Biological Opinion

Francis Marion National Forest
Revised Land Management Plan

FWS Log No.04ES1000-2016-F-0628

U.S. Department of Agriculture
Forest Service

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Prepared by:
U.S. Fish and Wildlife Service
South Carolina Ecological Services Field Office
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

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ACRONYMS

BA - Biological Assessment
BO - Biological Opinion
CFR - Code of Federal Register
DBH - Diameter at Breast Height
DC - Desired Conditions
EO - Element of Occurrence
ESA - Endangered Species Act
FHA - Foraging Habitat Analysis
Forest Plan - Land and Resource Management Plan
Forest Service- U.S. Forest Service
FR - Federal Register
Francis Marion or forest - Francis Marion National Forest
ITP - Incidental Take Permit
MA 1 - Management Area 1
MA 2 - Management Area 2
MALAA - May Affect, Likely to Adversely Affect
MMS - Managed Stability Standard
NLAA - Not Likely to Adversely Affect
NWR - National Wildlife Refuge
PBG - Potential Breeding Groups
Permit - Incidental Take Permit
RCW - Red-cockaded Woodpecker
RPMs - Reasonable and Prudent Measures
Service - U.S. Fish and Wildlife Service
T&Cs - Terms and Conditions
T&E -Threatened and Endangered
Threatened and Endangered Species - At Risk Species
USDA - U.S. Department of Agriculture

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service), have evaluated the impacts of the implementation of the management activities proposed in the Francis Marion Revised Land and Resource Management Plan (Forest Plan) on 259,625 acres to be conducted within the Francis Marion National Forest (Francis Marion or forest). The planning area includes all Federal land managed or administered by the Forest Service in Berkeley and Charleston Counties, South Carolina. The purpose of the Forest Plan as described by the Forest Service is to guide future projects, practices, uses and protection measures to assure sustainable multiple-use management of the Francis Marion. The Forest Plan describes activities that would likely be implemented, resulting in public benefits and long-term improved conditions on the forest. The Forest Plan emphasizes an adaptive management approach which will emphasize checking results as projects are implemented and making the plan more adaptable to changes in social, economic and environmental conditions.

The U.S. Forest Service (Forest Service) provided a biological assessment (BA) to assess the potential effects of implementing the management activities proposed in the revised Forest Plan on federally listed threatened and endangered species (T&E species) and designated critical habitat. The management activities of the Forest Plan include frequent prescribed fire to maintain or restore 98,000 acres of fire-adapted ecosystems including Upland Longleaf and Loblolly Pine Woodlands, Savannahs and Flatwoods, Carolina Bays, and Depressional Wetlands. Approximately 5% of these prescribe fires will be growing season burns annually. According to the Forest Plan, within three years of plan approval, the amount of prescribe fire would increase by almost 20,000 acres per year for a total average of 50,000 acres per year, including 10,500 to 16,500 acres annually of the total amount of growing season burns. Upland longleaf, loblolly pine forest, wet pine savannahs, and flatwood ecosystems will be maintained and restored through a timber sale program and prescribed fire. Pond cypress savannahs and Carolina bays will be maintained, improved and restored with frequent and growing season fires. In addition, the Forest Service will provide a flow of early to late-successional habitats by reducing hazardous fuels and providing a sustainable amount of high-quality timber for local economies using primarily timber harvest.

The Forest Service is addressing species diversity by maintaining or restoring ecological conditions needed to support T & E species on at least 25,000 acres per year. Breeding sites for the frosted flatwoods salamander will be restored and maintained along the Talbot Terrace within ten years of plan approval. Open longleaf pine flatwoods and savannas will be provided for the red-cockaded woodpecker (RCW) population of at least 450 active clusters and 350 potential breeding groups. An average group size of greater than 3 birds per group with a reproductive success average of greater than 2 fledglings per successful nest is proposed within 10 years of plan approval. The Forest Plan will provide ecological conditions to support maintain and restore 9 stable to increasing populations for the federally endangered American chaffseed (*Schwalbea americana*); 5 stable to increasing populations for the federally endangered pondberry (*Lindera melissifolia*); and 3 stable to increasing populations of the federally endangered Canby's dropwort (*Oxypolis canbyi*) within 10 years of plan approval.

The following table summarizes effects determination for five T&E species that occur or may occur on the Francis Marion or that the forest plan potentially affects.

Table 1. Species considered in the 2016 BA analyses for the proposed action and effect determinations.

Common Name	Scientific Name	Federal Status	Conclusion	Associated Ecosystem on the Forest
American chaffseed	*Schwalbea americana*	Endangered	MALAA	Fire-maintained upland longleaf and loblolly pine-dominated woodlands
Canby's dropwort	*Oxypolis canbyi*	Endangered	MALAA	Fire-maintained Carolina bays and depressional wetlands
Frosted flatwoods salamander	*Ambystoma cingulatum*	Threatened	MALAA	Fire-maintained upland longleaf woodlands; wet pine savannas and flatwoods, Carolina bays and depressional wetlands in the Wando Area of the Forest
Pondberry	*Lindera melissifolia*	Endangered	MALAA	Fire-maintained Carolina bays and depressional wetlands
Red-cockaded woodpecker	*Picoides borealis*	Endangered	MALAA	Fire-maintained upland longleaf and loblolly pine woodlands and wet pine savannas and flatwoods

MALAA-May affect, likely to adversely affect

Additionally, the Service concurs with your determination that the Forest Plan is not likely to adversely affect the federally listed wood stork (*Mycteria americana*) and will have no effect on Bachman's warbler (*Vermivora bachmanii*), the West Indian manatee (*Trichechus manatus*), and the designated critical habitat for the frosted flatwoods salamander (*Ambystoma cingulatum*). In view of this, we believe that the requirements of section 7 of the Endangered Species Act (ESA) have been satisfied for the five species above. However, obligations under section 7 of the ESA must be reconsidered if (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner which was not considered in this assessment, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

CONSULTATION HISTORY

January 14, 2015 – Forest Service Biologists met with Service Biologists to review the federally T&E species list that would be addressed in the biological assessment (BA).

August 2015 – The Service received the Draft Revised Land Management Plan from the U.S. Forest Service.

August 14, 2015 – The Service received the Draft Environmental Impact Statement from the U.S. Forest Service.

November 10, 2015 – The Service commented on the Draft Revised Land Management Plan dated August 2015 and Draft Environmental Impact Statement dated August 14, 2015.

July 25, 2016 – The Service received the U.S. Forest Service' BA and their request to initiate formal consultation.

September 9, 2016 – The Service requested additional information on the BA after our initial review and noted that we could not initiate formal consultation until all information was received.

September 15, 2016 – The Service received additional information related to the project from the U.S. Forest Service.

September 21, 2016 – The Service provided written acknowledgement of receipt of all information necessary to initiate formal consultation on the proposed action, as required in the regulations governing interagency consultations (50 Code of Federal Regulations [CFR] 402.14).

November 10, 14, and 17, 2016 – Conference calls were held between the Service and the U.S. Forest Service personnel to discuss the BA and clarify any issues within the BA.

BIOLOGICAL OPINION

This document is the Service's BO that states our opinion as to whether implementation of the proposed revision of the Francis Marion Land and Resource Management Plan (Forest Plan) is likely to jeopardize the continued existence of the American chaffseed *(Schwalbea americana)*, Canby's dropwort *(Oxypolis canbyi)*, frosted flatwoods salamander *(Ambystoma cingulatum)*, pondberry *(Lindera melissifolia)*, and the red-cockaded woodpecker *(Picoides borealis)*. Your biological assessment (BA) was received on July 25, 2016, and the additional information as requested by the Service was received on September 19, 2016.

The BO evaluates the effects of the proposed action, interrelated and interdependent actions, and cumulative effects relative to the status of the species to arrive at a determination of whether the action is or is not likely to jeopardize the continued existence of the species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFE §402.02).

This BO is based on information provided in the revised Forest Plan, the BA, the draft Environmental Impact Statement, and other sources of information. A complete administrative record of the consultation is on file at the South Carolina Ecological Services Field Office, Charleston, South Carolina.

Programmatic consultation approach

This programmatic BO establishes a two-level consultation process for activities completed under the Forest Plan. Evaluation of the Forest Plan at the plan level represents the Level 1 consultation and all subsequent project-specific evaluations for future actions completed under the Forest Plan are Level 2 consultations. Under this programmatic approach, the Francis Marion must continue to review all future individual projects to determine if they may affect a listed species (including species listed in Table 1) or designated critical habitat. Future projects that <u>may affect</u> listed resources are subject to Level 2 consultation; written notification to the Service, including a biological evaluation of such projects is required. Projects that may affect, but are <u>not likely to adversely affect</u> listed species or designated critical habitat will require written concurrence from the Service through informal Level 2 consultation. In most cases the response time for these concurrences should be significantly abbreviated.

Projects that are <u>likely to adversely affect</u> listed species or designated critical habitat will be individually reviewed to determine: 1) whether they were contemplated in the Level 1 programmatic opinion and 2) if they are consistent with the guidelines established in the Level 1 programmatic opinion and whether the reasonable and prudent measures and terms and conditions provided in the incidental take statement are applicable. This will ensure that the effects of any incidental take resulting from individual projects are minimized. The original programmatic opinion taken together with all project documentation contained in the Level 2 consultation will make up the complete BO for each Level 2 project.

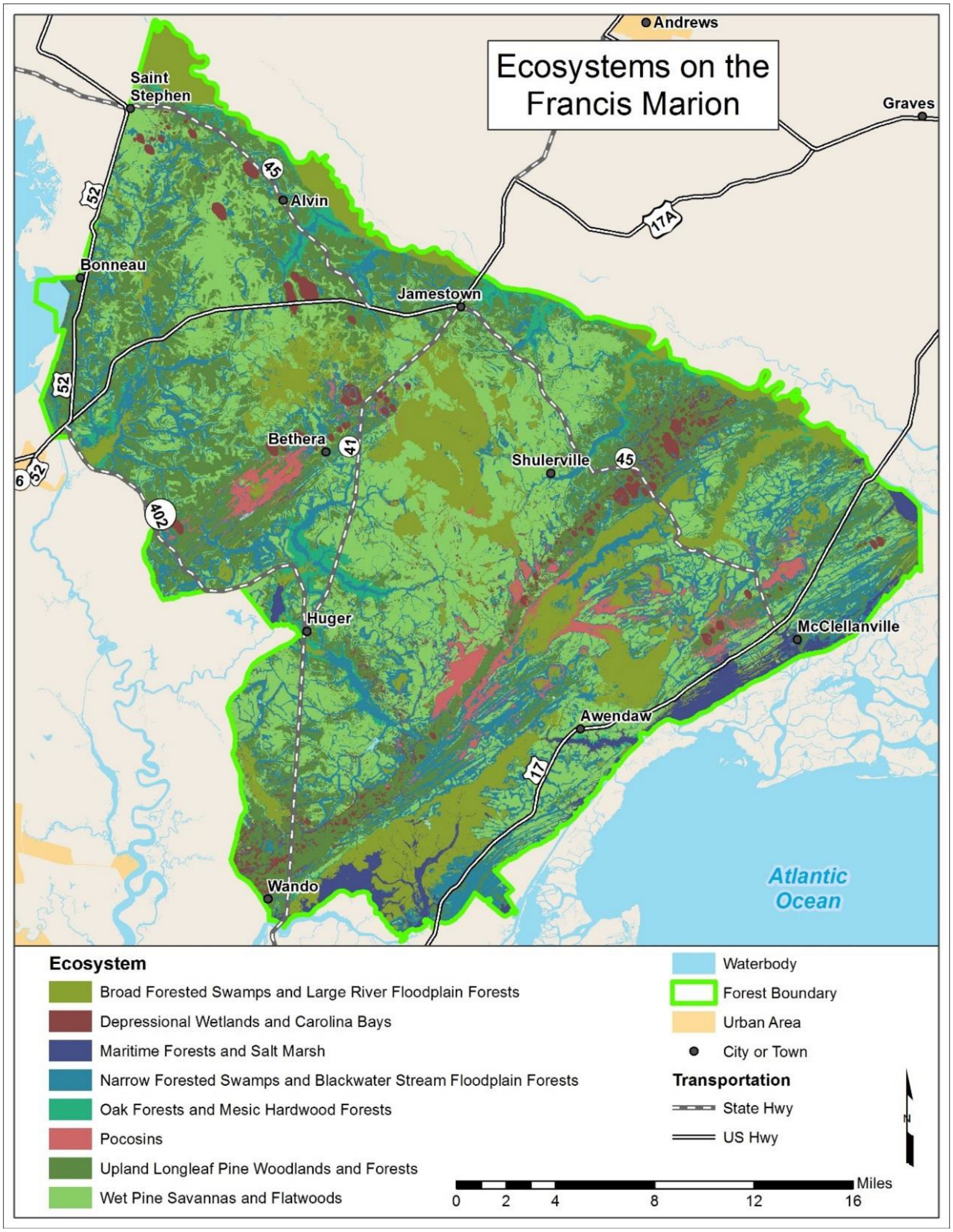

Figure 1: Ecosystems (not including rivers and streams) on the Francis Marion National Forest.

DESCRIPTION OF THE PROPOSED ACTION

Action Area

The action area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is defined by measurable or detectable changes in land, air and water or other measurable factors that will result from the proposed action. The action area is not limited to the "footprint" of the action, but rather encompasses the biotic, chemical, and physical impacts to the environment resulting directly or indirectly from the action. In general, the action area for the purposes of this analysis is all lands, under any ownership, within the proclamation boundary of the Francis Marion. The Service has described the action area to include the 259,625 acre Francis Marion National Forest.

Proposed Action

The purpose of the Forest Plan as described by the Forest Service is to guide future projects, practices, uses and protection measures to assure sustainable multiple-use management of the Francis Marion National Forest. A BA was prepared by the Forest Service to assess potential effects on federally listed T & E species, and critical habitat, which occur or may occur within the forest. The Forest Plan supports an adaptive management approach, which emphasizes checking results as projects are implemented and making the forest plan more adaptable to changes in social, economic, and environmental conditions.

Desired Conditions

The revised Forest Plan includes coarse-filter desired conditions for forest-wide distribution and quality of habitats and conditions for two management areas and fine-filter desired conditions for federally protected species. The management areas are listed below (Table 2).

Management Areas

Two management areas are proposed within the Forest Plan for the Francis Marion based on the ability to provide the desired fire return intervals. While there are several important ecological processes occurring (fires, storms, floods, insect outbreaks, etc.), the Forest Service focuses on those that they can actively manage through prescribed burning. To address the role of fire in restoration of these ecosystems, two management areas were developed based on the Forest Service's ability to apply frequent (1-3 years), low-intensity fire on a landscape level and how that would affect the ability to achieve desired conditions for these ecosystems.

> **Management Area 1** (MA1) is the portion of the forest where frequent, low-intensity fire can be used at the desired fire return interval for various ecosystems including the fire-adapted ecosystems.
>
> **Management Area 2** (MA2) is the portion of the forest where management efforts will have to focus on providing wildlife habitats using herbicides, mechanical methods, etc.

Table 2. Fire-adapted ecosystems by Management Area.

	Management Area (acres)	
Potential Ecosystem	**MA**	**MA2**
Upland longleaf and loblolly woodlands	33,500	18,000
Wet pine savannas and flatwoods	58,100	17,400
Carolina bays and depressional wetlands	6,400	2,100

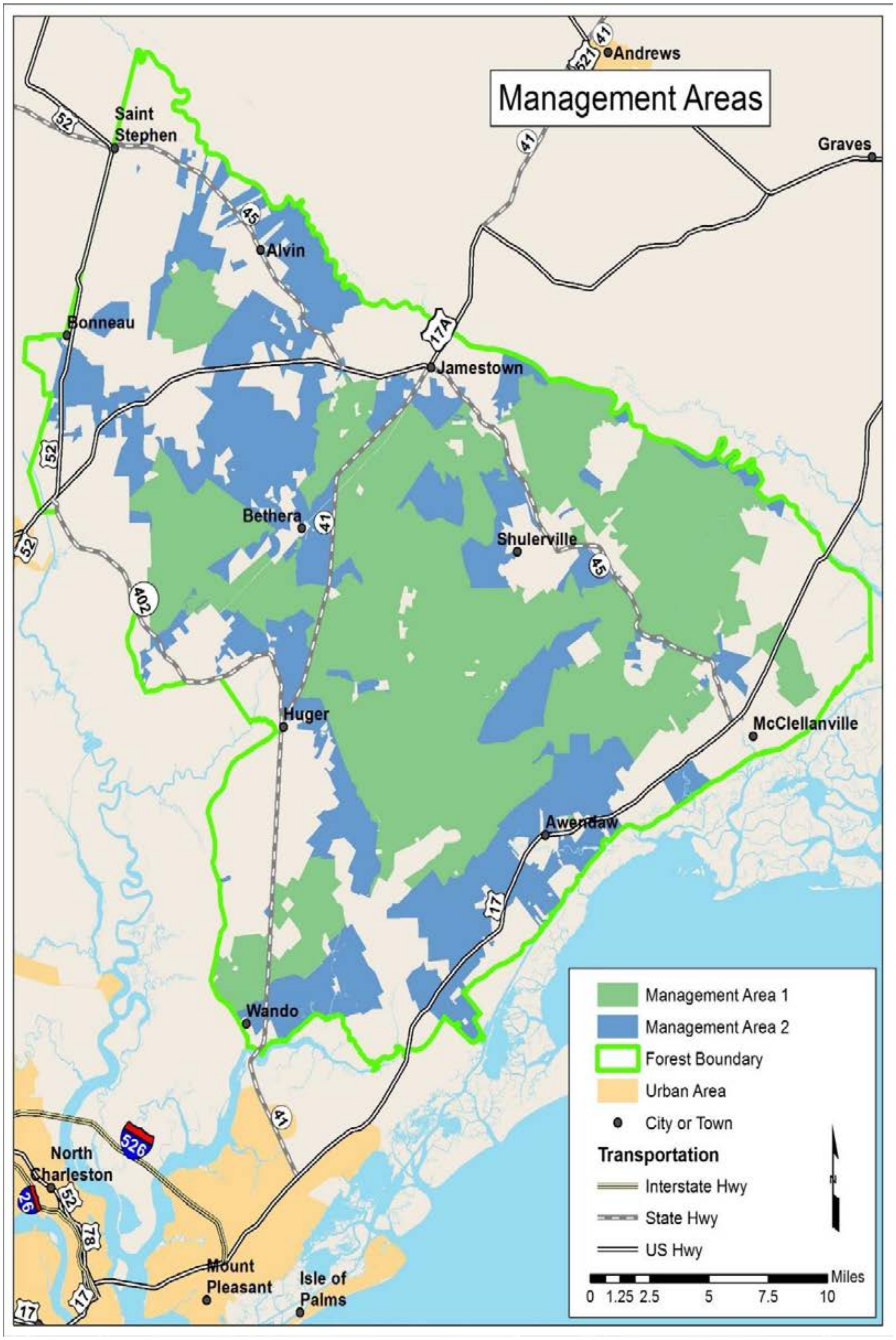

Figure 2: Management Areas on the Francis Marion National Forest.

Species Diversity

The Forest Service developed fine filter scale provisions, as needed, to ensure the persistence of Francis Marion at-risk species including federally-listed T&E, proposed and candidate species and species of conservation concern known to occur on the forest.

Specific Objectives and Management Strategies

The following are the Forest Service Objectives and Management Strategies that will be implemented to carry out the desired conditions on the forest:

<u>OBJ-ECO-2; Frequent Prescribed Fire for Ecosystem Maintenance or Restoration</u>

Prescribed Fire-Base level: Apply prescribed fire on at least 30,000 acres per year to maintain or restore fire-adapted ecosystems including longleaf pine woodlands, savannas and flatwoods, Carolina bays and depression ponds, and narrow river floodplains and swamps. Include at least 4,500 acres of those 30,000 acres (or approximately 15%) as growing season burns (April 1 – September 30) annually.

Prescribed Fire above base level: Within 3 years of plan approval, increase the amount of prescribed fire by 20,000 acres per year for a total of 50,000 acres per year of prescribed fire. Include approximately 10,500 to 16,500 acres of those 50,000 acres (or approximately 33 percent) as growing season burns annually. Check if any new burn blocks are currently in MA2 and should be converted to MA1 conditions.

> ***Management Strategy:*** The *Prescribed Fire-Base level* is based on the current prescribed burning program and that the fire program can be developed to achieve the *Prescribed Fire above base level.* Due to factors, such as weather conditions, it is anticipated that the prescribed burning program would typically vary annually between 30,000 to 50,000 acres total. Similarly, the amount of growing season burning would vary between 10,500 to 16,500 acres annually of the total amount. Stewardship contracting has the potential to increase funding opportunities, while partnerships and Wyden amendments could create efficiencies, such as reducing the amount of bladed fireline needed, in order to increase the prescribed fire potential. Collaboration with adjacent landowners and regulatory agencies requires particular attention in areas that have not had prescribed fire.

<u>OBJ-ECO-3; Upland Longleaf and Wet Pine Savanna and Flatwoods Ecosystems</u>

Maintain or restore upland longleaf and mesic wet pine savanna and flatwoods ecosystems and loblolly pine forest on approximately 91,500 acres in MA 1 within ten years of plan approval. Provide 68,500 acres to maintain condition class of the Upland Longleaf and Wet Pine Savanna Flatwoods ecosystems in MA 1 within ten years of plan approval. Maintain open pine woodlands or savannas with a canopy closure less than 60 percent (10-60 $feet^2$ basal area) in MA 1.

Longleaf Pine Base Levels: Maintain an existing 42,500 acres of longleaf pine by using the ecological processes of landscape-level, frequent, low-intensity prescribed fire, or by using other vegetation management practices to reach desired densities.

Loblolly Pine Base Levels: Maintain ecologically functioning loblolly pine woodlands on 49,000 acres by using the ecological processes of landscape-level, frequent, low-intensity prescribed fire or by using other vegetation management practices to reach desired densities.

Longleaf Pine above base level: Restore 26,000 acres of longleaf pine ecosystems by moving loblolly pine, mixed pine and longleaf pine forest-types to the desired structure and composition for longleaf pine ecosystems in MA1 (15,000 acres of wet pine savanna longleaf and 11,000 acres of upland longleaf ecosystems) within 10 years of plan approval;

Management Strategy: Maintenance and restoration efforts can be achieved through a timber sale program and prescribed burning in MA 1. A priority is to maintain longleaf pine ecosystems to maintain the condition class and restore longleaf ecosystems to improve condition class (as defined in the rangewide strategy for longleaf pine). To restore longleaf pine on xeric to mesic sites, different approaches are needed depending on the existing conditions:

- Open loblolly pine-dominated flatwoods and savannas would be maintained to provide suitable habitat conditions for at risk species until conversion to longleaf pine can be completed in the long- term.

- Some longleaf pine stands have the desired overstory composition, but not the desired structure, due to lack of fire. Introducing prescribed fire back into these stands will create the desired structure and move toward meeting the desired conditions.

- Some stands consist of younger mixed loblolly-longleaf pine overstory that can be moved toward the desired overstory composition by favoring longleaf pine during thinning.

<u>OBJ-ECO-4; Pond Cypress Savannas and Carolina Bays</u>

Maintain, improve, or restore Pond Cypress Savannas within Carolina Bays and depressional wetlands on 6,400 acres within MA 1 within 10 years of plan approval.

Management Strategy: Provide desired conditions through frequent and growing season fire that controls the encroachment of woody species in and adjacent to wetlands within MA 1.

<u>OBJ-MA2-2; Flow of Age Class</u>

Provide at least 5,000-6,000 acres of young age component (0-10) forest in loblolly pine or mixed pine- hardwood forests within MA 2 within ten years of plan approval.

Management Strategy: The strategy is to provide a flow of early to late-successional habitats; reducing hazardous fuels; and providing a sustainable amount of high-quality timber for local economies using primarily timber harvest.

OBJ-T&E-1; Frosted Flatwoods Salamander

Restore 1 to 2 additional breeding sites for frosted flatwoods salamander breeding wetlands along the Talbot Terrace within ten years of plan approval. Maintain the six known breeding wetlands.

Management Strategies: It is anticipated that the Service will release a Recovery Plan for frosted flatwoods salamander in 2017. The Francis Marion will work toward meeting the recovery goals when a Recovery Plan is released and coordinate with partners to expand the population.

OBJ-T&E-2; Red-Cockaded Woodpecker

Provide open longleaf woodlands for a red-cockaded woodpecker (RCW) population of at least 450 active clusters and 350 potential breeding groups with ten years of plan approval. Support an average RCW group size greater than three birds per group and reproductive success averages greater than two fledglings per successful nest with ten years of plan approval.

Management Strategy: The forest supports a recovered population for the RCW in upland longleaf and wet pine savanna ecosystems within MA 1 and contributes towards range-wide recovery efforts. Every project with the potential to affect RCW, will consider the terms and conditions of the BO, and guidelines in the most recent species Recovery Plan.

OBJ-T&E-3; Threatened and Endangered Plant Species

Provide ecological conditions to support maintain and restore nine stable to increasing populations for the federally endangered American chaffseed; five stable to increasing populations for the federally endangered pondberry; and three stable to increasing populations for the federally endangered Canby's dropwort within ten years of plan.

Management Strategy: Management strategies for maintaining and restoring federally protected plant species include frequent prescribed fire, open canopies, and population enhancement and propagation conducted in close coordination with the Service. The Francis Marion will coordinate with South Carolina Department of Transportation in the maintenance of American chaffseed along roadsides, and will manage habitats adjacent to roadsides to facilitate the management and movement of stable to increasing populations within natural stands.

OBJ-SCC-3; At Risk Species

Maintain or restore ecological conditions needed to provide stable to increasing populations for At Risk Species on at least 25,000 acres per year. Prioritize habitat restoration for declining species (listed in order of priority): 1) federally-listed T&E species; 2) Species of Conservation Concern with fewer than five known forest occurrences; and, 3) At Risk Species of high public and external interest. Maintain and restore ecological conditions for species of conservation concern as rare plant communities on 4600 acres identified across the Resource Integration Zones and at risk species associates.

Management Strategy: Collaborate with Federal, State, non-government agencies, and private partners to maintain and restore populations and associated habitats for At Risk Species using an all-lands approach.

- Collect and share inventory and monitoring information which documents locations, trends, habitat condition, threats, and management responses.
- Conduct propagation and population enhancement activities to maintain and enhance genetic diversity, encourage gene flow, and improve resistance to climate change and population resilience.
- Conduct widespread inventories for at-risk species populations to improve our understanding of distribution, habitat condition, threats and management needs.
- Maintain up-to-date digital databases of species occurrences and trends to share with State Wildlife and Heritage Programs, the Service, the South Atlantic Landscape Cooperative, Natureserve, and others.

OBJ-MUB-7; Wood Products

Wood Products Base Level: Within 10 years of plan approval, provide 60 million cubic feet (MMCF) of wood products from lands suitable for timber production. This level is established in recognition of current fiscal capability and organizational capacity.
Wood Products Desired level: Within 10 years of plan approval, provide a projected timber sale quantity (PTSQ) of 98 MMCF from lands suitable for timber production. In the second decade this quantity is 95 MMCF.

Management Strategy: The PTSQ is used to achieve desired conditions for ecological restoration and forest health objectives on national forest lands. Tree harvest is also used for other resource objectives, such as reducing hazardous fuels and establishing a sustainable flow of early and late seral habitats. The projected timber sale quantity is estimated using a variety of assumptions.

Timber harvest priorities in the first decade are:

- Convert loblolly pine to longleaf pine in MA1; See OBJ-ECO-3. Upland Longleaf and Wet Pine Savanna and Flatwoods Ecosystems;
- Thin 17,000 acres of pine stands to desired densities;
- Regenerate pine stands in MA 2 to provide early-successional habitat; and
- Improve composition of maritime forests and oak and mesic hardwood forests.

Standards (S) and Guidelines (G)

Standards and guidelines are constraints placed on project and activity decision making. They help achieve or maintain the desired condition(s), avoid or mitigate undesirable effects or meet applicable legal requirements.

Standards are mandatory; deviation from a standard is not allowed or the forest plan must be amended.

Guidelines differ from standards in that, on a case by case basis, a project need not adhere to the terms of a guideline, as long as the project design meets the guideline's intent; and is documented in a suitable NEPA document. The project record must support the finding that the guideline's intent is being met.

S1. Do not exceed 80 acres for even-aged openings for pine and pine-hardwood types and 40 acres for hardwood and hardwood-pine forest types except as follows:

- Where the forest type is being converted to longleaf pine or for other restoration activities.
- Where areas are managed as permanent openings (e.g., meadows, pastures, food plots, rights-of-way, woodlands, savannas and grasslands) even when within or next to created openings.
- Where natural catastrophic conditions such as fire, insect or disease attack or windstorm have occurred.

Proposals to exceed the even-aged opening limitations stated above are subject to 60 days public notice and review by the regional forester. Even-age regeneration areas are no longer considered openings when the reestablished stand has reached an age of five years. Even-aged or two-aged regeneration cutting may be scheduled next to uneven-aged stands at any time. Uneven-age harvest areas have no size limitations or dispersion requirements.

S13. Use seed mixtures that contain genetically and ecologically appropriate native species. Use of non-native plants is allowed when it complies with FS policy.

S14. Remove large wood added by harvest activities to streams unless it is compatible with native vegetation and aquatic habitat objectives and approved by a biologist. This is an exception to State BMPs.

S17. Do not use mechanical equipment on plastic soils when the water table is within 12 inches of the surface, or when soil moisture exceeds the plastic limit. Soil moisture exceeds the plastic limit if the soil can be rolled to pencil size without breaking or crumbling.

S19. Meet or exceed State Best Management Practices for water quality. See Standard S14 above.

S26. No firelines, temporary roads, or log landings in population sites for at risk plant species, except as needed to protect facilities, private property, or public safety.

S27. Protect existing RCW cavity trees during prescribed burning operations. Only use low-intensity fire within the cluster and around cavity trees to keep hazardous fuels at acceptable levels. Prior to prescribed burning clear vegetation and fuels around cavity trees or mulch around cavity trees.

S30. Use only aquatically labeled herbicides and surfactants within designated critical habitat for frosted flatwoods salamander and known habitat for Carolina gopher frog.
S32. Retain at least 4 suitable cavities within each active RCW cluster on the forest.
S33. Retain all potential RCW cavity trees (pines greater than 60 years in age) within RCW clusters, unless pine basal area is above 50 feet^2/acre and all trees are above 60 years within the clusters; protect RCW cavity trees by shielding cavities with restrictors, painting known cavity trees with highly visible paint, or replacing lost cavities with artificial ones.
S34. Require equipment cleaning practices on equipment, using equipment cleaning clauses in contracts, permits and agreements, when moving equipment from areas infested with non-native invasive plants (FSM 2903).
S35. No new permanent roads, trails, or recreational sites are allowed in rare plant communities and population sites for at-risk plant species.
S36. Use plant materials that contain genetically appropriate native plant species when maintaining and restoring vegetation. Use of non-native plants is allowed only when in compliance with Forest Service native plant policy (FSM2070).
S38. Cutting of active RCW cavity trees is prohibited unless formally authorized by the Fish and Wildlife Service.
S39. Use low psi ground pressure logging equipment when operating in these ecosystems and special areas: depressional wetlands, Carolina bays, pocosins, and at risk plants population sites.
S40. Do not use soil active herbicides (imazapyr, imazapic) in population sites for at-risk plant species.
S41. Within MA 1, prescribe burn habitat for fire-adapted at-risk species associates and rare communities at desired seasons (growing vs. dormant) and fire return intervals for associated ecosystems. (Table 2-1, Francis Marion BA; DC-ECO-2; DC-ECO-3; DC-ECO-4; DCECO-5; DC-ECO-7).

- Develop management practices which maintain and restore At Risk Species populations and their habitats during project planning and implementation.
- Implement mitigating measures to minimize impacts of recreation use and restoration activities on populations for at risk species where needed.
- Ensure that prescribed burning of fire-adapted At Risk Species and rare communities occurs at desired seasons and intervals.
- Align land acquisition practices to result in improved connectivity among habitats for at-risk species where needed.
- Adapt our management of at-risk species and habitats in response to population and habitat monitoring information.

G4. Tree stands planned for regeneration harvest should generally have reached culmination of mean annual increment of growth. Typically, even-age regeneration harvests should not be made prior to age 35 for loblolly pine or age 50 for longleaf pine. However, plantations of loblolly pine on longleaf pine sites may be harvested for restoration purposes as soon as they are merchantable. Generally, hardwood regeneration harvests will not be made prior to age 50.
G33. Temporary or new system roads, log landings and firelines should be located outside primary (538 feet) and secondary zones (1,476 feet) from the edge of known breeding ponds for frosted flatwoods salamander.

G35. Guidelines and recovery objectives in the most up-to-date Recovery Plan should be considered for all federally-listed species, when available. Collaborate with the Fish and Wildlife Service in the conservation of At Risk Species.
G36. Do not allow any mechanical activities within active RCW clusters during the nesting season (April 1– July 31). Exceptions may be made at the project level with authorization from the U.S. Fish and Wildlife Service.
G40. Encourage the use of weed-free materials (including but not limited to gravel, mulch, seeds, plant materials) to limit the accidental introduction and spread of non-native invasive plant species (including but not limited to gravel, mulch, seeds, plant materials)(FSM 2900). If certified weed-free materials become available in SC, then the use of those certified weed-free materials would be required for use on national forest lands.
G41. Commercially-purchased seed mixes should be tested by a certified seed laboratory for purity, viability, and noxious weed seed.

Species Considered and Evaluated

The Francis Marion biological assessment concluded that the proposed Forest Plan would result in a "likely to adversely affect" determination for the following listed species listed below:

Table 3. Threatened or endangered species considered in this analysis.

Common Name	**Scientific Name**	**Taxonomic group**	**Status**	**Associated Ecosystem(s) on the Forest**
American chaffseed	*Schwalbea americana*	Vascular Plant	Endangered	Fire-maintained upland longleaf and loblolly pine-dominated woodlands
Canby's dropwort	*Oxypolis canbyi*	Vascular Plant	Endangered	Fire-maintained Carolina bays and depressional wetlands
Frosted flatwoods salamander	*Ambystoma cingulatum*	Amphibian	Threatened	Fire-maintained upland longleaf woodlands; wet pine savannas and flatwoods, Carolina bays and depressional wetlands
Pondberry	*Lindera melissifolia*	Vascular Plant	Endangered	Fire-maintained Carolina bays and depressional wetlands
Red-cockaded woodpecker	*Picoides borealis*	Bird	Endangered	Fire-maintained upland longleaf and loblolly pine woodlands and wet pine savannas and flatwoods

CONCURRENCES

Additionally, the Service will concur with your determination that this action is not likely to adversely affect the federally listed American wood stork (*Mycteria americana*) and will have no effect on Bachman's warbler (*Vermivora bachmanii*), and the West Indian manatee (*Trichechus manatus*), or destroy or adversely affect the designated critical habitat for the frosted flatwoods salamander (*Ambystoma cingulatum*). In view of this, we believe that the requirements of section 7 of the ESA have been satisfied for these species. However, obligations under section 7 of the ESA must be reconsidered if (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner which was not considered in this assessment, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

STATUS OF THE SPECIES AND **CRITICAL HABITAT RANGEWIDE**

This section summarizes the biology and ecology as well as information regarding the status and trends of the covered species throughout their entire range. The Service uses this information to assess whether a Federal action is likely to jeopardize the continued existence of the aforementioned species, or adversely modify designated critical habitat. The "Environmental Baseline" section summarizes information on status and trends of the species specifically within the action area. This summary provides the foundation for the Service's assessment of the effects of the proposed action, as presented in the "Effects of the Action" section.

American chaffseed (*Schwalbea americana*)

Species description/critical habitat

American chaffseed, *Schwalbea americana* L., was first described by Linnaeus in *Species Plantarum* in 1753. *Schwalbea americana* is a monotypic genus that occurs in the family Orobanchaceae (formerly Scrophulariaceae). It is an erect perennial herb with stems that branch only at the base. The leaves are alternate, estipulate, sessile, and are ascending or erect, overlapping in a tight spiral (Kral 1983). The leaves, stems, and flowers are villous-puberulent. The 5-lobed flowers are reddish-purple and mature into dehiscent capsules that contain numerous linear, yellowish-tan seeds. The showy flowers have a high degree of bilateral symmetry elaborated for pollination by bees (Pennell 1935*)*. Flowering occurs from April to June in the southern part of the species' range, and from June to mid-July in the northern part of its range. Fruits start to mature in early summer in the South and October in the North (Johnson 1988). No critical habitat has been designated for American chaffseed.

Life history

Parasitism: American chaffseed is a hemiparasitic herb that photosynthesizes in addition to acquiring photosynthates via modified roots, haustoria, which connect to the vascular system of host species. Although American chaffseed can form haustorial connections with a wide variety of species, narrowleaf silkgrass (*Pityopsis graminifolia*) appears to be a favorable host species along with other composites and grasses (J. Glitzenstein, Tall Timbers, pers. comm. 2016; Kelly 2006). This relationship may be, in part, due to composites and grasses having a higher density of roots near the soil surface thereby increasing the likelihood that American chaffseed seedlings come into contact with the roots of host species (Service 2008). American chaffseed is considered the rarest root parasitic plant in the South. However, because there are many common hemiparasitic species, American chaffseed's hemiparasitic nature does not necessarily contribute to its' rarity (Obee and Cartica 1997).

Germination and seedling recruitment: In the field, germination and seedling recruitment appear dependent upon microsite soil disturbances, such as earthworm castings, pocket gopher activity (Kirkman and Drew 1995), old fire plow lines, and old logging roads (April Punsalan, personal observations 2016) and other minor disturbances that expose bare soil (i.e., prescribed fire). American chaffseed does not reproduce asexually via vegetative storage organs (e.g., rhizomes, bulbs, corms, etc.). Thus, recruitment is solely dependent upon sexual reproduction.

In controlled conditions, germination is high (90%) for seeds sown immediately after collection (i.e., within 24 hours) and 1-2 years post collection (Kirkman 1993; Van Clef 2001). Due to American chaffseed's hemiparasitic nature, seedlings have to be given additional nutrients or grown with host species such as narrowleaf silkgrass to survive *ex situ* safeguarding efforts. Norden (2002, pg. 58) demonstrated that low soil moisture or low water availability may inhibit seed germination and seedling establishment.

Because American chaffseed does not reproduce asexually and seeds do not survive long in the soil seedbank, soil disturbance via prescribed fire or other disturbances that expose bare soil are critical to the recruitment and survival of this species. Thus, the continued existence of American chaffseed at sites will depend on the long-term maintenance of early seral habitat (Obee and Cartica 1997) through prescribed fire or other innovative soil disturbance methods.

Seed longevity: Norden (2002, pg. 59) illustrated that buried American chaffseed seed will persist in the soil and remain viable for at least one year. Kelly (2003, pg. 5, 7) demonstrated that no germination occurred for seeds stored in field conditions for five years. Thus, American chaffseed does not appear capable of long-term dormancy within the soil (Service 2008; Kelly 2003).

Seed dispersal: The morphology of American chaffseed seed, somewhat flattened and compressed and enclosed in a loose-fitting sac-like structure, suggests wind dispersal; however, no information is available to support this hypothesis. Information is lacking on both the mechanism and distance of seed dispersal. Initial observations in New Jersey determined ants ignored American chaffseed seeds; therefore, ants unlikely serve as dispersal agents (T. Hampton, New Jersey Office for Natural Lands Management, *in litt.* 1995).

Population dynamics

Long-term demographic studies have not been conducted for this species. The rate of recruitment and loss of individuals from a population is unknown. Overall, anecdotal information (i.e., rangewide analysis of extirpated populations) shows that populations with greater than 200 individuals appear more stable, have greater resiliency, and can persist through time in comparison with small populations or populations that have fewer than 50 individuals. Because American chaffseed cannot reproduce asexually and sexual recruitment depends upon a frequent disturbance regime, such as fire, to expose bare mineral soil, small populations are more vulnerable to extirpation.

Habitat

American chaffseed occurs in fire-maintained longleaf pine savannas and flatwoods. Often it is found in ecotonal areas between peaty wetlands and xeric sandy soils. Kral (1983) described American chaffseed habitat as open grass-sedge systems in moist acidic sandy loams or sandy peat loams.

Status and distribution

American chaffseed is primarily a coastal plain species of the Atlantic and Gulf coasts. Exceptions to its coastal distribution, all of which are historical records, include: an occurrence in the sand plains near Albany, New York, which Pennell *(*1935*)* considered a possible remnant population of glacial migration along the shores of the Hudson River; occurrences from Tennessee and Kentucky on sandstone knobs and ridges of the Cumberland Plateau and Highland Rim; an inland site on the Montague sandplain near the Connecticut River; and a sand plain in Hubbardston, Massachusetts (TNC 1993).

Extant populations of American chaffseed are currently known from 43 locations in New Jersey, North Carolina, South Carolina, Georgia, Alabama, Louisiana, and Florida (an occurrence reported from Mississippi at the time of Federal listing has since been determined not to be American chaffseed). States with only historic records include Massachusetts, Connecticut, New York, Delaware, Maryland, Virginia, Mississippi, Texas, Tennessee, and Kentucky. See a description of State-by-State historical and extant occurrences below.

Alabama

Two extant sites in Bullock County occur on Sehoy Plantation (A. Schotz, Alabama Natural Heritage Program, pers. comm. 2016). Three historic sites are known from Baldwin, Geneva, and Mobile Counties (TNC 1993).

Connecticut

Two historic occurrences are known from Middlesex County (TNC 1993) and New London County (Crow 1982).

Delaware

One historic occurrence is known from New Castle County where it was last observed in 1875. This site was destroyed by the dredging and widening of the Chesapeake and Delaware Canal (TNC 1993).

Florida

Historically, there were ten occurrences in Florida located in Brevard, Duval, Highlands, Hillsborough, Levy, Putnam, Volusia, Gadsden, and Leon Counties. Currently, there are only two extant American chaffseed populations located in Florida; one occurrence in Okaloosa County and one in Leon County (Service 2008; M. Jenkins, Florida Plant Conservation Program, pers. comm. 2016).

Georgia

Historically, there were a total of 14 occurrences known from Baker, Baldwin, Dougherty, Early, Miller, Pike, and Worth Counties. Currently, there are ten extant occurrences of American

chaffseed in Georgia. Six occurrences are located on the Ichauway Plantation, a 28,000 acre private ecological reserve in Baker County. Two extant occurrences are located on a private quail plantation in Dougherty County (T. Patrick, Georgia Department of Natural Resources, pers. comm. 2016). The remaining two extant occurrences are located on private lands managed for quail in Bake and Worth Counties. Similarly to quail plantations in Florida and South Carolina, management practices for quail on private plantations in Georgia provide and maintain suitable habitat for American chaffseed due to annual fire prescription.

Kentucky

Two historic occurrences are known from McCreary County near the Tennessee border. American chaffseed was last observed in Kentucky in 1935 (Kentucky State Nature Preserves Commission 1991).\

Louisiana

There are two extant occurrences for American chaffseed in Louisiana. One population occurs at a TNC Mitigation Bank site called CC Roads. The other extant population occurs on private land, the site is referred to as Beauregard Parish (D. Walther, Service, pers. comm., 2016).

Maryland

Two historic occurrences are reported, one from Worcester County near Ocean City, where it was last observed in 1893, and one from Anne Arundel County. Both locales were surveyed in 1979; no American chaffseed was found (Broome et al. 1979).

Massachusetts

Ten historic occurrences are recorded from Barnstable, Bristol, Dukes, Franklin, Nantucket, Norfolk, Plymouth, and Worcester Counties (TNC 1993). The species was last observed in Massachusetts in Nantucket County in 1963. Extensive areas of suitable habitat in the State have been searched for American chaffseed, without relocating the species. Lack of fire, coupled with intense development pressure, indicates minimal prospects for finding American chaffseed in Massachusetts (B. Some, Massachusetts Division of Fisheries and Wildlife, *in litt.* 1990).

Mississippi

Two historic occurrences are known from Covington and Jackson Counties (Rawinski and Cassin 1986). The occurrence reported as extant at the time of listing, in Noxubee County on the Noxubee NWR (Service 1992), is now considered invalid. The plants previously identified as American chaffseed at the Noxubee National Wildlife Refuge (NWR) have been verified as being *Parenucellia viscosa*, a European native closely related to American chaffseed (C. Norquist, Service, *in litt.* 1993). No extant populations of American chaffseed are known to occur in Mississippi.

New Jersey

A total of 19 occurrences, only one of which is extant, is known from Atlantic, Burlington, Camden, Cape May, Cumberland, and Ocean Counties (New Jersey Department of Environmental Protection 1994). By the early 1970s there were still four extant occurrences in New Jersey: one in Cape May County, one in Camden County, and two in Burlington County. The Camden County occurrence and one of the Burlington County occurrences were lost, apparently to habitat succession from fire suppression. By 1980, only two occurrences of American chaffseed remained in New Jersey. In 1986, the Cape May population was destroyed by the construction of a new road, leaving only one extant occurrence in Burlington County (G.A. Marshall, New Jersey Division of Parks and Forestry, in *litt.* 1991). The Burlington County occurrence is located at the northernmost extent of the current range of American chaffseed, and is the only known occurrence north of North Carolina. The site is within Lebanon State Forest, although portions of the road shoulder along the highway remain under the jurisdiction of Burlington County. Additionally, part of the occurrence is on land the State leases to a cranberry grower under a 25-year lease. The lease was initiated in 1983 and amended in 1984 (New Jersey Department of Environmental Protection and Energy 1993). The Burlington County site is easily accessible and well known, making it particularly vulnerable to human disturbance. Trampling and removal of plants at the site and mowing at inopportune times for the species have been problems in the past. In 1993, the Lebanon State Forest, Burlington County, the cranberry grower, and the New Jersey Office of Natural Lands Management signed a management agreement to provide increased site protection and to implement a coordinated on-site management program for American chaffseed. As a result of this agreement, barriers to vehicles have been built in the area to prevent inadvertent disturbance, and coordination has increased to ensure that mowing occurs in the dormant season (i.e., October- November). Although mowing and hand-thinning of shrubby vegetation are conducted on the site, it is suspected a fire is needed to reinvigorate conditions suitable for American chaffseed (R. Cartica, New Jersey Division of Parks and Forestry, Office of Natural Lands Management, Trenton, New Jersey, pers. comm. 1994). Due to the increased management of the site in the past few years, the population does not appear to be declining at this time (T. Hampton, New Jersey Office of Natural Lands Management, pers. comm. 1995).

New York

One historic occurrence is recorded from Albany County in the sandplains where American chaffseed was last observed in 1865 (TNC 1993).

North Carolina

A total of 24 occurrences are known from Bladen, Cumberland, Hoke, Moore, Pender, and Scotland Counties (TNC 1993), six of which are considered extirpated and 18 extant. At the time of listing, only one occurrence was reported as extant in North Carolina; the increase is attributed to additional searching and the recognition of separate occurrences on Fort Bragg. Of the 18 extant occurrences, 17 are located on Fort Bragg on or near live-ammunition impact zones in Cumberland and Hoke Counties. The other extant occurrence is located next to a roadside in Moore County.

The extent of American chaffseed on Fort Bragg appears to be related to military shelling activities on the base, which result in frequent fires in and around the live-ammunition impact zones. Sixteen extant occurrences are located in three impact areas that have 2-year fire return interval. The frequent fires (in what were once fire-maintained communities) maintain a high diversity of herbs under widely scattered longleaf pine and pond pine (*Pinus serotina*). Without the frequent fires, most of the areas occupied by American chaffseed would be dense, shrub dominated pocosins or dominated by dense stands of turkey oak (*Quercus laevis*) as is the case under the artificial, fire-suppressed conditions prevailing in the sandhill coastal plain of North Carolina (A.S. Weakley, North Carolina Natural Heritage Program, *in litt.* 1990). The occurrences on Fort Bragg are afforded some protection under the Act as well as Army regulation AR 420-74 (Chapter 11 draft), Fort Bragg's range regulation No. 350-6, and Fort Bragg's Draft Endangered Species Management Plan (J. Shipley, Department of Defense, Fort Bragg, i*n litt.* 1995). The total number of extant occurrences may be less than 18 once the populations or subpopulations on Fort Bragg are delineated following NatureServe's 2km population guidelines (NatureServe 2016). After delineation, NC may support five populations with four populations occurring on Fort Bragg. Further population delineation analyses are needed and will be completed in the next 5-year review for this species.

South Carolina

At the time of listing in 1995, there were 42 extant populations that occurred across Berkeley, Charleston, Clarendon, Florence, Horry, Jasper, Lee, Sumter, and Williamsburg Counties (Porcher 1994). In the 2008 five-year review, 33 extant occurrences were reported for South Carolina. Currently, there are only eight extant populations in South Carolina occurring in Lee, Berkeley, Williamsburg, and Georgetown Counties. Four extant populations occur on the Francis Marion. Two of the occurrences are very small and declining due to the lack of prescribed fire (fire return interval- 4.5 years) and the other two appear stable. The other two extant SC populations are large and robust and occur on private quail plantations managed with annual fire prescription.

Virginia

One historic occurrence is recorded from an area between Sussex and Greensville Counties, where it was observed in 1937. The species' persistence in this region, which has been heavily affected by agriculture, pine plantations, and highways, is highly doubtful (J.C. Ludwig, Virginia Natural Heritage Program, *in litt.* 1990).

Reason for listing

Historically, American chaffseed occurred in all the coastal States from Massachusetts to Louisiana, and the inland States of Kentucky and Tennessee. At the time American chaffseed was listed, it had been extirpated from New York, Massachusetts, Delaware, Connecticut, Maryland, Virginia, Tennessee, Kentucky, Texas, and Mississippi. American chaffseed was listed as federally endangered on September 29, 1992 (Service 1992) because the species was

extirpated from over half of its' historical range. In addition, there was a decline in known occurrences.

Range-wide trends

The trend for American chaffseed across most of its range is one of decline. Range-wide, there are only 43 extant populations. Further delineation of populations using the NatureServe's 2km rule (NatureServe 2016) may result in only 30 extant populations (only five populations for NC versus the 18 currently reported). Many of the extant populations are small and declining and without frequent prescribed fire will likely be extirpated. Approximately, 50% (43/72) of American chaffseed populations have been extirpated since the 1995 Recovery Plan.

Conservation needs

1. At all American chaffseed extant sites manage habitat through prescribed fire on a two-year rotation to ensure stable to increasing populations. For small, declining populations, apply prescribed fire on a 1.5 mean fire return interval, preferably annually.
    - Ensure variability in seasonality of prescription, i.e., burn during the dormant and growing season (preferably late fall).

2. Complete conservation plans and management agreements for populations on public land that outline how American chaffseed populations will be maintained through prescribed fire and other potential disturbance or soil disturbance mechanisms to avoid further extirpation, aid recruitment, and ensure recovery.

3. Conduct experiments to determine the effects of other disturbances, such as mowing, soil disking, raking, firebreak construction, etc., to determine the beneficial and/or adverse effects on American chaffseed.

4. Investigate whether direct seeding methods in areas with human-induced soil disturbance (e.g., manually disked areas) would be an effective method for increasing population sizes for small, declining populations.

5. Work across multiple partners (The Nature Conservancy, Service, USFS, and SCDNR) to leverage resources to ensure that fire prescription occurs on a 2-year or annual fire rotation.

Threats and habitat modification/destruction

Fire suppression and vegetational succession of fire-maintained ecosystems across the Atlantic and Gulf Coasts region is the greatest threat to American chaffseed. If sites or populations are not regularly maintained through prescribed fire, American chaffseed will be lost from the system. Across this species' range, the largest, healthiest populations are ones that are burned annually by quail plantation managers. Fort Bragg supports the largest populations on Federal land due to 2-year fire return intervals from the military trainings (J. Gray, Department of Defense, Fort Bragg, pers. comm. 2016).

Other threats to the species' survival include the conversion of fire-maintained flatwoods and savannas to commercial pine plantations, which can create dense canopies unsuitable for American chaffseed. Potential threats to the species on public lands include inadvertent disturbance to plants and possibly, commercial pine straw raking. Overall, the greatest threat to the continued survival of this species on both public and private land is the lack of prescribed burns and/or fire suppression where this species occurs.

Because the soils are level, deep, and suitable for building sites in the sandy pineland communities where American chaffseed occurs, sites are especially vulnerable to development (Service 1995). In addition, many American chaffseed populations were or are along the Atlantic Coast where development pressures are high (Rawinski and Cassin 1986). While the demise of many populations can be attributed to the direct loss of habitat to development (Rawinski and Cassin 1986; Johnson 1988; TNC 1993), development also presents indirect threats to the species, as urbanization generally results in total fire suppression, which ultimately leads to the loss of fire-maintained ecosystems inhabited by American chaffseed.

Climate change

Higher temperatures can increase the evaporation and water loss from plants. Droughts in combination with population growth and land-use change will likely add to the strain in the water supply. Moisture availability appears to play an important role in the both the flower production and seedling recruitment of American chaffseed. As such, as temperatures and the occurrence of droughts increase, American chaffseed populations, especially ones not in ecotonal areas between freshwater depressional wetlands and uplands, may experience a decline.

Recovery criteria

The recovery criteria to downlist this species includes 50 viable sites with long-term protection plans, four out of the 50 sites have to occur in the northern region. All of the sites must have management agreements. Currently, there are only 43 extant populations for this species. No recovery criteria to delist this species have been determined. One of the recommendations for future actions in the 2008 five-year review was to develop a delisting strategy, delisting criteria, and a post delisting monitoring strategy. Thus, a revised Recovery Plan with recovery criteria to delist this species is needed.

Canby's dropwort (*Oxypolis canbyi*)

Species description/critical habitat

Canby's dropwort, *Oxypolis canbyi* (Coulter & Rose), Fernald, is one of five Southeastern species in the exclusively American genus *Oxypolis*. Canby's dropwort was originally described as a variety of the more common *O. filiformis* (Coulter and Rose 1900). Fernald (1939) later elevated the taxon to a full species based on differences in leaf and fruit morphology.

Canby's dropwort is a perennial herb with "quill-like" leaves that are hollow and septate (Service 1990). It has a compound umbel inflorescence composed of 5-9 rays containing five-parted

flowers. Flowering occurs from mid-August to October. Flowers mature into an indehiscent fruit (schizocarp). The indehiscent fruit splits into separate one-seeded segments (carpels) at maturity. The seed margins have thick, corky wings that help distinguish it from other *Oxypolis* species (Tucker et al. 1983).

No critical habitat has been designated for Canby's dropwort.

Life history

Growth: Canby's dropwort is an obligate, emergent wetland species that exhibits adaptive vegetative and reproductive features for surviving in a wet environment. Canby's dropwort has septate leaves (divided into partitions) that may aid the free circulation of gases in the intercellular partitions during alternating periods of extreme wet and drought and may help keep the stems buoyant during times of flooding. In addition, Canby's dropwort reproduces asexually via rhizomes which helps the species reproduce in nutrient-poor environments. Lastly, the seeds have thick, corky margins that may help keep the seeds buoyant and aid in water dispersal.

Reproduction, germination and seedling recruitment: Canby's dropwort can reproduce both asexually and sexually. It vegetatively reproduces from stoloniferous rhizomes and under the right conditions can become a dominant species. The flowers can self-and cross-pollinate. Some flowers are bisexual (contain both male and female flowers) while others may only have male flowers in the inner portion of the umbel and female flowers on the outer portion of the umbel. The bisexual flowers are protandrous (male gametes developing before female), which is indicative of some degree of outcrossing (Service 1990). However, because most populations are small and isolated, cross-pollination among populations may not occur.

No research has been conducted on the germination ecology of Canby's dropwort. Safeguarding propagation efforts have demonstrated that seeds mature late fall (October-November) and germinate the following fall in pots (J. Glitzenstein, Tall Timbers, pers. comm. 2016). Seedling recruitment is rarely observed in the field. Due to asexual reproduction, it is hard to determine if seedling recruitment has occurred in close proximity to parent plants (Service 1990).

Population dynamics

Long-term demographic studies have not been conducted for this species. The rate of recruitment and loss of individuals from a population is unknown. Overall, it appears that Canby's dropwort is a long-lived perennial that routinely reproduces asexually and sexual recruitment may be tied to a disturbance regime.

Habitat

Canby's dropwort occurs in pond cypress savannas, Carolina bays, wet pine savannas, shallow pineland ponds and cypress-pine swamps (Service 1990). Canby's dropwort typically occurs along the margins of the freshwater depressional wetlands listed above (April Punsalan, personal observation, 2016). Pond cypress (*Taxodium ascendens*) is usually the dominant tree species, although swamp tupelo (gum) (*Nyssa biflora*) and other wetland trees are often present. In South

Carolina, the pond cypress savannas have widely fluctuating water tables, periodic hot fires, and little or no organic layer (it has been burned off) (Gaddy 2016).

Status and distribution

Historically, this species occurred along the coastal plain of Delaware, Maryland, North Carolina, South Carolina, and Georgia. Currently, it only occurs in Maryland, South Carolina, and Georgia. See a description of State-by-State historical and extant occurrences below.

Delaware

Historically, there was one population in Sussex County.

Maryland

There is one Canby's dropwort population in Queen Anne's County. This population contains approximately 400 stems (W. Knapp, North Carolina Natural Heritage Program, pers. comm. 2016).

Georgia

At the time of listing, Georgia supported eight extant populations. Currently, Georgia supports seven extant Canby's dropwort populations across Burke, Dooly, Jenkins, Lee, and Screven Counties.

North Carolina

There is one historic population located in Scotland County. The Nature Conservancy and The North Carolina Plant Conservation Program are trying to restore the bay with the historic Canby's dropwort record in hopes of getting propagules to naturally regenerate (L. Starke, North Carolina Plant Conservation Program, pers. comm. 2016).

South Carolina

In 1990, there were 15 extant Canby's dropwort populations in South Carolina. Currently, there are only four extant Canby's dropwort populations in Bamberg, Clarendon, Colleton, and Lee County. Three of the populations are protected and one population does not have any formal protection.

Reason for listing

This species was listed due to habitat loss and degradation (Service 1990). In addition, at the time of listing there were 25 extant populations and nine were destroyed (Service 1990).

Range-wide trends

Canby's dropwort has declined across most of its range. At the time of listing, there were 25 extant populations. Currently, there are only 12 extant Canby's dropwort populations across the species' range. The status of this species has severely declined due to habitat conversion (ditching and draining of bays for agriculture) and lack of habitat management, i.e., woody encroachment and fire suppression (Service 2015).

Conservation needs

1. Protect extant populations through land acquisition and manage habitat (i.e., reduce woody encroachment).

2. Implement management necessary for long-term reproduction, establishment, maintenance, and vigor of extant populations.

3. Study germination ecology.

4. Search for additional populations.

5. Safeguard all extant populations via *ex situ* collections.

Threats and habitat modification/destruction

The most significant threat to Canby's dropwort is the direct loss or alternation of its rare wetland habitat. Ditching and draining of wetland areas, primarily for agriculture and silviculture, have reduced the frequency, depth, and duration of surface water, lowered the groundwater table, and changed the vegetative composition in many areas of the mid-Atlantic coastal plain where the species historically occurred (Service 1990). Reducing surface water, changing soil moisture levels and lowering of the water table enables other plants to become established, modifies vegetative succession, and makes sites less conducive overall to the plant's growth and reproduction (Murdock and Rayner 1990).

Climate change

Climate change may exasperate the effects on individual populations by increasing the frequency, duration, and severity of droughts. Also due to global climate change, precipitation events during the growing season may occur from more intense storms that result in sudden flood events. The relation of all these factors, as well as the potential management implications, should be considered further (Service 2015).

Recovery criteria

There must be 19 Canby's dropwort populations and they must all be protected and self-sustaining for this species to be delisted. None of these criteria have been met.

Frosted Flatwoods Salamander (*Ambystoma cingulatum*)

Species description/critical habitat

The Service listed the flatwoods salamander as threatened on April 1, 1999 (64 FR 15691). Revised listing*:* *Ambystoma cingulatum* was split into two distinct species in 2009 (74 FR 6700), the reticulated flatwoods salamander (*A. bishopi*) was listed as endangered, and the frosted flatwoods salamander (*A. cingulatum*) retained threatened status. Also in 2009, 22,970 acres of critical habitat is designated for the frosted flatwoods salamander within Florida, Georgia, and South Carolina.

Life history

The frosted flatwoods salamander is a pond-breeding amphibian with a complex life cycle; i.e., there is an aquatic egg and larval life history stage, as well as a terrestrial metamorphosed juvenile and adult stage. As adults, flatwoods salamanders migrate to ephemeral (seasonally-flooded) wetlands to breed in the fall, where females lay eggs singly on bare mineral soil in small depressions that later fill with water (Anderson and Williamson 1976; Palis 1995a, 1997). Once inundated, well-developed embryos hatch into larvae in the winter and metamorphose between March and May after an 11 to 18 week larval period (Palis 1995a). Juveniles normally disperse from ponds shortly after metamorphosing, but may stay near ponds during seasonal droughts (Palis 1997). Juveniles, along with 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 return to their natal pond to breed during the fall months (Petranka 1998).

Population dynamics

Overall decreasing; the number of individuals per population, and number of populations throughout the historic range have declined; recent surveys demonstrate significantly fewer extant populations of frosted flatwoods salamander. Out of the original 25 populations described in the final rule (74 FR 6700, April 2015), only nine are currently known to still exist, based on surveys conducted on public lands in 2014/2015. In Florida, there currently are five populations in Apalachicola National Forest, two at St. Marks National Wildlife Refuge, and one at Fort Stewart in Georgia. A ninth possible population, located in the Francis Marion, has not had a detection of this species since 2010 (J. Palis, pers. comm., 2016.). The Service and partners have had limited opportunity to evaluate private land populations since the final rule in 2009.

Status and distribution

This species historically occurred east of the Apalachicola/Flint River system in Florida, the southern and southeastern regions of Georgia and the southern coastal plain region of South Carolina. Comparison of historical locations with records since 2000 demonstrate that the distributions of both species of flatwoods salamanders have been significantly reduced (Semlitsch et al., in review). This decline is occurring at multiple spatial scales; i.e., there has been a reduction in the number of populations (as legally defined), along with a loss of individual breeding ponds within populations, which has diminished the probability of long-term persistence of this species. The potential for metapopulation dynamics (i.e. the natural exchange

of individuals among discrete populations (via migration or dispersal) in the same general geographical area (Akçakaya et al. 2007) is now extremely limited.

The combined data from all survey work completed from 1990 to 2009 in Florida, Georgia, and South Carolina indicated that there were 25 legally defined populations of the frosted flatwoods salamander remaining at the end of that period (74 FR 6700). Fifteen of these populations were known from Baker, Franklin, Jefferson, Liberty, and Wakulla Counties in Florida. In Georgia, six populations occurred in Bryan, Evans, Liberty, and McIntosh Counties, Georgia, all on Department of Defense lands (five on Fort Stewart Military Installation and one on the Townsend Bombing Range). In South Carolina, four populations were known from Berkeley, Charleston, and Jasper Counties.

With some exceptions (e.g. Apalachicola National Forest), populations have become increasingly isolated and are currently so spatially separated that it is unlikely, if not impossible, for animals to share any genetic material. Because of this genetic distinctiveness, Pauly et al. (2012) advised against the use of eastern panhandle populations as a source for future reintroduction on the Atlantic Coastal Plain, assuming that source populations from within the Atlantic Coastal Plain were available. Moreover, the remaining populations in South Carolina and at Fort Stewart, Georgia are extremely important from a conservation perspective as they represent the only known extant populations of frosted flatwoods salamander in the entire Atlantic Coastal Plain (Pauly et al. 2012). Yet only eight adults and approximately 12 larvae have been captured on the Francis Marion in the past 20 years.

Apalachicola National Forest and St. Marks National Wildlife Refuge harbor the greatest number of remaining populations, as well as number of breeding sites within populations. Some ponds are more isolated than others and some are clustered in areas near known occupied sites. It should be noted that there may still be sites that could potentially harbor salamanders within the historical range that have not yet been adequately sampled. Increased survey effort in areas outside historically known ponds is recommended.

Reason for listing

The species is overall decreasing; the number of individuals per population, and number of populations throughout the historic range have declined, and recent surveys demonstrate significantly fewer extant populations of frosted flatwoods salamander. Out of the original 25 populations described in the final rule (74 FR 6700, April 2015), only nine are currently known to still exist, based on surveys conducted on public lands in 2014/2015. In Florida, there currently are five populations in Apalachicola National Forest, two at St. Marks National Wildlife Refuge, and one at Fort Stewart in Georgia. A ninth possible population, located in the Francis Marion in South Carolina, has not had a detection of this species since 2010 (J. Palis, pers. comm., 2015). We and our partners have had limited opportunity to evaluate private land populations since the final rule in 2009.

Range-wide trends

Historically, flatwoods salamanders occurred throughout the Coastal Plain of the southeastern U.S., across South Carolina, Georgia, Alabama, and the panhandle of Florida (Palis and Means, 2005). Over time and despite recently increased efforts to survey historical locations and find new populations, the combined range of reticulated frosted flatwoods salamander and frosted flatwoods salamander has dwindled from 458 historical locations (i.e. mostly individual breeding sites) prior to 1999 to only 49 locations over the last five years (89.3% loss; Semlitsch et al., in review). When the final rule was published (74 FR 6700) in 2009, there were 25 existing populations (some including multiple breeding sites) of frosted flatwoods salamander. These populations were legally defined as those salamanders using breeding sites within 3.2 km of each other, barring an impassable barrier such as a perennial stream (64 FR 15692). Ecologically, this legal definition best describes a metapopulation.

As of the end of the 2014/15 breeding season, there were nine known and currently occupied breeding populations (based on unpublished data from W.J. Barichivich, U.S. Geological Survey; J. Mott, The Nature Conservancy; K. Enge, Florida Fish and Wildlife Conservation Commission; J. Jensen, Georgia Department of Natural Resources; and J. Palis, Palis Environmental Consulting). The seven largest and most resilient of these nine populations occur at Apalachicola National Forest and St Marks National Wildlife Refuge. A small population (one known breeding pond) remains on Fort Stewart, Georgia. Despite considerable sampling effort the status of another small population on the Francis Marion remains uncertain as no observations of frosted flatwoods salamanders has been made since 2010.

Apalachicola National Forest and St. Marks National Wildlife Refuge harbor the greatest number of remaining populations, as well as number of breeding sites within populations. Some ponds are more isolated than others and some are clustered in areas near known occupied sites. It should be noted that there may still be sites that could potentially harbor salamanders within the historical range that have not yet been adequately sampled. Increased survey effort in areas outside historically known ponds is recommended.

Threats and habitat modification/destruction

The main threat to the flatwoods salamander is loss of both its longleaf pine/slash pine flatwoods terrestrial habitat and its isolated, seasonally inundated breeding habitat. The combined pine flatwoods (longleaf pine-wiregrass flatwoods) historical acreage was approximately 32 million acres (Wolfe et al. 1988; Outcalt 1997). The combined flatwoods acreage has been reduced to 5.6 million acres or approximately 18% of its original extent (Outcalt 1997). These remaining pine flatwoods (non-plantation forests) areas are typically fragmented and degraded, with second-growth forests.

Many ecologists consider fire suppression to be the primary reason for the degradation of remaining longleaf pine forests. The disruption of the natural fire cycle has resulted in an increase in hardwood midstory and understory and a decrease in herbaceous ground cover (Wolfe et al. 1988; Gorman et al. 2013). Ponds surrounded by pine plantations and protected from the natural fire regime may become unsuitable flatwoods salamander breeding sites due to

canopy closure and the resultant reduction in emergent herbaceous vegetation needed for egg deposition and larval development sites (Palis 1993). In addition, lack of fire within the pond during periods of dry-down may result in chemical and physical (vegetative) changes that are unsuitable for the salamander (Bishop and Haas 2005; Gorman et al. 2013). Large scale prescribed fire is often accomplished in the dormant season, and can have negative effects on salamander habitat (Bishop and Haas 2005). However, these burns can be important for reducing woody fuels and decreasing wildfire danger, but more emphasis should be placed on burning the sites when they are dry while avoiding burning when salamanders may be migrating to and from the pond. Follow-up burns should be used to ensure wetlands benefit from fire even when prescribed fires are incomplete or do not pass through the basin.

Fragmentation of the longleaf pine ecosystem, resulting from habitat conversion, threatens the survival of the remaining flatwoods salamander populations. Large tracts of intact longleaf pine flatwoods habitat are fragmented by roads and pine plantations. Most flatwoods salamander populations are widely separated from each other by unsuitable habitat. General ecological studies have shown that the loss of fragmented populations is common, and recolonization is critical for their regional survival (Fahrig and Merriam, 1994; Burkey, 1995). After local extirpation, amphibian populations may be unable to recolonize areas due to their physiological constraints, relatively low mobility, and site fidelity (Blaustein et al. 1994).

Roads also contribute to habitat fragmentation by isolating blocks of remaining contiguous habitat. They may disrupt migration routes and dispersal of individuals to and from breeding sites. In addition, vehicles may also cause the death of flatwoods salamanders during migrations across roads (Means 1996). Road construction is also a recurring threat in the remaining flatwoods salamander habitats. Roads can cause disruptions to groundwater and sheetflow, and have serious direct and indirect impacts on the breeding ponds.

Conversion of natural pine flatwoods to intensively managed (i.e., impacted by heavy mechanical site preparation, high stocking rates, and low fire frequencies) slash or loblolly pine plantations often degrades frosted flatwoods salamander habitat by creating well-shaded, closed-canopied forests with an understory dominated by shrubs or pine needles (Means et al. 1996). According to Enge et al. (2014), commercial forestry using silvicultural Best Management Practices (Florida Forest Service 2012) will likely extirpate flatwoods salamander populations over time. Disturbance-sensitive groundcover species, such as wiregrass, dropseed, and perennial forbs are either greatly reduced in extent or are replaced by weedy pioneering species (Schultz and White 1974; Moore et al. 1982; Outcalt and Lewis, 1988; Hardin and White 1989).

Land use conversions to urban development and agriculture eliminated large acreages of pine flatwoods in the past (Schultz 1983; Stout and Marion 1993; Outcalt and Sheffield 1996; Outcalt 1997). State forest inventories completed between 1989 and 1995 indicate that flatwoods losses through land use conversion are still occurring (Outcalt 1997). Urbanization, especially in the panhandle of Florida and around major cities, is reducing the available pine forest habitat. Wear and Greis (2002) identified conversion of forests to urban land uses as the most significant threat to southern forests. These authors predicted that the South could lose about 12 million forest acres (about 8% of its current forest land) to urbanization between 1992 and 2020.

Forestry management which includes intensive site preparation may adversely affect flatwoods salamanders both directly and indirectly (Means et al. 1996). Bedding (a technique in which a small ridge of surface soil is elevated as a planting bed) alters the surface soil layers, disrupts the site hydrology and often eliminates the native herbaceous groundcover. This can have a cascading effect of reducing the invertebrate community that serves as a food source for flatwoods salamander adults. Intensive site preparation also destroys subterranean voids such as crayfish burrows, root channels, etc. that are the probable fossorial habitats of adult salamanders and may result in entombing, injuring, or crushing individuals.

Flatwoods salamander wetland breeding sites have also been degraded or altered. The number and diversity of these often small wetlands have been reduced by alterations in hydrology, agricultural and urban development, incompatible silvicultural practices, shrub encroachment, dumping in or filling of ponds, conversion of wetlands to fish ponds, domestic animal grazing, and soil disturbance (Vickers et al. 1985; Ashton 1992). Hydrological alterations, such as those resulting from ditches created to drain flatwoods sites or fire breaks and plow lines, for example, represent one of the most serious threats to flatwoods salamander breeding sites. Lowered water levels and shortened hydroperiods at these sites may prevent successful flatwoods salamander recruitment.

Pesticides and herbicides may pose a threat to amphibians such as the frosted flatwoods salamander, because their permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb 1986). Negative effects on amphibians may include delayed metamorphosis, paralysis, reduced growth rates, and mortality (Bishop 1992). Herbicides used in the vicinity of flatwoods salamander breeding ponds may alter the density and species composition of vegetation surrounding a breeding site and reduce the number of potential sites for egg deposition, larval development, or shelter for migrating salamanders. However, the potential for negative effects from pesticide and herbicide use can be reduced by following label directions for application and avoiding aerial spraying over areas adjacent to breeding ponds (Tatum 2004). Aerial spraying of herbicides over outdoor ponds has been shown to reduce zooplankton diversity, a food source for larval frosted flatwoods salamanders and cause very high (68-100 percent) mortality in tadpoles and juvenile frogs (Relyea, 2005). Additionally, herbicides, if used according to the label and used in specific applications, may aid in restoration of upland and wetland habitat that have been altered by fire suppression and/or exclusion.

Another natural threat is the presence of predatory fish. These fish have a marked effect on invertebrate communities and alters prey availability for larval salamanders with the potential for negative effects on larval fitness and survival (Semlitsch, 1987).

Climate change

Climate change, especially in combination with other stressors, is a daunting challenge for the persistence of amphibians (Walls et al. 2013). Sea level rise is becoming and will likely continue to increase as a threat to the extant populations of both species of flatwoods salamanders. Some of the remaining populations occur in very low lying areas within a short distance of the Gulf Coast. These populations are already vulnerable to high tide storm-influenced saltwater

intrusion, and these threats will likely increase as sea level rise from global climate change continues. Climate change models predict the occurrence of more variable patterns of precipitation in the future, with longer droughts and larger (but fewer) rainfall events, in addition to increased temperatures (Heisler-White et al. 2008; Lucas et al. 2008). Increases in the occurrence of drought and heavy precipitation events are known to be impacting a variety of amphibians, including those that breed in ephemeral wetlands (Walls et al. 2013). In addition to rainfall amounts, the timing of precipitation events is an important stimulus for reproduction in many pond-breeding amphibians (Walls et al. 2013). Thus, climate change may have an impact on frosted flatwoods salamanders by altering the timing of fall and winter rains, as well as creating drier winters than historically would have occurred (Chandler 2015). For example, a decline in the adult population was observed in a frosted flatwoods salamander breeding wetland over the course of a three year winter drought (Palis et al. 2006).

Recovery criteria

Neither a draft Recovery Plan nor an outline containing objective, measurable criteria has been approved for the species. However, recovery criteria for frosted flatwoods salamander has been developed which includes restoration and maintenance within wetland breeding sites and upland habitat using frequent lightning season prescribed fire.

The Service anticipates incidental take of frosted flatwoods salamander will be difficult to detect for the following reasons: (1) the fossorial nature of most of the salamander's life cycle, with individuals rarely encountered above ground except during the breeding season; and (2) suitable habitat may not be occupied or occupation is unknown.

Pondberry (*Lindera melissifolia*)

Species description/critical habitat

Pondberry, *Lindera melissifolia* (Walt.) Blume, was first described by Thomas Walter as a distinct species in 1788, based on a collection from Berkeley County, South Carolina. Pondberry is a distinctive species, with diagnostic characters that clearly distinguish it from the other two species of spicebush in the southeastern United States, *L. benzoin* and *L. subcoriacea.* Pondberry is a deciduous, aromatic shrub that grows up to 2 meters (6 feet) in height. Plants are rhizomatous and generally grow in clones of numerous, usually unbranched, stems. Leaves are alternate, elliptical, somewhat thin and membranaceous, with entire margins. Pondberry is dioecious, individual plants either bearing female or male flowers. Pistillate flowers are less conspicuous than staminate flowers. Fruits are approximately 1 centimeter (cm) long at maturity and are bright red. Flowers appear in the spring, prior to leaf development (usually in February and March), and the fruit matures by late summer or fall (Tucker 1984; Service 1993).

No critical habitat has been designated for pondberry.

Life history

Growth and reproduction: Pondberry is an understory shrub, adapted to shade conditions, with a peak photosynthetic capacity at low light conditions (Wright 1990; Aleric and Kirkman 2005). Photosynthesis declines at 100 percent sunlight, with a reduction in plant biomass (Aleric and Kirkman 2005). While pondberry exhibits the capacity to acclimate to a variety of light conditions, studies in both natural and experiment settings suggest that plant survival and growth may be highest at low to moderate light levels (Aleric and Kirkman 2005; Lockhart et al. 2012; Lockhart et al. 2013).

Pondberry stems flower in the second to fourth year of growth. Stems continue to grow in subsequent years but usually die by the sixth or seventh year. Young stems replace the dead stems at the base. Clones expand vegetatively via underground rhizomes, eventually consisting of many well-rooted stems. Thus, a mature colony usually consists of numerous dead stems along with younger leafy ones. Many populations consist predominantly of male plants. Evidence of seedling production or seedling establishment has rarely been observed in the wild (Tucker 1984; Service1993). Plants often occur in standing water in early spring, although these ponds are generally dry by April or May. Dormancy breaks with leaf expansion, which generally occurs in April, rather than at time of flowering (Robert Wright, University of Central Arkansas, *in litt.* 1989).

Asexual reproduction: Vegetative reproduction from rhizomes and sprouts frequently creates distinct colonial patches of plants. Vegetative propagation from rhizomes and basal stem sprouts creates genetically identical clones, and colonial patches of plants actually represent one or a few genetically distinct individuals. A genetically distinct individual plant, which is a genet, can consist of many separate clonal stems/shrubs (ramets) within a colony. Thus, the terms plant, stem, and shrub have been variously used in the literature with different and potentially confusing meanings depending on the context. Here, the term plant will be used to refer to an individual shrub, represented by a single rooted stem with lateral stems-branches, unless otherwise clarified in context to mean a genetically distinct individual.

Sexual reproduction: Flowers are obligately insect pollinated, and cross pollination between male and female plants may involve up to a dozen potential pollinators, the most likely of which are various syrphid flies and ground dwelling or nesting bees, including digger bees (*Anthophora ursina*, *Ceratina calcarata*) and mining bees (*Andrena pallidifovea, Andrena imitatrix*) (Devall et al. 2001; Devall et al. 2004). No pollinator studies have been conducted, and the pollinator effectiveness of these or other species is unknown. Male flowers tend to open before females (Devall et al. 2004). Pondberry flowers in early spring, as early as late February depending on weather, and flowers are subject to damage from late frosts (Tucker 1984; Devall et al. 2001). Seeds fully form within 90 days after flowering, and fruits reach maturity in July and August (Connor et al. 2006). Fruit production is erratic, although it can be abundant in good years (Morgan 1983; Wright 1989a; Wright 1989b; Devall et al. 2001). Poor fruit production at sites with few plants and colonies may be associated with uneven sex ratios, flowering asynchrony, or other factors that limit cross pollination (Wright 1989a; Wright 1989b; Wright 1994). Pondberry in South Carolina, in the Francis Marion National Forest and the Marine Corps Air Base Station has only rarely been observed to produce flowers (EuDaly 2005).

Mature fruits are a bright red, firm, somewhat fleshy, one-seeded drupe, held by a persistent pedicel to the stem. Red, fleshy drupes are usually consumed and dispersed by birds (Ridley 1930). Dispersal agents may also include mammals (Smith et al. 2004) and water (Middleton 2002). Dispersal mechanisms of pondberry remain poorly understood. Pondberry's bright red fruits suggest that animals may play an important role in the dispersal of the species (Service 1993; 2007; Smith et al. 2004). While numerous animals have been associated with pondberry plants (e.g., Smith et al. 2004; Abilio et al. 2008; Leininger et al. 2009), only the hermit thrush (*Catharus guttatus*) has been confirmed as a short-range dispersal agent of pondberry. Other, larger animals, such as black bears (*Ursus americanus*) have been proposed as potential long-range dispersal agents (Devall et al. 2004; Smith et al. 2004). Water has also been proposed as a potential dispersal agent of this species (e.g., Devall et al. 2001; Smith et al. 2004), but Hawkins et al. (2011) observed neither fruits nor seeds floating during flooding experiments and noted that water movement in pondberry habitats is limited.

Seedling recruitment has rarely been observed in the field (Wright 1989a, 1989b, 1990; Devall et al. 2001; Aleric and Kirkman 2005; Connor et al. 2006). However, Aleric and Kirkman (2005) have suggested that since pondberry seedlings do not possess distinctive cotyledons, seedlings may have been missed.

Habitat

Pondberry has been variously classified as an obligate (Reed 1988) and facultative (Lichvar 2013) wetland species, occurring in seasonally flooded wetlands of the Atlantic and Gulf Coastal Plain. These wetlands occur in at least five primary and distinctive hydrogeomorphic settings: Carolina bays, limestone or limesink ponds, sand ponds, lowland sand prairie depressions, and riverine bottomland hardwoods. With the exception of bottomland hardwood sites, the majority of sites are geographically isolated wetlands with precipitation as the primary source of hydrology, although some bays and limesinks may receive shallow groundwater (Schalles and Shure 1989; Lide et al. 1995; Chmielewski 1996). Carolina bays and limesinks have been collectively described with other seasonally inundated depressions in the southeastern United States as seasonally ponded, isolated wetlands and non-alluvial depression wetlands (e.g. Kirkman et al. 1999). Bays and limesinks as referenced here do not include Citronelle ponds and Grady ponds in Alabama and Mississippi. Extant pondberry sites in Carolina bays are in North Carolina and South Carolina; sites in limesink and related depressions are in South Carolina, Georgia, and Alabama; sand ponds are in Arkansas; sand prairie depressions are in southern Arkansas, and bottomland hardwoods in Arkansas and Mississippi. In bottomland hardwoods, the hydrology at pondberry sites is maintained by overbank flooding, local rainfall or storage in depressions or at sites with soils that impede drainage independent of overbank flooding, or a combination of the previous two factors. Atlantic or Gulf Coastal Plain depressions storing precipitation typically have subsurface soil or geological features that impede drainage.

Status and distribution

Alabama

Pondberry was rediscovered in Alabama at two sites in Covington County (Schotz 2005), which comprise two separate populations. About 350 plants occur in one pond, with swamp tupelo (*Nyssa biflora*), myrtle dahoon (*llex myrtifolia*), and red maple (*Acer rubrum*). Several thousand plants occur at one end of the other pond, where the other end recently was clearcut, bedded, and planted for pine production. Associated woody vegetation includes swamp tupelo, laurel oak (*Quercus laurifolia*), myrtle dahoon, and slash pine (*Pinus elliottii*). Both ponds/sites are owned by a timber company, and at least one site is threatened by continued conversion to intensive pine plantation management (Service 2014).

Arkansas

Currently, Arkansas has approximately 17 populations in eight counties. These counties include Clay (3), Craighead and Poinsett (1; extending across the county boundary), Crittenden (1), Jackson (9), Lawrence (2), and Woodruff (1). Three of these populations are protected or partially protected on State-owned lands (Service 2014). One of Arkansas' pondberry populations extends across the State line into Missouri.

Florida

Pondberry is known historically from Florida only from collections by A.J. Chapman made in the mid-1880s. No specific locality information occurs on the specimens (Tucker 1984).

Georgia

Information from Carter (2010) and Patrick (2012, *in litt.*) indicate that Georgia supports approximately 13 extant pondberry populations in seven counties: Baker (2), Calhoun (3), Effingham (1), Miller (2), Taylor (1), Wheeler (2), and Worth (2). Combined, these populations represent at least 7,200 ramets/stems (Carter 2010).

Louisiana

Pondberry is historically known from Louisiana. Recent searches have failed to locate pondberry populations within the State (e.g., Gulf Coast Biological Surveys, Inc. 2003).

Mississippi

Sixteen extant pondberry populations, estimated to total at least 44,000 stems/plants (Service 2007), occur in Mississippi, all of which are associated with bottomland hardwood forests within the Mississippi Alluvial Valley. Extensive searches by U.S. Forest Service personnel and affiliates have located a number of colonies of pondberry within the Delta National Forest in Sharkey County. Together, these Delta National Forest plants/colonies account for 13 of the State's pondberry populations and Service (2007) estimated at least 35,000 stems/plants (Service 2014).

Missouri

Missouri has one population along the Arkansas–Missouri State border in Ripley County. Part of these plants/colonies in Missouri occur on Sand Ponds Natural Area, which is owned and managed by the Missouri Department of Conservation (Service 2007), while The Nature Conservancy owns adjacent land with additional plants/colonies (Service 2014). This population extends into Arkansas.

North Carolina

North Carolina has two extant pondberry populations in Cumberland and Sampson Counties, both of which are protected by the State (Service 2014).

South Carolina

Currently, 13 extant pondberry populations are known to occur in South Carolina. Two pondberry populations occur on the U.S. Department of Energy's Savannah River Site in Aiken County. Beaufort County's two populations are located on the U.S. Marine Corps Air Base (1) and on privately owned land (1). Berkley County has five pondberry populations, all of which are on the Francis Marion National Forest. Dorchester County has one population on privately owned land. Marion County has three populations, all of which are on the Woodbury Heritage Preserve. Stem counts and estimates indicate that South Carolina's statewide population is at least 72,000 plants/stems (Service 2007; South Carolina Heritage Trust 2011, 2012).

Marion County's three pondberry populations were recently discovered in 2009-2012 on the Woodbury Heritage Preserve and are associated with depressional ponds and swamp forests. The Preserve is part of the greater Woodbury Wilderness Management Area and is owned and managed by South Carolina's Department of Natural Resources (Service 2014). Pondberry receives conservation considerations under sections 7 and 9 of the Endangered Species Act and resource management plans in Francis Marion National Forest, the Marine Corps Air Station, and the Savannah River Site (U.S. Department of Energy 2005; Service 2007).

Reason for listing

Due to population decline from habitat alteration and destruction, pondberry was officially listed as endangered under the Endangered Species Act of 1973 on July 31, 1986. Reasons for decline included habitat alteration and destruction through land-clearing, drainage modification, or timber harvesting.

Range-wide trends

The range-wide trend for pondberry is stable to declining. Populations in Alabama, Missouri, and North Carolina are likely stable. Most populations in South Carolina are located on State- or federally-owned lands and, while some populations are declining, recent searches have located additional populations on State and Federal lands. Recent surveys in Georgia have been unable to relocate three populations and their current status is unknown. Continued searches in

Arkansas have identified one new population and increased the known area occupied by pondberry in another population; however, clearing and logging activities have extirpated five populations and reduced the size of four others. In Mississippi, there is no monitoring data for recent years, but previous monitoring data indicate an overall decline, while conditions at many sites are unchanged. Further monitoring is needed at sites range-wide (Service 2014).

Conservation needs

1. Define what characterizes a “self-sustaining” pondberry population.

2. Work with Federal and State entities, non-governmental organizations, and private individuals to permanently protect and manage existing habitats and populations, including the development and implementation of management plans, as needed.

3. Characterize potential threats posed by laurel wilt disease. Identify methods and management practices to limit this disease’s potential to negatively impact pondberry and its associated habitats.

4. Study the feasibility of and necessary methodology to augment genetically depauperate and sexually limited populations.

5. Develop guidelines to efficiently establish plants and seedlings in natural habitats.

Threats and habitat modification/destruction

Habitat destruction, fragmentation, altered hydrology, and encroaching vegetation remain persistent threats to pondberry colonies and populations. Geographically isolated wetlands that once sustained pondberry have been cleared for agriculture or timber operations. Similarly, agricultural and silvicultural activities adjacent to some pondberry sites have deleteriously affected these sites by altering hydrological regimes. Other sites have been extirpated by or are threatened by hogs or domestic cattle. Encroaching vegetation can reduce the suitability of some sites for pondberry.

Small populations especially those with many fewer genets (genetically distinct individuals) than ramets (clonal stems) fragmentation, and strongly biased sex ratios may increase the likelihood of developing inbreeding depression and reduce the ability of many populations to adapt to changing environments. This is particularly likely for small, isolated populations in the eastern portion of pondberry’ s range. The lethal laurel wilt disease is an emerging threat to pondberry (Service 2014).

Climate Change

Climate change has the potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, and myriad plant physiological responses (Hawkins et al. 2008). The specific impacts of climate change to

pondberry populations are poorly understood; however, a variety of impacts are possible. For example, climate change may threaten pondberry populations if the wetland habitats that the species relies on become drier (Devall 2009). Service (2007) noted that pondberry is susceptible to decline during drought cycles, especially in geographically isolated wetlands, such as Carolina bays, limesinks, and related depressions in the Atlantic Coastal Plain, and the sand ponds of Arkansas and Missouri where the hydrology depends most directly on rainfall. In bottomland hardwood systems in Mississippi and Arkansas, the frequency and duration of overbank flooding at pondberry sites and populations also can vary depending on climatic conditions within local watersheds as well as regional climatic conditions in the Mississippi Valley (Service 2007). Additionally, climate change may exacerbate the spread of infectious diseases among plants, particularly if arthropod vectors become more widespread and abundant (Anderson et al. 2004; Garrett et al. 2006; Hawkins et al. 2008). Given the variety and complexity of climate change's potential effects (Hawkins et al. 2008), more research is needed to assess its potential long-term impacts on pondberry populations and habitats (Service 2014).

Recovery Criteria

Recovery criterion for downlisting pondberry to threatened is the protection of 15 self-sustaining populations. The criterion for delisting is the permanent protection of 25 self-sustaining populations. Furthermore, determining what constitutes a self-sustaining population and what geographical distribution of populations is required to ensure the long-term survival of the species were listed recovery tasks. These criteria have not been met (Service 2014).

Red-cockaded woodpecker *(Picoides borealis)*

Species/critical habitat

The Service identified the red-cockaded woodpecker (RCW) as a rare and endangered species in 1968 and officially listed it as endangered in 1970 (Federal Register 35:16047). No critical habitat has been designated for the RCW. A complete discussion of the status of the species in South Carolina and throughout its range can be found in the Service's Revised Recovery Plan (Recovery Plan, Service 2003). In addition, a 5-year review found no change to the status of the species (Service 2006). These documents are incorporated here by reference.

Life history

The RCW has an advanced social system that revolves around family groups. A typical RCW group includes one pair of breeding birds, the current year's offspring (if any), and zero to four "helpers". Helpers are usually male offspring from previous breeding seasons that assist the breeding pair by incubating eggs, feeding the young, excavating cavities, and defending the territory (Ligon 1970; Lennartz and Harlow 1979; Lennartz et al. 1987; Walters et al. 1988). The RCW nesting season occurs from April to July. Incubation lasts approximately 9-10 days, and the young fledge 24- 26 days after hatching. Some juvenile males disperse from their natal territory prior to the next breeding season in an attempt to find vacant territories, or to establish their own (Hooper et al. 1980; Recovery Plan Service

2003). Others may remain and become helpers during subsequent nesting seasons. Most juvenile females disperse after fledging, although some may remain with the group as helpers (Walters et al. 1988). The average dispersal distance of fledgling males and females is about three miles (Walters 1991; Letcher et al. 1998). RCWs exhibit relatively low adult mortality rates; annual survivorship of breeding males and females is high, ranging from 72 to 84 percent and 51 to 81 percent, respectively (Lennartz and Heckel 1987; Walters et al. 1988; DeLotelle and Epting 1992). In North Carolina, survival rates of RCWs fall to around 50% beginning at age 9 in females and age 11 in males (Walters et al. 1988).

Each group of RCWs occupies a discrete territory consisting of its cavity trees, called a "cluster", and adjacent foraging habitat (Walters 1990). The RCW requires mature (usually 60 or more years old) live pine trees to excavate its nesting and roosting cavities. The cavity trees are essential to the RCW because they provide shelter and a place to nest and raise young (Ligon 1970). A typical cluster contains 1-20 cavity trees, and the breeding male usually chooses the best, most recently excavated natural cavity as the nest tree, or selects cavity trees with higher resin yields (Conner and Rudolph 1989). Such cavity trees may enhance the survival of the nestlings by decreasing the parasite load of nestlings and incubating adults, and providing a resin barrier to reduce snake or other predation.

Once established, clusters are often utilized for many consecutive years or even decades, largely passed down from one generation to the next (Walters 1990). Hardwood encroachment into the midstory lessens the habitat quality, eventually leading to cavity abandonment when the hardwood midstory reaches cavity height (Conner and O'Halloran 1987; Costa and Escano 1989). Cluster abandonment may also occur as a result of displacement by competing cavity dwellers, or meteorological events such as hurricanes (Conner and O'Halloran 1987).

Population dynamics

The recovery of the RCW is directly linked to the viability of discrete populations within selected southeastern States (Service 2003). Populations required for recovery are distributed among 11 recovery units based on physiographic region to ensure the representation of broad geographic and genetic variation in the species. Viable populations within each recovery unit, to the extent allowed by habitat limitations, are essential to recovery of the species as a whole. Until the 1990s, most RCW populations were considered stable at best, or declining. However, RCW population trends since the early 1990s are improving, with an estimated 6,105 active RCW clusters range-wide (Service 2006). The species will be considered recovered and removed from the Endangered Species list when five criteria are met. The criteria establish a tier of populations within the 11 recovery units that contain sufficient suitable nesting and foraging habitat and are not dependent on the installation of artificial cavities to remain stable.

Long-term viability of an RCW population, in genetic terms, depends on the presence of an adequate number of breeding individuals for the natural processes that increase genetic variability (e.g., mutation and recombination) to offset the natural processes that decrease genetic variability (e.g., genetic drift and inbreeding). Additionally, any prediction of a

population's viability should also consider the population's ability to survive population fluctuations due to demographic and environmental fluctuations (Koenig 1988) or natural catastrophes.

Reproductive rates, population density, and recolonization rates may influence RCW population variability more than mortality rates, sex ratios, and genetic viability. Therefore, dispersal of adult birds to assume breeding roles in vacant clusters is essential for population persistence (Daniels et al. 2000; Schiegg et al. 2002).

Although the relationship between RCW population variability and density is not well understood, recent studies indicate spatial distribution of territories is important in long-term population stability. Conner and Rudolph (1991) found that, in sparse populations, RCW group size and the number of active clusters decreased as fragmentation increased. Hooper and Lennartz (1995) suggested that populations with less than 4.7 active clusters within 1.25 miles on average had critically low densities that inhibited population expansion. Results from a spatially explicit simulation model of RCW population dynamics suggest that population growth rate may depend more on the number and spatial distribution of territories, than on the initial composition of the population (Letcher et al. 1998). Achieving a self-sustaining population required fivefold more territories when territories were randomly spaced than when they were maximally clumped, and populations with as few as 49 territories were stable when those territories were highly aggregated. Populations of more maximally aggregated groups are likely to persist over the short term (i.e., 20 years) (Crowder et al. 1998).

Natural population growth (i.e., without recruitment clusters) occurs at extremely low rates (one to two percent per year) in this species (Walters 1991), and the availability of cavity trees is limiting (Copeyon 1990; Allen 1991). New groups or new territories arise by two processes, pioneering and budding (Hooper 1983). Pioneering is the occupation of vacant habitat by construction of a new cavity tree cluster and is relatively rare. Budding is the splitting of a territory, and the cavity tree cluster within it, into two. Budding is more common than pioneering in RCWs, since the new territory contains cavities from the outset (Recovery Plan, Service 2003).

Inactive clusters are important to maintaining extant populations of RCWs and may provide a short-term opportunity to enhance habitat available to RCWs, and thus increase the number of groups in populations (Doerr et al. 1989). After a territory is abandoned for two or more years, it is almost never reoccupied. This abandonment is typically because cavities are unsuitable due to deterioration or hardwood encroachment (Beckett 1971; Conner and Locke 1982; Copeyon et al. 1991).

The technology to induce new territories at desired locations exists and management for optimum territory clumping is, therefore, possible (Letcher et al. 1998). Artificial cavities can be installed in unoccupied habitat that is otherwise suitable (Copeyon 1990; Allen 1991), and these cavities typically become subsequently occupied by dispersing subadult birds (Carrie et al. l999; Conner et al. 1999). Adding artificial cavities to sites already occupied increases group size (Carrie et al. 1999). Artificial cavities provide additional

roosting opportunities for subadult males, encouraging them to remain in their natal clusters and potentially inherit the territory (Carrie et al. 1999). Females may also benefit when additional cavities are provided because they are the most subordinate members of the RCW social group, and therefore, may not always be able to secure adequate roost cavities.

Inducing the formation of RCW groups in restored habitat with artificial cavities is an established and successful technique (Copeyon et al. 1991; Walters et al. 1992; Gaines et al. 1995; Watson et al. 1995). Within one year of restoring habitat and providing artificial cavities at 20 unoccupied territories in the Sandhills of North Carolina, 90 percent of the sites were occupied by RCWs (Copeyon et al. 1991). Translocating RCWs is another method successfully used to establish new groups (Rudolph et al. 1992; Allen et al. 1993; Hess and Costa 1995; Costa and Kennedy 1994; Franzreb 1999). Translocation can include augmenting a solitary-bird group or translocating a pair of subadult RCWs [i.e., unrelated male and female (Costa and Kennedy 1994)]. Franzreb (1999) found that 63.2 percent of translocated birds (including adults and juveniles) remained at the release site for at least 30 days and 51.0 percent reproduced.

Status and distribution

The RCW was listed as endangered due to documented declines in local populations and massive reduction in foraging and nesting habitat. The life history of RCWs is closely tied to the occurrence of fire-maintained old growth pine forests that once dominated the southeastern United States. Only 3 million acres of longleaf pine forest remain of the estimated 60 to 92 million acres once in existence (Frost 1993). The history of timber harvesting for agriculture, short timber rotations, and the suppression of fire reduced the amount and quality of RCW foraging and nesting habitat.

At the time of listing, the total number of individuals had declined to less than 10,000 in widely scattered and isolated populations (Recovery Plan, Service 2003). Most RCW populations, regardless of location or land ownership, were considered stable at best, but more likely declining (Costa 1995). Costa and Escano (1989) documented RCW population declines in at least 10, and perhaps as many as 17 populations on National Forests. James (1995) estimated that the number of active clusters range-wide declined 23 percent between the early 1980s and 1990. Since the early 1990s, numerous RCW populations have increased, particularly on Federal lands, as a result of management activities.

In 2003, it was estimated that 14,068 RCWs inhabited 5,627 active clusters across 11 States in the southeast United States (Recovery Plan, Service 2003). National Forests, military installations, and National Wildlife Refuges contain the majority of extant populations and most of the habitat that is potentially suitable for RCWs. Conservation of RCWs as a species will depend on prudent management of habitats on those Federal lands. National Forests support the majority of the core populations required for recovery of the species, and therefore, have a uniquely important role in the species' recovery. Prior to the 1980s, most populations on National Forests were declining, but management efforts during the past several decades, especially prescribed burning and cavity management, stabilized most of those populations and led to increases in some (Recovery Plan, Service 2003). As of

January 2006, 6,105 active clusters across 11 States were reported (Service 2006). Recovery is progressing. Core populations are continuing to increase, and there have been substantial enrollment in the Safe Harbor program protecting RCWs on private lands.

Threats and habitat modification/destruction

A complete discussion of the threats to the RCW is contained in the Service's Recovery Plan (Recovery Plan, Service 2003, pages 140-161) and 5-year status review (Service 2006). A succinct summary from the 5-year review (Service 2006) states the primary threats to species viability for RCWs all have the same basic cause, lack of suitable habitat. These threats included: 1) insufficient numbers of cavities and continuing net loss of cavity trees, 2) habitat fragmentation and its effects on genetic variation, dispersal, and demography, and 3) lack of foraging habitat of adequate quality. Other associated threats to species viability for RCWs include range-wide population isolation, within population isolation (i.e., isolation of clusters), and genetic and demographic threats to viability inherent to small populations discussed above.

Climate change

The varying and dynamic elements of climate change are inherently long term, complex and interrelated. Although we may anticipate the direction of change it may not be possible to predict precise timing or magnitude. These impacts may take place gradually or episodically in major leaps.

According to the Intergovernmental Panel on Climate Change Reports (IPCC 2007, 2013), warming of the earth's climate is "unequivocal," as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The IPCC Report (2007) describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds.

Scientific evidence indicates a rapid and abrupt climate change, rather than the gradual changes that have been currently forecasted (IPCC Report 2007), posing a significant challenge for fish, wildlife, and plant conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Service will incorporate potential climate change effects as part of their long-range planning activities (Service 2009a; 2009b).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and by local effects (e.g., elevation, topography, latitude, proximity to the ocean). Temperatures are predicted to rise from 2°C to 5°C for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing, and distribution), storms (frequency and intensity), and sea level. The 2007 IPCC report found a 90 percent probability of 7 to 23 inches of sea level rise by 2100. The exact magnitude, direction, and

distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current models project a wide range of regional changes, but generally project the interior southeast to be drier and coastal areas to be wetter.

Significant threats to RCW populations that may be exacerbated by climate change are increased numbers and intensity of hurricanes (Emanuel 2005; Webster et al. 2005) and increased episodes and duration of drought events. Drought events can increase the likelihood of insect outbreaks (i.e. southern pine beetle). Hurricanes can significantly reduce a RCW population by impacts to cavity trees, and by damage to forest stability and structure, both important to RCWs that may require years to recover.

Recovery criteria

Recovery criteria identified as necessary to remove the RCW from ESA protection are found in the Recovery Plan (Service 2003, pages 140-161) and 5-year review (Service 2006). Pertinent to this proposed action, Criterion 1 within the Recovery Plan (Service 2003) requires that 12 populations of RCWs each contain at least 350 PBGs, and one population to contain 1000 PBGs from among 13 designated primary core populations. Also, each of these 13 populations is not to be dependent on continuing installation of artificial cavities to remain at or above this population size.

Summarizing from the Recovery Plan (Service 2003), research has expanded our understanding of the foraging ecology of RCWs considerably but not perfectly (as described above). The Recovery Plan provides two sets of guidelines for the management of foraging habitat: 1) the recovery standard; and 2) the standard for managed stability. The recovery standard (see pages 188-189 in Recovery Plan) defines "good quality foraging habitat" and is a description of the desired future condition of RCW foraging habitat on any properties involved in species recovery. Many RCW territories do not currently meet this standard. The recovery standard, when applied forest-wide, will provide the landscape that is considered necessary to achieve recovery within individual populations. The recovery standard, however, is not used to evaluate the anticipated level of incidental take related to project impacts on foraging habitat.

The managed stability standard (see pages 292-294, Appendix 5 in the Recovery Plan) is to be used for instances in which a landowner cannot manage to the recovery standard and defines the minimum foraging habitat requirements considered necessary to avoid foraging habitat-related incidental take (Service Memo; May 2005). That is, it identifies the quantity and quality of foraging habitat necessary for a breeding group to (a) survive and (b) reproduce, based on foraging habitat alone. Wide-scale (population or property-level) implementation or application of the managed stability standard will not allow us to achieve recovery of the species because it will fail, over the long term, to: 1) ensure adequate nesting habitat or good quality foraging habitat, 2) prevent population fragmentation with subsequent problems related to demographic stochasticity and perhaps genetic variability, and 3) support a population's long-term survival or ability to achieve

recovery.

Summary

The analysis of effects in the BA is a programmatic assessment of proposed actions that affect RCWs as a consequence of the management of loblolly pine with even-aged silvilculture in MA 2, restoration of wet savanna-flatwoods MA 1, and restoration and management of upland longleaf pine in MA 1. These actions primarily involve timber harvest with associated mechanical operations and prescribed fire to achieve certain desired conditions as described in the Plan and BA for ecosystems. The operations to achieve or sustain desired ecosystem and other conditions are regulated by standards and guidelines. Standards are "mandatory and violation requires an elevated level of review" and guidelines may include deviations "with appropriate documentation and analysis justifying the deviation" (BA p. 25). Standards and guidelines for activities do not explicitly prohibit those that may affect or may likely adversely affect the RCW. Thus, the BA evaluates how three primary factors affect the RCW due to timber harvests and silviculture by a coarse filter method using RCW foraging habitat analysis (FHA), the operation of mechanical equipment within RCW cluster polygons during the breeding season, and prescribed fire to achieve management objectives in MA 2, and to sustain and restore wet savannas-flatwoods and upland longleaf pine in MA 1.

The analysis estimated maximum potential effects to RCWs on an average annual interval in terms of number of individual RCW groups or clusters. At the Francis Marion RCW population level, these individual and project-level effects were synthesized and assembled in a future model of annual time-series (2016 – 2031) RCW population abundance (active clusters) as a consequence of individual affects and natural population growth. The BA model predicts the RCW population will increase from 477 currently active clusters to 497 in the future as a result of maximum annual adverse project impacts compensated by natural growth rates. Although Francis Marion may not actually implement future projects at a maximum effect level due to project-level decisions or operational resources, the BA approach is a programmatically appropriate, although challenging, strategy to integrate estimates of maximum effects to individual RCW clusters and the population.

As evaluated here, the BA model of future Francis Marion RCW growth rates and future population size is sensitive to the past time-series used to compute growth rates, the source of data for past time-series, the population growth rate parameter and method of calculation, annual variation in growth rates, and estimates of maximum annual number of RCW clusters affected. For comparison to the BA model, these factors were included and evaluated in several different RCW population growth models while incorporating the maximum number of adversely affected clusters according to the BA method. Results of the Service's analysis indicated that the BA prediction of an increasing RCW population during the project period is uncertain under a maximum effects scenario and the future population may actually decline under certain conditions.

The Service and the Forest Service discussed and further considered these factors during consultation. In response, the Forest Service has modified the proposed action to regulate the future amount and extent of adverse effects to sustain a RCW population of at least 400 active clusters. Capping the amount and extent of incidental take to sustain 400 active clusters also will

continue to support the designated Francis Marion Primary Core recovery population at or above the recovery population size objective of 350 potential breeding groups (PBGs). On average, 96 percent of the active clusters at Francis Marion are occupied by PBGs. Thus, a minimum population of 400 active clusters will support on average 384 PBGs.

ENVIRONMENTAL BASELINE

American chaffseed (*Schwalbea americana*)

Status of the species within the action area

Within the action area, there are four extant American chaffseed populations and five historic populations (Cordesville, Highway 41, Harleston Dam, Ballfield, and Mill Creek). The status of American chaffseed within the action area has substantially decreased since 1999 (Table 4). In 1999, there were seven extant American chaffseed populations. Currently, there are only four extant American chaffseed populations and only two of these are stable (Halfway Creek Road and Witherbee Road) (Table 4). Unfortunately, five American chaffseed populations have been extirpated in the action area. Since American chaffseed cannot reproduce asexually and does not have vegetative storage organs and seeds need bare soil to germinate, small populations cannot persist without active management. Thus, populations that are left alone and not managed with prescribed fire are essentially on the path of local extinction or extirpation.

American chaffseed populations on the Francis Marion National Forest

Lethcoe Road Population

In 2016, the Lethcoe Road population had 22 individuals and none were flowering. In addition, the American chaffseed individuals appeared very unhealthy (i.e., hardly any leaves and small in stature). As such, individuals were hard to locate during May field surveys due to the lack of leaves (April Punsalan, personal observations, 2016). Without immediate active management (i.e., prescribed fire annually or an on 2-year interval), the Lethcoe population may be extirpated in the near future (10-15 years).

French Quarter Creek Road Population

In 2016, the French Quarter Creek Road population had only four original individuals and seven planted individuals (propagule source: Longlands Plantation, Williamsburg County) (Table 4). Five individuals flowered in 2016.

Halfway Creek Road Population

The Halfway Creek Road population is the largest, healthiest (i.e., number of individuals and number of flowering individuals) population within the action area. The population numbers have increased since 1999, from 364 to 920 individuals (Table 4). This population contains the greatest genetic diversity for this species' range-wide (Godt and Hamrick 1998). This site occurs in close proximity to a wetland depression and may have more moisture availability in comparison with the other sites in the action area.

Witherbee Road Population

The Witherbee Road population numbers have decreased overtime, from 467 to 223 individuals (Table 4). This population is still large enough to persist if management practices such as prescribed fire are implemented on a regular basis. This site may be more susceptible to potential negative impacts associated with climate change such as drought because it does not occur in an ecotonal area between a depressional wetland and uplands like the Half Way Creek Road population.

Harleston Dam Road Population

This population was last observed in May 1979. In 2015, Jeff Glitzenstein reintroduced 236 American chaffseed propagules (129 propagules from the Half Way Creek Road source; 107 propagules from Longlands Plantation). In 2016, 25 individuals survived the outplanting (Table 4). No individuals were flowering in 2016.

Table 4: American chaffseed (*Schwalbea americana*) monitoring trends from 1999-2016, Francis Marion National Forest. Data and table prepared by Robin Mackie, Forest Botanist/Ecologist, Francis Marion National Forest. Monitoring conducted by Jeff Glitzenstein[1], Donna Streng[2], Danny Carlson[3], Robin Mackie[4], Mark Danaher[5], and Ricky Wrenn[6]

Population	**1999**[1,2]	**2001**[1,2]	**2004**[1,2]	**2008**[1,3,4]	**2010**[1,3,4]	**2012**[4,5,6]	**2013**[1]	**2014**[3,5,6]	**2016**
C.115 - Hwy. 41	**3**	**3**[2,3,4]	**3**	**0**[4]	**0**	**0**	**0**	**0**	**0**
C.192 - Ballfield	**9**	**4**[3,4]	**2**	**0**[4]	**0**	**0**	**0**	**0**	**0**
C.107 - French Quarter Creek Rd	**47**	**21**[3,4]	**22**	**4**[4]	**2**	**3**	**4**	**4**	**4 original, 7 planted**
Harleston Dam	**0**	**NM**	**0**	**0**	**0**	**0**	**0**	**0**	**25 planted**
C.204 - Lethcoe Rd	**35**	**26**[3,4]	**64**	**33**[4]	**25**	**22**	**19**	**28**	**22**
C.196/205 – Halfway Creek Rd. All	**364**	**420**	**132**	**145**	**102**	**163**	**166**	**181**	**920**
C.80/C.87 Witherbee Rd. All	**467**	**770**	**581**	**298**	**276**	**366**	**300**	**238**	**223**
C.90 - Cordesville	**10**	**NM**	**1**	**0**[4]	**0**	**0**	**0**	**0**	**0**
TOTAL	**935**	**1244**	**842**	**499**	**405**	**554**	**489**	**451**	**1202**

NM=Not Monitored, Jeff Glitzenstein, 2016

Canby's dropwort (*Oxypolis canbyi*)

Status of the species within the action area

There is only one historic location of Canby's dropwort on the Francis Marion National Forest in Tibwin Bay. This population was located in 2000 and at the time of discovery contained 10 stems. In 2016, no individuals were relocated (April Punsalan, personal observations, 2016). There were approximately 10-15 stems of water cowbane (*Oxypolis filiformis*) growing along the margin of the bay (April Punsalan 2016, personal observations). Water cowbane looks very similar to Canby's dropwort. A voucher specimen was not made at the time Canby's dropwort was confirmed at Tibwin Bay. Canby's dropwort is primarily an inner coastal plain species. Tibwin Bay occurs in the outer coastal plain and has more organic matter in comparison with other bays inhabited by Canby's dropwort (Chick Gaddy, Terra Incognita, pers. comm. 2016). Thus, further investigations and discussions should be made about the validity of Canby's dropwort occurring on the forest. *Oxypolis* species occurring on the forest should be collected, vouchered, and examined by an expert for identification.

Frosted flatwoods salamander (*Ambystoma cingulatum)*

Status of the Species within the action area

Within the action area of the forest plan, there are approximately 1,300 acres of designated critical habitat for frosted flatwoods salamander, 1,175 of which are located on the Francis Marion within the Wando Resource Integration Zone. The designated critical habitat, which lies along Hoover and Brick Church roads, currently contains six historical frosted flatwoods salamander ponds. The breeding ponds within the Francis Marion have been altered due to lack of fire and previous land management practices such as silviculture site preparation causing modification in hydrology.

Infrequent observations have been made in the Francis Marion for frosted flatwoods salamanders since the early 1950's. Only eight adults and approximately 12 larvae have been captured on the Francis Marion in the past 20 years (Harrison 2004; Harrison 2005; Palis 2009; Palis 2001). During the last 30 years, observations were made by Moulis and Seyle (1987) and Moulis and Williamson (1998). John Fauth captured four adults in October 1995 and a single larvae in 2003 (Harrison 2003), William Resetarits encountered an adult on Hoover Road in June 1997 (internal Forest Service documentation, BA, page 37) and a single adult was captured in Hoover Pond in 2002 (Harrison 2003). Unsuccessful surveys for frosted flatwoods salamanders on Francis Marion were conducted by Forest Service employees (1991), Bennett (1995), Humphries (2000), Harrison (2001), Waldron (2001), Harrison (2003) and Palis (2009). The species was documented on the forest in 2010 (Palis 2010) near Powerline Road, in the northeastern area of the critical habitat. That same wetland failed to yield larvae in 2015 or 2016 following four consecutive years (2011-2014) of winter drought (Palis 2015; Palis 2016).

Pondberry (*Lindera melissifolia*)

Status of the species within the action area

There are five extant pondberry populations across the forest: Hoover Road/Brickchurch Road, Conifer Road, Whiddon Bay, Honey Hill, and Echaw Road populations. No pondberry populations have been extirpated. New populations have been discovered across the forest over the years in ponds near extant populations. Currently, there are 24 sites or subpopulations that represent the five populations. The 1994-2016 monitoring trends demonstrate that pondberry has remained stable across the forest.

Honey Hill Population

Honey Hill supports the largest pondberry populations on the forest. There are two large colonies that have approximately up to 1000 stems. A road intersects this population. On the east side of the road the population is stable to increasing from recent collaborative restoration efforts. Currently, the west side of the road appears to be declining (J. Glitzenstein, Tall Timbers, pers. comm. 2016).

Echaw Road Population

The Echaw Road population is the smallest on the forest and only has 10-20 small stems. In addition, the site was augmented with a pondberry propagule source from Georgetown County (J. Glitzenstein, Tall Timbers, pers. comm. 2016).

Whiddon Bay

The Whiddon Bay population has approximately 1000-2000 stems. This population appears to be declining due to recent fires (J. Glitzenstein, Tall Timbers, pers. comm. 2016).

Hoover Road/Brick Church Road Population

This population has approximately 150 stems and occurs in two ponds. One pond has undergone succession and loblolly encroachment may have caused a decline in the number of pondberry individuals (J. Glitzenstein, Tall Timbers, pers. comm. 2016).

Red-cockaded woodpecker (*Picoides borealis*)

Status of the species within the action area

The Francis Marion supports the third largest population of the federally endangered RCW in the U.S. and is one of 13 designated core recovery populations. Prior to Hurricane Hugo in 1989, the RCW population consisted of approximately 477 groups and was one of the only known naturally expanding populations. In one night, Hurricane Hugo killed an estimated 63 percent of the RCW population, destroyed 87 percent of the cavity trees and 59 percent of the foraging habitat across the Francis Marion (Hooper et al. 1990; Hooper et al. 1991). Due to extensive

habitat management and installation of more than 2,800 artificial cavities, the RCW population has rebounded to approximately 477 active clusters including 460 breeding groups, and 4,596 cavity trees in active foraging partitions.

EFFECTS OF THE ACTION

American chaffseed (*Schwalbea americana*)

Effects of the Forest Plan Objectives and Management Strategies

Threatened and Endangered Plant Species (OBJ-T&E-3)

The Forest Plan aims to provide the ecological conditions to restore and maintain nine stable to increasing American chaffseed populations. The use of frequent prescribed fire, open canopies, and population enhancement will be used to maintain the two stable populations remaining on the Francis Marion, ensure that the two small, declining populations (Lethcoe Road, French Quarter Creek Road) do not become extirpated, and restore and/or reintroduce five populations to return to historic levels of American chaffseed on the forest. The Forest Plan directs that the Recovery Plans for listed species, including American chaffseed, be implemented. The Forest Plan also ensures that partnerships will continue by directing cooperation and coordination with responsible government and land resource management agencies regarding federally listed species. Overall, we believe that the Forest Plan objectives, management strategies, and desired ecological conditions of the Forest Plan are consistent with the ecological needs of American chaffseed, most importantly the 1-3 year prescribed fire return interval.

Effects of the specific management actions

Prescribed Fire (OBJ-ECO-2)

Literature Review on the effects of fire on American chaffseed

American chaffseed is a high fire frequency indicator species that occurs in habitats that were the most fire exposed in the presettlement landscape. In addition, American chaffseed occurs in the highest fire frequency band of the southern United States (Frost and Wilds 2005). American chaffseed represents a small percentage of high fire frequency indicator species that need nearly an annual fire regime (Frost and Wilds 2005). Thus, it is not a surprise or coincidence that some of the largest and most stable American chaffseed populations occur on quail plantations that are burned annually (J. Glitzenstein, Tall Timbers, pers. comm. 2016). The estimated historic range mean fire interval for American chaffseed is 1.5 years (Frost and Wilds 2005). According to Frost and Wilds (2005), the peak fire season was when fires traveled the furthest and burned the greatest area due to the availability of large amounts of dry, winter-dead fine fuel. The peak fire season was likely February-March for south Florida and March and early April for mid-Atlantic coastal plain. More importantly in regards to the recovery of American chaffseed, in presettlement times, a second fire season was carried out by Native Americans annually in the fall (Frost and Wilds 2005).

Annual fall fires across American chaffseed populations on the Francis Marion would increase the stability and size of populations by reducing woody competition, stimulating flower production, and possibly creating soil disturbance for seedling recruitment the following growing season. Research has demonstrated that fire will increase the flowering response for American chaffseed populations the year in which the burn occurred (Kirkman et al. 1998, pg. 124). One American chaffseed population on the Francis Marion bloomed twice in one year due to a late summer burn (J. Glitzenstein, Tall Timbers, pers. comm. 2016). American chaffseed populations, post 6-8 weeks of prescribed fire, have flowered twice per year (J. Gray, Department of Defense, Fort Bragg, pers. comm. 2016).

Small American chaffseed seeds need bare mineral soil to germinate (Service 2008). Research conducted on seedling recruitment in response to fire and soil disturbance, demonstrated that the greatest seedling emergence occurred for plots receiving the highest amount of soil disturbance (Van Clef 2000). On the Francis Marion, many American chaffseed individuals are growing along old road beds or firebreaks, suggesting that soil disturbance provided a seedbed for germination and subsequent seedling recruitment (April Punsalan, personal observations, 2016).

In MA 1, the Francis Marion plans to apply frequent prescribed fire for ecosystem maintenance or restoration on at least 30,000 acres per year to maintain or restore fire-adapted ecosystems including longleaf pine woodlands, savannas and flatwoods, and Carolina bays and depression ponds. In addition, at least 4,500 acres of those 30,000 acres will be growing season burns (April 1-September 30) annually. If the Francis Marion applies prescribed fire on 30,000 acres across the ecosystems identified as fire-adapted (Table 2), approximately 30% of the fire-adapted ecosystems (30,000/98,000) will be burned annually. In addition, only 4,500 acres would be growing season burns across 98,000 acres (Upland Longleaf Pine, Wet Pine Savannas, and Depressional Wetlands), which means only five percent of the fire-adapted ecosystems would receive a growing season fire. The management strategy for the prescribed fire-base level is based on the current prescribed burning program. Ninety percent of the fire-adapted ecosystems will be burned on a 3-year rotation. Ten percent of the fire-adapted ecosystems will not get burned on the 3-year return interval.

The management strategy for the prescribed fire-base level is based on the current prescribed burning program. The 1996-2012 prescribed fire trends for American chaffseed populations across the Francis Marion show an average fire return interval of 4.5 years for seven populations/16 sites (Table 5). The French Quarter Creek Road population, a very small declining, nearly extirpated (only four remaining individuals) American chaffseed population was not burned from 1996-2002 (five years). In addition, from 1996-2008, the population was only burned once. In 2008, there were only four individuals remaining. Similarly, the Lethcoe population has declined overtime and currently only contains 24 individuals. This population has experienced fire suppression or lack of prescribed fire for greater than four years twice from 1996-2016, going without fire from 2006-2010 and then again from 2013-2016. After analyzing the Francis Marion burn history and monitoring data, there appears to be a direct correlation between lack of fire and declining American chaffseed populations on the Francis Marion.

Since American chaffseed is a high fire frequency indicator species needing fire return intervals on an average of 1.5 years, for the prescribed fire objective (OBJ-ECO-2) to have a beneficial

effect or a positive response without a negative impact, American chaffseed populations will have to be prioritized within the 30,000 acre annual fire prescription goal. Thus, the Francis Marion should prioritize the 30,000 acres across fire-adapted ecosystems to ensure that habitats containing high frequency indicator species such as American chaffseed are burned first rather than less fire-adapted ecosystems or areas not containing high frequency fire indicator species. If American chaffseed populations cannot be burned on a 1-3 year, preferably 2-year interval, the Service recommends collaborative Stewardship opportunities be implemented (e.g., interagency burn team, Wyden Agreement) to ensure American chaffseed populations on the Francis Marion remain extant and expand rather than become extirpated.

The Forest Plan states that within three years of plan approval, the goal would be to increase the amount of prescribed fire by 20,000 acres per year for a total of 50,000 acres per year. Under this fire management regime, approximately 50% of the fire-adapted ecosystems would get burned per year. The burn program would need to have an annual 50,000 acre prescription across the ecosystems identified as fire-adapted to maintain stable to increasing populations of American chaffseed. If the forest cannot burn 50,000 acres per year or does not prioritize the 30,000 acres per year to include American chaffseed populations, then American chaffseed will be directly affected by loss of suitable habitat and the small populations (French Quarter Creek Road and Lethcoe Population) will likely be extirpated. *American chaffseed* populations across Fort Bragg that receive fire on 2-year intervals have remained extant since identified by the Nature Conservancy in 1993 (J. Gray, Department of Defense, Fort Bragg, pers. comm.). In addition, one population that was identified in 1993 only had one individual, after 10 years of a 2-year fire return interval, the population increased to 70 individuals. Some of the largest and few remaining American chaffseed populations across this species' range occur on quail plantations that are burned annually. Hence, small American chaffseed populations on the Francis Marion, i.e., Lethcoe and French Quarter Creek, should be burned annually for several years and then return to a 2-year fire return interval to ensure they remain extant. Because the Endangered Species Act takes an ecosystem-based approach to recovery, reintroduction efforts should be second in priority with prescribed fire being the top priority for recovery efforts.

Overall, the desired conditions identified for American chaffseed in the Forest Plan include the maintenance of an open forest canopy with a diversity of native herbaceous species maintained with a low intensity, 1-3 year prescribed fire return interval. Based on this information, we expect beneficial effects for American chaffseed to occur across the forest from a reduction in woody encroachment, an increase in herbaceous diversity, increase in solar radiation, and an in soil disturbance or bare mineral soil from a 1-3 year fire return interval. The benefit or negative impact of effects will determine on timing of fire prescription, with early April fires potentially causing mortality of individuals and late summer or fall fires having more of a beneficial effect (i.e., increase in flower production). However, prescribed fires, regardless of season, would have an overall beneficial effect on American chaffseed. To maintain that interval under the current frequent prescribed fire forest objective, the forest will have to prioritize *American chaffseed* populations in the annual burn rotations or increase to the 50,000 acres per year quota.

In conclusion, American chaffseed populations occur in habitats that were the most fire exposed in the original landscape, with the reduction of fire comes the dense growth of graminoids, shrubs, and tree saplings. Because the fire return interval across the Francis Marion where

American chaffseed occurs is not occurring on a 1-3 year fire return interval, mean 1.5 year interval, plants have persisted without fire along roads in open areas maintained by mowing or other human disturbance. The Francis Marion contains the only American chaffseed populations on Federal property in South Carolina. In addition, plants do not receive protection off of Federal property. Moreover, South Carolina does not have a plant protection law. The Francis Marion, Halfway Creek Road American chaffseed population has the greatest genetic diversity across this species' range (Godt and Hamrick 1998). Thus, the Francis Marion populations are *critical* to the recovery of this species. American chaffseed populations on the Francis Marion that experience a 2-year fire return interval would likely increase in size. The Francis Marion could support some of the largest American chaffseed populations across this species' range given the right fire return interval.

Table 5: American chaffseed (*Schwalbea americana*) site prescribed burning trends, Francis Marion National Forest, 1996-2012. Data and table prepared by Robin Mackie, Forest Botanist/Ecologist, Francis Marion National Forest.

Population	**Site**	**1996**	**1998**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
HIGHWAY 41	C115				X May				X			X Apr		X		
BALLFIELD	C192				X May				X				X			
FRENCH QUARTER CREEK ROAD	C111, Interior						X May						**?**		X May	
	C111, Near Road						X May						X		X May	
LETHCOE (FS 230), *C.204*	C.204, South of 5130		X April	X Nov		X May		X May		X Mar				X		
HALFWAY CREEK ROAD	C196	X				X Feb			X May			X Apr		X		
	C.205, East of FS5319	X	X Nov	X Nov		X Feb			X May						X Aug	
	C.205, West of FS 5319	X	X Nov	X Nov		X Feb			X May							
CORDESVILLE	C89,C90			X Feb	X May	X										
WITHERBEE ROAD	C80	X		X Feb			X Jan			Feb	X		X (in part)			
	C78,C79										X Apr		X		X Apr	
	C87		X April				X Feb		X Mar				X		X (in part) Feb	
	C.88		Mar	May					Mar			X Nov			X Feb	
	C87,Roy's Place		X April	X May			X		X							
HARLESTON DAM	C101									X June				X		
	C196								X May			X Apr		X		

Habitat Restoration (OBJ-ECO-3)

Overall American chaffseed will benefit from the maintenance and restoration of longleaf and mesic wet pine savannas and flatwood ecosystems and loblolly pine forest across 91,500 acres in MA 1. Moreover, American chaffseed will benefit from the open pine woodlands or savannas with a canopy closure of less than 60 percent (10-60 feet^2 basal area) in MA 1. Beneficial effects may include an increase in flower production, available moisture (e.g., a decrease in the basal area of pines may increase soil moisture availability), and germination and seedling establishment. Fort Bragg supports the largest American chaffseed populations on Federal property and the average basal area is 20-40 feet^2 (J. Gray, Department of Defense, Fort Bragg, pers. comm. 2016). In addition, Longlands Quail Plantation has the largest population of American chaffseed in the world and the average basal area is 40 feet^2 (L. Comalander, Milliken Forestry Company, Inc., pers. comm. 2016). Given that the largest American chaffseed populations have a basal area less than the current longleaf forests in which they occur on the Francis Marion, the populations would likely benefit from a reduction in basal area.

The means (timber harvest, mechanical chipping, selective herbicide, and/or fireline construction) by which the Francis Marion will achieve their restoration goals may unavoidably cause short-term adverse effects to American chaffseed through direct mortality or injury. However, American chaffseed populations are flagged annually across the Francis Marion; therefore, it is unlikely that any individuals would be directly impacted from felled trees or log landings because their locations are well known across the forest and they would be avoided during activities. To reduce adverse effects, the removal of trees should occur in winter. The restoration of longleaf and mesic wet pine savannas across the forest will have a positive indirect effect on American chaffseed by providing potential habitat for future introductions or natural recruitment.

Objective (OBJ-ECO-3) also states that 42,500 acres of longleaf pine will be maintained by frequent, low-intensity prescribed fire and 26,000 acres of longleaf pine will be restored by the removal of loblolly pine within 10 years of plan approval. If the 42,500 acres of longleaf identified for restoration will include the Halfway Creek Road, Lethcoe Road, and Witherbee Road populations, then American chaffseed will greatly benefit and the populations will likely not only remain stable but would increase in size. The restoration of 26,000 acres of longleaf pine by the removal of loblolly pine within 10 years of approval would greatly benefit American chaffseed indirectly by providing potential habitat for the natural recruitment and/or introduction of American chaffseed in suitable areas.

Vegetation Management (OBJ-MA2-2, OBJ-MU-7)

The Forest Plan will provide at least 5,000-6,000 acres of young age component (0-1) in loblolly pine or mixed pine-hardwood forests within MA 2 within 10 yrs. of plan approval. The timber or vegetation management to provide this early seral component will not directly or indirectly affect American chaffseed because all of the extant American chaffseed locations occur in MA 1. In addition, it is highly unlikely given the habitat types (loblolly pine or mixed pine-hardwood forests) that unidentified American chaffseed populations occur in these areas. In addition, these areas occur in the urban wildland interface where fire suppression has occurred due to the

challenge of burning near urban areas. As such, the likelihood of American chaffseed occurring in these areas and being impacted by the young age component in MA 2 is very low.

Under OBJ-MUB-7, 17, 000 acres of pine stands would be thinned to desired densities. This objective may directly affect some individuals or top-kill a few individuals from felled trees. However, the location of American chaffseed individuals on the forest are well known and are flagged annually for monitoring and would be reflagged before timber harvesting activities would occur.

Summary of effects associated with the Forest Plan

We anticipate that the Forest Plan management objectives, strategies and guidelines, will improve the quality and quantity of suitable habitat for American chaffseed within the action area. Some individuals may be adversely impacted as a result of timber management actions. However, we anticipate that the Forest Plan guidelines will greatly limit the extent to which these adverse effects will occur. Overall, the management objectives and strategies, such as a 1-3 year fire return interval, thinning of longleaf pine forests, and conversion of loblolly to longleaf will have a beneficial impact on American chaffseed. Nine American chaffseed populations will be maintained and restored through a 1-3 year burn return interval, a reduction in basal area for appropriate longleaf and mesic wet pine savannas and flatwoods, restoration of longleaf flatwoods and savannas via loblolly removal, and reintroduction of historic populations. Under the direction of the Forest Plan, we anticipate that the Forest Service will be able to maintain and restore the nine American chaffseed populations on the forest. It is important to emphasize that this effects analysis is predicated on the fact that all Forest Plan objectives, standards, and guidelines will be fully implemented. If not, this analysis may no longer be valid.

Canby's dropwort (*Oxypolis canbyi*)

Effects of the Forest Plan Objectives and Management Strategies

Threatened and Endangered Plant Species (OBJ-T&E-3)
The Forest Plan aims to provide the ecological conditions to restore and maintain three stable to increasing Canby's dropwort populations. Pond cypress savannas and Carolina Bays will be restored on 6,400 acres within MA 1 within 10 years of plan approval. The Forest Plan objectives and management strategies would have a positive impact on the habitat that Canby's dropwort *may* occur in.

The Forest Plan directs that the Recovery Plans for listed species, including Canby's dropwort, be implemented. The Forest Plan also ensures that partnerships will continue by directing cooperation and coordination with responsible government and land resource management agencies regarding federally listed species. The Service and USFS need to have further discussion to determine if restoring potential historic Canby's dropwort populations on the forest should be a recovery objective.

Effects of the specific management actions

Prescribed Fire (OBJ-ECO-2)

The proposed prescribed fire objective under the Forest Plan could have a negative impact on Canby's dropwort individuals either through direct mortality or injury of above ground stems. However, some of the largest Canby's dropwort populations occur in areas that are very open with little woody competition. In addition, some small, declining Canby's dropwort populations increased in size post prescribed fire (D. Landau, The Nature Conservancy, Maryland/DC Chapter, pers. comm. 2016). As such, the prescribed fire objective under the Forest Plan will overall have a beneficial impact on the species by reducing woody competition and improving suitable habitat.

Habitat Restoration (OBJ-ECO-4)

Canby's dropwort will benefit from the Forest Plan objective to maintain, improve, and restore pond cypress savannas, Carolina Bays and depressional wetlands on 6,400 acres in MA 1. Loblolly and woody vegetation encroachment occurs in several depressional wetlands across the forest. The use of prescribed fire and mastication to restore freshwater depressional wetlands will only improve habitat conditions for Canby's dropwort (or other *Oxypolis* species).

The means (woody species control, selective herbicide, and mastication) by which the Francis Marion will achieve their goals may unavoidably cause short-term adverse effects to Canby's dropwort through direct mortality or injury. The standards and guidelines, described in more detail in the Proposed Action Section, will reduce adverse effects to this species. Also, the flagging of individuals before management activities occur and conducting activities during the dormant season will reduce adverse effects to Canby's dropwort.

Vegetation Management (OBJ-MA2-2, OBJ-MU-7)

The Forest Plan will provide at least 5,000-6,000 acres of young age component (0-10) in loblolly pine or mixed pine-hardwood forests within MA 2 within 10 yrs. of plan approval. The timber or vegetation management to provide this early seral component will not directly or indirectly affect Canby's dropwort because timber removal will occur in loblolly pine or mixed pine-hardwood forests within MA 2, not depressional wetlands. In addition, Canby's dropwort populations occur within MA 1, not MA 2.

Under OBJ-MUB-7, 17,000 acres of pine stands would be thinned to desired densities. This objective would unlikely adversely affect Canby's dropwort because thinning activities are targeted for pine forests and not depressional wetlands. The objective could have a beneficial effect on Canby's dropwort or pond cypress savannas by reducing the basal area of surrounding forests in close proximity to depressional wetlands.

Summary of effects associated with the Forest Plan

We anticipate that the Forest Plan management objectives, strategies and guidelines, will improve the quality and quantity of suitable habitat for Canby's dropwort within the action area. Some individuals may be adversely impacted as a result of management actions. However, we anticipate that the Forest Plan guidelines will greatly limit the extent to which these adverse effects will occur. Overall, the management objectives and strategies, such as a 1-3 year fire return interval and restoration of pond cypress savannas will have a beneficial effect on Canby's dropwort. Three Canby's dropwort populations will be maintained and restored on the forest through a 1-3 burn return interval, restoration of pond cypress savannas, and reintroduction of Canby's dropwort historic populations within 10 years of plan approval. Further investigation and discussion needs to occur to determine if reintroducing Canby's dropwort on the forest is a recovery objective. It is important to emphasize that this effects analysis is predicated on the fact that all Forest Plan objectives, standards, and guidelines will be fully implemented. If not, this analysis may no longer be valid.

Frosted flatwoods salamander (*Ambystoma cingulatum*)

Effects of the Forest Plan Objectives and Management Strategies

Species Diversity (OBJ-T&E-1)

Within 10 years of plan approval, the Forest Plan aims to restore 1 to 2 breeding sites for the frosted flatwoods salamander along the Talbot Terrace, as well as maintain 6 of their original breeding sites. High quality breeding habitat will be provided, including fire-maintained longleaf pine dominated woodlands, wet pine savannas, and flatwoods. The Forest Plan also ensures that partnerships will continue by directing cooperation and coordination with responsible government and land resource management agencies regarding federally listed species.

We believe that the overall Forest Plan objectives, management strategies and desired conditions of the Forest Plan are consistent with the ecological needs of frosted flatwoods salamander. We expect that implementation of this plan will protect and manage a viable population of frosted flatwoods salamander. While there is currently no Recovery Plan for frosted flatwoods salamander, any management activities that could potentially affect potential breeding ponds or adjacent upland habitat would be conducted in accordance with Service guidance for conservation of this species.

Effects of the specific management actions

Prescribed Fire (OBJ-ECO-2)

Within MA1, the goal is to apply prescribed fire on at least 33,500 acres (33%) per year to maintain or restore fire-adapted ecosystems including upland longleaf and loblolly woodlands, wet pine savannas and flatwoods, and Carolina bays and depression ponds. This includes at least 4,500 acres of those 33,500 acres (or approximately 15%) as growing season burns (April 1 –

September 30) annually. This prescribe fire-base level is based on the current prescribed burning program. Presently, the Forest Plan promotes low-intensity fire, averaging 1 to 3 years in the dormant season, occasionally burning in the growing season. According to the proposed plan, within 3 years of plan approval, the amount of prescribe fire would increase by almost 20,000 acres per year for a total average of 50,000 acres per year, including 10,500 to 16,500 acres of growing season burns.

Suitable habitat conditions for frosted flatwoods salamander breeding sites of the Francis Marion have been declining over the years, primarily due to fire suppression and previous land use changes. If the Francis Marion cannot burn 50,000 acres per year or does not prioritize the 33,500 acres per year to include growing season fire within the frosted flatwoods salamander breeding sites, frosted flatwoods salamander, will be directly affected by the continual decline of suitable breeding sites. A continuation of the current prescribed fire program will not benefit frosted flatwoods salamander unless more growing season burns for breeding sites are prioritized within the Forest Plan and implemented on the ground.

As a result of fire suppression, increased cover from woody vegetation (pond cypress) in breeding ponds contributes to decreasing herbaceous vegetation and hydroperiod (evapotranspiration). In addition, prescribed burns within the breeding ponds are often conducted during the dormant season, rather than during the growing season, which yields little restoration value. Ponds are generally wet during the dormant season which prohibits an exhaustive burn of all shrubby vegetation through the ecotone and leaf litter debris within the breeding pond basin. Also, dormant season fire may not be ideal for these salamanders as the breeding season occurs during this time. Dormant season fire can remove cover used by salamanders during ingress and egress from breeding ponds, expose areas that would provide cover for egg deposition sites, and may even cause direct or indirect mortality when it coincides with salamander movements.

Prescribed fire should occur during the lightning season when wetlands are dry and fire will successfully carry through the dry breeding ponds. The ponds located in the designated critical habitat should be burned in consecutive years, during the growing season, until the ponds are once again adequate for frosted flatwoods salamander breeding. It is necessary that fire burns through the pond basin, or at least portions of the pond basin, until appropriate vegetation and structure have been restored to qualify as suitable habitat for frosted flatwoods salamander breeding. Mechanical treatments with handheld equipment (e.g., brush saws and chainsaws) may also be used to reduce canopy cover and facilitate herbaceous vegetation growth (Gorman et al. 2013).

Appropriate management, including growing season burns, will be necessary to improve the conditions within the frosted flatwoods salamander habitat including both upland pine woodlands and the ephemeral breeding ponds. Keeping habitat from being degraded by lack of fire, changes in hydrology, and potential invasion of exotic plant species will be a significant challenge. Frequent growing season fires will help return this ecosystem to an open canopy closure, reduce shrubby vegetation encircling the ponds, and create a more diversified layer of herbaceous species.

Habitat Restoration (OBJ-ECO-3)

Upland Longleaf and Wet Pine Savanna and Flatwoods Ecosystems

According to the BA, breeding ponds for frosted flatwoods salamander have suffered greatly due to historical land management practices that were carried out prior to the establishment of the Francis Marion in 1936. Industrial logging, soil and hydrological disturbance, can have serious direct and indirect impacts on the breeding ponds. Some of the most serious threats to the breeding ponds include the construction of ditches created to drain flatwoods sites, fire breaks and plow lines, which can impede salamander migration, and tram beds used to haul timber, causing a disruption to groundwater and sheet flow. Forestry management which includes intensive site preparation may adversely affect flatwoods salamanders both directly and indirectly (Means et al. 1996). Intensive site preparation also destroys subterranean voids such as crayfish burrows, root channels, etc. that are the probable fossorial habitats of adult salamanders and may result in entombing, injuring, or crushing individuals.

The Forest Service intends to restore the upland longleaf and wet pine savanna and flatwoods ecosystems, which make up 58,100 acres in MA 1, through frequent, low-intensity fire averaging 1-3 year intervals and a timber sale program. Pine woodlands and savannas will be maintained with a canopy closure of less than 60 percent (10-60ft^2basal area) in MA 1. According to the BA, different approaches are needed to restore longleaf mesic to xeric sites, depending on the existing conditions:

- Open loblolly pine-dominated flatwoods and savannas would be maintained to provide suitable habitat conditions for at risk species until conversion to longleaf pine can be completed in the long- term.
- Some longleaf pine stands have the desired overstory composition, but not the desired structure, due to lack of fire. Introducing prescribed fire back into these stands will create the desired structure and move toward meeting the desired conditions.
- Some stands consist of younger mixed loblolly-longleaf pine overstory that can be moved toward the desired overstory composition by favoring longleaf pine during thinning.

The frosted flatwoods salamander would greatly benefit from the restoration of the upland longleaf, wet pine savanna and flatwoods ecosystems. Thinning loblolly stands, converting to longleaf, and using prescribed fire on a 1-3 year interval, would open up the canopy of the breeding ponds, allowing sunlight to promote a diversity of herbaceous vegetation within the ecotone. Evapotranspiration will also be reduced, allowing the ponds to retain water for longer period, permitting more *A. cingulatum* larvae to develop and migrate from the ponds.

Vegetation Management (OBJ-ECO-4)

Pond Cypress Savannas and Carolina Bays

The frosted flatwoods salamander will benefit from the Forest Plan objective to maintain, improve, and restore depressional wetlands on 6,400 acres in MA1. These ecosystems are represented by Pond Cypress Savannas and Carolina Bays which 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.

Large scale prescribed fire is often accomplished in the dormant season, and can have negative effects on salamander habitat (Bishop and Haas 2005). However, these burns can be important for reducing woody fuels and decreasing wildfire danger, but more emphasis should be placed on burning the sites when they are dry while avoiding burning when salamanders may be migrating to and from the pond. Follow-up burns should be incorporated to ensure wetlands benefit from fire when prescribed fires are incomplete or do not pass through the basin.

Summary of effects associated with the Forest Plan

We anticipate that the Forest Plan management objectives, strategies and guidelines, will improve the quality and quantity of suitable habitat for frosted flatwoods salamander within the action area. Some individuals may be adversely impacted as a result of timber management actions. However, we anticipate that the Forest Plan guidelines will greatly limit the extent to which these adverse effects will occur. Overall, the management objectives and strategies, such as a 1-3 year fire interval, thinning of longleaf pine forests, and conversion of loblolly to longleaf will have a beneficial impact on. Six breeding sites for frosted flatwoods salamander will be restored through a 1-3 burn return interval, a decrease of basal area for appropriate longleaf and mesic wet pine savannas and flatwoods, and historic populations. Under the direction of the Forest Plan, we anticipate that the Forest Service will be able to maintain and restore the six frosted flatwoods salamander populations on the forest. It is important to emphasize that this effects analysis is predicated on the fact that all Forest Plan objectives, standards, and guidelines will be fully implemented. If not, this analysis may no longer be valid.

Pondberry (***Lindera melissifolia***)

Effects of the Forest Plan Objectives and Management Strategies

Threatened and Endangered Plant Species (OBJ-T&E-3)
The Forest Plan aims to provide the ecological conditions to restore and maintain five stable to increasing pondberry populations. The use of prescribed fire, woody shrub removal, and potential population enhancement will be used to maintain the five pondberry populations. Pondberry does not appear to need a high fire frequency return interval like American chaffseed. Overall, the Forest Plan objectives and management strategies would improve the habitat for pondberry. The Forest Plan directs that the Recovery Plans for listed species, including pondberry, be implemented. The Forest Plan also ensures that partnerships will continue by directing cooperation and coordination with responsible government and land resource management agencies regarding federally listed species. We expect that implementation of this plan will protect and manage viable pondberry populations.

Based upon anecdotal observations, the use of prescribed to restore the ponds could have a negative impact on pondberry if the fire return interval is too frequent. This species is not a high fire frequency indicator species like American chaffseed and likely does not need to be on a fire

return interval of 1-3 years. As such, the restoration of freshwater depressional wetlands should include manual woody vegetation removal and hydrological restoration first or primarily with a potential fire return interval of 3-5 years. More monitoring and research is needed to determine what fire return interval would be beneficial to the species.

Effects of the specific management actions on pondberry

Prescribed Fire (OBJ-ECO-3)

Literature Review on the fire effects on pondberry

Pondberry is able to survive fires by regenerating from belowground rhizomes (Tucker 1984; Wright 1989; Unks 2011). Land managers and conservationists have suggested using frequent burning as a way to manage and maintain habitat for pondberry in Atlantic and Gulf Coastal Plain populations and, indeed, is being used to manage various populations (Glitzenstein et al. 2003; Glitzenstein and Streng 2004; Unks 2011; B. Pittman, South Carolina Department of Natural Resources, *in litt.* 2012). However, Beckley's (2012a) study of pondberry populations in the Carolinas, found that the largest pondberry populations were those that experienced infrequent fires. Furthermore, pondberry was most frequently encountered in areas with 51-70 year fire return intervals. Glitzenstein and Streng (2004) suggest that periodic, high intensity fires may be required to adequately control competing vegetation, but Unks (2011) cautions that such high intensity fires have the potential to also kill pondberry. Clearly, the relationship between pondberry and fire is complex and further study is warranted. Given the potential benefits and risk that fires pose to pondberry populations, use of fire as a management tool must be carefully examined prior to initiation of a prescribed fire program (Service 2014).

In MA1, the Francis Marion plans to apply frequent prescribed fire for ecosystem maintenance or restoration on at least 30,000 acres per year to maintain or restore fire-adapted ecosystems including longleaf pine woodlands, savannas and flatwoods, and Carolina bays and depression ponds. In addition, at least 4,500 acres of those 30,000 acres will be growing season burns (April 1-September 30) annually.

The proposed prescribed fire objective under the Forest Plan Revision could have a negative impact on pondberry individuals either through direct mortality or injury of above ground stems. The prescribed fire-base level is based on the current prescribed burning program, which two ponds or populations (Conifer Road and Whiddon Bay) may be in decline due to a too frequent return fire interval for pondberry (J. Glitzenstein, Tall Timbers, pers. comm. 2016).

Habitat Restoration (OBJ-ECO-4)

Pondberry will benefit from the Forest Plan objective to maintain, improve, and restore depressional wetlands on 6,400 acres in MA 1. Loblolly has encroached upon several ponds, including Brickchurch/Hoover Road population and Conifer Road. Because pine trees have high water consumption year round, the mastication or removal of loblolly trees would indirectly have a beneficial effect on pondberry by restoring hydrological input to the system.

The means (woody species control, selective herbicide, and mastication) by which the Francis Marion will achieve their goals may unavoidably cause short-term adverse effects to pondberry through direct mortality or injury. The standards and guidelines, described in more detail in the Proposed Action Section, will reduce adverse effects to this species. Also, the flagging of individuals before management activities occur and conducting activities during the dormant season will reduce adverse effects to pondberry.

Based upon anecdotal observations, the use of prescribed to restore the ponds could have a negative impact on pondberry if the fire return interval is too frequent. This species is not a high fire frequency indicator species like American chaffseed and likely does not need to be on a fire return interval of 1-3 years.

Vegetation Management (OBJ-MA2-2, OBJ-MU-7)

The Forest Plan will provide at least 5,000-6,000 acres of young age component (0-10) in loblolly pine or mixed pine-hardwood forests within MA 2 within 10 yrs. of plan approval. The timber or vegetation management to provide this early seral component will not directly or indirectly affect pondberry because timber removal will occur in loblolly pine or mixed pine-hardwood forests within MA 2, not depressional wetlands.

Red-cockaded woodpecker

<u>Effects of the Forest Plan Objectives and Management Strategies</u>

Prescribed Fire (OBJ-ECO-2)

Frequent prescribed fire is critically required to sustain and restore RCW habitat. The Francis Marion plan generally proposes to increase the frequency of prescribed fire for ecosystem restoration, except in MA 2. Francis Marion standards and guidelines include raking of fire fuels from the base of cavity trees to reduce or avoid the risks of burning and destroying cavity trees and killing or harming RCW eggs or nestlings in cavities. Although Francis Marion concluded that the incidental ignition or destruction of cavity trees has been avoided in the past, Francis Marion also found that the future effects of the Forest Plan are unlikely to completely avoid accidental burning of cavity trees. If an active cavity or cavity tree is incidentally burned and destroyed by prescribed fire, the Francis Marion intends to install and artificial cavity as a replacement if no other suitable and unoccupied cavity is available. However, the Forest Plan does not include a specific time interval for such cavity replacement where one would be required. The Service considers effects of prescribed fire are not likely to be adverse when an artificial cavity is provided within 24-48 hours of the loss of an active cavity.

The incidental ignition of a nesting cavity tree during the breeding season may kill eggs and nestlings. According to the BA, RCWs are likely to re-nest in another suitable cavity after the loss of nest or offspring due to prescribed fire. In the absence of specific Francis Marion data on re-nesting after an incidental loss due to prescribed fire, the rate of re-nesting in response to natural causes indicates that re-nesting is not likely. Re-nesting rates are annually variable and can vary among populations from around 4 to 24% (Conner et al. 2001). Re-nesting data from

Francis Marion is an average of 4%, annually ranging from 0 - 10% (Conner et al. 2001). In a probabilistic manner, re-nesting is not likely.

Data from Fort Bragg, North Carolina represents one of the most extensive sources on effects of prescribed fire and wild land fire to RCW cavities and nests. Estimating and relating adverse incidental effects of prescribed fire at Francis Marion to effects at Fort Bragg are imperfect because of potential differences in fire fuel loads, fire intensity, and forest community types. However, the Fort Bragg data are considered the best available for the purposes of comparison and estimation because of the comparably large RCW population at Fort Bragg, with 488 active clusters during 2015, and a similar number of expected cavity trees.

Intensive post-fire monitoring at Fort Bragg during 2000 – 2007 involved about 75 percent of all active RCW clusters for effects to cavity trees, cavities, and nesting and re-nesting rates. Based on prescribed fire effects without wild land fire, Fort Bragg extrapolated these data for an estimate of the loss of eight cavity trees and one nest per year (U.S. Army 2008, Service 2008). The Service considers these as reasonable maximum estimates for incidental adverse effects of prescribed fire in Francis Marion. Because prescribed fire is essential to restore and sustain RCW habitat, these are unavoidable and minor effects relative to the Francis Marion RCW population size and net beneficial effects expected to sustain the population. The net adverse annual effect of cavity and nest loss under Francis Marion prescribed fire standards, guidelines, and measures to replace cavities will not significantly or cumulatively reduce the Francis Marion population size.

Upland longleaf and loblolly pine woodlands and wet pine savanna and flatwoods ecosystems within MA 1 support a recovered population for RCWs of 350 potential breeding groups and 450 active clusters. The Francis Marion supports the third largest population of the federally endangered red-cockaded woodpecker in the United States and is 1 of 13 designated primary core recovery populations identified in the Red-cockaded Woodpecker Recovery Plan, 2003, posted on http://www.fws.gov/rcwrecovery/. High quality nesting and foraging habitat occurs as upland pine and wet pine savanna ecosystems within 0.5 miles of cluster centers and includes large, live old pines which provide cavity trees for nesting, low densities of small pines, little to no hardwood mid-story, and diverse and abundant herbaceous ground-cover. Guidelines in the most recent Recovery Plan in the management of cavities, clusters, foraging habitat, and monitoring are considered during project development.

Mechanical operations in RCW cluster polygons during the breeding season (G36)

Proposed habitat and forest management actions in the BA may affect RCWs and habitat at different spatial or geographic units. The term “cluster” when generally used frequently applies to the entire RCW territory or its surrogate 0.5-mile or 0.25 mile foraging partition within RCW cluster polygons.

Standard and conservative Service guidelines in the Recovery Plan are to avoid the use of mechanized equipment in the cluster polygon during the breeding season. This completely avoids a disruption or reduction in RCW reproduction by reducing incubation, egg hatching rates, rates of feeding nestlings, and fledgling production. Moreover, extreme levels of noise and

disturbance may lead to RCW dispersal and abandonment of the territory by one or more members of the group, and possibly the entire RCW group.

Otherwise, mechanical operations such as timber harvesting or hauling timber through cluster polygons may disturb and harass RCWs. The Francis Marion Guideline 36 (BA p. 26) prohibits any mechanical activities within active RCW clusters during the breeding season, except as otherwise authorized by the Service. The Francis Marion in the past has avoided such mechanical operations in cluster polygons during the breeding season. However, the Francis Marion is dominated by a low-lying coastal plain landscape, topography, with seasonally hydric soils that has resulted in most roads managed by Forest Service, or other entities, being placed at upland sites where RCW clusters also frequently occur.

Although Francis Marion states they intend to comply with Guideline 36 (Robin Mackie, pers. comm.), the Guideline provides discretion as otherwise approved by the Service. Accordingly, the BA includes estimates maximum annual effects by harvesting timber in cluster polygons during the breeding season. In contrast, an analysis is not available on the extent that timber harvested within a cluster polygon or elsewhere outside of a cluster polygon could be annually hauled on a road through another one or more of the 48 managed cluster polygons with a road.

At least 48 managed Francis Marion RCW cluster polygons are bisected by roads of different types (Table 6). The extent timber could be hauled through these clusters would be difficult and probably highly uncertain to programmatically estimate. This is because the site specific location of other timber harvests and project-level restoration treatments on the forest would have to be estimated relative to the existing road network and most likely routes of hauling. At this time, the only reasonable conclusion is that the maximum annual estimates of adverse effects to RCWs in the BA would be underestimated if timber is transported through cluster polygons.

Effects of mechanical operations and harvesting timber within cluster polygons during the breeding season are likely to be adverse without other qualifying information on the nature, duration, and extent of the action. It is difficult to precisely predict the nature, amount, or extent of such disturbances to nesting, incubation, feeding rates of nestlings, fledge production, and RCW group size. RCWs are not completely intolerant of noise or disturbances, although most of the substantial and available research concerns effects of noise from military training (Delaney et al. 2011) where infrequent and short-term training exercises, depending on noise levels, did not significantly affect RCW reproductive success or productivity. It is possible that a select timber harvest operation over a very short interval, perhaps 1 hour or less in duration, during the breeding season may not disrupt reproduction or harass RCWs. However, actual data is not available for such effects. The BA procedures for estimating maximum annual adverse effects conservatively assume that any timber harvest within a cluster polygon during the breeding season will be adverse. Moreover, the number of clusters adversely affected by these actions is arithmetically removed from the annual RCW population size estimate for that particular year to biologically reflect a loss of the actual RCW-occupied cluster and territory.

Otherwise, precisely estimating the effects of timber harvest during the breeding season as well as hauling timber through cluster polygons remains uncertain. Potential factors to consider for effects of hauling timber through cluster polygons include the nature of the existing road and

type, amount, and frequency of other vehicular traffic through the cluster. For example, effects of hauling timber on a public road with regular vehicular use through a cluster polygon during the breeding season may be quite different from that on a closed Forest Service road with only infrequent vehicular use. Until or unless other data are available for analysis, the Service must conservatively consider that effects of hauling and harvesting timber in cluster polygons is likely to be adverse.

Foraging habitat analysis

The BA includes RCW Foraging Habitat Analysis (FHA) for effects of timber harvests to achieve desired management and ecosystem conditions. RCW FHA is a spatially explicit assessment of the quality and quantity of foraging habitat allocated within 0.5 miles to a RCW cluster or group, referred to as a foraging partition or partition. Since a partition typically consists of multiple distinct forest stands, FHA is a stand-level and partition-level assessment. FHA concerns the attributes of suitable and potentially suitable foraging habitat in stands that are tallied for partition-level characteristics. FHA is conducted to inform and fulfill a variety of management objectives including foraging habitat maintenance, restoration and improvement, and impacts of projects by Federal and non-Federal entities that temporarily or permanently reduce foraging habitat. The FHA standards for comparing current habitat conditions to post-project or desired future conditions are the RCW recovery standard for good quality foraging habitat (GQFH), the managed stability standard (MSS), or a Service-approved modified MSS (mMSS) or modified GQFH (mGQFH).

The MSS is a minimum habitat condition to establish or retain to avoid incidental take by a Federal or non-Federal project with a temporary or permanent reduction to foraging habitat in RCW-occupied habitat. Projects that reduce foraging habitat below the MSS minimum normally will be considered by the Service as likely to be adverse, in the absence of a modified MSS (see next section). Satisfying the MSS does not account for potential adverse effects of activities that may result in take by harassment (50 CFR 17.3), such as a behavioral disturbance by logging, noise, mechanical or other operations within an active cluster during breeding season. Wide-scale implementation of foraging habitat management strictly at the MSS level is not expected to support recovery, as described in the Recovery Plan, because it will not ensure availability of

Managed Stability Standard
(Recovery Plan pages 291 – 296)

Within designated foraging partitions, provide each RCW group a minimum of 3,000 ft^2 pine basal area from pines ≥ 10” dbh, on a minimum of 75 acres. Count the basal area (ft^2) of such pines and the acres provided from only the pine stands with each of the following characteristics:

a. Stands that are at least 30 years old and older.
b. Average BA of pines ≥ 10” dbh is 40 – 70 ft^2/acre.
c. Average BA of pines < 10” dbh is < 20 ft^2/acre.
d. No hardwood midstory or if a hardwood midstory is present, it is sparse and less than 7 ft. in height.
e. Total stand basal area for stems ≥ 10” dbh, including overstory hardwoods, is < 80 ft^2/acre.
f. All stands counted as foraging habitat are recommended to be within 0.25 miles of the cluster, and any stand counted as foraging habitat be within 200 ft. of another foraging stand or the cluster itself.
g. Frequent prescribed burning of foraging habitat, especially during the growing season, is strongly recommended. Development and protection of herbaceous groundcovers facilitates prescribed burning and benefits red-cockaded woodpeckers.

As further clarified here, the criterion (a) for stand age may include stands less than 30 years of age when all other criteria are fulfilled. However, pines in these younger stands must have a suitable and well developed bole for foraging.

The total stand basal area criterion (e) only applies to canopy pines and hardwoods ≥ 10” dbh. Depending on site conditions, the minimum dbh for canopy stems may be adjusted. The contribution of canopy hardwoods is limited to 10 ft^2/acre at the maximum pine stocking (criterion b) of 70 ft^2/acre. When pines ≥ 10” are at least 40 ft^2/acre but less than 70 ft^2/acre, there should be little to no canopy hardwoods present and less than 10 ft^2/acre.

The recovery standard for GQFH (Recovery Plan, pages 188 – 189) is the desired condition on properties with populations managed for recovery. When fulfilled for individual RCW group foraging partitions and throughout a population, GQFH will provide landscape conditions essential to support recovery within individual populations. This includes trees of sufficient size and age for the excavation of natural cavities throughout the landscape. The objective of GQFH is to enhance RCW fitness (e.g. group size and fledgling production) while reducing the home range size of individual groups to increase population size carrying capacity on managed properties. For each partition, the objective is to provide 120 acres of stands with GQFH, preferably with 50 percent or more within 0.25-miles of the cluster center, with foraging habitat not separated by more than 200’ of non-foraging habitat.

Foraging Habitat Recovery Standard
(Recovery Plan pages 188 – 189).

In systems of medium to high site productivity (site index 60 or more, for the dominant pine species), provide each group of woodpeckers 120 acres of good quality habitat as defined below. A specific exception to this area requirement is made for longleaf and shortleaf habitat types under group selection silviculture (Recovery Plan pages 200 – 201). In systems of low site productivity (site index below 60, for the dominant pine species), provide each group of woodpeckers 200 - 300 acres) of good quality habitat as defined below. Some aspects of the following definition of good quality habitat may not be achievable on extremely dry or wet sites.

Good quality foraging habitat has some large old pines, low densities of small and medium pines, sparse or no hardwood midstory, and a bunchgrass and forb groundcover with the following characteristics. The acres of stands with GQFH within a foraging partition are added for the partition total to achieve 120 acres of GQFH.

a. 18 or more pines per acre that are ≥ 60 years old and ≥ 14” dbh. The minimum average BA for such pines is 20 ft^2/acre. Recommended minimum rotation ages apply to all land managed as foraging habitat.
b. Average BA of pines 10 – 14” dbh is 0 – 40 ft^2/acre.
c. Average BA of pines < 10” dbh is < 10 ft^2/acre and < 20 stems/acre.
d. Average BA of pines ≥ 10” dbh is at least 40 ft^2/acre (e.g. the BA for pines in the combined categories a and b is at least 40 ft^2/acre).
e. A herbaceous ground cover of native, fire-dependent species of at least 40 percent with sufficient density to carry a growing season fire once every 5 years.
f. No hardwood midstory or sparse and less than 7 feet in height.
g. Canopy hardwoods are less than 10 percent of the number of canopy trees in longleaf stands and less than 30 percent in loblolly and shortleaf stands. Areas with natural oak inclusions and likely present prior to fire suppression may be retained but are not counted in the total acreage dedicated to foraging habitat.
h. All of this habitat (stand) is within 0.5 miles of the cluster center, and preferably, 50 percent or more is within 0.25 miles of the cluster center.
i. Foraging habitat is not separated by more than 200 feet of non-foraging stands. Non-foraging areas include 1) predominately hardwood forest, 2) pine stands less than 30 years of age, 3) cleared non-forest areas, 4) highways, 5) utility rights of way, and 6) bodies of water.

The FHA in the BA is a coarse-scale assessment of potential post-project or treatment conditions following timber harvests relative to the MSS. It is coarse because the site-specific nature of future project level treatments cannot be reasonably foreseen at specific stands and partitions for this level of planning. Also stand-level forest habitat conditions in terms of number and basal area of pines for FHA are only available at this stage of analysis and forest planning for some, but not all, stands that may be treated for ecosystem management and other purposes.

The BA does not include FHA for effects of treatments that may sustain, improve, or temporarily or permanently reduce GQFH. The overall direction of the Forest Plan includes consideration of the RCW Recovery Plan, which implicitly would incorporate GQFH management objectives. The general extent that GQFH conditions may be affected mostly are the consequences of the desired attributes for the upland longleaf pine ecosystem and wet savanna-flatwoods in MA 1. As further described below, management objectives in MA 2 will not establish or sustain GQFH

or RCW recovery. However, desired habitat conditions and management in MA 1 appear sufficient to sustain the designated recovery population with at least 400 active clusters and sufficient foraging habitat for more than 350 PBGs during the Plan period and as a consequence of proposed actions.

A common feature of the BA FHA is the conclusion that any forest stand that fails the minimum MSS as a pre-treatment condition will not adversely affect RCWs regardless of the nature of a timber harvest or silvicultural prescription and the post-treatment stand condition. This isn't always true. The Service agrees that thinning overstocked pines in stands that, as a pre-treatment condition, fails associated MSS criteria will normally improve foraging habitat conditions for a net project benefit. The purpose of the MSS is to ensure that post-project, at least 75 acres fulfilling the MSS remain in a RCW partition to minimally avoid an adverse effect (e.g. harm). However, clearcutting loblolly pine as proposed for even-aged management in MA 2 or to restore longleaf pine in MA 1 in a stand that fails the MSS as a pre-treatment condition is not always or automatically not likely to adversely affect the RCW by FHA. This issue and condition for analysis involves the extent a stand selected for thinning, clearcutting, shelterwood, or related treatment for regeneration minimally of potentially suitable foraging habitat and foraging habitat conditions in the affected partition.

A full partition-level analysis may be required to assess the availability, amount, and distribution of suitable and potentially suitable foraging habitat in these conditions. Potentially suitable stand-level foraging habitat consists of sufficient pines ≥ 10" dbh and ≥ 40 ft^2/acre that, with treatment, can establish MSS-suitable or GQFH conditions. Such stands usually are overstocked with excessively dense pines to fulfill associated MSS or GQFH criteria, or contain an excessive hardwood canopy or midstory condition that can be treated to establish suitable foraging habitat. The Service will consider clearcutting, modified even-aged harvests, or thinning of pines ≥ 10" dbh to < 40 ft^2/acre in potentially suitable foraging habitat as likely adverse when MSS-suitable habitat fails to exist as a pre-treatment condition in any stand in the partition, but potentially suitable habitat is available for treatment. An analysis that potentially suitable but MSS-unsuitable foraging habitat can always be eliminated by a timber harvest leads to an unacceptable condition that virtually all pines in a MSS-deficient RCW-occupied partition with potentially suitable habitat could clearcut or otherwise harvested without any adverse effect.

These conditions normally require treatments in other potentially suitable habitat to establish MSS-suitable habitat in the affected partition. Alternatively, the stand with a proposed treatment by clearcutting, modified even-aged regeneration, or thinning of foraging pines to < 40 ft^2/acre requires modification and treatments to establish suitable foraging habitat. The extent these conditions exist in certain stands and partition were not specifically evaluated in the BA because site-specific stand-level and partition-level data are not available relative to site-specific
RCW GQFH are not described in the Forest Plan, but the desired conditions correspond with associated GQFH attributes of the Recovery Plan. The long-term desired condition is described as a forest ecosystem structure with a 0 – 10 year age class comprising 6 - 8.5 percent (BA p. 13). Apart from periodic clearcutting or harvesting off-site loblolly for longleaf restoration, the long-term forest age structure at this composition and with uneven-aged management generally appears to include an unusually large 0-10 year age class. If this is a long-term desired condition managed on an area-based form of uneven-aged regulation (e.g. Guldin 2006), then 6 - 8.5

percent of the upland longleaf ecosystem would consist predominately of longleaf pines in this age young age class with an approximate 110-120 year maximum age of longleaf pine patches. This system is capable of providing GQFH, although ecological conditions for long-lived longleaf are capable of supporting much older pines.

The BA analysis identified 302 RCW groups with 0.25-mile foraging partitions within the upland longleaf pine woodlands ecosystem. Loblolly and loblolly pine-hardwood stands were identified as the most likely to be subject to restoration treatments by harvesting and planting of longleaf. Given the annual estimate of stands and acres to be treated, the analysis also assumed that adverse effects of conversion to longleaf would only be limited to the 14 percent of stands that failed the MSS as a pre-treatment condition. As previously described, adverse effects also may occur by clearcutting and the removal of MSS-unsuitable loblolly pine in partitions with potentially suitable habitat, but without any MSS-suitable or GQFH-suitable stands. Similarly, the analysis included effects of timber harvests in cluster polygons, but not hauling timber through other cluster polygons during the breeding season.

Evaluation of BA RCW Model of Maximum Adverse Effects and Future Population Size

The BA presents a time-series RCW abundance model (Table 6, BA Table 2) to estimate the future annual RCW populations size as a consequence of the annual maximum number of adversely affected active clusters and natural population growth rates for the 2016 - 2031 project period. The BA model is an analysis of net project effects on future RCW population size. It is a synthesis of all maximum annual adverse effects to clusters as a result of implementing even-aged loblolly pine management in MA 2, restoring wet pine savanna and flatwoods, and upland longleaf pine restoration. The BA estimates these combined activities would adversely affect up to 15 active clusters annually. Maximum effects also assume that all active clusters adversely affected during any particular year would be abandoned by RCWs for that year. Annual percent future population growth rates were based on average rates computed during the past ten years, assuming these rates would remain unchanged for the future. The BA model projected the annual RCW population size for number of active clusters based on average annual future growth and minus the maximum number of affected clusters each year. As depicted by the BA, the net future effect is an estimated population of 497 active clusters, an increase of 20 active clusters from the initial population of 477 active clusters in 2016. Thus, the BA predicts the RCW will not decline in the future as a result of maximum annual adverse project impacts.

Given the annual estimate of maximum adverse effects and the method of analysis, results of the BA model are the consequence of the estimated annual percentage population growth rate during the past 10 years (0.037) and the proportion (0.033) of active clusters in the population that would be adversely affected. Because the average annual population growth rate is greater than the proportion of active clusters adversely affected, the population was projected to increase each year. According to the BA (p. 53), the proportion of all active clusters maximally and adversely affected was derived from a maximum annual estimate of 15 active clusters, representing 3.3% (0.033) of the 465 active clusters during 2015. The BA procedure conservatively assumes that with an annually increasing population in each future year, the maximum absolute number of active clusters annually and adversely affected for each future year is not fixed or limited to 15, but will be a 0.033 proportion of all active clusters. This implicitly assumes that with additional future active clusters, proposed actions also may adversely additional clusters.

The BA model is an important strategy to evaluate net programmatic effects at the level of individual RCW groups and the population as whole. The Francis Marion population is one of 13 designated primary core recovery populations in the RCW Recovery Plan. The Francis Marion recovery population size objective of 350 PBGs has been attained and positively surpassed based on the estimated 477 active clusters comprised by 458 PBGs in 2015. Thus, the net effect of the BA model programmatically predicts that the maximum effect of proposed actions through 2031will sustain the recovery population size objective above 350 PBGs.

The assumptions, rationale, and methods in the BA for estimating an annual maximum project effect to individual RCW clusters and to the population are important elements of this analysis. At least three primary factors affect these results.

First, estimates of average annual population growth rates are affected by the past time-series year interval of RCW abundance selected for computation, the method of calculating growth, and the source of Francis Marion time-series RCW abundance data. These factors are interrelated. Average annual percent growth in the BA is based on past 10-year population data for the 2005-2015 period. Since 2006, the overall population trend has been increasing, although the absolute annual change is variable. Earlier and different past periods include episodes of an increasing and decreasing population that will affect the average annual value.

The annual average rate or percent population growth calculated in the BA reflects the general metric in various guidelines and objectives in the RCW Recovery Plan. These recovery objectives concern threshold rates or percentages for desired population growth toward a recovery population size goal, or population declines for management to avoid, and other factors for recovery management. The annual rate for active clusters, computed as percent growth in BA, is $\% = ((N_t - N_{t-1})/N_t) *100$, where N_t is number of active clusters at time t and N_{t-1} is the number the previous year. However, two other population growth parameters are the intrinsic growth rate $r = \ln(N_t/N_{t-1})$ and the finite rate of increase, lambda, $\lambda = N_t/N_{t-1}$, where r and λ are related as $r = \ln(\lambda)$ and $\lambda = e^r$. When the rate change for growth, without conversion to percent growth, and r is greater than 0, there is a population increase and when less than zero, a decrease. Lambda, as a population size ratio, is greater than 1 with an increase, and less than one with a population decline.

These three methods of computing growth generate similar but sufficiently different values that can affect the estimated number of future active clusters, or PBGs, and other comparisons depending on thresholds or differences of significance. The deterministic BA method for projecting a future RCW population size was based on an estimated annual average 0.037 rate during the past 10-year 2005 – 2015 period (BA p. 53). Based on Francis Marion data from Danaher (2014), average annual growth rates (rate change, Figure 4) were not greater than the average 0.037 computed in the BA during any of the 2- to 19-year past periods. The exact population data for the BA calculation of average annual growth is not currently known. Francis Marion active cluster data as used and supplemented here is slightly different than the BA data. Computing the average annual rate for the 2005 – 2015 10-year period from another source of data (Service 2016) for number of active clusters each year also does not equal or exceed the 0.037 growth value (Table 8).

The threshold population growth value for comparison to the BA maximum effects and growth model (BA Table 2) is whether the average annual growth rate is equal or greater than the 0.033 annual proportion of active clusters adversely affected, or $\lambda \geq 1.033$, $r \geq 0.0325$, and the rate change ≥ 0.033 (3.3%). Of the 1996 -2015 RCW time-series abundance (active clusters) trends evaluated according to Francis Marion (U.S. Forest Service 2014), there are only two series (8-year 2007-2015 and 9-year 2006-2015) when the estimated average annual λ, *r*, or rate-percentage would deterministically predict a stable or increasing future RCW population if used in the maximum BA effects model (Table 8). The future 2016 - 2031 RCW population would decline based on average annual λ, *r*, and rate (e.g. percent) from the 16 other time series by the deterministic BA method.

A second factor potentially affecting the BA model future model projection is the assumption that past factors affecting Francis Marion population growth will continue to operate during the 2016 - 2031 future period. This is not an unusual assumption with most any model of future growth based on past rates. However, an important assumption is that future growth based on the last 10 years will mostly be derived as a result of RCW budding and pioneering (BA p. 53). According to the BA, growth rates during the past 10-years were dominated by budding and pioneering, and not the induction of new RCW groups at recruitment clusters with artificial cavities. Budding occurs when one or more existing RCW territories are subdivided by a new RCW group upon excavation of natural cavities. Budding reduces RCW territory size. Rates of budding are increasing in certain RCW populations apparently in response to habitat restoration and the increased number, distribution, and availability of suitable old pines for cavity excavation. However, the maximum density of RCW clusters sustained in response to budding in any population and in response to habitat quantity and quality is poorly understood at the present time. For the purposes of the BA and this analysis, it is assumed that territory quantity/quantity and availability of trees for natural cavities is not a future limiting factor for continued budding and growth in the Francis Marion population, although it is an uncertain factor.

Third, the future prediction of RCW population size in the BA is deterministically based by the average annual percent growth for each future time interval. As recognized in the BA (p. 56), the "deterministic model is very sensitive to variation in both the population growth rate and the number of clusters adversely affected." Historical past trends in annual Francis Marion RCW population size, and associated annual growth rates, are variable. Future predictions of population size by methods including effects of annual variation may result in different future population size estimates.

To further assess the BA model, stochastic effects of variation in annual RCW population growth rates were evaluated by Monte Carlo simulations. Annual Francis Marion RCW population growth rates during the past 10-years, or any past period, are not constant. Annual growth rates are variable and can be described by statistical parameters of the average rate and probability distribution of other observed values around the arithmetic mean. Monte Carlo methods for simulating future annual RCW population growth rates are achieved by randomly drawing a value of the annual growth rate for each future 1-year time step based on its probability. Furthermore, annual average growth and variation in growth rates for the Francis Marion population are affected by the source of time-series RCW abundance data. There are three

sources of data for annual number of RCW active clusters during the past 10 years: BA data (Forest Service 2016), Francis Marion data (Forest Service 2014), and Service data (2016). Each source has a slightly different number of active clusters for a particular year. The Service recommends that annual surveys for number of active clusters and/or PBGs be conducted during the breeding season. The cause for the differences in these data is not known, but probably involves reports and surveys of active clusters at different periods of the year.

Methods

Variation in annual population growth rates were simulated using Monte Carlo techniques by two different methods. The first method, referred to as the reference method, reflected the procedures in the BA model for maximum annual effects for estimating the future 2016 - 2031 population sizes and trends, except that annual variation for λ was included in each 1-year future forecast and with replications. The second alternative method estimated parameters for future population size and growth for the 2016 - 2031 period according to a stochastic exponential growth model (SEM) and procedures by Dennis et al. (1991) and Morris et al. (1999). The SEM is fundamentally a least squares linear regression of the log transformed incremental 1-year change in abundance (active clusters) as the dependent variable against the square root of the incremental time interval as the independent variable, as:

$$y_i = [\log({N_i}/{N_{i-1}})]/\sqrt{t_i}$$

One of the advantages of the SEM method is that log-scale incremental changes of population size are independent, while incremental changes of actual population sizes are not (Dennis et al. 1991). The procedure generates unbiased maximum likelihood estimates for the slope of the fitted regression line, as the infinitesimal growth rate (μ) and the continuous rate of increase $r = \mu + \sigma^2/2$. The mean square residual error is σ^2, and the standard error is $\sqrt{\sigma^2/t_q}$ where t_q is the total number of years in the time-series abundance interval. Simulations by this method were based on annual variation in the growth rate *r*.

Population growth parameters for the reference and SEM methods were calculated from time-series annual number of active clusters for the past 10-year 2006 – 2015 period. This 10-year period was selected to best approximate and compare simulations to the same period used by the BA model method. Growth parameters were computed and simulated for each of the three sources of RCW active cluster time-series abundance. Three Monte Carlo simulations were conducted for the reference and SEM model based on the estimated average annual growth parameter and standard deviation derived from BA, Francis Marion, and Service time-series data. Each simulation was replicated 100 times, representing 100 different 2016 – 2013 future series for each of the three past time-series data sources. Parameters calculated for the results of each simulation included the number and percentage of 100 replicates in which the future population declined during at least one year to 400 or fewer active clusters. All computations and simulations were performed in Excel.

Each simulation with the reference and SEM method began in 2016 with 477 active clusters. The number of active clusters for the next year (2017) was computed according to the BA model

procedures, except that the annual population growth parameter was randomly selected from its respective probability distribution. The baseline was the number of active clusters the previous year minus the maximum number affected by projects during that previous year. The randomly selected growth parameter – λ for the reference model and *r* for the SEM model -- was multiplied by the baseline cluster number with other calculations as necessary to compute the number of active clusters for the current year. This procedure was repeated each year through 2031. Other than randomly selecting the population growth parameter from its probability distribution each year, the procedure followed the BA maximum effect methods.

Each simulation was replicated 100 times, representing 100 different 2016 – 2013 future series for each of the three past time-series data sources. Parameters calculated from simulation output the number and percentage of 100 replicates in which the population declined during at least one year to 400 or fewer active clusters.

Results

Mean λ for the three data sources in reference model simulations ranged from 1.0311 to 1.0317. Each simulation included periods when the future population was less than 400 active clusters. With FWS data, 13 percent of 100 population replicates included one or more years when the population declined to less than 400 active clusters. For simulations based on BA and Francis Marion - Danaher data, 23 percent and 21 percent of replicates respectively declined to less than 400 active clusters.

Using the average annual λ for the 2005-2015 period, without variation, from different time-series data sources in the deterministic BA model procedure to estimate the 2016 – 2031 population would have resulted in an overall declining RCW population. An average annual λ of at least 1.033 would be required to sustain a stable or increasing population by the BA deterministic model of maximum effects. By simulating stochastic and other sources of variation in population growth rates, results of reference model simulations included episodes of increasing as well as declining populations.

The average intrinsic growth (*r*) calculated by the alternative SEM method for the same data sources and time-series periods ranged from 0.0301 for BA data to 0.0363 for FMNF data. The approximate λ for these values, for comparison to estimated reference model rates, is 1.0306 for BA data and 1.0370 for Francis Marion data. None of the SEM simulations for the future 2016-2031 period included any periods when the population declined to less than 400 active clusters, although a general declining population size trend was evident.

The SEM model simulations also were sensitive to the past-time series interval to estimate growth parameters. For example, simulations of intrinsic growth rates for Francis Marion data computed from 2002-2015 intervals generated a number of declining future populations. Of the future time-series replications, 33 populations declined to less than 400 active clusters. Extending the past time interval from 2005 to 2002 for computing SEM growth rate parameters included a longer period of relatively small incremental changes in population size, followed by the 2004 - 2006 period of decline, and then the strong subsequent growth.

Table 6. Roads and system type within Francis Marion managed cluster polygons. Data from Francis Marion.

	CLUSTERSTATUS					
SYSTEM	**Active**	**Inactive**	**Recruit-Active**	**Recruit-Inactive**	**Unknown**	**Grand Total**
C - COUNTY, PARISH, BOROUGH	5	1		1	2	9
NFSR - NATIONAL FOREST SYSTEM ROAD	11	8	3	2	6	30
SH - STATE HIGHWAY	3	2			1	6
UNKNOWN	1					1
US - US HIGHWAY OR ROUTE	1	1				2
Grand Total	**21**	**12**	**3**	**3**	**9**	**48**

Table 7. Minimum area (acres) of pines within a 0.5-mile RCW foraging partition required to sustain the minimum 75 acres of habitat suitable for the managed stability standard (MSS) and 120 acres of good quality foraging habitat (GQFH) for the RCW recovery objective, as affected by rotation interval under even-aged management and a theoretical even stand age-class distribution.

Rotation Interval (yrs.)	Minimum Partition Area (acres)	
	MSS	GQFH
100	107	300
90	112	360
80	120	480
70	131	--
60	150	--

Table 8. BA Table 2 and method for projected RCW population change during plan implementation.

Cluster baseline = (previous year clusters – (previous year clusters * 0.033))
Cluster growth = 0.037 * cluster baseline
Current active clusters = cluster baseline + cluster growth

Year	**Active clusters**	**Maximum clusters affected**
2016	477	16
2017	478	16
2018	480	16
2019	481	16
2020	482	16
2021	484	16
2022	485	17
2023	486	17
2024	488	17
2025	489	17
2026	490	17
2027	492	17
2028	493	17
2029	495	17
2030	496	17
2031	497	17

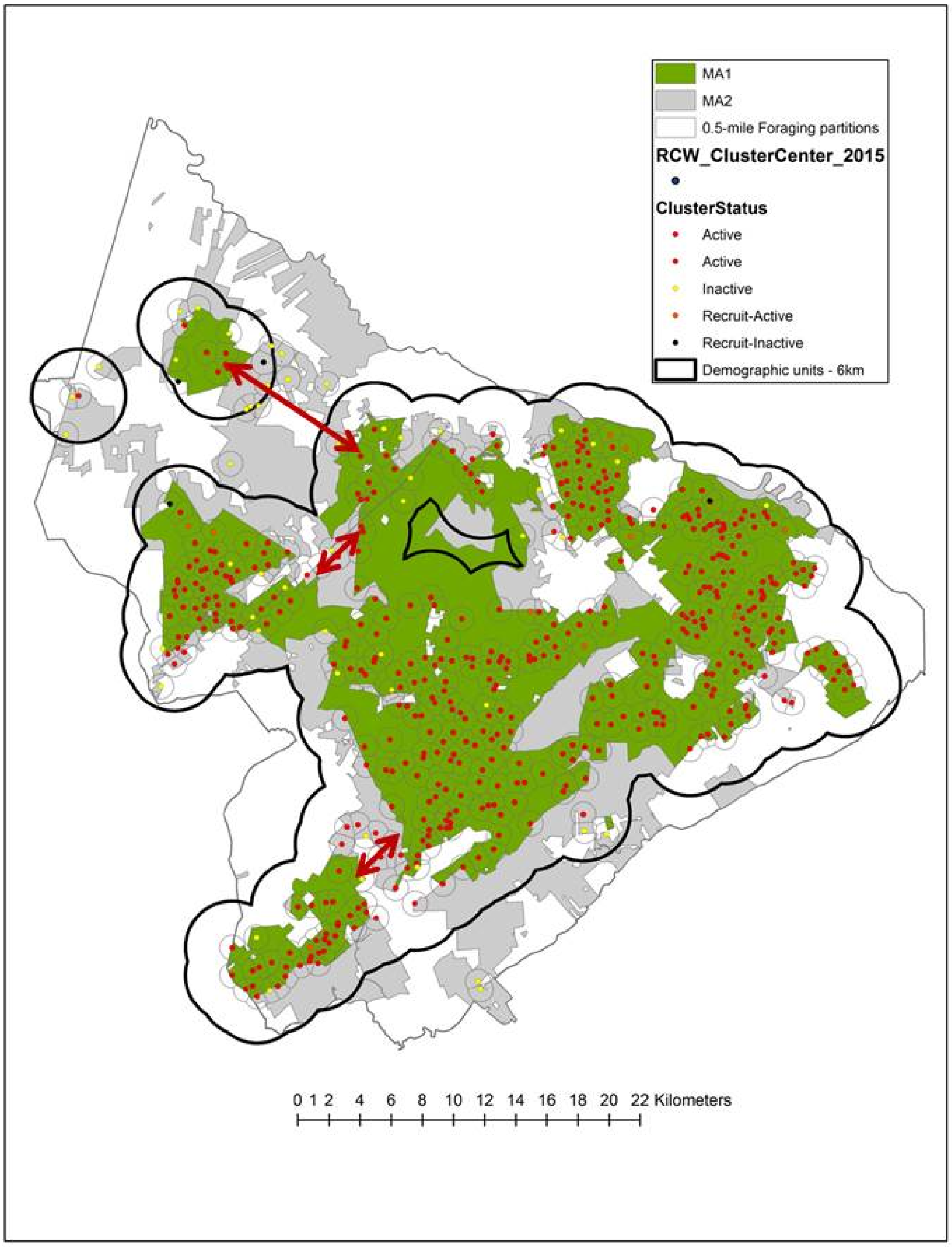

Figure 3. RCW demographic populations on FMNF, spatially defined as aggregations of active clusters within 6 km (3.7 miles), and important areas (red arrows) to either establish or maintain demographic connectivity.

Figure 4. RCW Francis Marion population size and trend, active clusters. Data and graph prepared Mark Danaher, Francis Marion,2014.

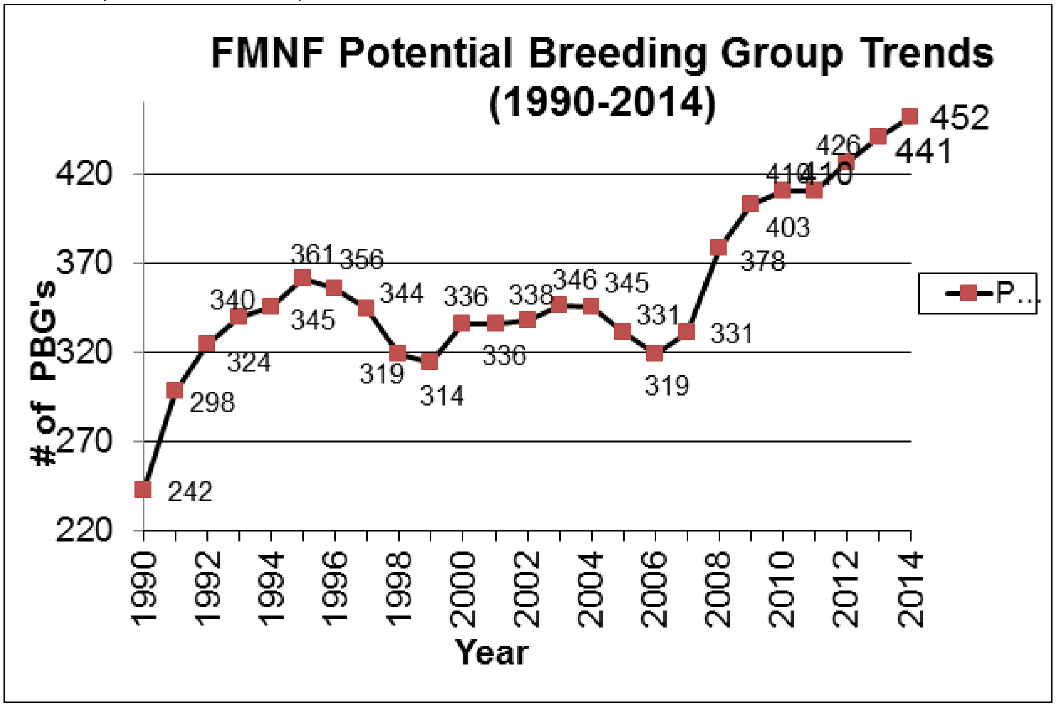

Figure 4. RCW Francis Marion population size and trend, active clusters. Data and graph prepared Mark Danaher, Francis Marion,2014.

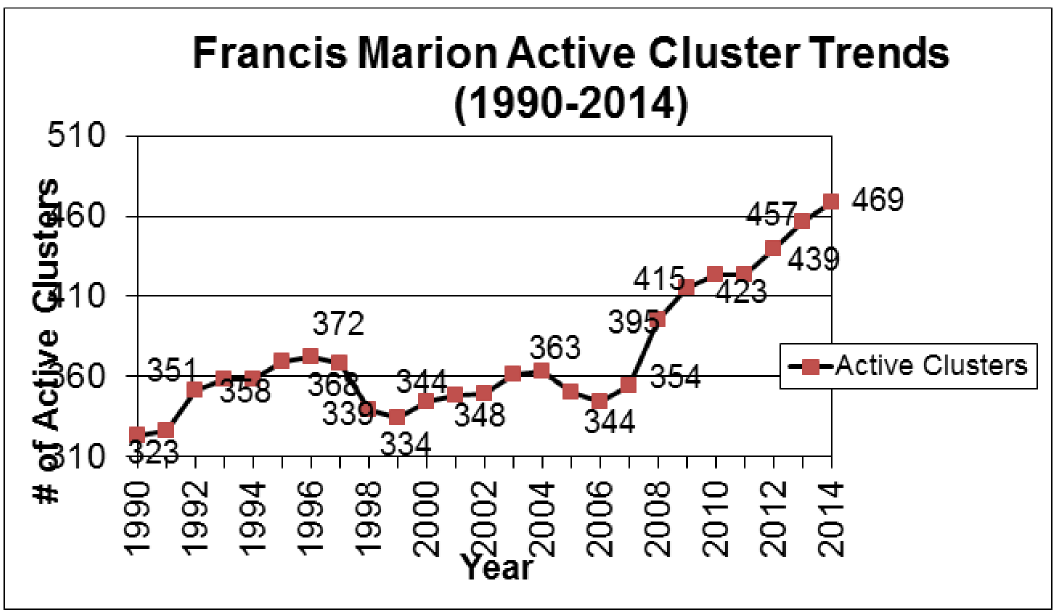

Figure 5. RCW FMNF population size and trend, potential breeding groups. Data and graph prepared Mark Danaher, FMNF, 2014.

Table 9. Number of Francis Marion RCW active clusters by year comparing annual 1-year growth parameters, and effects of the time-series year period on the average annual parameter. Highlighted average annual parameters are greater than the average annual 0.033 maximum proportion of clusters annually and adversely affected by in the BA model (BA p. 53, BA Table 2). Population size (active clusters) data from Forest Service (2014).

Year	Active Clusters	λ	r	Rate Change
1996	372			
1997	368	0.9892	-0.0108	-0.0109
1998	339	0.9212	-0.0821	-0.0855
1999	334	0.9853	-0.0149	-0.0150
2000	344	1.0299	0.0295	0.0291
2001	348	1.0116	0.0116	0.0115
2002	349	1.0029	0.0029	0.0029
2003	361	1.0344	0.0338	0.0332
2004	363	1.0055	0.0055	0.0055
2005	350	0.9642	-0.0365	-0.0371
2006	344	0.9829	-0.0173	-0.0174
2007	354	1.0291	0.0287	0.0282
2008	395	1.1158	0.1096	0.1038
2009	415	1.0506	0.0494	0.0482
2010	422	1.0169	0.0167	0.0166
2011	423	1.0024	0.0024	0.0024
2012	439	1.0378	0.0371	0.0364
2013	457	1.0410	0.0402	0.0394
2014	469	1.0263	0.0259	0.0256
2015	477	1.0171	0.0169	0.0168
Time Series		Parameter Average		
19-year 1996-2015		1.0139	0.0131	0.0123
18-year 1997-2015		1.0153	0.0144	0.0136
17-year 1998-2015		1.0208	0.0201	0.0194
16-year 1999-2015		1.0230	0.0223	0.0216
15-year 2000-2015		1.0226	0.0218	0.0211
14-year 2001-2015		1.0233	0.0225	0.0217
13-year 2002-2015		1.0249	0.0240	0.0232
12-year 2003-2015		1.0241	0.0232	0.0224
11-year 2004-2015		1.0258	0.0248	0.0239
10-year 2005-2015		1.0320	0.0310	0.0300
9-year 2006-2015		1.0374	0.0363	0.0353
8-year 2007-2015		1.0385	0.0373	0.0361
7-year 2008-2015		1.0274	0.0269	0.0265
6-year 2009-2015		1.0236	0.0232	0.0229
5-year 2010-2015		1.0249	0.0245	0.0241
4-year 2011-2015		1.0305	0.0300	0.0295
3-year 2012-2015		1.0281	0.0277	0.0272
2-year 2013-2015		1.0217	0.0214	0.0212

Table 10. Francis Marion RCW 10-year past time-series abundance data from different sources, with average annual λ, mean λ, with results from a Monte Carlo simulation, 100 replicates, of future growth and population size 2016 – 2031 based on the BA Table 2 maximum annual number of adversely affected clusters.

Year	BA Data		FMNF Danaher		FWS	
	Active Clusters	λ	Active Clusters	λ	Active Clusters	Λ
2005	353		350		*350*	
2006	344	0.9745	344	0.9829	350	1.0000
2007	354	1.0291	354	1.0291	363	1.0371
2008	395	1.1158	395	1.1158	395	1.0882
2009	415	1.0506	415	1.0506	415	1.0506
2010	423	1.0193	422	1.0169	422	1.0169
2011	431	1.0189	423	1.0024	422	1.0000
2012	439	1.0186	439	1.0378	439	1.0403
2013	457	1.0410	457	1.0410	457	1.0410
2014	469	1.0263	469	1.0263	469	1.0263
2015	477	1.0171	477	1.0171	*477*	1.0171
$\bar{x}$		1.0311		1.0320		1.0317
Σ		0.0358		0.0354		0.0263
Simulation Results						
$\bar{x}$ years <400[1]		0.8		0.9		0.4
95% CI[2]		0.5 – 2.8		0.6 – 1.3		0.1 – 0.7
Max Years <400[3]		9		10		10
#sims (%) < 400		23 (23%)		21 (21%)		13 (13%)

[1]Mean number of years per simulation, from 100 replications, during which the population declined to < 400 active clusters..
[2]95% confidence interval for 1.
[3]Maximum number of years during a single 15-year future time-series when the population declined to less than 400 active clusters.
[3]Number of 2016 – 203replicate simulations, from 100, in which the population declined in one or more years to 400 active clusters.

Table 11. Alternative SEM model parameters and simulation results for 2016-2031 period, from an initial population size of 477 active clusters, with maximum annual adverse effects by the BA method.

Data Source Interval	Data Source	*r*	σ	r^2	#Replicates < 400 active clusters	Final pop size, $\bar{x} \pm s$
2005-2015	FMNF	0.0363	0.0094	0.6709, p<0.0092	0	488 ± 18.7
2005-2015	FWS	0.0310	0.0077	0.6256, p<0.0524	0	454 ± 12.5
2005-2015	BA	0.0301	0.0110	0.4634,p<0.0237	0	447 ± 21.2
2002-2015	FMNF	0.0232	0.0100	0.3057,p<0.0524	33	406 ± 14.3

r is mean intrinsic growth rate and σ is estimated standard deviation for the data source interval.
r^2 is coefficient of determination and with significance.

Discussion

Future estimates of Francis Marion RCW growth rates and population size are sensitive to the past time-series used to compute growth rates, the source of data for past time-series, the growth rate parameter and method of calculation, annual variation in growth rates, RCW territory density and quality limitations for continued growth by budding, and other factors. Without any adverse project effects, the future RCW population by these deterministic or stochastic simulations of growth parameters estimated for the 2005-2015 period would rapidly increase within 4 years to exceed 500 active clusters. In 2014, there were 524 managed active, inactive, or recruitment clusters on Francis Marion. The future Francis Marion population size is not unlimited. The RCW is a highly conservation reliant species that depends on management and provision of suitable cavities and suitable foraging habitat by a variety of treatments. Past RCW population trends with changes in the number of active clusters or PBGs at Francis Marion are unlikely to absolutely reflect stochastic demographic or environmental variation. The suitability of cavities and foraging habitat, the availability of old pines for cavity excavation, and territory densities also may affect growth rates. Also, estimates of the past number of active clusters or PBGs are subject to sampling and estimation error. Since 2011, the Francis Marion procedure for estimating the total number of active cluster is based on an approximate 20 percent random sample survey of all managed clusters. The percent sample is established so that after a 5-year period, 100% of all managed clusters would have been surveyed. Each year, the number of active clusters identified is added to the number from the previous year surveys for the total population estimate. This assumes the status of active clusters or PBGs in previous years has not changed.

These factors, without more information and analysis, increase uncertainty of future population size estimates. Although the BA model was generally conservative in the methods to estimate the maximum number of adversely and annually affected clusters, some potential effects were not included. For example, the disturbance and potential harassment by hauling timber harvested elsewhere but through other RCW clusters during the breeding season could not be reasonably predicted. As a programmatic plan, the exact location of a timber harvest, the haul routes, and nature of the road with baseline traffic, and the number of subsequent affected clusters require more specific spatial and other information that would not be available except at a specific project planning level. However, at least 412 RCW cluster polygons are intersected by roads of some type on Francis Marion (Forest Service 2016b).

CUMULATIVE EFFECTS

Cumulative effects include the impacts of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Although we are aware of no major non-Federal actions that are reasonably certain to occur within the action area, it may be expected that some activities, particularly on private lands, could have a cumulative negative effect on American chaffseed, Canby's dropwort, frosted flatwoods salamander, red-cockaded woodpecker and pondberry in the action area. Actions performed on private lands that may adversely affect the species listed above in the future include urban development, fire suppression, application of herbicides, and timber harvest.

CONCLUSION

American chaffseed (*Schwalbea americana*)

After reviewing the current status of American chaffseed, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, if followed, is not likely to jeopardize the continued existence of American chaffseed (*Schwalbea americana*).

Currently, there are only two stable populations, Halfway Creek Road and Witherbee Road, on the Francis Marion. The Lethcoe and French Quarter Creek populations are both small, declining populations that will require Forest Plan implementation to remain extant. The Francis Marion supports the world's greatest genetic diversity of this species. In addition, it is the only population that occurs on Federal property in the state. Because the Francis Marion American chaffseed populations are protected and contain the greatest genetic diversity, the Francis Marion American chaffseed populations are extremely important to the recovery of this species. Five populations across the Francis Marion have already been lost due to lack of prescribed fire. Over 50% of American chaffseed populations have been lost in South Carolina due to fire suppression. As such, the Service recommends that the longleaf pine forests supporting American chaffseed be prioritized for prescribed burn within the 30,000 acre annual prescribed fire objective. This species holds the greatest recovery potential under the Forest Plan management objectives and strategies. So, we conclude that the proposed action is not expected to, directly or indirectly, reduce appreciably the likelihood of both the survival and recovery of this species in the wild by reducing their reproduction, numbers, or distribution. It is important to emphasize that this effects analysis is predicated on the fact that all Forest Plan objectives, strategies, and guidelines will be fully implemented. If not, this analysis may be no longer valid.

Canby's dropwort (*Oxypolis canbyi*)

The status of Canby's dropwort across the forest is questionable. There are no extant populations of Canby's dropwort on the Francis Marion. Canby's dropwort is primarily an inner coastal plain species and typically does not occur in the outer coastal plain in SC. The presence and misidentification of water cowbane (*Oxypolis filiformis*) on the forest for Canby's dropwort has occurred in the past by professional botanists. Water cowbane and Canby's dropwort are phenotypically very similar; one can only distinguish the two by closely observing both the fruits and rhizomes. No Canby's dropwort voucher specimens (Herbarium collections) of Canby's dropwort exist for the Francis Marion. As such, further discussion, collection, and identification of the *Oxypolis* species growing across the forest should be made before reintroducing the inner coastal plain genotype to the Francis Marion. The water cowbane currently growing on the Francis Marion may be able to hybridize with the inner coastal plain Canby's dropwort genotype.

After reviewing the current status of Canby's dropwort, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, if followed, is not likely to jeopardize the continued existence of Canby's dropwort (*Oxypolis canbyi*).

Frosted flatwoods salamander (*Ambystoma cingulatum*)

Out of the original 25 populations described in the final rule (74 FR 6700, April 2015), only nine are currently known to still exist, based on surveys conducted on public lands in 2014/2015. In Florida, there currently are five populations in Apalachicola National Forest, two at St. Marks National Wildlife Refuge, and one at Fort Stewart in Georgia. A ninth possible population, located on the Francis Marion, has not been reported since 2010 (J. Palis, pers. comm.). In South Carolina, four populations were historically reported from Berkeley, Charleston, and Jasper Counties. Moreover, the remaining populations in South Carolina and at Fort Stewart, Georgia are extremely important from a conservation perspective as they represent the only known extant populations of *A. cingulatum* in the entire Atlantic Coastal Plain (Pauly et al. 2012). Yet only eight adults and approximately 12 larvae have been captured on the Francis Marion in the past 20 years (M. Danaher, USFS, pers. comm. 2016)

Direct and indirect effects of the Revised Forest Plan to individuals of frosted flatwoods salamander and associated critical habitat would be minimized by adherence to the following design criteria:

> S30. In critical habitat for the frosted flatwoods salamander, use aquatic labeled herbicide and surfactants selectively applied to target unwanted vegetation, as needed only when ponds are dry (typically outside the breeding season May 1 through October 1).
>
> S39. Use low psi ground pressure logging equipment when operating in these ecosystems and special areas: depressional wetlands, Carolina bays, pocosins, and at risk plants population sites.
>
> G16. Firelines should be avoided when possible in riparian management zones along lakes, perennial or intermittent streams, springs, wetlands or water-source seeps, or otherwise minimize the length of firelines in riparian management zones.
>
> G33. Temporary or new system roads, log landings and firelines should be located outside primary (538 feet) and secondary zones (1,476 feet) from the edge of known breeding ponds for frosted flatwoods salamander.

We anticipate that the Forest Plan management objectives, strategies and guidelines, will improve the quality and quantity of suitable habitat for frosted flatwoods salamander within the action area. Some individuals may be adversely impacted as a result of timber management actions. However, we anticipate that the Forest Plan guidelines will greatly limit the extent to which these adverse effects will occur. Overall, the management objectives and strategies, such as a 1-3 year fire return interval, thinning of longleaf pine forests, and conversion of loblolly to longleaf will have a beneficial impact on frosted flatwoods salamander. Six breeding sites for frosted flatwoods salamander will be restored through a 1-3 burn return interval, a decrease of basal area for appropriate longleaf and mesic wet pine savannas and flatwoods, and toric populations. Under the direction of the Forest Plan, we anticipate that the Forest Service will be

able to within 10 years of plan approval, restore one to two breeding sites for the frosted flatwoods salamander along the Talbot Terrace, as well as maintain six of their original breeding sites. It is important to emphasize that this effects analysis is predicated on the fact that all Forest Plan objectives, standards, and guidelines will be fully implemented. If not, this analysis may no longer be valid.

After reviewing the current status of frosted flatwoods salamander, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, if followed, is not likely to jeopardize the continued existence of the frosted flatwoods salamander.

Pondberry (*Lindera melissifolia*)

The status of pondberry in the action area has increased over the last ten years and new subpopulations are continually being found. The Forest Plan objectives and strategies may directly and indirectly adversely impact some individuals. However, these impacts will most likely be either injury or death of individuals from direct exposure to management actions. We do not expect that the adverse impacts will elicit population-level responses. Thus, the overall impact on the five local populations from the proposed Forest Plan is expected to be positive. Therefore, we conclude that the proposed action is not expected to, directly or indirectly, appreciably reduce the likelihood of both the survival and recovery of this species in the wild.

After reviewing the current status of pondberry, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, if followed, is not likely to jeopardize the continued existence of *Lindera melissifolia* (pondberry).

Red-cockaded woodpecker *(Picoides borealis)*

In response to recent Service and Forest Service discussion of earlier results of this analysis, the Forest Service has modified the proposed action to regulate the future amount and extent of adverse effects to sustain a population of at least 400 active clusters. Capping the amount and extent of incidental take to sustain at least 400 active clusters also will continue to support the designated Francis Marion Primary Core recovery population at or above the recovery population size objective of 350 potential breeding groups (PBGs). During 2002-2015, 95.8 percent (0.958 ± 0.014) of Francis Marion active clusters were occupied by PBGs. Thus, a minimum population of 400 active clusters will support on average 384 PBGs.

The Francis Marion is one of 13 designated primary core recovery populations in the 2003 RCW Recovery Plan, each with a recovery population size objective of 350 PBGs. A Francis Marion population of 400 active clusters and ~384 PBGs would continue to sustain the recovery population at or above its recovery population size objective of 350 PBGs.

The management standard to sustain a population of at least 400 active clusters effectively resolves programmatic uncertainty on the annual and cumulative amount or extent of adverse effects as a result implementing future projects under a revised Francis Marion plan. However,

additional procedures for implementing future projects are required to adequately assess, monitor, and track impacts and population size.

Overall, these procedures should include measures to: 1) annually survey and estimate the total baseline population size in terms of active clusters and PBGs, 2) evaluate direct and indirect impacts of individual proposed projects to RCWs, 3) subtract or reduce the total (past plus current) number of adversely affected clusters from the annual baseline population number when projects are authorized, 4) cumulatively tract the total number of adversely affected clusters authorized by individual projects in the current and previous years, for which projects have not been completed, relative to most recent annual baseline population size estimate, 5) monitor completed projects with adverse impacts to clusters to assess post-project effects, and 6) adjust the number of adversely affected clusters according to results of monitoring.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered to be a prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below as the terms and conditions are non-discretionary, and must be undertaken by Francis Marion and become binding conditions of any contract, grant or permit issued as appropriate for the exemption in section 7(o)(2) to apply. Francis Marion has a continuing duty to regulate the activity covered by this incidental take statement. If Francis Marion (1) fails to assume and implement the terms and conditions, or (2) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permits or grant documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Francis Marion must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(I) (3)]

Amount or Extent of Take Anticipated

In meeting the provisions for incidental take in Section 7(b) (4) of the ESA, the Service has reviewed the best available information relevant to this proposed action. Based on this review, the Service expects that implementation of the proposed actions may result in the following amount and extent of incidental take.

Frosted Flatwoods Salamander

The Service anticipates incidental take of frosted flatwoods salamander (*Ambystoma cingulatum*) will be difficult to detect for the following reasons: (1) the fossorial nature of the salamanders life cycle (i.e., with individuals rarely encountered above ground except during the breeding season); (2) suitable habitat may not be occupied or occupation is unknown; and finding evidence of take is nearly impossible. It is important to remember this is a species that has evolved in mostly fire dependent communities and is well suited for survival in such areas. While it is possible for the application of prescribed fire to result in unintended take, the likelihood is quite low. Ground disturbing activities (such as fireplows) are more likely to cause take in the form of harm to habitat and possibility of direct take on salamanders. However, there is no reliable way to calculate the number of animals taken by the proposed action. This BO

requires several precautions and actions designed to minimize the impact on the salamanders. The use of fire is so intrinsically important to the maintenance of quality salamander habitat, that the overall beneficial effect of the fire far outweighs the potential for take of salamanders. The Forest Service anticipates that directly and indirectly an unspecified number of frosted flatwoods salamanders within 1,300 acres of designated Critical Habitat, potentially usable by frosted flatwoods salamanders, could be taken in the form of harm and harassment as a result of the proposed action. In addition, incidental take should also apply to other areas of the Francis Marion if frosted flatwoods salamanders are found outside of their Critical Habitat. However, adverse effects will be difficult to detect or quantify due to their fossorial nature as adults and there secretive larval stage.

Red-cockaded woodpecker

Incidental take is expected primarily in the form of harassment and/or harm in response to: 1) harvesting timber within active cluster polygons and hauling timber through active cluster polygons during breeding season, 2) even-aged final loblolly pine timber harvests in MA 2, 3) the harvest of loblolly pine and replacement with longleaf pine for upland longleaf ecosystem restoration in MA 1, and 4) the harvest of loblolly pine with restoration of longleaf pine and thinning loblolly or longleaf pine stands to < 40 ft^2/acre of pines ≥ 10” dbh for restoration of the savanna-flatwoods ecosystem. It is not possible to identify the specific clusters affected by these actions at this time due to the programmatic nature of the forest plan. Effects of harassment are expected to be temporary by disrupting normal breeding behavior, including incubation and feeding nestlings and fledglings, and with abandonment of the occupied cluster by one or more adults. Upon completion of the mechanical operations during the breeding season, normal breeding behavior and territory occupancy is expected during subsequent breeding seasons. Incidental take by harm and/or harassment by these activities is expected to adversely affect no more than 16 active clusters each year during the first five years of the plan, and no more than 17 active clusters each year during the last five years of the plan, and not to exceed an amount or extent to reduce the population to less than 400 active clusters during any single year. In addition, prescribed fire is expected to destroy no more than four active cavities or cavity trees, and injure or kill nestlings or eggs in one nest per year.

Reasonable and Prudent Measures and Terms and Conditions

Frosted flatwoods salamander

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take.

- The Forest Service will engage in habitat restoration and maintenance for the frosted flatwoods salamander within designated critical habitat. This measure also applies to other parts of the forest if or when frosted flatwoods salamander are found.

Terms and Conditions

To implement the reasonable and prudent measures, the following terms and conditions are required.

1. Every effort should be made to first maintain suitable wetland breeding and upland habitat where it occurs and expand /restore such habitat to suitable and preferred condition as soon as possible.
2. Frequent 1-3 year fire return interval, growing season burn, should be utilized.
3. Maintenance of hydrological function should be incorporated for restoring habitat.
4. Restoration and management for flatwoods salamanders should be effectively focused on the need for demographic connectivity and recolonization.

Red-cockaded woodpecker

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take.

- The Forest Service will develop a plan and system to implement and regulate future projects assuring that a RCW population of at least 400 active clusters and more than 350 PBGs is sustained.

Terms and Conditions

To implement the reasonable and prudent measure, the following terms and conditions are required.

1. With Service approval of the following methods and procedures, the Service will develop and implement an annual RCW survey based on a random sample of all managed clusters, with a statistically rigorous annual estimate of the population size in terms of number of active clusters and PBGs. To ensure the amount and extent of incidental take does not reduce the population to less than 400 active clusters and sustains more than 350 PBGs, the annual sample will be used as a statistical hypothesis and test that the proportion of observed active clusters and PBGs is equal to or greater than the proportion required to minimally to sustain the population objective.
2. Foraging habitat analysis will be conducted to assess impacts of timber harvests in 0.5-mile foraging partitions according to MSS and GQFH criteria, based on guidelines in the 2003 RCW Recovery Plan and the Service's 2005 memorandum from the Assistant Regional Director, and guidance from the Service's South Carolina Ecological Services Field Office and RCW Recovery Coordinator. The RCW foraging habitat matrix program is not required to conduct FHA, although it may be used if desired. Where adverse effects (e.g. harm) are predicted in response to a reduction of foraging habitat, FHA will include direct and indirect effects at the RCW group and neighborhood level.
3. Cluster polygons will be identified where timber will be harvested during the breeding season. A cluster polygon is the minimum convex polygon of all cavities used by RCWs

plus a 200-foot buffer. Francis Marion will mark cluster polygons in the field by painted trees or other visible measures within which timber will be harvested. Timber sale contracts will include information on the specific location and marking of cluster polygons, with additional conditions limiting the total period of time of mechanical operations for timber harvest and removal in polygons. Where more than one road is available to haul harvested timber during the breeding season, roads will be selected and contractors will be required to use roads that do not bisect cluster polygons. If unavoidable, roads will be selected to minimize the number of cluster polygons through which timber will be hauled.

4. All project-level impacts will be evaluated in a BA and submitted to the Service for review and concurrence that the proposed action and effects are within the scope of the BO.
5. Develop and use a system of records to annually and cumulatively track the number RCW clusters and/or cluster polygons for which take (e.g. harm or harass) has been authorized by projects. The system will include each RCW cluster affected with its unique cluster identification number of code that is compatible with the Francis Marion GIS system; the type of project authorized (e.g. harm or harass); and the date of project authorization, contract approval, and completion of the approved activity. The system will include a stand identification code that is compatible with the Francis Marion GIS where treatments were authorized that resulted in incidental take (e.g. harm).
6. The baseline number of active clusters estimated from the annual survey will be adjusted and reduced each year by the total number of active clusters for which incidental take has been authorized by approved projects. The baseline number will not be less than 400 active clusters.
7. The baseline population size (active cluster) number can be adjusted as a result of monitoring project impacts. For projects with disturbance and harassment due to cutting or hauling timber through cluster polygons during the breeding season, post-project monitoring documenting to document presence of an active cluster will result in the addition of such cluster back to the baseline population number. For projects with adverse direct or indirect effects (harm) due foraging habitat impacts, post-project monitoring documenting the presence of an active cluster and RCW group for five years post-project, and comparable to that of the RCW group composition and structure pre-treatment, can be added back to the baseline population number with Service approval.
8. Future projects will not be authorized or implemented that reduce the population baseline number to less than 400 active clusters.
9. An annual report to the Service will consist of the data and statistical results of estimated population number of active clusters and PBGs from the random sample, the identification of all managed clusters and those sampled for the population estimate, the status of each sampled cluster, the baseline population number, the system of records, and the number and identity of clusters added back to the baseline.

CONSERVATION MEASURES

Section 7(a)(1) directs all Federal agencies to share the responsibility and cost of listed species recovery by *utilizing their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species* (50 CFR 402.01). Rather than only considering individual Federal agency actions adversely affecting listed species (as with section 7(a)(2) consultations), section 7(a)(1) provides a path to identify and focus listed species conservation efforts across each Federal agency's entire authority and/or program footprint, which, together, will cumulatively promote proactive recovery of listed species. Conservation measures are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help carry out Recovery Plans, and to promote interagency cooperation. The BA proposes a conservation strategy to reduce the amount or extent of incidental take. The Service conservation measures along with the conservation strategy proposed by the BA will increase the chance of recovery or avoid and/or minimize a threat (potential or ongoing) to a listed species:

1. Develop a conservation plan, under the framework of Section 7(a)(1), for all federally listed species, including American chaffseed, Canby's dropwort, frosted flatwoods salamander, pondberry and red-cockaded woodpecker. A Francis Marion conservation plan would help identify and prioritize conservation efforts. For an example of a conservation plan please see the U.S. Army Corps of Engineers' section 7(a)(1) conservation plan, available at: https://www.fws.gov/MississippiES/pdf/LMR%20Conservation%20Plan%20Final%20USACE%20CIP%2023%20July%202013.pdf

2. Designate the Talbot Ridge or Cainhoy Ridge Area along Halfway Creek Road as a Special Interest Area or Research Natural Area. Talbot Ridge or Cainhoy Ridge supports four federally listed species, including American chaffseed, frosted flatwoods salamander, pondberry, and red-cockaded woodpecker.

3. Implement recovery tasks listed in Recovery Plans for federally listed species. In the absence of an approved Recovery Plan, the Forest Service should coordinate with the Service to determine priority recovery tasks as needed.

4. Coordinate with Federal, Tribal, State, and local governments, private and nonprofit entities, and landowners (i.e., Wyden Amendment) to accomplish prescribed burning and ecosystem restoration goals.

5. Monitor trends in population status and/or habitat of federally listed species.

6. Consult with the Service on all future site specific actions covered under the Forest Plan.

7. Conduct widespread inventories for at-risk species populations to improve our understanding of distribution, habitat condition, threats and their management needs.

8. Share federally listed and at-risk species element occurrence data with State

Wildlife and Heritage Programs, U.S. Fish and Wildlife Service, the South Atlantic Landscape Cooperative, and NatureServe.

American chaffseed

1. Burn the Halfway Creek Road and Witherbee Road population on a two-year rotation to ensure stable to increasing populations.
    - Ensure variability in seasonality of prescription, i.e., burn during the dormant and growing season (preferably late summer or early fall).

2. Burn the Lethcoe and French Quarter Creek Road population on an average 1.5 fire return interval or annually to ensure these two populations remain extant and do not become extirpated in the near future.

    - Ensure variability in seasonality of prescription, i.e., burn during the dormant and growing season (preferably late summer or early fall).

3. Consult with the Service for future reintroductions. Since the Francis Marion contains the greatest genetic diversity for this species across its range, use the local forest genotype for reintroductions or population augmentations. Do not introduce American chaffseed genotypes from other counties.

4. Coordinate with the Service prior to harvesting and/or performing thinning operations within 100 feet of American chaffseed plants. Suitable habitats for American chaffseed within areas intended for timber harvesting and/or thinning should be surveyed prior to beginning operations.

5. Coordinate with the Service prior to applying herbicides within 100 feet of American chaffseed. Herbicides should be applied at the lowest rates required to control targeted species. Preference will be given to targeted herbicide application over broadcast application.

6. Conduct soil disturbance and direct seeding experiments near extant American chaffseed populations to increase population size.

Canby's dropwort

1. Determine which *Oxypolis* species occur on the forest since no voucher specimen exists for the Canby's dropwort record or population that historically occurred on the forest. Coordinate with the Service to determine if restoring potential historic Canby's dropwort on the forest should be a recovery objective.

2. Coordinate with the Service prior to harvesting and/or performing thinning operations within 100 feet of Canby's dropwort plants. Suitable habitats for Canby's dropwort within areas intended for timber harvesting and/or thinning should be surveyed prior to beginning operations.

3. Coordinate with the Service prior to applying herbicides within 100 feet of Canby's dropwort. Herbicides should be applied at the lowest rates required to control targeted species. Preference will be given to targeted herbicide application over broadcast.

Frosted flatwoods salamander

1. Coordinate with Service to provide conservation measures or recovery tasks until the Recovery Plan for the frosted flatwoods salamander is complete.

2. Conduct surveys in areas of historically known ponds.

3. Use aquatic labeled herbicide and surfactants in critical habitat for the frosted flatwoods salamander, apply to target unwanted vegetation, as needed only when ponds are dry (typically outside the breeding season May 1 through October 1).

Pondberry

1. Monitor populations after prescribed fire to determine the best fire return interval for pondberry on the forest.

2. Remove loblolly pines during the dormant season from depressional wetlands containing pondberry.

3. Coordinate with the Service prior to harvesting and/or performing thinning operations within 100 feet of pondberry plants/colonies. Suitable habitats for pondberry within areas intended for timber harvesting and/or thinning should be surveyed prior to beginning operations.

4. Coordinate with the Service prior to applying herbicides within 100 feet of pondberry. Herbicides should be applied at the lowest rates required to control targeted species. Preference will be given to targeted herbicide application over broadcast application. Herbicides should not be applied in pondberry habitats during periods when these areas are flooded or during high wind conditions. Hand control of invasive plants should be used within pondberry colonies and their associated buffers.

Red-cockaded woodpecker

1. Implement modified even-aged (two-aged) management and permanently retain the shelterwood stock for future potential RCW cavity trees for loblolly pine regeneration in MA 2. In MA 1, retain a residual loblolly pine stock and overstory with underplanting longleaf pine for restoration of upland and wet savanna-flatwoods longleaf ecosystem sites. The residual loblolly can serve as potential future cavity trees, provide fuel for prescribed fire to reduce potential shrub and hardwood encroachment during regeneration, and enhance RCW dispersal and demographic connectivity.

2. Conduct an assessment of partition size (acres), cluster densities, and cluster status history at localities with concentrated RCW clusters and loblolly pine stands slated for longleaf pine restoration. To potentially increase partition-level foraging habitat and management flexibility, assess spatially strategic opportunities to eliminate inactive and recruitment clusters from management to increase partition area in neighboring cluster and partitions, while sustaining a RCW population of at least 400 active clusters.

3. Identify and implement treatments in stands to minimally establish MSS-suitable stand and partition-level conditions, and with GQFH elements, in RCW partitions where loblolly pine will be harvested in other stands for longleaf restoration in MA 1 and regeneration in MA 2.

4. Increase the frequency and total annual acres of growing season prescribed fire to increase rates of foraging habitat restoration in MA 1.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in your request for formal consultation for the proposed project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion or the project has not been completed within five years of the issuance of this BO; (3) the agency action is subsequently modified in a manner, that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

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