United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Service Consultation Code:	04EF2000-2013-I-0025
Corps Application No.:	SAJ-2012-01564 (SP-AWP)
Date Received:	September 19, 2013
Consultation Initiation Date:	March 26, 2015
Applicant:	All Aboard Florida LLC
Project:	All Aboard Florida Passenger Rail Service, Miami to Orlando
Counties:	Indian River, St. Lucie, Martin, Palm Beach, Brevard, and Orange

Dear Colonel Kirk:

The U.S. Fish and Wildlife Service (Service) has reviewed your letter dated September 19, 2013, and other information submitted by the U.S. Army Corps of Engineers (Corps) for All Aboard Florida (AAF) Limited Liability Corporation's (LLC) request to obtain a Corps' permit under Section 404 of the Clean Water Act. The permit will authorize the filling of wetlands in association with Phase II of the AAF Passenger Rail Service Project (AAF Project). This document transmits the Service's Biological Opinion on Phase II of the AAF Project and its effects on the threatened Florida scrub-jay (*Aphleocoma coerulescens*; scrub-jay) and the endangered fragrant prickly-apple (*Cereus eriophours* var. *fragrans* = *Harissia fragrans*). It also includes and summarizes our concurrences for the Corps' determinations for endangered West Indian manatee (*Trichechus manatus*) and Lakela's mint (*Dicerandra immaculata*), as well as the threatened eastern indigo snake (*Drymarchon corais couperi* = *Drymarchon couperi*) and wood stork (*Mycteria americana*). This document is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*), and the provisions of the Fish and Wildlife Coordination Act of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*).

This Biological Opinion is based on information provided in the Corps' letter to the Service dated November 21, 2014; the draft Environmental Impact Statement (DEIS) for the AAF Project dated September 2014; information on the Phase II of the AAF Project from the applicant's consultant; and meetings, telephone conversations, emails, and other sources of information. A

complete record of this consultation is on file at the Service's South Florida Ecological Services Office, Vero Beach, Florida.

Consultation History

Phase I of the AFF Project includes the construction of three new stations (West Palm Beach, Fort Lauderdale, and Miami), acquisition of five train sets, construction of a second track along most of the 66.5-mile (mi) (107-kilometer [km]) long by 100-foot (ft) (30.5-meter [m]) wide corridor, and 16 new round-trip intercity passenger train trips (32 one-way trips) on the West Palm Beach to Miami section of the Florida East Coast Railroad (FECR) corridor. The Federal Railroad Administration (FRA) and AAF LLC conducted an environmental review of Phase I in 2012 and 2013 and made a finding of "No Significant Impact." FRA concluded that Phase I has independent utility, and could be advanced and serve a transportation need even if Phase II were not constructed. As a result of the environmental review process conducted, FRA authorized AAF LLC to construct the Phase I component of the Project. However, to date, FRA has not determined if a Railroad Rehabilitation and Improvement Financing (RRIF) loan would be provided for Phase I. The Service has already concluded consultation on Phase I of the AAF Project and provided a concurrence letter on this portion of the project (Service 2012).

In a letter to the Service dated September 19, 2013, the Corps indicated that the FRA was developing a DEIS for the AAF Project and the Corps agreed to be a cooperating agency in the development of the DEIS. As such, the Corps assumed responsibility for completing consultation with the Service for the AAF Project. The Corps determined that the AAF Project may affect, but is not likely to adversely affect, the eastern indigo snake, scrub-jay, West Indian manatee, and wood stork. The Corps requested the Service's concurrence for these determinations.

On September 22, 2014, the Service received the DEIS for the AAF Project from the FRA.

In an email to the Corps dated November 6, 2014, the Service advised the Corps that we concluded Phase II of the AFF Project will result in adverse effects and take of the scrub-jay.

In an email to the Corps dated November 17, 2014, the Service advised the Corps to request that the Service initiate formal consultation for Phase II of the AAF Project's adverse effects to the scrub-jay.

In a letter to the Service dated November 21, 2014, the Corps requested that the Service initiate formal consultation on Phase II of the AAF Project for adverse effects the scrub-jay pursuant to section 7 of the Act.

In an email to the Service dated March 9, 2015, the Corps provided verification from the AAF LLC, in the form of a receipt from Morgan Lake Wales Preserve Conservation Bank in Highlands County, Florida, that two scrub-jay credits were acquired by the AAF LLC. The

purpose of the credit acquisition is to help minimize the adverse effects of the AAF Project to the scrub-jay.

In an email to the Corps dated March 9, 2015, the Service stated that we have received photo documentation from Florida Department of Environmental Protection (FDEP) staff at the Savannas Preserve State Park (SPSP) that several specimens of the fragrant prickly-apple occur within the AAF Project right-of-way near the SPSP. The Service notified the Corps that based on this evidence the Service finds that Phase II of the AAF Project may affect, and is likely to adversely affect, the fragrant prickly-apple. Consequently, the Service would initiate formal consultation for Phase II of the AAF Project's adverse effects to the fragrant prickly-apple.

In an email to the Service dated March 26, 2015, the Corps determined that Phase II of the AFF Project may affect, but is not likely to adversely affect, the fragrant prickly-apple and Lakela's mint, and requested the Service's concurrence for these determinations. As discussed above, the Service finds that Phase II of the AAF Project is likely to result in adverse effects to the fragrant prickly-apple. Therefore, we will consult formally on the AAF Project's adverse effects to the fragrant prickly-apple, and this species will be included in the Service's Biological Opinion for the AFF Project provided below.

As of March 26, 2015, the Service has received all the information necessary for initiation of formal consultation on the scrub-jay and fragrant prickly-apple for the AAF Project as required in the regulations governing interagency consultations (50 CFR § 402.14).

BIOLOGICAL OPINION

The purpose of this Biological Opinion is to document the Service's opinion as to whether Phase II of the AAF Project is likely to jeopardize the continued existence (referred to in this document by the term "jeopardy") of the scrub-jay and the fragrant prickly-apple. Jeopardy is defined under the Act as an action that is reasonably expected, directly or indirectly, to diminish a species' numbers, reproduction, or distribution so that the likelihood of survival and recovery in the wild is appreciably reduced. In making a determination on whether an action will result in jeopardy, the Service begins by reviewing the current status of the species, or "baseline." Added to the baseline are the various direct, indirect, interrelated, and interdependent effects of the proposed Federal action. The Service also examines the cumulative effects of other non-Federal actions that may occur in the action area, including State, Tribal, local, or private activities that are reasonably certain to occur in the project area.

DESCRIPTION OF PROPOSED ACTION

AAF LLC is proposing to construct and operate a privately owned and operated intercity passenger railroad system that will connect Orlando and Miami, with intermediate stops in Fort Lauderdale and West Palm Beach, Florida. To finance the project, AAF LLC has applied for $1.6 billion in Federal funds through the FRA's RRIF program. The RRIF is a loan and loan

guarantee program administered by FRA as described in 49 Code of Federal Regulations (CFR) part 260. Under this program, the FRA Administrator is authorized to provide direct loans and loan guarantees that may be used to acquire, improve, or rehabilitate rail equipment or facilities or develop new intermodal or railroad facilities. AAF LLC proposes to implement the AAF Project through a phased approach. Phase I will provide rail service on the West Palm Beach to Miami section, while Phase II will extend service to Orlando.

Phase II of the AAF Project includes constructing a second track adjacent to the existing track within the existing 128.5-mi (206.8 km) long by 100-ft (30.5 m) wide corridor from West Palm Beach to Cocoa. In addition, a new 32.5-mi (52.3 km) long by 100 to 150-ft (30.5 to 45.7 m) wide railroad line with two tracks will be constructed parallel to State Road (SR) 528 from Cocoa to the Orlando International Airport. Three locations were considered for the new railroad line, FRA's Final Environmental Impact Statement (August 2015) selected the route 100 ft (30.48 m) south of SR 528 right-of-way boundary south of the paved travel lanes. Based on the results of surveys conducted by the consultants for AFF LLC, the Service is not aware of any listed species that will be adversely affected within the footprint of this selected route. Phase II also includes: constructing a new vehicle maintenance facility on property owned by the Greater Orlando Airport Authority; straightening curves and reconstructing 18 bridges within 128.5 mi (206.8 km) of the FECR Corridor from West Palm Beach to Cocoa; and additional bridge work along the corridor from West Palm Beach to Cocoa. Some of remaining project right-of-way would be maintained as dirt roadway to allow maintenance access by motor vehicles. Ongoing maintenance of tracks, ancillary equipment (*e.g.*, signals, *etc*.), and vegetation in the railroad right-of-way will occur following construction of the project.

Phase II, as proposed, will add 16 new round-trip intercity passenger train trips (32 one-way trips) on the new railroad segment and on the FECR Corridor between Miami and Orlando. Maximum operating speeds along the entire corridor will range from 79 to 125 miles per hour (mph) (127.1 to 201.2 km per hour [kph]), depending upon the location. Operating speeds will be greatest along the SR 528 corridor because this section of the corridor does not contain at-grade highway crossings.

Staging areas for construction equipment and materials will be located on developed lands (*e.g.*, parking lots, developed and disturbed lands) within the existing Phase II corridor for the portion of the corridor from West Palm Beach to Cocoa and within the Orlando International Airport lands. The majority of the construction supplies and materials will be brought to the construction site by trains using the existing rail line. At this stage of project, the locations and numbers of staging areas for the section of the project from Cocoa to the Orlando International Airport lands have not yet been determined. Therefore, the Service will not consider the staging areas for the section of the project from Cocoa to the Orlando International Airport lands in this consultation and Biological Opinion. When the staging areas are identified, the Corps or the FRA will determine if any federally listed species may be affected by the action and if reinitiation of consultation on the project is warranted pursuant to the requirements of section 7 of the Act.

The FRA's safety regulations (49 CFR 213.321) require the maintenance of vegetation within project right-of-way in order to prevent fires and maintain visibility. The maintenance activities will be conducted by the FECR (owners of the project footprint). Maintenance activities include mowing vegetation as needed within the entire right-of-way to maintain a height of no more than 8 inches from 6 ft from the edge of the track roadbed to the brush line. Encroaching brush from the existing brush line will be trimmed back at least 5 ft each time the right-of-way is moved. Vegetation will be trimmed around all switches, signal houses, crossings, and bollards in the track right-of-way. Spraying of vegetation with herbicides to control vegetation will occur as needed within 12 ft of each track roadbed and around all signals and signal boxes. All created debris will be mulched and all trash found in the right-of-way will be picked up and properly disposed.

Phase II of the AAF Project is located in Palm Beach County, Martin County, St. Lucie County, Indian River County, Brevard County, and Orange County, Florida (Figure 1).

Information provided by FDEP staff at the SPSP indicated that the fragrant prickly-apple occurs in the AAF Project footprint from Midway Road to County Line Road in St. Lucie County, Florida. To minimize adverse effects to this species, AAF LLC will conduct the following conservation measures prior to construction of Phase II.

1. The consultants for AAF LLC will coordinate with staff from the SPSP, and other public conservation lands if necessary, in order to facilitate the translocation of any fragrant prickly-apple specimens that occur within Phase II of the AAF Project footprint to public conservation lands at the SPSP or other suitable protected lands agreeable to the Service.
2. All specimens of the fragrant prickly-apple found to occur in the Phase II footprint will be removed, relocated to the SPSP, and replanted.
3. Care will be taken not to injure or unduly stress the plants during the relocation process, and appropriate relocation techniques will be applied as needed to increase the potential for the successful relocation and long-term survival.

Action Area

The action area for Phase II of the AAF Project is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. Phase II will result in: the construction of an additional track within an existing railroad right-of-way from Miami to Cocoa; the extension of a double-tracked railroad from Cocoa to Orlando, and the construction and installation of ancillary facilities including stations and a maintenance facility; and the establishment high-speed passenger rail service consisting of 16 round trips per day from Miami to Orlando to Miami. The Service notes that the establishment of the AAF Project will increase noise and disturbance along lands adjacent to the rail corridor. However, the extent of the Phase II's effects to surrounding lands is difficult to discern. Consequently, the Service has established the action area for Phase II as all lands within the footprint, and all lands within 500 ft (152.4 m) of the footprint. The 500-ft (152.4 m) buffer is an estimate by the Service of how far disturbance (*i.e.*, noise from moving trains) that could potentially affect scrub-jays and other

wildlife is likely to extend from the project footprint. In addition, the action area includes all lands within the SPSP to account for the transplanting of fragrant prickly-apple specimens from the project footprint to the SPSP. The Service has determined that an action area of this size is sufficiently large to capture the direct and indirect effects resulting from Phase II of the proposed AAF Project.

Species not likely to be adversely affected by the proposed action

Eastern indigo snake

Phase II of the AAF Project is located in the geographic range of the eastern indigo snake. To protect this species during construction, the Corps agreed to include the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013) as a condition of their permit. The Corps determined the AAF Project may affect, but is not likely to adversely affect the eastern indigo snake. Based on the protective measures, the Service concurs with the Corps' determination for the eastern indigo snake. Critical habitat has not been designated for the eastern indigo snake.

West Indian manatee

Phase II of the AAF Project is located in geographic range of the West Indian manatee. Construction activities associated with Phase II may be located within waterways where the species may occur. To protect the West Indian manatee, the AAF LLC has agreed to follow the Florida Fish and Wildlife Conservation Commission's (FWC) *Standard Manatee Conditions for In-Water Work* during construction of the project (FWC 2011). Phase II will not result in impacts to seagrasses or West Indian manatee foraging sites. The Corps has determined that the AAF Project may affect, but is not likely to adversely affect the West Indian manatee. Based on the proposed protective measures, the Service concurs with this determination. West Indian manatee critical habitat will not be affected by the AAF Project.

Wood stork

Phase II of the AAF Project is located in the geographic range of the wood stork. According to the DEIS, the AAF Project will fill from 128 to 157 ac (51.8 to 63.5 ha) of wetlands, canals, and ditches that provide potential foraging habitat for the wood stork. The Corps determined that the AAF Project may affect, but is not likely to adversely affect the wood stork. The Service concurs with this determination based on the Corp's proper use of the key in our South Florida Programmatic Concurrence for the Wood Stork (Service 2010a). Prior to construction the AAF LLC will provide suitable foraging habitat compensation in accordance with the Habitat Management Guidelines for the Wood Stork in the Southeast Region (Service 2010a) to replace lost foraging value. Critical habitat has not been designated for the wood stork.

Lakela's mint

Phase II of the AAF Project is located in the geographic range of the Lakela's mint. Specimens of Lakela's mint were not observed in the project footprint during surveys conducted by AAF LLC's consultant. The Corps determined that the project may affect, but is not likely to adversely affect Lakela's mint. Based on the information provided, the Service concurs with the Corps determination for Lakela's mint. Critical habitat has not been designated for Lakela's mint.

STATUS OF THE SPECIES/CRITICAL HABITAT

This section summarizes biology and ecology of scrub-jay and fragrant prickly-apple as well as information regarding the status and trends of the species throughout their entire range. A thorough history of the biology and ecology of both the scrub-jay and fragrant prickly-apple can be found in the *South Florida Multi-Species Recovery Plan* (Service 1999).

Florida scrub-jay

Please see Enclosure A for the Status of the Species for the Florida scrub-jay. Critical habitat has not been designated for the scrub-jay; therefore, critical habitat will not be affected by the AAF Project.

Fragrant prickly-apple

Please see Enclosure B for the Status of the Species for the fragrant prickly-apple. Critical habitat has not been designated for the fragrant prickly-apple; therefore, critical habitat will not be affected by the AAF Project.

Analysis of the species/critical habitat likely to be affected

Phase II of the AAF Project has the potential to adversely affect the scrub-jay and fragrant prickly-apple. The project will increase the likelihood of injury or death of scrub-jays due to collisions with high-speed passenger trains, and increase disturbance to scrub-jays from noise related to the operation of the trains. Both species will be affected by habitat destruction as a result of the construction of the AAF Project. These threats will be analyzed more thoroughly below in the Effects of the Action section of this Biological Opinion.

ENVIRONMENTAL BASELINE

Status of the species within the action area

As stated previously, the action area is defined as all areas to be directly or indirectly affected by the Federal action, and not just the immediate area involved in the action. For the purposes of this consultation, the action area includes all lands within the project footprint, and all lands

within 500 ft [152.4 m] of the project footprint, and all lands within the SPSP in St. Lucie County, an area roughly estimated to be 18,711 acres (7,572 hectares) to 18,906 acres (7,653 hectares).

Florida scrub-jay

Scrub-jays have been documented in the action area within the Phase II AAF Project footprint. Scrub-jay call surveys were conducted by the AAF LLC's consultant within suitable habitat (*i.e.*, lands containing scrub oaks [*Quercus* spp.]) in the AAF Project footprint and lands immediately adjacent to the project footprint during March 2013, following the Service's survey guidance (Service 2004). Areas of suitable scrub-jay habitat occurred in Brevard, Indian River, St. Lucie, and Martin Counties. The majority of suitable scrub-jay habitat was found adjacent to the project footprint, and very little suitable habitat occurred within the AAF Project footprint. Scrub-jays were observed at the following locations:

Brevard County: 1) Approximately 0.2 and 0.3 mi (0.32 and 0.48 km) Southeast of Gus Hipp Boulevard and immediately west of AFF Project footprint within the Helen and Allen Cruickshank Sanctuary in Rockledge, Florida (Figure 2); 2) Approximately 0.79 mi (1.27 km), 0.85 mi (1.37 km) and 0.98 mi (1.58 km) southeast of Malabar Road and immediately west of the AAF Project footprint in Malabar, Florida (Figure 3); 3) Approximately 0.14 mi (0.22 km), 0.23 (0.37 km) and 0.35 mi (0.56 km) Northwest of Jordan Boulevard and immediately west of the AAF Project footprint in Malabar, Florida (Figure 3); 4) Approximately, 0.5 mi (0.8 km), 0.6 mi (0.97 km), 0.7 mi (1.13 km), and 0.8 mi (1.29 km) south of Jordan Boulevard and immediately west of the AAF Project footprint in Malabar, Florida (Figure 3); and 5) Approximately 0.52 mi (0.84 km), 0.67 mi (1.1 km), 0.96 mi (1.5 km), 1.23 mi (1.98 km), and 1.47 mi (2.37 km) south of Micco Road and immediately West of the AAF Project footprint in Micco, Florida (Figure 4).

Indian River County: Approximately 0.71 mi (1.14 km), 0.80 mi (1.29 km), 0.93 mi (1.50 km), 1.11 mi (1.77 km), and 1.2 mi (1.93 km) southeast of Roseland Road and immediately west of the AAF Project footprint in the North Sebastian Conservation Area, Sebastian, Florida (Figure 5).

St. Lucie County: 1) At the power lines approximately 2.3 mi (3.7 km) south of Midway Road and immediately west of the AAF Project footprint in SPSP, Port St. Lucie, Florida (Figure 6); 2) Approximately 0.36 mi (0.58 km) southeast of power lines and immediately west of the AAF Project footprint in the SPSP, Port St. Lucie, Florida (this record was not documented during survey, but provided by SPSP staff)(Figure 6); 3) Approximately1.32 mi (2.12 km) northwest of Walton Road and immediately west of the AAF Project in the SPSP, Port St. Lucie, Florida (Figure 6); 4) Approximately 0.5 mi (0.8 km) northwest of Walton Road and immediately west of the AAF Project footprint in the SPSP, Port St. Lucie, Florida (Figure 7); 5) Approximately 0.03 and 0.09 mi (0.05 and 0.14 km) southeast of Walton Road and immediately west of the AAF Project site in the SPSP, Port St. Lucie, Florida (Figure 7); and approximately 0.10 mi (0.16 km), 0.16 mi (0.26 km), and 0.20 mi (0.32 km) northwest of County Line Road and

immediately west of the AAF Project footprint in the SPSP in Port St. Lucie, Florida (this record was not documented during survey, but provided by FDEP staff) (Figure 8).

Martin County: 1) Approximately 0.45 mi (0.72 km) and 0.50 mi (0.8 km) southeast of the entrance to Hobe Sound National Wildlife Refuge Headquarters and adjacent to the AAF Project footprint in Johnathan Dickinson State Park (JDSP)(Figure 9); 2) Approximately 0.1 mi north of Johnathan Dickinson Way and immediately west of the AAF Project footprint in JDSP (Figure 9); 3) Approximately 0.9 and 0.95 mi (1.4 and 1.5 km) southeast of Jonathan Dickinson Way and immediately west of the AAF Project footprint in JDSP (Figure 9); and 4) approximately 0.43 mi (0.69 km) north, 0.31 mi (0.5 km) north-northeast, 0.21 mi (0.34 km) northeast, and 0.17 mi (0.27 km) east-northeast of the Johnathan Dickinson Missile Tracking Annex facility and immediately west of the AAF Project footprint (Figure 9).

In summary, the survey results demonstrate that scrub-jays were mostly observed outside of, and adjacent to, the AAF Project footprint. In a few cases, scrub-jays were observed crossing the existing rail track to investigate the source of the scrub-jay calls being broadcast during the survey. Scrub-jays were observed at 33 locations including 15 in Brevard County, 5 in Indian River County, 13 in St. Lucie County, and 9 in Martin County. The number of scrub-jay territories, the number of birds in each territory, and the spatial extent of each territory were not determined during the surveys. However, based on the survey results the Service estimates that the AAF Project footprint passes near at least 16 to 19 active scrub-jay territories.

Fragrant prickly-apple

Information provided by FDEP staff from the SPSP indicate that at least 190 specimens of the fragrant prickly-apple were observed within 50 ft of the center line of the existing railroad track during a survey of the project footprint from Midway Road to County Line Road in March 2015. The FDEP indicated that many additional specimens of the fragrant prickly-apple were likely missed because the survey focused on areas known to contain high densities of cactus.

Factors affecting the species environment within the action area

Florida scrub-jay

Habitat for the scrub-jay in the action area has been lost due to residential and commercial development, and degraded due to the lack of fire or vegetation management. Expected human population growth and associated development in the action area threatens remaining scrub-jay habitat. The overgrowth of vegetation in scrub habitats is known to significantly reduce the quality of these habitats to scrub-jays (Breininger et al. 1996; Fitzpatrick et al. 1991; Woolfenden and Fitzpatrick 1996). Scrub-jays are adapted to early successional habitat conditions. Lack of fire or vegetation management results in the loss of open areas scrub-jays use to cache acorns and forage for prey. Moreover, overgrown vegetation in scrub habitats provides more favorable conditions for predators and competitors of scrub-jays (Miller and Stith 2002).

Roads and highways within the action area represent a potential threat of injuries or mortalities to scrub-jays resulting from collisions with motor vehicles. Scrub-jays are a vagile and low-flying species that, by habit, seldom move a significant distance away from their territory. Therefore, it's possible that scrub-jays may adapt to the presence of motor vehicle traffic in the action area. However, ongoing population growth accompanied by more development will likely increase the number of roadways built and motor vehicle used in the action area. This in turn will increase the potential that scrub-jays will be struck and injured or killed due to collisions with motor vehicles.

Fragrant prickly-apple

The fragrant prickly-apple is affected by similar factors within the action area as described for the scrub-jay above. Habitat for the fragrant prickly-apple in the action area has been lost due to residential and commercial development, and degraded due to the lack of fire or vegetation management. Individual plants and plant clusters are also killed and removed as habitat is lost and degraded. The expected population growth and associated development in the action area threatens fragrant prickly-apple and its remaining habitat.

In addition, the presence of invasive and exotic invasive plant species has resulted in the loss of habitat for the fragrant prickly-apple. Exotic plants such as Brazilian pepper (*Schinus terebinthifolius*) form dense stands that reduce or cover areas where fragrant prickly-apple plants could establish.

Climate Change

Our analyses under the Act include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel on Climate Change (IPCC), "climate" refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time; thus "climate change" refers to a change in such a measure which persists for an extended period, typically decades or longer, due to natural conditions (*e.g.*, solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450). Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC (2014 and citations therein). Information for the United States at national and regional levels is summarized in the National Climate Assessment (Melillo *et al*. 2014 entire and citations therein; see Melillo *et al.* 2014, pp.28-45 for an overview). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it (See Melillo *et al*. 2014, Appendix 3, pages 760-763 for a discussion of climate modeling, including downscaling). In our analysis, we use our expert

judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

Climate change may result in an increase in the intensity or frequency of tropical storms and hurricanes in Florida. Since small scrub-jay populations are more vulnerable to these events, they may be extirpated at an increased rate. The Atlantic Multi-decadal Oscillation (AMO) influences rain patterns in Florida. We are currently in an AMO wet phase that is predicted to persist through 2020 (Service 2010b). The increased rainfall associated with this phase could reduce our ability to effectively use prescribed burning to manage habitat in optimal conditions for scrub-jays and may negatively affect breeding success of scrub-jays should rain events occur during nesting season.

It is not clear what effect increases in frequency and amount of rainfall associated with climate change and the wet phase of the AMO may have on the fragrant prickly-apple. Additional rainfall could benefit the species by providing more favorable conditions for seedling establishment. Conversely, additional rainfall may facilitate the growth of competing plant species, increasing shading and resulting in the death of existing plants or preventing the establishment of new individuals.

It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

EFFECTS OF THE ACTION

Factors to be considered

Florida scrub-jay and fragrant prickly-apple

The Phase II AAF Project site contains scrub-jay and fragrant prickly-apple habitat. Both species are currently found within portions of the proposed construction footprint and additional scrub-jay locations are known adjacent to the footprint. The timing of construction for this project relative to sensitive periods of the species' life cycle is unknown. However, given the size and scope of the AAF Project it is likely that is the project construction will occur throughout the year over 2 to 3 years and, therefore, will overlap with the breeding season of the scrub-jay. Construction of Phase II of the AAF Project will alter soils and vegetation within the project footprint, and the operation of trains associated with the project will result in ongoing disturbance. The disturbance to scrub-jays from the operation of the AAF Project and habitat loss from construction will be permanent. For fragrant prickly-apple, the project represents a loss of currently available habitat for this species, which may be permanent, although the possibility exists that the fragrant prickly-apple could reestablish itself following completion of construction activities within the disturbed land remaining in the project footprint.

Effects of the action

The AAF Project will add a second railroad track to the existing rail corridor from West Palm Beach to Cocoa, add a new railroad track from Cocoa to Orlando, and introduce new high-speed rail passenger service (32 one-way trips per day) from Miami to Orlando.

Florida scrub-jay and fragrant prickly-apple

Beneficial effects: Beneficial effects are those effects of the proposed action that are completely positive, without any adverse effects to the listed species or its critical habitat. The proposed action is not anticipated to result in any beneficial effects to the scrub-jay or the fragrant prickly-apple.

Interrelated and interdependent actions: An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that does not have independent utility apart from the action under consultation. Interrelated or interdependent actions are not expected to result from the project.

Florida scrub-jay

Direct effects: Direct effects are those immediate effects of the project on the species or its habitat. Much of the Phase II AAF Project footprint adjacent to the active scrub-jay territories described above already consists of an active railroad bed. The vegetated portions of the project footprint in many of these areas consist primarily of thick stands of the exotic shrub Brazilian pepper with some native vegetation. Construction will remove some vegetation that may be used by scrub-jays for perching as they move back and forth across the right-of-way. Overall, the project will result in a minimal loss of habitat for the scrub-jay. AAF LLC provided compensation for impacts to scrub-jay habitat through the acquisition of 2 ac (2 credits) from Morgan Lake Wales Conservation Bank in Highlands County, Florida.

The installation of a new railroad track will temporarily increase disturbance to scrub-jays adjacent to the project footprint. Construction will require use of some motor vehicles in the project footprint for minor land clearing and preparation of the new track bed; most construction materials will be brought to the construction site by rail. Human activity within the project footprint due to the construction activities will also increase temporarily. Scrub-jays may avoid the project footprint during construction activities due to the increased noise and human activity. However, because the birds that occupy the area currently are subject to a large amount of the noise from the freight trains, and scrub-jays are known to be tolerant of human activity, the birds are expected to, at most, shift the use of their territories to avoid the additional disturbance, and are not anticipated to abandon their territories. Consequently, the Service does not anticipate that the disturbance from construction activities will adversely affect scrub-jays.

The operation of the AAF Project is likely to increase the amount of disturbance (*i.e.*, noise) experienced by scrub-jays occurring in the action area. According to the DEIS for the AAF Project, existing freight trains in the project footprint generate noise levels of 67 decibels at a distance of 50 ft (15.2 m) from the tracks. The amount of noise in decibels provided by the high-speed passenger rail locomotives was not provided in the DEIS. However, passenger trains travel at significantly greater speeds than freight trains and are expected to generate greater noise levels. The operation of additional rail traffic associated with the AAF Project will increase the amount and frequency of noise and vibrations currently experienced by scrub-jays in the area. Due to the operation schedule of the AAF Project, the increase in disturbance due to high-speed train traffic will occur only within daylight hours. The effects of anthropogenic noise, including noise from trains, on scrub-jays, as well as birds in general, are not well understood. To our knowledge, there have been no studies that have specifically assessed the effects of train noise on the scrub-jay, and it is unclear how scrub-jays will respond to the additional noise resulting from the AAF Project. Studies investigating effects of road noise from cars provide some insight on potential effects. The U.S. Department of Transportation Federal Highway Administration (FHWA 2004) reported a synthesis of the effects of road noise on wildlife species including birds and found variable responses among avian species. The most comprehensive experimental studies on the effects to birds (Foppen and Reijnen 1994, Reijen et al. 1987, Reijnen and Foppen 1994, Reijnen and Foppen 1995, Reijen et al. 1995, Reijen et al. 1996) demonstrate that many species of small breeding birds in both grassland and forest habitats appear to avoid areas in proportion to the traffic noise and volume at distances up to 1.86 mi (3 km). However, other studies that reviewed an extensive number of species found most species were neutral and a few species actually increased in numbers adjacent to roads, presumably due to food or habitat provided by rights-of-way (Adams and Geis 1981). Road noise presents a constant disturbance in the environment due to the volume of car traveling the roadways compared to the episodic passing of the trains from the AAF Project. Therefore, scrub-jays have the opportunity to occupy the habitat adjacent to the train tracks without any disturbance from the AAF Project intermittently throughout the day and through the entire night. Based on the available information, the Service anticipates that it is likely that scrub-jays will increase their avoidance of the project footprint to some extent. The effect of the avoidance is unknown but, in a worst-case scenario, the avoidance could ultimately result in the reduction or loss of territories and, consequently, a loss of reproductive productivity.

The AAF Project is likely to increase the probability that scrub-jays will be injured or killed due to collisions with trains. Although scrub-jays were not observed forging within the project footprint during call surveys conducted by the AAF LLC's consultant, it is reasonable to expect that scrub-jays occasionally occur within the project footprint perching on existing vegetation or foraging to the ground. In addition, scrub-jays were observed flying over the railroad corridor in some instances. Currently, scrub-jays occurring in and adjacent to the project footprint in the action area are exposed to relatively slow-moving freight train traffic. A total of 10 to 14 freight trains per day travelling at average speeds of 23 to 33 mph (37 to 53 kph) occur within the project footprint. Mumme et al. (2000) found that scrub-jays living adjacent to roads acclimated or "learned" about the road within 2 years; therefore, the Service expects that scrub-jays

occupying this area are acclimated to the presence of the freight train traffic. These birds likely detect and avoid the relatively slow moving freight trains.

The AAF Project will greatly increase rail traffic within the occupied scrub-jay areas and the new rail traffic will be moving at a significantly higher rate of speed. The AAF Project rail service from Miami to Orlando will increase rail traffic by 16 round-trip high-speed passenger train trips per day (32 one-way trips). Operating speeds will range from 79 to 125 mph (127.1 to 201.2 kph). The addition of high-speed passenger train traffic in the action area will likely result in the injury or death of some scrub-jays due to collisions with trains. We anticipate that the probability of a bird being struck will be greatest immediately after the high-speed rail service begins because individuals adapted to the slow moving trains will not have acclimated to the movement of the high-speed trains and will be more likely to misjudge the trains and collide. Based on what was observed along the road-side, we expect that over time scrub-jays will adapt to the presence of the high-speed rail traffic and improve their avoidance of the passenger trains.

Indirect Effects: Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Effects from the trains' operation (*e.g.*, disturbance) on scrub-jays were considered as a direct effect (discussed above). As such, the proposed action is not anticipated to result in any additional indirect effects to scrub-jays.

Fragrant prickly-apple

Direct Effects: Phase II of the AAF Project will result in the direct loss of habitat for the fragrant prickly-apple where the species is known to occur within the action area in St. Lucie County. Individual plants may be killed or damaged due to land clearing and construction activities as the existing habitat for this plant species is converted to a railroad track with rock base and maintained as a right-of-way. Land clearing will kill any plant specimens and destroy or disrupt the seed beds of fragrant prickly-apple within the project footprint. To minimize AAF Project's effects to fragrant prickly-apple, all known specimens in the project footprint (survey results indicated 190 specimens but transplanting will include any plants found at the time of transplanting) will be removed and replanted in the SPSP. It is possible that some of the specimens will be stressed during the removal and relocation procedures and will not survive after they are replanted in the SPSP. However, due to the experience of staff at the SPSP at relocating plants, the Service anticipates that most of the fragrant prickly-apple specimens moved into the SPSP will survive. The possibility also exists that a few of the specimens of fragrant prickly-apple occurring in the project footprint will not be detected and will be killed or damaged by the land clearing activities associated with the AFF Project.

The fragrant prickly-apple is not expected to occur in the project footprint following construction; therefore, the AAF Project may contribute to the continued fragmentation of habitat for the fragrant prickly-apple in the region and result in a small reduction of the geographic distribution of these species. However, it is possible that in the future the fragrant prickly-apple may re-establish itself in the small amount of disturbed land that exists in the AAF Project corridor due to the species' ability to reproduce vegetatively from broken stems of existing

plants. If plants do not reestablish, the AAF Project may affect persistence of this species in the action area.

Indirect Effects: As stated above, it is possible that fragrant prickly-apple plants could re-establish themselves in the action area sometime in the future. It is also possible that the disturbed area adjacent to tracks will become occupied with invasive and exotic invasive plant species. These plants, such as Brazilian pepper, often form dense stands and can exclude fragrant prickly-apple plants from re-establishing. If fragrant prickly-apple re-establishes within the right-of-way, maintenance activities associated with the project could result in the loss of plants that recolonize. For example, maintenance materials or equipment could be inadvertently placed on specimens and crush them. We recommend that AAF LLC develop a maintenance plan that prevents the establishment of invasive exotics and identifies the potential for federally listed plants recolonizing the right-of-way. The plan should include education for maintenance staff to advise them how to identify listed plant species and take appropriate actions during maintenance activities to ensure they are not affected.

Species response to the proposed action

Florida scrub-jay

Scrub-jays may respond to the construction activity by temporarily avoiding lands near AAF Project footprint. The temporary avoidance is not anticipated to adversely affect the local scrub-jays. Following completion of the construction, scrub-jays may respond to the operational disturbance (*e.g.*, noise and vibration) from the additional high-speed train traffic by: 1) adapting to the disturbance and persisting within their existing territory; 2) avoiding lands near the train tracks and either reducing the size of their territory or expanding their territory to include xeric uplands in the action area; 3) abandoning their existing territory and establishing a completely new territory within xeric uplands in the action area; or 4) abandoning their existing territory and failing to establish a new territory. Consequently, the possibility exists that the disturbance from operation of the AAF Project could reduce foraging areas available to scrub-jays (based on avoidance behavior) or cause scrub-jays to abandon their territories, and ultimately reduce reproductive success and scrub-jay numbers. Based on our observations of scrub-jays adapting to disturbances along the current rail tracks and the species tolerance of disturbance in other localities (*e.g.*, adjacent to roads), the Service finds it reasonably likely that scrub-jays will adapt to the presences of the new trains and will not suffer any adverse effects from noise or vibration. However, the possibility exists that scrub-jays will increase their avoidance the rail corridor to some extent.

As stated above, the addition of high-speed passenger rail traffic in the action area will likely result in the injury or death of at least some of the scrub-jays that occur near the train tracks due to collisions with trains. Although there are no studies of scrub-jay survivorship along train tracks, Mumme et al. (2000) found that scrub-jays living along roads experience a significantly higher mortality rate than scrub-jays living away from roads. Over the 9-year study, annual mortality of the breeding birds adjacent to the roads was 0.375± 0.030 [posted speed limit

55 mph (89kph)]. Mortality decreased as birds acclimated to living adjacent to the roads and the likelihood of mortality for breeding birds decreased after 2 years (Mumme et al. 2000). Mumme et al. (2000) also found that juveniles that fledged from territories adjacent to the roads experienced elevated mortality above juveniles fledged away from roads between ages of 30 to 90 days, as they were approaching independence.

The number and frequency of trains in Phase II of the AAF Project will be less than the number and frequency of cars that traveled the road in the Mumme et al. (2000) study. However, the speeds of the trains will be significantly greater. We estimate that the action area includes 16 to 19 active territories. Based on scrub-jay biology each active territory could have a family group of 2 to 8 individuals. For the purposes of this biological opinion, we will assume that there are 16 family groups with 3 individuals, for a total of 48 scrub-jays adjacent to the project footprint. We anticipate that the high-speed trains may have a higher mortality rate for scrub-jays than cars [0.375$\pm$ 0.030 breeders per year (Mumme 2000)] because of their increased speed, the length of the train and associated turbulence, and the inability of scrub-jays to maneuver to avoid an object traveling 79 to 125 mph (127.1 to 201.2 kph). Therefore, we anticipate that annual mortality of all scrub-jays (breeders and young) could be 1 individual annually, 2 percent of the adjacent population. Because the high-speed train will be a novel addition to the environment, we anticipate that during the first 2 years of operation the rate of mortality will be greater: up to 3 individuals (breeders and young) per year, 6 percent of the adjacent scrub-jay population. These mortality rates may be a conservative estimate because scrub-jays in the area are already familiar with freight trains in these areas; however, without data on high-speed trains, the Service finds this to be appropriate based on the best available data. This loss of individuals, 3 per year for the first 2 years and 1 individual per year thereafter, is not anticipated to result in the loss of any of the active territories along the AAF Project, and therefore, will not result in a decrease in the overall range of the species.

Fragrant prickly-apple

As discussed above, the specimens of the fragrant prickly-apple that occur in the AFF Project footprint will be removed and relocated to protected conservation lands in the SPSP. It is possible that some of the specimens will be stressed during the removal and relocation procedures, and will not survive after they are replanted in the SPSP. However, due to the experience of staff at the SPSP at relocating plants, the Service expects that most of the fragrant prickly-apple specimens moved into the SPSP will survive. The possibility also exists that a few of the specimens of fragrant prickly-apple occurring in the project footprint will not be detected, and will be killed or damaged by the land clearing activities associated with the AFF Project. Although most of the project footprint will be transformed into railroad tracks and associated track beds, it is possible that in the future individual plants could reestablish from the seed bank or vegetatively within the small amount of open disturbed land that will remain. The potential for plants to re-establish could be hampered if exotic plants establish and prevent fragrant prickly-apple from growing or maintenance activities inadvertently kill individual plants.

CUMULATIVE EFFECTS

Florida scrub-jay and fragrant prickly-apple

The Service defines cumulative effects considered in this Biological Opinion as the effects of future State, Tribal, local, or private actions (*i.e.*, non-Federal actions) reasonably certain to occur in the action area. Our definition of cumulative effects does not include future Federal actions unrelated to the proposed action because these actions require separate consultation pursuant to section 7 of the Act.

Anticipated future county (local) actions in the action area that will adversely affect the scrub-jay and fragrant prickly-apple habitat include the issuance of county building permits. Permits to construct single-family homes and commercial buildings within the action area are required by Brevard County, Indian River County, St. Lucie County, and Martin County. Many of the construction projects impacting scrub-jay habitat in the action area will require both a county building permit and a Corps permit, and will require consultation under section 7 of the Act. A small proportion of construction projects requiring county building permits will not impact wetlands and will not require a permit from the Corps. We are unaware of any non-federal actions that are reasonably certain to occur in the action area. Consequently, the proposed action has no associated cumulative effects.

CONCLUSION

After reviewing the current status of the scrub-jay and the fragrant prickly-apple, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Phase II AAF Project, as proposed, is not likely to jeopardize the continued existence of the scrub-jay or the fragrant prickly-apple. We have reached this conclusion because: 1) the AAF Project will not result in a significant loss of scrub-jay habitat; 2) the mortality of scrub-jays due to collisions with trains is a small fraction of the number of birds occupying the area and will not result in the loss of any existing territories; 3) scrub-jays are anticipated to acclimate to the presence of the high-speed passenger trains over time, thereby reducing the level of anticipated scrub-jay mortality; and 4) AAF LLC will translocate fragrant prickly-apple specimens found in the project footprint; therefore, few individuals are expected to be lost. Critical habitat has not been designated for these species and will not be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act 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 to attempt to engage in any such conduct." "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 that include, but are not limited to, breeding, feeding, or sheltering. "Harm" is 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. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of 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 prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the AAF LLC, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the AAF LLC to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps 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)].

Sections 7(b)(4) and 7 (o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE

Florida scrub-jay

Operation of the AAF Project is expected to result in incidental take of scrub-jays from collisions with trains that injure or kill scrub-jays. The amount of incidental take of scrub-jays resulting from the AAF Project is difficult to quantify; however, based on the annual mortality rate of scrub-jays along roads, we estimate that as much as 6 percent of the population or 3 individuals will be injured or killed per year for the first 2 years, and 2 percent of the population or 1 individual per year will be killed thereafter for the life of the project. We anticipate the number individuals taken due to collision will decrease overtime as the scrub-jays in the territories adjacent to the AAF Project acclimate to the trains over time. The Service has determined that this amount of anticipated take is not likely to result in jeopardy to the species. If this amount of take is exceeded during the course of this action, such take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide modification of the reasonable and

prudent measures. Because of the difficulty in detecting individual bird mortalities along the train right-of-way through monitoring (due to detection of individuals, scavenging, etc.) the Service will use the number of trains per day (32 one-way trips) as a threshold for take. In addition, the Service is providing a Term and Condition to monitor at least 8 of the active scrub-jay territories along Phase II of the AAF Project to ensure that the loss of individual birds associated with the AAF Project does not result in the loss of an active territory. Consequently, any increase in the number operational trains for Phase II of the AAF Project above 32 one-way passenger trains per day or any loss of a monitored territory will be considered exceedance of the amount of incidental take authorized in this Biological Opinion and will require re-initiation of consultation under the Act.

Fragrant prickly-apple

As indicated above, Sections 7(b)(4) and 7 (o)(2) of the Act generally do not apply to Federally listed plant species. Consequently, the fragrant prickly-apple will not be discussed further in this incidental take statement.

Effect of the Take

In the accompanying Biological Opinion, the Service determined the level of anticipated take is not likely to result in jeopardy to the scrub-jay. Critical habitat has not been designated and will not be affected.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service finds the following reasonable and prudent measures are necessary and appropriate to reduce take and to minimize the effects of the proposed project on the scrub-jay:

1. Ensure that the level of incidental take anticipated in this Biological Opinion is commensurate with the analysis contained herein.
2. Ensure staging areas identified for the AAF Project do not affect any federally listed species.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and AAF LLC must comply with the following terms and conditions that implement the reasonable and prudent measures described above and outline monitoring and reporting requirements. These terms and conditions are non-discretionary.

1. The following term and condition implements reasonable and prudent measure 1:
    a. AAF LLC must develop a monitoring program prior to operation of Phase II for at least 8 active scrub-jay territories along the AAF Project. The purpose of the monitoring program is to verify that the scrub-jay territories remain active when all 32 one-way train trips are operating, demonstrating that take has not been exceeded.
    b. The monitoring program will be implemented for at least 3 years, at the beginning of the operation of the 32 one-way trips, when mortality of scrub-jays is anticipated to be greatest.
    c. The monitoring plan must select territories that represent multiple areas along the track (*i.e.*, multiple Counties).
    d. The Service must approve the monitoring program prior to implementation.

2. The following term and condition implements reasonable and prudent measure 2:
    a. When the staging areas are identified the Corps or the FRA will need to determine if any federally listed species may be affected by the action and notify the Service prior to proceeding.

MONITORING AND REPORTING REQUIREMENTS

Pursuant to 50 Code of Federal Regulations 402.14(i)(3), the Corps and AAF LLC must provide adequate monitoring and reporting to determine if the amount or extent of take is approached or exceeded. AAF LLC must provide an annual report notifying the Service as to the number of daily train trips in operation (*i.e.*, train trips per day). AAF LLC must also provide an annual report to the Service detailing the monitoring of the 8 scrub-jay territories and their status.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office: U.S. Fish and Wildlife Service; 1339 20th Street, Vero Beach, Florida; 772-562-3909. Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission: South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002. Care should be taken in handling sick or injured specimens to ensure effective treatment and in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens, or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following:

1. To minimize the adverse effects to the fragrant prickly-apple the Service recommends the following:
    a. The translocation plan for the fragrant prickly-apple should be submitted to the Service for review and approval a minimum of 90 days prior to the anticipated translocation activities. The Service recommends working with an entity experienced in cactus translocation in developing the plan.
        i. The translocation plan should establish success criteria for survival of fragrant prickly-apple following translocation.
        ii. Material broken-off of fragrant prickly-apple specimens during translocation should be salvaged for future propagation.

    b. To minimize ongoing take of fragrant prickly-apple within the right-of-way AAF LLC should develop a right-of-way maintenance plan that prevents the establishment of invasive exotics and identifies the potential for federally listed plants to recolonize the right-of-way.
        i. The plan should include education for maintenance staff that advises them how to identify listed plant species and implement appropriate actions during maintenance activities to ensure they are not affected.

2. AAF LLC should develop education material for passengers about native Florida wildlife species; the scrub-jay and fragrant prickly-apple should be highlighted. This education material should be made available at the train stations and on plaques on the trains.

REINITIATION NOTICE

This concludes formal consultation on the AAF 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 (see below); (2) 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; (3) 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 (4) a new species is listed or critical habitat designated that may be affected by the action. The amount of incidental take authorized by this consultation may be exceeded should impacts from the proposed project

increase or mitigation fail to provide habitat values proposed and analyzed within this Biological Opinion. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation and effort in protecting federally listed species and fish and wildlife resources. If you have any questions regarding this project, please contact John Wrublik at 772-469-4282.

Sincerely yours,

for Roxanna Hinzman
Field Supervisor
South Florida Ecological Services Office

Enclosures

cc: w/enclosures (electronic copy only)
Corps, Cocoa, Florida (Andrew Phillips)
EPA, West Palm Beach, Florida (Ron Miedema)
FWC, Tallahassee, Florida (FWC-CPS)
NOAA Fisheries, West Palm Beach, Florida (Brandon Howard)
Service, St. Petersburg, Florida (Todd Mecklenborg)
Service, Vero Beach, Florida (Robert Register)

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Figure 1. Location map of AAF Project in Florida.

Figure 2. Locations where scrub-jays were observed near AAF Project corridor in Rockledge, Brevard County Florida during March 2013 surveys.

Figure 3. Locations where scrub-jay were observed near AAF Project corridor in Malabar, Brevard County Florida during March 2013 surveys.

Figure 4. Locations where scrub-jay were observed near AAF Project corridor in Micco, Brevard County Florida during March 2013 surveys.

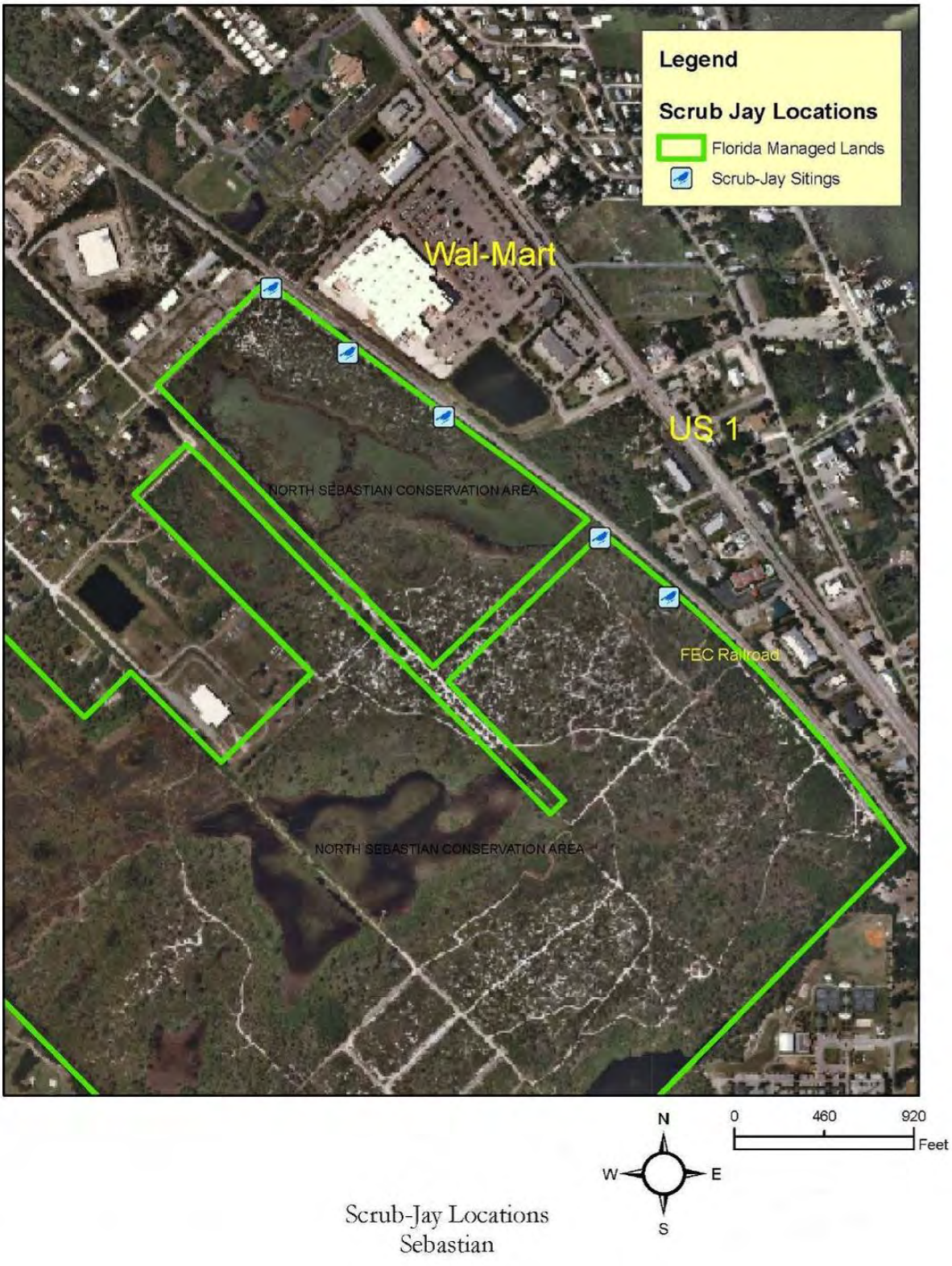

Figure 5. Locations where scrub-jays were observed near AAF Project corridor in Indian River County, Florida during March 2013 surveys.

Figure 6. Locations where scrub-jay were observed near AAF Project corridor in St. Lucie County, Florida during March 2013 surveys.

Figure 7. Locations where scrub-jays were observed near AAF Project corridor in St. Lucie County, Florida during March 2013 surveys.

Figure 8. Locations where scrub-jays were observed near AAF Project corridor in St. Lucie County, Florida during March 2013 surveys.

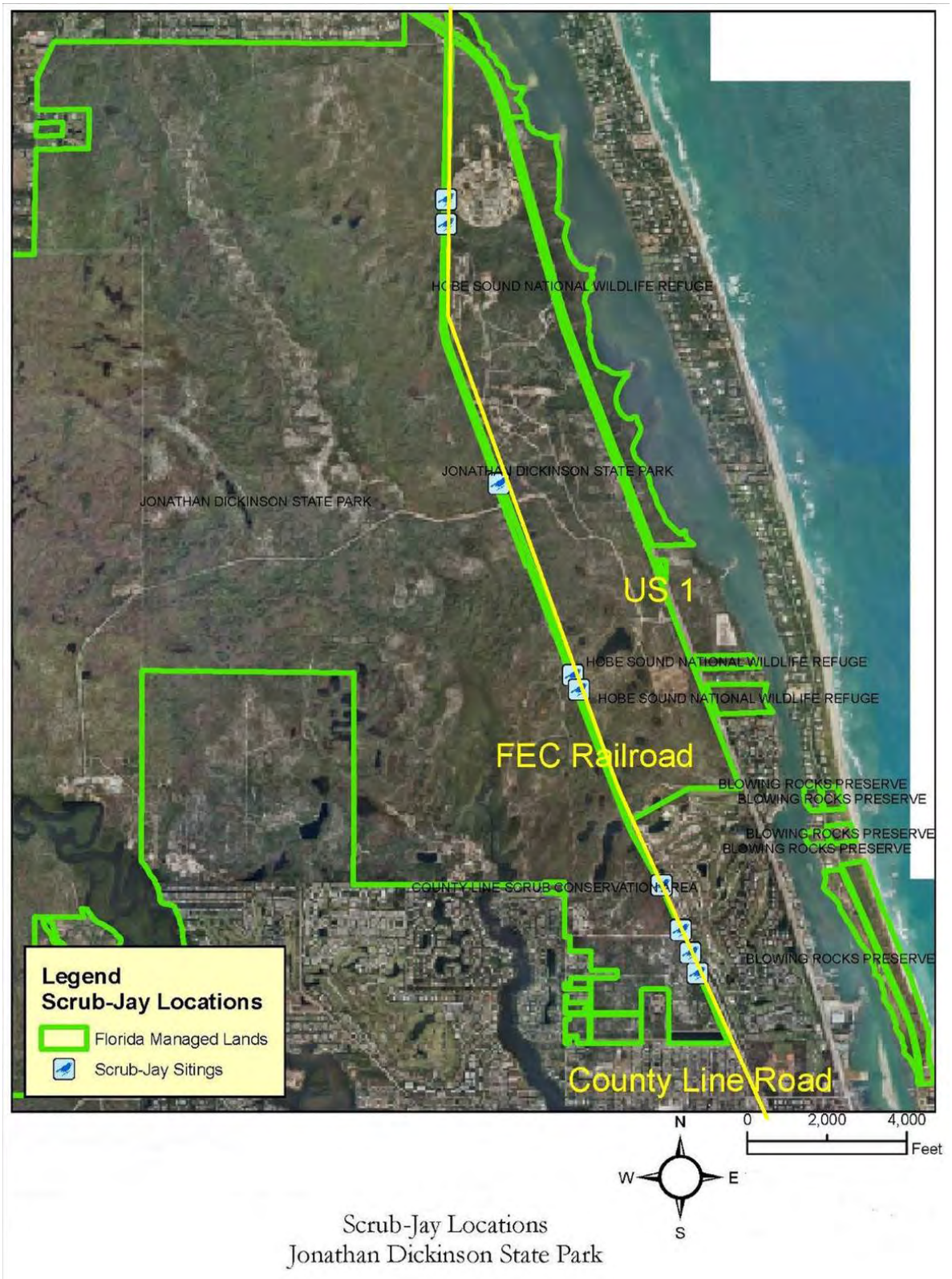

Figure 9. Locations where scrub-jay were observed near AAF Project corridor in Martin County, Florida during March 2013 surveys.

STATUS OF THE SPECIES – Florida Scrub-jay (*Aphelocoma coerulescens*)

Legal Status – Federal: *threatened* State: *threatened*

The U.S. Fish and Wildlife Service (Service) listed the Florida scrub-jay as threatened under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.) on June 3, 1987 (52 FR 20715 20719).

Species Description

Appearance

Florida scrub-jays are about 10 to 12 inches long and weigh about 3 ounces. They are similar in size and shape to blue jays (*Cyanocitta cristata*), but differ significantly in coloration (Woolfenden and Fitzpatrick 1996a). Unlike the blue jay, the scrub-jay lacks a crest. It also lacks the conspicuous white-tipped wing and tail feathers, black barring, and bridle of the blue jay. The scrub-jay's head, nape, wings, and tail are pale blue, and its body is pale gray on its back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-gray "bib" (Woolfenden and Fitzpatrick 1996a). Scrub-jay sexes are not distinguishable by plumage (Woolfenden and Fitzpatrick 1984), and males, on the average, are only slightly larger than females (Woolfenden 1978). The sexes may be identified by a distinct "hiccup" call made only by females (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1986). Scrub-jays that are less than about 5 months of age are easily distinguishable from adults; their plumage is smoky gray on the head and back, and they lack the blue crown and nape of adults. Molting occurs between early June and late November and peaks between mid-July and late September (Bancroft and Woolfenden 1982). During late summer and early fall, when the first basic molt is nearly done, fledgling scrub-jays may be indistinguishable from adults in the field (Woolfenden and Fitzpatrick 1984).

Taxonomy

Scrub-jays are in the order Passeriformes and the family Corvidae. They have been called a "superspecies complex" and described in four groups that differ in geographic distribution within the United States and Mexico: *Aphelocoma californica*, from southwestern Washington through Baja California; *A. insularis*, on Santa Cruz in the Channel Islands, California; *A. woodhousii*, from southeastern Oregon and the Rocky Mountains and Great Plains to Oaxaca, Mexico; and *A. coerulescens* in peninsular Florida [American Ornithologists' Union (AOU) 1983]. Other jays of the same genus include the Mexican jay or gray-breasted jay (*A. ultramarina*) and the unicolored jay (*A. unicolor*) of Central America and southwest North America (Woolfenden and Fitzpatrick 1996b).

The Florida scrub-jay, which was originally named *Corvus coerulescens* by Bosc in 1795, was transferred to the genus *Aphelocoma* in 1851 by Cabanis. In 1858, Baird made *coerulescens* the type species for the genus, and it has been considered a subspecies (*A. c. coerulescens*) for the past several decades (AOU 1957). It recently regained recognition as a full species (Florida scrub-jay, *Aphelocoma coerulescens*) from the AOU (AOU 1995) because of genetic, morphological, and behavioral differences from other members of this group: the western scrub-jay (*A. californica)* and the island scrub-jay *(A. insularis)*. The group name is retained for species in this complex; however, it is now hyphenated to "scrub-jay" (AOU 1995). This species account references the full species name, *A. coerulescens*, as listed in the Federal Register (Service 1987), and from here on in the document, Florida scrub-jays will be referred to as scrub-jays.

Life History

Scrub-jays have a social structure that involves cooperative breeding, a trait the other North American species of scrub-jays do not show (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1990). Scrub-jays live in families ranging from two birds (a single-mated pair) to extended families of eight adults (Woolfenden and Fitzpatrick 1984) and one to four juveniles. Fledgling scrub-jays stay with the breeding pair in their natal (birth) territory as "helpers," forming a closely-knit, cooperative family group. Prebreeding numbers are generally reduced to either a pair with no helpers or families of three or four individuals (a pair plus one or two helpers) (Woolfenden and Fitzpatrick 1996a).

Scrub-jays have a well-developed intrafamilial dominance hierarchy with breeder males most dominant, followed by helper males, breeder females, and, finally, female helpers (Woolfenden and Fitzpatrick 1977; Woolfenden and Fitzpatrick 1984). Helpers take part in sentinel duties (Woolfenden and Fitzpatrick 1984; McGowan and Woolfenden 1989), territorial defense (Woolfenden and Fitzpatrick 1984), predator-mobbing, and the feeding of nestlings (Stallcup and Woolfenden 1978) and fledglings (Woolfenden and Fitzpatrick 1984; McGowan and Woolfenden 1990). The well-developed sentinel system involves having one individual occupying an exposed perch watching for predators or territory intruders. When a predator is seen, the sentinel scrub-jay gives a distinctive warning call (McGowan and Woolfenden 1989; McGowan and Woolfenden 1990), and all family members seek cover in dense shrub vegetation (Fitzpatrick *et al.* 1991).

Scrub-jays are non-migratory and permanently territorial, occupying multipurpose territories year-round (Woolfenden and Fitzpatrick 1978; Woolfenden and Fitzpatrick 1984; Fitzpatrick *et al.* 1991). Territory size averages 22 to 25 acres (Woolfenden and Fitzpatrick 1990; Fitzpatrick *et al.* 1991), with a minimum size of about 12 acres (Woolfenden and Fitzpatrick 1984; Fitzpatrick *et al.* 1991). The availability of territories is a limiting factor for scrub-jay populations (Woolfenden and Fitzpatrick 1984). Because of this limitation, nonbreeding adult

males may stay in their natal territory as a helper for up to 6 years, waiting for either a mate or territory to become available (Woolfenden and Fitzpatrick 1984). Regardless, to become a breeder, a scrub-jay must find a territory and a mate.

Scrub-jays can become established with a territory as breeders in several ways:

1. By replacing a breeder on a non-natal territory (Woolfenden and Fitzpatrick 1984);
2. Through "territorial budding," where a helper male becomes a breeder in a segment of its natal territory (Woolfenden and Fitzpatrick 1978);
3. By inheriting their natal territory following the death of a breeder;
4. By establishing a new territory between existing territories (Woolfenden and Fitzpatrick 1984); or
5. Through "adoption" of an unrelated helper from a neighboring family to replace the resident breeder (Woolfenden and Fitzpatrick 1984).

New territories can also be created by human intervention by way of restoring habitat through effective habitat management efforts in areas that are overgrown (Thaxton and Hingtgen 1994).

Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that scrub-jays are monogamous. The pair retains ownership and sole breeding privileges in its particular territory year after year. Courtship to form the pair is lengthy and ritualized and involves posturing and vocalizations made by the male to the female (Woolfenden and Fitzpatrick 1996b). Copulation between the pair is generally out of sight of other scrub-jays (Woolfenden and Fitzpatrick 1984). Woolfenden and Fitzpatrick reported never observing copulation between unpaired scrub-jays or courtship behavior between a female and a scrub-jay other than her mate. Age at first breeding in the scrub-jay varies from 1 to 7 years, although most individuals become breeders between 2 and 4 years of age (Fitzpatrick and Woolfenden 1988). Persistent breeding populations of scrub-jays exist only where there are scrub oaks in sufficient quantity and form to provide an ample winter acorn supply, cover from predators, and nest sites during the spring (Woolfenden and Fitzpatrick 1996b).

Nests are typically constructed in shrubby oaks, at a height of 1.6 to 8.2 feet (Woolfenden 1974). Sand live oak (*Quercus geminate*) and scrub oak (*Q. inopina*) are the preferred shrubs on the Lake Wales Ridge (Woolfenden and Fitzpatrick 1996b), and myrtle oak (*Q. myrtifolia*) is favored on the Atlantic Coastal Ridge (Toland 1991) and southern Gulf coast (Thaxton 1998). In suburban areas, scrub-jays nest in the same evergreen oak species, as well as in introduced or exotic trees; however, they build their nests in a significantly higher position in these oaks than when in natural scrub habitat (Bowman *et al.* 1996). Scrub-jay nests are an open cup, about 7 to 8 inches outside diameter and 3 to 4 inches inside diameter. The outer basket is bulky and built of coarse twigs from oaks and other vegetation, and the inside is lined with tightly wound

palmetto or cabbage palm (*Sabal palmetto*) fibers. There is no foreign material as may be present in a blue jay nest (Woolfenden and Fitzpatrick 1996b).

Nesting is synchronous, normally occurring from March 1 through June 30 (Woolfenden and Fitzpatrick 1984). On the Atlantic Coastal Ridge and southern Gulf coast, nesting may be protracted through the end of July. In suburban habitats, nesting is consistently started earlier (March) than in natural scrub habitat (Fleischer 1996), although the reason for this is unknown.

Clutch size ranges from one to five eggs, but is typically three or four eggs (Woolfenden and Fitzpatrick 1990). Clutch size is generally larger in suburban habitats, and the birds try to rear more broods per year (Fleischer 1996). Double brooding by as much as 20 percent has been documented on the Atlantic Coastal Ridge and in suburban habitat within the southern Gulf coast, compared to about 2 percent on the Lake Wales Ridge (Thaxton 1998). Scrub-jay eggs measure 1.1 inches in length by 0.8 inch in breadth (Woolfenden and Fitzpatrick 1996b), and coloration "varies from pea green to pale glaucous green… blotched and spotted with irregularly shaped markings of cinnamon rufous and vinaceous cinnamon, these being generally heaviest about the larger end" (Bendire 1895). Eggs are incubated for 17 to 19 days (Woolfenden 1974), and fledging occurs 15 to 21 days after hatching (Woolfenden 1978). Only the breeding female incubates and broods eggs and nestlings (Woolfenden and Fitzpatrick 1984). Average production of young is two fledglings per pair, per year (Woolfenden and Fitzpatrick 1990; Fitzpatrick *et al.* 1991), and the presence of helpers improves fledging success (Woolfenden and Fitzpatrick 1990; Mumme 1992). Annual productivity must average at least two young fledged per pair for a population of scrub-jays to support long-term stability (Fitzpatrick *et al.* 1991).

Fledglings depend upon adults for food for about ten weeks, during which time they are fed by both breeders and helpers (Woolfenden 1975; McGowan and Woolfenden 1990). Survival of scrub-jay fledglings to yearling age class averages about 35 percent in optimal scrub; while annual survival of both adult males and females averages around 80 percent (Woolfenden and Fitzpatrick 1996b). However, data from Archbold Biological Station suggests that survival and reproductive success of scrub-jays in suboptimal habitat is lower (Woolfenden and Fitzpatrick 1991). These data help explain why local populations inhabiting unburned, late successional habitats become extirpated. Similarly, data from Indian River County show that mean annual productivity declines significantly in suburban areas where Toland (1991) reported that productivity averaged 2.2 young fledged per pair in contiguous optimal scrub, 1.8 young fledged per pair in fragmented moderately-developed scrub, and 1.2 young per pair fledged in very fragmented suboptimal scrub. The longest observed lifespan of a scrub-jay is 15.5 years at Archbold Biological Station in Highlands County (Woolfenden and Fitzpatrick 1996b).

As previously stated, juveniles may stay in their natal territory for up to 6 years before dispersing to become breeders (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1986). Once scrub-jays pair and become breeders, generally within two territories of their natal area,

they stay on their breeding territory until death. In suitable habitat, fewer than 5 percent of scrub-jays disperse more than 5 miles (Fitzpatrick *et al.* 1991). All documented long-distance dispersals have been in unsuitable habitat such as woodland, pasture, or suburban plantations. Scrub-jay dispersal behavior is affected by the intervening land uses. Protected scrub habitats will most effectively sustain scrub-jay populations if they are located within surrounding habitat types that can be used and traversed by scrub-jays. Brushy pastures, scrubby corridors along railway and road rights-of-way, and open burned flatwoods offer links for colonization among scrub-jay populations. Stith *et al.* (1996) believe that a dispersal distance of 5 miles is close to the biological maximum for scrub-jays.

Scrub-jays forage mostly on or near the ground, often along the edges of natural or man-made openings. They visually search for food by hopping or running along the ground beneath the scrub or by jumping from shrub to shrub. Insects, particularly orthopterans (*e.g.*, locusts, crickets, grasshoppers, beetles) and lepidopteran (*e.g.*, butterfly and moth) larvae form most of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Small vertebrates are eaten when encountered, including frogs and toads (*Hyla femoralis, H. squirella,* rarely *Bufo quercicus,* and unidentified tadpoles), lizards (*Anolis carolinensis, Cnemidophorus sexlineatus, Sceloporus woodi, Eumeces inexpectatus, Neoseps reynoldsi, Ophisaurus compressus, O. ventralis*), small snakes (*Thamnophis sauritus, Opheodrys aestivus, Diadophis punctatus*), small rodents [cotton rat (*Sigmodon hispidus*), *Peromyscus polionotus,* and black rat (*Rattus rattus*) young], downy chicks of the bobwhite (*Colinus virginianus*), and fledgling common yellowthroat (*Geothlypis trichas*). In suburban areas, scrub-jays will accept supplemental foods once the scrub-jays have learned about them (Woolfenden and Fitzpatrick 1984).

Acorns are the principal plant food (Woolfenden and Fitzpatrick 1984; Fitzpatrick *et al.* 1991). From August to November each year, scrub-jays may harvest and cache 6,500 to 8,000 oak (*Quercus* spp.) acorns throughout their territory. Acorns are typically buried beneath the surface of bare sand patches in the scrub during fall, and retrieved and consumed year round, though most are consumed in fall and winter (DeGange *et al.* 1989). On the Atlantic Coastal Ridge, acorns are often cached in pine trees, either in forks of branches, in distal pine boughs, under bark, or on epiphytic plants, between 1 to 30 feet in height. Other small nuts, fruits, and seeds also are eaten (Woolfenden and Fitzpatrick 1984).

Habitat

The scrub-jay has specific habitat needs. It is endemic to peninsular Florida's ancient dune ecosystems or scrubs, which occur on well-drained to excessively well-drained sandy soils (Laessle 1958; Laessle 1968; Myers 1990). This relict oak-dominated scrub, or xeric oak scrub, is essential habitat to the scrub-jay. This community type is adapted to nutrient-poor soils, periodic drought, and frequent fires (Abrahamson 1984). Xeric (dry) oak scrub on the Lake

Wales Ridge is predominantly made up of four species of stunted, low-growing oaks: sand live oak, Chapman oak (*Q. chapmanii*), myrtle oak, and scrub oak (Myers 1990). In optimal habitat on the Lake Wales Ridge, these oaks are 3 to 10 feet high, interspersed with 10 to 50 percent unvegetated, sandy openings, and a sand pine (*Pinus clausa*) canopy of less than 20 percent (Woolfenden and Fitzpatrick 1991). Trees and dense herbaceous vegetation are rare. Other vegetation noted along with the oaks includes saw palmetto (*Serenoa repens*) and scrub palmetto *(Sabal etonia*), as well as woody shrubs such as Florida rosemary and rusty lyonia.

Scrub-jays occupy areas with less scrub oak cover and fewer openings on the Merritt Island-Cape Canaveral Complex and in southwest Florida than is typical of xeric oak scrub habitat on the Lake Wales Ridge (Schmalzer and Hinkle 1992b; Breininger *et al.* 1995; Thaxton and Hingtgen 1996). The predominant communities in Merritt Island-Cape Canaveral Complex are oak scrub and scrubby flatwoods. Scrubby flatwoods differ from scrub by having a sparse canopy of slash pine (*Pinus elliottii*); sand pine is rare. The shrub species mentioned above are common, except for scrub oak and scrub palmetto, which are more often found on the Lake Wales Ridge. Runner oak (*Q. minima*), turkey oak (*Q. laevis*), bluejack oak (*Q. incana*), and longleaf pine (*Pinus palustris*) also have been reported. The Kennedy Space Center located in Brevard County, supports one of the largest contiguous populations of scrub-jays. Studies conducted there give good descriptions of this habitat type (Schmalzer and Hinkle 1992b).

Optimal scrub-jay habitat occurs as patches with the following attributes:

1. Ten to 50 percent of the oak scrub made up of bare sand or sparse herbaceous vegetation;
2. Greater than 50 percent of the shrub layer made up of scrub oaks;
3. A mosaic of oak scrubs that occur in optimal height (4 to 6 feet) and shorter;
4. Less than 15 percent canopy cover; and
5. Greater than 984 feet from a forest (Breininger *et al.* 1998).

In some cases, scrub-jay habitat occurs as patches of oak scrub within a matrix of little-used habitat of saw palmetto and herbaceous swale marshes (Breininger *et al.* 1991, Breininger *et al.* 1995). These native matrix habitats supply prey for scrub-jays and habitat for other species of conservation concern. The flammability of native matrix habitats is important for spreading fires into oak scrub (Breininger *et al.* 1995; Breininger *et al.* 2002). Degradation or replacement of native matrix habitats with habitat fragments and industrial areas attract predators of scrub-jays, such as fish crows (*Corvus ossifragus*), that are rare in most regularly burned native matrix habitats (Breininger and Schmalzer 1990; Woolfenden and Fitzpatrick 1991). Matrix habitats often develop into woodlands and forests when there is a disruption of fire regimes. These woodlands and forests are not suitable for scrub-jays, decrease the habitat suitability of nearby scrub, attract predators, and further disrupt fire patterns.

Distribution

Historically, oak scrub occurred as numerous isolated patches in peninsular Florida. These patches were concentrated along both the Atlantic and Gulf coasts and on the central ridges of the peninsula (Davis 1967). Probably until as recently as the 1950s, scrub-jay populations occurred in the oak scrub and scrubby pine flatwoods habitats of 39 of the 40 counties south of, and including Levy, Gilchrist, Alachua, Clay, and Duval Counties. Historically, most of these counties would have contained hundreds or even thousands of breeding pairs (Fitzpatrick *et al.* 1994). Only the southernmost county, Monroe, lacked scrub-jays (Woolfenden and Fitzpatrick 1996a). Although scrub-jay numbers probably began to decline when European settlement began in Florida (Cox 1987), the decline was first noted in the literature by Byrd (1928). After 40 years of personal observation of the Etonia scrub (now known as Ocala National Forest), Webber (1935) observed many changes to the previously-undisturbed scrub habitat found there, noting "The advent of man has created a new environmental complex."

In 1999, Stith divided scrub-jays into 21 metapopulations based on what were assumed to be physical barriers to scrub-jay dispersal in the landscape. Subsequent study of scrub-jay genetics resulted in the division of scrub-jays into 10 major genetic groups (Coulon *et al.* 2008). Current recovery efforts are focused on the genetic groups located in the Ocala National Forest, the Atlantic Coast near Cape Canaveral Air Station, and the Lake wales Ridge in central Florida.

Population Dynamics

A statewide scrub-jay census was last conducted in 1992 and 1993, at which time there were an estimated 4,000 pairs of scrub-jays (Fitzpatrick *et al.* 1994). At that time, the scrub-jay was considered extirpated in ten counties (Alachua, Broward, Clay, Duval, Gilchrist, Hernando, Hendry, Pinellas, and St. Johns), and were considered functionally extinct in an additional 5 counties (Flagler, Hardee, Levy, Orange, and Putnam), where 10 or fewer pairs remained. Recent information indicates that there are at least 12 to 14 breeding pairs of scrub-jays located in Levy County, higher than previously thought (Miller 2004); and there is at least one breeding pair remaining in Clay County (Miller 2004). A scrub-jay has been documented in St. Johns County as recently as 2003 (Miller 2003). Populations are close to becoming extirpated in Gulf coast counties (from Levy south to Collier) (Woolfenden and Fitzpatrick 1996a). In 1992 and 1993, population numbers in 21 of the counties were below 30 breeding pairs (Fitzpatrick *et al.* 1994). Based on the amount of destroyed scrub habitat, scrub-jay population loss along the Lake Wales Ridge is 80 percent or more since pre-European settlement (Fitzpatrick *et al.* 1991). Since the early 1980s, Fitzpatrick *et al.* (1994) estimated that, in the northern third of the species' range, the scrub-jay has declined somewhere between 25 and 50 percent. The species may have declined by as much as 25 to 50 percent in the last decade alone (Stith *et al.* 1996).

Stith (1999) used a spatially explicit individual-based population model developed specifically for the scrub-jay to complete a metapopulation viability analysis of the species. The species' range was divided into 21 metapopulations demographically isolated from each other. Metapopulations are defined as collections of relatively discrete demographic populations distributed over the landscape; these populations are connected within the metapopulations through dispersal or migration (Hanski and Gilpin 1991). A series of simulations were run for each of the 21 metapopulations based on different scenarios of reserve design ranging from the minimal configuration consisting of only currently protected patches of scrub (no acquisition option) to the maximum configuration, where all remaining significant scrub patches were acquired for protection (complete acquisition option) (Stith 1999). The assumption was made that all areas that were protected were also restored and properly managed.

Results from Stith's (1999) simulation model included estimates of extinction, quasi-extinction (the probability of a scrub-jay metapopulation falling below 10 pairs), and percent population decline. These were then used to rank the different statewide metapopulations by vulnerability. The model predicted that five metapopulations (Northeast Lake, Martin, Merritt Island, Ocala National Forest, and Lake Wales Ridge) have low risk of quasi-extinction. Two of the five (Martin and Northeast Lake), however, experienced significant population declines under the "no acquisition" option; the probability for survival of both of these metapopulations could be improved with more acquisitions.

Eleven of the remaining 21 metapopulations were shown to be highly vulnerable to quasi-extinction if no additional habitat was acquired (Central Brevard, North Brevard, Central Charlotte, Northwest Charlotte, Citrus, Lee, Levy, Manatee, Pasco, Saint Lucie, and West Volusia). The model predicted that the risk of quasi-extinction would be greatly reduced for 7 of the 11 metapopulations (Central Brevard, North Brevard, Central Charlotte, Northwest Charlotte, Levy, Saint Lucie, and West Volusia) by acquiring all or most of the remaining scrub habitat. The model predicted that the remaining 4 metapopulations (Citrus, Lee, Manatee, and Pasco) would moderately benefit if more acquisitions were made.

Stith (1999) classified two metapopulations (South Brevard and Sarasota) as moderately vulnerable with a moderate potential for improvement; they both had one or more fairly stable subpopulations of scrub-jays under protection, but the model predicted population declines. The model predicted that the rest of the metapopulations could collapse without further acquisitions, making the protected subpopulations there vulnerable to epidemics or other catastrophes.

Three of the metapopulations evaluated by Stith (1999) (Flagler, Central Lake, and South Palm Beach) were classified as highly vulnerable to quasi-extinction and had low potential for improvement, since little or no habitat is available to acquire or restore.

On protected lands, scrub-jays have continued to decline due to inadequate habitat management (Stith 1999; Boughton and Bowman 2011). However, over the last several years, steps to reverse this decline have occurred, and management of scrub habitat is continuing in many areas of Florida (Hastie and Eckl 1999; Stith 1999; The Nature Conservancy 2001; Turner *et al.* 2006). If the decline can be reversed, managed lands have the potential to support about twice the number of scrub-jays groups as in 2009-2010 (Boughton and Bowman 2011).

Critical Habitat – No critical habitat has yet been designated for this species.

Threats

Habitat Loss

Scrub habitats have continued to decline throughout peninsular Florida since listing occurred, and habitat destruction continues to be one of the main threats to the scrub-jay. Cox (1987) noted local extirpations and major decreases in numbers of scrub-jays and attributed them to the clearing of scrub for housing and citrus groves. Eighty percent or more of the scrub habitats have been destroyed along the Lake Wales Ridge since pre-European settlement (Fitzpatrick *et al.* 1991; Turner *et al.* 2006). Fernald (1989), Fitzpatrick *et al.* (1991), and Woolfenden and Fitzpatrick (1996a) noted habitat losses due to agriculture, silviculture, and commercial and residential development have continued to play a role in the decline in numbers of scrub-jays throughout the state. Statewide, estimates of scrub habitat loss range from 70 to 90 percent (Woolfenden and Fitzpatrick 1996a). Various populations of scrub-jays within the species' range have been monitored closely, and more precise estimates of habitat loss in these locations are available (Snodgrass *et al.* 1993; Thaxton and Hingtgen 1996).

Toland (1999) estimated that about 70 to 78 percent of pre-European settlement scrub habitats had been converted to other uses in Brevard County. This is due mainly to development activity and citrus conversion, which were the most important factors that contributed to the scrub-jay decline between 1940 and 1990. A total of only 10,656 acres of scrub and scrubby flatwoods remain in Brevard County (excluding Federal ownership), of which only 1,600 acres (15 percent) is in public ownership for the purposes of conservation. Less than 1,977 acres of an estimated pre-European settlement of 14,826 acres of scrubby flatwoods habitat remain in Sarasota County, mostly occurring in patches averaging less than 2.5 acres in size (Thaxton and Hingtgen 1996). Only 10,673 acres of viable coastal scrub and scrubby flatwoods remained in the Treasure Coast region of Florida (Indian River, Saint Lucie, Martin, and Palm Beach Counties) according to Fernald (1989). He estimated that 95 percent of scrub had already been destroyed for development purposes in Palm Beach County.

Habitat Fragmentation

Habitat destruction not only reduces the amount of area scrub-jays can occupy, but may also increase fragmentation of habitat. As more scrub habitat is altered, the habitat is cut into smaller and smaller pieces, and separated from other patches by larger distances; such fragmentation increases the probability of inbreeding and genetic isolation, which is likely to increase extinction probability (Fitzpatrick *et al.* 1991; Woolfenden and Fitzpatrick 1991; Stith *et al.* 1996; Thaxton and Hingtgen 1996). Dispersal distances of scrub-jays in fragmented habitat are further than in optimal unfragmented habitats, and demographic success is poor (Thaxton and Hingtgen 1996; Breininger 1999).

Predation

Most scrub-jay mortality probably is from predation (Woolfenden and Fitzpatrick 1996b). The second most frequent cause may be disease, or predation on disease-weakened scrub-jays (Woolfenden and Fitzpatrick 1996b). Known predators of scrub-jays are listed by Woolfenden and Fitzpatrick (1990), Fitzpatrick *et al.* (1991), Schaub *et al.* (1992), Woolfenden and Fitzpatrick (1996a, 1996b), Breininger (1999), and Miller (2004); the list includes: eastern coachwhip (*Masticophis flagellum*) (adults, nestlings, and fledglings), eastern indigo snake (*Drymarchon corais couperi*) (adults and fledglings), black racer (*Coluber constrictor*) (eggs), pine snake (*Pituophis melanoleucus*), and corn snake (*Elaphe guttata*). Mammalian predators include bobcats (*Lynx rufus*), raccoons (*Procyon lotor*), sometimes cotton rats (eggs), black rats, and domestic cats (*Felis catus*, known to eat adults). Franzreb and Puschock (2004) also have documented spotted skunks (*Spilogale putorius*) and grey fox (*Urocyon cinereoargenteus*) as mammalian predators of scrub-jay nests. Fitzpatrick *et al.* (1991) postulated that populations of domestic cats are able to eliminate small populations of scrub-jays. Avian nest predators include the great horned owl (*Bubo virginianus*), eastern screech-owl (*Otus asio*), red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), fish crow, boat-tailed grackle (*Quiscalus major*), common grackle (*Q. quiscula*), American crow (*Corvus brachyrhynchos*), blue jay, and swallow-tailed kites (*Elanoides forficatus*).

Fitzpatrick *et al.* (1991) reported overgrown scrub habitats are often occupied by the blue jay, which may be one factor limiting scrub-jay populations in such areas. Raptors which seem to be important predators of adult scrub-jays are merlin (*Falco columbarius*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*A. cooperii*), and northern harrier. During migration and winter, these four raptor species are present in areas that contain scrub habitat, and scrub-jays may experience frequent confrontations (as many as one pursuit a day) with them (Woolfenden and Fitzpatrick 1990). In coastal scrub, Woolfenden and Fitzpatrick (1996b) report that scrub-jays are vulnerable to predation by raptors in October, March, and April, when high densities of migrating accipiters and falcons are present. Woolfenden and Fitzpatrick (1996b) and Toland (1999) suggest that, in overgrown scrub habitats, hunting efficiency for scrub-jay predators is

increased. Bowman and Averill (1993) noted scrub-jays occupying fragments of scrub found in or near housing developments were more prone to predation by free-roaming cats and competition from blue jays and mockingbirds. Woolfenden and Fitzpatrick (1996a, 1996b) stated proximity to housing developments (and increased exposure to free-roaming cats) needs to be taken into consideration when designing scrub preserves. Young scrub-jays are especially vulnerable to ground predators (*e.g.*, snakes and mammals) before they are fully capable of sustained flight.

Disease

The scrub-jay hosts two protozoan blood parasites (*Plasmodium cathemerium* and *Haemoproteus danilewskyi*), but incidence is low (Woolfenden and Fitzpatrick 1996b). Several scrub-jays sick from these two agents in March 1992 survived to become breeders. The scrub-jay carries at least three types of mosquito-borne encephalitis (Saint Louis, eastern equine, and "Highlands jay") (Woolfenden and Fitzpatrick 1996b). Of particular concern is the arrival of West Nile virus (the agent of another type of encephalitis) in Florida during 2001 (Stark and Kazanis 2001); since corvids have been particularly susceptible to the disease in states north of Florida, it is expected scrub-jays will be affected (Breininger *et al.* 2003).

Woolfenden and Fitzpatrick (1996b) noted three episodes of elevated mortality (especially among juveniles) in 26 years at Archbold Biological Station. Each of these incidents occurred in conjunction with elevated water levels following unusually heavy rains in the fall, although high mortality does not occur in all such years. During the most severe of these presumed epidemics (August 1979 through March 1980), all but one of the juvenile cohort and almost half of the breeding adults died (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1990). The 1979 through 1980 incident coincided with a known outbreak of eastern equine encephalitis among domestic birds in central Florida (Woolfenden and Fitzpatrick, 1996b). From the fall of 1997 through the spring of 1998, the continuing population decline of scrub-jays along the Atlantic coast and in central Florida may have been augmented by an epidemic of unknown origin (Breininger 1999).

At Cape Canaveral Air Force Station, Stevens and Hardesty (1999) noted a decline in juvenile survival from 60 to 70 percent in the preceding years to 22 percent in 1997 and 1998. It stayed low (only 25 percent) in 1998 and 1999 before again climbing into the mid-60 percent range. Also, adult survival dropped from 70 to 80 percent survival in the preceding years to 50 to 60 percent in 1997 and 1998. Overall, their annual surveys documented the largest one-year drop (pairs decreased by 17 percent and birds by 20 percent) in this population at the same time as the presumed statewide epidemic.

A host of naturally-occuring parasites have been documented on scrub-jays and are not believed to have a negative impact on scrub-jay population levels. However, the sticktight flea

(*Echidnophaga gallinacea*; Woolfenden and Fitzpatrick 1996b), which occurs on some individuals, usually at low densities is believed to lower fitness and potentially cause death (Boughton *et al.* 2006). The host vector for this flea was a domestic dog (*Canis familiaris*) suggesting that introduction of human pets into scrub-jay areas may increase parasite loads and reduce fitness.

Inadequacy of Existing Regulatory Mechanisms

Florida's State Comprehensive Plan and Growth Management Act of 1985 is administered mostly by regional and local governments. Regional Planning Councils administer the law through Development of Regional Impact reviews; at the local level, although comprehensive plans contain policy statements and natural resource protection objectives, they are only effective if counties and municipalities enact and enforce ordinances. As a general rule, counties have not enacted and enforced ordinances that are effective in protecting scrub-jays (Fernald 1989).

The Wildlife Code of the State of Florida (Chapter 68A, Florida Administrative Code) prohibits taking of individuals of threatened species, or parts thereof, or their nests or eggs, except as authorized. The statute does not prohibit clearing of habitat occupied by protected species, which limits the ability of the FWC to protect the scrub-jay and its habitat.

Nonnative and Invasive Species

Fernald (1989) reported many of the relatively few remaining patches of scrub within the Treasure Coast region of Florida had been degraded by trails created by off-road vehicles, illegal dumping of construction debris, abandoned cars and appliances, or household waste. The invasion of these areas by exotic species, including Brazilian pepper (*Schinus terebinthifolius*), white cypress-pine (*Callitris glaucophylla*), and Australian pine (*Casuarina equisetifolia*) increases the degradation of the habitat. Other human-induced impacts identified by Fernald (1989) include the introduction of domestic dogs and cats, black rats, greenhouse frogs (*Eleutherodactylus planirostris*), giant toads (*Bufo marinus*), Cuban tree frogs (*Osteopilus septentrionalis*), brown anoles (*Anolis sagrei*), and other exotic animal species. These exotic species may compete with scrub-jays for space and food.

Fire Suppression

Lightning strikes cause all naturally-occurring fires in south Florida scrub habitat (Abrahamson 1984; Hofstetter 1984; Woolfenden and Fitzpatrick 1990). Fire has been noted to be important in maintenance of scrub habitat for decades (Nash 1895; Harper 1927; Webber 1935; Davis 1943; Laessle 1968; Abrahamson *et al.* 1984). Human efforts to prevent and control natural fires have allowed the scrub to become too dense and tall to support populations of scrub-jays, resulting in the decline of local populations of scrub-jays throughout the state (Fernald 1989;

Fitzpatrick *et al.* 1994, Percival *et al.* 1995; Stith *et al.* 1996; Thaxton and Hingtgen 1996; Woolfenden and Fitzpatrick 1990; Woolfenden and Fitzpatrick 1996a; Toland 1999). A primary cause for scrub-jay decline is poor demographic success associated with reductions in fire frequency (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1991; Schaub *et al.* 1992; Stith *et al.* 1996; Breininger *et al.* 1999), and today fire suppression may exceed habitat loss as the single most important limiting factor (Woolfenden and Fitzpatrick 1991; Woolfenden and Fitzpatrick 1996a; Fitzpatrick *et al.* 1994). Human interference with natural fire regimes is associated with increases in shrub height, decreases in open space, increases in tree densities, and the replacement of scrub and marshes by forests (Duncan and Breininger 1998; Schmalzer and Boyle 1998; Duncan *et al.* 1999). As a result, mean family size declines, and eventually the number of breeding pairs can decline by 50 percent every 5 to 10 years (Woolfenden and Fitzpatrick 1991; Breininger *et al.* 1999; Breininger *et al.* 2001).

Many scrub-jays occur in habitat conditions where their long-term persistence is doubtful, although their persistence in these areas can occur for many years (Swain *et al.* 1995; Stith *et al.* 1996; Root 1998; Breininger *et al.* 2001). Stith *et al.* (1996) estimated at least 2,100 breeding pairs of scrub-jays were living in overgrown habitat. Toland (1999) reported most of Brevard County's remaining scrub (estimated to be 15 percent of the original acreage) is overgrown due to fire suppression. He further suggests the overgrowth of scrub habitats reduces the number and size of sand openings which are crucial not only to scrub-jays, but also many other scrub plants and animals. Reduction in the number of potential scrub-jay nesting sites, acorn cache sites, and foraging sites presents a problem for scrub-jays. Fernald (1989) reported overgrowth of scrub has led to a decline of species diversity and abundance as well as a reduction in the percentage of open sandy patches (Fernald 1989; Woolfenden and Fitzpatrick 1996b). Fitzpatrick *et al.* (1994) believed fire suppression was just as responsible as habitat loss in the decline of the scrub-jay, especially in the northern third of its range. Likewise, the continued population decline of scrub-jays within Brevard County between 1991 and 1999 has been attributed mainly to the overgrowth of remaining habitat patches (Breininger *et al.* 2001). Breininger *et al.* (1999) concluded optimal habitat management is essential in fragmented ecosystems maintained by periodic fire, especially to lessen risks of decline and extinction resulting from epidemics and hurricanes.

Fitzpatrick *et al.* (1991), Fitzpatrick *et al.* (1994), and Woolfenden and Fitzpatrick (1996a) expressed concern for the management practices taking place on Federal lands at Ocala National Forest, Merritt Island National Wildlife Refuge at the Kennedy Space Center, and Cape Canaveral Air Force Station, all supporting large contiguous populations of scrub-jays. They predicted fire suppression or too frequent fires (on the latter two), and silvicultural activities involving the cultivation of sand pine on Ocala National Forest, would be responsible for declines or local extirpations of scrub-jays in these large contiguous areas of scrub. These areas should be where populations are most secure because of Federal agencies' responsibilities to promote conservation and recovery under section 7(a)(1) of the Act. Data from Archbold

Biological Station show that fire-return intervals varying between 8 and 15 years are optimal for long-term maintenance of productive scrub-jay populations in central Florida (Woolfenden and Fitzpatrick 1996b). These intervals also correspond with those yielding healthy populations of listed scrub plants (Menges and Kohfeldt 1995; Menges and Hawkes 1998). Optimal fire-return intervals may, however, be shorter in coastal habitats (Schmalzer and Hinkle 1992a; Schmalzer and Hinkle 1992b).

Urban Development

Housing and commercial developments within scrub habitats are accompanied by the development of roads. Since scrub-jays often forage along roadsides and other openings in the scrub, they are often killed by passing cars. Research by Mumme *et al.* (2000) along a two-lane paved road indicated that clusters of scrub-jay territories found next to the roadside represented population sinks (breeder mortality exceeds production of breeding-age recruits), which could be supported only by immigration. Since this species may be attracted to roadsides because of their open habitat characteristics, vehicular mortality presents a significant and growing management problem throughout the remaining range of the scrub-jay (Dreschel *et al.* 1990; Mumme *et al.* 2000), and proximity to high-speed, paved roads needs to be considered when designing scrub preserves (Woolfenden and Fitzpatrick 1996a).

Another potential problem in suburban areas supporting scrub-jays is supplemental feeding by humans (Bowman and Averill 1993; Woolfenden and Fitzpatrick 1996a; Bowman 1998). The presence of additional food may allow scrub-jays to persist in fragmented habitats, but recruitment in these populations is lower than in native habitats. However, even though human feeding may postpone local extirpations, long-term survival cannot be ensured in the absence of protecting native oak scrub habitat necessary for nesting. In addition, scrub-jays in suburban settings often create elevated nests in tall shrubbery. During March winds, these nests tend to be susceptible to destruction (Woolfenden and Fitzpatrick 1996b; Bowman 1998).

Hurricanes

Hurricanes also pose a potential risk for scrub-jays, although the exact impact of such catastrophic events is unknown. Breininger *et al.* (1999) modeled the effects of epidemics and hurricanes on scrub-jay populations in varying levels of habitat quality. Small populations of scrub-jays are more vulnerable to extirpation where epidemics and hurricanes are common. Storm surge from a Category Three to Five hurricane could inundate entire small populations of scrub-jays, and existing habitat fragmentation could prevent repopulation of affected areas. However, this model also predicted that long-term habitat degradation had greater influence on extinction risk than hurricanes or epidemics. Preliminary results of the impact of Hurricane Charley on the Charlotte County scrub-jay populations indicates that at least one member of all 20 family groups surveyed after the storm had survived (Miller 2006).

Climate Change and Sea Level Rise

According to the Intergovernmental Panel on Climate Change Report (IPCC) (2007), 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 2007 IPCC report describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife 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 Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean, etcetera). Temperatures are predicted to rise from 2^{o}C to 5^{o}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 rise. However, 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 offer a wide range of predicted changes.

Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

For the scrub-jay increases in storm frequency and sea level rise will likely have natural/biological effects, such as reduction in available habitat (destruction during storms and inundation from sea level rise), and decreased nesting success, if storms coincide with nesting. In addition, sea level rise is likely to increase man-made effects, as the human population moves from the coast to central parts of the State. This human migration will increase the demand for development and could lead to increased loss of scrub habitat. In addition, the increased human

population would likely increase the threats associated with human interactions such as fire suppression, predation, disease, and non-native species described above.

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STATUS OF THE SPECIES – Fragrant prickly-apple (*Cereus eriophorus* var. *fragrans* = *Harissia fragrans*)

Legal Status – *endangered*

The U.S. Fish and Wildlife Service (Service) listed the fragrant prickly-apple as endangered under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.) on November 1, 1985 (50 FR 45621). The reason for listing was substantial losses of suitable habitat. *Cereus eriophorus* var. *fragrans* has been placed within the genus *Harrisia*. However, the former classification *C. e.* var. *fragrans*, and its common name, fragrant prickly-apple, were used in the federal regulations to list the species (50 CFR 17.12) and the recent taxonomic change has not yet been adopted in the list of endangered and threatened wildlife and plants (December 1998). To maintain consistency with the Service's recovery plan for this species and 50 CFR 17.11 and 17.12, we will use *C. e.* var. *fragrans* until the name is officially changed in the Federal regulations. A complete fragrant prickly-apple life history discussion may be found in the MSRP. In addition, a 5-year review was completed in 2010 resulting in no change to the listing status of the species (Service 2010).

Species Description

Fragrant prickly-apple is a slender, solitary tree cactus that may have from one to eight, spiny, cane-like, stout, and succulent stems. The columnar stems are 2.5 to 5.0 centimeters (cm) in diameter, and have 10 or 12 ridges alternated with deep, sharp grooves (Benson 1982). Stems may be erect, or for longer stems, the plant may recline over neighboring vegetation. The branching can be extensive, and the roots of this cactus are coarse, fibrous, and shallow (Small 1920). The spine-bearing regions (areoles) are aligned along its ridges about 2 cm apart. Each areole bears 9 to 13 spines, which are mostly grayish and yellowish at the tip, with one spine longer (2 to 4 cm) than the rest.

Fragrant prickly-apple has initial flower buds that are 1 cm long, white, and exceedingly hairy. Buds often appear on the plant one to two months prior to flower growth. About 9 days after initiation of flower growth, the flower opens (Rae 1995). The flowers are fragrant, showy, solitary, and open only at night. The buds are 12 to 20 cm long when about to open and 7.5 to 10 cm in diameter when open. The ovary bears many lanceolate scales while the flower tube has only a few scattered scales. A tuft of long white hairs [10 to 15 millimeters (mm) long] protrudes from the axil beneath each scale. The sepals are narrowly linear, with green outer sepals and nearly white inner ones. There are numerous spatulate petals, white or pinkish, with unevenly toothed margins. The stamens are numerous and are composed of white filaments and yellow anthers. The style is elongate with 9 to 12 stigmas (Service 1988). The fruits are attached at the narrower end; they average 4 to 6 cm in diameter and are a dull red. The fruit does not split and has long tufts of white hairs that remain persistent with the scale bases (Leon

and Alain 1953). The fruits are swollen at the base and finely pitted; each contains approximately 1,500 black seeds that are about 3 mm long (Rae 1995).

Life History

Fragrant prickly-apple reproduces sexually and by regeneration by vegetative reproduction. Plants flower from April to October with two distinct peaks. The first peak is in the spring with flowering starting in April and reaching a peak in May. Some sporadic flowering occurs in the summer. In September and October, another minor peak in flowering occurs. Flowering is uncommon in the late fall, and no flowering occurs from January through March. Fruit set follows flowering with a major peak in May and a minor peak in September. A large standing crop of fruit remains on plants for approximately 8 months of the year.

According to Rae (1995), mature plants are greater than 41 cm in length. The smallest plant to flower was 14.5 cm in stem length and the smallest plant to set fruit was 41 cm in length. In his study, 63 percent of the mature plants flowered. At two sites in the Savannas Preserve State Park (SPSP), in St. Lucie County, 38 and 60 percent of flowers successfully produced fruits and 44 and 61 percent of mature plants successfully set fruit. A positive relationship was observed between total length of the stems and branches of a plant and the total annual production of fruit.

The means for seed dispersal are uncertain, but there is evidence that birds consume the fruit of fragrant prickly-apple. Additionally, most individuals of this species are found within the drip line of other plants, suggesting avian seed dispersal. Rodents or gopher tortoises (*Gopherus polyphemus*) may also distribute the seeds. In addition to sexual reproduction, long stems will occasionally snap off of existing plants. After falling to the ground, stems may re-root at several places creating a small group of genetically identical plants (Rae 1994a).

Vegetative growth of this perennial species is slowest from November to March. Growth accelerates in April and May, with the fastest growth occurring from July through September. The growth rate drops off rapidly after September (Rae 1994a, 1995). These cacti are often found to occur in distinct clusters (Bradley et al. 2002a; Woodmansee et al. 2007).

The fragrant prickly-apple is characterized as a long-lived species with late maturity, low fecundity, and low adult mortality (Rae and Ebert 2002). Larger plants tend to have higher fecundity and lower mortality rates (Rae and Ebert 2002); therefore, the larger individuals in the population are extremely important to overall population health (Rae and Ebert 2002). Bradley and Hines (2007) noted that fragrant prickly-apple can survive for at least 19 years, based on the identification of individuals in 2007 that were tagged as adults in 1988.

Mortality of the fragrant prickly-apple can result from a variety of causes. Bradley and Hines (2007) identified mortality of adult plants resulted from the following: all-terrain vehicle or other

vehicle damage, vandalism (chopped by machete), herbicide damage, burial by drifting sand, over-shading by love-vine (*Cassytha filiformis*), damage due to feral hogs (*Sus scrofa*), blown down by hurricane winds, and crushed by falling trees. The majority of the dead plants observed were killed by hurricane winds and treefall. Desiccation is also a source of mortality for very young seedlings (Moore 2009). If rains do not occur during these important weeks of development, the cacti tend to dry out because they do not have enough water stored to survive (Moore 2009). Rae and Ebert (2002) noted that the two primary causes of mortality in the sites they studied were over-shading and over-exposure to sunlight resulting in desiccation.

Habitat

The fragrant prickly-apple occurs in early-successional sand pine scrub and coastal hammock habitats (Rae 1994b). Habitat requirements include well-drained sandy soils with ground water normally deeper than 9 feet (3 meters) (Watts and Stankey 1980), and partial shade provided by surrounding plants during a portion of the day (Rae 1994b). The known sites are limited to St. Lucie sand. The most common plant species in this community include sandhill jointweed (*Polygonella fimbriata*), hairy jointweed (*P. ciliata*), tall jointweed (*P. gracilis*), sand live oak (*Quercus geminata*), myrtle oak (*Q. myrtifolia*), cabbage palm (*Sabal palmetto*), and pricklypear (*Opuntia humifusa*). Much of the Atlantic Coastal Ridge was cleared in the 1880s for pineapple plantations, but commercial pineapple cultivation was abandoned by 1920. The vegetative community has yet to regain its previous level of diversity or productivity. The vegetative succession has been arrested and the plant community has not succeeded to the climax sand pine habitat type (Rae 1994a, 1995).

This cactus prefers partial shade, which is often provided by surrounding plants that shelter it from sun for a portion of the day (Rae 1994b). Surrounding vegetation is often used for support by fragrant prickly-apple for its long stems. Other plants may serve as nurse plants for the seedlings, protecting them from direct sun, but this has not been studied. Overgrowth and shading by sand live oaks (*Quercus geminata*) and other species may cause reproductive failure and premature death. Growth and productivity seems to be greater for plants in areas that are partially shaded.

Distribution

At the time of listing fragrant prickly-apple was only known to occur in St. Lucie County (Service 1985). Historically, fragrant prickly-apple occurred in coastal hammock habitats on the east coast of Florida in St. Lucie, Indian River, Brevard, and Volusia Counties, although some accounts in other areas were erroneously reported due to misidentification with Simpson's prickly-apple (*Cereus gracilis* var. *simpsonii*) (Service 1985; Service 1999; Woodmansee et al. 2007). Fragrant prickly-apple was reportedly collected in Everglades National Park (ENP), but this is not confirmed (NPS 2007; Sadle 2009). Because Simpson's prickly-apple commonly

occurs in ENP, there is much confusion over identification of these two species, there is no voucher specimen available in herbarium collections for confirmation, the fragrant prickly-apple is limited in distribution, and ENP lacks the habitats believed to support fragrant prickly-apple, it is thought that the species was misidentified (NPS 2007; Sadle 2009).

Rae and Ebert (2002) observed population declines of fragrant prickly-apple on two sites in St. Lucie County, Florida from 1988 through 1993, and numbers of this cactus declined by 27.2 percent and 32.6 percent, respectively. The reduction was attributed primarily to low recruitment rates and high mortality. From 1993 through 1996, plants on these sites declined by approximately another 40 percent (Rae and Ebert 2002). Due to the decline in cactus numbers, a preliminary program was initiated in 1998 by the Institute for Regional Conservation (IRC) and the Florida Department of Environmental Protection to monitor the entire population. The population estimate for the species was determined to be 879 in 1999; 1,206 in 2000; and 1,744 in 2001 (Bradley et al. 2002a), and overall the population was reported to be stable (Bradley et al. 2002a). Bradley et al. (2002b) reported approximately 2,150 plants occurred within nine subpopulations at or near the SPSP in 2002 (approximately 63 percent of these plant were actually on protected lands rather than on inholdings or the railroad right-of-way). Bradley et al. (2002b) estimated that the total population may number up to 3,000. A more recent monitoring study of three fragrant prickly-apple subpopulations in the SPSP found that the population declined from 1,094 plants in the winter of 2003 to 739 plants in the winter of 2007 (Bradley and Hines 2007). The authors suggested that the decline in numbers of plants may have been due to impacts from the hurricanes that occurred in 2004 (Bradley and Hines 2007).

The fragrant prickly-apple was re-discovered in Volusia County at Canaveral National Seashore in 2006 (Woodmansee et al. 2007). Approximately 96 cacti were located during visits to the Volusia County site, and the plants appeared to be healthy (Woodmansee et al. 2007). A total of 62 plants were confirmed on 14 private sites that were surveyed around SPSP in 2006 and 2007 (Woodmansee et al. 2007).

The current range of this plant species is greatly reduced (Service 2010). Although the species currently occurs in disjunct locations within its historic range, most of the suitable habitat has been destroyed or converted for residential housing and commercial activities (Service 1999). The Florida Natural Areas Inventory (FNAI) reported that as of 2009, fragrant prickly-apple occurs on 10 confirmed sites and 1 unconfirmed site. Nine of the 10 confirmed sites are located in and around the SPSP in St. Lucie County (FNAI 2009) and 1 is located in Volusia County (Woodmansee 2006; FNAI 2009). Six of the 10 confirmed sites are protected, 2 are on privately owned properties, and 3 are partially protected (FNAI 2009). The unconfirmed site is in Indian River County (Woodmansee et al. 2007; FNAI 2009); it remains unconfirmed because only a single sterile plant was observed on a coastal berm when surveys were conducted in 2006 (Woodmansee et al. 2007; FNAI 2009). It is possible that the current range of the species also

includes Brevard and Indian River Counties, as these counties occur between confirmed locations and appropriate habitat is available (Woodmansee et al 2007).

Threats

Threats to the fragrant prickly-apple still persist. A large portion of the current occupied range of the species (*i.e.*, approximately 63 percent of known occupied sites in and around the SPSP) has been protected for conservation purposes. However, remaining occupied habitat within private lands is threatened to be lost due to development for commercial or residential purposes. The pressure to convert these lands will increase if Florida's human population continues to grow as predicted. The fragrant prickly-apple is also vulnerable to the encroachment of exotic plants and overgrowth of other vegetation due to suppression of natural fires or the lack of other forms of vegetation management (*i.e.*, exotic vegetation treatment and removal, prescribed burns, mechanical vegetation treatment). Excessive vegetation growth increases canopy cover that limits the amount of sunlight needed for survival of the fragrant prickly-apple, and increases the likelihood that the species is crushed by falling branches (Bradley et al. 2002b). Consequently, the application of vegetation management is essential to maintain optimal habitat for the fragrant prickly-apple. Although the lack of vegetation management was largely considered a problem restricted to private lands in the past, management of fragrant prickly-apple habitat on public conservation lands may currently also be at risk due to the uncertainties of land management agencies receiving adequate funding to conduct such tasks in the current climate of shrinking government budgets. The species' restriction to specialized habitat, its limited distribution, and its limited reproductive capacity also renders it vulnerable to random natural events, such as freezes and hurricanes. Given the sensitivity of the species to storm events and drought, climate change is also considered a threat to fragrant prickly-apple.

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