U.S. Fish and Wildlife Service
Draft Recovery Plan
For the Frosted Flatwoods Salamander
(*Ambystoma cingulatum*)

Photo Credit: Mark Mandica, The Amphibian Foundation

Prepared by:
Harold Mitchell
U.S. Fish and Wildlife Service
Panama City Field Office
Panama City, FL

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DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and subject to additional peer review before they are adopted by the U.S. Fish and Wildlife Service. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not obligate other parties to undertake specific tasks. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the U.S. Fish and Wildlife Service's South Atlantic - Gulf Regional Office, Atlanta, Georgia.

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Draft Recovery Plan for the
Frosted Flatwoods Salamander (*Ambystoma cingulatum*)

This recovery plan describes criteria for determining when the frosted flatwoods salamander should be considered for delisting, lists site-specific actions that will be necessary to meet those criteria, and estimates the cost for implementing recovery actions. Additionally, cursory information on the species' biology and status are included, along with a brief discussion of factors limiting its populations. A detailed discussion of these and other topics pertinent to the recovery of frosted flatwoods salamander can be found in the Species Status Assessment and the Draft Recovery Implementation Strategy. These supplemental documents are available at https://www.fws.gov/panamacity/. The Recovery Implementation Strategy (RIS) and Species Status Assessment (SSA) are finalized separately from the Recovery Plan and will be updated on a routine basis.

CURRENT STATUS AND SPECIES BIOLOGY:

The flatwoods salamander (*Ambystoma cingulatum)* was federally listed in 1999 (64 FR 15691) as a threatened species under the Endangered Species Act of 1973 as amended (Act). In 2009, the frosted flatwoods salamander was split from the endangered reticulated flatwoods salamander (*A. bishopi*) and critical habitat was designated for both species (74 FR 6700), with 22,970 ac (9,297 ha) in 19 sub-units designated for the frosted flatwoods salamander. In September 2019, the most recent 5-year review was signed recommending reclassifying this species as endangered because of new information and declining trends. As of Spring 2020, this recommendation has yet to be considered because of the Service's high classification workload and higher priorities.

Adult frosted flatwoods salamanders are moderately-sized (76 mm snout-vent length, 135 mm total length) mole salamanders with relatively short, pointed snouts and stout tails (Martof and Gerhardt, 1965; Palis, 1996; John Palis, Palis Environmental Consulting 1995, unpublished data). Their heads are small and only about as wide as the neck and shoulder region (Petranka, 1998). They weigh from 4.5 to 14.8 g (adult males and adult gravid [containing mature eggs] females, respectively; Palis, 1996; John Palis, Palis Environmental Consulting, 1995, unpublished data). Pierson Hill (Florida Fish and Wildlife Conservation Commission, personal communication, May 16, 2018) captured a gravid female up to 17.4 gram. Their bodies are black to chocolate-black with fine, irregular, light gray lines or specks that form a cross-banded pattern across the back. In some individuals, the gray pigment is widely scattered and "lichen-like." Melanistic, uniformly black individuals have been reported (Carr, 1940). The venter (underside) is dark gray to black with a scattering of gray spots or flecks.

Frosted flatwoods salamanders are pond-breeding amphibians with complex life cycles (i.e., there is an aquatic larval stage, as well as a terrestrial juvenile and adult stage). As adults, flatwoods salamanders migrate to seasonally flooded wetlands to breed in the fall. Females lay eggs singly, or in small clusters, usually near the base of plants in soil, in dry areas of the pond basin (Anderson and Williamson, 1976; Palis, 1995a, 1997). During oviposition, females select

microhabitats that maximize moisture retention, such as beneath or within the leaves of herbs and clumping grasses. Provided ample winter rainfall and subsequent pond filling, well-developed eggs hatch releasing their larvae. The larval period is 11 to 18 weeks followed by the emergence of juveniles between March and May (Anderson and Williamson, 1976; Palis, 1995a, 1997). Pierson Hill (Florida Fish and Wildlife Conservation Commission, personal communication, May 16, 2018) found a larval period of 15 to 22 weeks for *A. cingulatum* raised in captivity. Juveniles normally disperse from ponds shortly after metamorphosis, but may stay on or near ponds during seasonal droughts (Palis, 1997). Juveniles and adults are highly fossorial and spend much of their time in crayfish burrows or root channels until they reach sexual maturity (1 year for males; 2 years for females) and most return to their natal pond to breed during the fall months (Petranka, 1998).

HABITAT REQUIREMENTS:
Breeding wetlands are located within mesic (moderate moisture) to intermediate-mesic pine-dominated flatwoods/savanna communities where adults and juveniles live outside of the breeding season. Pine flatwoods/savannas are characterized by low, flat topography and relatively poorly drained, acidic, sandy soil that becomes seasonally saturated. In the past, this ecosystem was characterized by open pine woodlands maintained by frequent fires. Naturally ignited by lightning during late spring and early summer, these flatwoods historically burned at intervals ranging from 1 to 4 years (Clewell, 1989). More recent information suggests a shorter interval, closer to a 1-2-year fire return interval (Noss, 2018). The groundcover of longleaf pine flatwoods/savanna ecosystem is typically dominated by wiregrass (*Aristida stricta* [= *A. beyrichiana*]; Kesler et al., 2003) but with a highly diverse suite of grasses and forbs.

Flatwoods salamanders breed and deposit eggs in wetlands with dry basins, not yet inundated with water (Anderson and Williamson, 1976; Hill, 2013; Powell et al., 2013; Gorman et al., 2014). Females select areas within breeding wetlands that have complex and diverse stands of herbaceous vegetation, minimal peat, and concave depressions for egg deposition. Such small depressions likely minimize desiccation of developing embryos in the otherwise dry wetland (e.g., Gorman et al., 2009; Jones et al., 2012). As noted, management of breeding wetlands for this species should include a suite of management actions that increase the cover of herbaceous vegetation while maintaining bare mineral soils for egg-laying habitat (Gorman et al., 2014).

Larval frosted flatwoods salamanders generally occur in acidic (pH 3.4 to 5.6), tannin-stained ephemeral wetlands (swamps and marshes) that typically range in size from <1 to10 acres (ac) (0.4 to 4.0 hectares [ha]), but may reach or exceed 30 ac (12 ha) (Palis, 1997; Safer, 2001). It is important to note that much of the pH data was not collected before anthropogenic influences may have changed pH levels. In short, pH levels may have been closer to neutral, especially with increased water levels (Noss and Rothermel, 2015). Pond depth fluctuates greatly, but is usually less than 0.5 meters (m) in areas where larval salamanders are found (Palis, 1997). Ponds typically fill in late fall or early winter and dry in late spring or early summer. When dry, breeding ponds historically burned naturally due to periodic, lightning-ignited wildfires (especially during late spring and summer); thus, fire scars are frequent on live trees within the basin, and smaller trees and shrubs are often killed or top-killed. Depending on canopy cover and midstory, the herbaceous ground cover of breeding sites can vary widely, although larvae are most often associated with higher amounts of herbaceous cover (Sekerak 1996; Gorman et al.,

2009; Gorman et al., 2013) which, on average, covers >40% of the wetland (Gorman et al., 2009; Gorman et al., 2013). Most, but not all, breeding sites exhibit distinct vegetative zonation, with bands of different herbaceous plant assemblages in shallow versus deeper portions of the pond. The ground cover is dominated by graminaceous species but includes characteristic herbs and forbs. The basin of breeding sites generally consists of relatively firm mineral sediment with little or no duff, peat, or muck. Burrows of crayfish (genus *Procambarus*, principally) are a common feature of flatwoods salamander breeding sites and may be important physical elements to the salamander life history strategy.

LIMITING FACTORS:

Currently, the frosted flatwoods salamander faces several limiting factors. These include low population density, restricted range, low-quality breeding and upland habitat, vulnerability to stochastic events (e.g., extended drought, storm surge from hurricanes), inadequate habitat management (i.e., not enough growing season fire applied to the habitat to achieve meaningful restoration range wide, too little use of known restoration techniques, besides fire, to aid in the restoration of degraded former or potential breeding ponds), and inadequate funding to address recovery actions. Genetic bottlenecking could limit the ability for natural recovery in areas of extremely low population densities, particularly in the northeast portion of the historic range (sometimes referred to as the eastern clade) from Fort Stewart, GA, to southern South Carolina. Recovery actions identified in this plan are aimed at reducing or eliminating these factors. Adjacent lands have some potential to support flatwoods salamanders, but surveys are mostly absent or lacking. Increasing survey effort within this region will eliminate uncertainty about the number and location of extant populations.

RECOVERY STRATEGY**:**

The recovery goal is to conserve and protect the frosted flatwoods salamander and its habitat so that its long-term survival is secured, populations are capable of enduring threats, and it can be removed from the list of threatened and endangered species. The initial recovery strategy for frosted flatwoods salamanders is to prevent their extinction and provide a path toward recovery of this species by restoring healthy, self-sustaining populations throughout the historic range to the extent possible, while restoring and maintaining adequate high-quality breeding and upland habitats to the greatest extent possible. Periodic evaluations of the status of recovery efforts and extant populations will measure success as recovery actions go forward.

RECOVERY OBJECTIVES:

Recovery objectives identify outcomes that will lead to achieving recovery goals and delisting. The recovery objectives over the next 20 years are to 1) determine if the species is progressing toward the overall objective of restoring adequate redundant populations to representative portions throughout its historic range where possible (Figure 1), and 2) whether the extant populations demonstrate resiliency to the extent that the species no longer requires the protection of the Endangered Species Act. This will be accomplished by restoring and managing both breeding and upland habitats necessary to its complex life cycle, implementing successful reintroduction and translocation measures, and by reducing anthropogenic threats that resulted in its original federally listed status.

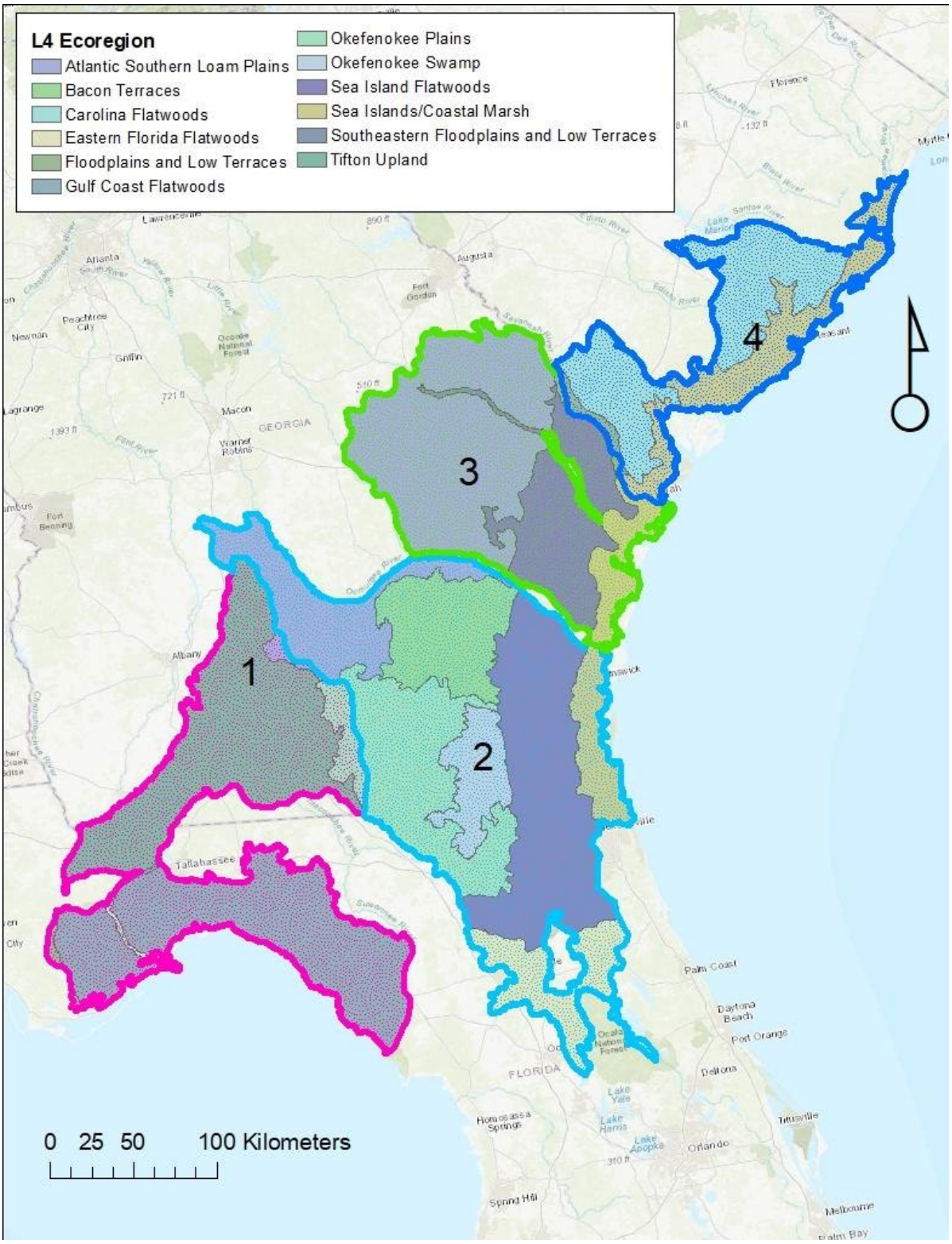

Figure 1. Recovery management units (RMU) for the frosted flatwoods salamander (courtesy of J. Barichivich, USGS). The RMU delineations illustrated are not precise lines, but bubbles based the ecoregions containing currently occupied sites and historic range.

Delisting Criteria:
This recovery plan sets forth criteria which, when met, will increase the range of extant populations; will increase the number of individuals and populations; and will reduce threats to the species existence. Justification for these criteria is found in the accompanying RIS and section 3.4 of the SSA. We believe delisting may be considered when the following criteria are met:

(1) At least 101 resilient metapopulations exhibit a stable or increasing trend are extant or re-established as evidenced by natural recruitment and multiple age classes.

(2) Approximately 25 resilient metapopulations are present in each of the four Recovery Management Units (RMUs; Figure 1) that represent the spatial distribution of historic range: RMU 1 (St Marks/Apalachicola Complex), RMU 2 (Southeastern Georgia/North Florida Complex), RMU 3 (Fort Stewart Complex), and RMU 4 (South Carolina Complex). The precise number in each RMU is dependent on habitat suitability and availability, but an approximate equal distribution will allow for sufficient redundancy across the historic range.

(3) Threats have been addressed and/or managed to the extent that the species will remain viable into the foreseeable future. Breeding and adjacent upland habitats within the resilient metapopulations are protected long-term though management agreements, public ownership, or other means, in sufficient quantity and quality to support growing populations.

<u>Justification for Delisting Criteria</u>

A resilient metapopulation describes the ability of a species to withstand stochastic disturbance. It is positively related to population size and growth rate and may be influenced by connectivity among populations. Generally, populations need abundant individuals within habitat patches of adequate area and quality to maintain survival and reproduction in spite of disturbance. A resilient metapopulation would include at least 14 suitable wetlands within a 1.5 km radius of a cluster that includes at least 3 regularly occupied (larval detections once every 3 years) wetlands within an approximately 500 m radius and connected to 22 or more wetlands through stepping stone arrangement, surrounded by suitable upland habitat. This definition of a metapopulation is based on Brooks et al. (2019b) who indicated that wetlands within 1.5 km of other occupied wetlands were most likely to be occupied and genetic data (Wendt 2017) confirmed the small scale of connectivity (<1 km).

The major threats to this species have been significantly reduced or eliminated as to no longer pose a threat to its continued survival. Feral swine, improper or overuse of pesticides and herbicides, presence of predatory fish in breeding ponds, lack of regular lightning season fire to maintain suitable habitats, disruptions to hydrology including ditching and addition of impervious surfaces, road construction or increased traffic near breeding ponds, invasive plants, and disease are all threats that must be ameliorated to the extent possible.

ACTIONS NEEDED:
The recovery actions identified below are those that, based on the best available science, are necessary to recover the frosted flatwoods salamander. We have included an estimated cost and ordered by priority for implementation. Specific goals and details are expanded upon in the RIS.

Table 1. Recovery actions with estimated cost and priority number.

Recovery Action	**Estimated costs**	**Priority**
Ensure adequate, high quality habitat is available to support resilient frosted flatwoods salamander populations	$149,661,000	1
Increase the number of resilient frosted flatwoods salamander populations to the extent possible within the four RMUs	$4,900,000	2
Improve knowledge needed to increase the number of resilient frosted flatwoods salamander populations through research and adaptive management	$378,000	3
Research needs and data gaps	$2,690,000	
Land acquisition (not multiplied 4 times to get 20-year cost)	$29,000,000	
Total Estimated Cost: 20 years	$186,629,000	

DATE OF DOWNLISTING AND DELISTING:
If all actions described in the Recovery Implementation Strategy are fully funded and implemented, including cooperation of all partners needed to achieve recovery, delisting is expected to take at least 20 years. We anticipate that recovery criteria for delisting could be met by 2040.

COST ANALYSIS:
Costs are projected toward our 20-year goal. We anticipate reaching recovery success resulting from this plan, assuming full funding and support from all applicable agencies and partners; lower funding levels will extend the anticipated time to recovery. Cost estimates to implement recovery actions and activities for the 20-year period of recovery are: $186,629,000.

By far, the largest costs associated with the recovery of the frosted flatwoods salamander deals with the recovery and maintenance of its habitat through the use of prescribed fire, mechanical

vegetation management, and use of herbicides. Cost estimates are a pooled average of costs estimated by land managers throughout the range of the salamander on a "per acre" basis.

A more detailed breakdown of the first five years costs is found in Table 1 of the RIS. Figures above are rounded to the nearest 1000, dollar figure, and therefore may not match exactly the more precise estimates given in Table 1 of the Recovery Implementation Strategy. For the top 3 recovery actions, the 5year costs were multiplied by 4 to give a 20-year total for recovery. This was done to reflect the recurring needs for ongoing habitat and population work. Two items, land acquisition and research needs, were "one time" items and not multiplied by 4 for the 20-year totals and were therefore separated out in the table above.

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