1. Spatially-balanced random sampling locations at FOPU with labels, 2010.

Appendix C. Species detections by sampling location.

Table C-1. Species or species sign detected at each sampling location at FOPU, 2010. Refer to Appendix B for labeled sampling locations. Shaded cells indicate that the ARD malfunctioned and only recorded two days of data (i.e., one-half of the planned amount).

Scientific Name	2	4	6	A1	A2
<i>Bufo terrestris</i>				X	
<i>Anolis carolinensis</i>				X	