



Department of Defense Legacy Resource Management Program

Coordinated Mission-sensitive Bird and Herpetofaunal Inventories on DoD Installations, 2023

**Department of Defense Partners in Amphibian
and Reptile Conservation and Department of
Defense Partners in Flight**



February, 2024



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INTRODUCTION

The DoD Partners in Amphibian and Reptile Conservation (DoD PARC) and DoD Partners in Flight (DoD PIF) networks have created lists of Department of Defense Mission-sensitive Species (MSS); these are species that may be at risk of becoming listed under the Endangered Species Act and have high potential to impact the military mission should they become listed. The DoD MSS lists help DoD Natural Resources Managers prioritize monitoring and management efforts of those species and their habitats to help reverse population declines and/or prepare installations for potential listings.

This report documents the results of field surveys for reptile, amphibian, and avian MSS at Navy Tactical Towed Array Calibration Facility-Bugg Spring (hereafter called Bugg Spring) and Marine Ocean Terminal Sunny Point (MOTSU). The surveys represent a collaboration between the DoD PIF and DoD PARC networks. The primary objective of the surveys was to search for DoD MSS that may occur on the two military sites but have not been confirmed present. These data improve the understanding of the distribution of DoD MSS on military lands across the range of each species and, if confirmed present, assist military natural resource managers to plan, prioritize, and implement conservation and management actions that benefit these species.

This project was funded by the DoD Legacy Resource Management Program. It was originally planned that three military installations would be surveyed in 2023. However, the researchers felt that conducting two surveys events at two military sites would result in higher quality data than conducting one survey at each of three military sites.

SITE DESCRIPTIONS

BUGG SPRING

The Bugg Spring facility is in Lake County, Florida, about 3.5 miles south of Leesburg, and about 40 miles northwest of the city of Orlando. Only 85 acres in size, Bugg Spring is the Navy's principal activity for calibration of tactical submarine towed arrays. It also performs acoustic evaluation measurements on a variety of developmental towed arrays both for the submarine and the surface ship community.

Habitat types include a sinkhole lake, spring-run stream, woodlands, residential lawn, an

abandoned citrus orchard, cleared meadow, and building and parking lots (Figure 1). Woodlands consisting of deciduous hardwood uplands, forested wetlands, and scrubby flatwoods are the most

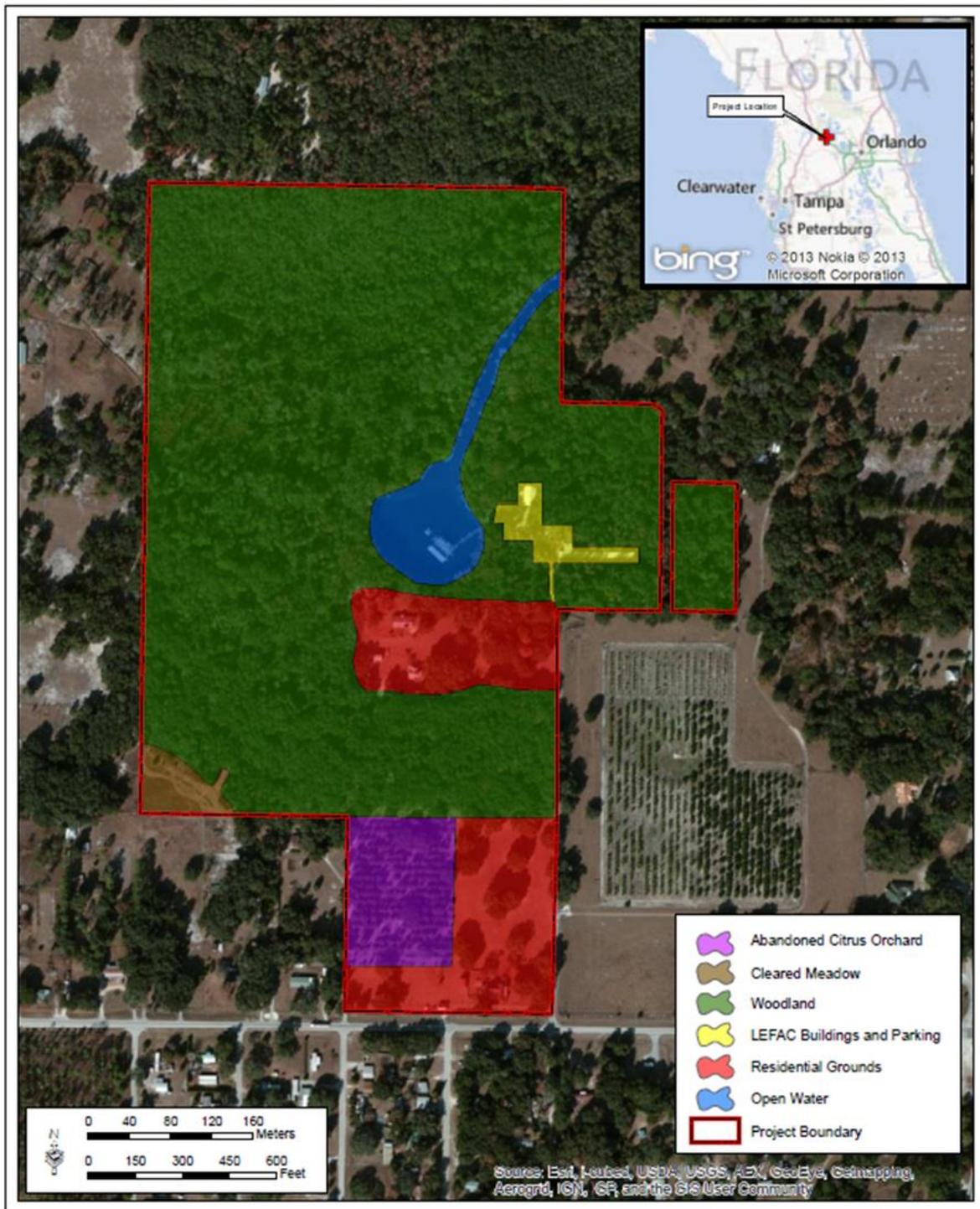


Figure 1. Land Cover Map of Navy Tactical Towed Array Calibration Facility-Bugg Spring. Source: Integrated Natural Resources Management Plan, 2023

abundant habitat of the naval facility and comprises approximately 63 acres. The sinkhole lake (approximately 400 feet across at its widest point and 175 feet deep) sits in a bowl-shaped depression in the center of the facility and drains via a spring-run stream towards the northeast.

MOTSU

MOTSU is an Army installation in Brunswick County, North Carolina, approximately 15 miles south of the city of Wilmington. The Main Terminal consists of 8,645 acres located on the west bank of the Cape Fear River. Surrounding the terminal to the north, west, and south is a 4,267-acre blast safety easement, a portion of which is located on the east bank of the Cape Fear River. The primary mission of the Army installation is to plan, coordinate, and execute the safe movement and transfer of defense munitions, hazardous materials, and other general cargo through MOTSU and activate the Ports of Wilmington and Morehead City, North Carolina, during both exercise and contingency operations.

Habitats include longleaf pine savanna, pine flatwoods, pocosin, bottomland hardwood swamp, cypress savanna, small depression ponds, and a variety of disturbed habitats used for material storage, roads and railways (Figures 2, 3). Substantial efforts to restore Longleaf Pine (*Pinus palustris*) and associated habitat to benefit the federally endangered Red-cockaded Woodpecker (RCWO; *Dryobates borealis*) have been conducted at MOTSU with great success since the 1980s. Prescribed fire and mechanical treatments have been used widely across the installation to restore the open, park-like habitat the RCWO depends upon.

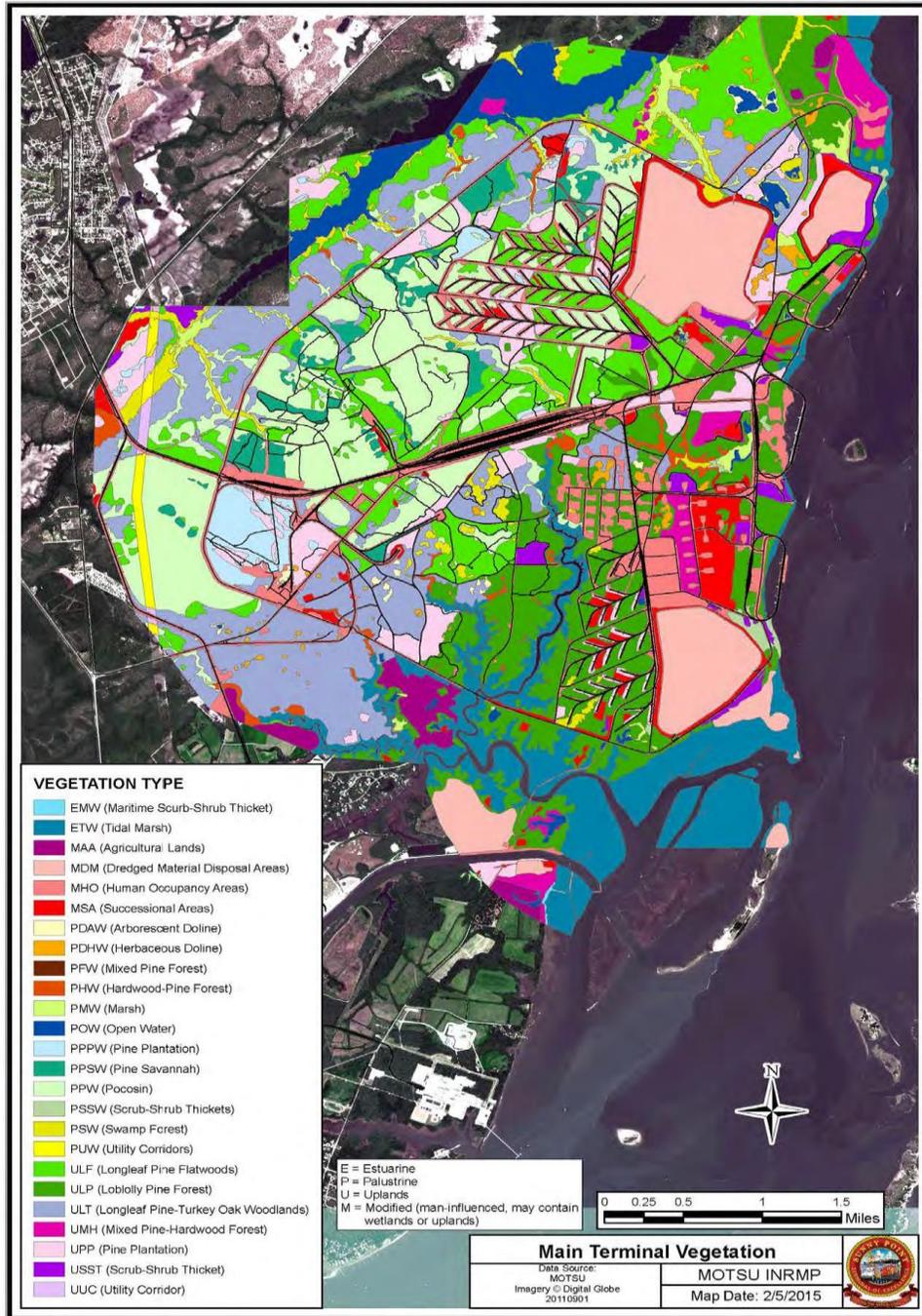


Figure 2. Vegetation Types of the MOTSU Main Terminal. Source: Integrated Natural Resources Management Plan, 2023.

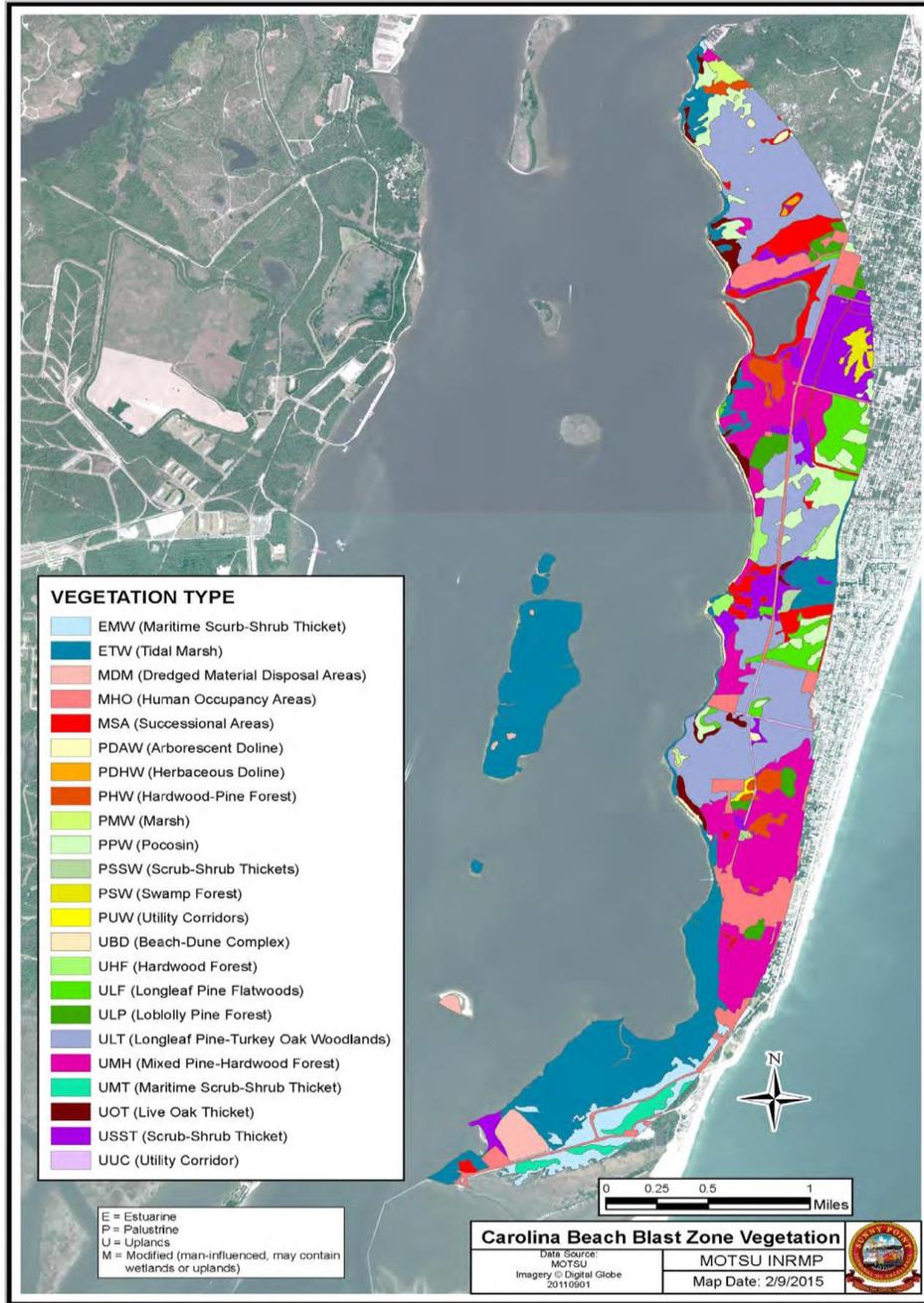


Figure 3. Vegetation Types of the MOTSU Carolina Beach Blast Zone Easement. Source: Integrated Natural Resources Management Plan, 2023.

METHODS

HERPETOFAUNAL SURVEYS

BUGG SPRING

Surveys focused on determining the presence/absence of five herpetofaunal DoD MSS at Bugg Spring (Table 1). A primary method used was Visual Encounter Surveys (VES), which involves searching selected wetland and upland habitats for wildlife when the probability of encounter is high (appropriate microhabitat, weather, and time of day for the target species). When surveying for herpetofauna, particular attention was taken to search under fallen logs, loose tree bark, plywood boards, and other discarded materials since these items are known to provide cover habitat for these species. VES surveys occurred mostly during daylight hours, but also were performed at night using flashlights and headlamps.

Aquatic turtle species were identified by using binoculars as they basked on logs in the water. Terrestrial turtles, such as Gopher Tortoise, were identified by observing them outside the entrances to their burrows.

Table 1. Herpetofaunal DoD MSS with the Potential to Occur on Bugg Spring and MOTSU.

Common Name	Scientific Name	Military Installation
Eastern Diamond-backed Rattlesnake	<i>Crotalus adamanteus</i>	Bugg Spring, MOTSU
Florida Pinesnake	<i>Pituophis melanoleucus mugitus</i>	Bugg Spring
Gopher Frog	<i>Rana capito</i>	Bugg Spring, MOTSU
Gopher Tortoise	<i>Gopherus polyphemus</i>	Bugg Spring
Spotted Turtle	<i>Clemmys guttata</i>	Bugg Spring, MOTSU



Figure 4. Wildlife Acoustics SM2+ Acoustic Logger. Source: Wildlife Acoustics.

DoD PARC biologists employed a sweeping dip net method in open water habitats using a D-frame net to sample fauna. This method was not used systematically in all open water areas, but rather, was employed when conditions were conducive for collection of herpetofauna.

Three automated acoustic data recorders (Wildlife Acoustics Inc. SongMeter [model SM2+] acoustic recorders fitted with SMX-II acoustic microphones) were used to record the vocalizations of frogs and toads at the Bugg Spring installation (Figure 4). Acoustic recorders were deployed at three wetland

sites from February to August 2023. Each unit was programmed to record three minutes of audio every hour from 7:00 -12:00 pm daily. Thus, each night, one unit would record 18 minutes of audio. Wildlife Acoustics Kaleidoscope software was used to analyze the acoustic recordings from the data loggers. The software allowed the researchers to view the recordings in both spectrograph and waveform format in addition to listening to the files.

During the survey events, all observations of amphibian and reptile species encountered were recorded to supplement previous inventory efforts and to enhance the installations Integrated Natural Resources Management Plans (INRMP) species lists. Species of herpetofauna that were captured by hand or could be photographed without capture were documented using the HerpMapper applet. For each HerpMapper entry, the species' common and scientific name, date, time, latitude/longitude, age class, and photographic voucher were recorded.

MOTSU

Surveys at MOTSU focused on determining the presence/absence of three DoD MSS (Table 1). Visual Encounter Surveys were the most common survey method used during survey events, however use of binoculars to search for basking turtles and dip netting were also used. Acoustic loggers were not used at MOTSU nor were Gopher Tortoise surveys, as this species is not present in North Carolina.

Due to the extensive acreage of the MOTSU, surveys were conducted by concentrating field work at 16 sites scattered around the property where the habitat looked suitable for the target DoD MSS (Appendix A). A vehicle was used to travel from one site to another, during which observations of herpetofauna were also documented.

Four 24-inch by 12-inch collapsible hoop nets (Promar TR-503 model) were used to survey for turtles at the MOTSU installation. Each hoop net was baited with a partially opened can of sardines, placed in the water, and secured with rope to maintain the location. Biologists ensured that the top 3 – 4 inches of the hoop net extended above the water line to allow turtles and other organisms space to breathe even if water levels raised because of a rain event. Each hoop net was sampled at least once each day.

DoD PARC biologists cruised asphalt roads slowly on three nights at the MOTSU installation (May 10, 11 2023; August 17, 2023) to identify snakes using the road as a source of heat, or other organisms crossing the road (e.g. anurans and turtles). During the evening surveys, biologists stopped at several freshwater sources to listen for frog calls, which were used to identify frog or toad species vocalizing. The lack of paved roads at the Bugg Spring installation prevented using this method at that site.

As with those species encountered at Bugg Spring, herpetofauna that were captured by hand or could be photographed without capture at MOTSU were documented using the HerpMapper

applet.

AVIAN SURVEYS

BUGG SPRING

The one-day survey effort on 4 May 2023 focused on visual and auditory surveys of all birds to maximize the detection of species using habitats at the Bugg Spring facility. Field surveys were conducted by Richard Fischer (ERDC-EL) and John Arnett (U.S. Navy). Because of the small size of the installation, only one day was needed to conduct a survey that would yield information on the majority of breeding birds present on the installation. Furthermore, it was more productive to conduct area searches, rather than point counts, to maximize detections of birds. Area searches were conducted in all accessible habitats and efforts were focused on detecting avian DoD MSS. Four different types of habitats (Lowland Hardwood Forest, Upland Mixed Forest, Upland Even-aged Hardwood, and Aquatic; Figure 5) were surveyed. The survey was initiated at sunrise and continued until approximately 1100 hrs, which captured the peak timing for breeding bird activity.



Figure 5. Typical mixed-hardwood upland habitat at the U.S. Navy Bugg Spring facility. Picture by Rich Fischer.



Figure 6. Natural Resources Manager John Arnett, U.S. Navy, surveying aquatic habitat on the Bugg Spring sinkhole lake. Picture by Rich Fischer.

MOTSU

MOTSU surveys focused on detecting all avian species present at sampling points with a focus on three avian DoD MSS (Bachman's Sparrow (BACS; *Peucaea aestivalis*), Northern Bobwhite (NOBO; *Colinus virginianus*), and Southeastern American Kestrel (AMKE; *Falco sparverius Paulus*), and the federally endangered RCWO. The primary method used at MOTSU consisted of establishing point count stations using a systematic sampling scheme sufficient to sample suitable habitats for the targeted MSS. One hundred and three (103) point-count stations from May 30 to June 1 at MOTSU (Figure 7). Point-count survey locations at MOTSU covered most of the installation and surveys targeted the majority of pine-savannah habitat (Figure 8) that is known to host BACS, NOBO, AMKE, and RCWO.

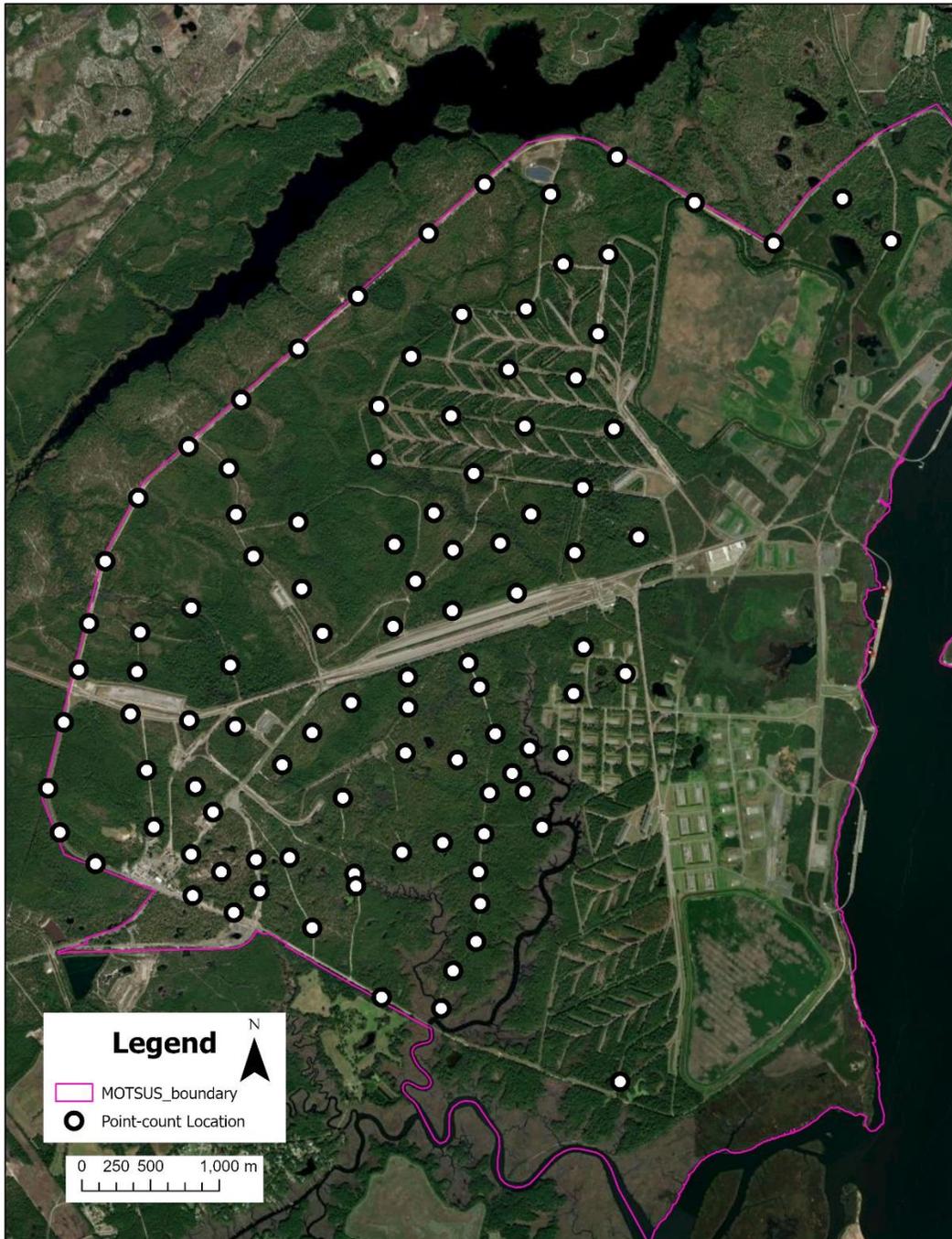


Figure 7. Locations of the 103 avian point counts (white circles) conducted at MOTSU from May 30th - June 1st.



Figure 8. Pine savannah habitat with wiregrass understory managed specifically for endangered RCWO at MOTSU. Picture by Jacob Jung.

It was determined that the portion of the installation east of the Cape Fear River at MOTSU was largely lacking suitable habitat for the targeted DoD avian MSS; therefore surveys focused on the mainland portion of the installation (Figure 7). Point-count locations were at least 250 meters apart with only a few exceptions. Point-count surveys consisted of standing in a stationary location and recording all species seen or heard during the 5-minute duration of the survey (Figure 9). Surveys were initiated at sunrise and continued for up to four hours after sunrise, which captures the peak timing for breeding bird activity. These field surveys were conducted by Jacob Jung and Andrew Sharp (ERDC-EL).



Figure 9. Trained observer conducting an avian point count at MOTSU during spring 2023 surveys. Picture by Jacob Jung.

RESULTS

HERPETOFAUNAL SURVEYS

Bugg Spring

Field surveys were conducted at Bugg Spring during February 22-24, 2023 by Chris Petersen and John Arnett; May 4-5 by Rob Lovich and John Arnett; and August 11, 2023 by Rob Lovich and John Arnett.

DoD PARC network members conducted the surveys on foot and traversed the majority of the naval property, with the exception of the northwestern section, as the vegetation was too dense to access this area. Thirty (30) herpetofaunal species (12 amphibians and 18 reptiles) were confirmed present during the three survey events (Table 2).

Table 2. Amphibians and Reptiles Confirmed at Bugg Spring During 2023.

Order	Species Type	Common Name	Scientific Name
Amphibian	Frog or Toad	Southern Cricket Frog	<i>Acris gryllus</i>
Amphibian	Frog or Toad	Oak Toad	<i>Anaxyrus quercicus</i>
Amphibian	Frog or Toad	Southern Toad	<i>Anaxyrus terrestris</i>
Amphibian	Frog or Toad	Greenhouse Frog	<i>Eleutherodactylus planirostris</i>
Amphibian	Frog or Toad	Eastern Narrow-mouthed Toad	<i>Gastrophryne carolinensis</i>
Amphibian	Frog or Toad	Green Treefrog	<i>Hyla cinerea</i>
Amphibian	Frog or Toad	Pine Woods Treefrog	<i>Hyla femoralis</i>
Amphibian	Frog or Toad	Squirrel Treefrog	<i>Hyla squirella</i>
Amphibian	Frog or Toad	American Bullfrog	<i>Lithobates catesbeianus</i>
Amphibian	Frog or Toad	Pig Frog	<i>Lithobates grylio</i>
Amphibian	Frog or Toad	Southern Leopard Frog	<i>Lithobates sphenocephalus</i>
Amphibian	Frog or Toad	Spring Peeper	<i>Pseudacris crucifer</i>
Reptile	Crocodylian	American Alligator	<i>Alligator mississippiensis</i>
Reptile	Lizard	Green Anole	<i>Anolis carolinensis</i>
Reptile	Lizard	Brown Anole	<i>Anolis sagrei</i>
Reptile	Lizard	Indo-Pacific House Gecko	<i>Hemidactylus garnotii</i>
Reptile	Lizard	Southeastern Five-lined Skink	<i>Plestiodon inexpectatus</i>
Reptile	Lizard	Little Brown Skink	<i>Scincella lateralis</i>
Reptile	Snake	Southern Black Racer	<i>Coluber constrictor priapus</i>
Reptile	Snake	Ring-necked Snake	<i>Diadophis punctatus</i>
Reptile	Snake	Brahminy Blindsnake	<i>Indotyphlops braminus</i>
Reptile	Snake	Eastern Ratsnake	<i>Pantherophis alleghaniensis</i>
Reptile	Snake	Eastern Gartersnake	<i>Thamnophis sirtalis sirtalis</i>
Reptile	Turtle	Florida Softshell	<i>Apalone ferox</i>
Reptile	Turtle	Gopher Tortoise	<i>Gopherus polyphemus</i>
Reptile	Turtle	Coastal Plain Cooter	<i>Pseudemys concinna floridana</i>
Reptile	Turtle	Florida Red-bellied Cooter	<i>Pseudemys nelsoni</i>
Reptile	Turtle	Peninsula Cooter	<i>Pseudemys peninsularis</i>
Reptile	Turtle	Eastern Musk Turtle	<i>Sternotherus odoratus</i>
Reptile	Turtle	Eastern Box Turtle	<i>Terrapene carolina</i>

The Gopher Tortoise (*Gopherus polyphemus*) was the only DoD MSS confirmed present during the surveys (Figure 10). Approximately seven active Gopher Tortoise burrows, located primarily in the residential grounds near Highway 470, were observed during the survey events. Two burrows were also observed on the northern perimeter of the abandoned orchard. Tortoises were occasionally observed at burrow entrances. Gopher Tortoise had been confirmed present on the site during previous surveys.



Figure 10. Gopher Tortoise.
Picture by Chris Petersen

The Endangered Species Act-listed American Alligator (*Alligator mississippiensis*) was confirmed present on the Bugg Spring facility (Figure 11). American Alligators were commonly observed in and on the edge of the spring. Reproduction is likely occurring on the site, as juvenile alligators were observed during all field visits. This species had been confirmed present on the site previously.



Figure 11. Juvenile American Alligator.
Picture by Chris Petersen

The three acoustic loggers recorded 84.5 hours of data and confirmed the presence of 12 species of frogs and toads. The two most common species recorded vocalizing on the loggers were the Green Treefrog (*Hyla cinerea*) and non-native Greenhouse Frog (*Eleutherodactylus planirostris*). No salamander species were documented on the property during the surveys, however the presence of the Eastern Newt (*Notophthalmus viridescens*) had been confirmed during previous surveys.



Figure 12. Indo-Pacific House Gecko.
Picture by Chris Petersen

The most frequently observed lizards were Green Anole (*Anolis carolinensis*), Southeastern Five-lined Skink (*Plestiodon inexpectatus*) and the non-native Brown Anole (*Anolis sagrei*). The non-native Indo-Pacific House Gecko (*Hemidactylus garnotii*) was observed and captured during nighttime surveys on the side of a building located outside the gated area of the installation (Figure 12).



Figure 13. Brahminy Blindsnake.
Picture by J.D. Willson

Five species of snakes were confirmed present during the surveys. This study represents the first time that the non-native Brahminy Blindsnake (*Indotyphlops braminus*) was documented on the naval installation (Figure 13).

Seven species of turtles were confirmed on the Bugg Spring installation, the majority of which were aquatic species. The Gopher Tortoise and Eastern Box Turtle (*Terrapene carolina*) were the only two turtle species confirmed present that are primarily terrestrial species. The Eastern Box Turtle was documented only by finding the carapace (upper shell) of a deceased individual.

MOTSU

Surveys were conducted at MOTSU during May 9-11, 2023 by Chris Petersen and Jeffrey DeBerry; and August 17, 2023 by Robert Lovich. A total of 23 herpetofaunal species (10 amphibians and 13 reptiles) were confirmed present during the two field survey events at MOTSU (Table 3). No herpetofaunal DoD MSS were confirmed present. However, the ESA-listed American Alligator was encountered in several wetland habitats of the installation. This species is Federally protected by the ESA as a Threatened species, due to their similarity of appearance to the American crocodile. See Appendix B for detailed descriptions of the 16 sites surveyed and the amphibians and reptiles species detected at each site.

Table 3. Amphibians and Reptiles Confirmed at MOTSU During 2023.

Order	Species Type	Common Name	Scientific Name
Amphibian	Frog or Toad	Southern Cricket Frog	<i>Acris gryllus</i>
Amphibian	Frog or Toad	Southern Toad	<i>Anaxyrus terrestris</i>
Amphibian	Frog or Toad	Eastern Narrow-mouthed Toad	<i>Gastrophryne carolinensis</i>
Amphibian	Frog or Toad	Green Treefrog	<i>Hyla cinerea</i>
Amphibian	Frog or Toad	Pine Woods Treefrog	<i>Hyla femoralis</i>
Amphibian	Frog or Toad	Squirrel Treefrog	<i>Hyla squirella</i>
Amphibian	Frog or Toad	American Bullfrog	<i>Lithobates catesbeianus</i>
Amphibian	Frog or Toad	Green Frog	<i>Lithobates clamitans</i>
Amphibian	Salamander	Two-toed Amphiuma	<i>Amphiuma means</i>
Amphibian	Salamander	Eastern Newt	<i>Notophthalmus viridescens</i>
Reptile	Crocodylian	American Alligator	<i>Alligator mississippiensis</i>
Reptile	Lizard	Green Anole	<i>Anolis carolinensis</i>
Reptile	Lizard	Eastern Six-lined Racerunner	<i>Aspidoscelis sexlineata sexlineata</i>
Reptile	Lizard	Southeastern Five-lined Skink	<i>Plestiodon inexpectatus</i>

Reptile	Lizard	Broad-headed Skink	<i>Plestiodon laticeps</i>
Reptile	Snake	Eastern Cottonmouth	<i>Agkistrodon piscivorus piscivorus</i>
Reptile	Snake	Northern Black Racer	<i>Coluber constrictor constrictor</i>
Reptile	Snake	Northern Rough Greensnake	<i>Opheodrys aestivus aestivus</i>
Reptile	Snake	Eastern Ratsnake	<i>Pantherophis alleghaniensis</i>
Reptile	Snake	Red-bellied Snake	<i>Storeria occipitomaculata</i>
Reptile	Turtle	Snapping Turtle	<i>Chelydra serpentina</i>
Reptile	Turtle	Eastern Musk Turtle	<i>Sternotherus odoratus</i>
Reptile	Turtle	Yellow-bellied Slider	<i>Trachemys scripta scripta</i>



Figure 14. Depression Wetland Pond Habitat. Picture by Jef DeBerry

Many of the amphibian and reptile species detected at MOTSU were in or around depression wetlands dominated along the margins by Bald Cypress (*Taxodium distichum*) and Pond Cypress (*T. ascendens*; Figure 14). Species such as Southern Cricket Frog (*Acris gryllus*), Green Frog (*Lithobates clamitans*), America Bullfrog (*Lithobates catesbeianus*), and Eastern Newt (*Notophthalmus viridescens*) were common species in this habitat. Some of more shallow depression wetlands were dry, or mostly dry, during the survey event in May 2023. This caused many amphibians to concentrate under logs and other surface debris within the wetlands, and sometimes dozens of Eastern Newts were found under a single log (Figure 15).



Figure 15. Eastern Newts Located Under a Log in a Dry Depression Wetland. Picture by Chris Petersen

Lizards were the most common reptiles detected during the surveys. Green Anole (*Anolis carolinensis*) and Eastern Six-lined Racerunner (*Aspidoscelis sexlineata sexlineata*) were very common throughout the installation. Visual Encounter Surveys were conducted for Eastern Glass Lizard (*Ophisaurus ventralis*) along the railroad tracks north of the Class Yard where they were reported previously, but none were detected.

AVIAN SURVEYS

Bugg Spring

One hundred and fifty-five (155) individuals comprising 30 bird species (Table 4) were confirmed present during area searches on 4 May 2023 at Bugg Spring (Table 4). The avian community included a broad mix of wetland and upland species. No DoD MSS were detected but Swallow-tailed Kite (*Elanoides forficatus*; DoD PIF Tier 2 Species) was detected on two occasions flying over the facility. Because of access issues, and difficult wet terrain, surveys were unable to be performed in areas to the north of the deep sinkhole where a Bald Eagle has been documented nesting in the area (John Arnett, personal communication).

Table 4. Common and Scientific Names of All Birds Detected at Bugg Spring, FL, 4 May 2023. MSS Tier 2 species are highlighted in orange.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Count</u>
Mourning Dove	<i>Zenaida macroura</i>	36
Northern Cardinal	<i>Cardinalis cardinalis</i>	17
Northern Parula	<i>Setophaga americana</i>	14
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	10
Carolina Wren	<i>Thryothorus ludovicianus</i>	10
American Crow	<i>Corvus brachyrhynchos</i>	8
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	8
Tufted Titmouse	<i>Baeolophus bicolor</i>	8
Red-eyed Vireo	<i>Vireo olivaceus</i>	6
Pileated Woodpecker	<i>Dryocopus pileatus</i>	5
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	4
Red-shouldered Hawk	<i>Buteo lineatus</i>	3
Downy Woodpecker	<i>Dryobates pubescens</i>	2
Fish Crow	<i>Corvus ossifragus</i>	2
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	2
Sandhill Crane	<i>Antigone canadensis</i>	2
White Ibis	<i>Eudocimus albus</i>	2
White-eyed Vireo	<i>Vireo griseus</i>	2
Yellow-throated Vireo	<i>Vireo flavifrons</i>	2
Swallow-tailed Kite	<i>Elanoides forficatus</i>	2
Anhinga	<i>Anhinga anhinga</i>	1
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	1
Carolina Chickadee	<i>Poecile carolinensis</i>	1
Common Gallinule	<i>Gallinula galeata</i>	1
Common Nighthawk	<i>Chordeiles minor</i>	1
Common Yellowthroat	<i>Geothlypis trichas</i>	1
Gray Catbird	<i>Dumetella carolinensis</i>	1
Little Blue Heron	<i>Egretta caerulea</i>	1
Swainson's Thrush	<i>Catharus ustulatus</i>	1
Wild Turkey	<i>Meleagris gallopavo</i>	1

MOTSU

One thousand two hundred and fifty-seven (1,257) individuals comprising 63 bird species (Table 5) were detected during point-count surveys from May 30th – June 1st. Species associated with pine savannahs were well represented in the survey results. Two MSS (BACS [Figures 16, 17] and NOBO [Figure 18]) as well as one well-documented federally endangered species (RCWO) were confirmed present.

Additionally, Red-headed Woodpecker (*Melanerpes erythrocephalus*), Prothonotary Warbler (*Protonotaria citrea*), Prairie Warbler (*Setophaga discolor*), and King Rail (*Rallus elegans*), all DoD PIF Tier 2 species, were detected.

Table 5. List of avian species detected at MOTSU, including number of points detected and total number of individuals detected during May 30 – June 1st surveys. Endangered species are highlighted in blue, MSS Tier 1 species in green, and MSS Tier 2 species in orange. Detections refers to the number of point-counts (out of 103) where the species was detected, while Individuals refers to the total number of individuals that were detected.

Species	Detections	Individuals	Species	Detections	Individuals
Pine Warbler	83	105	Red-cockaded Woodpecker	8	11
Great crested Flycatcher	66	77	Turkey Vulture	7	7
Carolina Wren	64	77	Brown Thrasher	6	6
Mourning Dove	64	79	Northern Rough-winged Swallow	4	6
Tufted Titmouse	55	67	Pileated Woodpecker	4	5
Northern Cardinal	51	61	Summer Tanager	4	4
Northern Bobwhite	50	75	American Robin	3	3
Brown-headed Nuthatch	43	62	Great blue Heron	3	4
Red-headed Woodpecker	38	41	Osprey	3	3
Red-bellied Woodpecker	34	37	Gray Catbird	2	2
Eastern Bluebird	31	32	Killdeer	2	4
Eastern Towhee	31	33	Prairie Warbler	2	3
Bachman's Sparrow	26	38	White-eyed Vireo	2	2
Brown-headed Cowbird	25	27	White Ibis	2	2
Blue-grey Gnatcatcher	24	25	Wild Turkey	2	6
Common Nighthawk	21	27	Yellow-billed Cuckoo	2	2
Common Yellowthroat	20	21	Yellow-throated Vireo	2	2
Laughing Gull	20	81	Anhinga	1	1
Blue Grosbeak	18	19	Barn Swallow	1	2
Carolina Chickadee	17	19	Double-crested Cormorant	1	1
Eastern Wood-pewee	16	16	Eastern Kingbird	1	1
Blue Jay	13	13	European Starling	1	1
Common Grackle	12	30	Fish Crow	1	1
American Crow	11	15	Green Heron	1	1
Downy Woodpecker	11	12	King Rail	1	1
House Finch	11	13	Orchard Oriole	1	1
Northern Flicker	11	12	Red-eyed Vireo	1	1
Northern Mockingbird	11	11	Rock Pigeon	1	6
Chipping Sparrow	9	10	Red-tailed Hawk	1	1
Indigo Bunting	9	9	Sanderling	1	1
Prothonotary Warbler	9	10	Yellow-breasted Chat	1	1
Red-winged Blackbird	9	11			



Figure 16. Bachman's Sparrow observed during point-count surveys at MOTSU during spring 2023. Picture by Jacob Jung.

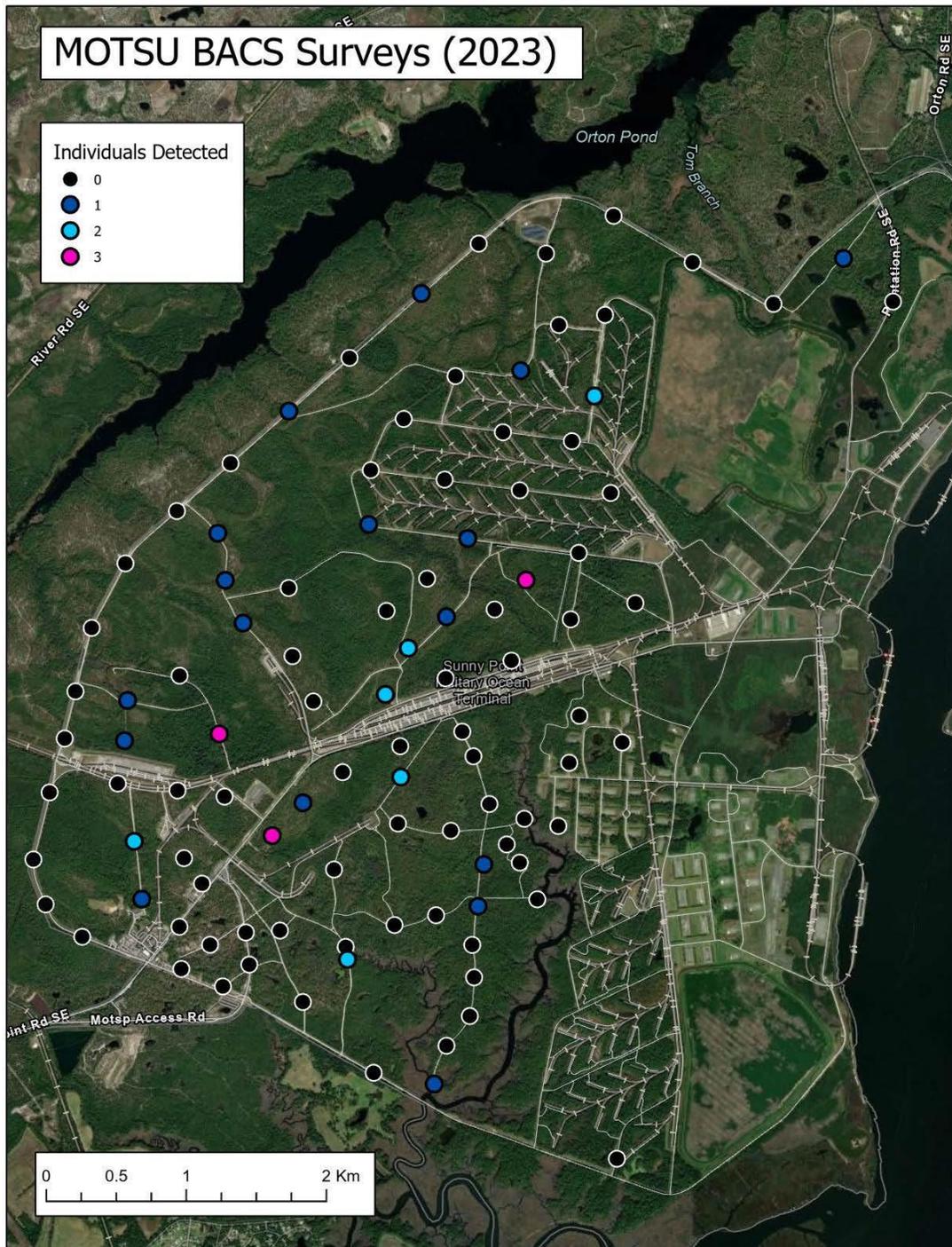


Figure 17. Bachman’s Sparrow detection map during surveys at MOTSU.

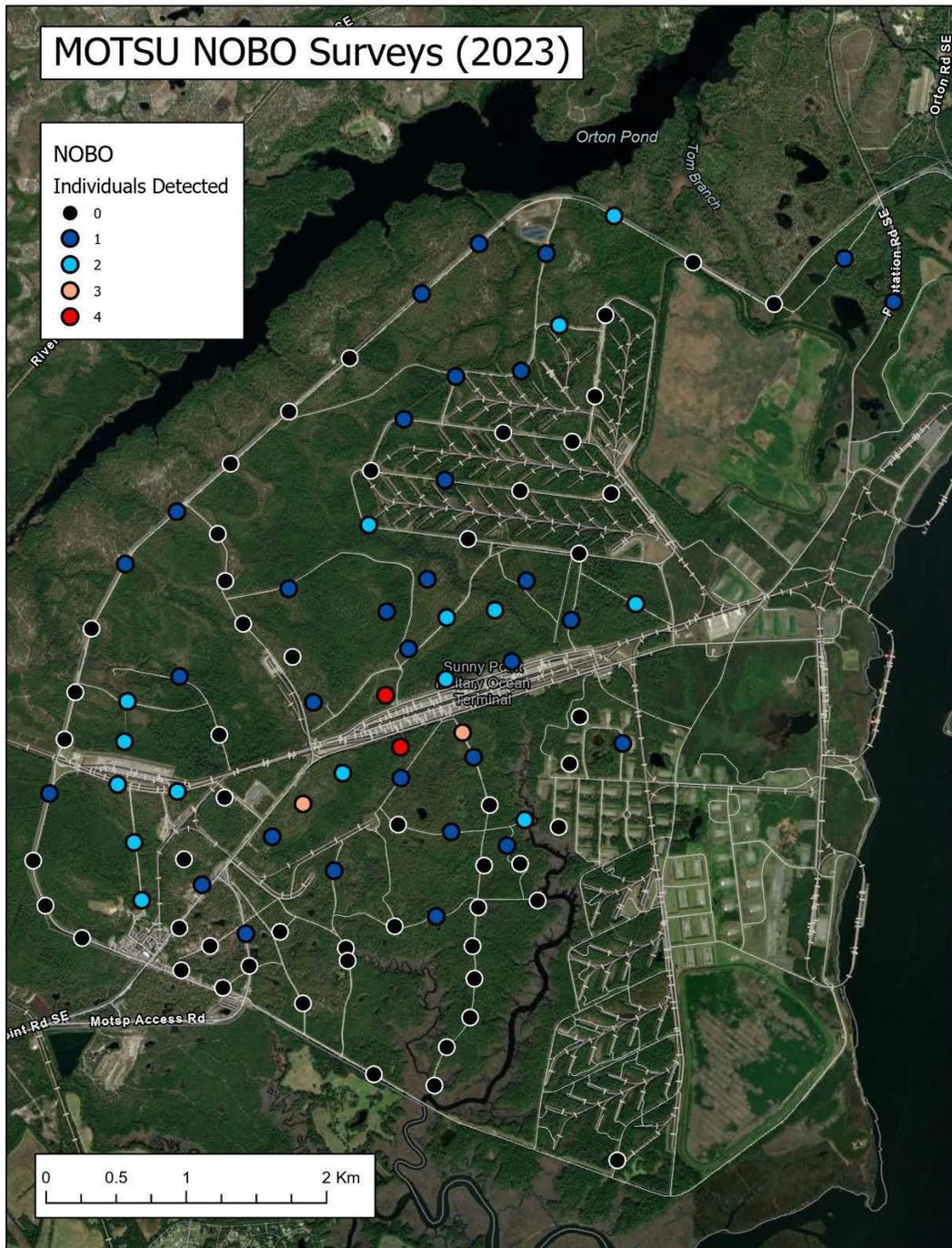


Figure 18. Locations of Northern Bobwhite detections during point count surveys at MOTSU.

DISCUSSION

HERPETOFAUNAL SPECIES

Bugg Spring

During surveys at Bugg Spring 30 amphibian and reptile species were confirmed present, representing approximately 67% of all herpetofauna species previously documented on the site. The first observation of the Brahminy Blindsnake, a non-native species was detected. The Gopher Tortoise, a species known to occur on the site, was the only DoD MSS observed on Bugg Spring.

Spotted Turtles were not confirmed present on Bugg Spring, even though portions of the forested wetlands surrounding the spring appear suitable for this species. It is concluded that Spotted Turtles are very unlikely to occur on Bugg Spring because this species is generally uncommon in central and southern Florida, is not known to occur in Lake County, Florida, and that multiple surveys for herpetofauna on the Navy site have not confirmed the presence this species.

While the Eastern Diamond-backed Rattlesnake is known to occur in Lake County, Florida, this species was not confirmed present on the Bugg Spring property. It is concluded that the Eastern Diamond-backed Rattlesnake is unlikely to occur on Bugg Spring primarily because the upland woodlands that are present on and surrounding Bugg Spring are substandard for this species, which prefers open-canopied pine stands maintained by high-frequency fire. This is further supported by the fact that previous surveys conducted in 2018 and 2020 for herpetofauna on the naval property have not confirmed the presence of this species.

The Gopher Frog was not confirmed present on the Bugg Spring property during this survey. Though the Gopher Frog is confirmed present in Lake County, Florida, this species is very unlikely to occur on the Bugg Spring property. This conclusion is based on the fact that mating calls of this species were not recorded on the three acoustic data loggers deployed at the site, and the lack of suitable breeding habitat (ephemeral to semi-permanent wetlands that lack large predatory fishes) on the installation.

Lastly, no observations of the Florida Pinesnake were recorded during this survey. This species is confirmed present in Lake County, Florida, and this species has the potential to occur on Bugg Spring since the site contains the primary habitat of this species (well-drained sandy soils, including upland pine forests and sandhills, scrubby flatwoods, oak scrub, dry oak forests, old fields and agricultural borders). As Florida Pinesnakes are known to occupy Gopher Tortoise burrows, the presence of Gopher Tortoise on Bugg Spring is also a good indicator of the potential presence of the snakes.

MOTSU

At MOTSU 23 amphibian and reptile species were detected, representing approximately 40% of all the species of herpetofauna that had been documented on the site during previous survey efforts. The first observations of a Red-bellied Snake and the Snapping Turtle on the Army base was recorded during this survey.

Spotted Turtles were not confirmed present on MOTSU during this survey, even though many wetland habitats were encountered that appeared suitable for this species. Voucher specimens from the North Carolina Museum of Natural Resources confirm the occurrence of Spotted Turtles in Brunswick County, North Carolina and areas adjacent to the base. However, no Spotted Turtles were captured in the hoop net traps, nor are there any reports of this species from base personnel, North Carolina Resource Commission (NCRC), or records in HerpMapper and iNaturalist. It is concluded that Spotted Turtles are unlikely to occur on MOTSU because this species is generally uncommon in the southeastern portion of North Carolina and, perhaps more importantly, multiple surveys completed on the Army base by herpetologists have not confirmed the presence of this species.

The Eastern Diamond-backed Rattlesnake was not confirmed present on the MOTSU property during this survey. It is concluded that the Eastern Diamond-backed Rattlesnake is unlikely to occur on MOTSU, even though there is extensive suitable habitat for the species on the Army base. This conclusion is based on the fact that this species has not been confirmed present in Brunswick, County North Carolina (the nearest population is approximately 55 miles away at Marine Corps Base Camp Lejeune) and there have not been any observations of this species from base personnel, or records in HerpMapper and iNaturalist. Additionally, biologists from the NCRC have extensively searched prescribed burned areas on the base over several years and have not confirmed the presence of this species.

Gopher Frogs were not observed or captured during surveys; however, there are several ponds on MOTSU that have historically supported Gopher Frogs. The NCRC has been monitoring these ponds for the last 17 years and have only documented egg masses from two ponds near the visitor center and recorded a single calling male from a third pond located east of the administration area. The primary pond used by Gopher Frogs in more recent years is not located on the MOTSU property, but is directly adjacent to the Army base on a tract of land currently owned by the town of Southport. The NCRC was able to collect eggs from the two ponds on MOTSU for head-starting in 2015 and 2016, but the majority of eggs have come from the pond on the Southport tract. Due to the close proximity of all three of those ponds, all head-started animals were released into the Southport pond. Thirty-six head-started frogs were released in 2015 and seventy-one frogs were released in 2016. There have not been any additional head-starting efforts since that time, mostly because no eggs were detected in any of the ponds. Gopher Frogs are still likely present on MOTSU, but their distribution is limited to only a few ponds located in the southern portion of the Main Terminal.

AVIAN SPECIES

Bugg Spring

Thirty (30) different bird species were detected during the one-day area search. Although no MSS were confirmed present, two Swallow-tailed Kites were observed on multiple occasions flying over the area, both on and off the installation. These likely represent foraging birds that nest in bottomland hardwood forests in the region. The moderately diverse bird community on Bugg Spring suggests that the relatively undisturbed forested habitat within the installation fence line is providing regionally important habitat for a suite of moderately area-sensitive forest birds such as Pileated Woodpecker, Great Crested Flycatcher, Red-shouldered Hawk, and Yellow-throated Vireo. The aquatic deep-water habitat provides food, cover, and water for a suite of wetland- and riparian-dependent species (e.g., Common Gallinule, Anhinga, White Ibis).

Significant land clearing and development was noted in several areas adjacent to, and near, Bugg Spring. The installation has a direct hydrologic connection to both Lake Denham and Lake Dennis via a series of permanent channels. Aside from regional habitat loss, significant development has the potential to (a) alter hydrologic regimes within the main channel and its tributaries, and (b) contribute to decreased water quality via input of non-point source pollutants (e.g., sediment). These perturbations not only potentially threaten the installation mission within the deepwater spring, but also water quality and quantity necessary to maintain flooded bottomland hardwoods important for a variety of birds, herpetofauna, and other organisms. Navy should continue to monitor water quality, and water levels, as current and future development occurs on the nearby landscape.

The Swainson's Thrush was unanticipated and represented a late passage migrant that breeds primarily in the Canadian Boreal Forest. During pre- and post-breeding migration, Bugg Spring almost certainly serves as important stopover habitat for long-distance migrants.

MOTSU

Sixty-three (63) different bird species were detected over the course of three mornings. Survey efforts were focused on DoD Tier 1 MSS, which included both NOBO and BACS. At MOTSU, the primary habitats surveyed for these species were open southeastern pine woodlands. Both NOBO and BACS were abundant across the installation with NOBO detected at approximately 50% of survey points and BACS detected at 25% of sites. Pine Warblers were the most detected species at 83 of 103 point-count locations, further indicating the strong presence of pine-dependent species across the installation. MOTSU likely supports strong breeding populations of both NOBO and BACS because of the intense habitat management conducted for the federally endangered RCWO, which is also common across the installation. Red-cockaded Woodpeckers were detected at eight locations during surveys, with the installation documenting all nesting colonies that occur on MOTSU. Frequent rotations of prescribed fire to maintain RCWO habitat also benefit the two

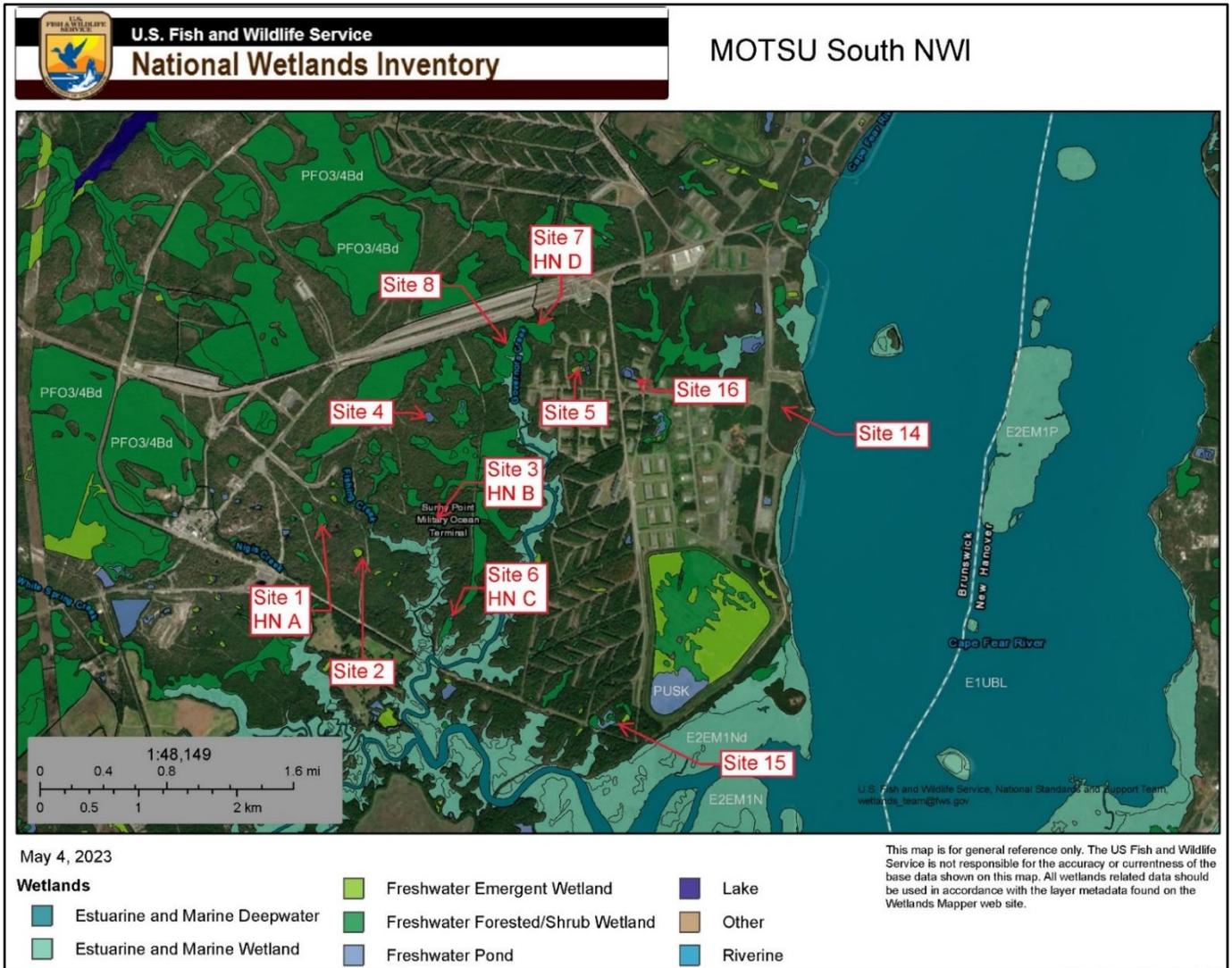
MSS that coexist in these pine-dominated habitats. Spring and summer prescribed burns occur on MOTSU with areas within the southern section of the installation undergoing recent burns just before the conducted surveys; therefore, these areas were not surveyed as understory vegetation was completely absent.

Several DoD MSS Tier 2 species were detected, including Red-headed Woodpecker, Prothonotary Warbler, Prairie Warbler, and King Rail. Red-headed Woodpeckers were the most frequently detected woodpecker species at the installation. Numerous depressional wetlands and small cypress swamps supported breeding territories of Prothonotary Warblers. King Rail was detected at a point count near the southernmost portion of the installation along Governor's Creek. A second visit to opportunistically listen for King Rail following a short playback session confirmed presence. A DoD MSS Tier 2 not detected at MOTSU included Henslow's Sparrow (*Centronyx henslowii*). Henslow's Sparrow is known to occur in North Carolina, but not as far south as Wilmington. It is possible that MOTSU could overwinter Henslow's Sparrow. Proactive monitoring and management of Tier 2 species is encouraged when and where appropriate, including monitoring outside of the breeding season.

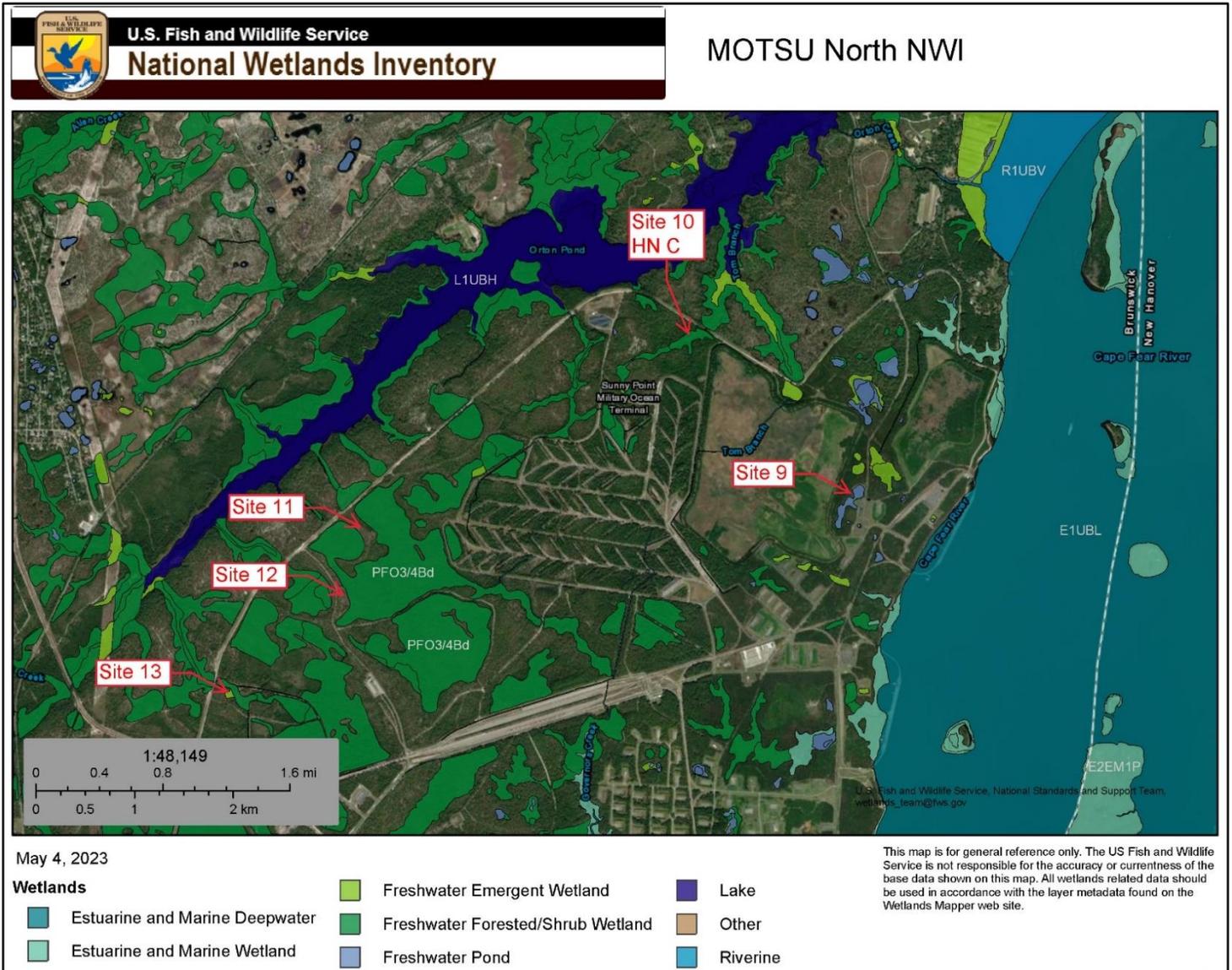
ACKNOWLEDGMENTS

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Appendix A: MOTSU SITE MAPS



Appendix A: MOTSU SITE MAPS



Appendix B

Sites Surveyed for Amphibians and Reptiles on MOTSU

Site 1: This area was located in the southwest part of MOTSU main base, to the east of the Public Works department building. It contained a complex of depression wetlands dominated along the margins by Bald Cypress (*Taxodium distichum*) and Pond Cypress (*T. ascendens*) (Figure 1). The largest wetlands still contained open water at the deeper portions, making it suitable habitat for turtles, frogs, salamanders and other herpetofauna. Visual encounter surveys were conducted in the pond and adjacent habitat and frog calls were identified.



Figure 1. Depression Wetland Pond Habitat.
Picture by Jef DeBerry



Figure 2. Two-toed Amphiuma.
Picture by Chris Petersen

Hoop Net A was set in this location on May 9, 2023. On May 10, 2023 (0900) Hoop Net A contained four Yellow-bellied Sliders (*Trachemys scripta scripta*) ranging in size (long axis of carapace) from about 4 inches to 10 inches. On May 11, 2023 another two Yellow-bellied Sliders and a Two-toed Amphiuma (*Amphiuma means*) were found in Hoop Net A (Figure 2). The net was removed from the location on May 11, 2023.

Species documented at Site 1 included: Green Anole (*Anolis carolinensis*), Squirrel Treefrog (*Hyla squirella*), Green Frog (*Lithobates clamitans*), Eastern Newt (*Notophthalmus viridescens*), Southern Cricket Frog (*Acris gryllus*), Yellow-bellied Slider, and Two-toed Amphiuma.

Site 2: This area was situated east of Site 1. Under normal circumstances this would have been a large, shallow depression wetland with open water and floating aquatic species. However, due to low rainfall conditions, water levels had dropped leaving only a few of the deepest depressions with water. This resulted in large concentrations of Eastern Newts in the pools. These areas were dominated by floating aquatic vegetation including American White Waterlily (*Nymphaea odorata*) and Watershield (*Brasenia schreberi*). A combination of VES, dip netting and frog call identification was utilized in the depression wetland and adjacent forested habitat.



Figure 3. Southern Toad.
Picture by Chris Petersen

Species documented at Site 2 included: Southern Toad (*Anaxyrus terrestris*; Figure 3), Eastern Six-lined Racerunner (*Aspidoscelis sexlineata sexlineata*), Eastern Newt, and Southern Cricket Frog, Yellow-bellied Slider. Several Red-headed Woodpeckers (*Melanerpes erythrocephalus*) were noted utilizing this area.

Site 3: This area was situated northeast of Site 2 at the head of Fishing Creek, a tributary of the Cape Fear River. There were several depression wetlands in this area that were searched. Similar to Site 1, this site contained some open water with Bald Cypress and Pond Cypress along the margins. A combination of VES, hoop net, and frog call identification was utilized in the depression wetland and adjacent forested habitat.

Hoop Net B was set in this location on May 9, 2023. On May 10, 2023 Hoop Net B contained two Yellow-bellied Sliders of medium size (Figure 4). Three small catfish, most likely Channel Catfish (*Ictalurus punctatus*), were also in the hoop net. The hoop net showed evidence of damage, potentially from an American Alligator that had been observed in an adjacent pond; therefore, the hoop net was removed from this location on May 10, 2023. Species documented at Site 3 included: American Alligator, Green Frog, Southern Cricket Frog, Southern Toad, American Bullfrog (*Lithobates catesbeianus*), and Eastern



Figure 4. Yellow-bellied Slider.
Picture by Jef Deberry

Site 4: This area was situated north of Site 3 and consisted of an approximately 1.5-acre open water pond surrounded by adjacent wetlands and pine forest. A large population of Common Sundew (*Drosera rotundifolia*), a native carnivorous plant that can be found in acidic boggy areas with full to partial shade, was located around the perimeter of the pond. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 4 included: Green Frog, Southern Cricket Frog, and Eastern Six-lined Racerunner.



**Figure 5. Eastern Cottonmouth.
Picture by Chris Petersen**

Site 5: This area was situated south of the Class Yard and was surrounded by ammo pads and a paved road. The habitat consisted of a complex of four ponds with adjacent wetlands and pine forest. A population of Yellow Pitcher Plant (*Sarracenia flava*), a native carnivorous plant found in savannas, seepage bogs, and pocosins, was observed in the vicinity of the ponds. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 5

included: Eastern Cottonmouth (*Agkistrodon piscivorus piscivorus*; Figure 5), American Bullfrog, Green Anole, Southeastern Five-lined Skink (*Plestiodon inexpectatus*), and Eastern Six-lined Racerunner. The carapace and plastron of a dead Snapping Turtle (*Chelydra serpentina*), was also found in Site 5.

Site 6: This site was located in the southern part of MOTSU near Governor's Creek, a tributary of the Cape Fear River. It was a small depression wetland surrounded by Bald Cypress and Pond Cypress along the margins and upland forest. A combination of VES, hoop net, and frog call identification was utilized in the depression wetland and adjacent forested habitat. Hoop Net C was set in this location on May 9, 2023. On May 10, 2023 Hoop Net C was checked, but was empty. An American Alligator was observed along the shore of the pond. The hoop net was removed from this location on May 10, 2023 to avoid damage. Species documented at Site 6 included: American Alligator, Green Frog and Yellow-bellied Slider.

Site 7: This site was located in the upper reaches of Governor's Creek where the Class Yard crossed the stream channel. Hoop Net D was set in a small sand bottom stream channel with adjacent mixed pine-deciduous forest on May 9, 2023. On May 10, 2023 Hoop Net D contained one medium Yellow-bellied Slider. On May 11 the hoop net was empty and was removed from this location. No other species were noted from this site.

Site 8: This site was located west of Site 7 along the wetland forest and marshes of upper Governor's Creek. A combination of VES and frog call identification was utilized around the

wetland and adjacent forested habitat. Species noted at Site 8 include: Eastern Narrow-mouthed Toad (*Gastrophryne carolinensis*), Southern Toad, Squirrel Treefrog, and Green Anole.

Site 9: Site 9 consisted of a complex of ponds located east of DA-2. The habitat along the pond edge was comprised of a mixture of pine forest and maintained grass. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species noted at Site 8 include: American Alligator and Eastern Narrow-mouthed Toad.

Site 10: This site was located along the northern perimeter of MOTSU in the upper reaches of an unnamed tributary to Tom Branch which drains to Orton Pond. Hoop Net C was set in a small sand bottom stream channel with adjacent bottomland hardwood forest on May 10, 2023. On May 11, 2023 Hoop Net C contained one Eastern Musk Turtle (*Sternotherus odoratus*; Figure 6) and five crayfish (*Cambarus* sp.). Hoop net C was removed from this location. The call of Pine Woods Treefrog (*Hyla femoralis*) was also noted from this site.



**Figure 6. Eastern Musk Turtle.
Picture by Chris Petersen**

Site 11: This area was situated near the northwest perimeter of MOTSU and consisted of Longleaf Pine on xeric sands with scattered Turkey Oak (*Quercus laevis*) and a dominance of wiregrass (*Aristida stricta*) in the understory. This area was noted on aerial photography due to the white signature of the sand. The site was managed to support RCWO as evidenced by the rings painted on pines denoting RCWO cluster boundaries as well as cavity trees. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species noted at Site 11 included: Green Anole, Eastern Six-lined Racerunner, and Yellow-bellied Slider.

Site 12: This area was just south of Site 11 and very similar in terms of vegetation (xeric pine sandhill). A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species noted at Site 11 included: Green Anole, Eastern Six-lined Racerunner, and Yellow-bellied Slider. Additionally, a small population of Purple Pitcher Plant (*S. purpurea*) was located to the east where the habitat transitioned to pocosin dominated by Leatherleaf (*Chamaedaphne calyculata*) and Pond Pine (*P. serotina*).

Site 13: This area appeared to be a constructed pond at the end of a dirt road. A large ditch that ran adjacent to the dirt road provided hydrology. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 11 included: Green Frog, Southern Cricket Frog, and Yellow-bellied Slider.

Site 14: This site consisted of recently burned mesic pine woodlands adjacent to the Cape Fear River situated between the South Wharf and the Central Wharf. The understory was largely dominated by trailing vines such as Virginia Creeper (*Parthenocissus quinquefolia*) and Eastern Poison Ivy (*Toxicodendron radicans*). A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 14 included: Squirrel Treefrog and Broad-headed Skink (*Plestiodon laticeps*).

Site 15: This site was located in the southern part of MOTSU southwest of DA-4. It consisted of bottomland hardwood swamp wetlands and small ponds which eventually drained to the Cape Fear River. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 15 included: Southern Cricket Frog, Eastern Six-lined Racerunner, and Northern Rough Greensnake (*Ophedryx aestivus aestivus*). The Northern Rough Greensnake (Figure 7) was found crossing a paved road in the vicinity of Site 15. Additionally, the remains of a dead juvenile American Alligator were observed in the swamp drainage.



Figure 7. Northern Rough Greensnake.

Site 16: This site was located adjacent to several ammo pads, similar to and just east of Site 5. It consisted of a medium-sized pond with a wetland fringe and a mixture of pine forest and mowed habitat. A combination of VES and frog call identification was utilized around the wetland and adjacent forested habitat. Species documented at Site 16 included: Red-bellied Snake (*Storeria occipitomaculata*), Northern Black Race (*Coluber constrictor constrictor*), Green Anole, Southern Toad, Green Frog, and Pine Woods Treefrog. Earlier in the day a dead Eastern Ratsnake (*Pantherophis alleghaniensis*) was found on a road south of Site 16.

Several area searches were conducted but not given site identifications. For example a search of several of the rail lines north of the Class Yard was conducted to search for Glass Lizards (*Ophisaurus* spp.) known to utilize the railroad lines. No observations of Glass Lizards were made.