Southeast Amphibian Research and Monitoring Initiative
National Wildlife Refuges
Summary Report for 2004

Dr. C. Kenneth Dodd, Jr, Principal Investigator
Dr. Margaret S. Gunzburger
Wildlife Biologists: William J. Barichivich, Jennifer S. Staiger

U.S. Geological Survey—Florida Integrated Science Centers
7920 NW 71st Street
Gainesville, FL 32653

Little Grass Frog (*Pseudacris ocularis*), Harris Neck NWR, October 2004

Background

Amphibian Declines

At the First World Congress of Herpetology, held in England in 1989, participants presented scientific papers and exchanged personal accounts of amphibian declines and disappearances. Based on the magnitude and geographic extent of documented declines and local extinctions of amphibian populations, the herpetologists concluded that amphibian declines represented a potential global environmental crisis. Research conducted by many scientists since the meeting has shown a variety of factors have contributed to the global amphibian decline, including acid precipitation, environmental contaminants, introduction of nonindigenous predators, disease agents, parasites, ultraviolet radiation, and unsustainable harvest and trade of amphibians. Habitat loss has been and continues to be a major factor contributing to declines and extinctions.

In the United States, amphibian declines of unknown origin were first reported on the island of Puerto Rico and in the western states, where many populations tend to be small and isolated. In addition, malformed amphibians were observed in high numbers in the upper Midwest and around the Great Lakes region into northern New England. Declines in the southeastern U.S. have been linked directly to habitat loss. Although all regions of the U.S. are not affected to the same degree, the scope of these declines and malformations suggests vigilance is needed throughout the Nation to ensure the conservation of amphibian populations.

USGS Amphibian Research and Monitoring Initiative (ARMI)

In 1998 an international meeting of herpetologists convened by the National Science Foundation concluded that significant amphibian declines have occurred in protected areas not subjected to obvious changes in habitat, such as National Parks, National Wildlife Refuges, and wilderness areas. Based on the information presented at this and other similar meetings, scientists concluded the numbers and geographic extent of the reports indicated the situation should be approached as a potential environmental crisis.

In 2000, the President of the United States and the Congress directed the Department of the Interior (DOI) agencies to develop a plan to initiate monitoring of trends in amphibian populations on DOI lands and conduct research into causes of declines. The DOI has stewardship responsibilities over vast land holdings in the US, much of which is occupied by or is potential habitat for amphibians. The U.S. Geological Survey (USGS), the science and research bureau for DOI, was given lead responsibility for planning and organizing this program, named the Amphibian Research and Monitoring Initiative (ARMI), in cooperation with the National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), and Bureau of Land Management (BLM). USGS is uniquely qualified to develop and provide scientific leadership for such an effort. It has a long history of employing research scientists who have pioneered studies on amphibian life history, sampling techniques, toxicology, and health-related issues, and it has responsibility for many natural resource monitoring programs at regional, national, and continental scales.

ARMI Objectives

1) Establish a network designed to monitor the status and changes in the distributions and abundance of amphibian species and communities in the United States.

2) Identify and monitor environmental conditions known to affect amphibians and document their differences across the Nation.

3) Conduct research that identifies causes of amphibian population change and malformations.

4) Provide information to managers, policy makers and the general public in support of amphibian conservation.

ARMI Framework

Studies by USGS scientists will concentrate on DOI and other federal lands, but ARMI will provide the framework for incorporating data collected on non-federal lands to encourage participation by states, universities, and non-governmental organizations. The framework can be conceptualized as a pyramid, with extensive and necessarily coarse measurements at many monitoring sites across the country (the base of the pyramid), mid-level efforts at a moderate number of sites to provide a regional perspective on the status of amphibians (the middle portions of the pyramid), and intensive research efforts at a relatively small number of index sites throughout the country (the top of the pyramid). Activities at the different levels of the framework are integrated by:

- Research on causes of change, which at all levels is guided by monitoring results
- Synthesis across ecological regions, scientific disciplines, and governmental and institutional boundaries
- Comparable protocols, analytical tools, training, and planning
- Common databases and reporting
- Ecological modeling

Monitoring efforts, the primary focus of ARMI, are conducted at all levels of the pyramid, but there is an emphasis at the middle level. Monitoring conducted at this level of the pyramid is carried out at mid-level monitoring areas, such as National Wildlife Refuges. Monitoring studies are designed to detect change in occurrence and abundance of species across the mid-level monitoring areas. There is an emphasis on estimating well-defined parameters using statistical approaches that are applicable across species, monitoring areas, and ARMI regions. One such approach is to use detection/non-detection data to estimate a population level parameter, proportion of area occupied (PAO), on a species by species basis, as well as a community level parameter, species richness.

The Southeastern ARMI (SEARMI) Program

For the purposes of the ARMI program implementation, the United States is divided into seven blocks of States that are the focus of regional herpetological investigations. The Southeastern Region encompasses the states of Florida, Georgia, Alabama, Tennessee, South Carolina, and North Carolina, as well as Puerto Rico and the U.S. Virgin Islands, an area approximately 1300 x 1660 kilometers (800 x 1000 linear miles), excluding the Caribbean territories. Within this area, DOI land holdings are numerous, ranging in size from "postage stamp" historical sites to extremely large ecosystem-wide parks and preserves. Most lands are administered by the NPS and FWS; BLM has certain responsibilities for oversight in coal mining areas (such as in northern Alabama), but there are no land holdings. SEARMI research and monitoring efforts are conducted from the Center for Aquatic Resource Studies of the Florida Integrated Science Centers, Gainesville, FL. Additional ARMI related research has been conducted by USGS biologists with the Miami-based Center for Water and Restoration Studies, although they have not received ARMI funding.

The southeastern U.S. far exceeds any other region of the Nation in the diversity and abundance of amphibians. With at least 144 species of amphibians, it has well over half of all the species known from the U.S., and it has been estimated that areas such as the Okefenokee Swamp in Georgia have literally millions of amphibians per square kilometer. Habitat diversity is likewise great, ranging from the high mountain peaks of the Great Smoky Mountains, to the humid forested lowlands of the coastal plain, and to the vast marshes of South Florida. Southeastern amphibians have diverse life histories, from aquatic salamanders that never leave the water and a great variety of salamanders and frogs that spend portions of their life cycle in both aquatic and terrestrial environments, to terrestrial salamanders that never enter the water. Some species are widespread and abundant, whereas others are rare, localized, and highly vulnerable to extirpation.

As in other regions, SEARMI monitors amphibians based on a three-tiered approach involving sites with intensive research (apex sites), sites that form the basic areas for

the core of monitoring activities (mid-level sites), and sites where inventories are conducted (base sites). With few exceptions, federal lands in the southeast have not been surveyed for amphibians or their habitats, thus requiring inventories before proceeding to more intensive study. For this reason, most current research focuses on mid-level and base sites. Another emphasis has been on the development of appropriate sampling techniques and in understanding the biases associated with their use. Information from SEARMI's inventory and monitoring program (data collected from the mid-level and apex sampling sites) will be used to assess the status of amphibians on DOI lands using PAO analyses. By making probabilistic arguments, PAO uses an estimation of site occupancy rate to measure species detection probabilities. More information on PAO appears in the scientific literature. SEARMI biologists are collecting extensive data on species and their habitats that will allow for an assessment of distribution patterns and trends, and the initiation of research on declines or problem areas should they be identified. Finally, we are developing partnerships and collecting data on amphibian distribution, available literature, and the extent of previous amphibian surveys on DOI lands.

Introduction to FWS National Wildlife Refuges Surveyed

This report summarizes USGS-SEARMI research and monitoring activities at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges from the initiation of the project at each refuge through the end of 2004 (Fig. 1).

St Marks National Wildlife Refuge (SMNWR)

Located in Florida's panhandle approximately 25 km south of Tallahassee, SMNWR encompasses 27,500 hectares of diverse upland and wetland habitats, including pine flatwoods, sandhills, coastal palm hammocks, and fresh and saltwater waterfowl impoundments. Established in 1931 to provide wintering habitat for migratory birds, SMNWR extends along the Gulf coast in Taylor, Jefferson, and Wakulla Counties. For management purposes the refuge is divided into three major sections or units. The easternmost of these, the St. Marks Unit, is generally bounded by the Aucilla River to

the east and by the Wakulla and St. Marks Rivers to the west. The Wakulla Unit runs west from the Wakulla and St. Marks Rivers to Spring Creek Hwy (CR 365). The westernmost section, the Panacea Unit, extends west from Spring Creek Hwy to the Ochlockonee River and Ochlockonee Bay (Fig. 2a).

SMNWR has a diversity of upland and wetland habitats and potentially supports 40 species of amphibians (21 frogs and 19 salamanders) and 68 species of reptiles (13 lizards, 34 snakes, 20 turtles, and one crocodilian). The Flatwoods Salamander (*Ambystoma cingulatum*), a federally threatened species, has been documented from many sites on SMNWR. In the late 1970's, data on presence of amphibians and reptiles were collected by the FWS during a study which quantified the relationships among forestry management practices and diversity and abundance of non-game wildlife (FWS, 1980). This previous study included 14 upland drift fence arrays which were monitored for two years, although some of the arrays were not as extensively monitored during the second year. SEARMI research at SMNWR began in May 2002.

Lower Suwannee National Wildlife Refuge (LSNWR)

Located along Florida's Big Bend region on the Gulf of Mexico, approximately 80 km WSW of Gainesville (Fig. 2b), LSNWR encompasses approximately 21,425 hectares of upland and wetland habitats. Established in 1979 to preserve unique coastal, flood plain, and upland ecosystems at the lower reach of the Suwannee River, the refuge stretches 42 km north to south in Levy and Dixie Counties, including lands along both banks of the Suwannee River from Yellow Jacket landing southwest to the Gulf of Mexico. The Dixie Co. portion extends north along the coast to Shired Island. The main Levy Co. portion runs south along the coast almost to the mouth of Ericson Creek. The Shell Mound Unit of LSNWR is just south of Ericson Creek and adjacent to Cedar Keys National Wildlife Refuge (administered and managed by LSNWR staff). Cedar Keys NWR is a complex of 13 islands (approx. 310 hectares) around the municipality of Cedar Key and was established in 1929 as a refuge for colonial wading birds.

LSNWR protects a diversity of aquatic and upland habitats including floodplain forest, salt marsh, hardwood swamp, cypress swamp, cabbage palm hammock, sandhill, scrub, and pine flatwoods. This refuge potentially supports 37 species of amphibians (21 frogs and 16 salamanders) and 66 species of reptiles (15 lizards, one amphisbaenid, 34 snakes, one crocodilian, and 15 turtles - excluding sea turtles). Historical information on the herpetofauna of the refuge is scant. Florida Museum of Natural History records included voucher specimens for only 18 species (three amphibians and 15 reptiles) from the refuge proper, most of which dated from the 1970's or earlier. SEARMI research began at LSNWR in May 2002.

Harris Neck National Wildlife Refuge (HNNWR)

HNNWR (Fig. 2c) is located ca. 46 km south of Savannah and 31 km north of Darien, in McIntosh Co., Georgia. The refuge comprises 1,255 hectares of mostly coastal deciduous and oak woodlands, grasslands, former cropland, and some pine. The refuge is surrounded by salt marshes and tidal creeks, limiting amphibian colonization. Harris Neck has a long history of human occupation (Amerindian, with plantations prior to the Civil War, a series of many small farms in the late 1800's-early 1900's, an airfield, a military base during World War II [Harris Neck Air Base], and under the ownership and management of several county, state, and federal government agencies after the war; see Sullivan, 1997) which certainly affected herpetofaunal species richness and distribution as a result of extensive habitat modification. It became a National Wildlife Refuge in 1962 and is managed primarily for waterfowl. Nearly all the wetlands are man-made impoundments, modified former tidal creeks, or ditches and borrow pits.

This refuge supports at least 12 amphibians (11 species of frogs and one species of salamander) and at least 17 species of reptiles (five lizards, seven snakes, one crocodilian, and four turtles - excluding sea turtles). It is likely additional reptiles, particularly snakes, occur on the refuge. Historical information on the herpetofauna of the refuge is apparently nonexistent, as we have been unable to locate any museum specimens from Harris Neck. SEARMI research began at HNNWR in Apr. 2004.

Savannah National Wildlife Refuge (SVNWR)

SVNWR (Fig. 2d) comprises 11,320 hectares in Georgia and South Carolina immediately upstream along the Savannah River from the city of Savannah. As with HNNWR, it is part of the Savannah Coastal Refuges Complex. The refuge has an extensive history of human occupation and use, from Amerindian through the plantation era, when the bottomlands and freshwater tidal marshes were extensively diked and modified for rice production (constructed from the mid to late 1700's). Designated in 1927, SVNWR is primarily managed for waterfowl, and water levels within the former rice fields (1,364 hectares) are carefully controlled. The refuge occasionally clears vegetation from the impounded areas, resulting in a variety of marsh habitats of different depths, vegetation structure, and species composition.

The northern part of SVNWR (upstream from the freshwater tidal marshes) consists mostly of extensive islands of bottomland hardwoods (cypress, gum, maple) that may or may not be periodically flooded. These islands contain creeks and an extensive number of woodland pools and channels which hold water for varying amounts of time. There is only one large pond on the refuge (Kingfisher Pond, an old borrow pit) not associated with the bottomlands. River bluffs and upland terraces on the refuge are few, as the refuge boundary often terminates at the base of the river bluff. However, some uplands and slopes are present along Dodge Tram Road on the north side of the river, and more extensive upland and swamp habitats are found on the south side of the river east of O'Leary (as marked on the USGS 7.5' Port Wentworth topographical map). This tract is called the Solomon Tract, and is one of the most recent additions to SVNWR. This is also the location for sampling in connection with the FWS malformed frog survey.

To date, 21 species of amphibians (15 species of frogs and six species of salamanders) and at least 12 species of reptiles (two lizards, six snakes, one crocodilian, and three turtles) have been reported from SVNWR. Undoubtedly, many more species will be found as sampling continues, especially among the reptiles. We are currently

examining historical information on the herpetofauna of the refuge, as well as the field notes from early collectors. SEARMI research began at SVNWR in Apr. 2004.

Objectives

The general objectives of the SEARMI program are: 1) to conduct an inventory of the amphibian (and reptile) species at each of the refuges, 2) collect environmental data to identify factors influencing distribution, activity, and detection probability of amphibians, 3) establish long-term monitoring programs for amphibians on the refuges, and 4) establish baseline data on the health of amphibians through disease monitoring. An additional objective at SMNWR is to resample FWS sites surveyed in the late 1970's.

Methods

Sampling Techniques

We used a variety of methods to sample amphibians (and reptiles) at each refuge (Table 1). Terrestrial sampling techniques included field searches (i.e., visual encounter surveys) for animals in the open and under cover objects (e.g., logs, rocks), drift fences with associated funnel and/or pitfall traps, PVC pipe refugia, and road cruises (i.e., making opportunistic observations while driving roads, typically at night). Aquatic sampling consisted of the use of dip nets (Memphis Net and Twine Co., HDD-2 with 3/16" sq. Delta mesh), crayfish traps (Johnson and Barichivich, 2004), and aural surveys (using automated frog-call data loggers, Barichivich, 2003).

Drift Fences

SMNWR

Drift fences with associated funnel and pitfall traps were used to sample amphibians and reptiles at 12 terrestrial sites. To compare current species composition to historic data, we used the identical drift fence placement and sampling protocols used by FWS

during their 1970s study (FWS, 1980). We installed four-armed drift fence arrays in a "+" pattern following Campbell and Christman (1982), the same method used in the FWS study (see Fig. 1a of Enge, 1997). We installed the fence arrays at 12 sites in Aug. 2002; two in the St. Marks Unit, three in the Wakulla Unit, and seven in the Panacea Unit (Fig. 2a). Each array consisted of eight funnel traps and eight pitfall traps. Double-ended funnel traps were made from wire window screen and 22.7 l (5 gal) buckets were used as pitfall traps. A plywood cover board shaded each trap and a sponge (moistened during each trap check) provided moisture and cover for trapped animals. We first opened the drift fence traps in Oct. 2002, and checked traps daily during sampling periods except during the coldest months, when they were checked every other day. Between sampling periods funnel traps were opened and hung from trees and pitfall traps were closed with tight-fitting lids. During 2004, the traps were set for eight consecutive nights in Mar. and Jun., and six nights in Sep.-Oct. Twenty-two nights were sampled per array (i.e., site), totaling 264 array-nights (Table 2). For each captured animal, we measured snout-vent length (SVL) with a plastic ruler or flexible measuring tape and determined sex when possible. We marked all captured animals (except snakes) by toe clipping (no more than two toes were clipped on any individual) with a site-specific mark.

LSNWR

Drift fences with associated funnel traps and PVC pipe refugia were used to sample amphibians and reptiles at 10 sites (five each in Levy Co. and Dixie Co., Fig. 2b). The arrays were installed in Apr. 2003, with much help from refuge staff. The five Dixie Co. arrays were located at or near isolated wetlands. The five Levy Co. arrays were located in habitats ranging from floodplain forest to sandhill uplands. Fence sections were painted green to camouflage the arrays and were installed in a three-armed "Y" pattern at eight sites. At two sites located around isolated ponds (LC-3, DC-3), we installed four fence sections parallel to the wetland edges. Each "Y" pattern array consisted of six funnel traps and six PVC pipes; the two arrays with four fence sections had eight funnel traps and eight PVC pipes. Double-ended funnel traps made from wire window screen were placed at the ends of each fence section when trapping. Plywood cover boards

shaded each trap and a sponge (moistened during each trap check) provided moisture and cover for trapped animals. Traps were checked daily during sampling periods. Between sampling periods funnel traps were opened and stored in fenced refuge compounds. PVC refugia allowed animal entry/exit, so were left *in situ*. Drift fence traps were set 3-4 consecutive nights during six sampling periods in 2004 for a total of 205 array nights (Table 2). For each captured animal, we measured SVL with a plastic ruler or flexible measuring tape and determined sex when possible. We marked all captured animals (except snakes) by toe clipping (no more than two toes were clipped on any individual). We marked individuals at all LSNWR arrays with the same mark.

Wetland Sampling

As almost all species of amphibians at these refuges breed in wetlands (e.g., ponds, streams, lakes), we sampled these habitats to inventory amphibian species richness, identify appropriate sites for long-term monitoring, and determine the distribution of breeding sites. Focusing long-term amphibian monitoring at wetlands will allow us to maximize species detection probabilities and identify important covariates (e.g., pH, fish predators) influencing detection and proportion of area occupied.

SMNWR

Using a combination of dip nets, frog-call data loggers, and crayfish traps, we sampled 17 wetlands at SMNWR in 2004, all in the Panacea Unit (Table 3, Fig. 2a). Most of the ponds were sampled more than once.

LSNWR

Using a combination of dip nets, crayfish traps, and frog-call data loggers, we sampled three wetlands in 2004 (Table 3, Fig. 2b).

HNNWR

Using a combination of dip nets, crayfish traps, frog-call data loggers, and time constrained sampling in saturated wetlands, we sampled 18 wetlands in 2004 (Table 3, Fig. 2c). Five sites were sampled in Apr., Jun., and Oct. typically using 2-4 crayfish

traps per site (totaling 60 trap nights). Terrestrial searches required 3.75 person/hours at three locations. In addition to the above, we conducted several road cruising surveys after dark to observe animals that were moving and to listen for frog choruses in order to identify breeding sites.

SVNWR

Using a combination of dip nets, crayfish traps, frog-call data loggers, and time constrained sampling in floodplain and swampy areas, we sampled 25 wetlands in 2004 (Table 3, Fig. 2d). Five sites were sampled in Apr., Jun., and Oct. typically using 2-4 crayfish traps per site (60 trap nights total sampling). We also used time constrained sampling (total 13 person/hours) in three locations that involved mostly upland habitats.

Water Quality Data

We collected standard abiotic field parameters likely to influence amphibian species distribution at most of the wetlands sampled. Using a Hydrolab® Quanta® water-quality meter we measured water temperature (°C), conductivity (µS/cm), pH, dissolved oxygen (mg/l), and % dissolved oxygen. More detailed water quality parameters were measured at selected wetlands in SMNWR by USGS Water Resources Discipline (WRD) personnel in Aug. 2004. Field parameters, major ions, nutrients, trace metals, and suspended/particulate organic carbon from these sites were analyzed by WRD.

Voucher Specimens and Disease Monitoring

We sometimes collected animals for voucher specimens, to confirm species identification, and for disease screening. Many voucher specimens were collected as dead-on-road (DOR) individuals, and turtle shells were collected when found. Because of difficulty in positively identifying amphibian eggs and small larvae, live specimens were occasionally collected and reared at the USGS lab in Gainesville, FL, to confirm species identifications. These specimens were preserved as vouchers once identifications were confirmed. All voucher specimens were (or will be) deposited in the herpetology collection of the Florida Museum of Natural History at the University of Florida, Gainesville.

We collected amphibian larvae at several wetlands in SMNWR to screen for *Dermomycoides* (=*Anuraperkinsus*), an emerging infectious disease organism. These specimens are currently being analyzed at the Gulf Coast Research Laboratory (GCRL) of the University of Southern Mississippi, Ocean Springs, MS.

Treefrog Sampling Grids

LSNWR

In Jul. 2003 we established two 100 m X 100 m grid arrays of PVC pipe refugia to conduct a pilot study on the short-term effects of prescribed fire on treefrog populations. Grid 1, located in flatwoods just to the southeast of the LC-3 drift fence array (Fig. 2b), was burned during summer 2004. Grid 2, located in pine flatwoods due east of the refuge headquarters (Fig. 2b), was last burned in May 2003. Each grid consisted of 121 individually numbered PVC pipes (approx. 1 m long, 25 mm diameter, schedule 40) placed in the ground at 10 m intervals. During sampling periods frogs were removed from the pipes, measured for SVL with a plastic ruler, weighed with a Pesola® balance, marked with an individual toe-clip number, and examined to determine gender. Frogs were then returned to the pipes in which they were found.

Results

At these four Coastal Plain refuges, SEARMI has detected 36 amphibian species and 57 reptile species (Table 4, Fig. 3). Capture totals given below for SMNWR and LSNWR are cumulative from the start of drift fence sampling at these refuges and do not include recaptures.

St. Marks NWR

We detected a total of 79 species of amphibians and reptiles at SMNWR through Oct. 2004. This includes captures and observations made with all of the methods used. The 31 species of amphibian were comprised of 20 frog and 11 salamander species. The

48 species of reptiles were comprised of 10 lizard, 27 snake, one crocodilian, and 10 turtle species (Table 4). Our detection rate of species previously unrecorded in our sampling has decreased, indicating we have probably recorded most species for this refuge we are likely to capture using our sampling techniques (Fig. 3).

Drift Fences

We captured 1,560 amphibians and 390 reptiles at the drift fences, for a total of 1,950 new captures through Oct. 2004 (Table 5). This included 20 species of amphibians (15 frogs, five salamanders, Fig. 4a) and 26 species of reptiles (eight lizards, 18 snakes, Fig. 4b). The cumulative number of species encountered at each site ranged from 15 species at three sites to 21 species at one site. The number of individuals captured per site varied from 64 animals at UBF to 549 at PRS. PRS and LPH were most productive in number of captures. Captures at these two sites were dominated by Eastern Spadefoots (*Scaphiopus holbrookii*) and Eastern Narrow-mouthed Toads (*Gastrophryne carolinensis*). Eastern Spadefoot was the most frequently captured species (613 individuals) due to the high number of captures at PRS and LPH. Eastern Spadefoots, Eastern Narrow-mouthed Toads (460 individuals), Southern Toads (*Bufo terrestris*, 190), and Florida Leopard Frogs (*Rana sphenocephala sphenocephala*, 122) comprised 89% of all amphibian captures (Table 5, Fig. 4a). We captured no Flatwoods Salamanders (*Ambystoma cingulatum*) during 2004, although we had previously captured 16 individuals at two array sites (BSF, UBF). Eastern Fence Lizards (*Sceloporus undulatus*) were the most frequently captured lizards (94 individuals). The Southern Black Racer (*Coluber constrictor*, 29 captures) was the most frequently encountered snake species (Table 5, Fig. 4b). No turtles were captured at the drift fences. Mortality of amphibians and reptiles captured in funnel and pitfall traps was low. We found four lizards, three snakes, and 29 frogs dead in the traps, a mortality rate of 1.8% of all captures (including recaptures).

Wetland Sampling

We detected 14 frog species and eight salamander species among the 17 wetlands sampled during 2004 (Table 6). Since the start of SEARMI surveys at SMNWR, we

have detected 16 frog species and eight species of salamander among 58 sampled wetlands.

Water Quality Data

In Aug. 2004 we assisted USGS WRD personnel in the collection and field processing of water samples from 10 sites, and in the installation of data-logging pressure transducers to hourly measure water level and temperature in 10 wetlands. Sampling was concentrated in the Panacea Unit and was co-located with amphibian monitoring sites (Table 3). Field parameters (pH, conductance, dissolved oxygen, temperature), major ions, nutrients, trace metals (including mercury), and suspended/particulate organic carbon were analyzed from all sites. To view WRD water quality data for this refuge from 2004, please see the USGS NWISWeb Weather Data site, which can be found at the USGS Water Resources home page (http://waterdata.usgs.gov/fl/nwis/qw). For more information on WRD water quality results contact Brian Hughes, Southeast Regional Hydrologic Research Coordinator for ARMI (US Geological Survey, 3039 Amwiler Road, Atlanta, GA 30360; Phone: 770-903-9162; E-mail: wbhughes@usgs.gov).

We collected water-quality field parameters (pH, conductance, dissolved oxygen, temperature) at 15 of the 17 ponds sampled in 2004. We measured these parameters at most of the ponds more than once. All of these wetlands were relatively isolated ponds in the Panacea Unit (Fig. 2a). Values for pH were acidic, with a range from 3.62 to 6.67 and a mean among all samples of 4.47. Conductivity was low, only exceeding 57 µS/cm at one of the 15 sites. Dissolved oxygen (DO, mg/l) and % DO varied considerably, ranging from 3.27 mg/l and 36.6% to 11.33 mg/l and 139.9%. Water temperatures ranged from 14.63 ºC to 34.23 ºC, with the lower temperatures recorded in Mar. 2004 and the higher ones in the summer and early fall samples (Table 7).

Voucher Specimens

We collected amphibians and reptiles as voucher specimens and amphibian larvae to rear in the lab to confirm species identification. Of note among these specimens were

one Southern Dusky Salamander (*Desmognathus auriculatus*), a refuge record for this species, and an individual siren representing an undescribed *Siren* species (Paul Moler, pers. comm.). Most specimens have been or will be deposited in the Florida Museum of Natural History, Gainesville, FL (Table 8).

Disease monitoring

During our survey activities at SMNWR we looked for diseased or malformed amphibians. No individuals exhibiting malformations or obvious disease symptoms were observed during 2004. In Mar., Jun., and Oct. 2004, SEARMI and GCRL personnel collected amphibian larvae to screen for the disease organism *Dermomycoides*. The results of these screenings are not yet available; for more information contact Dr. Robin Overstreet, GCRL (703 East Beach Drive, Ocean Springs, MS 39564; Phone: 228-872-4243; E-mail: robin.overstreet@usm.edu). The results of health screenings conducted by the USGS National Wildlife Health Center, Madison, WI, on specimens collected in 2003 are presented in Appendix I. For an overview of amphibian health in the SEARMI region, please see Appendix II.

Lower Suwannee NWR

We detected a total of 59 species of amphibians and reptiles at LSNWR through Sep. 2004. This includes captures and observations made with all of the methods used. The 23 amphibian species were comprised of 19 species of frogs and four species of salamanders. The 36 reptile species were comprised of eight lizard, 18 snake, one crocodilian, and nine turtle species (Table 4). Our detection rate of species previously unrecorded in our sampling has decreased, indicating we have probably recorded most species for this refuge we are likely to capture using our sampling techniques (Fig. 3).

Drift Fences

We had 485 new amphibian captures and 94 new reptile captures at the drift fences (in funnel traps and PVC pipes), for a total of 579 individuals, through Sep. 2004 (Table 5). This included 13 species of amphibians (all frogs, Fig. 5a) and 20 species of reptiles (seven lizards and 13 snakes, Fig. 5b). The cumulative number of species captured at

each site ranged from six at DC-5 to 15 at LC-1. The number of captures per site varied considerably, from 18 at DC-3 to 103 at LC-5. The most frequently encountered species was the Squirrel Treefrog (*Hyla squirella*, 136 new captures), found at eight of the 10 arrays. This species, the Florida Leopard Frog (127 individuals), and the Eastern Narrow-mouthed Toad (103 individuals at 10 arrays) accounted for 75% of all amphibian captures (Table 5, Fig. 5a). Treefrogs were almost always captured in PVC pipes. The Northern Green Anole (*Anolis carolinensis*, 16 individuals) and the Southern Black Racer (12 captures) were the most frequently captured lizard and snake species (Table 5, Fig. 5b). We found 14 dead animals (13 frogs, one snake) in funnel traps, a mortality rate of 3.5% for funnel trap captures (including recaptures). There was no mortality associated with the PVC pipe refugia.

Treefrog Sampling Grids

Species detected at these sampling grids included Pine Woods Treefrog (*H. femoralis*), Squirrel Treefrog, Barking Treefrog (*H. gratiosa*), and Green Treefrog (*H. cinerea*). Data from 2004 are in preparation; for more information contact Dr. Steve Johnson (Department of Wildlife Ecology and Conservation, UF - IFAS Plant City Campus, 1200 North Park Rd., Plant City, FL 33563; Phone: 813-707-7330; E-mail: johnsons@wec.ufl.edu).

Wetland Sampling

We detected nine frog species and three species of salamander at the three wetlands sampled at LSNWR in 2004 (Table 6).

Water Quality Data

No water quality sampling was conducted by USGS WRD personnel at LSNWR in 2004. For the 2003 WRD water quality data from this refuge, please see the USGS NWISWeb Weather Data site, which can be found at the USGS Water Resources home page (http://waterdata.usgs.gov/fl/nwis/qw). For more information on WRD water quality results contact Brian Hughes, Southeast regional hydrologic research

coordinator for ARMI (US Geological Survey, 3039 Amwiler Road, Atlanta, GA 30360; Phone: 770-903-9162; E-mail: wbhughes@usgs.gov).

We collected water-quality field parameter data (pH, conductance, dissolved oxygen, temperature) at three ponds in Apr. 2004. Values for pH were acidic in all ponds (pH 4.39, 5.50, and 5.63). Conductivity and DO values were relatively low in both ponds. Conductivity values were 42, 48, and 51 µS/cm, and DO values were 2.28, 3.54, and 4.34 mg/l, with % DO values of 24.9, 40.5, and 45.9%. Pond water temperatures were 17.69, 20.73, and 22.75 ºC (Table 7).

Voucher Specimens

We collected amphibians and reptiles as voucher specimens and amphibian larvae to rear in the lab to confirm species identification. Notable among these specimens was a Greenhouse Frog (*Eleutherodactylus planirostris*), representing a possible Dixie Co. record of this non-indigenous species (Table 8). The collected specimens have been or will be deposited in the Florida Museum of Natural History, Gainesville, FL.

Harris Neck NWR

We made one scouting trip to the refuge in Jan. 2004, followed by three intensive sampling periods in Apr., Jun., and Oct., and a very short visit to Borrow Pond and Plantation Fountain on Nov. 24 (Table 2). We detected a total of 29 species of amphibians and reptiles at HNNWR in 2004. This figure includes captures and observations made using all methods combined. The 12 amphibian species comprised 11 frog species and one species of salamander. The 17 reptiles included five lizards, seven snakes, one crocodilian, and four turtles (Table 4). Our detection rate of species previously unrecorded in our sampling is high and constant thus far, indicating we may detect additional species at HNNWR (Fig. 3).

Wetland Sampling

We detected 11 frog species and one species of salamander at 19 wetland sites (14 distinct ponds, ditches, or other sites) sampled in 2004 (Table 6). No amphibians were

detected at Blue Bill Pond because of the high salinity associated with tidal backflow. The most species rich wetlands thus far are Woody Pond (seven species), Borrow Pond (six) and Goose, Lucas, and Wigeon Ponds (five each). Borrow Pond seems particularly important because it is fishless and in close proximity to upland forest habitat with closed canopy cover. This is also the only location where the Chicken Turtle (*Deirochelys reticularia*) occurs on the refuge.

Water Quality Data

We collected water-quality field parameter data (pH, conductance, dissolved oxygen, temperature) at one location in Apr. and at nine locations in Jun. and Oct. Values for pH were acidic in all ponds except Blue Bill (Apr.), Goose (Oct.), Snipe (Jun.) and Teal (Oct.). The lowest pH was 4.45 in Borrow Pond in Oct. Dissolved oxygen values were very low in all wetlands, but conductivity was relatively high everywhere except for Borrow Pond. Percent DO values were very low except at Snipe Pond in Jun. Pond water temperatures varied between 19.3 and 27.6 ^{o}C during sampling (Table 7).

Terrestrial Sampling

We searched a number of terrestrial locations, particularly woodlands near the old bunker, the terrestrial areas below Woody dike, and various areas along the wildlife drive. The results of these observations are included in Table 6. The results of these observations are as follows:

4/6/04. Adjacent to Lucas Pond: *Eumeces inexpectatus, Cnemidophorus sexlineatus*.
Near fence gate into Lucas property: *Gopherus polyphemus*

6/28/04. Entrance road into refuge. DOR *Opheodrys aestivus* (preserved).

6/28/04. Refuge headquarters. *Bufo terrestris* on road [note: this is the only record we have for this species at HNNWR.]

6/29/04. Wildlife drive (UTM 17 047791; 3499169). *Agkistrodon contortrix*.

10/18/04. Red maple swamp near Widgeon Pond. *Nerodia fasciata*, *Gastrophryne carolinensis, Acris gryllus, Rana sphenocephala.*
Adjacent to Lucas Pond: *E. inexpectatus, Ophisaurus ventralis*.

10/19/04. Goose Pond, north side. *Elaphe alleghaniensis* (very large)

Wildlife Drive, runway area: *Opheodrys aestivus, Lampropeltis getula*.
Vehicle Storage Area, by fence: large shed skin of *Masticophis flagellum*.

Voucher Specimens

We collected a few amphibians as voucher specimens, mostly as larvae to rear in the lab to confirm species identification. We also collected a slider turtle (*Trachemys scripta scripta*) shell that had been picked up by refuge staff. Specimens have been or will be deposited in the Florida Museum of Natural History, Gainesville, FL (Table 8). Photographs of amphibians and reptiles from the refuge are included in Appendix III.

Savannah NWR

We made one scouting trip to the refuge in Jan. 2004, followed by three intensive sampling periods in Apr., Jun.-Jul., and Oct. (Table 2). We detected a total of 33 species of amphibians and reptiles at SVNWR in 2004. This includes captures and observations made with all of the methods used. The 21 amphibian species were comprised of 15 species of frog and six species of salamander. The 12 reptile species were comprised of two lizard, six snake, one crocodilian, and three turtle species (Table 4). Our detection rate of species previously unrecorded in our sampling is high and constant thus far, indicating that we are likely to detect additional species from SVNWR (Fig. 3).

Wetland Sampling

We detected 15 frog species and six salamander species at 24 wetland sites (five searches along Dodge Tram Road in floodplain habitats, Kingfisher Pond [=DT-2], six sites along the dikes north of Highway 170, five sites along the wildlife drive south of Highway 170, ponds/pools along transect 2 on Bear Island, three woodland pool areas on the Solomon Tract, three swampy areas on the Solomon Tract) at SVNWR in 2004 (Table 6). No amphibians were detected at site ND-5 because of the strong tidal fluctuation at this site along the Little Back River. The most amphibian species rich wetlands thus far are Kingfisher Pond (eight species), ST-3 (a small woodland pool, six species), and a low swampy area (DT-3) along Dodge Tram Road (five species). Most

of the rice fields are relatively depauperate in species richness, although biomass is undoubtedly quite high. These are the only areas where Greater Siren (*Siren lacertina*) and Two-toed Amphiuma (*Amphiuma means*) are found, both highly specialized aquatic salamanders.

Of particular interest was the finding of Marbled Salamanders (*Ambystoma opacum*) on Bear Island at several sites, Southern Dusky Salamanders on both sides of the Savannah River, River Frog (*Rana heckscheri*, a single large tadpole) at Kingfisher Pond, and Fowler's Toad (*Bufo fowleri*) on Bear Island and at Kingfisher Pond (Table 6). Standard field guides do not list Fowler's Toad as occurring in this area. However, the toads we observed, photographed, and tape recorded do not resemble either Southern Toads (*B. terrestris*) or American Toads (*B. americanus*), and most closely conform to the description of Fowler's Toad. We plan to examine specimens again this year and collect vouchers for further analysis. The Eastern Bird-Voiced Treefrog (*Hyla avivoca*) was only detected by its call (near Chisolm Landing).

Water Quality Data

We collected water-quality field parameter data (pH, conductance, dissolved oxygen, temperature) at seven locations in Jul. and six locations in Oct. 2004. Values for pH were generally only slightly acidic in all ponds, except for Kingfisher Pond (Oct.) and a small woodland pool (ST-3) on the Solomon Tract (also in Oct.). The lowest pH was 5.85 at Kingfisher Pond in Jul. Dissolved oxygen values were very low in all sampling sites, except the road puddle where FWS collects samples for the malformed frog study (SEARMI site ST-2); conductivity was relatively high everywhere except for Kingfisher Pond. Percent DO values were low everywhere. Pond water temperatures varied between 19.3 ºC and 27.4 ºC during sampling (Table 7).

Terrestrial Sampling

The opportunity for searching purely terrestrial sites at SVNWR is limited by a paucity of habitats. Three areas (uplands on Bear Island, the Solomon Tract, and DT-4 along Dodge Tram Road) were searched using time constrained methods. These searches

yielded the only records of the South Carolina Slimy Salamander (*Plethodon variolatus*) at several locations on the Solomon Tract, as well as several frogs using terrestrial habitats (Table 6).

In addition, the following observations were recorded:

04/07/04. Chisolm Landing: *Coluber constrictor* (basking).

04/08/04. Solomon Tract ST1. On bluff: 2 *Terrapene carolina* (1 male, 1 female).

07/01/04. Solomon Tract ST3. Next to woodland pool: *T. carolina* (female).

Dodge Tram Road DT4. Open woodlands: *Agkistrodon contortrix* (sunning, juvenile).

Dodge Tram Road DT5: *Eumeces* sp., *Scincella lateralis* (leaf litter), 4 snake eggs of unknown species.

10/21/04. Solomon Tract ST1. On bluff: *A. contortrix* (juvenile w/bright yellow tail).

Same location and time: *Storeria occipitomaculata* (small, crawled across the copperhead!).

Voucher Specimens

We only collected a few amphibians as voucher specimens, mostly as larvae to rear in the lab to confirm species identification. Of particular importance was the finding of the Southern Dusky Salamander along Dodge Tram Road and the Marbled Salamander on Bear Island (Table 8). Specimens have been or will be deposited in the Florida Museum of Natural History, Gainesville, FL. Photographs of amphibians and reptiles from the refuge are included in Appendix III.

Plans for 2005 and Beyond

In 2005, we plan to continue monitoring amphibians and reptiles at SMNWR and LSNWR and inventory amphibians and reptiles at HNNWR and SVNWR with quarterly visits to each refuge. At SMNWR, we will conduct 10 day sampling trips during which we will monitor amphibian and reptile populations at our drift fence sites and in wetlands. We will also continue to collect amphibian specimens for disease screening.

Our goal is to develop our monitoring at SMNWR into a long-term, apex-level research site for SEARMI. At LSNWR we plan to continue to monitor the herpetofauna at our drift fence sites and associated wetlands, and also expand our wetland sampling to more localities within the refuge. At HNNWR and SVNWR we will continue to sample wetlands and terrestrial habitats to complete our inventory of amphibians and reptiles at these sites. We also plan to conduct a pilot study assessing the potential for disease transmission through fish stocking at these refuges.

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Table 1. Sampling methods utilized by USGS SEARMI at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges during 2004.

Refuge	Drift Fence w/funnel traps	Drift Fence w/pitfalls	PVC	Crayfish Trap	Froglogger	Dip net	Visual Encounter Survey
St. Marks	X	X		X	X	X	
Lower Suwannee	X		X	X	X	X	
Harris Neck				X	X	X	X
Savannah				X	X	X	X

Table 2. USGS SEARMI 2004 sampling dates and effort by sampling site at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges.

Site	Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Number of days sampled
SMNWR																			
Biggins Pond			16						20	22							1	5	9
Kingfisher Pond									11	15									5
Spear Top Pond			15																1
Wpt 103									20	22									3
Wpt 127			15																1
Wpt 128			15																1
Wpt 144			11	15					20	22									8
Wpt 150			11	15					17	19									8
Wpt 151			15																1
Wpt 19			11	15					17	19							2	5	12
Wpt 192			13	15					17								2	5	8
Wpt 200			15																1
Wpt 57			11																1
Wpt 68			11	15					17	19									8
Wpt 69									20	22							1	5	8
Wpt 79			11	15					17	19							1	5	13
Wpt192									19										
BSF			10	17					17	24							1	6	22
CLH			10	17					17	24							1	6	22
EYR			9	16					16	23					30		1	5	22
HYR			9	16					16	23					30		1	5	22
LPH			10	17					17	24							1	6	22
NAT			9	16					16	23					30		1	5	22
PRS			10	17					17	24							1	6	22
SBL			9	16					16	23					30		1	5	22
SPC			9	16					16	23					30		1	5	22
SYR			9	16					16	23					30		1	5	22
UBF			10	17					17	24							1	6	22
WBF			9	16					16	23					30		1	5	22
LSNWR																			
DC3 Pond					20														1
DC4 Pond					20														1
DC5 Pond					20														1
DC-1	3	6	30	31	1	2	4	7	8	11	13	16	30	31	1	2			24
DC-2	3	6	30	31	1	2	4	7	8	11	13	16	30	31	1	2			24
DC-3	3	6	30	31	1	2	4	7	8	11	13	16	30	31	1	2			24
DC-4	3	6	30	31	1	2	4	7	8	11	13	16	30	31	1	2			24
DC-5	3	6	30	31	1	2	4	7	8	11	13	16	30	31	1	2			24
LC-1			30	31	1		5	7	8	11	13	16	31		1	2			17
LC-2			30	31	1		5	7	8	11	13	16	31		1	2			17
LC-3			30	31	1		5	7	8	11	13	16	31		1	2			17
LC-4			30	31	1		5	7	8	11	13	16	31		1	2			17
LC-5			30	31	1		5	7	8	11	13	16	31		1	2			17
HNNWR																			

Site	Feb	Mar	Apr		May	Jun		Jul	Aug	Sep	Oct		Number of days sampled
Blue Bill Pond			6										1
Borrow Pond			5			29					19		3
Culvert Pond						29					19		2
Goose Pond			5	7							19	20	6
Goose Pond S						29	30						2
Lucas Borrow			6			29	30				19	20	5
Lucas Pond			5	7		29	30				19	20	7
Lucas Seepage											18		1
N Runway Ditch			5			29					19		3
Plantation Fountain						30					19		2
Red Maple Swamp											18		1
Roadside pool			7										1
Snipe Pond						29	30						2
Teal Pond											19	20	2
Wigeon Pond			5	6		29	30				19	20	6
Woody Pond			5	7		29	30						5
Woody Pond E dike											19	20	2
Woody Pond W dike											19	20	2
Woody Swamp											19		1
SVNWR													
1 Mile Hammock			7	9									3
Bear Is			8										1
DT-1						1							1
DT-2			7	9		1	2				21	22	7
DT-3						1							1
DT-4						1							1
DT-5						1							1
DT-6						1							1
E Chisolm/Dodge Tram Rd			7										1
HQ-1						1	2				21	22	4
ND-3						1	2						2
ND-4						1	2						2
ND-5											21	22	2
Rice 1			7	9									3
Rice 2			7	9									3
Rice 3			7	9									3
ST-1			1			1					21		3
ST-2						1					21		2
ST-3			8			1					21		3
ST-4											21		1
ST-5											21		1
ST-6											21		1
WD-3						1	2						2
WD-4											21	22	2
WD-5											21	22	2

Table 3. Coordinates for sites sampled by USGS SEARMI at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges.

Site Name	UTM-E	UTM-N	UTM zone	Aural	Collapsible funnel trap	Crayfish trap	Dip-net	Drift fence	Froglogger	PVC	Visual	WRD sample	Datalogger
SMNWR													
BSF	777716	3337735	16					X					
UBF	776608	3337911	16					X					
LPH	765767	3338562	16					X					
PRS	765790	3338989	16					X					
CLH	767730	3337878	16					X					
EYR	749814	3324508	16					X					
NAT	750125	3323984	16					X					
SPC	750729	3324137	16					X					
SYR	749070	3327336	16					X					
SBL	747418	3327553	16					X					
WBF	744888	3326039	16					X					
HYR	742317	3324648	16					X					
3 Corners Pond	749872	3322969	16	X			X				X		
405 Borrow	745567	3325766	16	X		X	X		X		X		
407 Pond	743647	3325573	16	X		X	X		X		X	X	
Biggins Pond	746570	3323072	16	X		X	X		X		X	X	X
Buckhorn Creek	744691	744691	16									X	
Buckhorn Woods Pond	744400	3327064	16	X		X	X		X		X		
Burnt Pond	749915	3327630	16	X			X				X		
Burnt Sinkhole Pond	749819	3327548	16	X			X				X		
Chicky Pond	750336	3324395	16	X			X				X	X	
Cingulatum Pond	774260	3338757	16				X		X		X	X	X
Corner Pond	747034	3327586	16	X		X	X		X		X	X	X
Corner Sinkhole	746940	3327532	16	X			X				X		
Ditched Pond	741490	3322532	16				X						
Eagle Nest Pond	750376	3327682	16				X						
Fat Nerodia Pond	746057	3324407	16	X			X				X	X	X
FL Trail Pond	766100	3338932	16		X		X	X	X	X	X	X	X
Goose Pond (Renfro)	748788	3322398	16	X		X					X	X	
Gum Forest Pond	751363	3327852	16	X		X	X		X		X	X	
Hawk Pond	744874	3325324	16	X		X	X		X		X	X	
Headquarters Pond	773370	3332137	16	X		X					X	X	
Jamie Pond	749859	3325877	16	X			X				X	X	
Jennifer's Sinkhole	747990	3327929	16	X			X				X	X	
Kingfisher Pond	747354	3322146	16	X		X	X		X		X	X	X
No Name Strand	745140	3324966	16				X						
ORSP Sink	741811	3321768	16								X		
Otter Creek	748080	3328005	16									X	
Otter Lake	748835	3323966	16			X	X		X		X	X	
Perched Pond	743245	3324488	16	X			X				X		
Perkinsus Pond	751035	3328377	16	X			X				X	X	X

Site Name	UTM-E	UTM-N	UTM zone	Aural	Collapsible funnel trap	Crayfish trap	Dip-net	Drift fence	Frog logger	PVC	Visual	WRD sample	Datalogger
Plum Orchard Pond	774826	3338857	16			X					X	X	
Pond 10	749834	3323024	16			X	X		X				
Pond 2	749184	3322169	16			X	X		X		X		
Pond 7	749608	3322158	16			X	X		X		X		
Pond 8	749682	3322086	16			X	X		X		X		
Prairie Pond	750401	3323961	16									X	
Printiss Pond	744431	3325997	16	X		X	X		X		X		
Printiss Pond 2	741688	3322542	16	X			X					X	
Ring Pond	751315	3326573	16	X		X	X		X		X	X	
SYR Creek	749518	3327019	16	X		X	X				X		
Shepard Spring	761521	3335747	16									X	
Small Prairie Pond	746380	3324168	16	X		X	X		X		X		
Smooth Oak Pond	750710	3328380	16				X				X		
SPC Prairie Pond	750401	3323961	16				X		X				
Spear Top Pond	752328	3330012	16	X			X				X		
Spike Buck Pond	744780	3326461	16	X		X	X				X	X	
Stony Bayou 1	774951	3335733	16			X							
Stony Bayou 2	775916	3334716	16			X							
Streetlight Pond	748010	3328282	16	X			X		X		X	X	X
SYR Pond	749104	3327398	16				X						
Talpoideum Pond	747248	3327146	16	X		X	X		X		X	X	
Tin Pile Pond	748893	3322018	16	X			X				X		
WBF Pond	744806	3325943	16	X		X	X		X		X	X	
Widowmaker Pond	749104	3327398	16										
Wpt 103	745998	3324492	16	X		X	X		X		X		
Wpt 127	753471	3326208	16	X			X				X		
Wpt 128	753012	3326212	16				X				X		
Wpt 144	744290	3326973	16	X	X	X	X		X		X		
Wpt 150	746654	3327182	16	X	X	X	X		X		X		
Wpt 151	751940	3327248	16	X			X				X		
Wpt 19	750312	3321070	16	X	X	X	X		X		X	X	X
Wpt 192	752419	3330376	16	X		X	X		X		X	X	X
Wpt 200	757098	3332928	16	X			X				X		
Wpt 57	749843	3322120	16								X		
Wpt 68	750151	3322421	16	X	X	X	X		X		X		
Wpt 69	747479	3322471	16	X		X	X		X		X	X	X
Wpt 79	749872	3322969	16	X	X	X	X		X		X	X	X
LSNWR													
DC-1	297263	3249618	17					X				X	
DC-2	298122	3252207	17					X				X	
DC-3	300352	3253869	17					X				X	
DC-4	303992	3259872	17					X				X	
DC-5	304089	3260116	17					X				X	
LC-1	300686	3251156	17					X					
LC-2	300290	3249875	17					X					
LC-3	301026	3249530	17					X					

Site Name	UTM-E	UTM-N	UTM zone	Aural	Collapsible funnel trap	Crayfish trap	Dip-net	Drift fence	Frog logger	PVC	Visual	WRD sample	Datalogger
LC-4	299408	3243511	17					X					
LC-5	304468	3239672	17					X					
LC-3 Pond	301012	3249524	17										
DC1 Pond	297163	3249618	17	X			X				X		
DC2 Pond	298149	3252214	17										
DC3 Pond	300352	3253869	17	X		X	X				X		
DC4 Pond	303992	3259872	17	X			X				X		
DC5 Pond	304089	3260116	17			X	X				X		
Grid 1	300946	3249509	17							X			
Grid 2	301712	3251035	17							X			
Sandfly Creek	300927	3246209	17									X	
McCormick Creek	298715	3243812	17									X	
Barnett Creek	299904	3242042	17									X	
Suwaneeee River	301478	3251786	17									X	
HNNWR													
Blue Bill Pond			17								X		
Borrow Pond	473461	3499861	17	X			X				X		
Culvert Pond	473391	3500445	17				X				X		
Goose Pond	474660	3500905	17	X		X			X		X		
Goose Pond S	474660	3500905	17	X		X			X		X		
Lucas Borrow	473751	3498331	17			X	X				X		
Lucas Pond	473590	3498216	17	X		X			X		X		
Lucas Seepage	473622	3498262	17								X		
N Runway Ditch	474569	3501066	17				X				X		
Plantation Fountain	475508	3500751	17				X				X		
Red Maple Swamp	474886	3499361	17								X		
Roadside pool	473385	3500449	17								X		
Snipe Pond	474001	3500256	17	X		X			X				
Teal Pond			17			X							
Wigeon Pond	475034	3499460	17			X			X		X		
Woody Pond	473713	3499346	17	X		X	X		X		X		
Woody Pond E dike			17			X							
Woody Pond W dike			17			X							
Woody Swamp			17								X		
SVNWR													
Bear Is	487409	3574055	17				X				X		
DT-1	490933	3565184	17	X			X				X		
DT-2	492492	3561681	17	X		X	X		X		X		
DT-3	491968	3563503	17	X							X		
DT-4	491846	3562316	17	X							X		
DT-5	491592	3564442	17	X							X		
DT-6	489975	3566022	17	X							X		
HQ-1	488878	3559112	17	X		X					X		
ND-1	490757	3560655	17	X		X			X		X		
ND-2	490685	3561563	17	X		X							

Table 4. Amphibian and reptile species documented by USGS SEARMI at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges through 2004. Counts including subspecies in parentheses.

Scientific Name	Common Name	SMNWR	LSNWR	HNNWR	SVNWR
Frogs					
Acris gryllus dorsalis	Florida Cricket Frog	X	X	X	
Acris gryllus gryllus	Coastal Plain Cricket Frog				X
Bufo fowleri	Fowler's Toad				X
Bufo quercicus	Oak Toad	X	X		
Bufo terrestris	Southern Toad	X	X	X	X
Eleutherodactylus planirostris	Greenhouse Frog (introduced)	X	X		
Gastrophryne carolinensis	Eastern Narrow-mouthed Toad	X	X	X	X
Hyla avivoca ogechiensis	Eastern Bird-voiced Treefrog				X
Hyla chrysoscelis	Cope's Gray Treefrog	X	X		X
Hyla cinerea	Green Treefrog	X	X	X	X
Hyla femoralis	Pine Woods Treefrog	X	X	X	X
Hyla gratiosa	Barking Treefrog	X	X		
Hyla squirella	Squirrel Treefrog	X	X	X	X
Osteopilus septentrionalis	Cuban Treefrog (introduced)		X[1]		
Pseudacris crucifer bartramiana	Southern Spring Peeper	X	X	X	
Pseudacris crucifer crucifer	Northern Spring Peeper				X
Pseudacris nigrita nigrita	Striped Southern Chorus Frog	X	X		
Pseudacris ocularis	Little Grass Frog	X	X	X	
Pseudacris ornata	Ornate Chorus Frog	X			
Rana catesbeiana	American Bullfrog	X	X	X	X
Rana clamitans clamitans	Bronze Frog	X	X		X
Rana grylio	Pig Frog	X	X	X	X
Rana heckscheri	River Frog	X			X
Rana sphenocephala sphenocephala	Florida Leopard Frog	X	X		
Rana sphenocephala utricularia	Southern Leopard Frog			X	X
Scaphiopus holbrookii	Eastern Spadefoot	X	X		
Number of frog species observed		20	19	11	15
Salamanders					
Ambystoma cingulatum	Flatwoods Salamander	X			
Ambystoma opacum	Marbled Salamander				X
Ambystoma talpoideum	Mole Salamander	X			
Amphiuma means	Two-toed Amphiuma	X	X		X
Desmognathus auriculatus	Southern Dusky Salamander	X			X
Eurycea quadridigitata	Dwarf Salamander	X	X		
Notophthalmus viridescens ssp.	Eastern Newt		X		
Notophthalmus viridescens louisianensis	Central Newt	X		X	X
Plethodon grobmani	Southeastern Slimy Salamander	X			
Plethodon variolatus	South Carolina Slimy Salamander				X
Pseudobranchus striatus spheniscus	Slender Dwarf Siren	X			
Siren intermedia intermedia	Eastern Lesser Siren	X			
Siren lacertina	Greater Siren	X	X		X
Siren sp. (undescribed species)	Undescribed	X			
Number of salamander species observed		11	4	1	6
Number of amphibian species observed		31	23	12	21

Scientific Name	Common Name	SMNWR	LSNWR	HNNWR	SVNWR
Lizards					
Anolis carolinensis carolinensis	Northern Green Anole	X	X	X	X
Aspidoscelis sexlineata sexlineata (=Cnemidophorus sexlineatus sexlineatus)	Eastern Six-lined Racerunner	X	X	X	
Eumeces egregius similis	Northern Mole Skink	X			
Eumeces fasciatus	Common Five-lined Skink	X	X		
Eumeces inexpectatus	Southeastern Five-lined Skink	X	X	X	
Eumeces laticeps	Broad-headed Skink	X	X		
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	X			
Ophisaurus ventralis	Eastern Glass Lizard	X	X	X	
Sceloporus undulatus	Eastern Fence Lizard	X	X		
Scincella lateralis	Little Brown Skink	X	X	X	X
Number of lizard species observed		10	8	5	2
Snakes					
Agkistrodon contortrix contortrix	Southern Copperhead			X	X
Agkistrodon piscivorus ssp.	Cottonmouth				X
Agkistrodon piscivorus conanti	Florida Cottonmouth	X	X		
Cemophora coccinea copei	Northern Scarletsnake	X	X		
Coluber constrictor priapus	Southern Black Racer	X	X		
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	X	X		
Diadophis punctatus punctatus	Southern Ring-necked Snake	X	X		
Drymarchon couperi	Eastern Indigo Snake		X		
Elaphe alleghaniensis (=*E. obsoleta*)[2]	Eastern Ratsnake	X	X	X	X
Elaphe guttata	Red Cornsnake	X			
Farancia abacura abacura	Eastern Mudsnake	X[1]	X		
Heterodon platirhinos	Eastern Hog-nosed Snake	X			
Heterodon simus	Southern Hog-nosed Snake		X		
Lampropeltis getula getula	Eastern Kingsnake	X[1]		X	
Lampropeltis triangulum elapsoides	Scarlet Kingsnake	X	X		
Masticophis flagellum flagellum	Eastern Coachwhip	X		X	
Micrurus fulvius	Harlequin Coralsnake	X			
Nerodia clarkii clarkii	Gulf Saltmarsh Snake	X			
Nerodia fasciata ssp.	Southern Watersnake		X		
Nerodia fasciata fasciata	Banded Watersnake	X		X	X
Nerodia floridana	Florida Green Watersnake	X			
Nerodia taxispilota	Brown Watersnake	X			X
Opheodrys aestivus	Rough Greensnake	X		X	
Pituophis melanoleucus mugitus	Florida Pinesnake	X			
Regina alleni	Striped Crayfish Snake	X	X		
Regina rigida rigida	Glossy Crayfish Snake	X	X		
Seminatrix pygaea pygaea	Northern Florida Swampsnake	X			
Sistrurus miliarius barbouri	Dusky Pygmy Rattlesnake	X	X		
Storeria dekayi wrightorum	Midland Brownsnake	X			
Storeria occipitomaculata ssp.	Red-bellied Snake				X
Storeria occipitomaculata obscura	Florida Red-bellied Snake		X		
Storeria victa (=*Storeria dekayi victa*)	Florida Brownsnake		X		
Thamnophis sauritus nitae	Blue-striped Ribbonsnake	X	X		
Thamnophis sauritus sackenii	Peninsula Ribbonsnake	X		X	
Thamnophis sirtalis similis	Blue-striped Gartersnake	X	X		
Thamnophis sirtalis sirtalis	Eastern Gartersnake	X		X	

Scientific Name	Common Name	SMNWR	LSNWR	HNNWR	SVNWR
Virginia valeriae valeriae	Eastern Smooth Earthsnake	X			
Number of snake species observed		27(29)	18	7	6
Crocodilians					
Alligator mississipiensis	American Alligator	X	X	X	X
Number of crocodillian species observed		1	1	1	1
Turtles					
Apalone ferox	Florida Softshell	X	X		
Chelydra serpentina osceola	Florida Snapping Turtle	X	X		
Deirochelys reticularia reticularia	Eastern Chicken Turtle	X		X	
Gopherus polyphemus	Gopher Tortoise	X	X	X	
Kinosternon baurii	Striped Mud Turtle	X	X		
Kinosternon subrubrum subrubrum	Eastern Mud Turtle	X		X	X
Malaclemys terrapin macrospilota	Ornate Diamond-backed Terrapin	X			
Pseudemys concinna concinna	Eastern River Cooter	X			
Pseudemys concinna floridana	Coastal Plain Cooter	X			
Pseudemys nelsoni	Florida Red-bellied Cooter		X		
Pseudemys peninsularis	Peninsula Cooter		X		
Pseudemys suwanniensis	Suwannee Cooter		X		
Sternotherus odoratus	Stinkpot	X			X
Terrapene carolina bauri	Florida Box Turtle		X		
Terrapene carolina carolina	Eastern Box Turtle				X
Terrapene carolina major	Gulf Coast Box Turtle	X			
Trachemys scripta scripta	Yellow-bellied Slider		X	X	
Number of turtle species observed		10(11)	9	4	3
Number of reptile species observed		48(51)	36	17	11
Total number of species observed		79(82)	59	29	33

1 - record for this species from near, not within, refuge boundary.
2 - *Elaphe alleghaniensis=E. obsoleta obsoleta, E. o. quadrivitatta, E. o. spiloides.*

Table 5. USGS SEARMI drift fence captures at St. Marks and Lower Suwannee National Wildlife Refuges through 2004. Counts reflect new captures through 2004.

SMNWR													Total captures per species	Number of sites with observations
Species Name	BSF	CLH	EYR	HYR	LPH	NAT	PRS	SBL	SPC	SYR	UBF	WBF		
Acris gryllus			1	1		2		1		2			7	5
Ambystoma cingulatum	8										8		16	2
Ambystoma talpoideum					1		1	5				1	8	4
Bufo quercicus			8	22		3		1	4	3		31	72	7
Bufo terrestris	24		24	8	2	26	15	6	10	65	2	8	190	11
Eleutherodactylus planirostris			2			1			9				12	3
Eurycea quadridigitata	1										1		2	2
Gastrophryne carolinensis	26	14	11	30	106	6	169	18	23	30	10	17	460	12
Hyla cinerea		5											5	1
Hyla femoralis	4		1	6				1	1	3		2	18	7
Hyla squirella					1		1						2	2
Notophthalmus viridescens		1									1	10	12	3
Plethodon grobmani							1						1	1
Pseudacris nigrita												1	1	1
Pseudacris ornata				1								4	5	2
Rana catesbeiana		1			2								3	2
Rana clamitans		1	1	1		1			1			2	7	6
Rana grylio	1	1				1			1				4	4
Rana sphenocephala	11	33	1	6	27	3	6	9	6	4	16		122	11
Scaphiopus holbrookii					216		334	53		10			613	4
Amphibians captured	75	56	49	75	355	43	527	94	55	117	38	76	1560	
Amphibian species	7	7	8	8	7	8	7	8	8	7	6	9	20	
Agkistrodon piscivorus											1	1	2	2
Anolis carolinensis	3	3	6		1	3	1	3	4	5		2	31	10
Cemophora coccinea	3		1	4	3		2		1	1	1	4	20	9
Cnemidophorus sexlineatus			9	2		18	2	9	14	10		2	66	8
Coluber constrictor	5	2	2	2		7	1		2	3	2	3	29	10
Diadophis punctatus					1		1				2	1	5	4
Elaphe guttata	1							1		1		1	4	4
Eumeces egregius			1			1						1	3	3
Eumeces fasciatus		1		1	1		2						5	4
Eumeces inexpectatus			2			3		2		1	1	5	14	6
Eumeces laticeps	2	5		4	3						2		16	5
Eumeces sp.											1		1	1
Heterodon platirhinos			3						1				4	2
Lampropeltis triangulum		4			1								5	2
Masticophis flagellum			1			1			1				3	3
Micrurus fulvius								1					1	1
Nerodia fasciata										1	1		2	2
Nerodia taxispilota			1										1	1
Regina rigida									2				2	1
Sceloporus undulatus			18	6		22	11	10	11	16			94	7
Scincella lateralis			1		4	1		3		4		2	15	6

SMNWR													Total captures per species	Number of sites with observations
Species Name	BSF	CLH	EYR	HYR	LPH	NAT	PRS	SBL	SPC	SYR	UBF	WBF		
Seminatrix pygaea										1	1		2	2
Sistrurus miliarius	2	4	2	1			2	1		2	1	1	16	9
Storeria dekayi	9										1		10	2
Thamnophis sauritus	2	4		2							8		16	4
Thamnophis sirtalis	6	6			2			1	1		4		20	6
Virginia valeriae			1							2			3	2
Reptiles captured	33	29	48	22	16	56	22	31	37	47	26	23	390	
Reptile species	9	8	13	8	8	8	8	9	9	12	13	11	26	
Total captures	108	85	97	97	371	99	549	125	92	164	64	99	1950	
Species per site	16	15	21	16	15	16	15	17	17	19	19	20	46	

LSNWR											Total captures per species	Number of sites with observations
Species Name	DC-1	DC-2	DC-3	DC-4	DC-5	LC-1	LC-2	LC-3	LC-4	LC-5		
Bufo quercicus		2				2	3	1		5	13	5
Bufo terrestris	1	1			1	6		5			14	5
Eleutherodactylus planirostris	2										2	1
Gastrophryne carolinensis	1	6	2	6	3	29	18	15	10	13	103	10
Hyla cinerea						1			3		4	2
Hyla femoralis	15	5	3	6		3	5	7		7	51	8
Hyla squirella	2			14	18	20	18	36	11	17	136	8
Pseudacris ocularis								1			1	1
Rana catesbeiana									1		1	1
Rana clamitans		1		3		10	10		1		25	5
Rana grylio				2							2	1
Rana sphenocephala	3	2	3	1		15	6	19	38	40	127	9
Scaphiopus holbrookii				1			1			4	6	3
Amphibians captured	24	17	8	33	22	86	61	84	64	86	485	
Amphibian species	6	6	3	7	3	8	7	7	6	6	13	
Agkistrodon piscivorus			1								1	1
Anolis carolinensis		2	2	4	1		1	1		5	16	7
Cemophora coccinea		1			2	1	3	3		1	11	6
Cnemidophorus sexlineatus				2						10	12	2
Coluber constrictor	1	3		3	3				1	1	12	6
Crotalus adamanteus								1			1	1
Diadophis punctatus						1		1	2		4	3
Eumeces fasciatus			1			1		1	1		4	4
Eumeces inexpectatus			1			1	1		1		4	4
Eumeces laticeps						1	7		4		12	3
Heterodon simus							1				1	1
Nerodia fasciata			1								1	1
Regina alleni								1			1	1
Regina rigida							1				1	1
Sceloporus undulatus			1	3							4	2
Scincella lateralis						1					1	1

LSNWR											Total captures per species	Number of sites with observations
Species Name	DC-1	DC-2	DC-3	DC-4	DC-5	LC-1	LC-2	LC-3	LC-4	LC-5		
Sistrurus miliarius		1	3						1		5	3
Storeria dekayi							1				1	1
Storeria occipitomaculata						1					1	1
Thamnophis sauritus	1										1	1
Reptiles captured	2	7	10	12	6	7	15	8	10	17	94	
Reptiles species	2	4	7	4	3	7	7	6	6	4	20	
Total captures	26	24	18	45	28	93	76	92	74	103	579	
Species per site	8	10	10	11	6	15	14	13	12	10	33	

Table 6. Amphibian and reptile species documented during wetland and time constrained surveys at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges during 2004.

SMNWR Species Name	Biggins Pond	Kingfisher Pond	Spear Top Pond	Wpt 103	Wpt 127	Wpt 128	Wpt 144	Wpt 150	Wpt 151	Wpt 19	Wpt 192	Wpt 200	Wpt 57	Wpt 68	Wpt 69	Wpt 79	Wpt192	Number of sites w/ observations
Amphibians																		
Acris gryllus	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	16
Ambystoma talpoideum															X			1
Amphiuma means							X			X								2
Bufo quercicus	X	X		X			X			X	X			X	X	X	X	10
Bufo terrestris							X							X		X	X	4
Eurycea quadridigitata										X								1
Hyla cinerea		X			1	1						X			X			5
Hyla femoralis	X	X		X			X	X		X	X	X		X	X	X		11
Hyla gratiosa	X	X		X			X	X		X	X			X	X	X		10
Hyla squirella	X	X		X			X									X		5
Notophthalmus viridescens louisianensis										X								1
Pseudacris crucifer							X											1
Pseudacris nigrita							X											1
Pseudacris ocularis				X			X									X	X	4
Pseudacris ornata			X										X					2
Pseudobranchus striatus spheniscus										X								1
Rana catesbeiana											X				X	X		3
Rana grylio	X				X	X	X		X	X	X	X			X	X		10
Rana sp.	X				X			X		X		X		X		X		7
Rana sphenocephala	X	X		X	X	X	X	X		X	X		X	X	X	X	X	14
Siren intermedia	X														X			2
Siren lacertina											X				X			2
Siren sp.		X																1
Amphibians observed	9	8	2	7	5	3	12	5	2	11	8	5	3	7	11	11	5	
Reptiles																		
Agkistrodon piscivorus					X			X			X							3
Alligator mississipiensis										X								1

SMNWR Species Name	Biggins Pond	Kingfisher Pond	Spear Top Pond	Wpt 103	Wpt 127	Wpt 128	Wpt 144	Wpt 150	Wpt 151	Wpt 19	Wpt 192	Wpt 200	Wpt 57	Wpt 68	Wpt 69	Wpt 79	Wpt192	Number of sites w/ observations
Anolis carolinensis	X													X		X		3
Coluber constrictor												X						1
Deirochelys reticularia											X					X		2
Nerodia fasciata										X	X							2
Nerodia floridana	X																	1
Sceloporus undulatus														X				1
Scincella lateralis														X				1
Thamnophis sauritus																X		1
Reptiles observed	2	0	0	0	1	0	0	1	0	2	3	1	0	3	0	3	0	
Total number of species	11	8	2	7	6	3	12	6	2	13	11	6	3	10	11	14	5	

LSNWR Species Name	DC3 Pond	DC4 Pond	DC5 Pond	Number of sites w/ observations
Amphibians				
Acris gryllus	X	X		2
Bufo terrestris			X	1
Hyla cinerea		X		1
Hyla femoralis		X		1
Hyla gratiosa	X			1
Pseudacris crucifer		X		1
Pseudacris ocularis		X		1
Rana clamitans		X		1
Rana sphenocephala	X	X	X	3
Amphibians observed	3	7	2	
Reptiles				
Alligator mississippiensis	X			1
Cnemidophorus sexlineatus	X		X	2
Reptiles observed	2		1	
Total number of species	5	7	3	

HNNWR Species	Blue Bill Pond	Borrow Pit Pond	Culvert Pond	Goose Pond	Goose Pond S	Plantation Fountain	Lucas Borrow	Lucas Pond	Lucas Seepage	N Runway Ditch	Red Maple Swamp	Roadside Pool	Snipe Pond	Teal Pond	Wigeon Pond	Woody Pond	Woody Pond E	Woody Pond W	Woody Swamp	Other	Number of sites w/ observations
Amphibians																					
Acris gryllus		X			X			X	X		X					X			X		7
Bufo terrestris																				X	1
Gastrophryne carolinensis			X	X				X		X	X				X						5
Hyla cinerea		X		X	X		X	X					X		X	X					8
Hyla femoralis		X								X											2
Hyla squirella																X					1
Notophthalmus viridescens		X		X		X	X								X	X	X				8
Pseudacris crucifer															X	X					2
Pseudacris ocularis		X																	X		2
Rana catesbeiana				X	X								X								3
Rana grylio					X			X					X			X	X				5
Rana sphenocephala		X	X	X	X	X	X	X	X	X	X	X	X			X			X		14
Amphibians observed	0	6	1	5	5	2	3	5	2	3	3	1	4	0	5	7	2	0	3		12
Reptiles																					
Agkistrodon contortrix																				X	
Alligator mississipiensis	X	X						X							X	X					5
Anolis carolinensis								X			X								X		3
Aspidoscelis sexlineata								X													1
Deirochelys reticularia																					1
Elaphe alleghaniensis				X															X		2
Eumeces inexpectatus								X	X												2
Gopherus polyphemus																				X	1
Kinosternon subrubrum					X																1
Lampropeltis getula																				X	1
Masticophis flagellum																				X	1
Nerodia fasciata		X									X					X					3
Opheodrys aestivus																				X	1
Ophisaurus ventralis								X													1
Scincella lateralis		X							X		X								X		4
Thamnophis sauritus		X																			1
Thamnophis sirtalis									X	X											2

HNNWR Species	Blue Bill Pond	Borrow Pit Pond	Culvert Pond	Goose Pond	Goose Pond S	Plantation Fountain	Lucas Borrow	Lucas Pond	Lucas Seepage	N Runway Ditch	Red Maple Swamp	Roadside Pool	Snipe Pond	Teal Pond	Wigeon Pond	Woody Pond	Woody Pond E	Woody Pond W	Woody Swamp	Other	Number of sites w/ observations
Trachemys scripta		X																			1
Reptiles observed	1	5	0	1	1	0	0	5	3	1	3	0	0	0	1	2	0	0	3	4	18
Total number of species	1	11	2	6	6	2	3	10	6	4	6	1	4	0	6	9	2	0	6	5	30

SVNWR Species	Bear Is	DT-1	DT-2	DT-3	DT-4	DT-5	DT-6	HQ-1	ND-1	ND-2	ND-3	ND-4	ND-5	ST-1	ST-2	ST-3	ST-4	ST-5	ST-6	WD-1	WD-2	WD-3	WD-4	WD-5	Other	Number of sites w/ observations
Amphibians																										
Acris gryllus		X	X														X									3
Ambystoma opacum	X																X									2
Amphiuma means												X												X		2
Bufo fowleri	X		X																							2
Bufo terrestris					X																	X				2
Desmognathus auriculatus		X																	X							3
Gastrophryne carolinensis		X		X		X																				3
Hyla avivoca							X																			1
Hyla chrysoscelis	X			X										X	X											4
Hyla cinerea			X								X	X								X		X				5
Hyla femoralis			X	X	X																					3
Hyla squirella					X	X									X											3
Notophthalmus viridescens										X						X	X		X							4
Plethodon variolatus														X		X			X							3
Pseudacris crucifer																X										1
Rana catesbeiana			X						X	X						X		X								5
Rana clamitans		X		X		X	X									X	X									7
Rana grylio			X					X			X	X								X	X	X	X	X		9
Rana heckscheri			X																							1
Rana sphenocephala			X	X			X	X	X	X					X	X			X	X	X					11
Siren lacertina								X		X												X	X			4
Amphibians observed	3	4	8	5	3	3	3	3	2	4	2	3	0	2	3	6	4	1	4	3	2	4	2	2		21
Reptiles																										

SVNWR Species	Bear Is	DT-1	DT-2	DT-3	DT-4	DT-5	DT-6	HQ-1	ND-1	ND-2	ND-3	ND-4	ND-5	ST-1	ST-2	ST-3	ST-4	ST-5	ST-6	WD-1	WD-2	WD-3	WD-4	WD-5	Other	Number of sites w/ observations
Agkistrodon contortrix					X									X												2
Agkistrodon piscivorus		X			X				X					X			X									5
Alligator mississipiensis									X												X					2
Anolis carolinensis					X	X								X						X						4
Coluber constrictor																									X	1
Elaphe alleghaniensis								X																		1
Eumeces sp.						X																				1
Kinosternon subrubrum															X	X										2
Nerodia fasciata									X										X				X			3
Nerodia taxispilota	X																									1
Scincella lateralis		X	X			X										X										4
Sternotherus odoratus								X								X								X		3
Storeria occipitomaculata														X												1
Terrapene carolina														X		X										2
Reptiles observed		2	1	0	3	3	0	2	3	0	0	0	0	5	1	4	1	0	1	1	1	0	1	1		13
Total number of species	4	6	9	5	5	6	3	5	5	4	2	3	0	7	4	10	5	1	5	4	3	4	3	3		34

Table 7. Abiotic field parameters of wetlands sampled at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges in 2004. Measurements were made with a Hydrolab® Quanta handheld meter.

Date	General location	Water Temperature (°C)	SpC (ms/cm)	DO (mg/L)	pH	% DO
SMNWR						
3/16/2004	Biggins Pond	22.73	0.025	7.68	4.4	88.60%
10/4/2004		30.86	0.03	5.51	4.73	74.00%
10/1/2004		31.93	0.029	6.91	4.04	94.10%
6/20/2004		32.49	0.034	8.87	4.7	121.20%
6/16/2004	Kingfisher Pond	21.95	0.026	7.49	4.17	85.30%
6/20/2004		31.94	0.032	6.31	4.64	85.10%
3/15/2004	Spear Top Pond	16.47	0.038	7.45	4.49	70.10%
6/20/2004	Wpt 103	27.83	0.031	5.73	6.67	66.10%
3/15/2004	Wpt 127	16.97	0.057	6.32	4.42	57.70%
3/15/2004	Wpt 128	16.66	0.077	3.59	3.68	36.60%
3/12/2004	Wpt 144	16.91	0.05	5.68	4.64	55.40%
3/12/2004	Wpt 150	17.64	0.013	8.93	5.56	93.50%
6/17/2004		28.92	0.018	6.33	5.7	57.00%
3/15/2004	Wpt 151	21.46	0.024	9.23	4.43	104.20%
3/12/2004	Wpt 19	23.02	0.034	9.88	4.41	114.90%
10/4/2004		28.12	0.028	7.32	3.93	93.10%
6/17/2004		32.34	0.026	5.97	4.31	83.60%
3/15/2004	Wpt 192	14.63	0.026	8.45	4.48	82.00%
10/4/2004		25.24	0.033	11.33	4.16	139.90%
6/17/2004		27.85	0.035	6.36	3.83	80.00%
3/15/2004	Wpt 200	18.07	0.037	5.89	5.42	58.90%
3/12/2004	Wpt 68	20.67	0.027	8.97	4.26	99.90%
6/17/2004		34.23	0.03	6.38	4.25	90.60%
10/1/2004	Wpt 69	27.34	0.026	5.35	3.62	67.70%
10/4/2004		27.56	0.026	3.95	3.75	50.00%
6/20/2004		31.9	0.031	6.24	4.51	85.50%
3/12/2004	Wpt 79	16.68	0.031	7.35	5.05	73.80%
10/1/2004		29.23	0.043	7.04	4.31	91.90%
10/1/2004		29.38	0.043	7.01	3.81	90.10%
6/17/2004		30.89	0.039	3.27	3.75	44.30%
LSNWR						
4/20/2004	DC3 Pond	22.75	0.048	3.54	4.39	40.50%
4/20/2004	DC4 Pond	17.69	0.042	4.34	5.63	45.90%
4/20/2004	DC5 Pond	20.73	0.051	2.28	5.5	24.90%
HNNWR						
4/6/2004	Blue Bill Pond		0.405		7.5	0.00%
10/19/2004	Borrow Pond	19.56	0.03	2.3	4.45	25.60%
6/29/2004		27.6	0.019	4.95	5.67	62.20%
10/19/2004	Culvert Pond	20.1	0.17	1.38	6.08	15.20%
6/29/2004		23.7	0.135	1.92	5.71	18.20%
10/19/2004	Goose Pond	22.21	0.376	1.01	7.3	11.70%
6/29/2004	Goose Pond S	23.9	0.252	0.4	5.88	4.60%
6/29/2004	Lucas Borrow	25.5	0.082	0.39	5.56	4.70%
10/19/2004		19.34	0.077	0.72	5.94	7.80%

Date	General location	Water Temperature (°C)	SpC (ms/cm)	DO (mg/L)	pH	% DO
6/29/2004	Lucas Pond	26.01	0.087	0.34	5.73	4.20%
10/19/2004		19.76	0.109	0.8	5.94	8.80%
6/29/2004	N Runway Ditch	24.65	0.252	0.5	6.52	5.90%
10/19/2004		19.95	0.246	1.45	6.78	16.00%
6/29/2004	Snipe Pond	28.3	0.427	7.87	7.77	101.30%
10/19/2004	Teal Pond	20.4	0.332	1.11	7.15	12.30%
6/29/2004	Wigeon Pond	25.2	0.469	0.34	6.05	4.20%
10/19/2004		21.16	0.468	0.6	6.3	6.70%
6/29/2004	Woody Pond	26.1	0.424	0.43	6.74	5.40%
10/19/2004	Woody Pond E dike	21.09	0.344	2.61	6.67	28.90%
SVNWR						
7/1/2004	DT-2	26.34	0.028	0.6	5.85	6.90%
10/21/2004		20.06	0.047	1.2	7.51	13.10%
7/1/2004	HQ-1	27.04	0.808	1.52	6.68	19.20%
10/21/2004		20.61	0.425	0.44	6.23	4.70%
7/1/2004	ND-3	25.4	0.3	0.97	6.69	11.70%
7/1/2004	ND-4	25.8	0.681	0.66	6.61	8.20%
7/1/2004	ST-2	27.4	0.053	3.08	6.9	38.90%
10/21/2004		19.52	0.078	3.33	6.89	32.00%
10/21/2004	ST-3	19.81	0.108	1.67	7.12	18.30%
7/1/2004	WD-3	26.2	1.117	0.74	6.87	9.20%
10/21/2004	WD-4	19.98	0.554	0.97	6.7	10.70%
10/21/2004	WD-5	19.28	0.135	0.66	6	7.10%

Table 8. Amphibian and reptile specimens collected at St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges by USGS SEARMI project during 2004.

Date	St.	Co.	UTM-E	UTM-N	Zone	Locality	Collector(s)	Species	FLMNH#
13-Mar-04	FL	Wakulla	752419	3330376	16	St. Marks NWR; Panacea Unit, found at edge of pond adjacent to FL Trail near RR305 (remains of possible raccoon predation)	WJB, JSS, BRH	*Deirochelys reticularia* (shell)	141628
13-Mar-04	FL	Wakulla	750312	3321070	16	St. Marks NWR; Panacea Unit, pond N of RR323, ca. 450m W of refuge boundary and US98	SAJ, WJB, JSS, CKD, BRH	*Pseudobranchus striatus*	A
13-Mar-04	FL	Wakulla	750312	3321070	16	St. Marks NWR; Panacea Unit, pond N of RR323, ca. 450m W of refuge boundary and US98	SAJ, WJB, JSS, CKD, BRH	*Eurycea quadridigitata* (larva)	141653
15-Mar-04	FL	Wakulla	750312	3321070	16	St. Marks NWR; Panacea Unit, pond N of RR323, ca. 450m W of refuge boundary and US98	WJB, SAJ, JSS, BRH	*Notophthalmus viridescens*	A
16-Mar-04	FL	Wakulla	746380	3324168	16	St. Marks NWR; Panacea Unit, at large prairie pond W of CR372, NW of Renfro Lk	SAJ, WJB, JSS, BRH	*Desmognathus auriculatus*	A
5-Apr-04	GA	McIntosh			17	Harris Neck NWR; original collection location/date unknown (was stored in refuge garage)		*Trachemys scripta* (shell)	A
6-Apr-04	GA	McIntosh	475034	3499460	17	Harris Neck NWR; Wigeon Pond	WJB, CKD	*Pseudacris crucifer* (6 larvae)	A
7-Apr-04	SC	Jasper	490944	3565161	17	Savannah NWR; river floodplain forest E of jct of Chisolm and Dodge Tram Rds	WJB, CKD	*Desmognathus auriculatus* (2)	A
8-Apr-04	GA	Effingham	484456	3563370	17	Savannah NWR; USGS-ARMI site ST-3	WJB, CKD	*Pseudacris crucifer* (larva)	A
8-Apr-04	GA	Effingham	487409	3574055	17	Savannah NWR; Bear Is.	WJB, CKD	*Ambystoma opacum* (5 larvae)	B
13-Apr-04	FL	Levy	301026	3249530	17	Lower Suwannee NWR; in flatwoods near USGS-ARMI site LSLC-3	SAJ	*Terrapene carolina* (shell)	141624
14-Apr-04	FL	Levy	300832	3248015	17	Lower Suwannee NWR; DOR on Loop Rd (appeared to have been stomped by a person)	SAJ	*Sistrurus miliarius*	A
20-Apr-04	FL	Dixie	300352	3253869	17	Lower Suwannee NWR; DC-3 Pond, in USGS-ARMI site LSDC-3	JSS, LIC	*Hyla gratiosa* (3 larvae)	141652
20-Apr-04	FL	Dixie	303992	3259872	17	Lower Suwannee NWR; DC-4 Pond, adjacent to USGS-ARMI site LSDC-4	JSS, LIC	*Pseudacris crucifer* (larva)	A
20-Apr-04	FL	Dixie	303992	3259872	17	Lower Suwannee NWR; DC-4 Pond, adjacent to USGS-ARMI site LSDC-4	JSS, LIC	*Pseudacris ocularis* (3 larvae)	A
4-Jun-04	FL	Levy			17	Lower Suwannee NWR; on N Loop Rd	SAJ, JEE, LIC	*Rana clamitans*	A
9-Jun-04	FL	Dixie	297163	3249618	17	Lower Suwannee NWR; captured in funnel trap at drift fence in USGS-ARMI site LSDC-1	JEE, LIC	*Eleutherodactylus planirostris*	A
20-Jun-04	FL	Wakulla	747479	3322471	16	St. Marks NWR; Panacea Unit, pond W of CR372, E of RR402	WJB, JSS, JEE, LIC	undescribed *Siren* sp. (P. Moler, pers. comm.)	B
20-Jun-04	FL	Wakulla	747479	3322471	16	St. Marks NWR; Panacea Unit, pond W of CR372, E of RR402	WJB, JSS, JEE, LIC	*Ambystoma talpoideum* (larva)	B
20-Jun-04	FL	Wakulla	747479	3322471	16	St. Marks NWR; Panacea Unit, pond W of CR372, E of RR402	WJB, JSS, JEE, LIC	*Hyla gratiosa* (larva)	A
30-Jun-04	GA	McIntosh	473713	3499346	17	Harris Neck NWR; Woody Pond	CKD, WJB, LIC, JEE	*Rana grylio* (larva)	A
30-Jun-04	GA	McIntosh	473713	3499346	17	Harris Neck NWR; Woody Pond	CKD, WJB, LIC, JEE	*Rana sphenocephala* (larva)	A
30-Jun-04	GA	McIntosh	473713	3499346	17	Harris Neck NWR; Woody Pond	CKD, WJB, LIC, JEE	*Hyla cinerea* (metamorph)	A
1-Jul-04	GA	Effingham	484593	3562642	17	Savannah NWR; USGS-ARMI site ST-2	CKD, WJB, LIC, JEE	*Hyla chrysoscelis* (larva)	A
15-Jul-04	FL	Dixie	304089	3260116	17	Lower Suwannee NWR; dead in funnel trap at drift fence in USGS-ARMI site LSDC-5	LIC, JEE	*Cemophora coccinea*	A
21-Oct-04	GA	Effingham	484456	3563370	17	Savannah NWR; USGS-ARMI site ST-3	CKD, WJB, MSG	*Rana sphenocephala* (larva)	A

Date	St.	Co.	UTM-E	UTM-N	Zone	Locality	Collector(s)	Species	FLMNH#
21-Oct-04	GA	Effingham	484456	3563370	17	Savannah NWR; USGS-ARMI site ST-3	CKD, WJB, MSG	*Rana* sp. (larva)	C

Codes:
A: not yet deposited in Florida Museum of Natural History (FLMNH), Gainesville, FL
B: being maintained live for research/education/outreach activities
C: being reared through metamorphosis for positive species identification

Collectors:
WJB - W.J. Barichivich, USGS
LIC - L.I. Casey, USGS
CKD - C.K. Dodd, Jr., USGS
JEE - J.E. Earl, USGS
MSG - M.S. Gunzburger, USGS
BRH - B.R. Hossack, USGS
SAJ - S.A. Johnson, USGS
JSS - J.S. Staiger, USGS

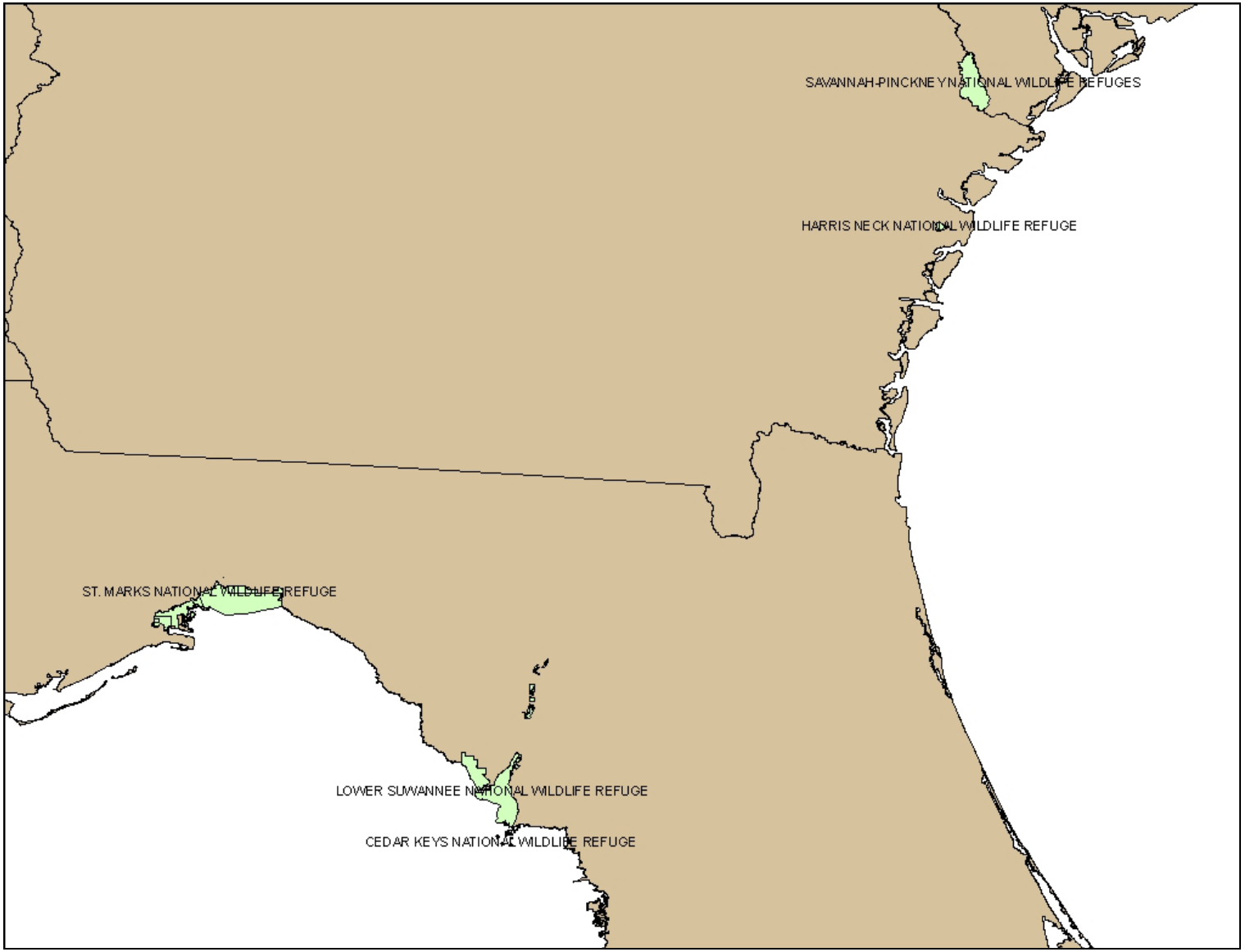


Fig. 1. General locations of St. Marks, Lower Suwannee, Harris Neck, and Savannah National Wildlife Refuges.

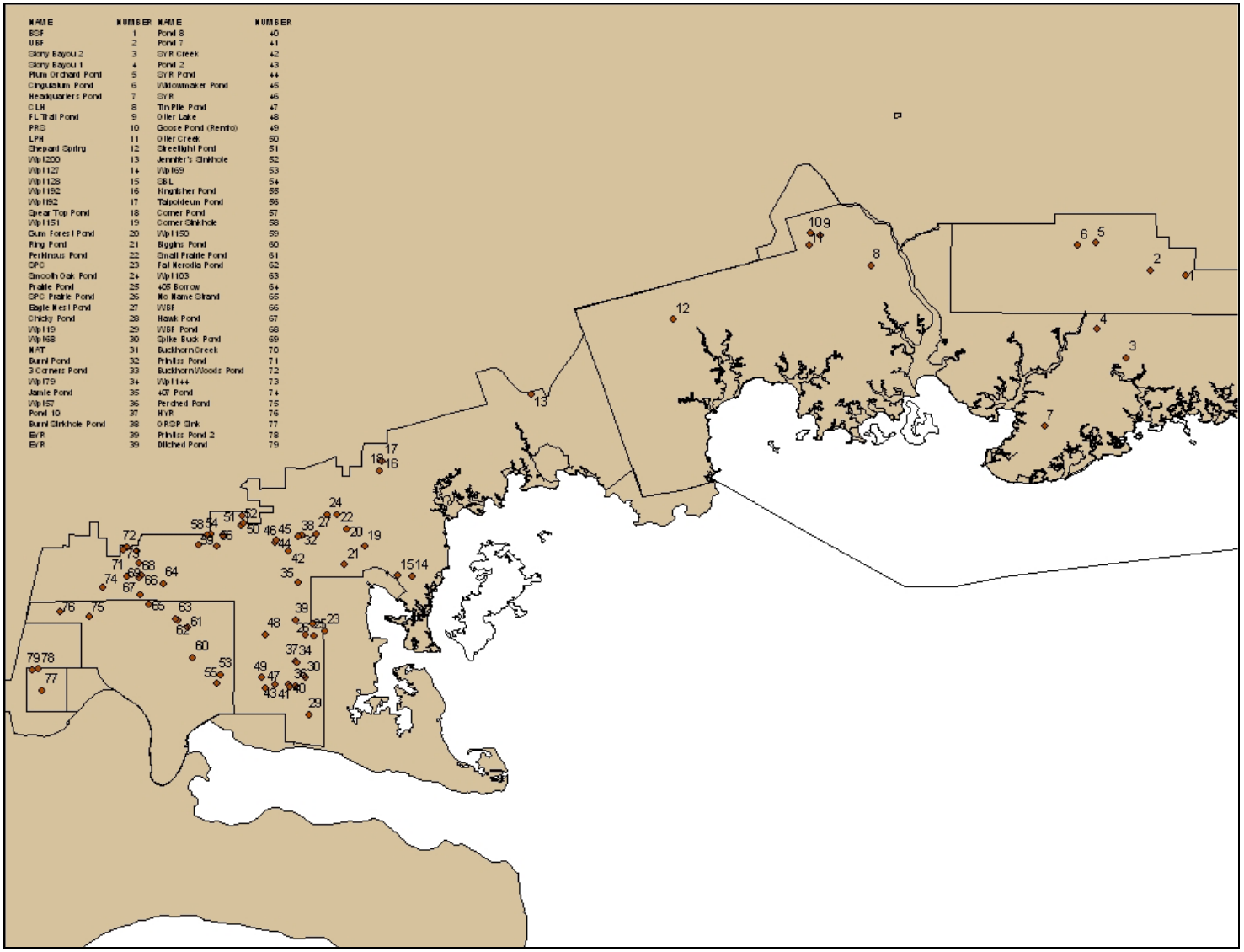


Fig. 2a. Locations of USGS-SEARMI project 2004 sampling sites at St. Marks National Wildlife Refuge.

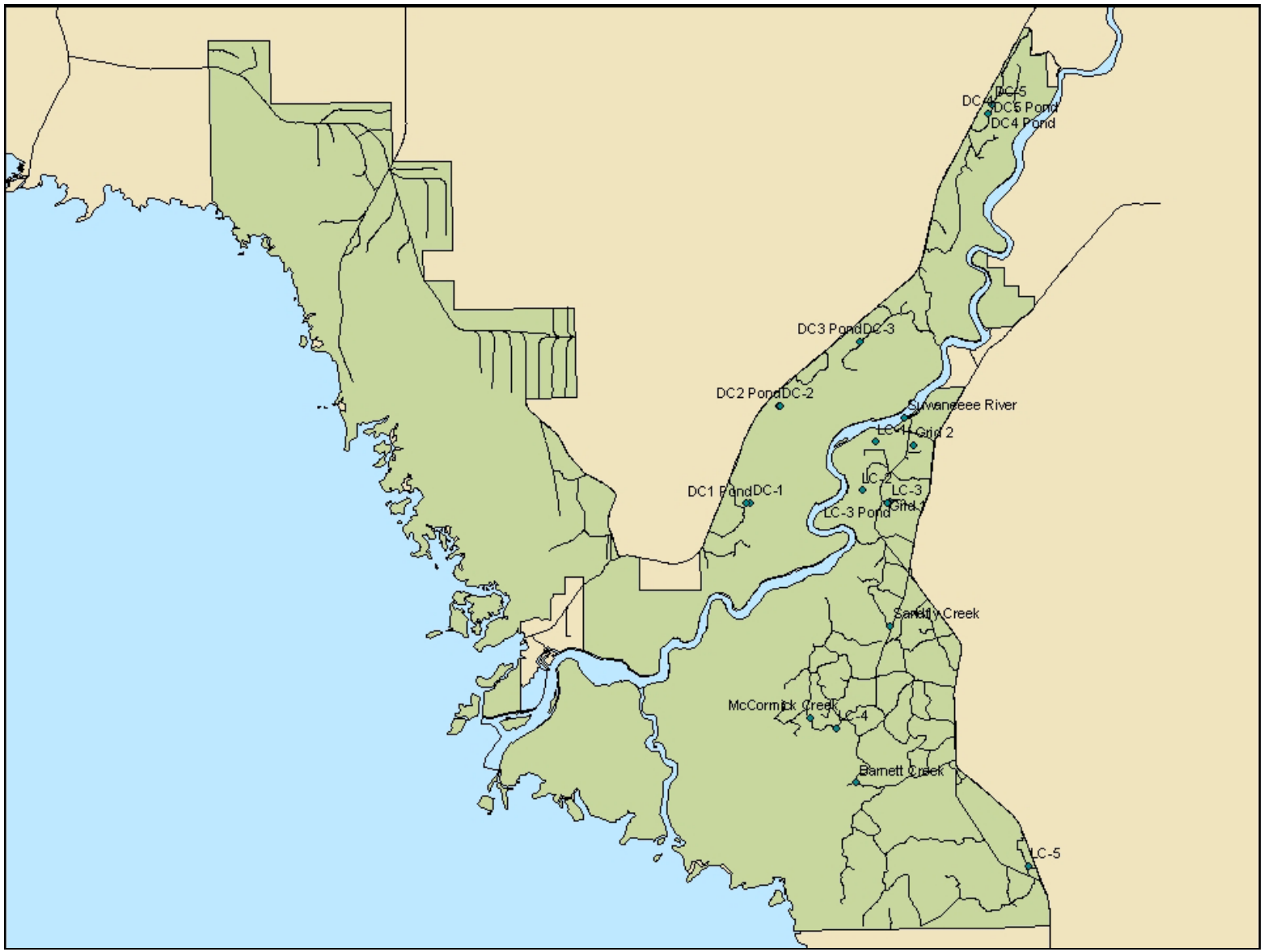


Fig. 2b. Locations of USGS-SEARMI project 2004 sampling sites at Lower Suwannee National Wildlife Refuge.

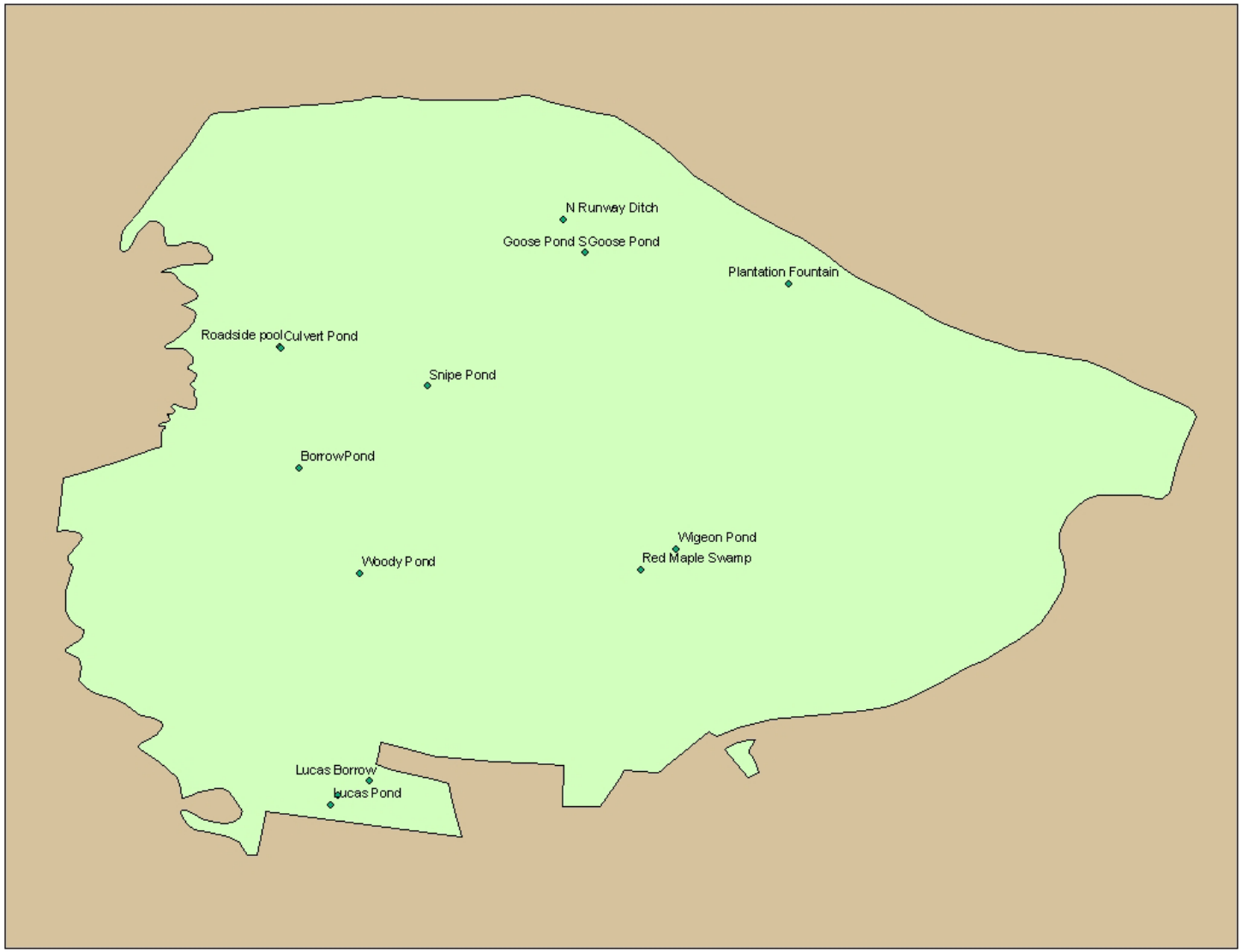


Fig. 2c. Locations of USGS-SEARMI project 2004 sampling sites at Harris Neck National Wildlife Refuge.

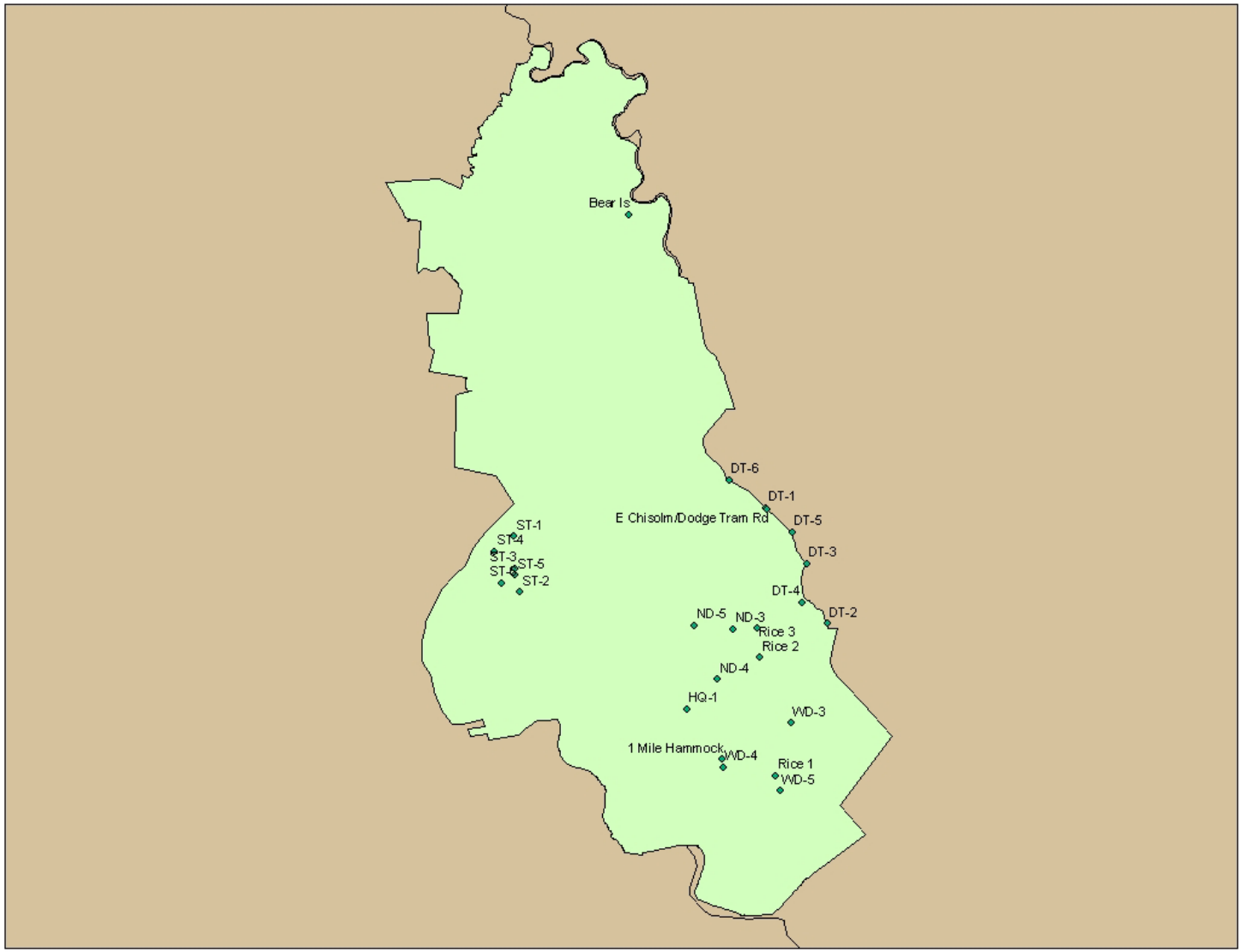


Fig. 2d. Locations of USGS-SEARMI project 2004 sampling sites at Savannah National Wildlife Refuge.

Fig. 3. Cumulative number of species of amphibians and reptiles collected at each refuge relative to sampling effort.

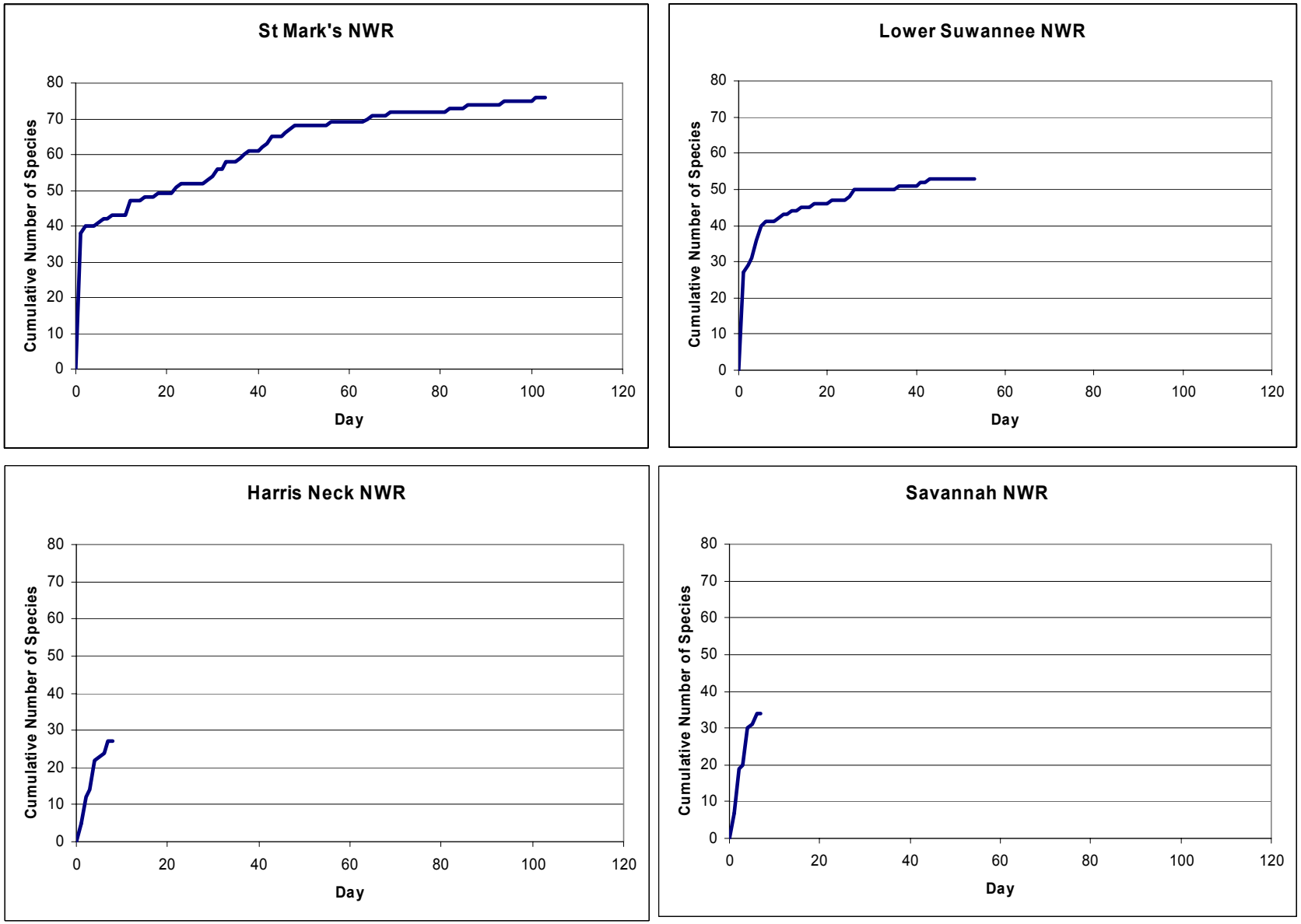
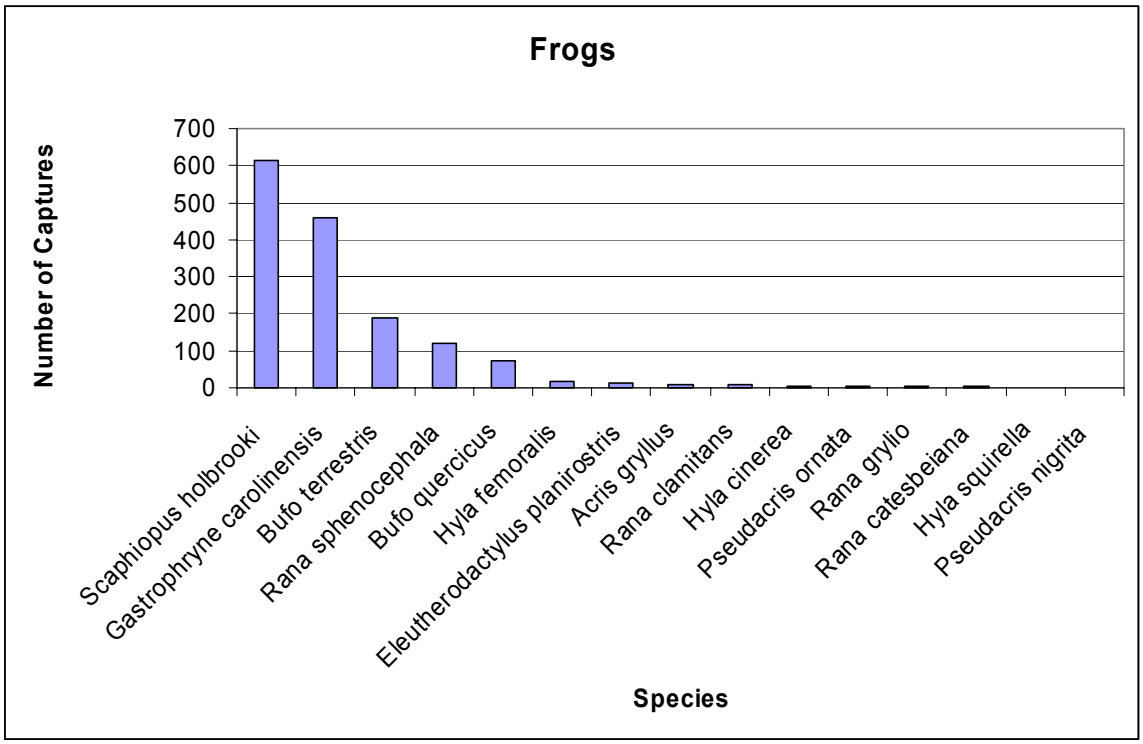


Fig. 4a. Amphibian captures at drift fences at St. Marks National Wildlife Refuge from 2002-2004.



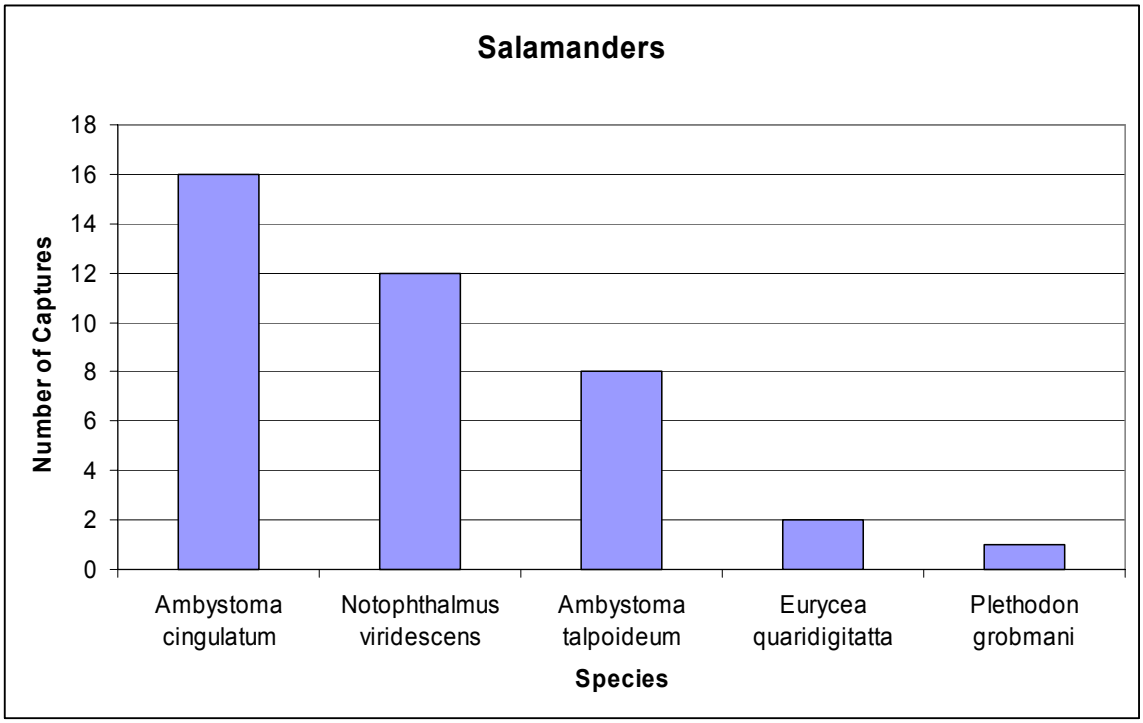
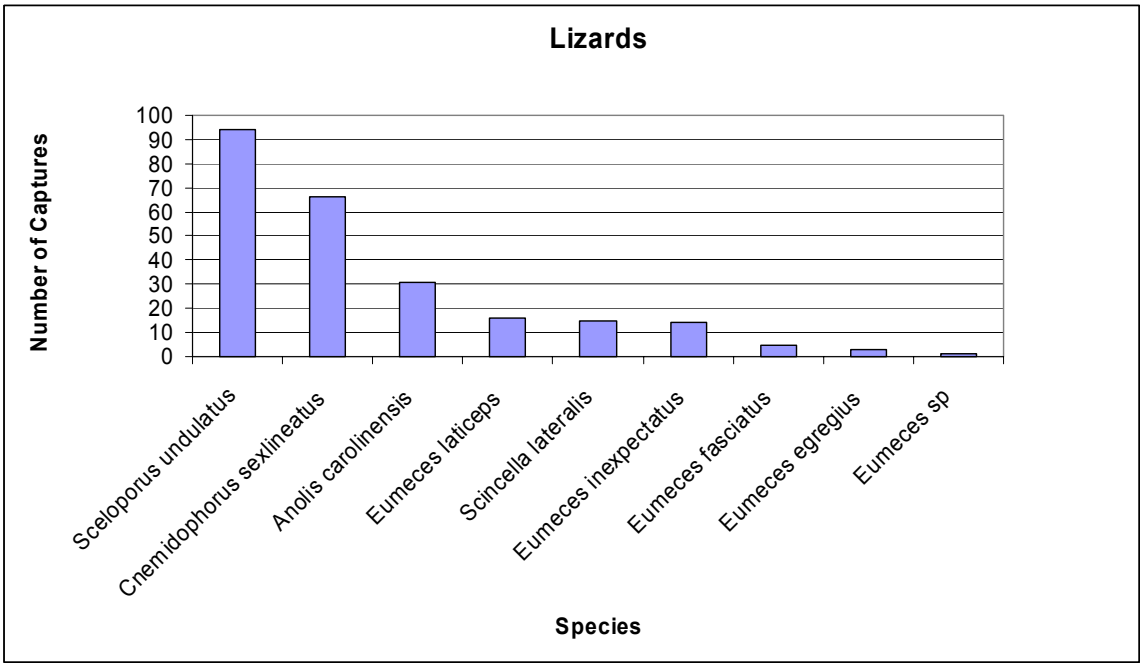


Fig. 4b. Reptile captures at drift fences at St. Marks National Wildlife Refuge from 2002-2004.



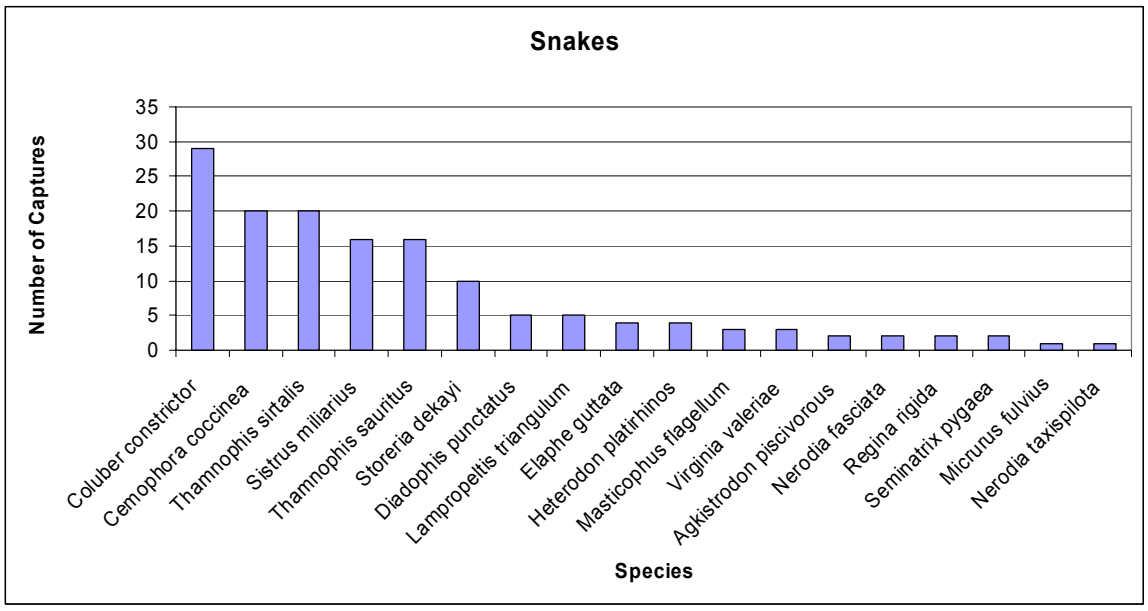


Fig. 5a. Amphibian captures at drift fences at Lower Suwannee National Wildlife Refuge from 2003-2004.

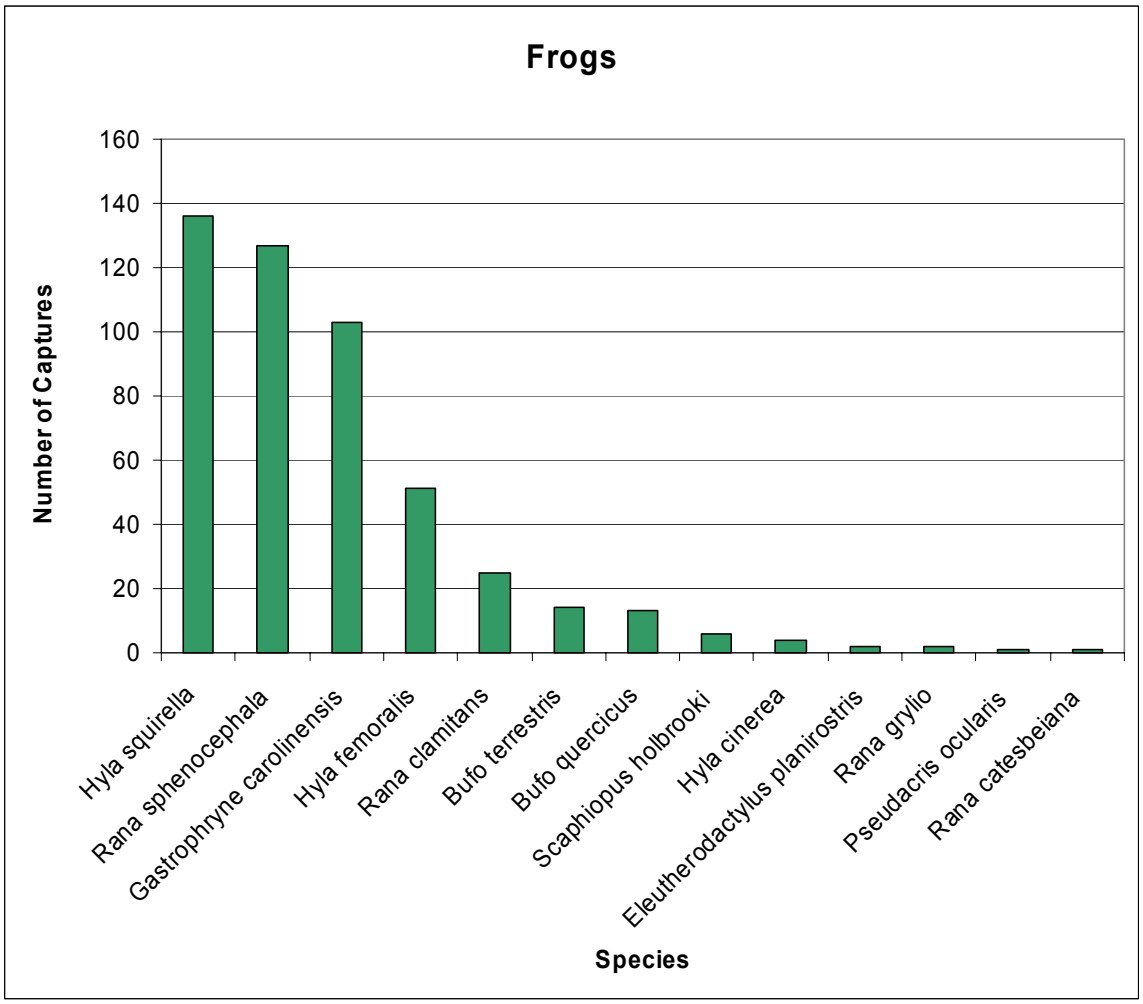
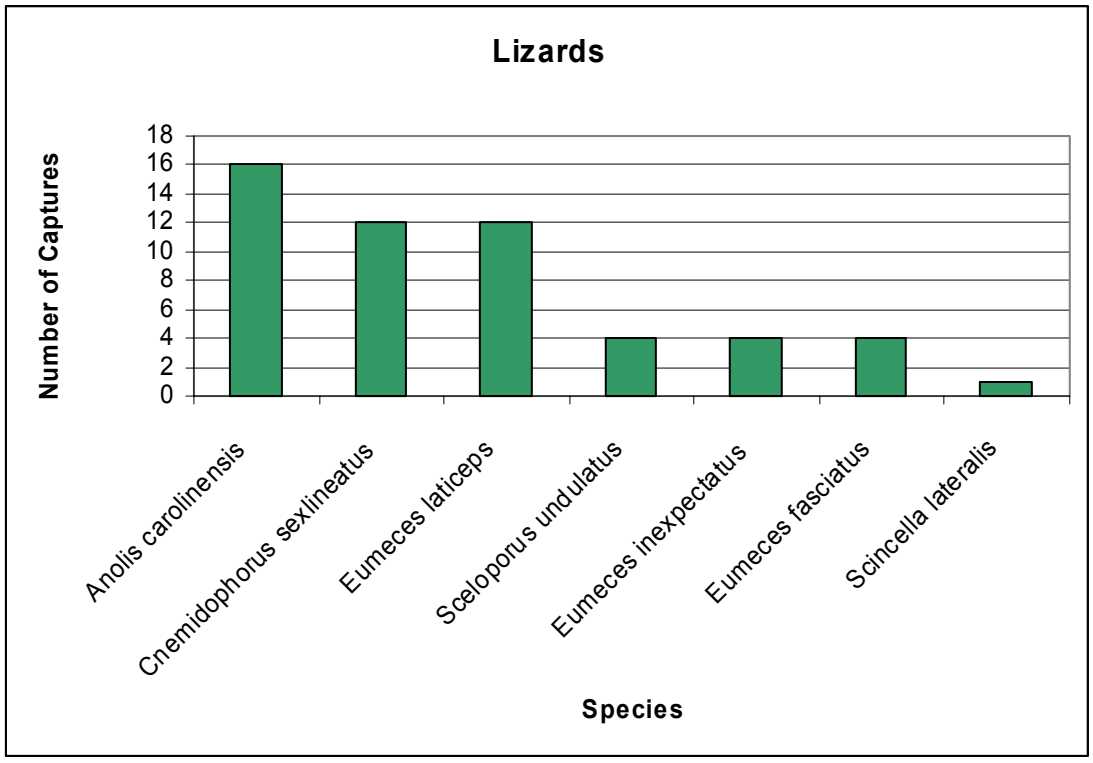
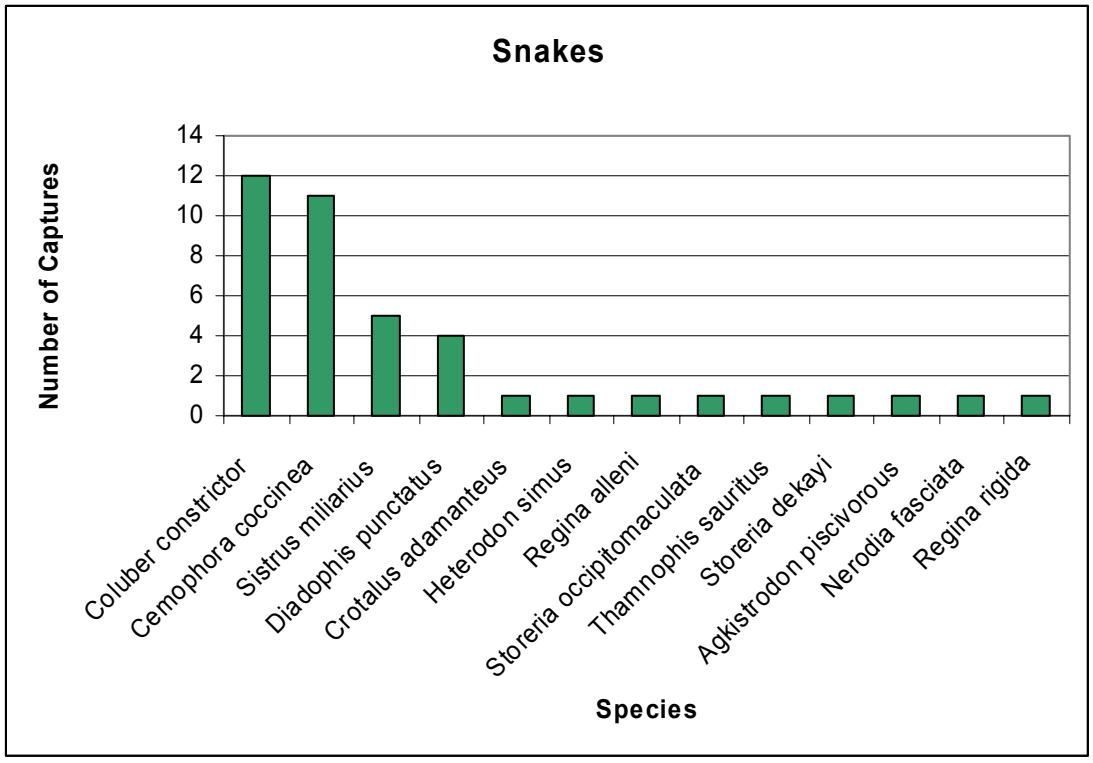


Fig. 5b. Reptile captures at drift fences at Lower Suwannee National Wildlife Refuge from 2003-2004.





Appendix I. National Wildlife Health Center Report on *Dermomycoides* spp. (= *Anuraperkinsus*) at St. Marks National Wildlife Refuge.

NATIONAL WILDLIFE HEALTH CENTER
6006 SCHROEDER ROAD
MADISON, WI 53711-6223
PHONE: (608) 270-2400 FAX: (608) 270-2415

FINAL PATHOLOGY REPORT on AMPHIBIANS from ST. MARKS NATIONAL WILDLIFE REFUGE

Submitter:
Drs. Steven Johnson & C. Ken Dodd
Florida-Caribbean Science Center
7920 NW 71st Street
Gainesville FL 32653

Date of Report: 20 November 2004

Case No.: 4864

Specimens:

NWHC Acsn No	Species	n=	Site Name	Capture Date	Primary Diagnosis
49-60,63-66	*R grylio*	16	Ring Pond	10 Feb 2003	Muscle infections by *Ichthyophonus* & microsporidian
061,062	*R grylio*	2	Stony Bayou #1	10 Feb 2003	Ectoparasitism by *Gyrodactylus* sp. in both larvae
035-048	*R sphenocephala*	14	Stony Bayou #1	10 Feb 2003	Ectoparasitism by *Gyrodactylus* sp. in all 14 larvae
016-034	*R sphenocephala*	19	Gum Forest Pond	10 Feb 2003	Muscle infections by *Ichthyophonus* in 2 larvae
001-015	*R sphenocephala*	15	Perkinsus Pond	10 Feb 2003	Infection by *Perkinsus*-like organism in 4 larvae
067-070	*R sphenocephala*	4	Perkinsus Pond	19 May 2003	Infection by *Perkinsus*-like organism in 1 larva
071-076	A *gryllus*	6	Perkinsus Pond	19 May 2003	Infection by *Perkinsus*-like organism in 1 larva
78-83, 89-96	A *gryllus*	14	Perkinsus Pond	18 Aug 2003	Normal (with a few pinworms)
084-088	*R clamitans*	5	Jennifer Sink	18 Aug 2003	Normal (with a few pinworms)
097-101	*R catesbeiana*-like	5	Jennifer Sink	18 Aug 2003	Normal (with a few pinworms)
077	[Fish]	1	Perkinsus Pond	19 May 2003	Normal

Final Diagnoses:

1. Viscera: Infection by *Perkinsus*-like protists in 4 of 15 larval *R. sphenocephala* from Perkinsus Pond (10 Feb).
2. Viscera: Infection by *Perkinsus*-like protists in 1 of 4 larval *R. sphenocephala* (#067) from Perkinsus Pond (19 May).
3. Viscera: Infection by *Perkinsus*-like protists in 1 of 6 larval *A. gryllus* (#072) from Perkinsus Pond (19 May).
4. Viscera: PCR-positive test for *Perkinsus*-like protists in 1 of 4 larval *R. sphenocephala* (#067) from Perkinsus Pond.
5. Viscera: PCR-positive test for *Perkinsus*-like protists in 2 of 6 larval *A. gryllus* (#072 & 076) from Perkinsus Pond.
6. Mesonephroi: Infection by myxozoa (*Leptotheca ohlmacheri*) in 1 of 15 *R. sphenocephala* from site Perkinsus Pond.
7. Skeletal muscle: Myositis due to infection by microsporidia-like protozoa in 5 of 16 larval *R. grylio* (#052, 056, 057, 060 & 063) from Ring Pond.
8. Skeletal muscle: Myositis due to infection by Mesomycetozoa (*Ichthyophonus* sp.) in 3 of 16 larval *R. grylio* from Ring Pond.
9. Skeletal muscle: Myositis due to infection by Mesomycetozoa (*Ichthyophonus* sp.) in 2 of 19 larval *R. sphenocephala* from Gum Forest Pond.
10. Intestine: Parasitism by pinworm-like nematodes (probably *Gyrinicola batrachiensis*) in 79 of 100 tadpoles from all 7 sites.
11. Skin: Ectoparasites typical of *Gyrodactylus* sp. in 14 of 14 larval *R. sphenocephala* from Stony Bayou #1.
12. Skin: Ectoparasites typical of *Gyrodactylus* sp. in 2 of 2 larval *R. grylio* from Stony Bayou #1.
13. Body cavity: Parasitism by unidentified metacercariae-like organisms in 2 of 19 *R sphenocephala* from Gum Forest Pond.
14. Body cavity: Parasitism by unidentified metacercaria-like organism in 1 of 5 *R catesbeiana*–like larva from Jennifer Sink Pond.
15. Viscera: Negative virus cultures in 74 of 74 tadpoles from all 7 sites.
16. Livers: Negative bacterial cultures in 14 of 14 tadpoles from 5 sites.

COMMENTS:
The specimens in this report consist of 100 live tadpoles (and one tiny fish) of 4 species that were captured on 3 different dates in 2003 in St Marks National Wildlife Refuge. A separate report was submitted previously for an additional 24 larval southern leopard frogs that were captured in December, 2002 (NWHC case number 18487). These 100 tadpoles were considered research and follow-up animals for investigations of a new amphibian disease that is currently referred to as a *Perkinsus*-like organism. Histological examinations were conducted on all 101 specimens; virus cultures were attempted on 74 tadpoles and bacterial cultures of the liver were attempted on 14 tadpoles

There remains some confusion about the number of sites from which tadpoles were captured in 2003; in the table of specimens (above), 7 sites are listed. However, sites were identified by two different methods (code numbers in February 2003 and by pond name in May and August 2003). It is likely one or more sites identified as Panacea Unit, Perkinsus Pond and Jennifer Sink are the same as the code-named sites of February 2003.

RESULTS:
Major findings and diagnoses are listed above. Only one major lethal infectious disease of amphibians was detected in histological examinations and cultures, however, an additional 2 infectious diseases of low morbidity and low mortality also were found. The lethal infection is a new, undescribed protozoan-like microorganism that is taxonomically related to the oyster disease agent, *Perkinsus* sp. The 2 diseases with low mortality rates were muscle infections by another protozoan parasite (microsporidia) and a primitive fungus called *Ichthyophonus* sp. Chytridiomycosis (infection by *Batrachochytrium dendrobatidis*) was not detected in tissue sections of these 100 tadpoles, although precise suitable tissue sections through the oral discs of all tadpoles were not obtained on histological slides.

Cultures for viruses and pathogenic bacteria were negative in these tadpoles. Virus cultures were attempted on 74 tadpoles; at least 4 tadpoles were sampled from each of the 7 sites. Livers of 14 tadpoles were submitted for bacterial cultures; all produced no bacterial growth. Special bacterial cultures for *Salmonella* sp. were attempted on 4 tadpoles; these cultures also were negative.

The common pinworm of many genera of tadpoles is *Gyrinicola batrachiensis*. This pinworm was detected during dissections or histological examinations of the intestines of 79 of 100 tadpoles from all sites. Number of pinworms per tadpole ranged from 1 to 30; most tadpoles had 1-3 pinworms, but actual parasite burdens per tadpole probably were higher because only the larger worms that were visible through the wall of the intestine were counted. Due to constraints of time, intestinal diameter and intestinal length, it was not possible to examine each tadpole thoroughly for intestinal parasites. The pinworm of tadpoles is considered innocuous; no morbidity or mortality has been associated with this gut parasite.

DISCUSSION:
The findings in these 100 tadpoles will be discussed from 3 aspects: type of disease, species of host and geographic sites

Amphibians (Hosts).
Five species of amphibian were submitted: 20 larval *Acris gryllus*, 5 larval *Rana clamitans*, 5 larval *R. catesbeiana* (or *R. catesbeiana*-like tadpoles), 18 larval *R. grylio*, and 52 larval *R. sphenocephala*.

Florida cricket frogs (*A. gryllus dorsalis*) were submitted from 1 site (Perkinsus Pond) on 2 dates. A total of 20 larvae were submitted. One of 6 cricket frogs from the May 2003 collections had histological evidence of infection by the *Perkinsus*-like organism. Tissues from 3 of 6 larvae were submitted for a polymerase chain reaction (PCR) test for the *Perkinsus*-like organism; 2 of 3 larvae were PCR test-positive and one was negative. One of the 2 PCR-positive larvae was also histologically positive, but one PCR-positive larva was histologically negative for the *Perkinsus*-like organism. There are several possible explanations for the PCR-positive and histologically-negative larva. Possible causes for the apparently inconsistent test results are 1) the tissue for the PCR test was contaminated during dissection with pond water or tissues in direct contact with pond water, such as gills, skin and intestine, 2) the larva was in a very early stage of infection by *Perkinsus*-like organisms in which the initial infective stage was not recognized in histological slides, 3) the larva was in an early stage of infection in which only one focus of liver (or intestine) contained the *Perkinsus*-like

organism and this portion was submitted for PCR testing, 4) tissues were contaminated accidentally in the molecular laboratory, or 5) the PCR primer is non-specific because other organisms may have a sequence of DNA that is similar to that of the *Perkinsus*-like organism.

Infection by the *Perkinsus*-like organism was not detected in 14 larval *A. gryllus* that were captured at the site in August, 2003. None of the other 2 species of tadpoles also captured in August, 2003, showed histological evidence of infection by the *Perkinsus*-like organism. However, the tadpole species (*R sphenocephala*) that may be most susceptible to infection by this organism was not present or not captured in August, 2003, so it is unclear whether the disease agent was or was not present in the pond by August. Studies in other states suggest the Perkinsus-like organism may persist in soil or sediments of ponds that dry during the summer, and even in ponds that dry and are burned.

A total of 13 cricket frogs were infected by pinworm-like nematodes. Prevalence of pinworm infection in all larval cricket frogs was 65%; prevalences in May and August were 83% and 57%, respectively. No other helminthic parasites were recognized in the 20 larvae. However, 2 larvae captured in May had histological abnormalities of their livers and mesonephroi ("kidneys") that were suggestive of infection by a Ranavirus. But because both tadpoles were dead on arrival and decomposed, and because virus cultures of their livers were negative, it is possible the suspected histological abnormalities were due to decomposition.

Bullfrogs (*Rana catesbeiana*) were submitted from 1 site only: Jennifer Sink. There is some question as to the precise identity of these tadpoles; it is possible they are an unrecognized new subspecies or species of ranid. A total of 5 larvae were captured and submitted in August, 2003.

Only two infectious diseases were detected in these 5 larvae; they were intestinal pinworms in 2 and an unidentified encysted metacercaria (immature trematode) in the body cavity of 1 larva. Although all 5 larvae had suspected enlarged livers at dissection, virus cultures, bacterial cultures and histological examinations of the livers were negative. Hence, the livers of these 5 larvae probably were normal and there was no evidence of infections by ranaviruses or the *Perkinsus*-like organism.

Bronze frogs (*R. c. clamitans*) were submitted from 1 site only: Jennifer Sink. A total of 5 tadpoles were submitted. One tadpole had intestinal pinworms, but no other infectious or parasitic diseases were detected in these larvae.

Pig frogs (*R. grylio*) were submitted from 2 sites: Ring Pond and Stony Bayou #1. A total of 18 tadpoles were submitted. Four distinct infectious diseases were detected in these 18 tadpoles, but infection by the *Perkinsus*-like organism was not found. Virus and bacterial cultures of the livers were negative, but one tadpole had virus-like inclusion bodies in mucosal cells of the stomach which may have been due to an adenovirus. Fifteen of 18 tadpoles had intestinal pinworms; each tadpole had 1 to 4 pinworms. Infections of skeletal muscles by 2 different organisms were found: 3 tadpoles were infected by the protistan, *Ichthyophonus* sp., and 5 were infected by an unidentified microsporidian-like protozoa; 2 tadpoles were infected by both organisms. The microsporidian-like organisms probably are a new disease agent in this host species, this age-group of amphibians, and in this refuge and state. *Ichthyophonus* sp. is widespread in amphibians east of the Mississippi River; the infection is most often detected in newts, bullfrogs, green (or bronze) frogs, wood frogs and spring peepers. Infections by *Ichthyophonus* sp. and microsporidia were very mild in these tadpoles and it is unlikely either infection caused illness or mortality. However, deaths due to both organisms have been reported in other species in other states and other countries. A fourth disease in the larval pig frogs was a monogean trematode on the skin (ectoparasite); the parasites on 1 tadpole were identified by our staff parasitologist as *Gyrodactylus* sp.; both tadpoles from Stony Bayou #1 were infected, as were all 14 larval *R. sphenocephala* from the same site. Finally, another unidentified microscopic protozoa-like or algae-like organism was found embedded in the epidermis and oral mucosa of 6 tadpoles from Ring Pond; this organism was about 40 microns in diameter and had numerous minute spherical clear vacuoles; the organism has been seen in amphibians from other Atlantic coastal states, but has not yet been identified; it could be a protozoan, an alga, an infective stage of a myxozoan, or some other organism.

Southern leopard frogs (*R. sphenocephala*) were submitted from 3 sites on 2 separate dates (February and May, 2003). A total of 52 larval southern leopard frogs were submitted. Five tadpoles from Perkinsus Pond that were collected on 2 dates (10 Feb and 19 May, 2003) had severe systemic infections by the *Perkinsus*-like organism; hence, the rate of infection by the *Perkinsus*-like organism in all sampled larval southern leopard frogs from St Marks NWR in 2003 was 9.6%, but if only those tadpoles from the Perkinsus Pond site are considered, then the rate of infection was 26.3% (5 of 19 tadpoles). Infections by the *Perkinsus*-like organism were not detected in any tadpoles from the other 4 sites. Based on date of capture, the infection rates in larval *R. sphenocephala* on 10 Feb and 19 May were 26.7% (4 of 15) and 25.0% (1 of 4), respectively.

Other infectious and parasitic diseases were detected in larval southern leopard frogs. These include *Gyrodactylus* sp. ectoparasites on the skin, myxozoa in the mesonephroi ("kidneys"), *Ichthyophonus* sp. in the skeletal muscles and pinworms in the intestines. The ectoparasites on the skin occurred only in the tadpoles from site Stony Bayou #1 and were similar to those in the larval pig frogs from the same site. The presumptive identification of these ectoparasites as *Gyrodactylus* sp. was based on their similarity in size, shape, locomotion and tissue location to those found and identified on the larval pig frogs. Only one species of helminth was detected in the gastro-intestinal tracts of the larvae: it was the tadpole pinworm, *Gyrinicola batrachiensis*. This pinworm was detected in the intestines of 48 (92.3%) of 52 tadpoles. Only one tadpole from Perkinsus Pond was infected by the myxozoan parasite, *Leptotheca ohlmacheri*; the infection typically is limited to the mesonephroi ("kidneys") and rarely is associated with disease or mortality. Because this parasitic infection is fairly common nationwide, the occurrence of this parasite in only 1 of 100 tadpoles (or 1 of 52 southern leopard frogs) is unusual because of the low prevalence.

Two (3.8%) of 52 larval southern leopard frogs had skeletal muscle infections by the primitive fungus, *Ichthyophonus* sp. Both infected tadpoles were from Gum Forest Pond, hence, 2 (10.5%) of 19 tadpoles from this site were infected. This infectious diseases was not found in leopard frog tadpoles at the other 2 sites. Muscle infections by the new, unidentified microsporidian protozoa were not detected in the southern leopard frogs.

Diseases & Parasites.
The diseases and parasites in this group of 100 tadpoles are discussed in the following paragraphs.

Virus infections were not confirmed by cultures in any of the 74 tadpoles from which virus cultures were attempted. Hence, it is considered very unlikely that easily cultured viruses, such as ranaviruses, were present in the submitted tadpoles, and it is unlikely virus infections contributed to the die-offs that were observed in mid-December, 2002 (see NWHC Pathology Report 18487, dated, 28 Feb 2003). However, one larval pig frog had abnormalities of the stomach mucosal cells (ie, intra-nuclear basophilic inclusion bodies) that were suggestive of a viral infection; the most likely type of virus to cause this abnormality was an adenovirus. Because the virus was not isolated in cultures and because there are other possible causes for the inclusion bodies, the diagnosis of adenoviral gastritis remains a presumptive diagnosis rather than a confirmed diagnosis.

Bacterial infections were not confirmed in cultures and histological examinations in these 100 tadpoles. Hence, there was no evidence of bacterial septicemia or red leg disease in these tadpoles.

Ichthyophonus infections of the skeletal muscle (ichthyophoniasis) were confirmed by histological examinations in 5 tadpoles from Ring Pond and Gum Forest Pond. Two species of frog (*R. grylio* and *R. sphenocephala*) were infected, but 3 species of frog (*R. clamitans*, *R. catesbeiana*-like and *Acris gryllus*) were not infected. This disease agent has an unsettled taxonomic history, and has been variously called a protozoan, protist and fungus; recent molecular analyses show the organism is related to other disease agents of fish and shellfish and has been assigned to the new clades called DRIPs and Mesomycetozoa. *Ichthyophonus* sp. was first described as an important disease agent of freshwater and marine fish, especially herring, where it is linked to population declines, population abundance cycles and die-offs. It is not clear whether *Ichthyophonus* sp. from freshwater fish, marine sources and amphibians are the same species or multiple species. This disease agent has been reported previously in southern leopard frogs but has not been reported from larval pig frogs (however, this is the first group of *R grylio* to be subjected to diagnostic examinations at this

Center). This organism is occasionally a cause of morbidity and mortality in eastern red-spotted newts in mid-Atlantic and New England states, and is a rare cause of morbidity and mortality in larval, recently metamorphosed and adult ranids and pseudacrids of several species. Adult anurans typically present in an emaciated condition with fungal organisms in >90% of skeletal muscle cells throughout the body, while recently metamorphosed ranids present with a firm prominent swelling around the urostyle and rump. Rates of infection by *Ichthyophonus* sp. in larval *R sphenocephala* and larval *R grylio* were 3.8% (2 of 52) and 16.7% (3 of 18), respectively. However, all infected larval *R sphenocephala* were from one site (Gum Forest Pond), hence the rate of infection at this site only among larval *R sphenocephala* was 10.5% (2 of 19 tadpoles).

Perkinsus-like organisms were found in only 6 of 100 tadpoles of 2 host species (*A. gryllus* and *R. sphenocephala*). The infections were massive and overwhelming in 5 of 6 tadpoles and mild in one tadpole. Interestingly, infections were not detected in 14 larval *A. gryllus* from Perkinsus Pond that were captured in mid-August, 2003, nor any of the other 2 species of tadpoles captured in August 2003. But in May, 2003, 1 of 4 larval *R. sphenocephala* and 1 of 6 larval *A. gryllus* from Perkinsus Pond were infected by the *Perkinsus*-like organism. Hence, 2 of 10 tadpoles from Perkinsus Pond in May, 2003, were infected by the *Perkinsus*-like organism. Among those tadpoles (n= 66) captured in February, 2003, four *R. sphenocephala* from one site only (Perkinsus Pond) were infected by the *Perkinsus*-like organism. Hence, rates of infection in all species of tadpole by capture dates were 6.1% (4 of 66) in February and 20% (2 of 10) in May. No infected tadpoles were found at the other sites; infections in *R. grylio*, *R. catesbeiana* and *R clamitans* were not found. In previously submitted tadpoles that were captured in December, 2002, (NWHC Pathology Report 18487, dated 28 Feb 2003) 12 (57.1%) of 21 larval *R. sphenocephala* (that were examined histologically) were infected by the *Perkinsus*-like organism. However, only 1 of 10 live tadpoles from this site was infected by the *Perkinsus*-like organism while 11 of 11 tadpoles that were found dead at the site were infected by the *Perkinsus*-like organism. Hence, during the course of a die-off due to infection by the *Perkinsus*-like organism essentially 100% of dead tadpoles have this infection while only 10% of live tadpoles have the infection. Even when a die-off appears to have abated at 8-10 weeks later (ie, 10 Feb 03), 26.7% of live tadpoles (4 of 15) may carry the infection, and 5 months later (ie, 19 May 03), 20% (2 of 10) of live tadpoles may have severe infections. Numerous other factors may contribute to the rates of infection among live tadpoles at a site; these include water temperature, host species, and density of larval populations (ie, crowding).

Microsporidiosis of skeletal muscle was diagnosed in one ranid species from one site collected on one date. All cases were minimal to mild infections and are deemed an incidental finding. It is unlikely this organism caused illness (morbidity) or mortality in the larval pig frogs, but because the organism is exceptionally small (about 1 x 2 microns) it may have been present in more organs and tissues than just the skeletal muscles. The precise identity of these microsporidia is unknown, but they may be the genera, Pleistophora or Microsporidium. Electron microscopy is necessary to identify microsporidia to genus and species. Similar muscle infections by microsporidia have been observed in larval Pacific treefrogs (*Pseudacris regilla*) from Oregon, and captive adult common toads (*Bufo bufo*) from England. It is possible the microsporidia in these larval pig frogs are the same species as those in *P. regilla* or *B. bufo*, but it also is possible these protozoa are a new genus or species.

Myxozoan infections were detected in the mesonephroi of only one *R. sphenocephala*. This parasite is fairly common in amphibians nationwide, and usually is detected in 50% or more of larvae from a site when it is found at a site. It is considered unusual that only 1 of 15 tadpoles from one pond was infected by this parasite. All myxozoa have complicated lifecycles, but the lifecycles of all parasitic myxozoa of amphibians have yet to be elucidated.

Helminthic infections were limited to pinworms in 79% of all tadpoles, ectoparasitic monogeans in tadpoles of 2 species from 1 site, and metacercarial infections of 3 tadpoles. Based on size, shape, color, location in hosts and age of hosts, the pinworms were considered typical of the ubiquitous pinworm of larval amphibians named *Gyrinicola batrachiensis*. Nearly all pinworms of all host vertebrates are considered innocuous parasites (they do not suck blood from the host nor burrow into the gut wall). Pinworm infection rates in larval *A. gryllus, R. catesbeiana, R. clamitans, R. grylio* and *R. sphenocephala* from all sites were 65%, 40%, 20%, 83.3% and 92.3%, respectively.

Metacercarial infections in these 100 tadpoles were rare. Only 3 tadpoles had evidence a few tiny encysted metacercariae within their body cavities. Encysted metacercariae of other genera and species in the stomachs,

pancreases, mesonephroi, skin and muscles of these tadpoles were not found. The significance of this exceptionally low prevalence of metacercariae in these tadpoles from this national wildlife refuge is unknown, but such a low prevalence is considered unusual. It suggests that other intermediate and final hosts for these parasites (aquatic snails, fish, fish- and frog-eating birds, etc) were not present at these sites, or were present in very low numbers.

Ectoparasites of the skin and gills were found in many tadpoles during dissections and histological examinations. The tiny worm-like parasites on the skin of all tadpoles from Stony Bayou #1 were identified as *Gyrodactylus* sp. No specific abnormalities of the skin were associated with this ectoparasite during histological examinations. Many tadpoles also had minimal to mild numbers of tiny ciliates in the gill chambers that were tentatively identified as *Trichodina* sp and *Epistylis* sp. Both genera of protozoa are common on the skin and gills of freshwater fish and amphibians; disease and mortality in amphibians have not been associated with these ciliates. The presence of these protozoa is interpreted as an incidental finding.

Chytrid fungal infections (oral chytridiomycosis) were not detected in any tadpoles in this group. However, nearly all the larval pig frogs had marked loss of black pigment (depigmentation) of the toothrows and jaw sheaths; while depigmentation often is due to oral chytridiomycosis, no chytrid organisms were detected in histological examinations in any of the 100 tadpoles in this report. The precise cause of the loss of pigment from the toothrows and jaw sheaths of the larval *R. grylio* remains undetermined.

Sites & Locations.
Amphibians were captured and submitted from 5 separate ponds within St Marks NWR in 2003. The sites and numbers of tadpoles (in parentheses) were Ring Pond (n= 16), Stony Bayou #1 (n= 16), Gum Forest Pond (n= 19), Jennifer Sink Pond (n= 10) and Perkinsus Pond (n= 39). In addition, 10 live and 14 dead fixed larval *R. sphenocephala* were captured and submitted from Perkinsus Pond in December, 2002; a final pathology report on these 24 tadpoles was completed and submitted on 28 Feb 2003 (NWHC case number 18487). A total of 124 tadpoles of 5 species from 5 ponds in St Mark NWR were submitted between December 2002 and August 2003.

Ring Pond. Larval pig frogs (*R. grylio*) were the only species submitted from this site in February, 2003. The site was not re-sampled in May or August. This site (pond) is potentially very interesting, because it was the only site in which tadpoles had microsporidial infections of their skeletal muscles; this microsporidial parasite may be a new disease of amphibians and may be worthy of further study and publications. Two other infectious diseases in pig frogs from this site were a second infection of the skeletal muscles by *Ichthyophonus* sp. in 3 (18.8%) of 16 tadpoles, and intestinal pinworms (*Gyrinicola batrachiensis*) in 14 (87.5%) of 16 larvae. None of the tadpoles from this site showed evidence of infection by the Perkinsus-like organism.

Gum Forest Pond. Larval southern leopard frogs (*R. sphenocephala*) were the only species submitted from this site in February, 2003. The site was not re-sampled in May and August. Three infectious diseases were detected in the 19 tadpoles from this site, including infection of the skeletal muscles by *Ichthyophonus* sp. in 2 (10.5%) of 19 tadpoles, unidentified encysted metacercariae in the body cavities of 2 (10.5%) of 19 tadpoles, and intestinal pinworms (*Gyrinicola batrachiensis*) in all 19 larvae. Infections by chytrid fungi, microsporidian, and the Perkinsus-like organism were not detected in these tadpoles.

Stony Bayou #1. Two larval pig frogs and 14 larval southern leopard frogs were captured at this site on one date (February, 2003). Only 2 parasitic infections were detected in these tadpoles: ectoparasitism by the monogean fluke, *Gyrodactylus* sp., and intestinal parasitism by the tadpole pinworm, *Gyrinicola batrachiensis*. The ectoparasites were found on every tadpole from this site, but the parasite was not found on tadpoles from any other site. Pinworms were detected in 10 of 14 southern leopard frogs and 1 of 2 pig frogs. No other infectious diseases were detected in the 16 tadpoles from this site.

Jennifer Sink Pond. Five larval bronze frogs and 5 larval bullfrogs were captured at this site on one date (August, 2003). Although many of these 10 tadpoles were thought to have swollen livers during dissections (necropsy diagnoses), no organisms were isolated in cultures and the livers appeared normal on histological slides. Intestinal pinworms and

one metacercaria were the only infectious diseases in these 10 tadpoles. There was no evidence of viral, bacterial, fungal, protistan and protozoal infections in tadpoles from this site.
Perkinsus Pond. A total of 39 tadpoles (and one tiny unidentified fish) of 2 species were collected from this site on 3 dates (February, May and August 2003). The name of this pond appears to have shifted or evolved over time; initially, this site was identified as "Panacea Unit" and site 04SMNWR10FEB0304.

Three distinct infectious and parasitic diseases were detected in the 19 larval southern leopard frogs and 20 larval Florida cricket frogs. These infections were *Perkinsus*-like organisms (6 tadpoles), renal myxozoa (1 tadpole), and intestinal pinworms (32 tadpoles). Infection by the *Perkinsus*-like organism was severe and systemic in 5 tadpoles and only mild in 1 tadpole. It is likely the tadpoles with the severe systemic infections would have died in 12-48 hr. Based on histological findings only, 4 (26.7%) of 15 larval *R. sphenocephala* were infected by the *Perkinsus*-like organism in February, 2003, while in May, 2003, 1 (25%) of 4 larval *R. sphenocephala* were infected; no larval leopard frogs were captured or examined in August, 2003. Among the larval *A. gryllus*, 1 (16.7%) of 6 tadpoles were infected in May, 2003, but 0 of 20 tadpoles were found with the infection in August, 2003. If the larval *R. sphenocephala* from December, 2002 (NWHC case #18487) are included, then the infection rates in leopard frogs only were 57.1% (12 of 21) in December, 2002, 26.7% (4 of 15) in February, 2003, and 25% (1 of 4) in May, 2003. These rates of infection suggest that this disease tends to persist at a site for >6 months following the initial observed onset of the die-off. These persistently high infection rates suggest this disease may kill >90% of ranid larvae at a site, thus resulting in negligible recruitment for that season.

All amphibians from this site were tadpoles. The tadpoles ranged in age from Gosner stages 25 to 28 in February and were Gosner stages 25 to 35 in May, 2003. The tadpoles from the previous case and report (NWHC case 18487) that were collected in December, 2002, were Gosner stages 25 to 29. This range in ages/stages suggests multiple breeding events in *R. sphenocephala* occurred between December 2002 and May, 2003. Tadpoles with infections by the *Perkinsus*-like organism were Gosner stages 25 and 26 in December, 2002, and were Gosner stages 25, 26 and 27 in February, 2003; the one infected tadpole in May, 2003, was Gosner stage 25. Hence, there is some tentative evidence that persistence of this disease agent at a site may depend on continued presence of hosts of a suitable age.

Renal myxozoa, due to infection by *Leptotheca ohlmacheri*, was detected in only one tadpole from this site in 2003. However, 2 of 16 tadpoles captured in December, 2002 (NWHC case 18487) also had this infectious disease. This parasite was not detected in larvae from any of the other 4 sites within the refuge. Illness (morbidity) and mortality have not been associated with this parasite, but infection rates in a population (in a pond) usually are much higher than 6.7% (1 of 15 tadpoles). It is possible this parasite has a seasonal lifecycle in which the parasite is mostly dormant during the winter and early spring; this could explain the low infection rate at this site. However, nothing is known or published on the lifecycles of amphibian myxozoan parasites, so any attempted explanation for the low prevalence of infection is speculative.

Larval anuran pinworms in these tadpoles were tentatively identified as *Gyrinicola batrachiensis* based on the size, shape, color, host's age and location in the hosts. All 19 larval *R. sphenocephala* were infected by this pinworm, and 13 of 20 larval *A. gryllus* were infected. This parasite was found in at least one tadpole of every species from every site and every capture date. This pinworm has been observed in tadpoles nationwide and is considered innocuous.

SUMMARY & RECOMMENDATIONS:
One serious infectious disease was detected in 2 species of anurans from this refuge in 2003. This disease is an infection by a primitive protozoan-like or primitive fungus-like organism ("protist") that is identified as a *Perkinsus*-like organism. This disease agent was previously reported from this refuge in sick and dead tadpoles that were found in December, 2002 (NHWC case report 18487). Although the rates of infection by this organism appears to have declined from 57% in December to 25-27% in May and August, 2003, these infection rates are considered unusually high for a generally lethal disease agent and suggest very poor recruitment of newly metamorphosed frogs from the site. The *Perkinsus*-like organism was not detected in histological examinations of 61 tadpoles from 4 other ponds within the refuge. Hence, it is possible this infectious disease is localized within the refuge to this pond. Management methods and control measures to prevent spread of this infectious disease by human activities appear warranted. At a minimum, these

methods should include a ban on translocation of animals, plants, and sediments from Perkinsus Pond to any other wetland. Machinery, boats and instruments that are used in this pond should be washed and disinfected with a bleach solution before being moved and used in other wetlands.

No other serious infectious diseases were confirmed in these 100 tadpoles. However, two cricket frogs from Perkinsus Pond which were dead on arrival had histological abnormalities suggestive of a virus infection; virus cultures of these tadpoles were negative. Hence, it is possible more than one lethal infectious disease is present at Perkinsus Pond. Additional monitoring of larval amphibians at this site appears warranted, because it should not be assumed any future die-offs among tadpoles is due only to infection by the *Perkinsus*-like organism.
Two new infectious diseases were detected in amphibians from this refuge. The first disease was ectoparasitism (skin infection) by the monogean trematode, *Gyrodactylus* sp. This parasite has not been previously seen or diagnosed in larval amphibians at this Center, but may be more common in southern, warmer regions of the USA or those sites where fish and larval amphibians are sympatric in a pond. No specific skin irritation or damage was observed in the affected tadpoles, so this parasite may be innocuous. The second new infectious disease was a microsporidian (protozoan) infection of the skeletal muscle cells of 5 larval pig frogs from one site (Ring Pond). Similar microsporidian parasites have been detected in frogs and toads from Oregon and England, but the precise identity (genus and species) of this minute organism can be determined only by electron microscopy. Additional studies of this parasite in larval *R. grylio* are warranted.

Although the presence of the usually lethal *Perkinsus*-like organism in tadpoles from one site in this refuge is troublesome, it should be noted that two other serious lethal infectious diseases were **not** detected in these 100 tadpoles, namely ranaviral infection and chytridiomycosis. Although there is a tentative diagnosis of ranaviral-like abnormalities in 2 cricket frogs that were dead on arrival at the diagnostic lab, no viruses were isolated in cultures of these 2 tadpoles and 72 other tadpoles.

Our Center will welcome the submission of any additional amphibians, reptiles, birds and small mammals that are involved in disease outbreaks or die-offs at this refuge and adjacent regions. Sick or dying wildlife may be submitted for diagnostic examinations at no charge to the submitter. However, please contact our Center by phone or electronic mail prior to mailing any specimens.

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Pathologist: D. Earl Green, D.V.M.
Diplomate, Amer. Coll. Vet. Pathol.

04-SMNWR = Perkinsus Pond
01-SMNWR = Stony Bayou #1
02-SMNWR = Ring Pond
03-SMNWR = Gum Forest Pond
Panacea Unit = Perkinsus Pond

This info obtained by phone from Jamie Barochovich on 23 Nov 04

Appendix II. National Wildlife Health Synopsis of Amphibian Health Screenings from the Southeast USGS ARMI region.

NATIONAL WILDLIFE HEALTH CENTER
6006 SCHROEDER ROAD
MADISON, WI 53711-6223
PHONE: (608) 270-2400 FAX: (608) 270-2415

Amphibians from Southeast ARMI Region

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
Alligator River NWR					
R sphenocephala					
Larva	5/12/2004	19066-001	4.160	Susp. Perkinsus-like organism	SQ effusion in L foot
Larva	5/12/2004	19066-002	4.420	Oral saprolegniasis	
Larva	5/12/2004	19066-003	6.150	Susp. Perkinsus-like organism	SQ effusion in HLs
Anderson Co (TN), Univ Tenn Arboretum					
P crucifer					
Adult	3/3/2004	19017-002	3.170	Open	Suspect heavy metal poisoning
Adult	3/3/2004	19017-003	1.700	Caustic skin burns	Suspect heavy metal poisoning
Adult	3/3/2004	19017-004	1.440	Open	Suspect heavy metal poisoning
Adult	3/3/2004	19017-005	2.010	Open	Suspect heavy metal poisoning
P sp					
Adult	3/3/2004	19017-008	0.870	Severe desiccation	Suspect heavy metal poisoning
P triseriata feriarum					
Adult	3/3/2004	19017-006	1.780	Open	Suspect heavy metal poisoning
Adult	3/3/2004	19017-007	3.150	Open	Suspect heavy metal poisoning
Everglades NP					
H cinerea					
Adult	4/2/2002	18120-001	5.450	Ranavirus isolated	Lungworm (*Rhabdias* sp.)
Adult	8/13/2003	18766-001	6.230	Skin ulcer	Renal oligochaete (*Dera hylae*)
Adult	8/13/2003	18766-002	8.770	Skin ulcers (3)	Renal oligochaete (*Dera hylae*)
O septentrionalis					
Adult	8/13/2003	18766-003	6.630	Renal oligochaetes (*Dera hylae*)	Splenitis
Adult	8/13/2003	18766-004	7.770	Renal oligochaetes (*Dera hylae*)	
Graham Co (NC), Stecoah Gap @ Appalachian Trail					
P cheoah					
Adult	10/24/2001	4765-099	4.240	***Salmonella*** sp. isolated	Pinworm
Adult	10/24/2001	4765-100	3.160	Normal	Brachyphalangy of LFL-I
Adult	10/24/2001	4765-101	2.970	Two spleens	
Adult	10/24/2001	4765-102	2.460	Normal	
Adult	10/24/2001	4765-103	1.240	Normal	Skin ulcer at vent
P teyahalee					
Adult	10/24/2001	4765-104	4.300	Normal	
Adult	10/24/2001	4765-105	2.580	Dysecdysis	Hydrocoelom
Adult	10/24/2001	4765-106	2.250	Normal	Bladder flukes
Adult	10/24/2001	4765-107	0.960	Normal	
Great Smoky Mountains NP, Cades Cove					
N viridescens					
Adult	5/22/2003	18659-001	7.880	Cause of death not determined	Autolysis & freeze artefacts
GSMNP, site not specified					
G porphyriticus danielsi					
Larva	3/30/2000	16826-001	0.970	*Dermosporidium*-like head nodule	

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
GSMNP Elkmont					
R sylvatica					
Adult	2/14/2001	17140-007	20.150	Multiple HL fractures	Renal metacercaria
Adult	2/14/2001	17140-008	25.600	Crushed skull (predation)	Autolysis
Adult	2/14/2001	17140-009	47.900	Crushed skull (predation)	Lungworm (Rhabdias)
GSMNP Finby Cave, Sinkhole 3					
R sylvatica					
Adult	2/12/2001	17140-010	41.800	Scavenged carcass	Autolysis
Adult	2/12/2001	17140-011	40.800	Autolysis	
Adult	2/12/2001	17140-012	45.400	Scavenged carcass	Autolysis
Adult	2/12/2001	17140-013	26.700	Scavenged carcass	Autolysis
Adult	2/12/2001	17140-014	36.500	Scavenged carcass	Autolysis
GSMNP Gourley Pond					
A maculatum					
Larva		4765-023	0.000	Autolysis	
Adult	2/15/2001	17213-005	19.510	Susp Ichthyophoniasis	Renal parasite
Larva	5/21/2001	4765-055	0.250	Autolysis (DoA)	
Larva	5/21/2001	4765-056	0.320	Autolysis (DoA)	
Larva	5/21/2001	4765-057	0.510	Normal	
Larva	5/21/2001	4765-058	0.340	Normal	
Larva	5/21/2001	4765-059	0.360	Normal	
Larva	5/21/2001	4765-060	0.480	Normal	
Larva	5/21/2001	4765-061	0.560	Normal	
Larva	5/21/2001	4765-062	0.460	Normal	Skin petechia
Larva	5/21/2001	4765-063	0.460	Normal	Splenomegaly
Larva	5/21/2001	4765-064	0.450	Normal	Skin petechia
Larva	5/21/2001	4765-065	0.470	Normal	
Larva	5/21/2001	4765-066	0.260	Normal	Petechia at vent
Larva	5/21/2001	4765-067	0.250	Normal	Skin petechia
Larva	5/21/2001	4765-068	0.210	Normal	
Larva	5/21/2001	4765-069	0.260	Normal	Small spleen
Larva	5/21/2001	4765-070	0.290	Normal	
Larva	5/21/2001	4765-071	0.230	Normal	
Larva	5/21/2001	4765-072	0.150	Normal	Skin petechia
Larva	5/21/2001	4765-073	0.230	Normal	
Larva	5/21/2001	4765-074	0.170	Normal	
Larva	5/21/2001	4765-075	0.300	Normal	Skin petechia
Larva	5/21/2001	4765-076	0.340	Normal	Skin petechia
Larva	5/21/2001	4765-077	0.210	Normal	
Larva	5/21/2001	4765-078	0.210	Normal	
Larva	5/21/2001	4765-079	0.180	Normal	
Larva	5/21/2001	4765-080	0.300	Normal	
Larva	5/21/2001	4765-081	0.190	Normal	
Larva	5/21/2001	4765-082	0.230	Normal	Skin petechia
Larva	5/21/2001	4765-083	0.160	Normal	Skin petechia
Larva	5/21/2001	4765-084	0.230	Normal	

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
GSMNP Gourley Pond					
A maculatum					
Larva	5/21/2001	4765-085	0.340	Normal	
Larva	5/21/2001	4765-086	0.300	Normal	Petechia at vent
Larva	5/21/2001	4765-087	0.320	Normal	
Larva	5/21/2001	4765-088	0.170	Normal	
Larva	5/21/2001	4765-089	0.320	Normal	Skin petechia
Larva	5/21/2001	4765-090	0.270	Normal	
Larva	5/21/2001	4765-091	0.240	Normal	Skin petechia
Larva	5/21/2001	4765-092	0.250	Normal	
Larva	5/21/2001	4765-093	0.250	Normal	
Fish: Dace					
Adult	5/21/2001	4765-001	4.280	Autolysis	Molluscs on gills
Adult	5/21/2001	4765-002	0.870	Autolysis	
N viridescens					
Adult	2/12/2001	17140-001	1.480	Advanced autolysis with watermold	
Adult	2/12/2001	17140-002	1.370	Advanced autolysis with watermold	Gut nematodes
Adult	2/12/2001	17140-003		Advanced autolysis with watermold	
Adult	2/12/2001	17140-004		Advanced autolysis with watermold	
P crucifer					
Adult	4/21/2001	17213-001	1.370	Autolysis	
P feriarum					
Adult	4/23/2001	17213-006	1.500	Normal	
R palustris					
Adult	3/16/2001	17213-003	16.400	Autolysis	
Adult	3/19/2001	17213-002	14.020	Autolysis	Lungworms (Rhabdias)
R sylvatica					
Adult	2/15/2001	17213-004	17.570	Autolysis	Renal metacercaria
Larva	5/16/2001	4765-004	0.770	Ranavirus isolated	Nematode in liver
Larva	5/16/2001	4765-005	1.090	Ranavirus isolated	Oral saprolegniasis
Larva	5/16/2001	4765-006	0.730	Ranavirus isolated	Autolysis
Larva	5/16/2001	4765-007	0.630	Ranavirus isolated	
Larva	5/21/2001	4765-008	3.230	Ichthyophoniasis	Pinworm
Larva	5/21/2001	4765-009	1.970	Normal	Pinworms
Larva	5/21/2001	4765-010	2.220	Ichthyophoniasis	Pinworms
Larva	5/21/2001	4765-011	2.150	Ichthyophoniasis	Susp Ranavirus (splenitis & nephritis)
Larva	5/21/2001	4765-012	1.980	Autolysis	
Larva	5/21/2001	4765-013	2.400	Hydrocoelom	Pinworms
Larva	5/21/2001	4765-014	2.070	Susp Ranavirus (hepatitis & nephritis)	Nematode in gall bladder
Larva	5/21/2001	4765-015	2.240	Susp Ranavirus (Hepatitis & splenitis)	Ichthyophoniais
Larva	5/21/2001	4765-016	0.390	Autolysis	
Larva	5/21/2001	4765-017	1.460	Autolysis	
Larva	5/21/2001	4765-018	1.320	Autolysis	
Larva	5/21/2001	4765-019	1.530	Autolysis	
Larva	5/21/2001	4765-020	1.160	Autolysis	

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
GSMNP Gourley Pond					
R sylvatica					
Larva	5/21/2001	4765-021	0.670	Normal	
Larva	5/21/2001	4765-022	1.570	Autolysis	
Larva	5/21/2001	4765-024	1.330	Autolysis	
Larva	5/21/2001	4765-025	1.910	Ichthyophoniasis	Pinworms
Larva	5/21/2001	4765-026	1.770	Normal	Pinworms
Larva	5/21/2001	4765-027	1.590	Autolysis	Pinworms
Larva	5/21/2001	4765-028	1.630	Autolysis	Pinworms
Larva	5/21/2001	4765-029	1.150	Autolysis	
Larva	5/21/2001	4765-030	1.110	Autolysis	
Larva	5/21/2001	4765-031	1.100	Autolysis	Pinworms
Larva	5/21/2001	4765-032	1.500	Autolysis	Pinworms
Larva	5/21/2001	4765-033	1.350	Autolysis	Pinworms
Larva	5/21/2001	4765-034	1.750	Autolysis	Pinworms
Larva	5/21/2001	4765-035	1.550	Autolysis	Pinworms
Larva	5/21/2001	4765-036	0.590	Autolysis	
Larva	5/21/2001	4765-037	0.810	Susp Ichthyophoniasis	
Larva	5/21/2001	4765-038	2.910	Autolysis	
Larva	5/21/2001	4765-039	1.660	Autolysis	
Larva	5/21/2001	4765-040	0.880	Autolysis	
Larva	5/21/2001	4765-041	1.830	Normal	
Larva	5/21/2001	4765-042	1.750	Normal	
Larva	5/21/2001	4765-043		Autolysis (DoA)	
Larva	5/21/2001	4765-044		Autolysis (DoA)	
Larva	5/21/2001	4765-045		Autolysis (DoA)	
Larva	5/21/2001	4765-046		Autolysis (DoA)	
Larva	5/21/2001	4765-047		Autolysis (DoA)	
Larva	5/21/2001	4765-048		Autolysis (DoA)	
Larva	5/21/2001	4765-049		Autolysis (DoA)	
Larva	5/21/2001	4765-050		Autolysis (DoA)	
Larva	5/21/2001	4765-051		Autolysis (DoA)	
Larva	5/21/2001	4765-052		Autolysis (DoA)	
Larva	5/21/2001	4765-053	0.810	Autolysis (DoA)	
Larva	5/21/2001	4765-054	0.310	Autolysis (DoA)	
GSMNP Methodist Pond					
R sylvatica					
Adult	2/15/2001	17140-006	18.300	Advanced autolysis with watermold	Chin skin laceration
GSMNP Oliver Fields					
P feriarum					
Adult	2/12/2001	17140-005	4.220	Advanced autolysis with watermold	
GSMNP Wildcat Creek					
P serratus					
Adult	5/7/2001	4765-003	1.200	Dysecdysis & autolysis	Susp skin ulcers

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
Monroe Co (TN), Hwy 165, 13miles E of Jtn w/Hwy					
P aureolatus					
Adult	10/25/2001	4765-094	3.190	Normal	Gut fluke & pinworms
Adult	10/25/2001	4765-095	2.680	Normal	Pinworm
Adult	10/25/2001	4765-096	1.910	Normal	
Adult	10/25/2001	4765-097	1.630	Normal	
Adult	10/25/2001	4765-098	1.640	Normal	
Okefenokee NWR, site not reported					
H femoralis					
Adult	6/26/2001	17284-001	1.400	Open	Chiggers (Hannemania sp)
St Marks NWR Gum Forest Pond					
R sphenocephala					
Larva	2/10/2003	4864-016	1.990	Gill protozoa	Pinworms
Larva	2/10/2003	4864-017	1.500	Pinworms	
Larva	2/10/2003	4864-018	2.260	Ichthyophoniasis	Pinworms
Larva	2/10/2003	4864-019	2.020	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-020	0.650	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-021	1.750	Mild hydrocoelom	Pinworms
Larva	2/10/2003	4864-022	2.090	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-023	1.720	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-024	1.230	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-025	3.300	Suspect Ichthyophoniasis	Pinworms
Larva	2/10/2003	4864-026	2.400	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-027	2.480	Pinworms	
Larva	2/10/2003	4864-028	1.430	Pinworms	
Larva	2/10/2003	4864-029	0.730	Pinworms	
Larva	2/10/2003	4864-030	3.770	Pinworms	
Larva	2/10/2003	4864-031	3.240	Pinworms	
Larva	2/10/2003	4864-032	1.040	Pinworms	
Larva	2/10/2003	4864-033	1.090	Pinworms	
Larva	2/10/2003	4864-034	0.390	Pinworm	
St Marks NWR Jennifer Sink Pond					
R catesbeiana					
Larva	8/16/2003	4864-097	2.530	Normal	Autolysis
Larva	8/16/2003	4864-098	1.550	Normal	Autolysis
Larva	8/16/2003	4864-099	1.550	Metacercaria in body cavity	
Larva	8/16/2003	4864-100	1.380	Pinworms	
Larva	8/16/2003	4864-101	5.720	Pinworm	
R clamitans					
Larva	8/16/2003	4864-084	0.740	Autolysis	
Larva	8/16/2003	4864-085	0.640	Autolysis	
Larva	8/16/2003	4864-086	1.080	Normal	Autolysis
Larva	8/16/2003	4864-087	0.610	Normal	
Larva	8/16/2003	4864-088	0.880	Pinworm	

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
St Marks NWR Perkinsus Pond					
A gryllus dorsalis					
Larva	5/19/2003	4864-071	0.160	Pinworm	Autolysis
Larva	5/19/2003	4864-072	0.150	Perkinsus-like organism	Autolysis
Larva	5/19/2003	4864-073	0.210	Autolysis	Pinworms
Larva	5/19/2003	4864-074	0.400	Autolysis	Pinworms
Larva	5/19/2003	4864-075	0.390	Pinworm	
Larva	5/19/2003	4864-076	0.490	Pinworms	
Larva	8/18/2003	4864-078	0.340	Autolysis	Pinworm
Larva	8/18/2003	4864-079	0.350	Autolysis	
Larva	8/18/2003	4864-080	0.450	Autolysis	Pinworms
Larva	8/18/2003	4864-081	0.630	Autolysis	Pinworms
Larva	8/18/2003	4864-082	0.600	Autolysis	Pinworm
Larva	8/18/2003	4864-083	0.100	Autolysis	
Larva	8/18/2003	4864-089	0.460	Autolysis	Pinworms
Larva	8/18/2003	4864-090	0.500	Autolysis	
Larva	8/18/2003	4864-091	0.600	Autolysis	
Larva	8/18/2003	4864-092	0.730	Autolysis	Pinworms
Larva	8/18/2003	4864-093	0.620	Autolysis	
Larva	8/18/2003	4864-094	0.440	Autolysis	
Larva	8/18/2003	4864-095	0.470	Pinworm	
Larva	8/18/2003	4864-096	0.490	Pinworms	
Fish, Minnow					
Adult	5/19/2003	4864-077	0.010	Normal	
R sphenocephala					
Larva	12/19/2002	18487-005	1.520	Pneumonia	
Larva	12/19/2002	18487-006	0.770	Normal	
Larva	12/19/2002	18487-007	1.860	Normal	
Larva	12/19/2002	18487-008	1.490	Normal	Pinworms
Larva	12/19/2002	18487-009	3.400	Normal	
Larva	12/19/2002	18487-010	0.800	Anuraperkinsosis	
Larva	12/19/2002	18487-011	3.580	Anuraperkinsosis	
Larva	12/19/2002	18487-012	0.950	Anuraperkinsosis	
Larva	12/19/2002	18487-013	0.870	Normal	
Larva	12/19/2002	18487-014	0.510	Normal	Pinworms
Larva	12/19/2002	18487-015	1.320	Anuraperkinsosis	
Larva	12/19/2002	18487-016	1.710	Anuraperkinsosis	Renal myxozoa
Larva	12/19/2002	18487-017		Anuraperkinsosis	Renal myxozoa
Larva	12/19/2002	18487-018	0.470	Normal	
Larva	12/19/2002	18487-019	0.700	Anuraperkinsosis	
Larva	12/19/2002	18487-020	0.520	Anuraperkinsosis	
Larva	12/19/2002	18487-021	0.950	Anuraperkinsosis	
Larva	12/19/2002	18487-022	1.040	Anuraperkinsosis	
Larva	12/19/2002	18487-023	0.970	Anuraperkinsosis	
Larva	12/19/2002	18487-024	0.220	Autolysis	Pinworms
Larva	2/10/2003	4864-001	1.170	Renal myxozoa	Pinworms
Larva	2/10/2003	4864-002	1.600	Pinworms	

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
St Marks NWR Perkinsus Pond					
R sphenocephala					
Larva	2/10/2003	4864-003	0.570	Perkinsus-like organism	Pinworms
Larva	2/10/2003	4864-004	0.600	Pinworms	
Larva	2/10/2003	4864-005	1.530	Pinworms	
Larva	2/10/2003	4864-006	0.760	Pinworms	
Larva	2/10/2003	4864-007	0.990	Pinworms	
Larva	2/10/2003	4864-008	0.260	Perkinsus-like organism	Pinworms
Larva	2/10/2003	4864-009	2.060	Perkinsus-like organism	Pinworms
Larva	2/10/2003	4864-010	1.550	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-011	1.250	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-012	3.020	Perkinsus-like organism	Pinworms
Larva	2/10/2003	4864-013	1.630	Pinworms	
Larva	2/10/2003	4864-014	1.710	Protozoal gastritis	Pinworms
Larva	2/10/2003	4864-015	1.460	Protozoal gastritis	Pinworms
Larva	5/19/2003	4864-067	0.530	Perkinsus-like organism	Pinworms
Larva	5/19/2003	4864-068	0.610	Pinworm	
Larva	5/19/2003	4864-069	0.930	Pinworms	
Larva	5/19/2003	4864-070	3.010	Pinworms	
St Marks NWR Prairie Pond					
R sphenocephala					
Larva	12/18/2002	18487-001	0.550	Plaques in tail fins	
Larva	12/18/2002	18487-002	1.030	Normal	
Larva	12/18/2002	18487-003	1.070	Normal	
Larva	12/18/2002	18487-004	0.920	Verminous hepatitis	Granulomas in pancreas & gut
St Marks NWR Ring Pond					
R grylio					
Larva	2/10/2003	4864-049	1.350	Erosion on spectacle	Pinworms
Larva	2/10/2003	4864-050	1.300	Depigmented toothrows	Oral multivacuolated protozoa
Larva	2/10/2003	4864-051	1.560	Depigmented toothrows	Pinworm
Larva	2/10/2003	4864-052	2.720	Depigmented toothrows	Pinworm & Microsporidial myositis
Larva	2/10/2003	4864-053	0.810	Depigmented toothrows	Pinworms
Larva	2/10/2003	4864-054	1.000	Depigmented toothrows	Pinworms & Gill protozoa
Larva	2/10/2003	4864-055	1.640	Depigmented toothrows	Vacuolated spherules in skin
Larva	2/10/2003	4864-056	2.140	Depigmented toothrows	Microsporidial myositis
Larva	2/10/2003	4864-057	3.410	Depigmented toothrows	Microsporidial myositis
Larva	2/10/2003	4864-058	1.760	Suspect adenoviral gastritis	Pinworms
Larva	2/10/2003	4864-059	2.470	Depigmented toothrows	Pinworms
Larva	2/10/2003	4864-060	1.030	Microsporidial myositis	Ichthyophoniasis
Larva	2/10/2003	4864-063	1.680	Microsporidial myositis	Ichthyophoniasis & pinworms
Larva	2/10/2003	4864-064	0.970	Depigmented toothrows	Pinworms
Larva	2/10/2003	4864-065	5.630	Depigmented toothrows	Pinworms
Larva	2/10/2003	4864-066	0.460	Depigmented toothrows	Skin micro-cysts
St Marks NWR Stony Bayou #1					
R grylio					
Larva	2/10/2003	4864-061	0.470	Depigmented toothrows	Ectoparasitism by ***Gyrodactylus*** sp.
Larva	2/10/2003	4864-062	0.540	Pinworm	Ectoparasitism by ***Gyrodactylus*** sp.

Life Stage	Capt Date	Case/Ac	Mass	PrimaryDx	MinorDx
St Marks NWR Stony Bayou #1					
R sphenocephala					
Larva	2/10/2003	4864-035	0.180	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-036	0.210	Ectoparasitism by Gyrodactylus sp.	Pinworms
Larva	2/10/2003	4864-037	0.160	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-038	0.160	Ectoparasitism by Gyrodactylus sp.	
Larva	2/10/2003	4864-039	0.140	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-040	0.220	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-041	0.490	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-042	0.170	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-043	0.190	Ectoparasitism by Gyrodactylus sp.	
Larva	2/10/2003	4864-044	0.440	Ectoparasitism by Gyrodactylus sp.	Pinworm
Larva	2/10/2003	4864-045	0.730	Ectoparasitism by Gyrodactylus sp.	
Larva	2/10/2003	4864-046	1.050	Ectoparasitism by Gyrodactylus sp.	
Larva	2/10/2003	4864-047	0.910	Ectoparasitism by Gyrodactylus sp.	Pinworms
Larva	2/10/2003	4864-048	1.610	Ectoparasitism by Gyrodactylus sp.	Pinworm
Wheeler NWR, Cain's Landing					
R sphenocephala					
Larva	5/25/2004	19081-001	0.410	Heavy mesocercarial parasitism (coelomitis)	Renal metacercariae
Larva	5/25/2004	19081-002	0.530	Heavy mesocercarial parasitism (coelomitis)	Renal metacercariae
Larva	5/25/2004	19081-003	0.320	Heavy mesocercarial parasitism (coelomitis)	Renal metacercariae
Larva	5/25/2004	19081-004	0.150	Heavy mesocercarial parasitism (coelomitis)	Renal metacercariae
Larva	5/25/2004	19081-005	0.300	Heavy mesocercarial parasitism (coelomitis)	Renal metacercariae
Larva	5/25/2004	19081-006	0.080	Heavy mesocercarial parasitism (coelomitis)	
Larva	5/25/2004	19081-007	0.120	Heavy mesocercarial parasitism (coelomitis)	Depigmented upper jaw
Larva	5/25/2004	19081-008	0.200	Heavy mesocercarial parasitism (coelomitis)	

D. Earl Green, DVM, DACVP
USGS, National Wildlife Health Center
6006 Schroeder Road
Madison WI 53711
Tel: 608-270-2482
Fax: 608-270-2415
david_green@USGS.gov

Appendix III: List of digital images of amphibians and reptiles in 2004 at Harris Neck National Wildlife Refuge, during the USGS-SEARMI research and monitoring project.

Agkistrodon contortrix contortrix	Southern Copperhead	ACON.JPG
Alligator mississipiensis	American Alligator	AMIS.JPG
Bufo terrestris	Southern Toad	BTER.JPG
Deirochelys reticularia	Eastern Chicken Turtle	DRET.JPG
Elaphe alleghaniensis (=*E. obsoleta*)	Eastern Ratsnake	EALL.JPG
Gopherus polyphemus	Gopher Tortoise	GPOL.JPG
Hyla cinerea	Green Treefrog	HCIN(larvae).JPG, HCIN.JPG
Hyla femoralis	Pine Woods Treefrog	HFEM (larvae).JPG
Hyla squirella	Squirrel Treefrog	HSQU.JPG
Kinosternon subrubrum subrubrum	Eastern Mud Turtle	KSUB.JPG
Nerodia fasciata fasciata	Banded Watersnake	NFAS.JPG
Notophthalmus viridescens louisianensis	Central Newt	NVIR(gilled).JPG
Pseudacris crucifer bartramiana	Southern Spring Peeper	PCRU(larvae).JPG, PCRU.JPG
Pseudacris ocularis	Little Grass Frog	POCU.JPG
Rana catesbeiana	American Bullfrog	RCAT (larvae).JPG
Rana grylio	Pig Frog	RGRY.JPG
Rana sphenocephala utricularia	Southern Leopard Frog	RSPH (larvae).JPG
Thamnophis sauritus	Ribbonsnake	TSAU.JPG

ACON.JPG

AMIS.jpg

BTER.JPG

DRET.jpg

EALL.JPG

GPOL.JPG

HCIN (larvae).jpg

HCIN.jpg

HFEM (larvae).jpg

HSQU.jpg

KSUB.jpg

NFAS.jpg

NVIR (gilled).jpg

OAES.JPG

PCRU (larvae).jpg

PCRU.jpg

POCU (larvae).JPG

POCU.JPG

RCAT (larvae).jpg

RGRY.JPG

RSPH (larvae).jpg

RSPH.jpg

TSAU.JPG

Appendix III: List of digital images of project sites taken in 2004 at Harris Neck National Wildlife Refuge, during the USGS-SEARMI research and monitoring project.

Borrow Pit Pond	BorrowPit.JPG
Goose Pond	Goose.JPG
Lucas Pond	Lucas.JPG
Lucas Borrow Pit	LucasBorrowPit.JPG
Seep west of Lucas Pond	LucasSeep.JPG
Snipe Pond	Snipe.JPG
Teal Pond	Teal.JPG
Wigeon Pond	Wigeon.JPG
Woody Pond	Woody Pond April04.JPG, Woody.JPG
Swamp below Woody dike	WoodySwamp.JPG

BorrowPit.jpg

Goose.jpg

Lucas.jpg

LucasBorrowPit.jpg

LucasSeep.jpg

Snipe.jpg

Teal.jpg

Wigeon.jpg

Woody Pond April04.JPG

Woody.jpg

WoodySwamp.jpg

Appendix III: List of digital images of amphibians and reptiles in 2004 at Savannah National Wildlife Refuge, during the USGS-SEARMI research and monitoring project.

Anolis carolinensis carolinensis	Northern Green Anole	ACAR.JPG
Agkistrodon contortrix contortrix	Southern Copperhead	ACON.JPG
Acris gryllus gryllus	Coastal Plain Cricket Frog	AGRY (larvae).JPG, AGRY.JPG
Amphiuma means	Two-toed Amphiuma	AMEA
Alligator mississipiensis	American Alligator	AMIS.JPG
Ambystoma opacum	Marbled Salamander	APOA (larvae).JPG, APOA (metamorph).JPG, APOA.JPG
Agkistrodon piscivorus	Cottonmouth	APIS.JPG
Bufo fowleri	Fowler's Toad	BFOW calling male.JPG, BFOW.JPG
Desmognathus auriculatus	Southern Dusky Salamander	DAUR.JPG
Elaphe alleghaniensis (=*E. obsoleta*)	Eastern Ratsnake	EALL.JPG
Hyla chrysoscelis	Cope's Gray Treefrog	HCHR.JPG
Kinosternon subrubrum subrubrum	Eastern Mud Turtle	KSUB.JPG
Nerodia fasciata fasciata	Banded Watersnake	NFAS.JPG.JPG
Nerodia taxispilota	Brown Watersnake	NTAX.JPG
Notophthalmus viridescens	Eastern Newt	NVIR.JPG
Pseudacris crucifer crucifer	Northern Spring Peeper	PCRU.JPG
Plethodon variolatus	South Carolina Slimy Salamander	PVAR.JPG
Rana catesbeiana	American Bullfrog	RCAT.JPG
Rana clamitans clamitans	Bronze Frog	RCLA (larvae).JPG, RCLA.JPG
Rana grylio	Pig Frog	RGRY.JPG
Rana heckscheri	River Frog	RHEC.JPG
Rana sphenocephala utricularia	Southern Leopard Frog	RSPH.JPG
Siren lacertina	Greater Siren	SLAC.JPG
Terrapene carolina carolina	Eastern Box Turtle	TCAR.JPG

ACAR.jpg

ACON.JPG

AGRY (larvae).jpg

AGRY.jpg

AMEA.jpg

AMIS.jpg

AOPA (larvae).jpg

AOPA (metamorph).jpg

AOPA.JPG

APIS.JPG

BFOW calling male.JPG

BFOW.JPG

DAUR.JPG

EALL.jpg

HCHR.JPG

KSUB.JPG

NFAS.JPG

NTAX.JPG

NVIR.jpg

PCRU tadpole.JPG

PVAR.JPG

RCAT.jpg

RCLA (larvae)JPG

RCLA.JPG

RGRY.jpg

RHEC.JPG

RSPH.JPG

SLAC.jpg

TCAR.JPG

Appendix III: List of digital images of project sites taken in 2004 at Savannah National Wildlife Refuge, during the USGS-SEARMI research and monitoring project.

Typical woodland pools on Bear Island	Bear Island.JPG, BearIs.JPG, BearIsAopacum.JPG
Impoundment adjacent to work compund	headquarters pond.JPG
Kingfisher Pond	Kingfisher.JPG
ST-1	north slope.JPG
DT-4	SavDT4.JPG
ST-3	SavST3.JPG
WD-3	SavWD3.JPG
WD-4	SavWD4.JPG

Bear Island.JPG

BearIs.jpg

BearIsAopacum.jpg

headquarters pond.JPG

Kingfisher.jpg

north slope.JPG

SavDT4.jpg

SavST3.jpg

SavWD3.jpg

SavWD4.jpg

APPENDIX IV

Sampling Schedule and Field Notes, 2004
Harris Neck and Savannah National Wildlife Refuges

January

27. Drove to Harris Neck NWR in McIntosh Co., Georgia. Foggy and warm in Gainesville when I left, and we had about an inch of rain last night. Foggy almost to HN, but the temperature dropped dramatically. Probably in the high 40's to 50's by the time I arrived. It cleared during the day to bring on a very pretty day. HN is below average on rainfall this year by 1" (based on Savannah weather). They seem to have no on-site weather station.

Met refuge biologist Debbie Barnard-Keinath, and several others of the HN (Karen Pacheco, Acting Refuge Manager), Refuge Complex (Robert Cail) and Savannah NWR staffs (Russ Webb). Gave a presentation on ARMI and what we would like to do at the refuge. They seemed attentive and interested in assisting us. They can offer GIS coverage, possible housing, volunteers at some point, or even interns. There seem to be no access problems. After the presentation, we all drove around to various possible sampling sites. Most of these are related to duck production, or at least toward migratory birds. The larger "ponds" are really just diked freshwater marshes or feeder canals; some have fish but some supposedly do not. I bet sampling would reveal just about everything has *Gambusia*. They manipulate the water levels of most of the "ponds," and even stock bluegill as food for the nesting wood storks. Wood storks are high on their list; we would have to avoid the nesting areas from April to July, and even surreptitiously approach the areas at other times. Most of the ponds are freshwater, but some might receive saltwater intrusion during serious storms.

They seem to have no information on reptiles except that alligators are everywhere there is water. They seem to have a rather healthy regard for their alligator population. Even some of the smaller ponds have alligator holes which could prove dangerous. They have diamondbacks, canebreaks, and cottonmouths–no idea about pygmies but the habitat looks promising. There are allegedly several gopher tortoises on the property (thought to be Army releases) and perhaps some box turtles. Linda P--- described a small lizard which seemed like a mole skink, and DB said there were glass lizards. Debbie pointed out several places where southern leopard frogs are common; some of the bigger ponds are said to have pig frogs, bullfrogs, sirens, and amphiumas (they are dredged up when ponds are "improved"). Also a "Fowler's toad" and salamander larvae (most probably *Notophthalmus*). Mammals are not obvious, and there are no reported pigs or bobcats. We saw an armadillo and gray squirrels.

The uplands are xeric oak hammocks interspersed with some planted pines (not much, though). The area was used as an Army airfield in WWII, and the runways crisscross much of the refuge. These areas are fairly open in low scrub and grasslands. The briar is reported to be fairly thick in some areas. Roads are everywhere making access extremely easy. However, the public is limited to the wildlife drive. There is very limited hunting (2 days for bow and 1 day for rifle). Some areas seem rarely visited, and vandalism may not be a big problem. In general, I was struck at

how little most of them seemed to know about the refuge – statements like, "I have only recently become aware this pond was here" (referring to a borrow pit not 100 ft from the visitor drive) left me with the impression that other little ponds might be out there.
They had no specific water quality issues. I asked if there were any problems left over from DOD occupation, and they said that they were unaware of any. We might be able to get really good baseline data. Said they were working with Lisa Irwin to get information on leopard frog malformations, but collection was difficult (didn't really understand why). No malformations were found.

Basically, they are open to anything, and will greatly appreciate any data we can provide.

Here are some locations:

Woody Dike:	31 deg 37.765N	81 deg 16.663W	Separates Woody Pond (a marsh) from Bluebill Pond (another marsh). The area in between is a low wet swampy area, ideal for certain salamanders.
Borrow Pit:	31 deg 37.995N	81 deg 16.801W	A small borrow pit with no fish but the possibility of an alligator. Deep. DB saw a salamander larva here, likely a newt.
Little Pond by Road:	31 deg 38.336N	81 deg 16.848W	A very small pond on left side of road.
Teal "Pond":	31 deg 38.365N	81 deg 16.068W	Really a feeder ditch. No fish (?). Leopard frogs here.
Wigeon Pond:	31 deg 37.799N	81 deg 15.799W	A small swampy wetland near the marsh, with alligators
Lucas Pond:	31 deg 37.203N	81 deg 16.664W	A large freshwater pond with much surrounding vegetation. Another small ditch-like pond is behind the small block house.

Most of these areas were photographed. In any case, DB will send us a map showing place names and locations. No frogs heard or seen, but a chilling cold night (25 deg) is expected.

28. Up early and at the wildlife drive on Savannah NWR by 8:15. Beautiful clear and cold (below freezing) weather with a right strong breeze. Walked out along the road and photographed the marsh; saw a young raccoon working the dirt access road. The refuge complex

area is across the main highway. Met Debbie, Russ, and Jennifer Adams (SCEP) there. Looked at aerial photos and got a basic run-down of refuge water operations. Primarily a waterfowl refuge where they manipulate water levels. Old rice plantation (the dikes reflect the former outlines of the rice fields). They periodically dig out vegetation, much the way they do in Florida; say there are lots of amphiumas and sirens churned up, possibly rainbow and mud snakes as well. Many animals apparently die or desiccate. I said that I would like to monitor the vegetation, and they said no problem. They said they would let me know when they are going to do it again. After getting the basic rundown, we left for the recently acquired Solomon tract.

The Solomon tract is in Chatham County near I-95 (southeast of the area marked "O'Leary" on the Port Wentworth Quad). This is mostly a high table, hardwood forested area on an east-facing bluff overlooking the Savannah River bottomland forest. There are numerous small ponds and wetlands throughout the tract, probably more so than are immediately apparent from the dirt road. We went to several of these, including the site where FWS did their malformation work. Leopard frogs and Fowler's toads were recorded by refuge personnel. This looks like an area we may find *Plethodon* and *Pseudotriton.*

Malformation Pond (ST2)	32 deg 12.013N	81 deg 09.806W [this is really just a large road rut]
Newt Pond (ST3)	32 deg 12.405N	81 deg 09.900W [found four *Notophthalmus viridescens louisianensis* under concrete slabs. They have arranged a coverboards and linear highway cloth drift fence here, with a few funnel traps]
Gum/Tupelo Slough	32 deg 12.174N	81 deg 10.194W

Pigs were quite evident at this site. We saw one herd and a lone male.

After we left the Solomon tract, we drove over to SC and went up the Purrysburg Road to Mill Stone landing (boat access). The historically-reported *A. cingulatum* ponds were just north of here on the left side of the highway. There is a housing development now, and it is clear that this area is developing fast along the river. The area across the river is supposedly virgin bottomland forest. We did not get out and do anything in this area, however. A more interesting area, based on aerial photos, is the region on Limehouse Quad just west of the Garret Cemetery. The refuge boundary runs along the east bank of the bottomland for the most part, but there are a few uplands; the aerial photos indicate the possibility of uplands in this relatively tiny area. Wish we could have got there.

Went into Savannah to buy topo maps, then an uneventful drive back to Gainesville. Arrived at ca. 18:45 – the leopard frogs were going strong upon my return (despite temps expected in the mid-20's).

Note: both refuges offered the possibility of housing. Need to contact John Robinette concerning a special use permit.

April (Ken, Jamie) [April notes recreated after laptop computer failure]

5. Drive to Harris Neck. After lunch, we drove around to check various sites and to set the data loggers and traps. At Borrow Pit Pond, we immediately captured *N. viridescens* and a very small juvenile *Deirochelys reticularia*. Jamie said he saw a much larger turtle hit the water as we approached.
15:10 to 15:25; Borrow Pit Pond
WJB, CKD
Clear, moderate wind above trees, calm at pond level
WT 17.7C
AT 17.1C
RH 38%
We dip-netted for a total of 0.5 man-hrs. Observed a large emydid escaping into pond and captured a hatchling DRET, 2 HCIN (1 adult, 1 subadult), and 3 NVIR (1%, 2&). Also captured odonates, crayfish, ranatra, notonectids, and whirligigs.

We set additional traps and data loggers at:

Lucas Pond (southern section) – this pond still was quite full, although it had obviously decreased in size around the boardwalk/dock where we put a frog logger. The traps were placed in the southern part of the pond at the southwest corner of the large field.
14:50; Lucas Pond (473590E, 3498216N, 17R)
WJB, CKD, DEB
Set FL# 09 at the dock (473590E, 3498216N) near house and FL#11 near boat shed with traps. Set 4 crayfish traps at near boat shed along the dike.

15:50; North Runway Ditch (474596E, 3501066N, 17R)
WJB, CKD
CKD netted several small RSPH tadpoles. Also caught water scavenger beetle and notonectids. Ditch was on the south side of north runway.

Goose Pond (both at north outflow and along northeast (#4) runway) – a small area, just big enough to set traps, is present just north of the runway here. Goose Pond is still reasonably full, although it has decreased in size based on the amount of exposed vegetation. The traps were placed on the southeast side of the pond area along the northeast (#4) runway.
Goose Pond (474660E, 3500905N, 17R)
WJB, CKD
Set FL# and three crayfish traps. Moved to a secondary location (474689E, 3501130N, 17R) and set one more crayfish trap. Saw two RSPH.

Wigeon Pond – much of this pond had dried since February, but there were several good sized puddles and the elongate area nearest the marsh had plenty of water. A very large alligator was half submerged in a (seemingly) tiny gator hole off the main pond area. It was obviously still very lethargic, but must be reckoned with in the future.
Wigeon Pond

WJB, CKD
Set FL#05 and two crayfish traps. Observed a very large AMIS in a pool too small to allow the entire alligator to submerge. A pod of juveniles was in the largest pool of the drying pond. Woody Dike – we set data loggers along the canal southeast of Woody Dike. We saw *Acris gryllus* here.
Woody Pond (473713E, 3499346N)
WJB, CKD
Set FL# on canal between SE corner of Woody Pond and Blue Bill Pond just downstream of water control structure.

6. Checked traps.

Dip netted Lucas Borrow Pit Pond and found a few *N. viridescens*. This is kind of a scummy elongate pond near the block house. Surprised not to find any tadpoles. We then walked completely around Lucas Pond. Saw alligators and turtles (*Trachemys scripta* ?). Turned a few boards in the field on the west side and found (and photographed) a *Cnemidophorus sexlineatus* and a *Eumeces inexpectatus*. On the northwest side of Lucas Pond there is a small seep that flows out toward the tidal marsh. This area might prove interesting. Large pretty live oak grove just north of the pond.
10:07 to 10:22; Lucas Borrow Pit (473751E, 3498331N)
WJB, CKD
AT 19.2 C
RH 51%
Sampled W end of linear pit. Captured 3 NVIR (2&larvae and 1 adult&) and odonates, notonectids, and whirligigs.

In the traps at Lucas Pond, found *R. sphenocephala*.
WJB, CKD
FL# 11 shorted when opened @10:30 but ran last night. One large RSPH tadpole, many GHOL and dyticids in traps. Walked clockwise around pond and saw a HCIN, many ACAR in NW corner near 131. Two cooter-like turtles and an alligator were basking on the W shore. Caught a CSE and an EINE under plywood in old field.

As we were leaving, Jamie spotted a large *Gopherus polyphemus* sitting just inside the refuge fence. It looked as if it had just been dropped off, and it carried a radio-transmitter. Turns out it was one of David Rostal's tortoises. We went back and got Debra, and returned to find and capture the tortoise. They seemed happy to have it.

Surveyed the bordering ponds along the northern (#1) runway. Most were dry, but we found one (North Runway Ditch: south side of the runway) that still had water and plenty of *R. sphenocephala* tadpoles. We saw *R. sphenocephala* adults at the north outflow of Goose Pond. Hurriedly checked traps at Goose Pond because of the intense swarms of noseeums. Never seen anything like it! Found *R. catesbeiana* and *R. sphenocephala* tadpoles.
Goose Pond
WJB, CKD
Saw 3 RSPH near trap at secondary location and caught GHOL, PLAT, *Uca* sp., and grass

shrimp. Captured 2 RSPH tadpoles, GHOL, dytisids, odonates, and crayfish at main location.

At Wigeon Pond, we had *Pseudacris crucifer* tadpoles and a few *N. viridescens* in the traps and in some net sweeps. The large alligator was still in position, only it seemed more buried in. Found an emerald green *Hyla cinerea* sitting on a thistle in the sun (photographed).
Wigeon Pond
WJB, CKD
Captured 1 newt and several *Pseudacris crucifer* tadpoles in traps. Tadpoles already popping rear legs but still unknown, retained for rearing. Large and small alligators still present. Also saw a bright chartreuse HCIN on a thistle on path to pond.

After checking these areas, we went over to the bunker and walked around it looking for rattlesnakes (did not find any) and then walked around the forest to the northeast portion of the refuge. Some of this area had been recently burned, and it really needed it. The forest is a mixture of pine and live oaks (interspersed) which leads to the water of the South Newport River. No beaches for terrapin nesting, although some can be seen in the distance across the river. We drove down to Thomas Landing, but there were no tadpoles in the old fountain (which is very shallow). Drove through the old military section of the refuge – there are many building foundations, but everything is very overgrown. Looks like virtually everything was removed, which jives with what I found on the internet.

At Woody Dike, we surveyed for about 30 minutes in the swamp below the dike (which feeds into Bluebill Pond). The water was down a lot since February, but there were still plenty of wet spaces. We found nothing except a lone *R. sphenocephala* – no snakes, salamanders or tadpoles. However, we picked up several *Acris gryllus* along Woody Pond, and I found a dead shriveled *N. viridescens* on the shore of Woody Pond. There are great numbers of alligators and *T. scripta* in this pond.
Woody Pond
WJB, CKD
Found a dead NVIR and live AGRY near water control structure. AGRY not FL subspecies as suggested by field guide. Conducted a time-constrained search in area below dike. Found nothing but heard a HSQU near the truck. Saw many alligator and turtles basking on downed wood near the dike.

Blue Bill Pond
WJB, CKD
Checked water quality for DEB and found conductivity to be extremely high, 4050□S/cm, and high pH, @7.5. Must be salt water intrusion through water control structure. Did see a small alligator.

7. Checked traps in morning.

Culvert Pond (473385E, 3500449N)
WJB, CKD
CKD made a couple of sweeps with a dip net. Only caught whirligigs but saw @4 RSPHE adults in the drying pool.

Goose Pond
WJB, CKD
Caught PLAT, Uca sp., GHOL, and a Clupeid at secondary location. Heard RCAT calling from SW corner of pond. Caught a large RCAT tadpole and a subadult in a CT. Other captures include 6 large RSPH tadpoles and an adult (dead & collected), an amplecting pair of NVIR, GHOL, dytisids, and crayfish.

Woody Pond
WJB, CKD
Captured 4 NVIR (2?, 2?), 2 unknown Pseudacris tadpoles, and GHOL. Saw the large AMIS in same hole.

Lucas Pond
WJB, CKD
FL#11 shorted at 10:00 while being moved. Caught 2 RSPH tadpoles, GHOL, whirligigs, and dytisids in traps. Found a large & (326mm T-T CL, 301mm N-N PL) with a transmitter near the gate (474118E, 3498117N). Returned to DEB for refitting. The transmitter or batteries have died and she hasn't been able to locate the tortoise for some time.

We drove over to Savannah NWR and met Russ Webb to get the keys. We drove the Wildlife Scenic Drive and found two areas to sample with traps and data loggers – one in the first major hammock (WD1) was a small shallow wetland within the hammock on it north side, and the other (WD2) was in a rice field just west of the levee along the drive. Many alligators were present, and we saw *Anolis carolinensis* as we placed traps at WD1. We continued north of SC 170 and set two more areas in the marshlands – one was just east of the west of the levee in a shallow wooded pool (ND1) and the other in a deep, relatively heavily vegetated plot full of cattails with some open water (ND2). Although this area was a rice field at one time, it looks like it's "gone native." It is very different from the field immediately to the south, which is shallow and very open. Apparently the refuge removes the vegetation periodically for waterfowl habitat, which drastically alters the structure and vegetative composition of the former fields.

WD1(489811E, 355756 N)
WJB, CKD
Put out FL#10 and 2 CT. Found 2 HCIN, and >4 ACAR. Heard RGRY and saw many fish.

WD2 (491163E, 3557083N)
WJB, CKD
Put out FL#09 and 2CT. Saw an American Bittern. Chinese tallow very dense along S shore.

ND1 (south of Lucknow Canal; 490755E, 3560656N)
Put out FL#05 and 2CT. Found APIS on dike (490702E, 3561357N).

ND2 (490685E, 3561563N)
Found short in FL#11 and reset to 15:30. The voice clock is still an hour slow. Put out logger and 2CT in a deep rice field.

Afternoon. Drove up the Dodge Tram Road along the South Carolina side of the refuge. Set traps in Kingfisher Pond (DT2) just inside the gate to the firing range. The road actually travels the boundary between the refuge property on the left and hunt club leased land on the right (as you go north). For the most part, the refuge land is low swamp floodplain forest, whereas the hunt club land is on reddish clay uplands. The road crosses several areas where the area is swampy and looks interesting.

Just northeast of the junction with Chisolm Road (comes in from the right), we pulled off and checked the low swampy floodplain (DT1). Almost immediately, we captured two *D. auriculatus* (photographed) – one adult and one juvenile -- and *Rana clamitans*. Continued up to Union Creek landing and checked the landing area. Photographed a *Coluber constrictor* sunning on a log. The creek is small and sinewy here.
Explored a slope and river floodplain forest northeast of the intersection of Chisolm and Dodge Tram roads (490944E, 3565161N). Found RCLA (SA), and 2 DARI (1 adult & 1 juvenile. DARI photographed and collected.

DT2 (Kingfisher Pond; 492495E, 3561681N)
WJB, CKD
Heard *Acris* calling and captured several. All identified as *Acris gryllus gryllus* but we need to be watchful for *crepitans*. FL#01 concealed along shoreline.

8. We met the crew doing bird surveys on Bear Island and headed out from Beck's Ferry south to transect 2. The FWS has three transects marked across Bear Island for hunter's to follow so they do not get lost. There is no trail per se, just a series of diamond-shaped markers posted on tree trunks. Transect 2 goes straight in from the river, which bends around so you parallel the river as you go east. There are series of cypress ponds with little undergrowth or aquatic vegetation, interspersed by some hardwood forests and muddy creeks. At high water, the whole area likely floods and flushes. We immediately found some very small depressions nearly dry that were separate from the more connected cypress depression ponds (BI1). These had very small *Ambystoma* larvae which we collected – found to be *A. opacum*. We kept going east, through the forest and checking remaining puddles and water isolated in creeks. Found nothing in the uplands, an adult *R. sphenocephala* in a creek bed, and a much larger *A. opacum* larva in one of the larger puddles (BI2). No tadpoles. We searched a little over two hours, eventually finding our way to another large creek (BI3). At this site, there were numbers of juvenile *B. fowleri* hopping around (some reddish), and Jamie found a *H. chrysoscelis*. Both species were photographed. Despite a brief shower, we did not hear any treefrogs calling. We estimate that we traveled about half way to Bear Creek, which appears to be rather substantial on the topo map.

Bear Island
WJB, CKD
Meet FWS biologists (Russ Web, John Robinette., and Pete of Wassaw Island) at work center and drove up to landing. Ken and I were dropped at hunter orientation transect 2 and spent until 12:00 dipping isolated pools and flipping logs. We worked from E to W, Savannah River toward Bear Creek. We found several *Ambystoma opacum* larvae in pools and collected 5 (4 small and 1 large) for rearing and photographs. Made it as for as (BI3: 487409E, 3574055N) were we found may BFOW and a HCHR after getting a measurable amount of rain.

WT 16.6
AT 19.3
RH 68%
On the way back to the landing we saw several large cooters basking on logs and log jams in the river. After returning to the landing we observed a juvenile NTAX around in the water around the riprap and a large NTAX and smaller individual basking on a log jam in an eddy upstream from the boat ramp.

We observed a very large and a juvenile *N. taxispilota* as we ate lunch back at the landing in the warm sun.

In the afternoon, we checked the traps:

WD1 (1 Mile Hammock)
WJB, CKD
We did not see, hear or catch any amphibians or reptiles. We did catch *Centrarchus*, EGLO, and crayfish.

WD2
WJB, CKD
CT produced 3 RSPH tadpoles, GHOL, and crayfish. We heard many RGRY calling from the rice field.

At ND-1 we caught traps-full of *R. sphenocephala* tadpoles (great quantities). We also trapped a *Nerodia fasciata* that was obviously taking advantage of the traps to fill his belly (photographed).
ND1 (Lucknow Canal)
WJB, CKD
RCAT called from rice field while we checked traps. CT produced >50 RSPH tadpoles of at least 2 size classes, a NFAS that had been eating tadpoles, and GHOL.

ND2
WJB, CKD
WE heard at least 2 RCAT calling form the rice field to the south. We caught a SLAC, GHOL, and mud minnows.

Large *Rana huckster* tadpole in one of the traps at Kingfisher Pond which we photographed. *Acris gryllus* are quite abundant along the shores of the ponds, with every color variant, some of which we photographed.
DT2 (Kingfisher Pond)
WJB, CKD
We heard RGRY calling while we checked the traps. Caught a very large RHEK tadpole and bluegill in the CTs. We also observed many AGRY.

Toward the end of the day, we drove over to the Solomon Tract. Rescued a juvenile *Trachemys scripta* as it tried to commit suicide on SC 170. The “malformation puddle” was dry, as were

most of the small puddles. However, at the newt site, we found a single *P. crucifer* tadpole, several *R. clamitans* tadpoles, a juvenile *Sternotherus odoratus* and several very tiny *Kinosternon subrubrum* (photographed).

We drove as far as we could parallel the bluff toward the interstate/railroad tracks (ST-1), and worked the west slope of the bottomland forest for about 40 minutes (as a great black thunderhead boomed just north of us). Found two *Terrapene carolina* (1 male: 1 female; photographed), and Jamie found a *H. chrysoscelis*. Interestingly, we did not turn up a *D. auriculatus* although the habitat is similar to that on the east side of the floodplain.

ST3; Newt Pond (Solomon Tract, 484456E, 3563370N)
WJB, CKD
Made a few sweeps of the dip net and caught RCLA, RSPH, and *Pseudacris crucifer* tadpoles. We also got ?NVIR, a hatchling KSUB, and a juvenile SODO.

ST1; Food Plot Hill (Solomon Tract, 484422E 3564331N)
WJB, CKD
Searched forested flood plain and slope for ca. 20 min. Found 2 TCAR and a HCHR.

9. We pulled traps first at Kingfisher Pond. There was a very loud chorus of *Bufo fowleri* (at least that's what they look like). We both photographed the animals and recorded their chorus. Pulled the traps at the other sites set in the rice fields. Again nothing at WD-1.

DT2 (Kingfisher Pond)
WJB, CKD
AGRY, RCAT, and BFOW calling. BFOW in large chorus. Recordings made and photos taken. No CT captures.

WD1 (1 Mile Hammock)
WJB, CKD
We did not see, hear or catch any amphibians or reptiles. EGLO, LGUL, and GHOL captured in CT.

WD2
WJB, CKD
RSPH tadpoles, ACAL (juvenile), and crayfish captured in CT. AMIS calling from the rice field.

ND1 (Lucknow Canal)
WJB, CKD
RCAT called from rice field while we checked traps. CT produced >30 RSPH. GHOL and crayfish also captured. Large AMIS across dike on canal.

ND2
WJB, CKD
RCAT and RSPH calling form the rice field to the south. Caught a SLAC, NVIR and mud

minnows.

Drove back to Gainesville in the afternoon.

June/July (Ken, Jamie, Linda Casey, Julia Earle)

28. Drive to Harris Neck NWR. Clear, sunny, and very warm conditions. We are "camping" in the former refuge headquarters, the staff having moved to the new office building. Essentially the refuge is deserted. We stopped in Darien on the way, but the antique stores and Fiddlers are closed on Mondays.

Borrow Pit Pond: visited only very briefly. The water is high, as they have had good rainfall recently. A number of *R. sphenocephala* jumped into the pond. Some, at least, appeared to be adults. A small (juvenile) alligator is present in the deep end, and Jamie saw a turtle slide into the water as we approached, although we did not get a good look at it.

Culvert Ditch: water present, with *R. sphenocephala* (juveniles) jumping into it.

Goose Pond: they are drawing Goose Pond down, so the water was very low (too shallow to set traps where we had in April). Hundreds of birds, particularly ibis, that took off upon our approach in a great whirling set of white wings. We set 2 crayfish traps – one on either side of the culvert at the southwest end where a canal connects Goose with Greenhead Pond.

North Runway Ditch: the ditch has very high water, and we observed several *R. sphenocephala* jump into it upon our approach.

Snipe Pond: we set 4 traps in this ditch which parallels the southwest runway. The ditch holds lots of water. *Rana catesbeiana* is calling at 16:35.

Wigeon Pond: the pond area is highly overgrown, making setting traps and observation very difficult. No alligator seen, but they must be present; a very large number of banana spider webs block every avenue. 2 traps set in deep puddles. *Hyla squirella* occasionally called.

Woody Pond: not surprisingly, the pond appears to be highly eutrophic, what with all the nesting birds crapping into it. 4 traps set along the east side of the dike. Many alligators. *Rana grylio* calling.

Lucas Pond: water high and highly covered by vegetation and floating plants. Ibis and egrets present. Set 4 traps on the south end, and 2 traps at the extreme northern end. *Rana grylio* and *Acris gryllus* were calling.

Lucas Borrow Pit: set 2 traps in very eutrophic water. *Rana sphenocephala* jumped into the water and seemed very active along the shoreline.

After setting all traps, we drove back to the headquarters complex to have dinner and to rest before the night survey. Found a DOR *Opheodrys aestivus* on the entrance road to the

headquarters, and preserved it.

After dark (roughly 21:15), we drove around the refuge to various locations to listen for frogs. The conditions were not ideal, as there was a nearly full moon and no storms nearby. These are the results:

Refuge HQ: *Bufo terrestris* sitting on road. Photographed.
Goose Pond (actually in ditch between Goose and Greenhead Ponds): *Gastrophryne carolinensis, R. catesbeiana. Hyla cinerea* were calling around Goose, especially at the southwestern edge.
Dike between Teal and Greenhead Ponds: a few *R. catesbeiana, R. grylio*, great numbers of *H. cinerea.* Most activity was coming from the Teal side of the road. UTM: 17 0474589; 3500508.
Woody Pond: huge numbers of *H. cinerea, A. gryllus, R. grylio* (good numbers scattered throughout). 1 raccoon hunting on the dike. Very large numbers of alligators, with eye shines everywhere.

Other notes: Screech owls, great numbers of fireflies over the pond areas, 3/4 moon, large numbers of whiny mosquitoes when we stop to listen. However, there are virtually no noseeums, which seems odd considering the April nightmare.

29. Cloudy giving way to another hot and sunny day. All morning, we checked traps and dipped ponds. These data have been transcribed onto the data sheets. This occupied us until 14:00:

Goose Pond (south section): *Rana* sp. (screamed into water).
North Runway Ditch: *R. sphenocephala* (juv around ditch), *G. carolinensis* dip netted. Also saw an adult *Thamnophis sirtalis*.
Snipe Pond: larval *R. catesbeiana* in trap and adults calling.
Borrow Pit Pond: dip netted for 60 person-hours. *A. gryllus* calling, *H. cinerea* (adult on vegetation), *N. viridescens* (adults, large and small larvae), *H. femoralis* (larvae, photographed), 2 unidentified tadpoles (photographed), *R. sphenocephala* (adults around pond).
Culvert Pond: *R. sphenocephala* (subadults hopping into water), *G. carolinensis* (larvae).
Wigeon Pond: nothing in traps.
Woody Pond: *R. grylio* calling, *R. sphenocephala* and *H. cinerea* (larvae in trap; specimens of both photographed to confirm identification), *A. gryllus* (calling). *Nerodia fasciata* observed.
Lucas Pond: calling *R. grylio* (also subadult in trap) and *G. carolinensis* (larvae in trap).
Lucas Borrow Pit: *R. sphenocephala* (observed), *N. viridescens* in trap.

After lunch, we drove down to Darien to look around. The antique stores are basically junk stores. We talked to the owner of Fiddlers, who lamented the continued cutting of cypress trees for wood chips. In late afternoon, Linda and I drove to an area which shows as slight depressions on the topo maps – couldn't find anything that might have held water. Nice mostly live oak and pine forest, with scant understory.

After dinner, we again road the roads around Harris Neck. There were many big storms in the vicinity (big thunderhead over the marsh to the west), but unfortunately none of them came over the refuge. All bluster and no deliver!

Lucas Pond: 21:30. Warm and humid, with thunder in the distance but no rain. *R. grylio, A. gryllus*, and *H. cinerea* calling.
Lucas Borrow Pit: *H. cinerea* calling all around the trees adjacent to the elongated ditch.
Wigeon Pond: *H. cinerea* and a screech owl occasionally called, but not much activity. UTM 17 0474791; 3499169: on the Wildlife Drive, east side, between Wigeon Pond and the sharp right turn; 22:15. *Agkistrodon contortrix*. Young adult or large juvenile sitting on the road. Jamie got photographs. Refuge personnel had had this species reported as present on the refuge, but they had no direct knowledge of it. Nicely marked individual.
Woody Pond: *H. cinerea, R. grylio, A. gryllus* calling. *R. sphenocephala* seen on dike. Again, large numbers of alligator red eye shines.
Borrow Pit Pond: large chorus of *H. femoralis*; also *A. gryllus* and *H. cinerea*.

30. Partly cloudy and very humid this morning. Collected the traps and recorded data (see data sheets) before leaving for Savannah NWR.

Goose Pond (south section): *R. sphenocephala* (juv in trap), *R. catesbeiana* calling. Also a *Kinosternon subrubrum* juvenile (photographed).
Snipe Pond: *R. grylio* calling, *R. catesbeiana* in trap (photographed).
Plantation Fountain: *Notophthalmus viridescens* (both very small larvae and breeding adults, 2 size classes of larvae are present). Checked with a dip net. UTM: 17 0475508 3500751.
Wigeon Pond: *G. carolinensis* (larvae in trap), unidentified *Hyla* (2 preserved).
Woody Pond: *R. grylio, R. sphenocephala*, *H. cinerea* (all larvae in trap; specimens of both *Rana* were retained to raise and confirm identification), *R. sphenocephala* (juv in trap).
Lucas Pond: calling *R. grylio*, *G. carolinensis* (larvae in trap).
Lucas Borrow Pit: *R. sphenocephala, H. cinerea* (both observed, nothing in traps).

Note on fish stocking: The fish (3 million bluegill worth $75,000) stocked on the refuge came from the FWS fish hatchery in Orangeburg, SC. Deb has seen tadpoles in the shipments, so there appears to be no screening prior to shipment or release. The contact official is Willie Booker.

We picked up the key at Savannah, and set 4 traps at various locations: 3 areas north of Highway 170 (including right at the Headquarters), 1 south along the Wildlife Drive, and Kingfisher Pond. These areas were designated by code numbers.

HQ1: Headquarters (17 0488878, 3559112)
ND3: waterfowl survey area (17 0490076, 3561532)
ND4: (17 0489667, 3560003)
WD3: last pull off on left before highway 170 on the wildlife drive (17 0491572, 3558678)
DT2: Kingfisher Pond (17 0492492, 3561681)

Immediately after we set our traps (except at Kingfisher Pond), a thunderstorm rolled through the refuge from the south (about 16:00). Although we were able to set traps at Kingfisher with no

problem, it rained pretty steadily till dark. *H. squirella* were calling at the motel. Dinner at the Cripple Crab.

1. Very cloudy with high humidity that only barely broke up all day. Checked traps in the morning (see data sheets), followed by a long trip up Dodge Tram Road in the afternoon doing 20 min time constraint surveys (20 x 4 = 80 survey hours per site). Ran into a guy from the Monkey Jungle Hunt Club who was curious about what we were doing there. No problems though. Surveys 5 sites up the road at roughly equal intervals. Habitats ranged from broad uplands of deciduous forest (DT4), to upland forest sloping to the river bottom forest (DT1, DT6), to areas adjacent to swamps (DT3) and in a depression that must hold water at high water in spring (DT5). Photos were taken at each habitat/sampling site. Chisolm landing was very overgrown and much debris (appliances) was left near the landing itself.

We then headed over to the Solomon Tract, and found tadpoles in Malformation Pond (ST2), which we collected. An adult *K. subrubrum* was buried deeply into the mud at the bottom of the "pond." Indeed, there was much more water in this area than there was in spring, and it appeared as though this area may be used extensively by amphibians. A number of shallow wetlands were noted, but no samples were taken since it was getting late and we weren't happy about not bringing the dip nets over to ST. We collected at the "newt pond" (ST3) and saw several ranids dive into the water (we could not identify them). Found a female *Terrapene carolina* and photographed her; nothing too special and with an (old?) burned area. She was alert and healthy looking, and moved soon upon release.

We continued onto the slope at ST1, and worked there for about 20 minutes as darkening clouds gathered. Found *Plethodon variolatus* and 1 *Agkistrodon piscivorus*, presumably looking for fish (and although he was down a log).

Here is the tally:

HQ1: *R. sphenocephala* (hopping in wet grass), *R. grylio* (calling).
WD3: *Siren lacertina* (adult, photographed).
ND3: *R. grylio* (calling).
ND4: *R. grylio* (calling, larvae in trap).
DT1: *Desmognathus auriculatus* (juv, photographed), *R. clamitans* (juvs, calling), *A. gryllus*, *G. carolinensis* (adults on forest floor). *Agkistrodon piscivorus* (2), *Scincella lateralis*.
DT2: *R. grylio, R. catesbeiana, A. gryllus* (all calling), *H. femoralis* (rain call of a few animals), *R. sphenocephala* (adults hopping on shoreline).
DT3: *G. carolinensis* (adults in leaf litter), *R. sphenocephala* (juvs), and *H. chrysoscelis*, *H. femoralis,* and *R. clamitans* calling.
DT4: *Bufo terrestris* (juv, photographed), *H. femoralis* and *H. squirella* (calling adults). *A. contortrix* (subadult, photographed), *Anolis carolinensis*.
DT5: *G. carolinensis* (adults in leaf litter), *R. clamitans* (juvs), *H. squirella* (calling). Also *Anolis carolinensis*, *Eumeces* sp., *S. lateralis*, and a clutch of 4 snake eggs (photographed; one had been opened. We put them in a hollow rotten log).
DT6: *R. clamitans* and *R. sphenocephala* (both juvs), *Hyla avivoca* (calling, first record from the refuge?).

ST1: *Plethodon variolatus* (subadult, photographed), *Rana* sp. *Agkistrodon piscivorus*.
ST2: *H. chrysoscelis* and *H. squirella* (occasional calls); *H. squirella* tadpoles (photographed).
ST3: *Rana* sp. (juv), unidentified tadpoles [we forgot the big dip nets]. *Terrapene carolina* (female, photographed), *K. subrubrum* (adult).

Dinner that night in Mi Tierrita. Pretty good, too!

2. Another cloudy morning that gave way to a partly clouded day. Checked the traps and packed them. Found a beautiful *Elaphe alleghaniensis* (yellow rat) as were pulling away from the refuge headquarters. It had obviously just eaten, as there was a very thick bulge in the center. Photographed.

HQ1: *R. grylio* calling, *S. lacertina* (in trap, photographed).
WD3: *Bufo terrestris* (metamorphs to juv size, some very tiny), *R. grylio* (hopping into water with scream, larvae in trap).
ND3: *R. grylio* (calling, larvae in trap).
ND4: *R. grylio* (larva in trap), *Amphiuma means* (adult, photographed).
DT2: *R. grylio*, *R. catesbeiana*, and *A. gryllus* calling, dip netting in shallow south section of the pond – *A. gryllus* (larvae, photographed), *R. grylio* (larva).

Drove back to Gainesville in the afternoon. Nothing special, but everyone a bit tired.

October (CKD, MSG, WJB)

18. Sunny in Gainesville but becoming increasingly cloudy in Georgia. Virtually overcast at Harris Neck, but fairly warm and still humid. Only volunteers are staffing the refuge, as the rest are on Blackbeard Island for the hunt. Set out almost immediately to place traps.

Woody: 3 traps at both ends of the dike. Several alligators and *Trachemys* basking in the sun, but not like July. There are hardly any birds left, and the place is quiet.

Borrow Pit: the small alligator was sunning on the bank, and many *R. sphenocephala* were hopping into the water. Most were probably young of this year.

Culvert Pond: a number of *R. sphenocephala* hopped into the water.

Goose Pond: we drove around the north side where the new water control structure had been built, and set two traps. Water flows from the canal down into Goose, which has water but is much lower than it was in April. We set three more traps on the south side in relatively shallow but none flowing water. Few birds present, and the bugs were quite tolerable in comparison with previous trips. Huge numbers of tree swallows flying over the general area.

Teal Pond: we set two traps along the road just before the ditch between Teal and Greenhead. Looks like a small ditch here, rather than a wetland marsh. Nothing jumped in the water.

Wigeon Pond: we did not see the alligator, and water was present. Most of the wet area was

rather shallow, but we found two areas to set traps. None of the horrendous spider webs present. We then surveyed the red maple swamp for about 30 minutes. Most of the area was dry, but there was a seepage stream along the north side. Turned lots of logs. Saw a very fat *Nerodia fasciata* (photographed) and a juvenile *Gastrophryne carolinensis*, *R. sphenocephala*, and *Acris gryllus*.

Lucas Pond/Lucas Borrow Pit: we set three traps in Lucas and two in Lucas Borrow Pit. Saw several R. sphenocephala at the borrow pit. Afterwards, we walked around Lucas, collecting several alligator feces along the way. Looked in the swampy area northwest of Lucas, and saw *R. sphenocephala* and *A. gryllus*. These seepy areas probably result from water seepage from Lucas Pond through the western berm. Hard to think anything unique, like salamanders, are currently here. On the way back to the truck, we turned several boards on the eastern side of the pond, and found a *E. inexpectatus* and a nice juvenile *Ophisaurus ventralis* (photographed).

On the road back to the main gate, we saw a *Thamnophis sirtalis* and a very large adult *O. ventralis* DOR.

About 20:00, we drove the wildlife trail through the refuge. Saw a few raccoons, and a few *Hyla cinerea*, but nothing else. Heard a very few *R. sphenocephala*. Many *H. squirella* and *H. cinerea* sitting on the trailer (photographed). Saw several pods of small alligators in Woody Pond, mostly near the shore. Few large ones or animals away from the shoreline.

Note -- met Dirk Stevenson again cycling the wildlife drive. Said tons of spadefoots bred in the roadside ditches during the hurricanes, but saw none in the refuge per se.

19. Clear beautiful morning, giving way to clouds and overcast most of the day. Still quite humid, and remained warm all night. The sun occasionally peaked through the overcast, and the heat made the insides of the coveralls sweat, which of course made me wet all day. I guess you get used to it. Still quite warm all day, but not as many alligators are out.

Started by checking Woody, but not much there except inverts. At Borrow Pit, we caught N. viridescens (adults, several large juveniles with gills, small -- 20-25 mm TL), one larval *Pseudacris ocularis* (photo; first confirmed from the refuge), and *R. sphenocephala* tads (about 25 mm TL, indicating possible overwintering or at least transformation during the winter) and adults diving for the pond. Found one very small *Thamnophis sauritus* and a neonate *Nerodia fasciata*, both of which we photographed. They were sitting along the shoreline. Short stop at Culvert Ditch, but nothing there (in water) although several *R. sphenocephala* were around in the periphery.

Stopped out at North Runway Pond, and caught two larval *Hyla femoralis*, one of which was transforming. This was the first record of this species from this location. At Goose Pond, absolutely nothing. However, I caught a very large *Elaphe obsoleta* crawling along the canal bank (north side of the pond proper just south of the water control structure on the eastern canal bank). Photographed (he really nailed Margaret). At Teal Pond, absolutely nothing.

Stopped for lunch before heading back. Fixed the rain/weather gauge so that it was standing straight up. Saw Karen, and gave her the snake shed and the alligator uric acid “feces.” All staff

are all over at Blackbeard Island getting ready for the hunt. At Wigeon, again nothing. Lots of wood storks, ibis, and egrets, however.

At Lucas Borrow Pit, we caught N. viridescens and a dead *R. sphenocephala* (which was preserved) in two traps. Nothing in Lucas Pond, however. Got GPS readings for the live Ophisaurus and the animals found DOR yesterday.

We drove back around to Woody Pond Swamp, and did a time constrained (20 min x 3) survey in the mucky wetlands mostly near the dam/berm. Caught *R. sphenocephala* and *A. gryllus*, *Scincella lateralis* and *Anolis carolinensis*. However, Margaret saw another large *E. obsoleta*, and she found an adult *P. ocularis*, which was photographed. Good to have the confirmation. We decided to show Margaret the "bunker," and it was good we did because we saw a beautiful *Opheodrys aestivus* and a large *Lampropeltis getula* along the way, both of which were photographed. Nothing at the bunker or on the road back. Stopped at the vehicle storage area and turned several pieces of metal and a door. Nothing underneath, but a very large snake shed with smooth scales. We could not guess what it might be, so we kept it to show to Kenney Krysko (note: identified as *Masticophis flagellum*).

About 7:30 after dinner, we did a night cruise but saw and heard nothing until nearly back at the office area, when a heavy rain shower fell. Saw a *R. sphenocephala* and several *H. cinerea* hopping across the road. Wonder if the rain heralds a cool front, and whether it will cool off a little tonight which would be nice. Warm and humid as it is.

20. Foggy and misty, damp, warm morning. Basically stayed overcast or cloudy all day, but slightly cooler than yesterday.

Pulled the traps in the morning, but we really didn't find anything of great interest. Very pretty over Woody Pond, with the mist giving a somewhat silver sheen to the water surface. Caught and photographed a small *Rana grylio* at Woody. Only caught a single *N. viridescens* otherwise, at Lucas Borrow Pit.

Drove up to Savannah NWR, and met Russ Webb at Headquarters. Then to have lunch at the beginning of the wildlife drive (fed nice small gray kitten -- very skittish), and on to setting traps (2 along wildlife drive; 2 north of US 17; Kingfisher Pond). Other than a few gators sitting along the canals, we saw nothing of interest (animal-wise). The autumn flowers (brilliant yellow) in the marshes contrast quite nicely with the green vegetation and blue sky. Makes it a very pleasant scene. Took photographs. The leaves are turning red on the Chinese tallow trees, which line the banks of too many dikes.
Staying at the Quality Inn in Hardeeville. Dinner at the Cripple Crab.

21. Cloudy and overcast. Heavy mist in the air in the morning, with a slight breeze making it feel quite cool. It never really warmed up to more than about 70F all day, and the gray humidity made it feel cooler than it might otherwise. Misty over the marshes all morning while we were checking traps.

Checked the traps in the morning, but we really didn't catch very much. One *Siren lacertina*

along the wildlife drive. Most of the traps along the drive and north of the highway had no amphibians. At Kingfisher Pond, we got an adult *R. grylio* and saw an alligator again, but no *R. heckscheri* unfortunately.

Spent the rest of the day surveying the Solomon Tract, and it proved rather interesting. We saw tadpoles of *Rana sphenocephala* (one dark with rather large spots, and a second more olive with rather small spots; we think both are leopard frogs, but have kept one of both morphs to raise them). We captured *Plethodon variolatus* in the forest east of the road -- not many, but enough to know this is a good population. Moisture present under the logs thanks to ca. 0.5 inches of rain last night. Along the margins of the wetland running north-south in this area (along the western margin of the tract), we turned up a single *Ambystoma opacum* (not sitting on eggs) and adult *Desmognathus auriculatus*, both of which were photographed. This is the first confirmed record of the Southern Dusky from the Georgia side of the refuge. We captured a neonate *Nerodia fasciata* -- very pretty, with a triangular flattened head to make it appear fierce.

We didn't see anything along the slope of the Savannah River bluff except a neonate *Agkistrodon contortrix* (with a bright lemon yellow tail). Surprisingly, a small *Storeria occipitomaculata* nearly crawled directly across it as we were about to photograph the copperhead, but we didn't get the photo. Tremendous amounts of pig damage throughout the forest, with armadillo trails throughout the bluff.

At the small woodland pools (ST-2, ST-3), we found larval *R. sphenocephala*, juvenile *R. catesbeiana* (moving from the river wetlands to the uplands ?), and a singular newt. No turtles this time. Photographed the bullfrog and terrestrial phase newt.

Finished working in this area about 17:15, after a short visit by Russ Webb. Glad he was able to see the *A. opacum*. Dinner at Mi Tierrita. Very good flan.

22. Nice day. Sunshine and very moderate temperatures (but cool on the dikes in the wind). We picked up all the traps, but nothing of great interest: Acris gryllus at Kingfisher Pond; *Rana grylio* at WD-4; *Amphiuma means* at WD-5; *Rana grylio* at Headquarters. Nothing at all in the tidal gum/cypress grove (ND-5), perhaps not very unexpectedly. There is too much tidal influence here to make trapping favorable.

Drive back to Gainesville was uneventful.

November (CKD, MLG)

24. Cool and gray; looks very much like winter. Stopped very briefly at Borrow Pit Pond and saw several *R. sphenocephala* jump into the water.