Ambystoma bishopi: Survey and Status of Designated Critical Habitat

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Executive Summary

In 2007, *Ambystoma bishopi* was recognized as a unique species separate from *A. cingulatum*. After this separation, the original Endangered Species Act listing of *A. cingulatum* in 1999 (64 FR 15691) had to be amended to incorporate the new species, *A. bishopi*. Critical Habitat was designated for each species in the Final Rule on March 12, 2009. Sixteen Critical Habitat Units (CHUs) were designated for *A. bishopi*, 2 in Georgia and 14 in Florida. This report describes efforts to update information on the occupancy and habitat quality of the 16 *A. bishopi* Critical Habitat Units during fall 2012 through spring 2013.

Qualitative descriptions of habitat quality for the breeding wetland and surrounding uplands are included for all 16 CHUs. Additionally, each CHU was given a High Priority (n=5), Medium Priority (n=5), and Low Priority (n=6) designation. The priority levels were assigned based on the Unit's ability to support an *A. bishopi* population.

For at least seven CHUs, historical records from 20 years ago likely reflect the presence of a remnant population that has since been extirpated. Urban/suburban encroachment, and agricultural, residential, and silvicultural modifications have reduced the quality of former *A. bishopi* breeding wetlands and surrounding uplands. If possible, CHUs should be redesigned around current habitat conditions (i.e. undeveloped land versus urban/suburban development) and the availability of multiple potential suitable breeding habitat.

Permission to sample wetlands on 5 of the CHUs was not obtained so only 11 of the 16 CHUs were site-visited. CPI staff conducted dipnet surveys of 15 of the 20 historical breeding wetlands and nine additional wetlands nearby to historical breeding wetlands but within the CHU. Each wetland was visited at least twice by CPI staff between late January and late April. Some wetlands were sampled more than twice in coordination with other biologists. No *A. bishopi* larvae were detected at any of the CHUs during the 2012-2013 breeding season. Because of the amount and timing of precipitation this year, however, lack of detection does not mean lack of presence.

A cooperative plan for future monitoring and research efforts is needed. Such a plan should incorporate regional, state, and federal government agencies as well as private organizations, non-profit organizations, and landowners. Ideally a long-term program would be created such that CHUs and potential breeding sites outside the Units are sampled in perpetuity. Short-term studies do not allow for the detection of natural fluctuations in community structure. At least ten years of no detection should be considered before a wetland is determined to be unoccupied by an *A. bishopi* population.

Acknowledgements

Ryan C. Means was instrumental to this project, assisting with field work and wetland assessment. D. Bruce Means provided valuable feedback and helpful discussion. Coastal Plains Institute greatly appreciates the participation, feedback, and access granted by all the land owners, land managers, and associated staff of the Critical Habitat Units including: Tyler Macmillian (Garcon Point Water Management Area), Barbara Almario and Matt Smith (Blackwater River Wildlife Management Area), Joseph Harrell and William J. Price (Santa Rosa County Schools), Matt Aresco and Margaret Aresco (Nokuse Plantation), Keith Cullen (Pine Log State Forest), Charlene Hopkins (Pine Log Wildlife Management Area), OC Martin, Kyla Cheynet and Kit Hart (Plum Creek), Gene Wilferd, Phil McMillan (Neal Land and Timber), John Jensen and John Denton (GA Dept. of Natural Resources), Lora Smith and Lindsay Boring (Joseph W. Jones Ecological Research Center). Finally, special thanks to Harold Mitchell and Linda LaClaire (US Fish and Wildlife Service) for guidance and assistance throughout the project.

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Introduction

In 2007, *Ambystoma bishopi* was recognized as a unique species and was separated from *A. cingulatum* based on mitochondrial DNA, morphology, and allozymes analyses (Pauley et al. 2007). Prior to this genetic work, the flatwoods salamander west of the Apalachicola-Flint Rivers and the flatwoods salamander east of the Apalachicola-Flint Rivers were under the same umbrella species, *A. cingulatum*. Work by Pauley et al. (2007) identified *A. bishopi,* the reticulated flatwoods salamander, as the species living west of the Apalachicola drainage and *A. cingulatum*, the frosted flatwoods salamander, as the species living east of the Apalachicola drainage.

The historical range of *A. bishopi* included parts of Alabama, Georgia, and Florida. Based on surveys conducted since 1990, only 20 recognized populations of *A. bishopi* now exist. These populations are restricted to Georgia (2) and Florida (18). Some of these populations are inferred from the capture of a single individual and 70% of the populations are supported by only one breeding site (USFWS 2009).

After *A. cingulatum* was separated into two species, the original Endangered Species Act listing of *A. cingulatum* in 1999 (64 FR 15691) was amended to incorporate the new species, *A. bishopi*. Critical Habitat was designated for each species in the Final Rule on March 12, 2009 (USFWS 2009). According to the Endangered Species Act (1973), the designation of critical habitat does not affect land ownership, establish a conservation area, allow government or public access to private lands, or require implementation of restoration or other measures by a private landowner. Critical habitat designation does prohibit Federal agencies from funding, authorizing, or carrying out any action that would jeopardize the continued existence of the species or result in the destruction or adverse modification of the critical habitat.

A. bishopi critical habitat was designated for 16 of the 20 recognized populations based on breeding site locations and the surrounding uplands (USFWS 2009). The habitat of four populations, all located on Department of Defense lands, was exempt from federal critical habitat designation. The USFWS examined the integrated natural resource management plan (INRMP) of each of the three military installations on which these four reticulated flatwoods salamander populations are found (Navy Outlying Landing Field Holley, Hurlburt Field, and Eglin Air Force Base). These installations were exempt from critical habitat designation because their INRMPs were found to provide a benefit for the species and features essential to the species' conservation (USFWS 2009). Eight units, some of which were divided into subunits, were designated for a total of 16 units and subunits, hereafter referred to as the 16 Critical Habitat Units (CHU). Two CHUs were designated in Georgia and 14 CHUs were designated in Florida.

This report describes efforts to update information on the occupancy and habitat quality of the 16 *A. bishopi* CHUs during fall 2012 through spring 2013. The report is organized into sections by

CHU. Within each section is a description of the current habitat quality of the Units as well as a description of historical and recent sampling events. A list of amphibian species detected at each wetland and CHU is located in Appendix A. Photos of wetlands within select CHUs are located in Appendix B.

Methodology

Access

CPI staff sent letters or emails and/or placed phone calls to the landowners/land managers of the 16 CHUs to request access permission. We obtained access to all or part of 11 Units. We were unable to gain access to four Units: RFS-2A, RFS-3A, RFS-8C, RFS-9A. We obtained access to half of a fifth Unit, RFS-8B. We were directly denied access by the landowner to the historical record wetland on the western side of RFS-8B, but we were able to access a wetland on the eastern half of this Unit. Fifteen of the 20 *A. bishopi* historical breeding wetlands were visited as part of this project (Figure 1).

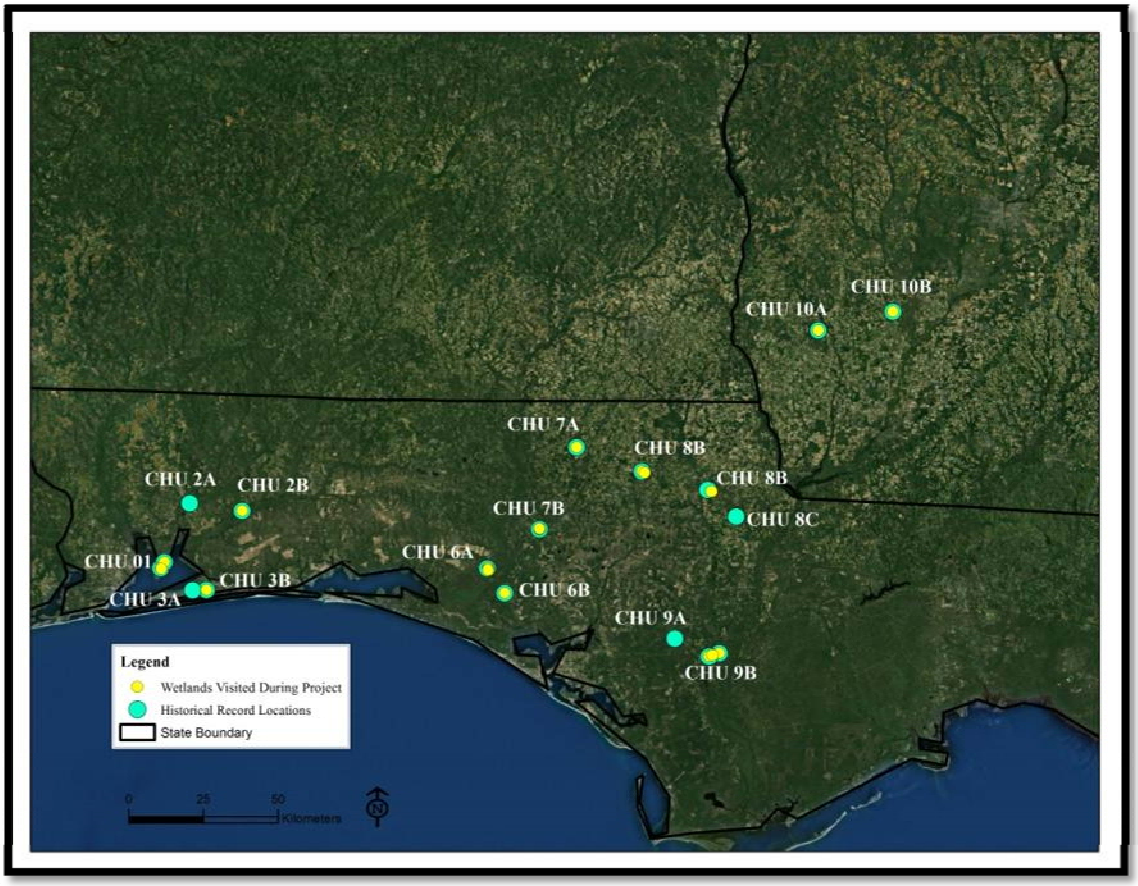

Figure 1. Map depicting the 16 Critical Habitat Units (CHU), Historical Record Wetlands, and Wetlands Visited as Part of this Project.

Habitat Quality Assessment

Qualitative descriptions of habitat quality for the breeding wetland and surrounding uplands are provided for all 16 CHUs. On-site breeding pond assessments followed protocol developed and tested by Means et al. (2010). Current condition of CHUs not visited by CPI staff was assessed using satellite imagery and/or information provided by third party observers.

Habitat quality was determined based on the primary constituent elements identified in the Federal Register Final Rule (USFWS 2009). Specific breeding habitat criteria for small depressional wetlands: seasonally flooded by rainfall in late fall or early winter and dry in late spring or early summer, geographically isolated from other water bodies, occur within pine flatwoods-savanna communities, have groundcover dominated by grasses and grass-like species and open canopies of pond cypress (*Taxodium ascendens*), black gum (*Nyssa sylvaticca*), and slash pine (*Pinus elliottii*), and have burrowing crayfish (Family: Cambaridae) fauna but lack predatory fish such as those in the Centrarchidae family (sunfish, bass) and bowfin (*Amia calva*). Specific dispersal habitat allows for movement between breeding and nonbreeding habitat and includes: a mix of vegetation types representing the ecotone between wetland and upland vegetation, an open canopy with abundant herbaceous vegetation, moist soils, and subsurface structure such as leaf litter or burrows. Upland habitat is a pine flatwoods-savanna community maintained by frequent fires that is within 457 m of accessible breeding wetlands, contains crayfish burrows or other underground habitat for shelter and food, has moist soils with water often near or at the surface, and with an abundant herbaceous ground cover, often including wiregrass.

Amphibian Sampling

Sampling methodology followed recommendations provided by Bevelhimer et al. (2008) and by Bishop et al. (2006). Surveys were conducted by sweeping either a heavy duty dipnet (Memphis Net and Twine Co. HDD-2 model) or a lighter duty dipnet (Forestry Suppliers Baitwell Net) with 3/16” mesh, depending on wetland condition. Sweeping efforts were not random but were concentrated in shallow areas with submerged or emergent herbaceous vegetation where *A. bishopi* larvae concentrate (Palis 1996). The number of dipnet sweeps per pond varied depending on wetland size. At least 100 sweeps were made for larger wetlands. Smaller wetlands were sampled by sweeping entirely around the herbaceous edges as well as through the wetland center. Each wetland was visited at least twice by CPI staff between 24 January 2013 and 8 May 2013. Some wetlands were sampled more than twice in coordination with other biologists.

Survey Results and Critical Habitat Unit Descriptions

RFS-1

Site Description

The elongated, oval shape of this 278 ha CHU is a result of two historical *A. bishopi* records - one from a wetland on the north side of the Unit (Wetland 1) and another record from a wetland on the south side of the Unit (Wetland 2) (Figure 2). Land ownership in this Unit is a mix between private and public entities. Sections of the northern part of the CHU are within the Yellow River Marsh Preserve State Park (YRMPSP), managed by the Florida Department of Environmental Protection. A significant portion of the historic RFS wetland, however, is located on private land. The extreme southern end of the CHU is part of Garcon Point Water Management Area (GPWMA), managed by the Northwest Florida Water Management District. Two wetlands are located within the GPWMA section of the CHU - Wetland 2, an historic *A. bishopi* wetland, and Wetland 3, a small shrub swamp located 0.3 km to the southeast.

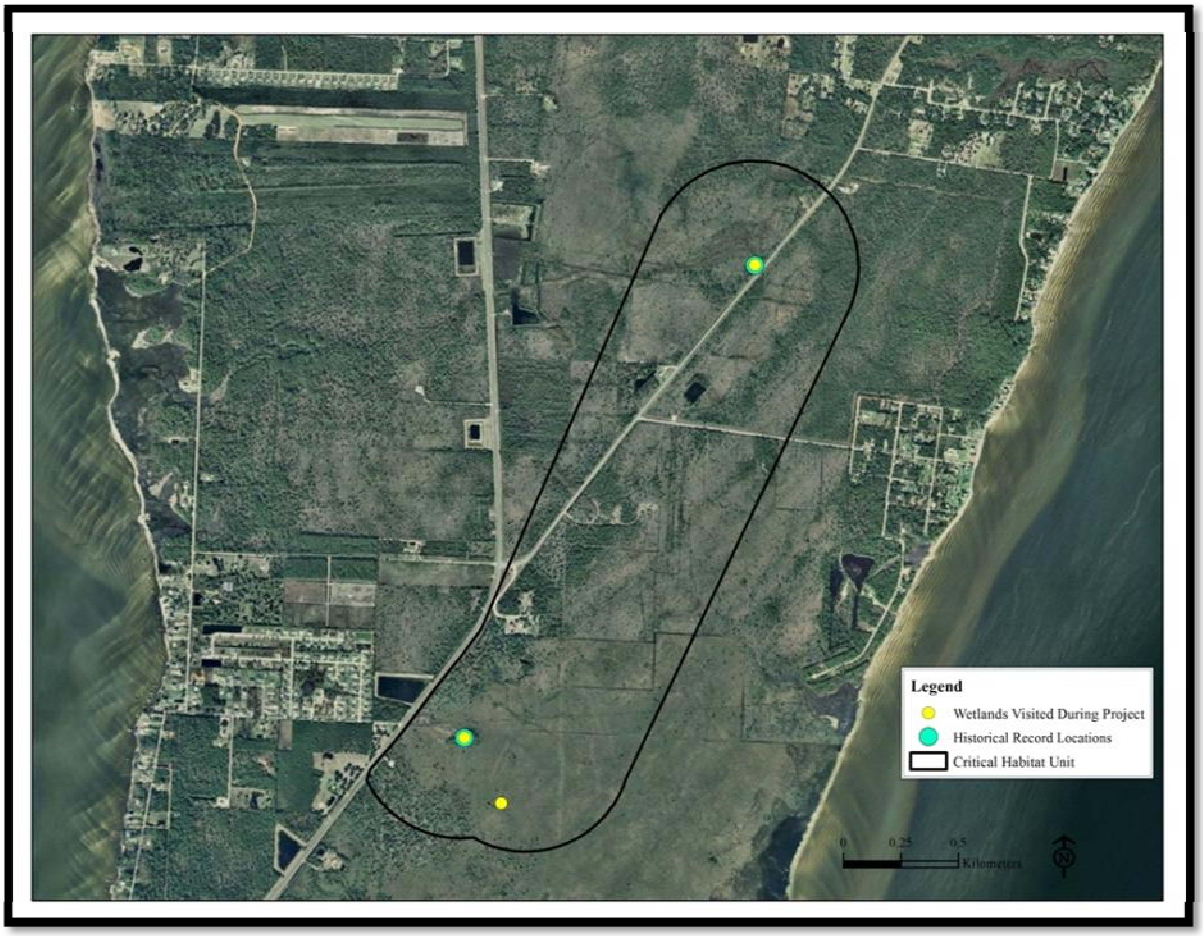

Figure 2. Map depicting CHU-01 in context of the surrounding area.

The hydrology of Wetland 1 has been severely altered through ditching, borrow pits, and vehicular tracks. A portion of this wetland is located on YRMPSP, the rest of the wetland is on private land with multiple owners. Garcon Point Rd., a relatively busy two-lane road that leads from I-10 to CR 281 and across Pensacola Bay to US 98, runs along the east side of the wetland. In its current state, Wetland 1 has a deeper cypress dome area adjacent to the road. The young pond cypress canopy covers over half the wetland and there is a heavy subcanopy of myrtle-leaved holly (*Ilex myrtifolia*) shrubs. Graminoids and other herbaceous vegetation grow throughout the wetland. A shallow wetland strand swamp leads from the deeper area to the north and west. Herbaceous vegetation, predominately wiregrass (*Aristida stricta*) and sedges, grow throughout the swamp strand. Slash pines are sparsely scattered throughout the wet prairie to the west. East of the wetland, on the other side of the road, the slash and longleaf (*Pinus palustris*) pines are more numerous.

Wetland 2 is a 0.5 ha cypress swamp embedded in an extensive wet prairie. Pond-cypress grows in the wetland canopy covering the majority of the wetland. Myrtle-leaved holly forms a dense subcanopy. Sphagnum (*Sphagnum sp.*) and graminaceous species grow throughout the wetland, sometimes forming dense patches. The surrounding uplands are extensive wet prairie with few trees and densely growing wiregrass. The uplands are managed by prescribed burn but the density of both the woody and herbaceous vegetation within and around the wetland signifies that fire is not regularly getting into the wetland basin itself.

CPI staff visited another potential breeding wetland (Wetland 3) in the southern end of the Unit that has no associated *A. bishopi* historical record. This <0.1 ha shrub swamp is embedded in the same extensive wet prairie system as Wetland 2. Young pond cypress trees form a canopy that covers less than a quarter of the wetland and over half the wetland is covered by a myrtle-leaved holly subcanopy. Herbaceous vegetation grows throughout the wetland. Remnants of Hurricane Ivan (2004) are still evident. Contractors were hired to remove debris from the wrack line but an old dock, nails, and other debris remain in the wetland.

Survey Results

A. bishopi larvae have been documented from two wetlands within this CHU. Larvae were encountered at Wetland 1, the northern-most wetland, during dipnet surveys that occurred in 1992, 1993, and 2006 (Palis 1993, Palis and Enge 2006). To the extent known, no documented dipnet surveys occurred between 2006 and 2013. No larvae were encountered during our dipnet surveys in 2013.

A. bishopi larvae were encountered twice in Wetland 2, the *A. bishopi* historical record wetland on the southern end of the CHU. Historical dipnet surveys of this wetland occurred at least once per year from 2003 - 2006 (Palis and Enge 2006). Larvae were encountered during the 2005 and 2006 surveys. No larvae were encountered during our dipnet surveys in 2013.

CPI staff surveyed a third wetland (Wetland 3) located in the southernmost end of the Unit twice during 2013 but did not encounter any *A. bishopi* larvae. No *A. bishopi* larvae were found during dipnet surveys conducted during the mid-2000s either (Palis and Enge 2006).

Summary and Recommendations

Prospects for a sustainable *A. bishopi* population on this CHU are mixed. The major road that bisects the CHU is a concern and could prove fatal to migrating salamanders (Means et al. 1996). To secure a sustainable *A. bishopi* population in the northern portion of the Unit, land acquisition of the Wetland 1 should be pursued. It appears that additional suitable wetland and upland habitat occurs on YRMPSP lands outside of this CHU. These areas could be examined and surveyed. If the property surrounding Wetland 1 is purchased, efforts to ameliorate the road impacts adjacent to the wetland could be pursued through the use of barriers. Tunnel or culvert systems also are an option but have varying degrees of success for amphibians (Merrow 2007, Aresco 2005). Tunnel design and methods would need to be considered to encourage amphibian movement from the wetland through the underpass to the YRMPSP property on the east side of the road. Other management recommendations already have been developed for this area (Palis and Enge 2006).

The southern section of the CHU has excellent prospects for a sustainable *A. bishopi* population. The land surrounding Wetland 2 is in public ownership (GPWMA) and management objectives are compatible with *A. bishopi* . Additional potential *A. bishopi* breeding wetlands exist outside the designated CHU to the south. Palis and Enge (2006) identified nine additional suitable wetlands within the Main Tract of GPWMA, all less than 2.5 km from the historical *A. bishopi* wetland (Wetland 2). More importantly, the habitat between these wetlands is intact and not separated by a road. *A. bishopi* management recommendations already have been developed for this area (Palis and Enge 2006).

A biannual, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population on this CHU. The last reticulated flatwoods salamander larvae recorded on this CHU was in 2006 but little to no sampling effort was made in the seven years between this project and prior surveys. Additional potential breeding wetlands exist outside of the CHU and also should be assessed and surveyed systematically.

RFS-2A

Site Description

This 66 ha CHU was delineated around a single historical *A. bishopi* breeding site (Figure 3). The wetland, and uplands surrounding the wetland, are all in private land ownership. CPI was unable to gain landowner permission to access the site so the following description is based on satellite imagery from 2012 and 2013.

Figure 3. Map depicting CHU-2A in context of the surrounding area.

The general hydrology of the CHU has been impacted by two utility right-of-way, as well as various land management activities. A 30-m wide utility right-of-way clips the northern end of the historic *A. bishopi* breeding wetland as well as a wetland strand to the east of the wetland. A 45-m wide right-of-way crosses the southern end of the CHU. This southern right-of-way and the adjacent residential properties, appear to have eliminated most of another forested wetland within the CHU. Vehicular tracks through the wetland are visible on satellite imagery. Most of the forested uplands within this CHU is planted pine plantation.

Survey Results

A. bishopi larvae were captured during a dipnet survey conducted in 1993 (Palis 1993). To the extent known, no additional dipnet surveys have been conducted since that date. As mentioned above, we were not granted access this site.

Summary and Recommendation

The likelihood of a single wetland sustaining an *A. bishopi* population in the long-term is questionable, especially if that land is not designated conservation land. There may be additional, suitable breeding sites both inside and outside the CHU. If land purchase is not an option, continue to try to develop relations with the landowners to gain access to the area for future surveys.

RFS-2B

Site Description

This 66 ha, circular CHU is centered around a single *A. bishopi* historic record wetland. The wetland is actually part of a complex that includes two nearby wetlands that are connected by wet prairie (Figure 4). The prairie often floods in the winter, which hydrologically connects the wetlands (Palis and Enge 2005). The property was formerly industrial forestland but was purchased by the State of Florida in 2008 (McElhone and Ford 2011). Since that time, extensive restoration activities have occurred including prescribed fire and mechanical and herbicidal removal of woody vegetation in the wetland. The western half of this CHU is part of the Blackwater River State Forest and the eastern half is on the Yellow River Water Management Area. The area is cooperatively managed by the Florida Forest Service, Northwest Florida Water Management District, and the Florida Fish and Wildlife Conservation Commission (FWC) as the Yellow River Wildlife Management Area.

The historic breeding wetland is a 0.3 ha marsh with no canopy cover. Myrtle-leaved holly shrubs once covered much of the wetland basin but were removed and treated with herbicide in 2011 (McElhone and Ford 2011). Now the sub-canopy covers less than a quarter of the wetland. Sedges, grasses, and emergent vegetation grow around slash piles that are spread throughout the wetland basin. A June burn this year, removed most of the slash piles from previous management activities (B. Almario, FWC, pers. comm.). The east side of the wetland is clipped by a 5-m wide utility line corridor. On the date of our second visit, ruts within this corridor held water and amphibian larvae. A wet prairie extends to the southwest of the wetland and the surrounding uplands are planted pines. Once a dense pine plantation, the uplands now are being restored through the use of thinning and prescribed fire (McElhone and Ford 2011).

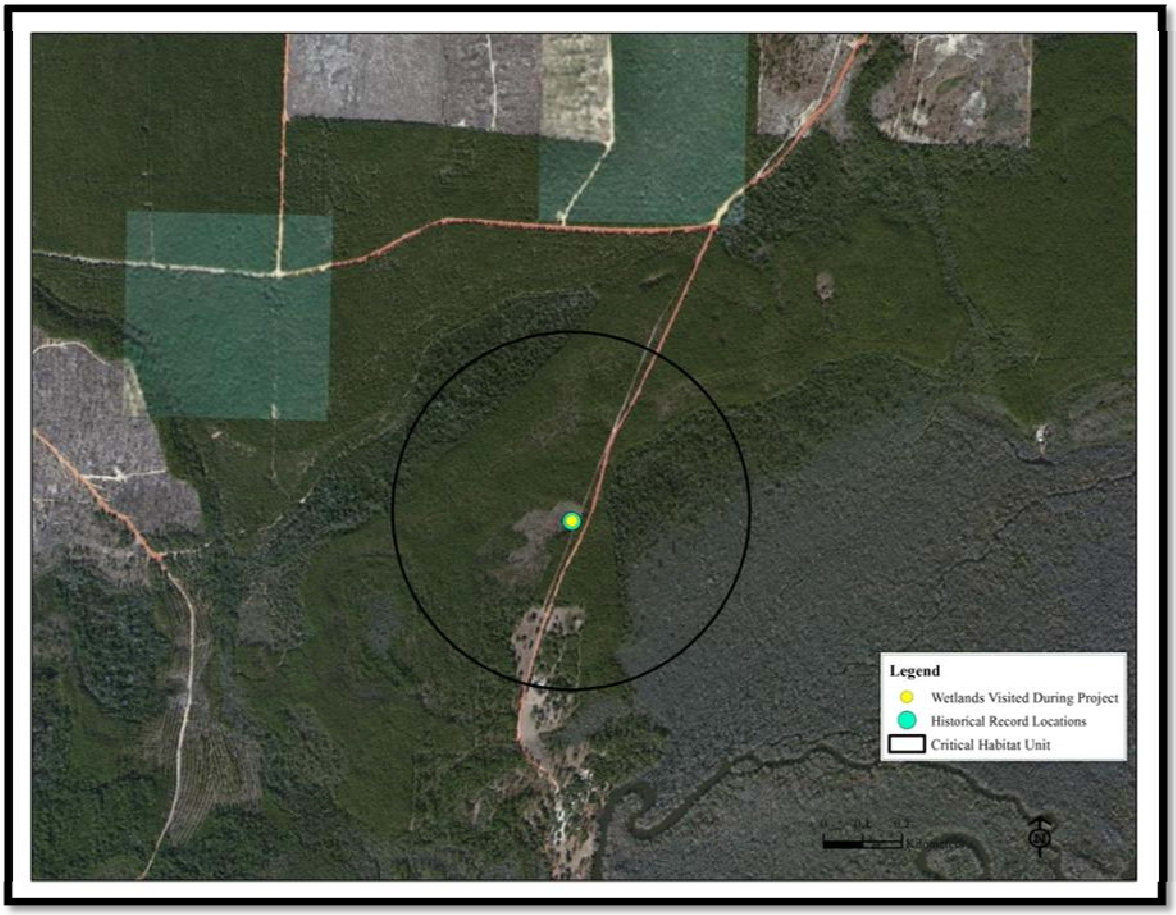

Figure 4. Map depicting CHU-2B in context of the surrounding area.

Survey Results

Multiple *A. bishopi* records exist for the historical breeding wetland within this CHU. Dipnet surveys in 1983, 1984, 1986, 1990, and 1993 yielded at least one *A. bishopi* larvae per effort (Palis 1993). Surveys conducted by FWC in 2003-2005 yielded no salamander larvae, although only one of those years could be considered a good sampling year (Palis and Enge 2005). FWC identified the historic breeding wetland as a Priority 1 wetland. As such, FWC staff have been conducting bi-and tri- annual winter dipnet surveys since 2008, when wetland conditions allow (B. Almario, FWC, pers. comm.). The wetland was sampled three times this year by CPI and FWC staff. No *A. bishopi* larvae were encountered, although other ephemeral wetland-breeding amphibians (southern chorus frog, *Pseudacris nigrita*, barking treefrog, *Hyla gratiosa*) were found. The last time *A. bishopi* was encountered on this CHU was in 1993.

Summary and Recommendation

It is unlikely that *A. bishopi* are utilizing the historic wetland as a breeding site. Larvae encountered during the 1980's and 1990's were likely part of a remnant population that was declining due to industrial forest land management practices. These incompatible practices (ditching, clear cutting, roller chopping, bedding, fire suppression, dense canopy) have caused decline of amphibian species in other locations as well (Vickers 1985, Palis 1997, Means et al. 1996, Means and Means 2005). Surveys conducted over the past 11 years have yielded no *A. bishopi* larvae. The presence of an *A. bishopi* population is possible however, as at least four to five of the past ten years were not optimal breeding years with respect to timing and amount of precipitation (Palis and Enge 2005, McElhone and Ford 2011).

Prospects for a sustainable *A. bishopi* population on this CHU are excellent. A large expanse of land surrounding the wetland already is in public ownership. Restoration of wetlands and uplands is ongoing with cooperation among several agencies (McElhone and Ford 2011). Additionally, an *A. bishopi* population would not need to depend on a single wetland for breeding habitat. There are three wetlands within the approximately 3-ha wet prairie/wet flatwoods wetland complex and a fourth wetland 0.5 km to the southwest (outside the CHU). FWC staff have ground-truthed and identified a total of 14 high priority or potential wetlands within YRWMA (McElhone and Ford 2011).

RFS-3A

Site Description

Over ten private individuals own the land within this 60 ha CHU. According to the property appraiser, most of the Unit is commercial/vacant, although there are some residential areas on the northwest side (Figure 5). The associated wetland is an approximately 11 ha mixed forested wetland. The wetland and surrounding uplands are severely fire suppressed and have a thick gallberry (*Ilex coriacea*), myrtle-leaved holly, and saw palmetto (*Serenoa repens*) component. The wetland itself has retained extensive herbaceous vegetation, including wiregrass around the wetland edge into the uplands.

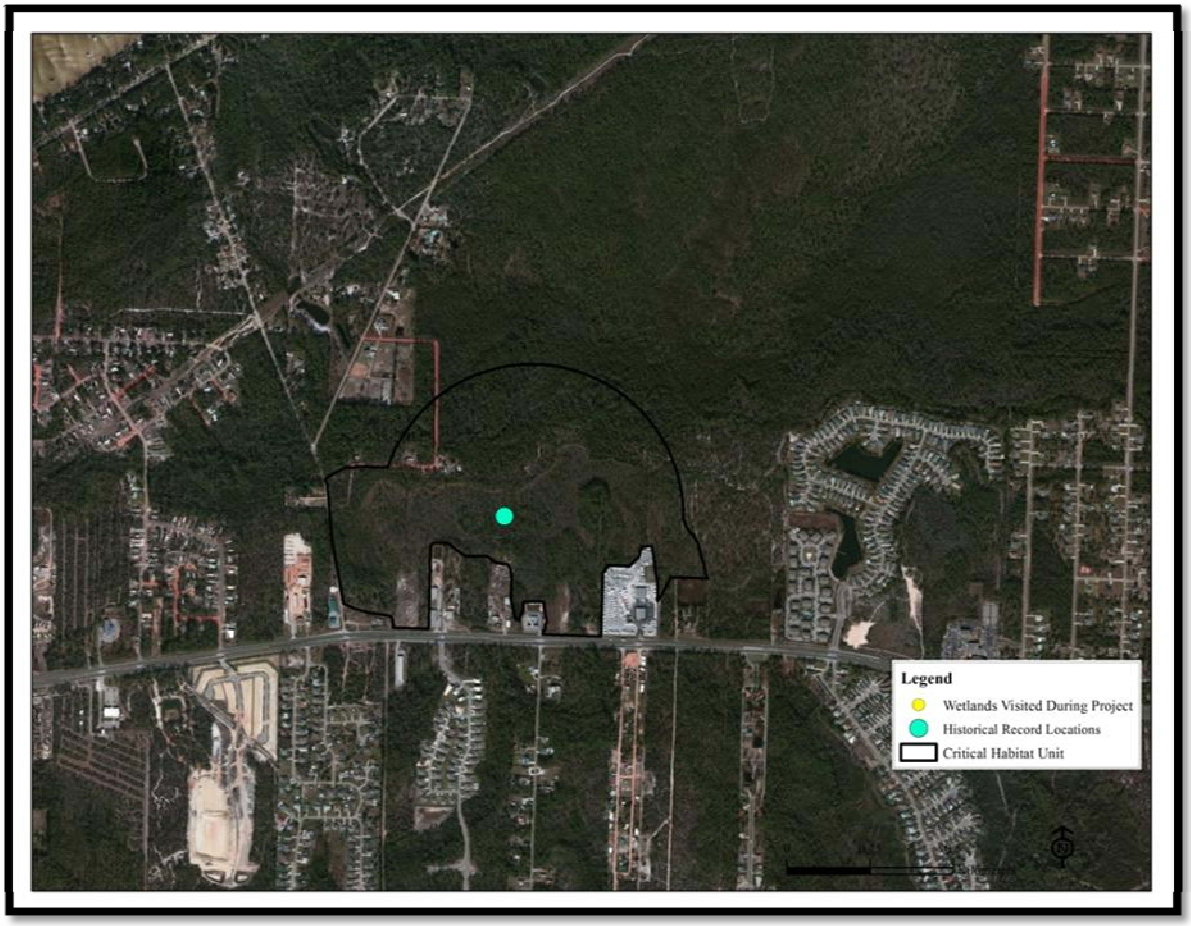

Figure 5. Map depicting CHU-3A in context of the surrounding area.

Survey Results

One historic record exists for this wetland from 1998 (H. Cooper, USFWS, unpubl. data). CPI was unable to locate documentation for any additional surveys since that date. CPI was unable to obtain landowner permission to access this site, so no sampling effort was conducted.

Summary and Recommendation

Prospects for a sustainable *A. bishopi* population within this Unit are extremely low. Satellite imagery from the past 20 years demonstrates the urban/suburban encroachment of a once forested area. Today, commercial businesses along US 98 (a divided, four-lane highway) border the Unit to the south and dense residential housing is encroaching from the east. The CHU itself remains forested and there is a large block of forested land (> 120 ha) to the north of the Unit. Overall, this Unit is an isolated patch surrounded by urban and suburban development. Fire/smoke management and potential sea level rise would be a challenge if the land were purchased for *A. bishopi* conservation.

RFS-3B

Site Description

This 23 ha CHU is delineated around a single *A. bishopi* breeding wetland. The n-shaped wetland is located on the northeast side of the Unit and comprises the majority of the Unit. An 8-ha rectangle of forested land forms the west side of the Unit and a large borrow pit was constructed at the southern end. As with the other CHU nearby, satellite imagery from the past 20 years demonstrates the urban/suburban encroachment of a once forested area (Figure 6).

Figure 6. Map depicting CHU-3B in context of the surrounding area.

The mixed swamp has deeper sections in which black gum and pond cypress trees form a canopy over the wetland and fetterbush and myrtle-leaved holly form a sub-canopy over the majority of the wetland. Leaf and needle litter are dense in these areas and herbaceous vegetation grows in scattered patches. In between the deeper lobes is a more shallow, open area that is more marsh-like in character. This area has extensive herbaceous vegetation but young pond cypress is

beginning to invade. This marsh area will succeed into swamp if fire is excluded and a drought persists.

Survey Results

A. bishopi was documented once in this CHU during a dipnet survey in 1998 (H. Cooper, USFWS, unpubl. data). CPI staff surveyed the wetland twice during the 2012-2013 breeding season and detected no *A. bishopi*. Other amphibians, including the winter-breeding ornate chorus frog (*Pseudacris ornata*), were found in the marsh area between the forested lobes.

Summary and Recommendation

It is unclear whether an *A. bishopi* population has persisted on this CHU. No *A. bishopi* have been documented in 15 years but only one survey has occurred during that time period. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population.

Due to the size of the CHU and the condition of the surrounding uplands, the possibility of this CHU supporting a sustainable *A. bishopi* population is extremely unlikely. The wetland is protected in perpetuity by a conservation easement but the CHU is completely surrounded by a dense housing subdivision. The wetland appears to be in good condition, especially the wet prairie in between the cypress domes. Water quality is likely a concern due to run-off and litter. CPI staff found anti-freeze and oil containers floating in the wetland along with other types of trash. The density of housing provides a smoke- and fire-management issue and the small size of this Unit reduces the likelihood that a long-term population of salamanders could persist.

RFS-6A

Site Description

This 86-ha CHU is located entirely on private land and is bisected by State Road 81 (Figure 7). Over half of the CHU is part of Nokuse Plantation, a private conservation initiative. Established in 2000, Nokuse is actively restoring its lands through the use of prescribed fire, planting of longleaf pine, and woody vegetation removal in the wetlands (M. Aresco, Nokuse Plantation, pers. comm.). The other sections of the CHU are owned by four individual private landowners, including the wetland within which the only *A. bishopi* record was documented. There are seven other ephemeral wetlands within the CHU, all but one located on Nokuse Plantation. Below are descriptions for five wetlands.

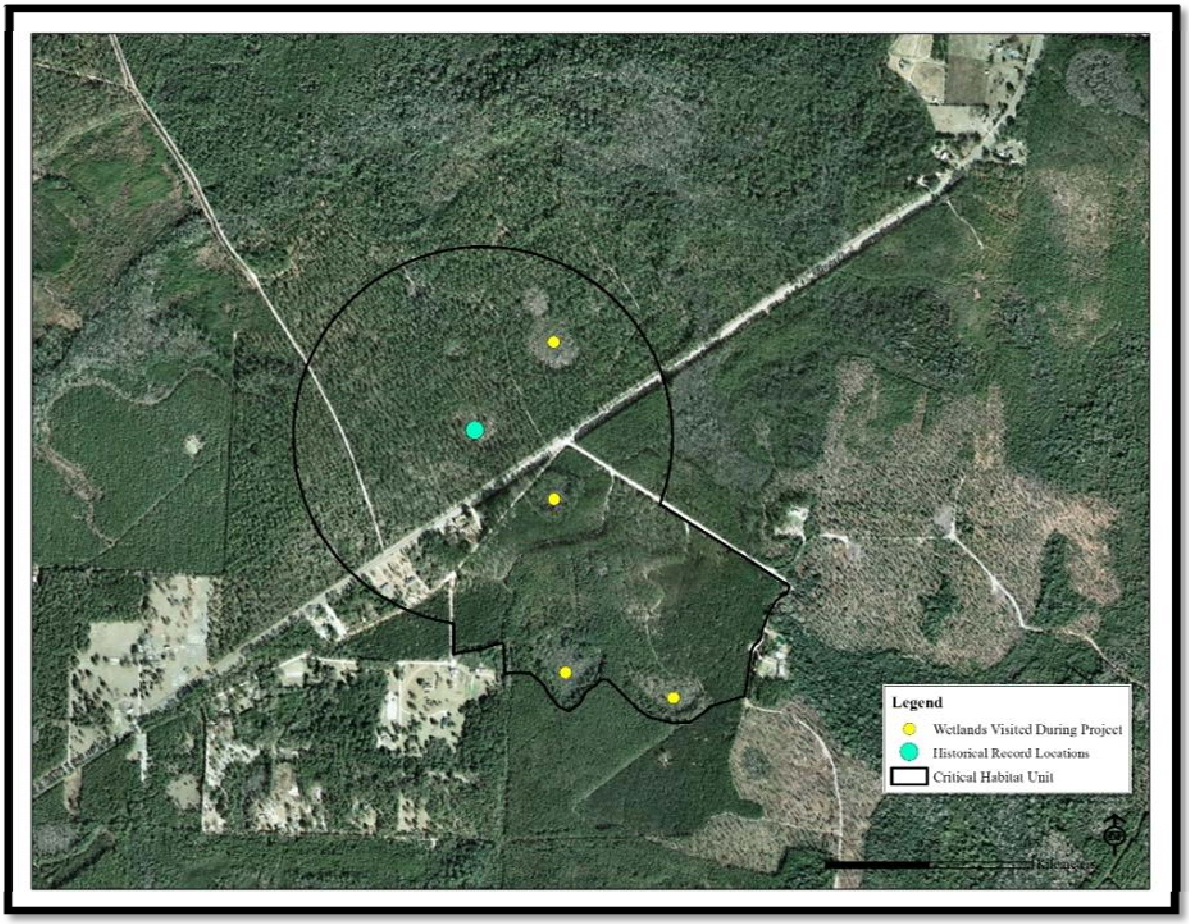

Figure 7. Map depicting CHU-6A in context of the surrounding area.

Wetland 1, the historical *A. bishopi* record wetland, is a 0.2 ha swamp. CPI staff did not have express permission from the landowner to access this wetland so the following description is based on satellite imagery, observations from the adjacent property, and third party observation (M. Aresco, Nokuse Plantation, pers. comm.) Swamp tupelo (*Nyssa biflora*) trees create a canopy over the entire wetland with myrtle-leaved holly forming a subcanopy. Sedges and grasses grow around the wetland edges, but are not abundant. An almost impenetrable thicket of woody vegetation grows around the wetland edge on the south side. The surrounding uplands are planted pines with a state highway, SR 81, 0.1 km to the south. This site was clearcut in March 2013 but the pond ecotone was not disturbed. The ecotone has dense wiregrass, especially on the north and east sides of the pond. The site has never been bedded or intensely site prepped.

Wetland 2 is a 1.1 ha, two- lobed swamp. Black gum trees and myrtle-leaved holly shrubs cover the entire wetland. Leaf litter and duff are thick. There are a few patches of herbaceous vegetation but for the most part, the herbaceous component is sparse. Uplands burned recently

but the fire did not penetrate into the wetland. The site does have intact wiregrass groundcover in many areas because it was never bedded. The 45-yr old upland slash pine plantation has been thinned (seed tree cut in early 1990's) with natural regeneration and scattered natural longleaf pine (M. Aresco, Nokuse Plantation, pers. comm.). The slash piles around the wetland edge will burn when the next fire burns into the wetland.

Wetland 3 is a circular swamp approximately 0.4 ha in size. This wetland is directly across SR 81 from the *A. bishopi* historical record wetland (Wetland 1). Black gum and pond cypress dominate the canopy and cover the entire wetland. Young gum trees and myrtle-leaved holly form a subcanopy that covers the majority of the wetland. Leaf litter, duff, and cypress needles thickly cover the wetland floor and herbaceous vegetation is sparse. A recent fire burned into the edges of the wetland but did not burn the wetland interior. A dirt road runs along the north side of the wetland and SR 81 is located just north of the dirt road. In the early 1950's a deep ditch was constructed running to the northeast draining into to the pond. Nokuse Plantation backfilled and eliminated the ditch in 2011 so that the pond again holds water (M. Aresco, Nokuse Plantation, pers. comm.). The surrounding uplands have been clearcut, were burned in October 2012, and replanted in longleaf pine as part of a restoration effort by Nokuse Plantation. The uplands on the east side of SR 81 were bedded by International Paper Co., resulting in greater historic ground disturbance than sites on the west side of SR 81.

Wetland 4 is a 1.0 ha ephemeral swamp located along the southern edge of the CHU. Pine, black gum, and pond cypress form a canopy over the entire wetland basin. The subcanopy also covers the entire wetland and is composed of titi (*Cyrilla sp.*), fetterbush (*Lyonia lucida*), and myrtle-leaved holly. Leaf litter and duff are thick on the wetland floor and herbaceous vegetation is sparse. A recent fire (January 2013) burned into the wetland edges. The surrounding uplands, outside of Nokuse Plantation, are a mix of rural residential and fire suppressed uplands. Groundcover in the uplands is almost completely woody vegetation. Nokuse Plantation staff are employing prescribed fire and mechanical restoration efforts in the area.

Wetland 5 is a 0.6 ha ephemeral swamp 0.2 km located southeast of Wetland 4. The canopy is dominated by young pond cypress and pine trees and covers a little over half the wetland basin. The subcanopy is dominated by myrtle-leaved holly bushes and covers the entire wetland basin. There is very little herbaceous vegetation growing in the wetland. A January fire burned throughout the wetland basin. Thinned pine plantation surrounds the west side of the wetland and the uplands to the east is a clearcut with broomsedge (*Andropogon virginicus*), blackberry (*Rubus sp.*), and longleaf pine seedlings that were planted in 2010.

Survey Results

There is only one record of an *A. bishopi* on this CHU. The first and last observation occurred in 1993 during one dipnet survey effort (Palis 1993). Nokuse Plantation staff have conducted several surveys since 2000. No A. bishopi have been encountered. Nokuse Plantation and CPI

staff sampled the historical *A. bishopi* breeding wetland and four nearby wetlands three times in 2013. No *A. bishopi* were detected.

Summary and Recommendation

It is unclear whether an *A. bishopi* population still exists on this CHU. No *A. bishopi* have been documented in 11 years on this Unit but sampling effort has been sporadic. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population.

Nokuse Plantation is actively restoring both uplands and wetlands. Current prospects for an *A. bishopi* population are low given the lack of herbaceous vegetation in the wetlands and the early stage of upland restoration efforts. In the future however, this area could potentially support an *A. bishopi* population. The area of Nokuse Plantation in the CHU are protected in perpetuity by conservation easements - to the west of SR 81 by a Department of Environmental Protection regulatory conservation easement and to the east of SR81 by a Florida Forever conservation easement held by the State of Florida Board of Trustees (part of an 18,880 acre conservation easement) (M. Aresco, Nokuse Plantation, pers. comm.).

RFS-6B

Site Description

This 66 ha, circular CHU was delineated around a single *A. bishopi* historic record (Figure 8). The entire CHU is located within Pine Log State Forest (PLSF) and also is a designated Wildlife Management Area. FWC is a cooperating agency and provides technical advice and management of wildlife populations (Hecht and Drayer 2007). Historically, the uplands were planted as a slash and sand pine (*Pinus clausa*) plantation and wildfires were suppressed. Now many areas have been thinned or restored to longleaf pine, and prescribed fire is applied on a 3-year burning regime (Enge 2005). A forested stream flows through the CHU just north and west of the *A. bishopi* historical record wetland. A north-south trending road bisects the Unit just east of the wetland. This gated, dirt road is open to foot-traffic only, except during hunting season when vehicular traffic is allowed.

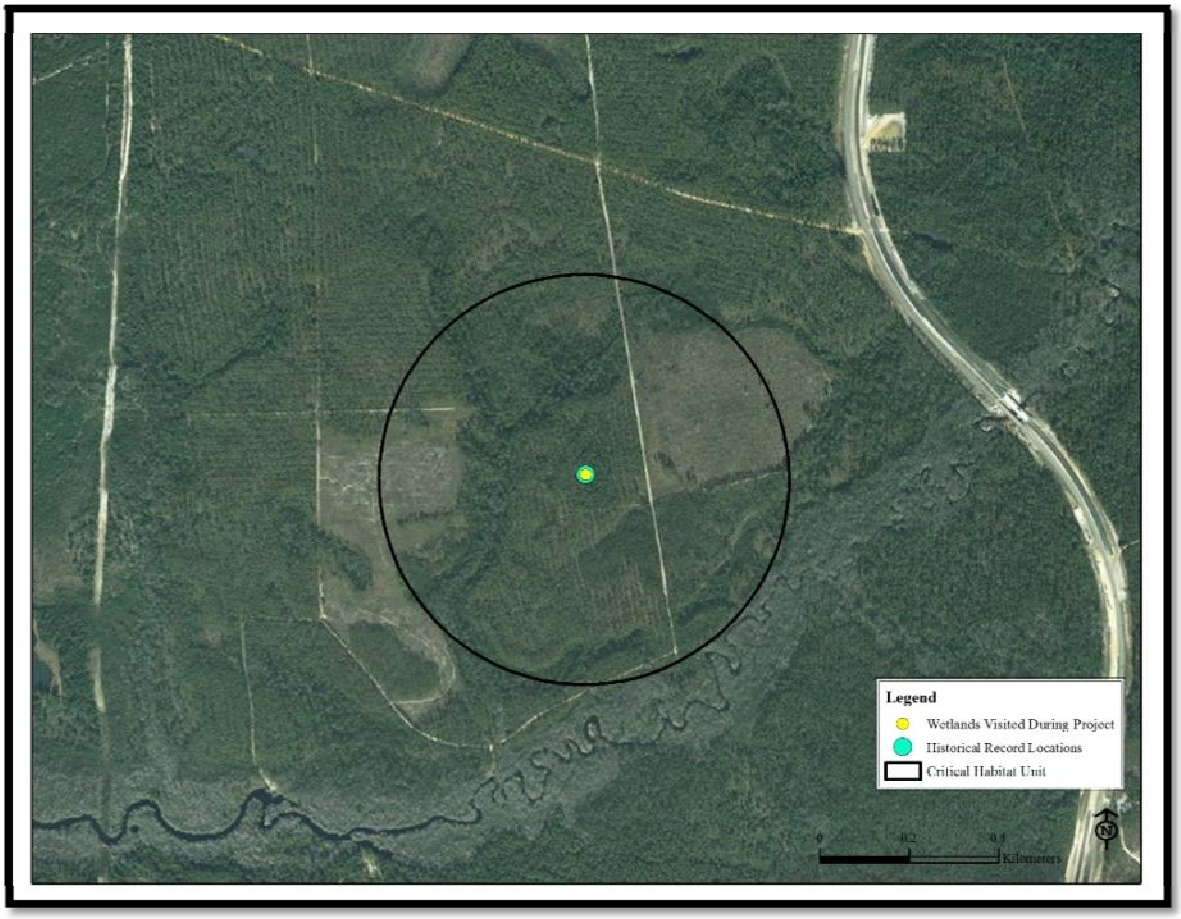

Figure 8. Map depicting CHU-6B in context of the surrounding area.

The historical *A. bishopi* breeding wetland is a little over 0.2 ha in size. This swamp is dominated by slash pine and pond cypress, which form a canopy over the majority of the wetland. Myrtle-leaved holly shrubs were once extensive but now cover less than a quarter of the wetland basin. Restoration efforts in the wetland began in 2009 with the removal of midstory and overstory vegetation followed by two growing season prescribed burns (Hopkins 2012). Some slash remains in the wetland. Pine needle and duff are thick but the more open areas of the wetland have scattered grasses, sedges, and ferns. Herbaceous vegetation grows throughout the upland ecotone. An old vehicular track leads into the east side of the wetland. The surrounding uplands were an old pine plantation that has been thinned. The dominant upland groundcover is a mix of woody (gallberry, saw palmetto) and herbaceous (broomsedge and wiregrass) vegetation.

Survey Results

The first record for *A. bishopi* on PLSF was in 1992 and larvae again were captured the following year (Palis 1993). There is no record of surveys conducted within this wetland between 1993 and 2002, however seven other wetlands on PLSF were unsuccessfully dipnet sampled in 1999 (Enge 2005). In 2002, FWC began annual *A. bishopi* surveys and monitoring on PLSF (Hopkins 2012). A single adult was captured in a drift fence in 2002 and one larva was captured in a dip net survey in 2005 (Enge 2005). The historic *A. bishopi* breeding wetland was visited by FWC and CPI staff four times this winter/spring (2012-2013). No *A. bishopi* larvae were found but several other species of ephemeral-wetland breeding amphibians were documented such as the mole salamander (*Ambystoma talpodieum*), southern chorus frog, and ornate chorus frog. The last recorded *A. bishopi* on PLSF was in 2005.

Summary and Recommendation

Continued sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population on this CHU. Despite extensive survey and monitoring efforts, *A. bishopi* have not been encountered in eight years. However, due to the amount and timing of precipitation, the historic wetland was not hydrated during the *A. bishopi* breeding season at least four of those years. FWC or DOF staff will continue annual dipnet surveys at the historic breeding site and have a systematic sampling protocol in place for other, potential wetlands (Enge 2005, Hopkins 2012). Results of sampling efforts over the next few years will determine whether a population of *A. bishopi* still remains on PLSF.

Prospects for a sustainable *A. bishopi* population on this CHU are excellent. Management recommendations for the *A. bishopi* already have been developed and are being incorporated for this area (Enge 2005, Hecht and Drayer 2007, Hopkins 2012). The road east of the wetland likely is not an issue in terms of mortality. Vehicle traffic is permitted during hunting season, a time of year that could correspond with salamander migration. However, salamanders migrate at night and typically during a rain event, a time when this road would not be heavily used.

Although there are no other potential breeding wetlands within the CHU, FWC staff identified five potential or highly potential wetlands on PLSF that are within 1 km of the *A. bishopi* historic breeding wetland, on the same side of SR 79, and north of Pine Log Creek (Hopkins 2012). These wetlands also should be considered critical for the long-term survival of an *A. bishopi* population on this CHU.

RFS-7A

Site Description

This 66 ha CHU is delineated around a single *A. bishopi* breeding wetland. The unit encompasses property owned by two private landowners. The hydrology of the CHU, and areas surrounding the CHU, has been impacted by residential, agricultural, and silvicultural land management activities (Figure 9). The north end of Tom Williams Bay is located on the east side of the CHU. The historical *A. bishopi* wetland may have been a part of this system before silvicultural activities separated the wetland from the lobes nearby. There are at least three other similarly isolated wetlands within the Unit. An agricultural matrix with a few forested patches surrounds the CHU and a dirt road crosses through the southern end.

Figure 9. Map depicting CHU-7A in context of the surrounding area.

The historic *A. bishopi* breeding wetland is a 0.2 ha swamp. Pine and pond cypress trees form a canopy over the entire wetland. Myrtle-leaved holly shrubs are thick and create a subcanopy across the entire wetland. Leaf litter is thick but herbaceous vegetation grows throughout the

wetland. A thick woody ring surrounds the wetland and the fire-suppressed uplands are planted pines with a thick woody understory.

Survey Results

The only record of *A. bishopi* in this CHU is from a dipnet survey in 1993 (Palis 1993). CPI staff surveyed the wetland twice in 2013. Crayfish and crayfish burrows were abundant but no *A. bishopi* larvae were detected.

Summary and Recommendation

Given the condition of the surrounding uplands, it is unlikely an *A. bishopi* population has persisted within the CHU. The larva encountered during the 1993 survey was likely a remnant from a historical population. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of *A. bishopi*.

RFS-7B

Site Description

This circular CHU is approximately 67 ha in size and was delineated around a single historic *A. bishopi* breeding wetland (Figure 10). Approximately 19 ha of the northern section, including several wetlands, owned by five individual landowners. The rest of the CHU, including the historic *A. bishopi* wetland, is owned by Plum Creek Timber Company. A hunt club leases the Plum Creek land and a gated dirt road runs along the southern end of the CHU.

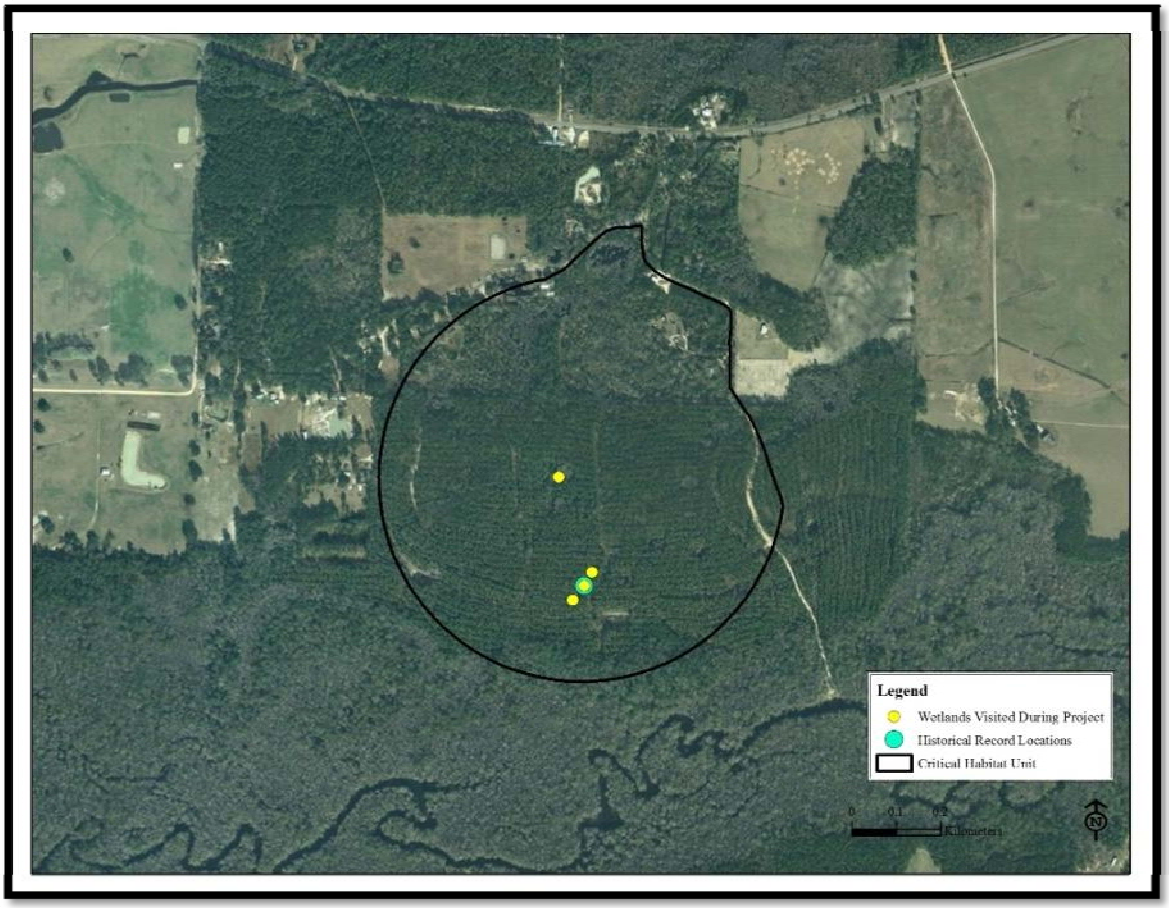

Figure 10. Map depicting CHU-7B in context of the surrounding area.

Plum Creek purchased the property in 2004 from Soterra. Following the critical habitat designation in 2009, Plum Creek developed a management plan for the area that was consistent with USFWS guidelines for the *A. bishopi* (K.Cheynet, Plum Creek, pers. comm.).

Our January site visit to this CHU occurred just after all the slash pine trees were clearcut from the entire area. Slash piles were left within and around the wetlands and vehicular tracks led up to two wetland edges. Harvesting occurred right up to the wetland edge, leaving no intact ecotone. This timber harvest was not consistent with the management plan developed for the area and was not conducted in accordance with Plum Creek's procedures, which require notification to the biological division before any work is conducted near sensitive species sites (K. Cheynet, Plum Creek pers. comm.).

Soon after our visit, Plum Creek initiated a conservation project on this site that included a low density planting of longleaf pine seedlings. No mechanical or chemical site-preparation was conducted. Targeted spot herbicide treatments will be used to release the longleaf pine from competing vegetation until they emerge from the grass stage, after which fire will be introduced

into the system. In addition, hunt club access to this area is now restricted to prevent further soil disturbance.

CPI staff visited four wetlands within this CHU, all on Plum Creek property. Many additional small wetlands are scattered throughout the property and were not visited due to time constraints. Three wetlands, including the historic *A. bishopi* record wetland form a string that may connect during times of high water. Leaf litter is heavy in all three wetland basins and there is no herbaceous vegetation. As mentioned above, the uplands surrounding these wetlands were planted pines that recently were clearcut.

Wetland 1 is a <0.1 ha, circular ephemeral forested swamp. Gum trees form a canopy over the whole wetland basin. Myrtle-leaved holly forms a subcanopy over a small portion of the basin. A vehicular track leads up to the edge of the wetland on the east side.

Wetland 2 is located 30 m northeast of Wetland 1 and is a tiny (0.02 ha) forested swamp. Gum trees form a canopy over the entire wetland and myrtle-leaved holly shrubs cover less than a quarter of the wetland. *A. bishopi* larvae were captured in herbaceous vegetation and pine litter around the edges of this wetland in 1993 (Palis 1993). As mentioned in the above paragraph, there is no herbaceous vegetation in this wetland now.

Wetland 3 is 20 m northeast of Wetland 2 and is a very small sink depression surrounded by gum trees. The trees provide a canopy over the majority of the wetland. There is no sub-canopy or groundcover vegetation.

Wetland 4 is a 0.4 ha swamp. Historically this swamp was likely a cypress dome but few large cypress remain. Pine and black gum form a canopy that covers the entire wetland. Gallberry and myrtle-leaved holly dominate the sub-canopy and cover less than half the wetland basin. Pine needles cover the wetland floor and there is no herbaceous vegetation. Large vehicular ruts adjacent to the wetland hold water longer than the wetland itself.

Survey Results

The first and only record of an *A. bishopi* on this CHU was in 1993 (Palis 1993). Plum Creek personnel accompanied a biologist from the Tallahassee USFWS office when they conducted a dipnet survey of the area prior to critical habitat designation (2007-2008). No *A. bishopi* larvae were identified (K. Cheynet, Plum Creek pers. comm.). CPI staff visited the wetland twice in 2013 and did not detect *A. bishopi*. Southern chorus frog larvae, another winter and ephemeral wetland-breeding amphibian species, were present.

Summary and Recommendation

It is unclear whether an *A. bishopi* population still exists on this CHU. No *A. bishopi* have been documented in 20 years but sampling has occurred only once during that time period. A

systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population.

Current prospects for an *A. bishopi* population are low given the lack of herbaceous vegetation in the wetlands and the early stage of upland restoration efforts. In the future however, this area could potentially support an *A. bishopi* population. The Unit provides an excellent opportunity to study ephemeral wetland and amphibian population response to forestry practices. The landowner is receptive to future conversations about scientific studies on the property and the possibility of supporting future *A. bishopi* populations.

RFS-8A

Site Description

This irregular-shaped CHU is 45-ha in size and involves six different private landowners. The hydrology of this area has been severely impacted by road building and agricultural, silvicultural, and residential land management practices (Figure 11). There are at least six isolated wetlands on the Unit. CPI staff visited two of these wetlands, one of which was the historical *A. bishopi* breeding wetland. The vast majority of the uplands outside the CHU are developed as agricultural lands. The exception is the timberlands to the east and southeast of the Unit.

Figure 11. Map depicting CHU-8A in context of the surrounding area.

Wetland 1, the historic *A. bishopi* breeding wetland, is an approximately 4-ha swamp that at one time connected to a larger wetland system to the south. The southern end of the wetland has been altered by the landowner and a permanent pond was constructed. CPI staff did not visit this section of the wetland but suspect berms were built around the constructed pond to separate it from the wetland. Pond cypress and black gum form a canopy that covers the entire wetland basin. Gum and cypress also make up the subcanopy, which covers over half the wetland. Herbaceous vegetation is sparse except on the west side of the wetland where sedges and graminoids are abundant. Trees and shrubs grow in a thicket around the east wetland edge, where the wetland borders a dirt road. The uplands surrounding the historical breeding wetland are completely developed as agricultural lands. US 90, a two-lane highway, cuts across the north end of the wetland. The roadside ditch connects with the wetland during times of high water.

CPI staff visited a second wetland within the CHU that is located on Plum Creek Timber Company land. This 4.5 ha forested swamp is completely surrounded by pine plantation. Pond cypress and gum trees form a canopy that covers the entire wetland. Fetterbush dominates the

subcanopy, and covers about half of the wetland basin. Herbaceous vegetation is sparse and grows only in scattered patches. We detected the presence of warmouth bass (*Lepomis gulosus*) in this wetland, which reduces the wetland's suitability as an *A. bishopi* breeding site (USFWS 1997).

Survey Results

Two *A. bishopi* specimens were collected somewhere in this vicinity in 1950. Forty-three years later, one larva was collected from a wetland within the CHU (Palis 1993). I was unable to find documentation of any other amphibian surveys in the area. CPI staff sampled the historic *A. bishopi* breeding wetland twice in 2013. No *A. bishopi* larvae were detected. Three other ephemeral wetland, winter-breeding amphibian species were encountered--pine woods treefrog (*Hyla femoralis*), ornate chorus frog, and southern chorus frog.

Summary and Recommendation

It is unclear whether an *A. bishopi* population still exists on this CHU. No *A. bishopi* have been documented in 20 years but sampling has occurred only once during that time period. Given the condition of the surrounding uplands, it is unlikely an *A. bishopi* population has persisted, especially near the historic breeding wetland. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of *A. bishopi*.

The southeastern portion of the CHU and the lands farther east and south on the CHU are better suited to providing *A. bishopi* habitat. This > 400-ha block currently is owned by Plum Creek Timber Company. The timber company property is the only land in this area that is forested and there are multiple wetlands in the area. The uplands are mostly densely planted pine with little herbaceous ground cover so restoration would need to occur before it could be considered suitable upland *A. bishopi* habitat. No historic records for *A. bishopi* have been documented for this area but it is unlikely sampling has occurred here either. The area may provide another excellent opportunity to study ephemeral wetland and amphibian population response to forestry practices. Plum Creek is receptive to future conversations about scientific studies on the property, however, they feel that RFS-7B is a higher priority site (K. Cheynet, Plum Creek pers. comm.).

RFS-8B

Site Description

This 156-ha, rectangular-shaped CHU incorporates eight different private. The eastern half of the Unit is a drier, more sandhill vegetation community and is owned by Plum Creek Timber Company. The uplands are planted pine. The western half of the CHU is owned by multiple private landowners. CPI staff was unable to obtain permission to visit the western half of the

CHU. Based on satellite imagery, it appears that most landowners have considerably manipulated the hydrology of the area (Figure 12).

Figure 12. Map depicting CHU-8B in context of the surrounding area.

The historic *A. bishopi* breeding wetland is now classified as "artificial lakes and ponds" according to the Cooperative Land Cover Map (FNAI 2010). The wetland appears to have been scraped, deepened, and denuded of vegetation. Based on satellite imagery, the destruction of this wetland occurred between fall 2010 and winter 2011. While the land surrounding the wetland is still forested, the wetland itself is no longer suitable breeding habitat for *A. bishopi*.

CPI staff visited a different wetland, located on Plum Creek Timber Company land approximately 1 km east of the historic breeding wetland. This small (<0.1 ha) shrub swamp has an open overstory and herbaceous vegetation covering over half the wetland. The uplands surrounding the wetland are planted pines and rise up on the west side to a sandhill community. Plum Creek conducted a heavy thinning in this area in an effort to enhance herbaceous vegetation and improve habitat quality for *A. bishop*.

Survey Results

The first record of an *A. bishopi* in this vicinity is from 1933 (Palis 1993). Eighteen years later, 35 museum specimens were submitted from the general area (Palis 1993). The only historical record for an *A. bishopi* from this CHU is from a dipnet survey conducted in 1993 (Palis 1993). As far as is known, no other amphibian surveys occurred between 1993 and 2013. CPI was denied access to the historical *A. bishopi* breeding wetland by the landowner. No *A. bishopi* larvae were detected in the wetland CPI visited on the eastern side of this CHU.

Summary and Recommendation

A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population. Given the condition of the surrounding uplands, it is unlikely an *A. bishopi* population has persisted, however, especially near the historic breeding wetland. Forested land remains east of this CHU but it is fragmented and may not contain suitable *A. bishopi* habitat. This site seems to have some potential based on the existing vegetation; however, it would be difficult to manage due to its relatively small size and proximity to roads and development (K. Cheynet, Plum Creek pers. comm.).

RFS-8C

Site Description

This irregular-shaped CHU is 99 ha in size and encompasses lands owned by three individuals and one timber company. A north-south trending state highway (SR 275) bisects the CHU (Figure 13). The building of this road isolated the northeastern tip of Wolf Slough from the larger system to the southwest. A dirt road, built perpendicular to SR 275, further isolated a small wetland from the slough. This wetland was likely a lobe of the larger slough system before road building occurred. *A. bishopi* larvae were detected in this small, isolated wetland east of SR 275 and south of the dirt road. CPI staff was unable to obtain permission from the individual landowner to access the historical *A. bishopi* breeding wetland.

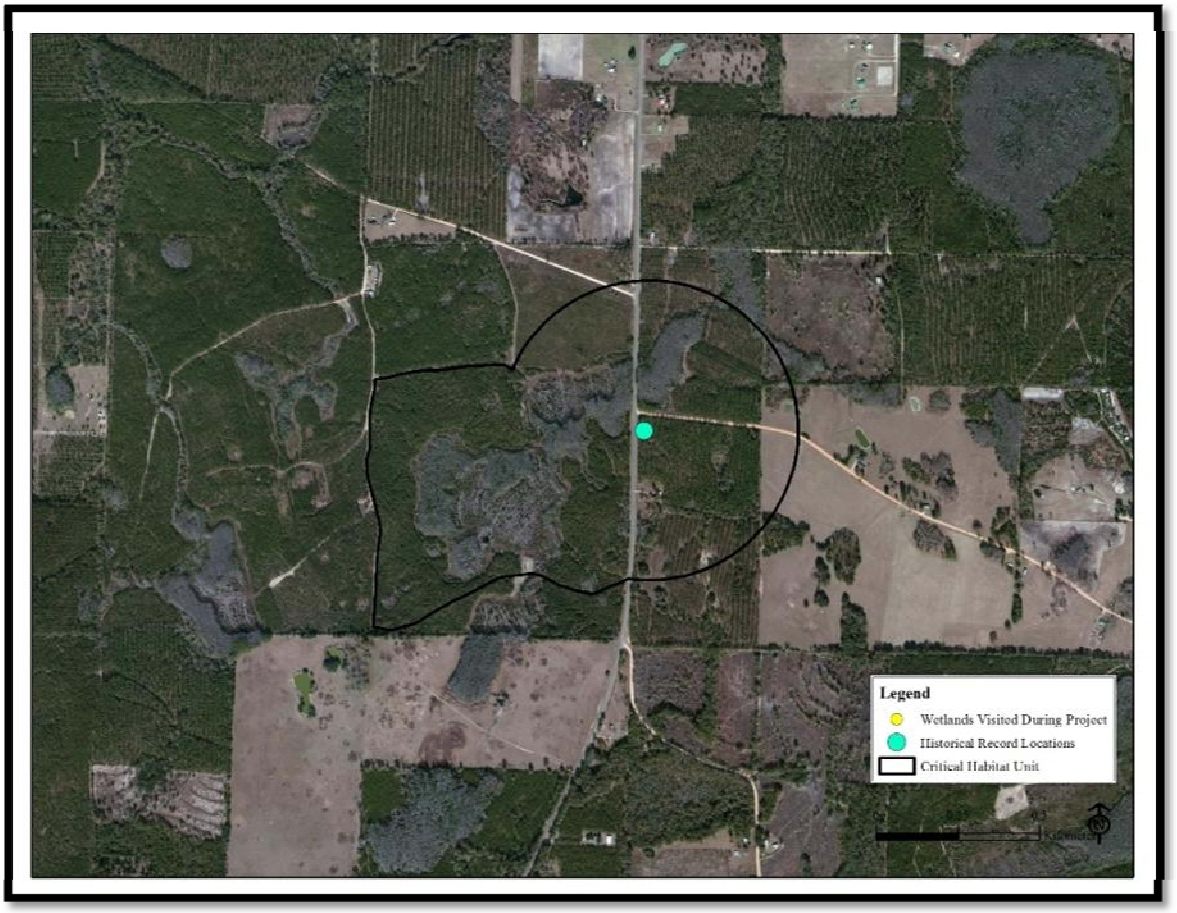

Figure 13. Map depicting CHU-8C in context of the surrounding area.

Survey Results

Two *A. bishopi* records exist from this CHU. Larvae were encountered in the small wetland mentioned above in 1992 and 1993. CPI staff was unable to obtain permission to sample the historical *A. bishopi* breeding wetland.

Summary and Recommendation

Habitat in this area is highly fragmented and the likelihood of an *A. bishopi* population persisting is small. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population within this CHU.

RFS-9A

Site Description

A gated road bisects this 66 ha, circular CHU that is within Bear Creek Timber Company and St. Joe Land and Development Company property (Figure 14). All four isolated wetlands within this CHU are owned by Bear Creek Timber Company and surrounded by pine plantations in various stages of succession. CPI was unable to gain access to the CHU.

Figure 14. Map depicting CHU-9A in context of the surrounding area.

Survey Results

A. bishopi larvae were detected in one wetland within this CHU in 1999 (M. Bailey, Conservation Southeast, Inc., pers. comm.). I was unable to find documentation of any other amphibian surveys before or after this date. CPI staff was not granted access to sample the historical *A. bishopi* breeding wetland.

Summary and Recommendation

Given the heavy site preparation employed for silvicultural activities, it is unlikely that an *A. bishopi* population has persisted in this CHU. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population.

Prospects for a future *A. bishopi* population in this area are good if land acquisition is an option. At least 10 isolated wetlands are less than 1 km from the historic *A. bishopi* breeding site and extensive, forested land surrounds this CHU. The uplands and wetlands would need a great deal of restoration before an *A. bishopi* population could be established. If land purchase is not an option, continue to try to develop relations with the landowners to gain access to the area for future surveys. Additionally, the landowner could be provided with information about forestry practices that are compatible with *A. bishopi*.

RFS-9B

Site Description

RFS-9B is a 355 ha, oval-shaped CHU that generally trends east-west (Figure 15). The entire Unit is pine flatwoods and lies within private property owned by the Neal Land and Timber. Neal Land and Timber's purchased has been managing the forests in this area since the 1930s. The company manages both pine and hardwood stands on a 50-year rotation with emphasis on the higher value forest products (P. McMillian, Neal Land and Timber, pers. comm.). Although the overall hydrology of this area has likely been impacted by silviculture-related practices, no bedding was evident surrounding the targeted wetlands. The forests in this area are burned regularly and there is an herbaceous component to the upland understory. Three wetlands were visited on this Unit but other potential breeding sites exist inside and outside of the designated Unit.

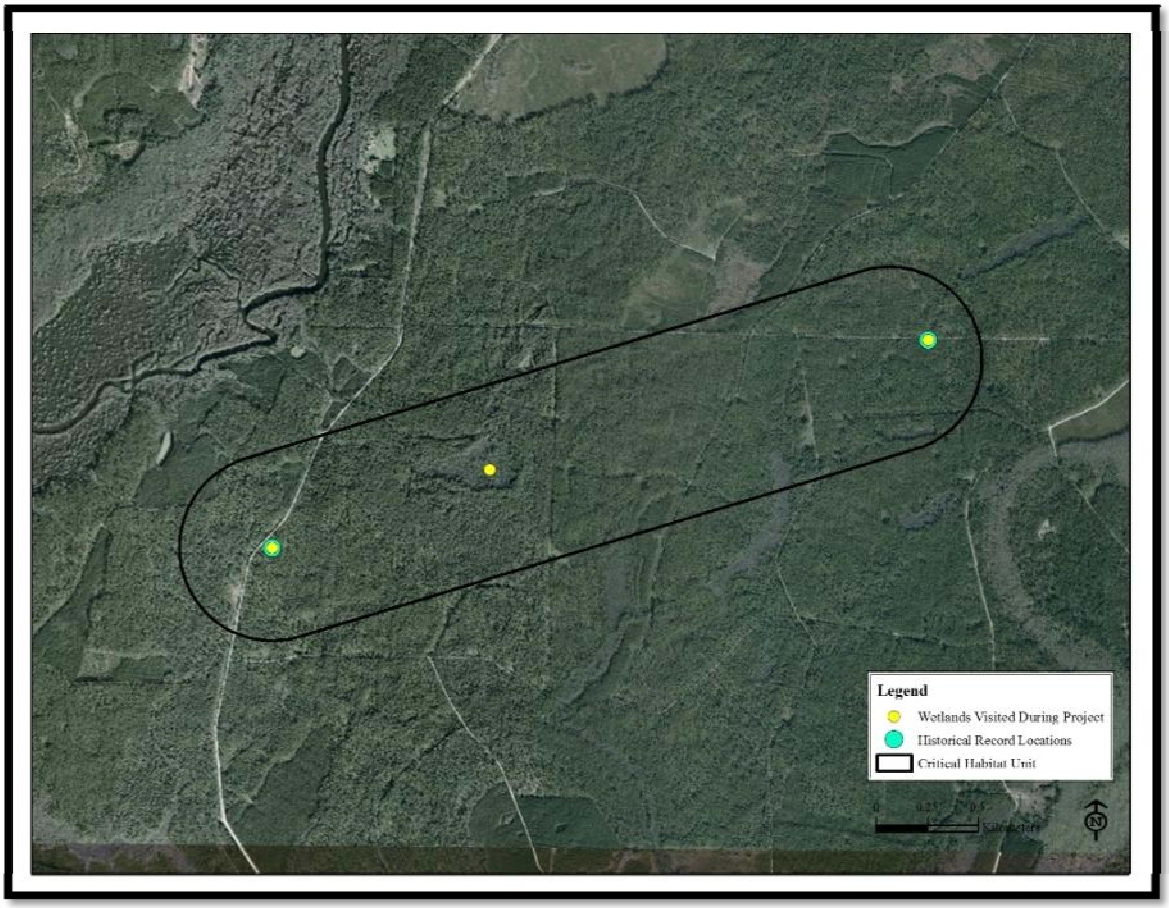

Figure 15. Map depicting CHU-9B in context of the surrounding area.

Wetland 1 is an *A. bishopi* historical record wetland located on the western end of the CHU. This 0.3-acre ephemeral black gum swamp has a myrtle-leaved holly midstory that covers about a quarter of the wetland. Herbaceous vegetation is scattered throughout the majority of the wetland. The surrounding uplands are open, pine plantation with a predominately gallberry groundcover. Some wiregrass grows around the edges of the wetland and throughout the uplands. A county road runs along the northwest side of the wetland. The roadside ditch has a longer hydroperiod than the wetland and connects during times of high water. The wetland has high potential of supporting an *A. bishopi* population and there may be other suitable breeding sites within 1 km. The wetland's location directly adjacent to a paved road could prove fatal to migrating salamanders (Means et al. 1996). The road does not appear to be a high-use road so the probability of direct mortality is likely low.

The other *A. bishopi* historical record from this Unit was documented from a grassy ditch along the south side of a gated, dirt road. This ditch was dry during both visits, but there is suitable habitat directly across on the north side of the dirt road. The grassy wet area on the north side of

the road appears to be the terminus of a larger wetland string to the north. Graminaceous species grow throughout the roadside and wetland. Southern chorus frog (another winter, ephemeral wetland-breeding amphibian) larvae were encountered during dipnet surveys this year. The area is surrounded by a regularly burned, open pine plantation with a mixed gallberry and herbaceous groundcover.

CPI staff visited a third, larger wetland that appeared to have potential based on satellite imagery. A site visit revealed the wetland to be more of a hardwood strand than an isolated wetland. While the surrounding forest is open pine plantation with large diameter trees, the low-lying area is connected to a small, intermittent creek strand and therefore likely would not be suitable *A. bishopi* breeding habitat.

Survey Results

Historical records for *A. bishopi* are documented from two sites within this CHU. These records are from a single dipnet survey conducted in 1991. No amphibian sampling occurred between 1991 and 2013. No *A. bishopi* larvae were found during the January and April surveys of 2013, therefore the last record of this species within RFS-9B was in 1991.

Summary and Recommendation

The pinelands within this CHU are expansive, regularly burned, and have the potential to support an *A. bishopi* population. The wetlands have an herbaceous component, providing suitable breeding habitat. Given that the Unit is located within a commercial timber property with primary management objectives other than wildlife, the long-term suitability of this Unit is not certain. The current condition of the Unit, however, does suggest compatibility between wildlife and timber objectives.

No *A. bishopi* have been documented in 10 years on this Unit but sampling effort has been extremely low (once in the past 10 years). A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population. Additionally, the landowner could be provided with information about forestry practices that are compatible with the *A. bishopi*. The Unit provides an excellent opportunity to study ephemeral wetland and amphibian population response to forestry practices. Neal Land & Timber is receptive to future conversations relating to future *A. bishopi* populations on their property (P. McMillan, Neal Land and Timber, pers. com.). However, their primary business and mission is to maintain a productive forest and activities outside that mission may be declined.

RFS-10A

Site Description

This circular, 66 ha CHU was delineated around a single, historic *A. bishopi* breeding wetland (Figure 16). The entire Unit is within Mayhaw Wildlife Management Area (MWMA), managed by the Georgia Department of Natural Resources. The area is principally flatwoods with large swamp systems to the southeast and the southwest of the Unit. A dirt track, generally trending east-west, bisects the CHU and another dirt track clips the eastern edge of the Unit. Most traffic on these roads is limited to hunting seasons. MWMA is primarily managed for game species such as white-tailed deer (*Odocoileus virginianus*) and eastern wild turkey (*Meleagris gallopavo*), and small game species such as northern bobwhite quail (*Colinus virginianus*).

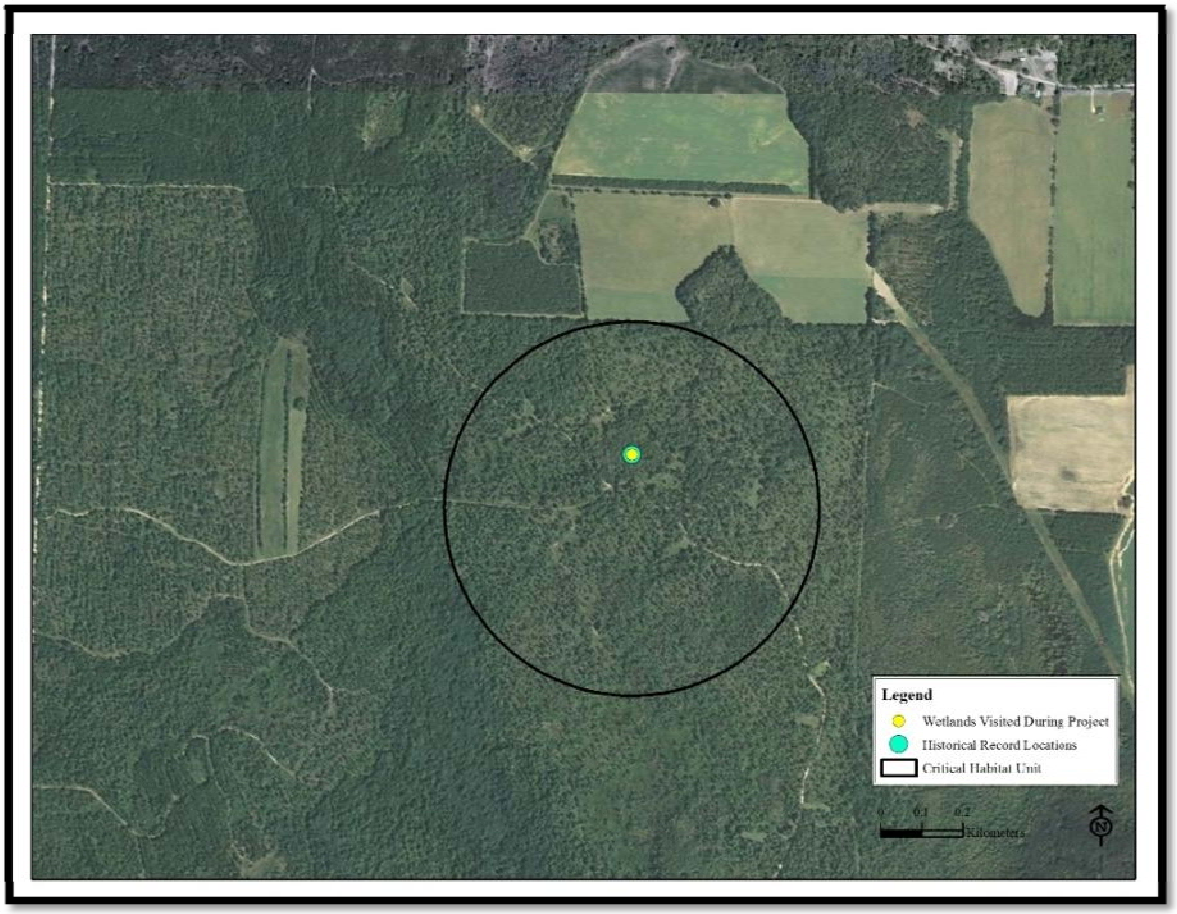

Figure 16. Map depicting CHU-10A in context of the surrounding area.

The historic *A. bishopi* breeding wetland is a 1.6 ha, circular, ephemeral swamp. Pond cypress dominates the canopy and covers about 75% of the wetland basin. Myrtle-leaved holly forms a sub-canopy over the majority of the wetland. Leaf litter and debris is abundant but there also are

large patches of completely submerged grasses growing in the wetland. Cutgrass (*Leersia oryzoides*), pickerelweed (*Pontederia cordata*), maidencane, and other grasses grow around the wetland edges, except on the southern side. The surrounding uplands are pine savanna with a mixed herbaceous and woody groundcover component.

Survey Results

The first record of an *A. bishopi* on this CHU was in 1998 when, during a dipnet survey, two larvae were captured (J. Jensen and S. Johnson, Georgia Department of Natural Resources, unpub. data). A single adult *A. bishopi* was subsequently detected in February 2001 during a drift fence study near the wetland. Drift fence arrays were operated for two years during the 2000-2001 and 2001-2002 breeding seasons (Guyer 2000, C. Guyer, Auburn University, pers. comm.). Students from a University of Georgia Herpetology course conducted non-standardized dipnet surveys in the wetland during the 2006-2012 *A. bishopi* breeding seasons. No *A. bishopi* were encountered (J. Maerz, University of Georgia, pers. comm.). Joseph W. Jones Ecological Research Station (JJERC) and CPI staff sampled the wetland three times in 2013. No *A. bishopi* were encountered although two other winter-breeding amphibians, marbled salamander (*Ambystoma opacum*) and ornate chorus frog, were detected.

Summary and Recommendation

Over 10 years has passed since the species was last detected on this CHU. Sampling effort during this time period was not systematic but did result in detection of 19 other amphibian species, including three other Ambystomatid species. A systematic, long-term sampling effort is needed in order to confirm or deny the presence of an *A. bishopi* population on this CHU.

Although it is unlikely that *A. bishopi* persists in the area, this CHU has good potential to support a population in the future. The growing season prescribed burns incorporated as part of the management objectives for game species also will provide suitable upland habitat for *A. bishopi*. As long as predatory fish are not introduced into the system, the Cypress Creek Waterfowl Impoundment project, that creates temporary impoundment and natural drawdown of the wetland complex (J. Denton, Georgia, Department of Natural Resources, pers. comm.), will continue to provide suitable ephemeral wetland habitat. Attention should be The 50 Year Management Plan for Mayhaw WMA was created before the detection of *A. bishopi* on the property, but an addendum to the Plan has been drafted and submitted (J. Jensen, Georgia Department of Natural Resources, pers. comm.).

RFS-10B

Site Description

RFS-10B is an elongated, north-south oriented, rectangular Unit encompassing 622 acres (Figure 17). The dominant forest type in the Unit is “natural pine”, which consists of 80-90 year old

longleaf pine with a wiregrass understory. Scattered live oak (*Quercus virginiana*) occur in less well-drained areas and slash pine rather than longleaf pine occurs around the wetlands. There are multiple wetlands found within the Unit including three *A. bishopi* historical breeding sites. The entire Unit is within the Joseph W. Jones Ecological Research Center (JJERC). The Center was established in 1991 on Ichauway, a 29,000-acre quail hunting plantation, to incorporate research and education into the management of longleaf pine ecosystems and water resources. Active management to maintain and/or restore both wetlands and uplands is ongoing. Management includes use of prescribed burns on a two-year return interval; prescribed burns take place from January through July depending on management objectives.

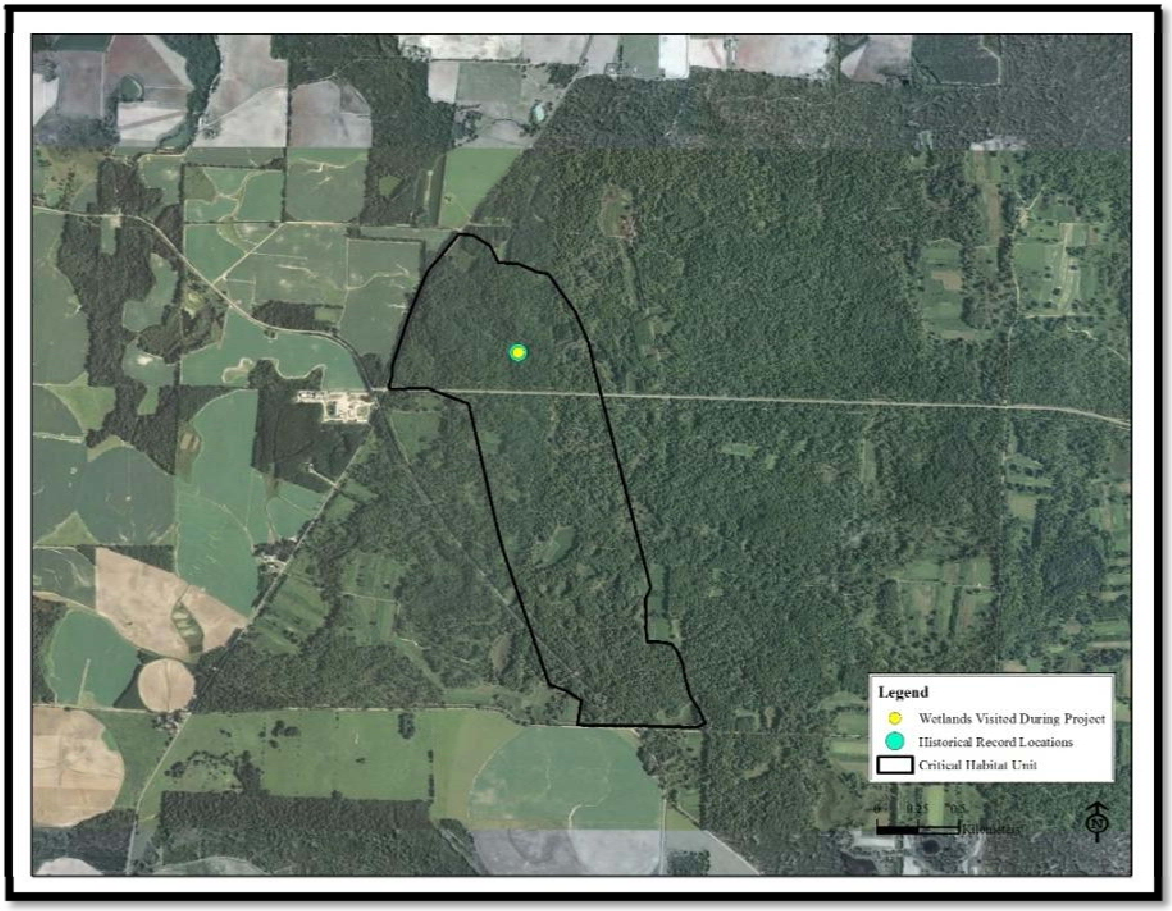

Figure 17. Map depicting CHU-10B in context of the surrounding area.

Wetland 01, also known as Wolf Pond, is a 4-ha cypress gum swamp bordered by a county road to the north. The wetland has full canopy cover and a moderate myrtle-leaved holly midstory. The midstory is particularly thick around the wetland edges. Herbaceous vegetation is scarce and grows in scattered patches. The majority of herbaceous vegetation grows along the southwest edge of the wetland. The proximity of two roads presents a smoke management

challenge, complicating prescribed burn efforts in the past. Hardwoods (*Quercus* spp.) were mechanically removed around the wetland in the summer of 2012, when the wetland was dry, to increase the possibility of effectively burning the wetland ecotone (L. Smith, JJERC, pers. comm.). Hardwood clearing in the uplands is also occurring. The uplands to the north and west of the wetland, outside of JJERC property, are heavily managed agricultural lands. A culvert, connecting this wetland to the agricultural fields to the north, allows runoff (pesticides, fertilizers, sediment, and fish) to enter the wetland. Once vegetation restoration efforts are completed, this wetland will likely be suitable to support an *A. bishopi* population. Currently, however, herbaceous vegetation is low and it is not prime breeding habitat. The proximity of the county road and the uplands outside of JJERC also are a concern, particularly if water quality is compromised by agricultural activities.

Wetland 02 is a 0.7-ha ephemeral cypress gum swamp with a minor myrtle-leaved holly midstory. Herbaceous vegetation grows in a ring around the wetland edge, covering about 5-25% of the wetland. The surrounding uplands are fire maintained pine savanna with a mixed herbaceous and woody groundcover. This wetland has great potential as *A. bishopi* breeding habitat.

Wetland 41 is a 0.5-ha ephemeral cypress dome or cypress savanna. Young cypress are starting to grow up within the wetland basin but there is no significant midstory. Herbaceous vegetation grows throughout the wetland. The surrounding uplands are fire maintained pine savanna with an herbaceous groundcover. This wetland has great potential as *A. bishopi* breeding habitat and is directly adjacent to three other wetlands in similar condition.

Survey Results

Records of *A. bishopi* have been documented from three wetlands within this CHU. Larvae were first captured during dipnet surveys in 1994 (Wetland 01 and Wetland 41) and 1997 (Wetland 02). Since that time, no *A. bishopi* have been detected despite extensive surveys conducted by JJERC staff and other invited biologists (the author included). JJERC survey efforts include a 3-year drift fence study at Wetland 02, annual dipnet surveys at the three historic wetlands from 2002 to 2012, and systematic dipnet surveys of an additional 37 depressional wetlands located on the property during 8 non-consecutive years from 2002 - 2013 (L. Smith, JJERC, pers. comm.). The three historic record wetlands were surveyed by myself and JJERC staff two times in 2013.

Summary and Recommendation

It is unlikely that an *A. bishopi* population still exists on this CHU. Extensive surveys have been conducted in the 15 years since the last individual was recorded, with no success. Given the history of consistent land management on JJERC, habitat loss can be ruled out as a cause of extirpation. Climate change (long-term droughts impacting wetland hydroperiod and seasonality

of precipitation) and disease are two possible causes. CPI is working on a very similar issue with the striped newt in the Apalachicola National Forest (Means et al. 2012).

This CHU has excellent potential to support a future *A. bishopi* population. In addition to the three historic recorded wetlands, at least 15 other wetlands within the Unit could provide suitable breeding habitat for *A. bishopi*. The landowner is a conscientious land steward and multiple conservation programs already are in place. Additionally, JJERC has ecologists on staff to facilitate repatriation or guide management and monitoring efforts. JJERC staff would be interested in discussing opportunities for repatriation and research and monitoring of *A. bishopi* with USFWS.

Conclusions

Critical Habitat Units

The size of an area an *A. bishopi* population needs to remain sustainable has been proposed by various sources. Movement by migrating flatwoods salamanders of 500 m to 1,700 m have been reported (Means et al. 1996, Ashton 1992). Incorporating this distance of movement would equate to an area of 79 - 907 ha. The USFWS recognizes a 457 m radius as the activity area around an *A. bishopi* breeding pond, an area that would encompass 66 ha (USFWS 2009). However, more than one breeding wetland is essential to maintaining a sustainable *A. bishopi* population. Wetland occupancy likely changes over time (Bishop et al. 2006) and multiple wetlands provide a buffer for a population with respect to wetland hydroperiod fluctuations, drought, catastrophic events, disease, and natural and anthropogenic fluctuations in ecological succession. Multiple wetlands also increase the number of breeding sites and therefore the number of juveniles recruited into the population.

Three or more breeding sites are needed for a flatwoods salamander population to be considered robust (FWC 2001) so the amount of land needed will depend on the configuration of those three or more wetlands. Only six of the 16 CHU encompass more than the 66 ha *A. bishopi* activity area around a single wetland. If possible, in order to ensure the long-term survival of this species, CHUs should be redesigned around current habitat conditions (i.e. undeveloped land versus urban/suburban development) and the availability of multiple potential suitable breeding habitat. For at least seven CHUs, historical records from 20 years ago likely reflect the presence of a remnant population that has since been extirpated. Protecting clusters of ponds, properly managing terrestrial habitats, and ensuring that corridors exist between ponds is required for the long-term persistence of this (and many other) ephemeral wetland-breeding amphibian species (Buhlmann and Mitchell 2000, Semlitsch 2000).

A. bishopi Monitoring

CPI concurs with Bishop et al. (2006) that a cooperative plan for future monitoring and research efforts is needed. Such a plan should incorporate regional, state, and federal government agencies as well as private organizations, non-profit organizations, and landowners. A balance between resource constraints and the need to understand the status of the population and condition of the habitat needs to achieved. Ideally a long-term program would be created such that CHUs and potential breeding sites outside the Units are sampled in perpetuity. Short-term studies do not allow for the detection of natural fluctuations in community structure. If larvae are encountered at a wetland, that wetland would not need to be sampled for two years, after which biannual sampling would resume until larvae are encountered.

Dipnet sampling is the preferred method of detecting the presence of *A. bishopi* (Bevelhimer et al. 2008, Bishop et al. 2006, Palis 1996). The timing of dipnet surveys should be scheduled based on date of wetland inundation. Adults typically migrate to the wetland during fall and winter nocturnal rain events (Bevelhimer et al. 2008, Means 1972). Females lay eggs at the edge of the dry wetland basin beneath leaf litter, under logs, at the entrance to crayfish burrows, or amid graminaceous vegetation (Anderson and Williamson 1976, Palis 1996). If water is available during oviposition, eggs are deposited underwater adhering to submerged vegetation, sticks, and twigs (Means 1972). Eggs hatch weeks or more than a month after deposition, when they are inundated by rising wetland levels (Bevelhimer et al. 2008, Anderson and Williamson 1976). Wetland hydration typically occurs between November and February (Bishop et al. 2006, Palis 1997). Larvae require 11 - 18 weeks for development (Palis 1995) and surveys need to be conducted when larvae are large enough to increase chance of detection. Therefore dipnet surveys for *A. bishopi* should be conducted between late January and early May, depending on each year's precipitation timing and amounts. At least two surveys each breeding season will increase the chance of detection (Gorman et al. 2009, Bishop et al. 2006). Flexibility needs to be built into the sampling schedule to account for each year's weather variation.

A. bishopi Detection

No *A. bishopi* larvae were detected at any of the CHUs during the 2012-2013 breeding season. Because of the amount and timing of precipitation this year, however, lack of detection does not mean lack of presence. The majority of the breeding season was unseasonably dry and complete wetland inundation did not occur until early February over much of the region. Consequently, any eggs that may have been laid this season likely were no longer viable by the time the wetlands filled. Out of over 100 groups of *A. bishopi* eggs observed at a breeding site on Eglin Air Force Base, less than five groups were still alive by the time the wetland inundated (C. Haas, T. Gorman, K. Jones, Virginia Tech, unpubl. data). While some of the CHUs likely no longer support *A. bishopi* populations, the lack of detection this year at others was likely due to factors relating to weather.

The determination of when a wetland should no longer be considered occupied by an *A. bishopi* population is still under consideration. Proposals of no detection after five consecutive years (FWC 2001) and no detection after three good sampling years (Enge 2005) have been submitted. A good sampling year in the latter description is defined by wetland basins and ecotones completely filling by January 1st and larvae detected at other wetlands in the region. However, the timing of adult migration as well as the timing of wetland inundation should be considered when determining whether a year is a good sampling year or not. *A. bishopi* breeding events and the time when eggs hatch can be separated by weeks or more than a month (Anderson and Williamson 1976). If rain events (and therefore breeding migrations) mostly occur later in the breeding season (December) and wetlands do not inundate until January or into February, eggs likely still will be viable by the time wetlands fill. Therefore a good sampling year could occur if wetland basins fill after January 1st.

We agree with Bishop et al. (2006) that wetland occupancy likely changes over time and that historical wetlands that have not produced larvae in five years could continue to support *A. bishopi* populations. The longevity of *A. bishopi* or *A. cingulatum* in the wild is still unknown. Females do not mature sexually until they are at least two years old and adults do not gain full size until their third or fourth year (Palis 1996). Longevity of a similar species in the region, *A. talpoideum*, has been documented at over eight years (Raymond and Hardy 1990). In a summary of 348 *A. cingulatum* surveys, Bishop et al. (2006) found that some wetlands contained larvae only once in eight years. Based on this information, at least ten years of no detection should be considered before a wetland is determined to be unoccupied by an *A. bishopi* population.

Priority Critical Habitat Units

The following is a ranking of Critical Habitat Units based on the likelihood of supporting a sustainable *A. bishopi* population. High priority CHUs have the ability to support an *A. bishopi* population in their current state or with minor modifications. Moderate priority CHUs have the ability to support an *A. bishopi* population in the future or if other criteria are met, such as cooperation from landowner or land acquisition. Low priority CHUs are unlikely to support a sustainable *A. bishopi* population due to the current condition of the uplands or wetlands, the amount of resources required to restore the lands, the likelihood that land could be acquired, and/or the lack of multiple nearby breeding sites.

High Priority Critical Habitat Units

RFS-01 - The majority of the Unit already is in public ownership and management objectives are compatible with *A. bishopi* habitat requirements. Land acquisition of the historical breeding wetland (Wetland 1) should be considered. An assessment of lands outside the CHU should be conducted and, depending on results, the southern and northwestern boundary of this CHU unit

expanded to incorporate multiple wetlands. Alternatively, the development of two CHU on Garcon Point could be considered. One Unit with an expanded northwestern boundary on the east side of Garcon Point Rd. and another Unit with an expanded southern boundary on the west side of Garcon Point Rd. Management guidelines already have been developed for this area.

RFS-2B - A large expanse of land surrounding the wetland already is in public ownership. Restoration efforts continue to improve the wetland and uplands. Consideration should be given to expanding this Unit to incorporate more potential breeding wetlands nearby. At 66 ha, this Unit may be too small to support a sustainable population. Management guidelines already have been developed for this area.

RFS-6B - The CHU is within a designated Wildlife Management Area. This Unit only contains one breeding wetland, consideration could be given to expanding this Unit to incorporate more potential breeding wetlands nearby. At 66 ha, this Unit may be too small to support a sustainable population. Management recommendations for *A. bishopi* already have been developed.

RFS-10A - Management objectives of this Wildlife Management Area are compatible with *A. bishopi*. Multiple potential breeding wetlands are within or just outside this Unit. Management guidelines for *A. bishopi* already have been developed.

RFS-10B - Although in private ownership, JJERC is a conscientious land steward and multiple conservation programs already are in place. Many potential breeding wetlands are contained within this Unit.

Moderate Priority Critical Habitat Units

RFS-6A - Once restoration activities are complete, this Unit has good prospects for supporting an *A. bishopi* population. Multiple wetlands could provide suitable breeding habitat. Coordination with Nokuse Plantation could ensure that upland and wetland management activities are compatible with *A. bishopi* habitat requirements. Land acquisition of the historical breeding wetland and surrounding uplands should be considered.

RFS-7B - Once restoration activities are complete, this Unit has good prospects for supporting an *A. bishopi* population. Coordination with the private timber company that currently owns the land would be needed such that upland and wetland management activities are compatible with *A. bishopi* habitat requirements. Land acquisition of the northern section of the Unit could be considered. At 67 ha, this Unit may be too small to support a sustainable population.

RFS-8A - The CHU in its current configuration does not have good prospects for supporting an *A. bishopi* population. Consideration should be given to the lands east and southeast of the Unit. At 45 ha, this Unit is likely too small to support a sustainable population and expansion should be considered. Coordination with the private timber company that currently owns the land

would be needed such that upland and wetland management activities are compatible with *A. bishopi* habitat requirements.

RFS-9A - Restoration of uplands, wetlands, and hydrology would be required. Coordination with the private timber company that currently owns the land would be needed such that upland and wetland management activities are compatible with *A. bishopi* habitat requirements. At 66 ha, this Unit may be too small to support a sustainable population and expansion should be considered.

RFS-9B - Coordination with the private timber company that currently owns the land would be needed such that upland and wetland management activities are compatible with *A. bishopi* habitat requirements.

Low Priority Critical Habitat Units

RFS-2A - The hydrology of this CHU would need to be restored, which is unrealistic given the residential housing and utility right-of-ways. The habitat surrounding the CHU is fragmented. At 66 ha, this Unit may be too small to support a sustainable population.

RFS-3A - Land acquisition and restoration would be needed. At 60 ha, this Unit may be too small to support a sustainable population. An assessment of lands outside the CHU would need to be conducted and the CHU unit expanded to incorporate more uplands and wetlands. Currently, the CHU only incorporates one wetland. Fire and smoke management would be an issue for managing this land due to proximity of major highway and urban encroachment. At 10 m in elevation and < 2 km from both the Gulf of Mexico and East Bay, the CHU would be impacted if sea levels were to rise.

RFS-3B - An amphibian population dependent on a single breeding site is not sustainable long-term. The wetland and CHU are completely surrounded by a dense housing development so there is no realistic possibility of expanding the CHU to incorporate more uplands and suitable breeding sites. At 23 ha, this Unit likely is too small to support a sustainable population.

RFS-7A - Land acquisition and upland, wetland, and hydrological restoration would be needed. The CHU is surrounded by a patchwork of agricultural lands. At 66 ha, this Unit may be too small to support a sustainable population.

RFS-8B - The historic *A. bishopi* breeding wetlands have been destroyed and the landscape within and around this CHU is highly fragmented due to industrial, agricultural, and residential activities. Extensive land acquisition and/or restoration would be required.

RFS-8C - The landscape within and around this CHU is highly fragmented due to silvicultural, agricultural, and residential activities as well as road construction. Extensive land acquisition

and restoration would be required. Lands that incorporate Wolf Slough and surrounding uplands, the majority of which are west of this CHU, should be assessed for potential suitability.

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APPENDIX A. List of Amphibian Species Encountered During this Project.

Critical Habitat Unit	**RFS-1**			**RFS-2B**	**RFS-3B**	**RFS-6A**					**RFS-6B**	**RFS-7A**
Wetland ID	1	2	3			1	2	3	4	5		
Salamandrids												
Ambystoma opacum, marbled salamander												
Ambystoma talpodieum, mole salamander						X	X	X			X	
Ambystoma tigrinum, tiger salamander												
Eurycea quadridigitata, dwarf salamander		X										
Anurans												
Acris gryllus, cricke frog	X			X	X	X	X			X	X	
Anaxyrus quercicus, oak toad												
Anaxyrus terrestris, southern toad				X								
Hyla chrysoscelis, Cope's gray treefrog												
Hyla cinerea, green treefrog												
Hyla femoralis, pine woods treefrog						X		X				X
Hyla gratiosa, barking treefrog				X		X		X				
Hyla squirella, squirrel treefrog												
Lithobates grylio, pig frog												
Lithobates clamitans, bronze frog						X						
Lithobates sphenocephalus, southern leopard frog				X	X	X		X	X	X	X	
Pseudacris crucifer, spring peeper												
Pseudacris nigrita, southern chorus frog			X	X		X	X			X	X	
Pseudacris ocularis, little grass frog		X									X	
Psuedacris ornata, ornate chorus frog					X						X	
Scaphiopus holbrookii, eastern spadefoot toad				X								

Note: Due to access issues, sampling did not occur at all Critical Habitat Units.

APPENDIX A. List of Amphibian Species Encountered During this Project.

Critical Habitat Unit	**RFS-7B**				**RFS-8A**		**RFS-9B**		**RFS-10A**	**RFS-10B**		
Wetland ID	1	2	3	4	1	2	1	2		1	2	41
Salamandrids												
Ambystoma opacum, marbled salamander									X			
Ambystoma talpodieum, mole salamander												
Ambystoma tigrinum, tiger salamander												X
Eurycea quadridigitata, dwarf salamander												
Anurans												
Acris gryllus, cricke frog	X	X	X	X			X	X			X	X
Anaxyrus quercicus, oak toad									X			
Anaxyrus terrestris, southern toad				X						X		
Hyla chrysoscelis, Cope's gray treefrog										X	X	
Hyla cinerea, green treefrog										X		
Hyla femoralis, pine woods treefrog											X	X
Hyla gratiosa, barking treefrog											X	
Hyla squirella, squirrel treefrog												X
Lithobates grylio, pig frog									X			
Lithobates clamitans, bronze frog												
Lithobates sphenocephalus, southern leopard frog	X	X	X	X	X		X	X	X		X	X
Pseudacris crucifer, spring peeper					X						X	
Pseudacris nigrita, southern chorus frog	X	X		X	X			X			X	X
Pseudacris ocularis, little grass frog	X											
Psuedacris ornata, ornate chorus frog					X				X		X	X
Scaphiopus holbrookii, eastern spadefoot toad												X

Note: Because of access issues, sampling did not occur at all Critical Habitat Units.

APPENDIX B. Photos of Wetlands within the 11 Critical Habitat Units Visited during the Project.

RFS-1, Wetland 1






RFS-1, Wetland 2

RFS-1, Wetland 3

RFS-2B

RFS-3B

RFS-6A, Wetland 1

RFS-6A, Wetland 2

RFS-6A, Wetland 3

RFS-6A, Wetland 4

RFS-6A, Wetland 5

RFS-6B

RFS-7A

RFS-7B, Wetland 1

RFS-7B, Wetland 2

RFS-7B, Wetland 3

RFS-7B, Wetland 4

RFS-8A, Wetland 1

RFS-8A, Wetland 2

RFS-8B

RFS-9B, Wetland 1

RFS-9B, Wetland 2

RFS-10A

RFS-10B, Wetland 1

RFS-10B, Wetland 2

Photo by L. Smith

RFS-10B, Wetland 41