



Anuran Community Monitoring at Canaveral National Seashore

2014 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2015/981



On the cover:
Squirrel Treefrog (*Hyla squirella*)
Photograph by Briana Smrekar

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Executive Summary

The southern United States hosts one of the most diverse amphibian communities in the world and supports the highest density of amphibian species in North America (Echternacht and Harris 1993). The South contains 63 species of frogs and toads, 11 of which are endemic; this accounts for almost 40% of the total number of anuran species in the United States (Dorcas and Gibbons 2008, Echternacht and Harris 1993). The park units in the National Park Service's (NPS) Southeast Coast Network (SECN) are home to 35 known anuran species (frogs and toads). Given their known population declines, sensitivity to anthropogenic stressors, and the diversity of amphibians in the southeastern United States, anuran communities are a priority for SECN monitoring efforts. This report summarizes anuran community vital signs monitoring data collected at Canaveral National Seashore (CANA, Canaveral) in 2014.

- Automated recording devices (ARDs) were used to collect data from 3/3/2014 through 5/23/2014 at 30 spatially balanced random locations.
- We detected vocalizations from 16 identifiable anuran species.
- A total of 600 vocalizations were detected on the recordings. Each detection represents an identifiable observation of a species or species group during one night of monitoring at a sampling location.
- The squirrel treefrog (*Hyla squirella*) had the highest frequency of occurrence at CANA in 2014. The greenhouse frog (*Eleutherodactylus planirostris*), a non-native species, had the second highest naïve occupancy rate. The eastern narrowmouth toad (*Gastrophryne carolinensis*), southern chorus frog (*Pseudacris nigrita*), and eastern spadefoot toad (*Scaphiopus holbrookii*) had the lowest naïve occupancy rates.
- The squirrel treefrog had the highest relative frequency of detection of vocalizations over the 77-day recording period in 2014; the greenhouse frog had the second highest frequency of detection.
- The squirrel treefrog and the greenhouse frog were the most widely distributed anurans at CANA in 2014.
- Two non-native anurans were detected at CANA in 2014: the Cuban treefrog and the greenhouse frog.
- Anuran communities will next be sampled in 2017.
- The full dataset and associated metadata can be acquired from the NPS Integrated Resource Management Applications (IRMA) portal at <http://irma.nps.gov>.

Introduction

Overview

Amphibian populations have declined in North America and many other areas around the world. Several factors have contributed to these 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, their effects can be exacerbated when combined with other anthropogenic stressors.

Amphibians have complex life cycles in which 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 depend can substantially impact the survival, reproduction, and persistence of a species. Given their habitat requirements, anatomy, and physiology, amphibians are considered good indicators of ecological condition.

The southern United States hosts one of the most diverse amphibian communities in the world and supports the

highest density of amphibian species in North America (Echternacht and Harris 1993). The South is home to 63 species of frogs and toads, 11 of which are endemic; this accounts for almost 40% of the total number of anuran species in the United States (Dorcas and Gibbons 2008, Echternacht and Harris 1993). Units in the National Park Service's (NPS) Southeast Coast Network (SECN) have 35 known anuran species (frogs and toads). Given their known population declines, sensitivity to anthropogenic stressors, and the diversity of amphibians in the southeastern United States, anuran 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 anuran community monitoring data summarized herein is a tool to assist park managers in fulfilling this mandate.

This report summarizes data collected as a part of the Southeast Coast Network Vital Signs Monitoring Program's efforts to assess the status and trends of anuran communities at Canaveral National Seashore (CANA).

Study Area

Canaveral National Seashore is located on the east coast of central Florida (Figure 1). Canaveral comprises approximately 57,000 acres, including Mosquito Lagoon, and the southern portion is jointly managed by the National Park Service and the United States Fish and Wildlife Service's (USFWS) Merritt Island National Wildlife Refuge. Canaveral's natural resources include a diverse assemblage of wildlife, plant communities, geophysical features and natural processes reflecting the complexity of the land/lagoon/sea interface of east-central Florida. Mosquito Lagoon, extending along the backside of Canaveral's barrier island, is the northernmost part of the Indian River Lagoon and has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. The lagoon acts as an important nursery area for a wide variety of game and non-game species.

Unlike many barrier islands, Canaveral National Seashore has a less complex dune system (i.e., primary and secondary) separating the lagoon from the ocean and generally consists of a single primary dune, averaging 3.7 meters (12 feet) in height. The uplands consist of live-oak (*Quercus virginiana*) / sabal palm (*Sabal palmetto*) hammocks and pine flatwoods interspersed with freshwater wetlands forming a unique and diverse mosaic. Canaveral provides habitat for many state- and federally-listed species. For example, 3,000–4,500 sea turtle nests are recorded on Canaveral's 24 miles of beach each year. Canaveral National Seashore also sustains nationally renowned recreational and commercial fisheries, including finfish, oysters and clams. The park has a rich Native American occupational history and several shell middens occur at the park. Park managers work cooperatively with the USFWS to implement a prescribed-fire management plan to maintain the integrity of the fire-adapted communities at Canaveral.

Canaveral has 18 known anuran species (NPSpecies 2015; Appendix A), including two non-native species: Cuban treefrog (*Osteopilus septentrionalis*) and greenhouse frog (*Eleutherodactylus planirostris*).

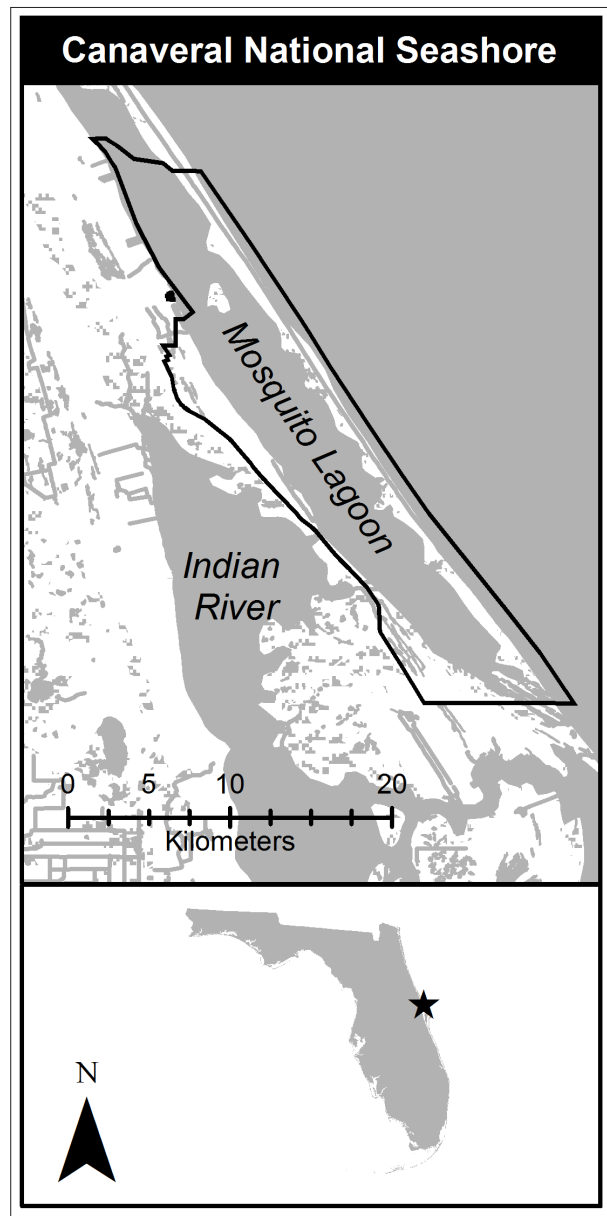


Figure 1. Location of Canaveral National Seashore.

Monitoring Objectives

Analysis of monitoring data is based on detections of vocal anurans using automated recording devices. A detection consists of one or more observations of a species or species group during one night of monitoring at a sampling location. The Southeast Coast Network has four monitoring objectives related to anuran communities based on post-metamorphic anuran vocalization data collected from March to mid-June in non-saline wetland and upland vegetation communities in all SECN parks (Byrne et al. 2013):

- Determine the status and trends in species richness and diversity of anuran communities. Species richness and diversity estimates are based on the total number of species detected (native and non-native).
- Determine the status and trends in occupancy by anuran species. Occupancy estimates provide insight into the likelihood of encountering a specific species in a given area. The rarity, diversity, and distribution of a species or group and associated relative comparisons provide insight into the composition of the sample.
- Determine the status and trends in frequency of detection of vocal anurans. Frequency of detection is the number of nights a species or species group is observed during the sampling event at each sampling location.
- Determine trends in the vocalization phenology of select anurans with high detectability. Vocal anuran calling patterns of species with high detectability (i.e., an unbiased detectability estimate generated from the occupancy-modeling process) will be analyzed to determine the status and trends in the first and last dates on which species are detected.



Pine woods treefrog at Canaveral National Seashore. Photo by Briana Smrekar.

Canaveral National Seashore

Southeast Coast Network
National Park Service
U.S. Department of the Interior

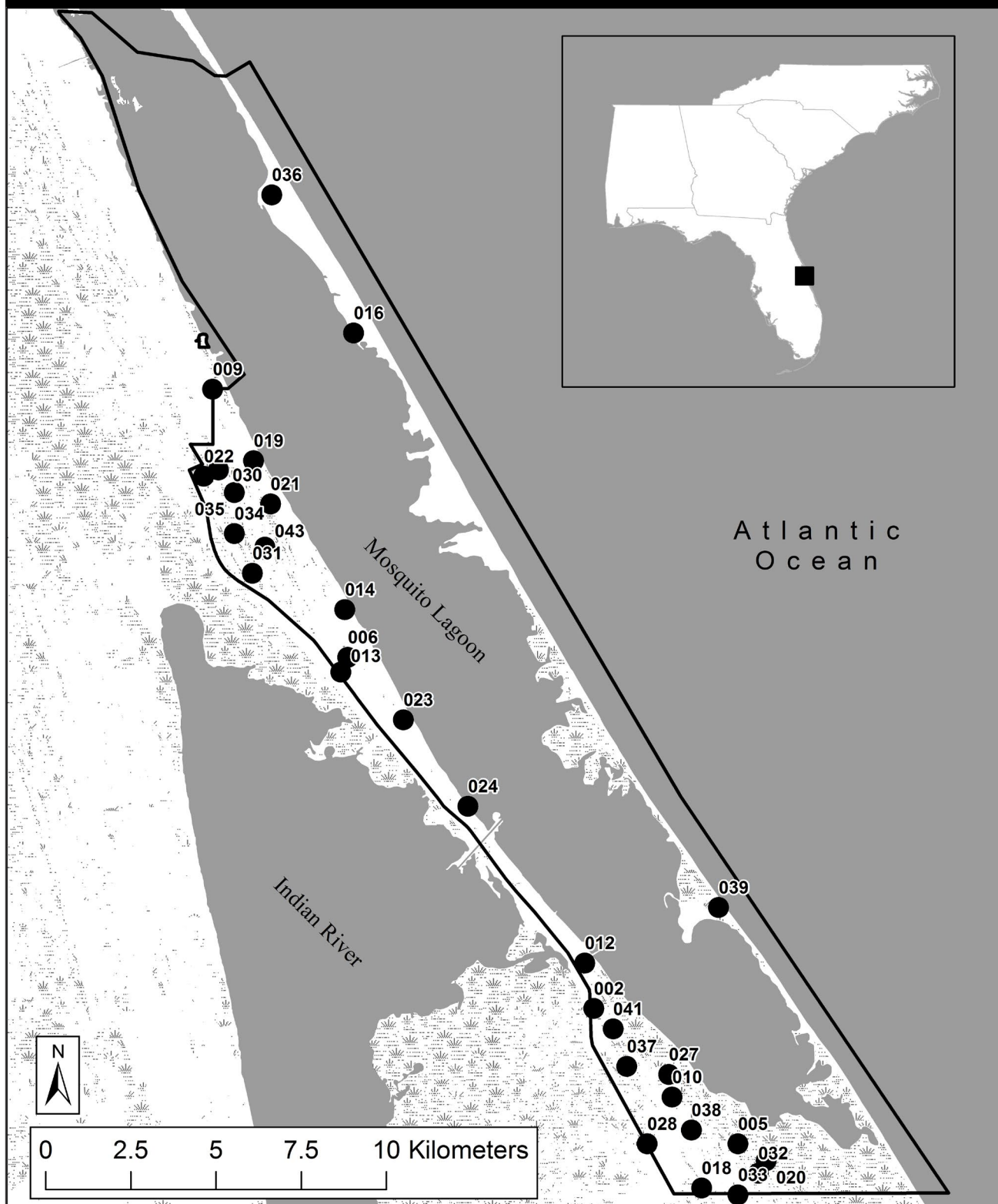


Figure 2. Spatially balanced random sampling locations at Canaveral National Seashore in 2014.

Methods

Sampling Design

The sampling design and sampling-location selection is detailed in Appendix B of the SECN Vocal Anuran Community Monitoring Protocol (Byrne et al. 2012) and in the sampling-location selection Standard Operating Procedure #1.1.1 (Byrne 2012). In summary, the seashore's administrative boundary was used as the sampling frame to allow for park-wide inference. The sampling frame was divided into a systematic 0.5-hectare grid; the center point of each grid cell served as the potential sampling location. 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 specified selection criteria (e.g., safety issues, accessibility) were not met. In 2014, anuran communities were sampled at 30 locations that met the selection criteria (Figure 2).

Taxonomic Standards

Taxonomy and nomenclature follow standards set forth in the Integrated Taxonomic Information System (ITIS; <http://www.itis.gov/>). The National Park Service uses the online application NPSpecies (<https://irma.nps.gov/npspecies>) to document “our knowledge about the occurrence and status of species on National Park Service lands,” including maintenance of species lists for NPS properties. The taxonomy and nomenclature in NPSpecies is periodically updated with the most current ITIS catalog. As noted on the ITIS webpage, the system intends not to “serve as a forum for cutting-edge taxonomic classifications,” but rather to use “classifications that have gained broad acceptance in the taxonomic literature and by professionals who work with the taxa.”

All vocalizations are identified to the finest (i.e., lowest) resolution possible in the taxonomic hierarchy. Only vocalizations identified to the species level are used in the analyses presented herein.

Data Collection

A passive sampling technique was used to collect recordings in the field. Recordings were then manually evaluated using Song Scope software (Wildlife Acoustics, Inc.) and data were extracted to be used in the anuran community monitoring data analysis. Anuran monitoring locations are co-located with the SECN landbird community and vegetation community monitoring locations.

Automated Recording Devices

Automated recording devices (ARDs) are often used to characterize soundscapes. Recently, this technology has been applied to wildlife species monitoring efforts. The use of ARDs is advantageous in SECN parks because of (a) the high number of vocal anurans (i.e., vocalizing frogs and toads) in SECN park units, (b) the assumed broad distribution of many of these species across park lands, (c) the crepuscular and nocturnal calling behavior that predominates among the vocal anurans in SECN park units (Mohr and Dorcas 1999, Bridges and Dorcas 2000, Todd et al. 2003), (d) the safety issues for personnel conducting night-time calling surveys, and (e) the adherence of detection/non-detection data from ARDs to the monitoring objective. Further, the devices produce recordings which serve as a permanent data product that can be further analyzed as technology improves. The recordings can also be analyzed by other researchers, analyzed for other taxa, or used to quantify the soundscape.

To address some of the known influences related to imperfect detection (MacKenzie et al. 2002, MacKenzie et al. 2006), automated recording devices were deployed for 77 days to ensure detection of species present at the park as well as to assess changes in calling phenology. After the deployment period, the devices were retrieved and audio files were analyzed by SECN staff to determine the date, time, and species of all vocal anurans that were detected.

As is the case with all data collected by ARDs, the information derived is based on species' detectability. The occupancy estimates and phenology trends are based on methodology and data collection that does not account for environmental cues that initiate calling behavior (e.g., rainfall, humidity, and temperature). Additionally, while every effort is made to ensure that the recording time frame is sufficient to encompass most vocalizing anurans, the recordings are only a portion of the time during which anurans are active. Based upon pilot monitoring efforts in the SECN from 2009–2012 and vocalization-phenology information in the region (Dorcas and Gibbons 2008), we determined the most appropriate timeframe for deploying the ARDs in SECN parks to be March through June.

ARDs were deployed at or near the center point of each selected 0.5-hectare grid cell (i.e., the sampling location). The devices were programmed to record every four days from 18:00 (6:00 p.m.) to 06:50 (6:50 a.m.) for 30 seconds every 10 minutes. This recording schedule continued for

11 weeks (i.e., 77 days) and provided 20 distinct sampling events. ARDs were deployed at Canaveral National Seashore from 3/3/2014 through 5/23/2014. A total of 22,972 minutes were recorded by all of the devices deployed. Of the 30 units deployed, 28 recorded the full 20 sampling events, and two ARDs recorded only partial data. The unit deployed at 023 malfunctioned for unknown reasons and recorded 10 sampling events, while the ARD at 020 was damaged by ants and recorded 19 sampling events.

Species occurrences were derived from the recordings by applying various algorithms in a Song Scope software environment, and through a manual-evaluation process implemented to maintain quality assurance and quality control standards. These processes are detailed in SOPs 1.4.2 and 1.4.21 of the SECN Vocal Anuran Community Monitoring Protocol (Byrne et al 2013).

Data Analysis

This protocol collects detection / non-detection data. In contrast to detections made from visual survey methods in which individuals can be seen, differentiated, and counted, detections from automated recording devices cannot be reliably associated with more than one individual. In general, one individual will vocalize multiple times during the survey period and is likely detected multiple times. Individual anurans vocalizing in a chorus also cannot be reliably differentiated by voice alone. Consequently, data-summary techniques do not equate one vocalization with one individual and are conducted accordingly.

Composition

Measures of community composition are often good indicators of abiotic variability, disturbance, or other stressors. Summaries related to composition include the total number of species detected (i.e., species richness), naïve occupancy, and relative detection frequency. Species richness is simply the number of native species detected.

Naïve occupancy is the percentage of the sampling locations where a species was detected at least once, without adjusting for probability of detection (i.e., detectability). Naïve occupancy is also referred to as frequency of occurrence. Naïve occupancy provides insight into the distribution of a species across the park and whether the species can be considered common or uncommon. Species with high values occur at more locations than those with low values.

Relative detection frequency uses the detection history as an index to communicate the frequency at which each species is detected relative to all other species detected in the sample. This estimate conveys information about the detectability of a species or, more specifically, a characteristic that makes a

species detectable (e.g., the vocalization behavior). Species with high relative-detection frequency values are detected more frequently than species with low values. To minimize the bias inherent in this summary from the influences of detectability, vocalization behavior, sound properties, and various aspects of the automated analysis process, the estimate of relative detection frequency is derived by pooling across the detection histories and sampling locations for each species.

Distribution

Understanding changes in the distribution of amphibian species is integral to informed management of species and their requisite habitats. Changes in species distributions over time provide useful information at both the local and landscape scale regarding how species respond to large-scale influences such as changing land use, climate, hydrology, or habitat availability and condition. Shifting species distributions alter species interactions and the food-web structure, thereby producing cascading effects on ecosystem processes (Montoya and Raffaelli 2010). Distribution maps for all anuran species encountered are presented in Appendix B.

Phenology

Phenology, the periodic life-cycle events of plants and animals as they are influenced by changes in the seasons, is an increasingly useful tool in monitoring climate change and its potential effects on amphibian populations (Blaustein et al. 2001, Gibbs and Breisch 2001, Corn 2005, Parmesan 2007, Blaustein et al. 2010, Todd et al. 2011). The timing of anuran territorial and mating vocalizations can provide insight into the initiation of the breeding season for these animals, and tracking these dates may prove to be a robust method for monitoring climate change, as it presents in the southeastern United States. The Southeast Coast Network reports the earliest and latest vocalization dates of select anuran species based on their known annual vocalization pattern and the recording window of our methodology. Species should be detected during three or more park-wide sampling events during the survey year to be considered for reporting in phenology. Vocalization start dates are reported for species that typically begin to vocalize well after the start of our recording schedule in SECN parks, while species known to cease vocalizing well before our recording schedule concludes are appropriate candidates for tracking vocalization end dates (Dorcas and Gibbons, 2008). Periodic synthesis reports, which will be published after multiple rounds of sampling, will summarize phenological history of anuran species detected across the Southeast Coast Network for which appropriate candidates for trend analysis are available.

Results

Composition

We detected 14 of the 16 native anuran species known to be present at Canaveral National Seashore in 2014 (Table 1). Two non-native anurans were also detected, the Cuban treefrog (*Osteopilus septentrionalis*) and the greenhouse frog (*Eleutherodactylus planirostris*).

Anuran diversity was high at Canaveral during 2014 sampling: three or more anuran species were present at two-thirds of the sampling locations (Table A-2). Accordingly, 9 of the 16 total species detected had naïve occupancy rates of over 25% for sampling locations located throughout the seashore (Table 1). Squirrel treefrog (*Hyla squirella*), detected at over three-quarters of the sampling locations in Canaveral National Seashore, had the highest frequency of occurrence (naïve occupancy) of all anurans detected during our 2014 surveying period, followed by the non-native greenhouse frog, which was detected at approximately 57% of sampling locations. The eastern spadefoot toad (*Gastrophryne carolinensis*) had the lowest frequency of occurrence, and was detected at only one sampling location (Table 1).

The squirrel treefrog had the highest relative detection frequency of vocalizations recorded by ARDs over the 77-day sampling period, with 109 vocal detections accounting for over one-sixth of all vocalizations. Together with the greenhouse frog, these two species contributed over 30% of all vocalizations detected at the seashore, which correlates with the high naïve occupancy rates for those two species. Eastern spadefoot toad had the lowest frequency of occurrence in 2014 (Figure 3, Table 1).

Based on observations of anuran monitoring efforts across all parks of the Southeast Coast Network from 2011 to 2014, it appears that anuran species with the highest naïve occupancy rates (i.e. the most commonly-observed species) are also usually the anurans with the highest relative detection frequencies of vocalizations. At Canaveral in 2014, the barking treefrog (*Hyla gratiosa*), southern cricket frog (*Acris gryllus*), oak toad (*Anaxyrus quercicus*) and southern

toad (*Anaxyrus terrestris*) showed notable departures from this observation (Table 1, Figure 3). The barking treefrog was detected at just over one-quarter of sampling locations and contributed over 10% of all vocalizations with 62 detections, making it the fourth most vocally-detected anuran in 2014. In contrast, the oak toad had the same naïve occupancy rate as the barking treefrog, but only contributed 3% of all vocalizations, a total of 18 vocal detections (Figure 3). Similarly, the southern cricket frog was detected at just one-sixth of the sampling locations, yet 51 vocal detections from this species made it the sixth most vocally-detected anuran. Contrast this with vocal detections of the southern toad. This species was detected at almost 47% of the sampling locations in the park, but was responsible for just eight total fewer vocal detections (43 detections) than the southern cricket frog. Indications are that some species, while present at a sampling location, are detected vocalizing only infrequently at each location over the duration of our ARD deployment period. Individual species vocalization patterns and responses to weather events, as well as limitations in Song Scope software recognizer file operations are the most likely causes of these apparent disparities in vocal detection efficiency.

Two non-native anurans were detected at Canaveral in 2014; the Cuban treefrog (*Osteopilus septentrionalis*) and the greenhouse frog. The frequency of occurrence of non-native anurans (Cuban treefrog and greenhouse frog) at Canaveral is 60% (Table 1, Table A-2). The Cuban treefrog was first reported to be present in the park by the SECN in 2009, and was subsequently added to the park species list (Byrne et al. 2010). In 2014, the greenhouse frog had the second highest naïve occupancy at the seashore, located at 17 of the 30 sampling locations and also comprising 13% of all vocal detections. The Cuban treefrog, located at one-sixth of all sampling locations, had a vocal relative detection frequency of just 1.8%.

New Species Records

All anuran species detected during the monitoring event were previously known to occur at Canaveral National Seashore.

Table 1. Percentage of sampling locations where each anuran species was detected (i.e., naïve occupancy) by method and across methods at Canaveral National Seashore, 2014.

Anuran Species	Naïve Occupancy
Squirrel Treefrog	76.7
Greenhouse Frog	56.7
Green Treefrog	50.0
Southern Foad	46.7
Pine Woods Treefrog	36.7
Pig Frog	30.0
Southern Leopard Frog	30.0
Oak Toad	26.7
Barking Treefrog	26.7
Little Grass Frog	23.3
Southern Cricket Frog	16.7
Cuban Treefrog	16.7
Eastern Narrowmouth Toad	10.0
Gopher Frog	10.0
Southern Chorus Frog	6.7
Eastern Spadefoot Toad	3.3
Total Locations Surveyed	30

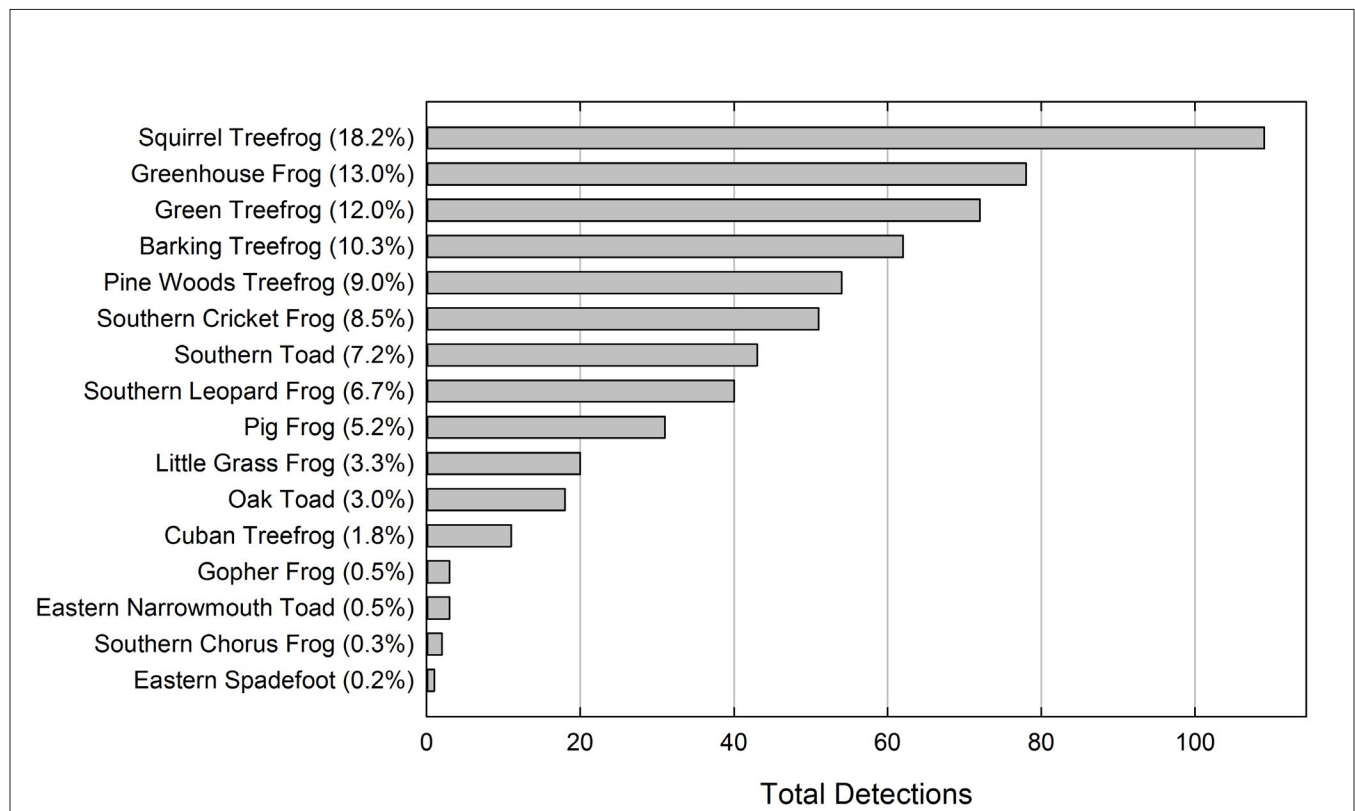


Figure 3. Number of anuran vocalization detections and the percent relative detection frequency (i.e., number of species vocalizations compared to all species' vocalizations) of recorded calls during automated recording device (ARD) deployment (3 March to 23 May 2014) at Canaveral National Seashore. Based on n=600 detections.

Distribution

The squirrel treefrog and the greenhouse frog were the most widely distributed anuran species at Canaveral National Seashore in 2014. Both species were found at sampling locations throughout the north-south expanse of the Seashore and on the east and west sides of Mosquito Lagoon (Figures B-7 and B-11, Appendix B). The southern toad (*Anaxyrus terrestris*) and the green treefrog (*Hyla cinerea*) were also widely distributed throughout the north-south and east-west expanses of the park, although at fewer sampling locations (Figures B-3 and B-4, Appendix B). Anurans found to have the narrowest distributions at Canaveral National Seashore in 2014 were the eastern spadefoot toad, the southern chorus frog (*Pseudacris nigrita*), the southern cricket frog (*Acris gryllus*), and the gopher frog (*Lithobates capito*). The gopher frog and the southern cricket frog were only detected at locations in the Bill's Hill area of the seashore, along the western shore of Mosquito Lagoon (Figures B-1 and B-13). The southern chorus frog was detected at two locations in the northern portion of the park, one on each side of Mosquito Lagoon, while the eastern spadefoot toad was found at only one sampling plot, located between the Mosquito Lagoon and the beach dunes

(Figures B-9 and B-16, Appendix B). Distribution maps for all anurans that were detected during the monitoring event are presented in Appendix B.

Phenology

Six species detected in 2014 would be appropriate candidates to determine trends in vocalization start dates. Two species with high occupancy rates and high relative detection frequencies at Canaveral National Seashore in 2014, the squirrel treefrog and the green treefrog, were first detected vocalizing on 3/17/2014 and 3/19/2014, respectively. The first detection of the pig frog (*Lithobates grylio*) occurred on 3/23/2014, while the oak toad was first detected on 3/31/2014. Finally, the non-native greenhouse frog was not detected until 4/9/2014, and the eastern narrowmouth toad was first detected vocalizing on 5/1/2014. One species is an appropriate candidate for tracking vocalization end dates in 2014. The southern chorus frog was last recorded vocalizing on 5/2/2014 (Figure 4).

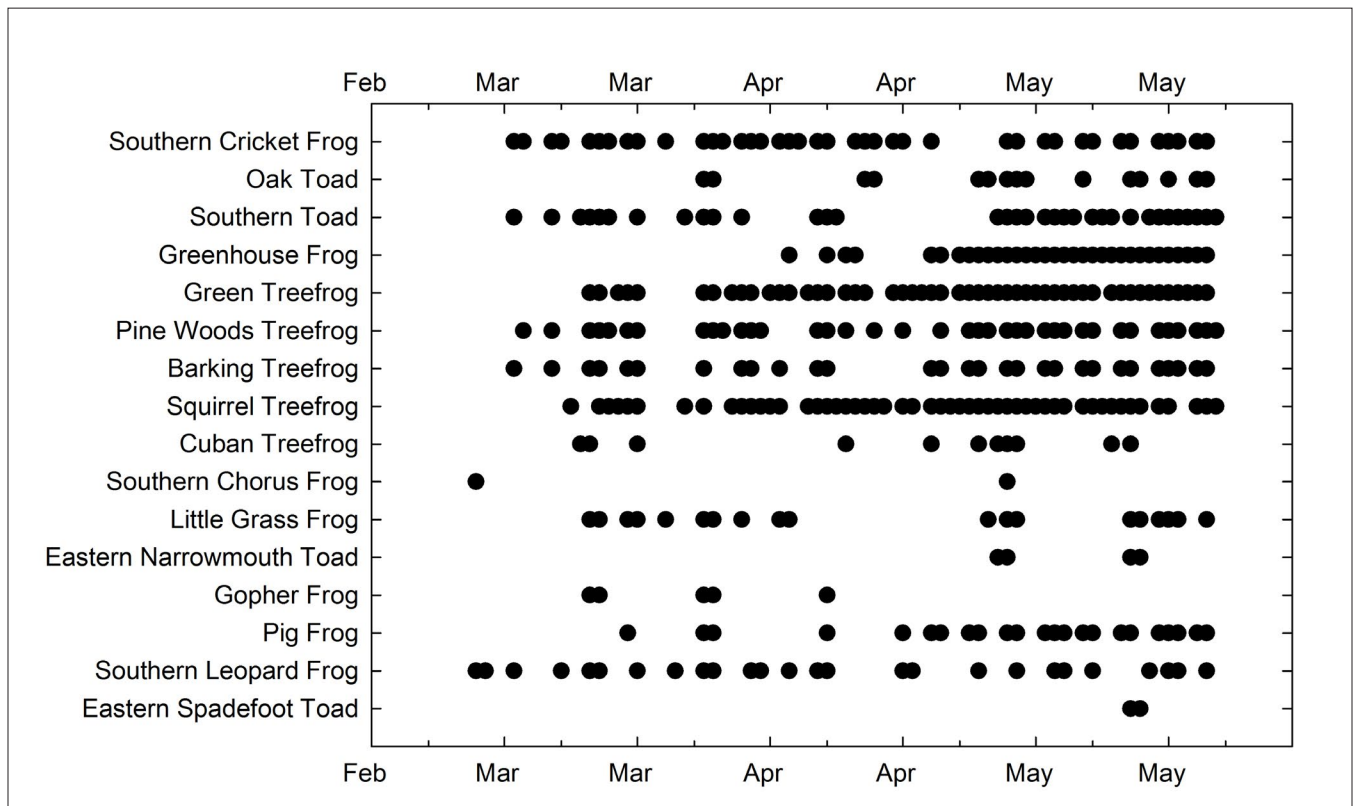


Figure 4. Vocalization phenology for species detected using automated recording devices (ARDs) at Canaveral National Seashore, from 3 March to 23 May 2014. Based on n=600 detections.

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Appendix A—Anuran Species Detection Data

Table A-1. Anuran species known to occur at Canaveral National Seashore based on the seashore’s certified species list (NPSpecies 2015) and those detected during this sampling effort.

Scientific Name	Common Name	NPSpecies	ARD
<i>Anaxyrus quercicus</i>	Oak Toad	X	X
<i>Anaxyrus terrestris</i>	Southern Toad	X	X
<i>Acris gryllus</i>	Southern Cricket frog	X	X
<i>Hyla cinerea</i>	Green Treefrog	X	X
<i>Hyla femoralis</i>	Pine Woods Treefrog	X	X
<i>Hyla gratiosa</i>	Barking Treefrog	X	X
<i>Hyla squirella</i>	Squirrel Treefrog	X	X
<i>Osteopilus septentrionalis</i>	Cuban Treefrog	X	X
<i>Pseudacris crucifer</i>	Spring Peeper	X	
<i>Pseudacris nigrita</i>	Southern Chorus Frog	X	X
<i>Pseudacris ocularis</i>	Little Grass Frog	X	X
<i>Eleutherodactylus planirostris</i>	Greenhouse Frog	X	X
<i>Gastrophryne carolinensis</i>	Eastern Narrowmouth Toad	X	X
<i>Lithobates capito</i>	Gopher Frog	X	X
<i>Lithobates clamitans</i>	Green Frog	X	
<i>Lithobates grylio</i>	Pig Frog	X	X
<i>Lithobates sphenoccephalus</i>	Southern Leopard Frog	X	X
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot	X	X

Table A-2. Anuran species or species sign detected at each sampling location at Canaveral National Seashore, 2014.

Species	2	5	6	9	10	12	13	14	16	18	19	20	21	22	23	24	27	28	30	31	32	33	34	35	36	37	38	39	41	43
Oak Toad		X				X														X	X	X	X	X					X	
Southern Toad	X			X		X	X		X				X		X				X	X			X	X			X		X	X
Southern Cricket Frog																			X	X			X	X						X
Green Treefrog	X	X		X	X	X		X	X					X		X	X		X	X				X			X		X	
Pine Woods Treefrog	X				X		X				X		X						X	X		X	X	X						X
Barking Treefrog													X	X					X	X			X	X					X	X
Squirrel Treefrog	X	X	X	X	X	X		X	X	X	X		X	X		X	X	X	X	X	X	X		X			X	X	X	
Cuban Treefrog						X			X							X			X							X				
Southern Chorus Frog									X										X											
Little Grass Frog		X				X													X	X			X	X					X	
Greenhouse Frog				X	X	X			X	X	X		X	X		X		X			X	X		X	X			X	X	X
Eastern Narrowmouth Toad						X			X										X											
Gopher Frog																			X				X	X						
Pig Frog	X			X										X				X	X	X			X	X					X	
Southern Leopard Frog	X												X	X			X		X	X			X	X					X	
Eastern Spadefoot																												X		

Appendix B—Distribution Maps for Anuran Species Encountered

Southern Cricket Frog
Acris gryllus

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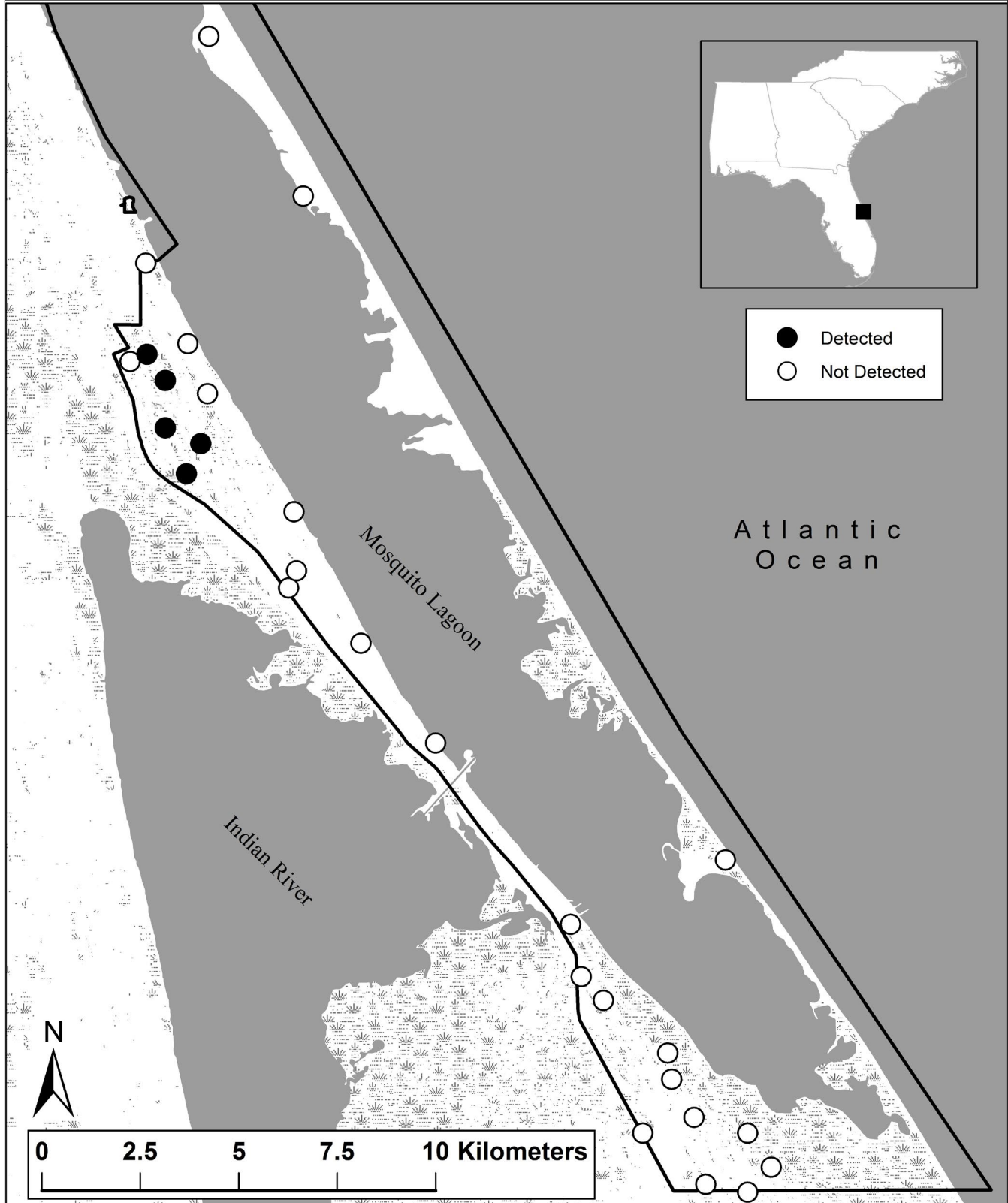


Figure B-1. Sampling locations where southern cricket frog (*Acris gryllus*) was detected at Canaveral National Seashore, 2014.

Oak Toad
Anaxyrus quercicus

Southeast Coast Network
National Park Service
U.S. Department of the Interior

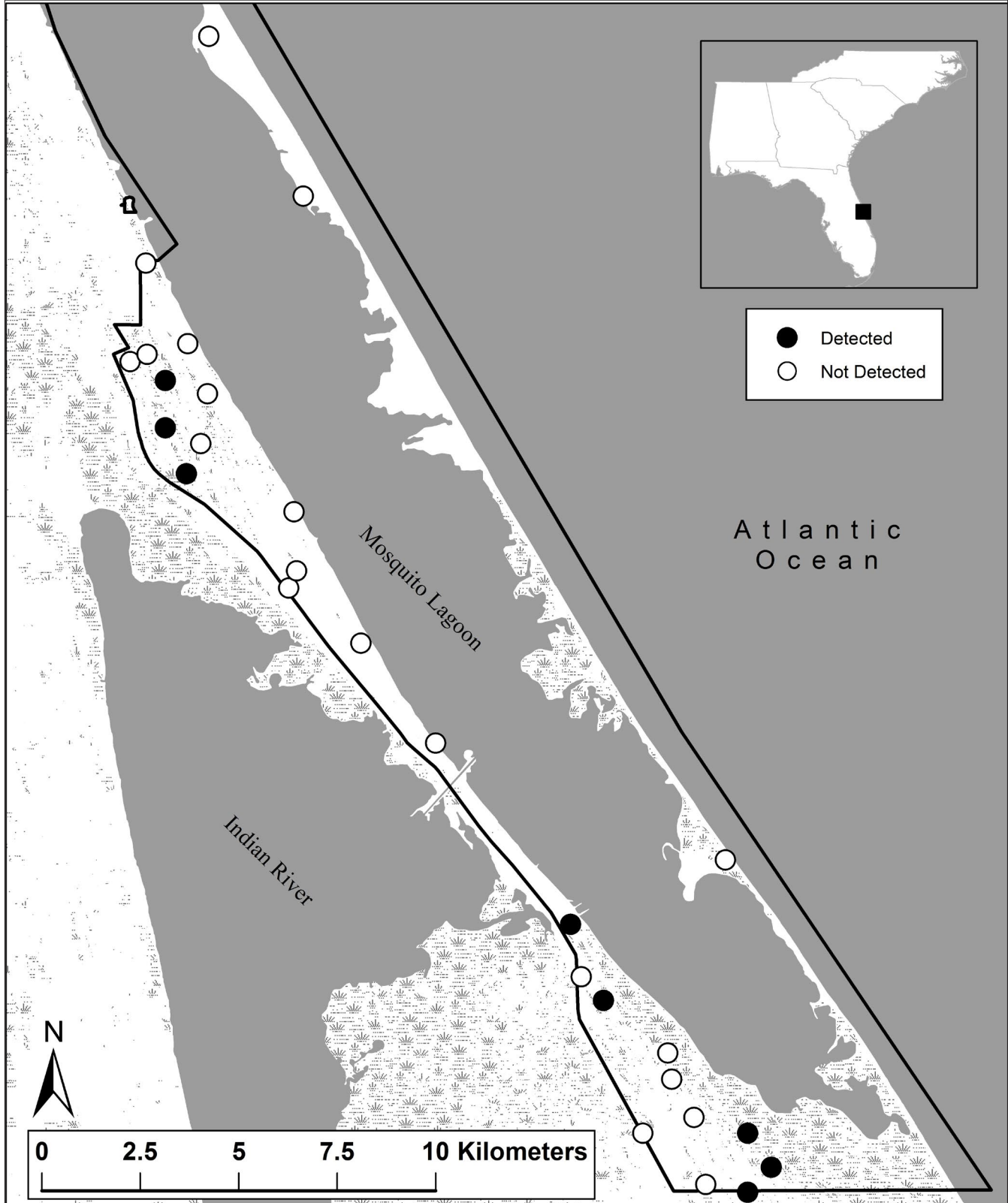


Figure B-2. Sampling locations where oak toad (*Anaxyrus quercicus*) was detected at Canaveral National Seashore, 2014.

Southern Toad
Anaxyrus terrestris

Southeast Coast Network
National Park Service
U.S. Department of the Interior

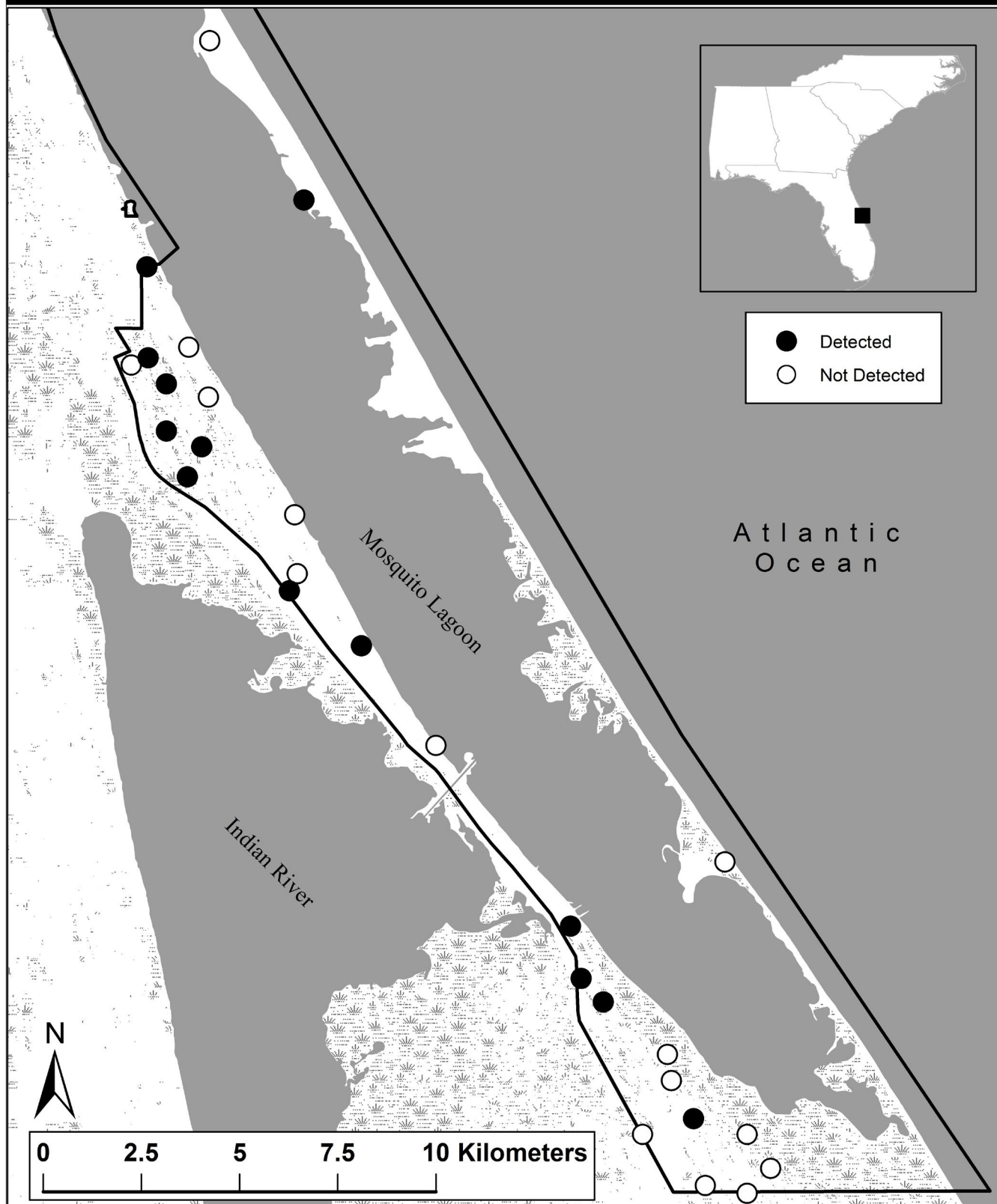


Figure B-3. Sampling locations where southern toad (*Anaxyrus terrestris*) was detected at Canaveral National Seashore, 2014.

Green Treefrog
Hyla cinerea

Southeast Coast Network
National Park Service
U.S. Department of the Interior

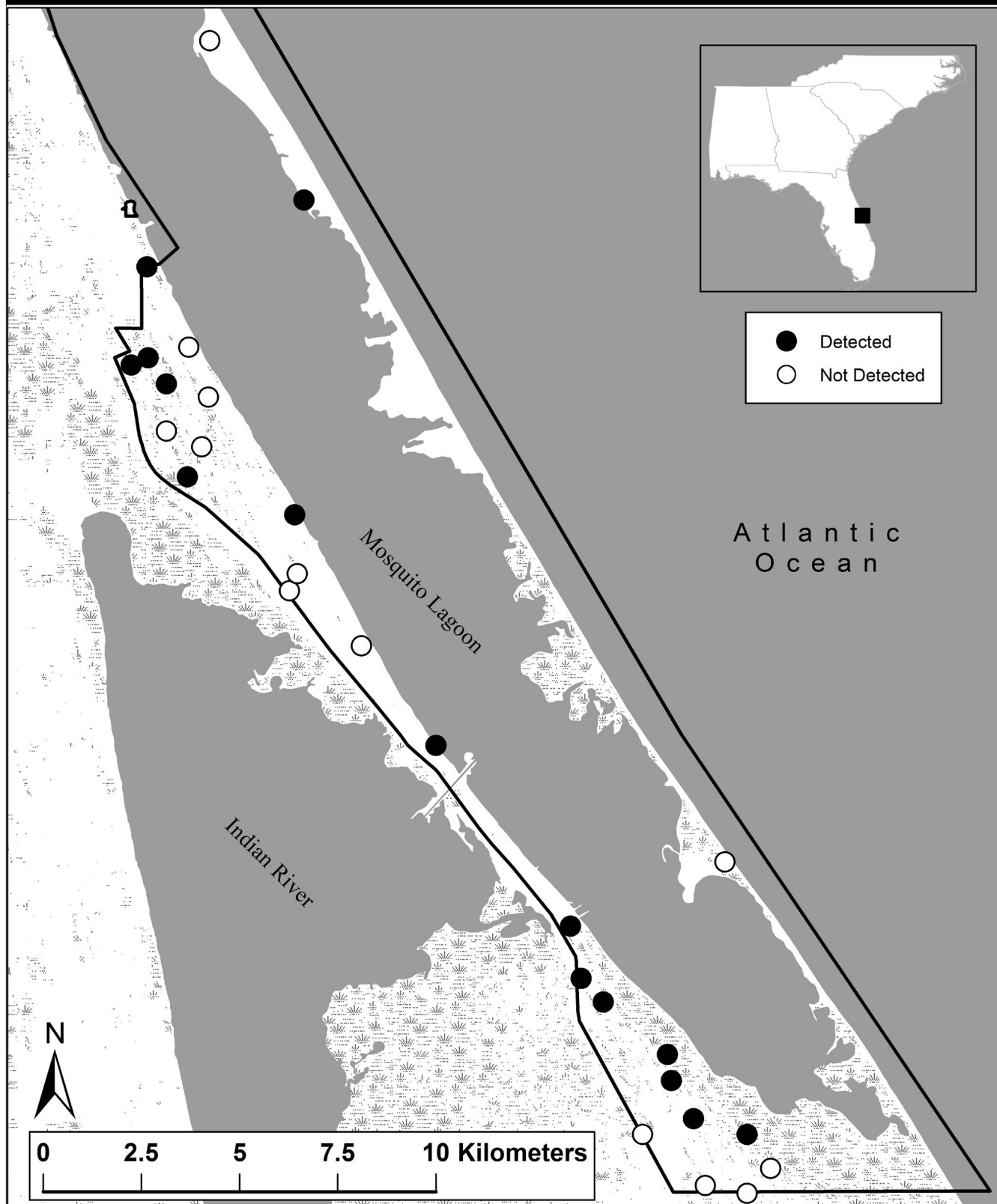


Figure B-4. Sampling locations where green treefrog (*Hyla cinerea*) was detected at Canaveral National Seashore, 2014.

Pine Woods Treefrog
Hyla femoralis

Southeast Coast Network
National Park Service
U.S. Department of the Interior

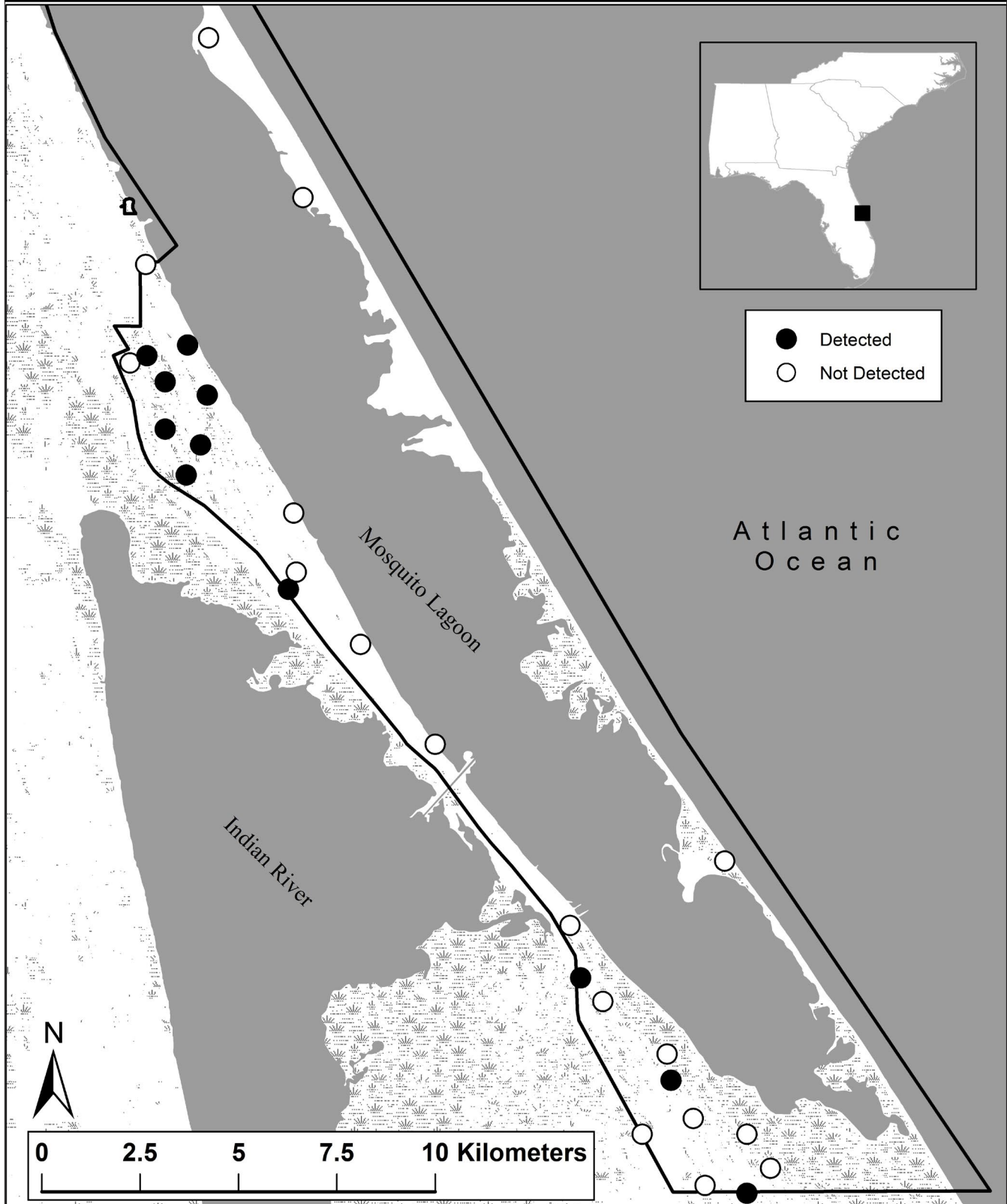


Figure B-5. Sampling locations where pine woods treefrog (*Hyla femoralis*) was detected at Canaveral National Seashore, 2014.

Barking Treefrog
Hyla gratiosa

Southeast Coast Network
National Park Service
U.S. Department of the Interior

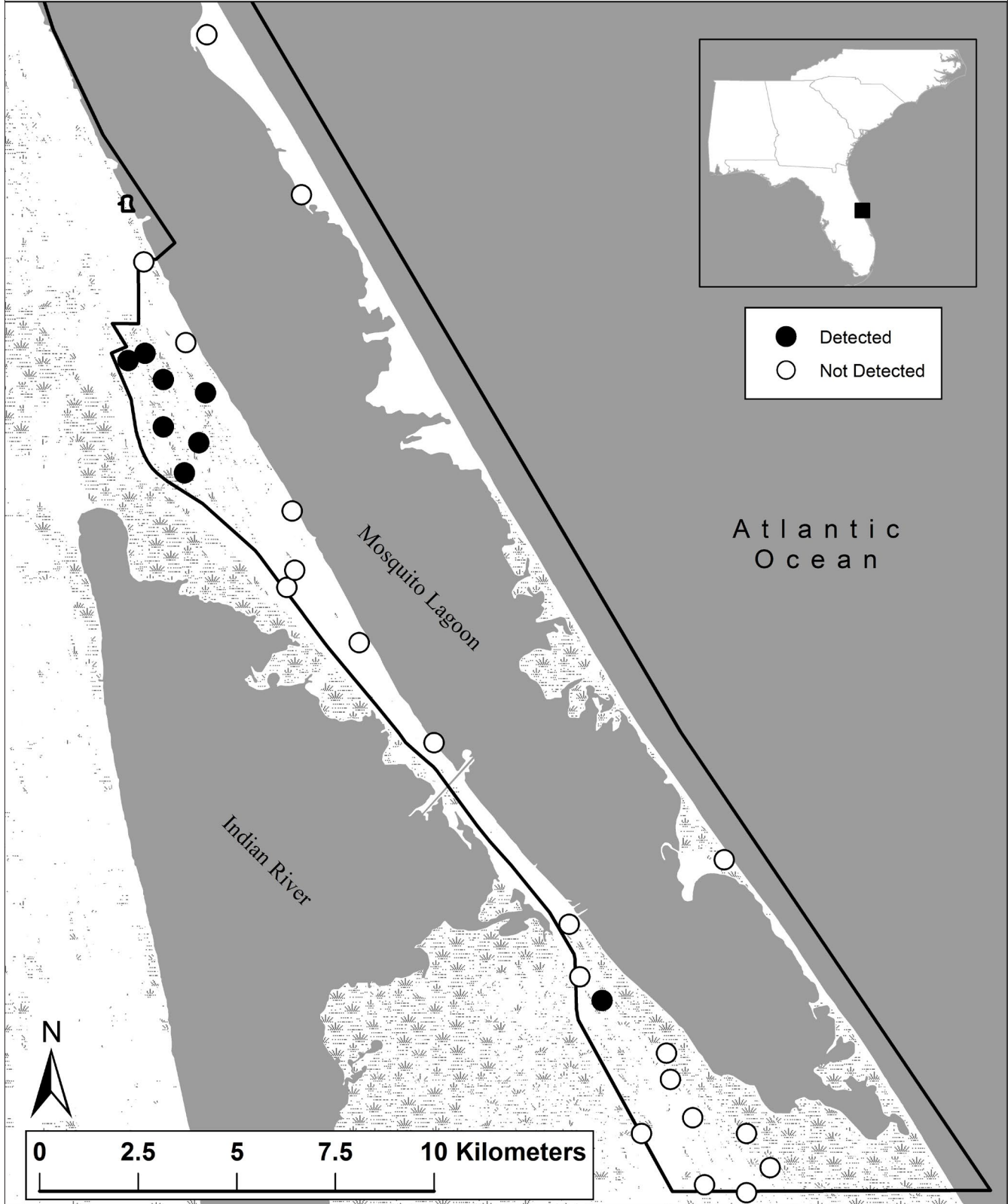


Figure B-6. Sampling locations where barking treefrog (*Hyla gratiosa*) was detected at Canaveral National Seashore, 2014.

Squirrel Treefrog
Hyla squirella

Southeast Coast Network
National Park Service
U.S. Department of the Interior

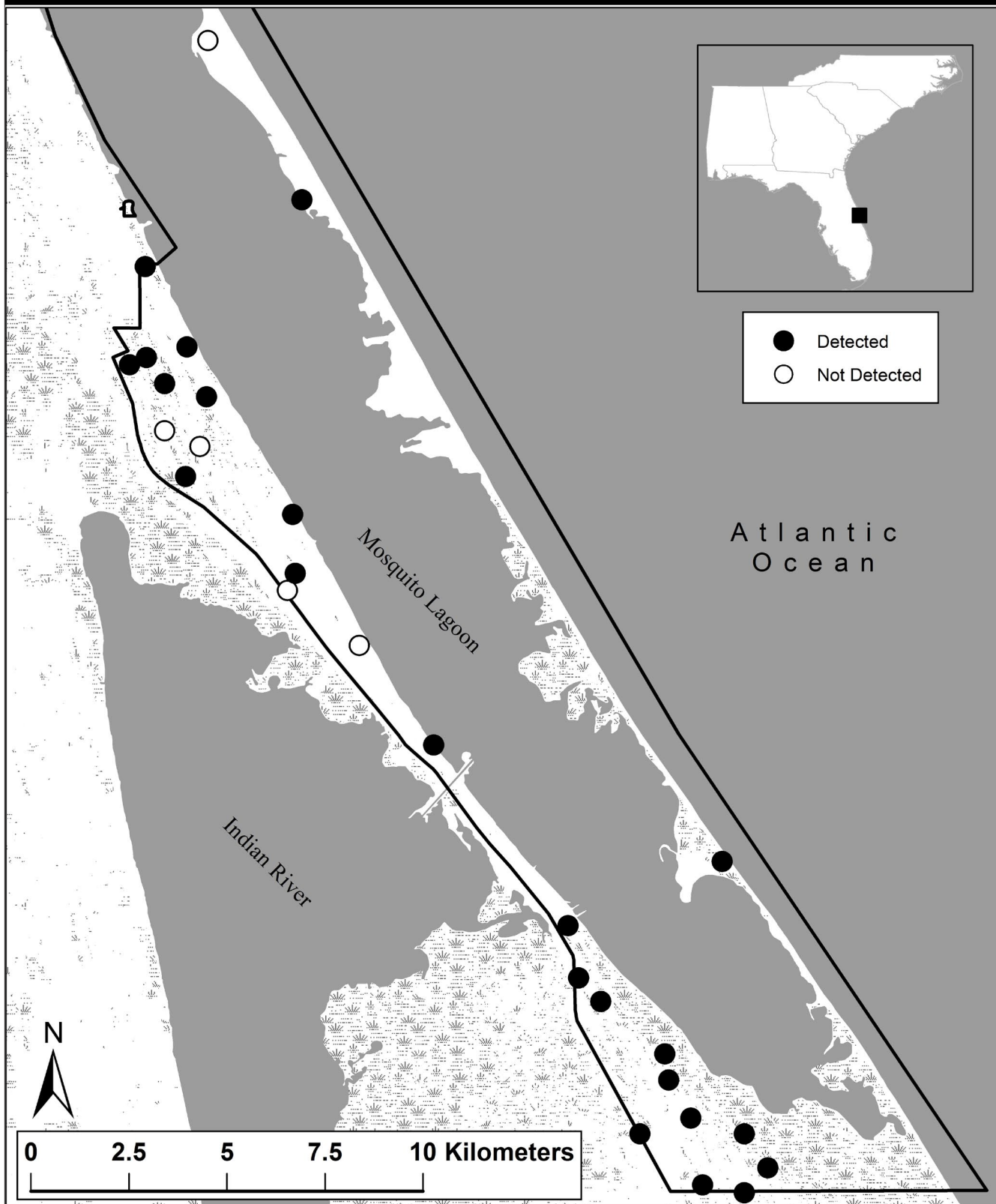


Figure B-7. Sampling locations where squirrel treefrog (*Hyla squirella*) was detected at Canaveral National Seashore, 2014.

Cuban Treefrog
Osteopilus septentrionalis

Southeast Coast Network
National Park Service
U.S. Department of the Interior

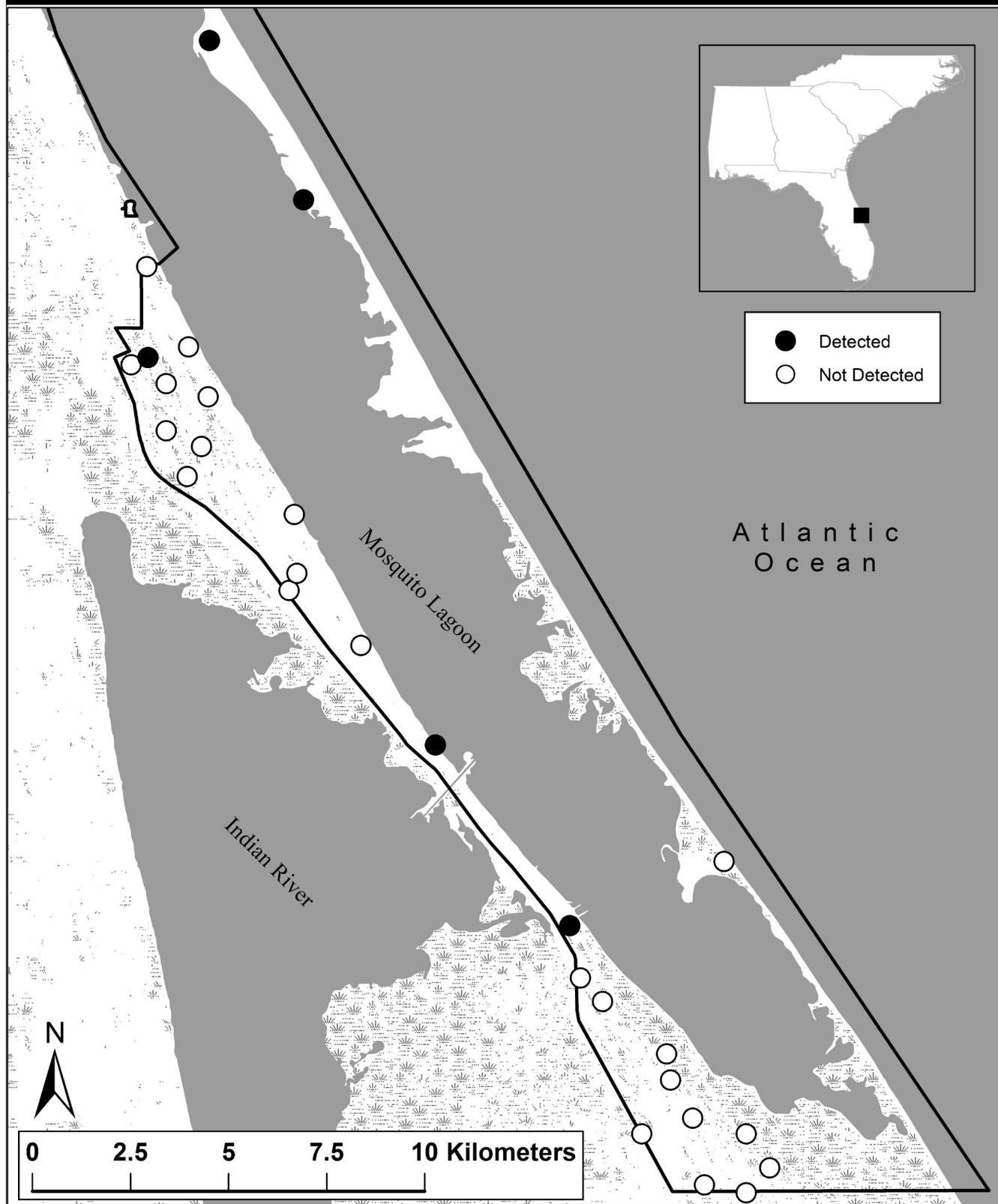


Figure B-8. Sampling locations where Cuban treefrog (*Osteopilus septentrionalis*) was detected at Canaveral National Seashore, 2014.

Southern Chorus Frog
Pseudacris nigrita

Southeast Coast Network
National Park Service
U.S. Department of the Interior

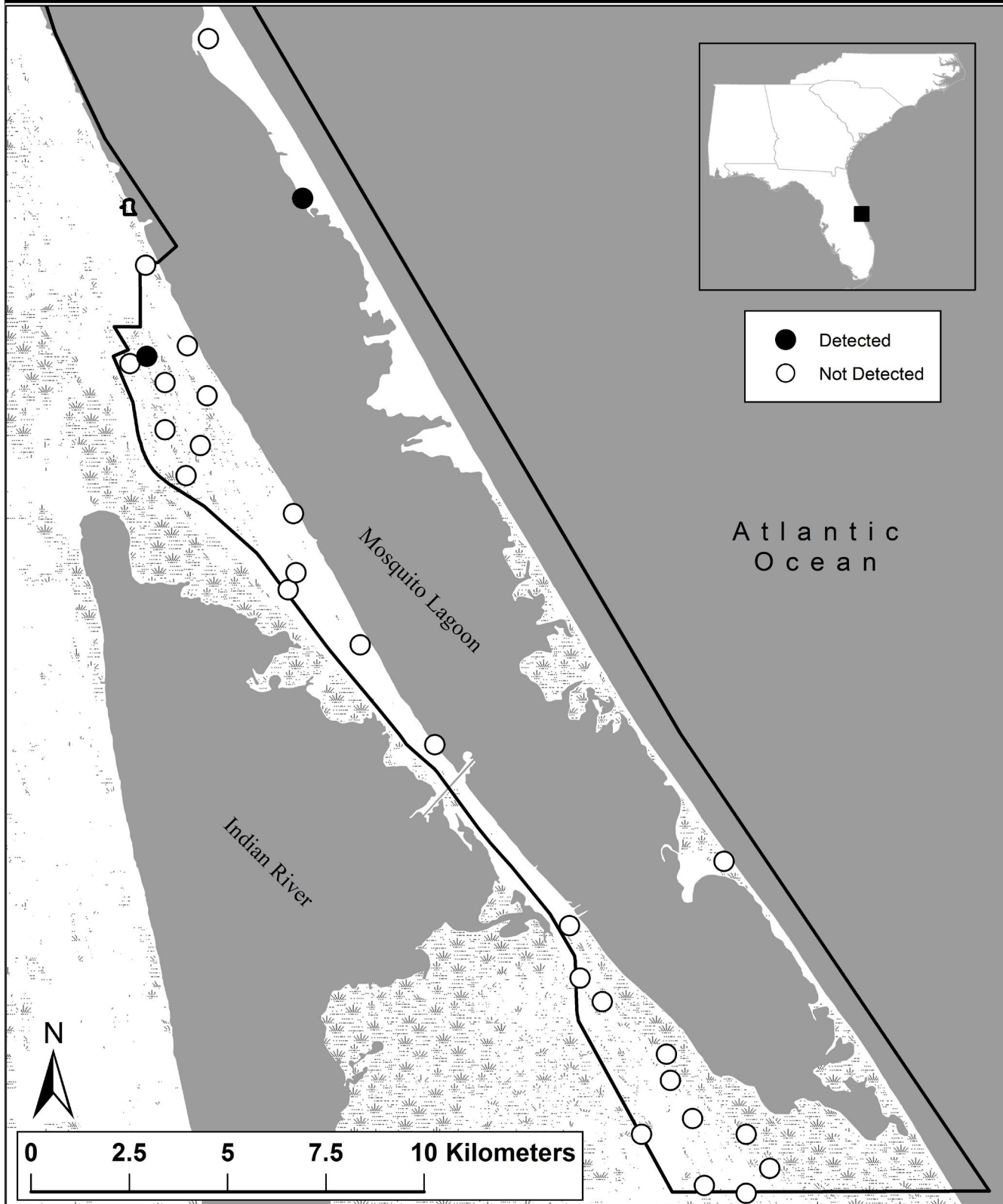


Figure B-9. Sampling locations where southern chorus frog (*Pseudacris nigrita*) was detected at Canaveral National Seashore, 2014.

Little Grass Frog
Pseudacris ocularis

Southeast Coast Network
National Park Service
U.S. Department of the Interior

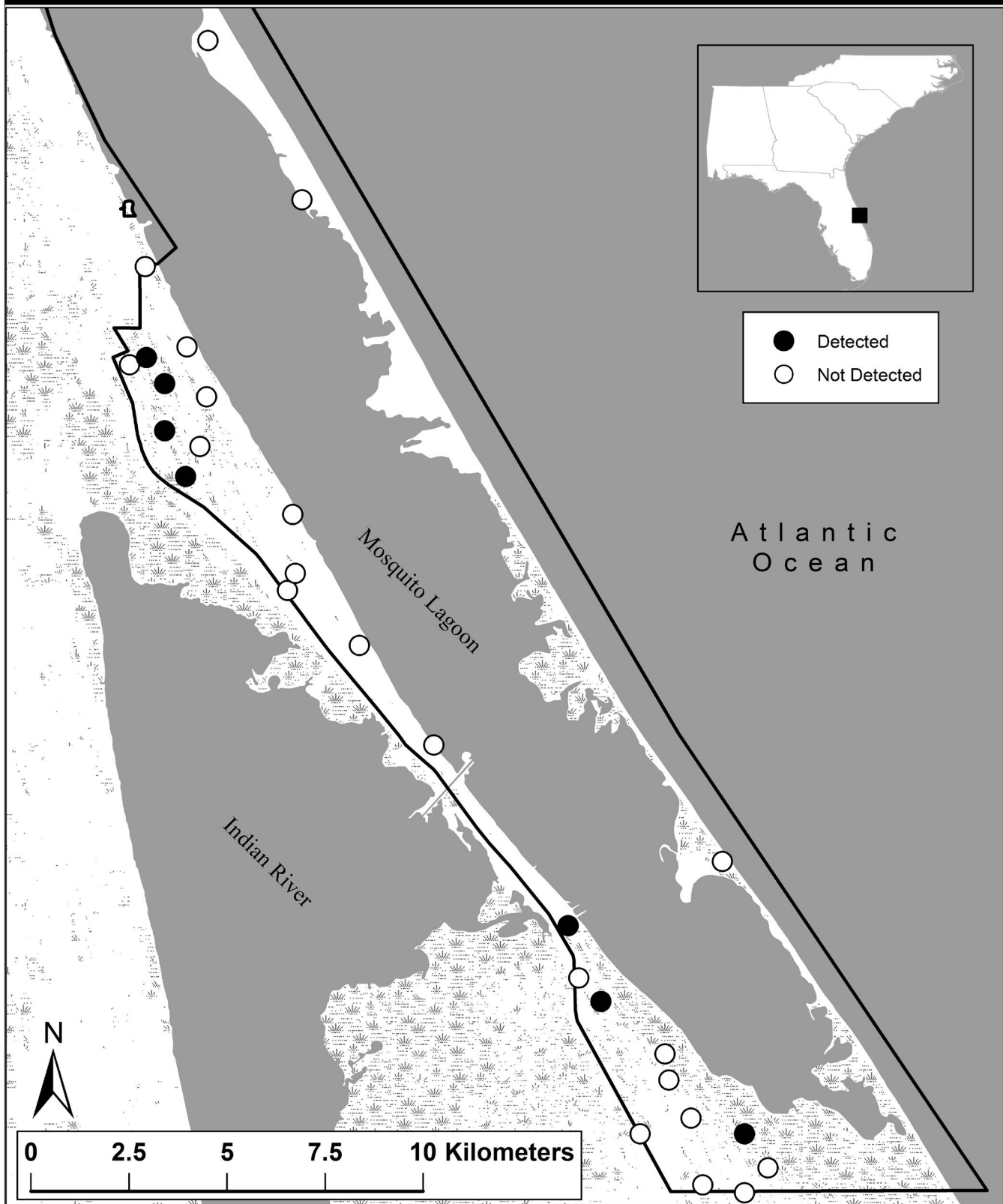


Figure B-10. Sampling locations where little grass frog (*Pseudacris ocularis*) was detected at Canaveral National Seashore, 2014.

Greenhouse Frog
Eleutherodactylus planirostris

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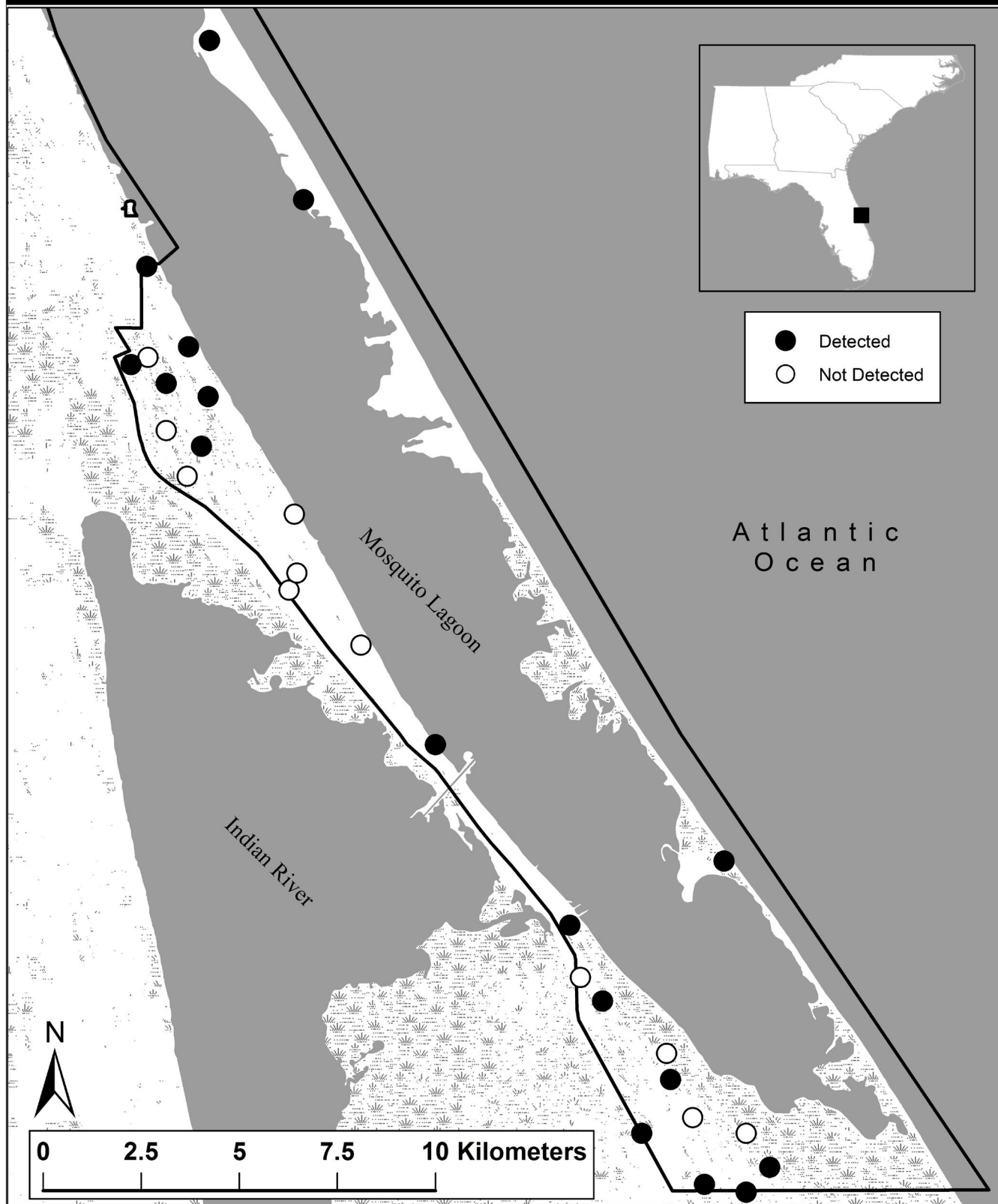


Figure B-11. Sampling locations where greenhouse frog (*Eleutherodactylus planirostris*) was detected at Canaveral National Seashore, 2014.

Eastern Narrowmouth Toad
Gastrophryne carolinensis

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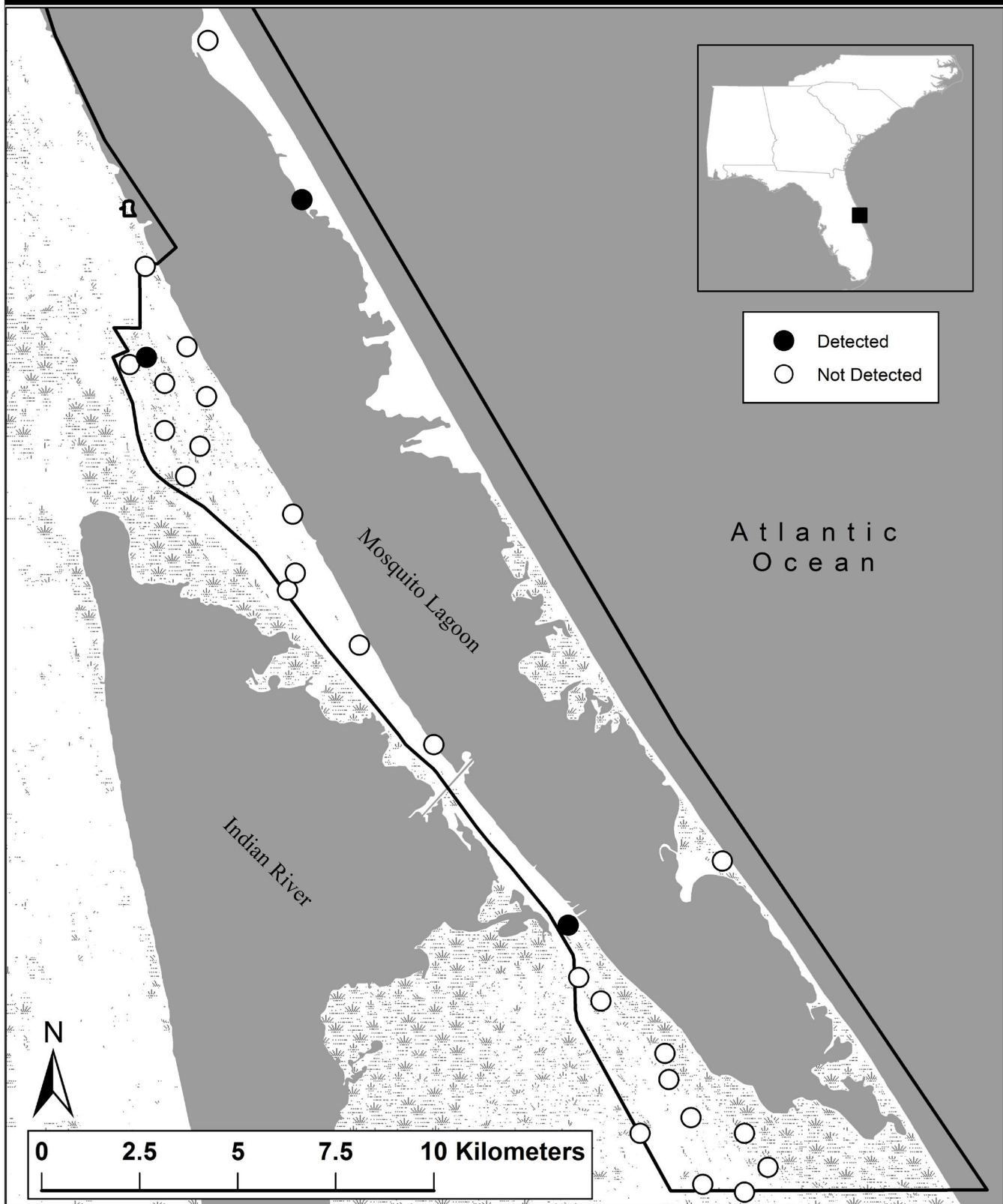


Figure B-12. Sampling locations where eastern narrowmouth toad (*Gastrophryne carolinensis*) was detected at Canaveral National Seashore, 2014.

Gopher Frog
Lithobates capito

Southeast Coast Network
National Park Service
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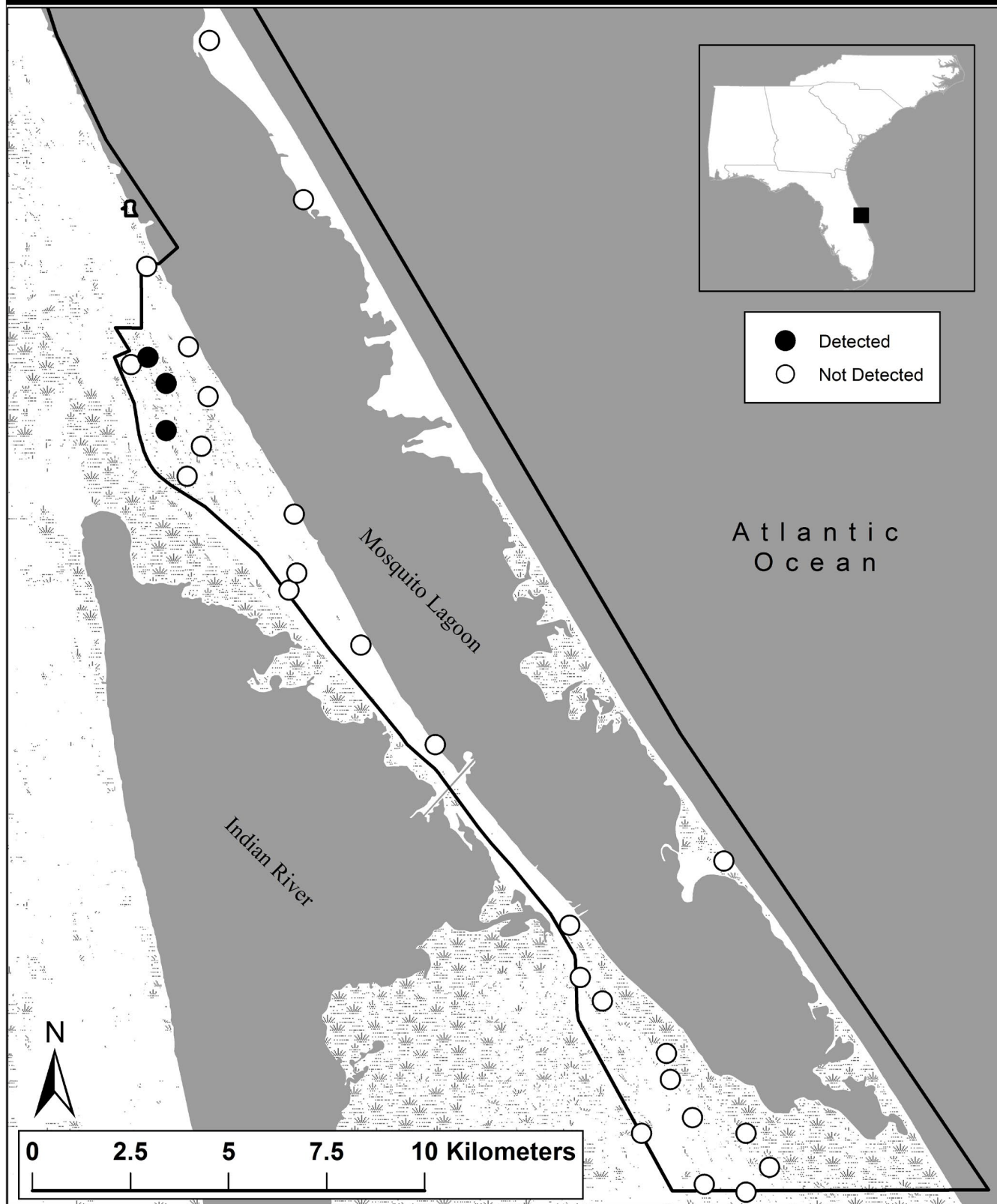


Figure B-13. Sampling locations where gopher frog (*Lithobates capito*) was detected at Canaveral National Seashore, 2014.

Pig Frog
Lithobates grylio

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National Park Service
U.S. Department of the Interior

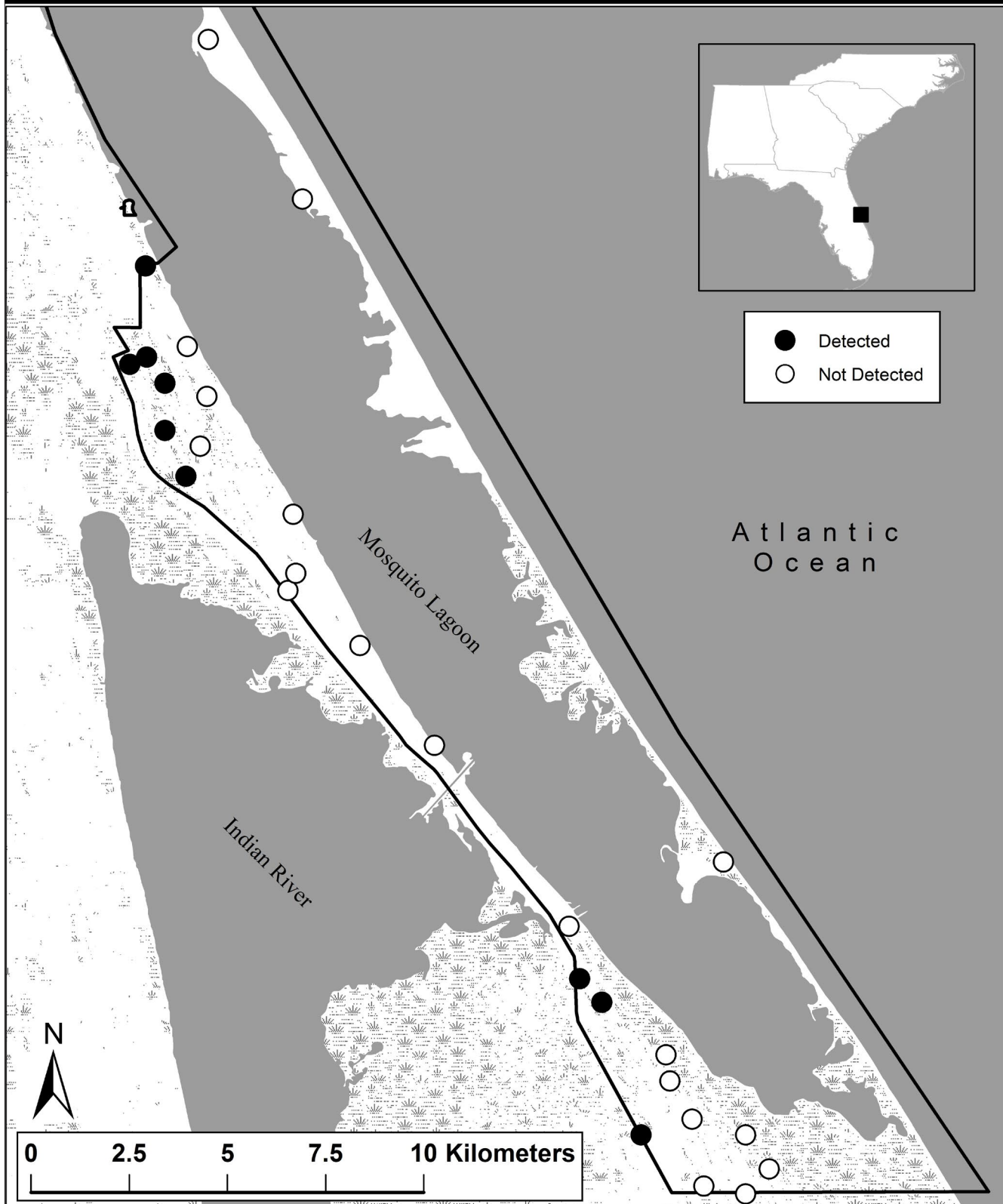


Figure B-14. Sampling locations where pig frog (*Lithobates grylio*) was detected at Canaveral National Seashore, 2014.

Southern Leopard Frog
Lithobates sphenoccephalus

Southeast Coast Network
National Park Service
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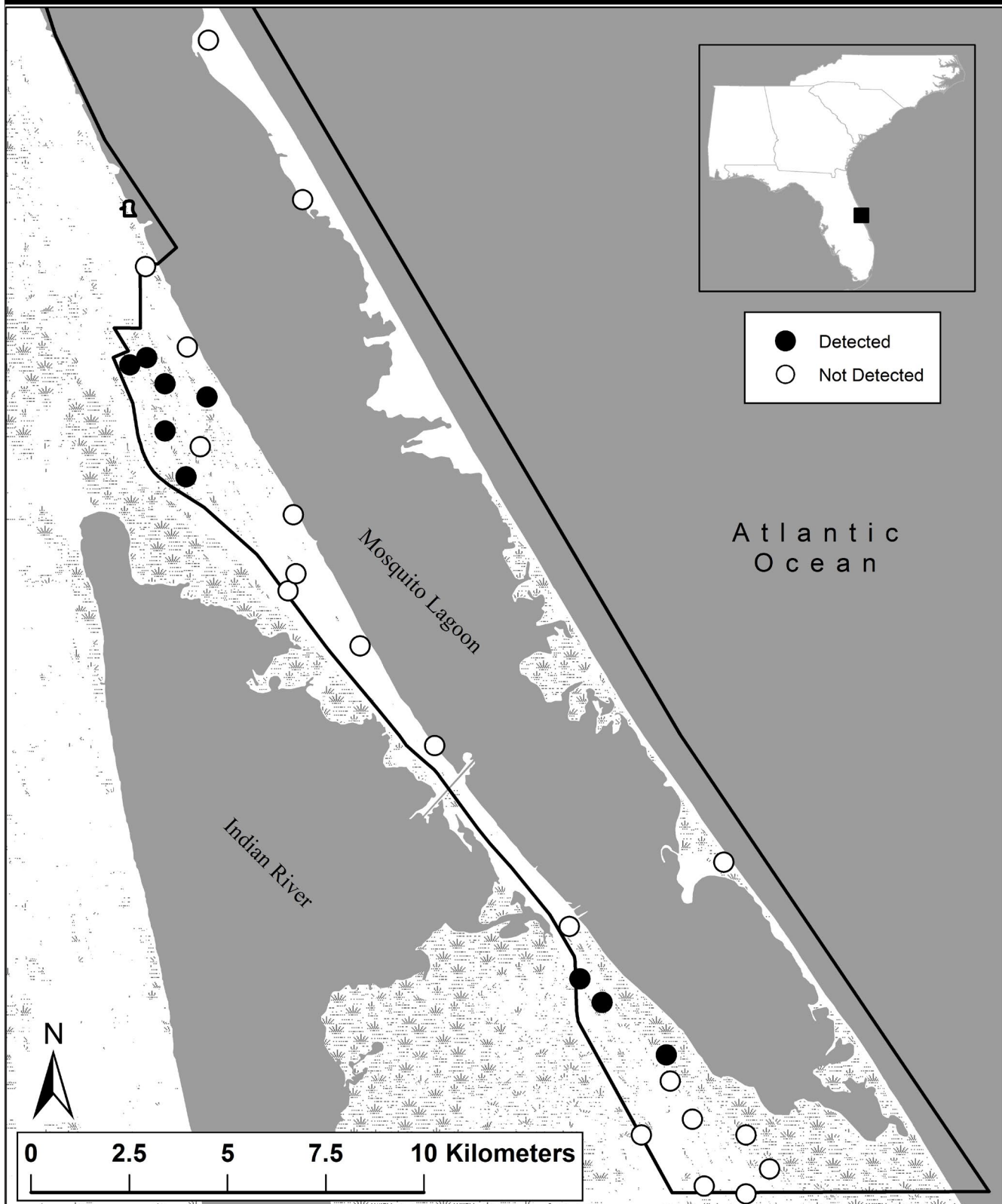


Figure B-15. Sampling locations where southern leopard frog (*Lithobates sphenoccephalus*) was detected at Canaveral National Seashore, 2014.

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