FINAL

Kennedy Space Center
Florida Scrub-Jay Compensation Plan

February 13, 2014

Prepared for:
Environmental Management Branch
TA-A4C
National Aeronautics and Space Administration
John F. Kennedy Space Center, Florida 32899

Prepared by:
Medical and Environmental Support Contract (MESC)
CLIN10 Environmental Projects
IHA Environmental Services Branch
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InoMedic HEALTH APPLICATIONS

ACRONYMS

Ac	Acre
BO	Biological Opinion
ADP	Area Development Plan
CCAFS	Cape Canaveral Air Force Station
CCF	Converter Compressor Facility
CCP	Comprehensive Conservation Plan
EO	Executive Order
CofF	Construction of Facilities
EA	Environmental Assessment
EES	Emergency Egress Systems
ESA	Endangered Species Act
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
ft	feet
ft^2	square feet
FWC	Florida Fish and Wildlife Conservation Commission
in	inches
IRL	Indian River Lagoon
GHe	Gaseous Helium
ha	hectares
HIF	Horizontal Integration Facility
IHA	InoMedic Health Applications, Inc.
kg	kilogram
km	kilometer
KSC	Kennedy Space Center
lbs	pounds
LC	Launch Complex
LH_2	Liquid Hydrogen
LOX	Liquid Oxygen
m	meter
m^2	square meters
mi	mile
MINWR	Merritt Island National Wildlife Refuge
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
RLV	Reusable Launch Vehicle

RP-1	Rocket Propellant 1
SLF	Shuttle Landing Facility
SRM	Solid Rocket Motor
USFWS	United States Fish and Wildlife Service
VPF	Vertical Processing Facility
VTOL	Vertical Take-off and Landing
VTVL	Vertical Takeoff Vertical Landing

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1.0 Introduction

Kennedy Space Center (KSC) is the premier launch complex for sending humans and payloads to space. The National Aeronautics and Space Administration (NASA) is at a critical crossroad in its transition to a mission that relies on redefining the Agency's relationship with industry and leveraging partnerships. In the years ahead, it will transform from a government and program-focused, single-user launch complex to a more capability centered and multi-user spaceport. NASA's mission, as established by the Office of the President and directed from Congress, is to expand commercial uses of space and the space industry. This is to assure that the substantial federal investment in KSC will continue to provide benefits to both the government and the private sector since the retirement of the Space Shuttle Program in 2011.

KSC's new mission is to enable government and commercial space access providers with facilities, an experienced workforce, and the knowledge necessary to support existing and new space programs. The KSC Planning and Development Office mission is to develop the world's premier spaceport to meet government and commercial space industry needs through comprehensive resource planning and the formation of partnerships to ensure the economic vitality of KSC. This requires NASA and KSC to adopt new ways of doing business, including forming partnerships with industry, the State of Florida, and other public and private entities.

KSC will expand its spaceport capabilities to include the processing, launch, and recovery of horizontally and vertically launched rocket-powered vehicles. The Shuttle Landing Facility (SLF) and existing structures in the Launch Complex (LC) 39 area are being repaired and/or renovated. Some of the proposed activities and initiatives will require construction of facilities on KSC lands that will be leased or otherwise permitted for use by commercial or outside governmental entities.

KSC's strategic priorities include environmental stewardship, sustainability, and evaluating the risks associated with future climate change. This involves focusing development and redevelopment into areas that can accommodate facilities and allow consolidation of compatible functional activities. Emphasis will be placed on meeting or exceeding Agency goals for energy and water conservation, and on sustainable design standards to lessen KSC's carbon footprint. On-site production of KSC energy needs from renewable sources will help meet these goals. Environmental stewardship also includes avoiding development in areas that are vulnerable to flooding and coastal inundation, avoiding areas that would require intensive site improvements and infrastructure expansion, and avoiding impacts to undisturbed landscapes and critical wildlife habitat.

KSC's new business model reduces dependence on NASA-appropriated funds for sustaining and recapitalizing spaceport infrastructure, while increasing availability to commercially owned and operated entities. The new model allows for non-traditional sources of funding initial facilities' costs, operation and maintenance, and their eventual replacement. The goal is for the spaceport to be increasingly self-sustaining. In the future model, NASA's programs involve a broader customer base that shares costs for common spaceport infrastructure and services. Federal ownership of the land that comprises KSC is retained, along with jurisdiction for land use planning, controls, and the integrated activities of the spaceport. However, the ownership and operation of space launch and support facilities, and spaceport infrastructure and services, become a blend of NASA, other U.S. government agencies, non-federal public entities, and private industry.

1.1 Purpose of Plan

Many organizations have interest in using NASA property on KSC. The purpose of this document is to consolidate the goals of ecosystem management associated with Florida Scrub-Jays and compliance with the Endangered Species Act (ESA) in order to streamline and reduce the costs of facility planning, impact assessment, and impact minimization. This will simplify the process and reduce regulatory uncertainty. However, the resulting process must be consistent with the Merritt Island National Wildlife Refuge (MINWR) Comprehensive Conservation Plan (CCP). In addition, this document considers anticipated construction impacts on KSC during the next 10 years and summarizes priorities in a spatially explicit manner. The document describes anticipated compensation requirements to facilitate restoration of degraded habitat in areas most important to the KSC Scrub-Jay population through resources provided to MINWR. The plan assumes that all construction on KSC is compensated on KSC.

Funding for specific Florida Scrub-Jay habitat management is seldom provided and has never been at the level needed to reach recovery goals. This compensation plan is intended to develop a partnership between the U.S. Fish and Wildlife Service (USFWS) and NASA to perform habitat management in specifically selected areas on KSC to compensate for new construction impacts associated with proposed commercial, state, and federal projects and programs.

1.2 Kennedy Space Center as a Population Recovery Core Area

Kennedy Space Center, combined with the adjacent Cape Canaveral Air Force Station (CCAFS), provides habitat for more threatened and endangered species than any other federal property in the continental U.S (Breininger et al. 1998). Lands on KSC not directly used by NASA for space operations are managed by the USFWS, who has primary responsibility for managing endangered species and wildlife at MINWR. These federal properties provide habitat for one of three remaining core Florida Scrub-Jay populations across the species range. The KSC/CCAFS core population is a unique genetic unit. In addition to being listed as a threatened species under the Endangered Species Act in 1987, the Florida Scrub-Jay is an indicator species for habitat quality important to many species in the scrub ecosystem (Noss et al. 1995).

The KSC Scrub-Jay population and habitat have declined for over 20 years, with this population currently estimated to be at about one-half carrying capacity (USFWS 2007). Causes of past declines at KSC are similar to those observed across the species' range and include habitat destruction, fragmentation, and degradation, although there are examples of recovery by small local populations on KSC.

Habitat degradation on Merritt Island started before the 1950s when natural scrub habitat was converted to support agriculture and human infrastructure (e.g., roads). These changes concurrently reduced the ability of natural fires to spread across the landscape. Fire increases the opportunity for open sandy areas to persist and lowers tree and shrub densities, conditions which are most conducive to Scrub-Jay survival (Breininger et al. 2009). A 20-year period of active fire suppression that ended in the early 1980s caused further habitat degradation.

Doubling the KSC Scrub-Jay population size by improving habitat quality is a goal of both the MINWR CCP and USFWS species recovery planning. Effective habitat management must result in jay recruitment exceeding mortality. Doubling the population requires intensive habitat management within four significant population areas identified on KSC (Breininger et al. 1996, 1999; U. S. FWS 2008). These areas are the least fragmented and have the highest topography, and are shown in red in Figure 1.

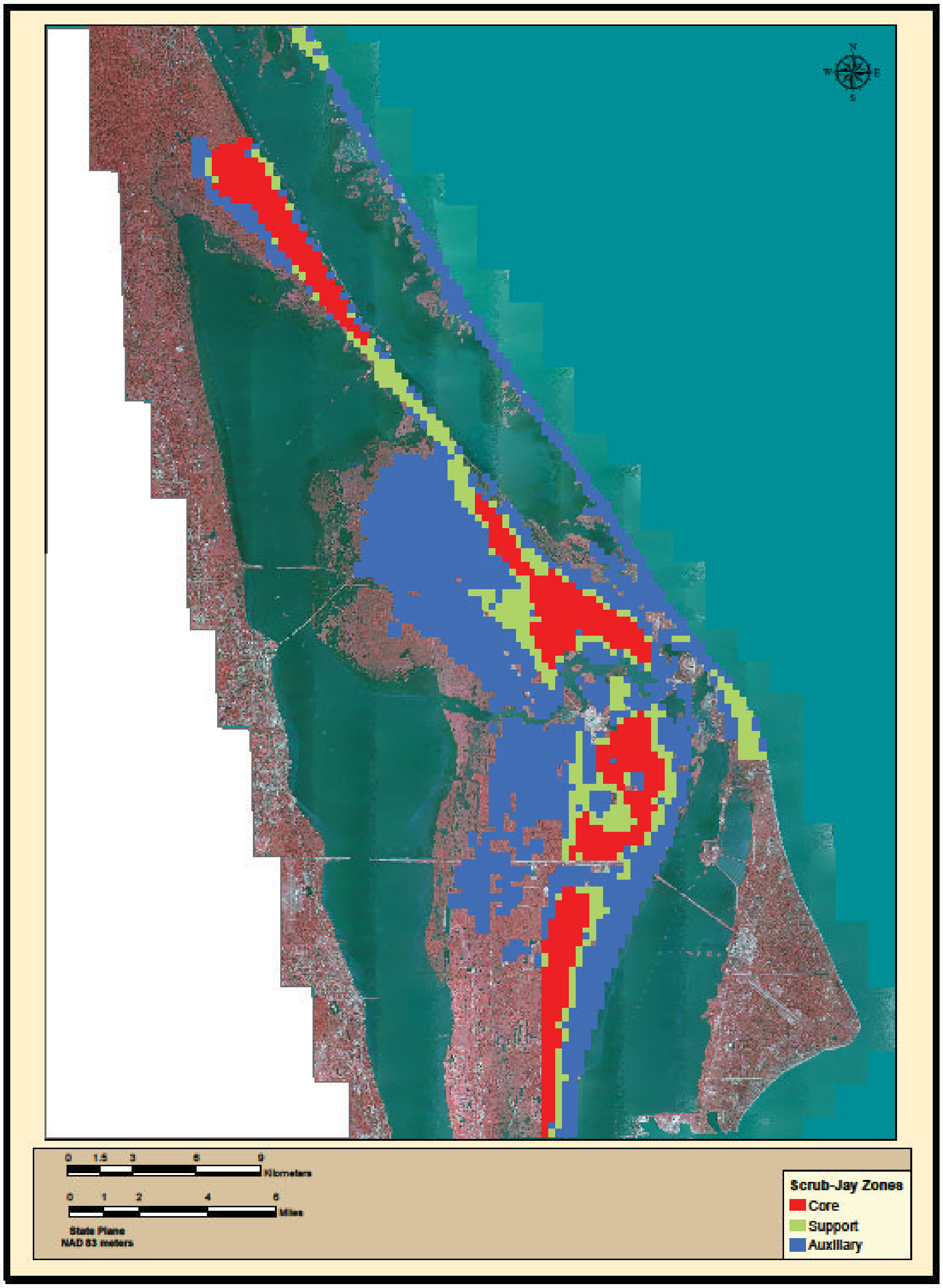

Figure 1. The spatial extent of the Florida Scrub-Jay zones on KSC requiring long-term management commitment to sustain the jay population.

1.2.1 Population and habitat quality targets

Currently there are about 300 Florida Scrub-Jay families on MINWR. The MINWR CCP identifies a population target of 500-650 Florida Scrub-Jay families with 350-500 families occupying optimal habitat. Meeting these objectives would result in a local population with low extinction risk. The Merritt Island/Cape Canaveral genetic unit is of primary importance in maintaining the species' viability.

Current studies on habitat quality on MINWR suggest there are 125 potential territories in habitat that is of medium height (1.2-1.7 m [meters] [4-5.5 (ft)] tall) with few open sandy areas, and 28 potential territories in medium height scrub with many open sandy areas (Breininger et al. 2010). Both medium-height scrub categories are optimal for jay survival, but open scrub typically has recruitment rates great enough to increase population size. Attaining the desired habitat and population goals will require more focused habitat management as well as a fuels management strategy.

1.3 Florida Scrub-Jay Cores, Support, and Auxiliary Habitats

Three types of scrub-jay habitats (core, support, and auxiliary) have been defined to categorize the importance and roles of different landscapes for maintaining Scrub-Jay populations. On KSC, core Scrub-Jay areas are described as primary habitat (oak scrub on well drained soils) and adjacent secondary habitat (large oak scrub ridges on poorly drained soils) that provide for large, contiguous clusters of territories. Contiguity of habitat is essential so that fire can spread across a landscape. It is also important for a species with low dispersal abilities and other social behaviors inherent to Scrub-Jays. Core habitats, which are important to meeting recovery goals, include large population source areas (where recruitment exceeds mortality) that occur within MINWR fire management units. A map depicting fire management units on KSC is included in Appendix 2. Population size estimates focus on primary and secondary potential territories, where recruitment can exceed mortality because there is enough oak cover (Breininger et al. 2006, 2009, 2010).

Tertiary territories are often included as part of core areas if they are adjacent to primary or secondary territories, or connect primary and secondary territories within the important fire management units. Tertiary territories are flatwoods with small scrub oak patches, and are population sinks where mortality usually exceeds recruitment. Core areas on KSC can support approximately 461 primary and secondary territories, almost enough to meet CCP goals.

Support areas (Figure 1) emphasize smaller clusters of primary and secondary territories outside of important fire management units. These may enhance population size and provide connectivity between population cores. The KSC support areas could support approximately 160 primary and secondary territories at carrying capacity. Together, core and support areas could provide habitat for 621 families, more than what is needed to meet minimum CCP goals.

Auxiliary areas are mostly tertiary territories, but include some primary and secondary territories (about 49) generally outside of fire management units. Some of these areas have value for connecting core areas, though connecting cores is less important than making core area populations sustainable. Most potential Scrub-Jay habitat on KSC occurs in auxiliary habitat. When auxiliary areas and all potential tertiary territories are included, the maximum population size for the KSC Florida Scrub-Jay is estimated at 959 families. It is probably not reasonable to assume that such a population could be achieved, even under the best circumstances, because recruitment and survival are poor in tertiary territories. Many tertiary territories are not adjacent to primary and secondary territories on which jays could rely for recruits.

Primary and secondary habitat in a contiguous landscape north of KSC within the boundaries of Canaveral National Seashore could support a few dozen families. The adjacent CCAFS could support nearly 300 additional families. A target of 700 families for all federal properties would easily meet the recovery planning goals of 70% of potential habitat within core areas.

1.3.1 Describing Habitat Using Grid Cells

Monitoring the habitat attributes within grid cells that represent potential Florida Scrub-Jay territories provides a tool to prioritize and adapt management in an ever-changing environment. Territory quality is important because recruitment and survival are determined by habitat features within territories that provide life requisites for this species. Habitat at the territory scale can be characterized using 10 hectares (ha) (25 acres [ac)]) grid polygon cells that represent the average territory size of a breeding pair at carrying capacity in optimal habitat. Habitat quality of each grid cell can partly be defined by static environmental features related to soils and vegetation potential. However, overall habitat quality states are dynamic and change with management history.

Within the grid cell classification system, potential territories are defined as having >70% of the cell comprised of scrub; these territories are further classified into primary, secondary, and tertiary based on soils and scrub oak cover. Primary territories intersect well drained oak scrub ridges; secondary territories intersect large oak scrub ridges on soils mapped as poor or moderately drained. Tertiary territories intersect small scrub oak patches.

1.3.2 Source-Sink Dynamics

Tertiary territories are usually population sinks. Primary and secondary territories are sinks under some territory quality states and sources when habitat state is optimal. Sink territories must be sustained by immigration, but are not considered a drain on the population because they provide population connectivity and habitat that can buffer changes in population size within sources. Sinks have value in population recovery and maintaining a viable population.

Source-sink theory provides an approach to develop management goals and compensation, but it is important to define source-sink applications explicitly; sources and sinks terminology has been applied in many different ways that lead to inconsistencies in theory and application. Here, sources refer to territories that, on average, have recruitment that exceeds mortality (Breininger and Carter 2003, Breininger and Oddy 2004). These territories are net exporters of individuals. Sinks refer to territory classifications that, on average, have mortality that exceeds recruitment. These territories can only remain occupied over many years by being net importers of individuals. Sinks may have been sources that transitioned to sinks. Scrub-Jays will seek breeding vacancies and actively disperse to many types of sinks, even though they preferentially select source habitats. Sinks can temporarily supply individuals to restored areas and help keep optimal territories occupied by supplying individuals to them after catastrophic events. The source-sink theory approach is useful for guiding management developing objectives to have source-to-sink ratios that yield a desired population growth rate. For population cores near carrying capacity or near a population target size, a desired ratio might be to have enough source territories to sustain losses in sinks. For cores far from carrying capacity or population target size, the desired ratio of source-to-sink needs to be maximized. This can lead to different fire management strategies because medium height closed territories may be sufficient in landscapes near capacity, but medium height open territories are needed in landscapes for significant population growth. Restoring medium height closed to medium height open usually requires mosaic (i.e., heterogeneous, patchy) fires. These are challenging to implement and may entail burning more frequently than what is necessary just to accomplish fuels management objectives.

2.0 Compensation Planning Cycle

2.1 Quantifying Impacts

Appropriate facility planning begins by minimizing future development in scrub, and minimizing fragmentation of core areas. Curtailing impacts to the MINWR managed fire program is also important and accomplished through training that addresses the need for controlled fires. This information is to be included in the planning and development phase of new agency contracts. At KSC, the formal National Environmental Policy Act

(NEPA) process begins when projects are first anticipated to ensure that all environmental laws and agency goals are addressed. Because no new major road construction is being proposed, impacts considered in this plan assume minimal disruption to controlled fire planning and implementation. Only scrub habitat impacts are addressed by this plan; other mitigation and compensation activities required for development and operations will be addressed during the formal NEPA process.

2.2 Compensation Acreages

Facility footprints will be overlaid on maps of core, support, and auxiliary scrub to determine compensation ratios that benefit species recovery and ecosystem management, while at the same time allowing spaceport development. The respective ratios for grid cells that are adjacent to existing development are indicated in the second column of Table 1. The ratios for grid cells that are not adjacent to existing development are higher (effectively doubled). The acreage of habitat expected to be destroyed within each category is multiplied by the compensation ratio and the areas of compensation acreages are summed across categories. An estimate of the current acreages of scrub habitat being considered for new projects within each habitat category is shown in column five of Table 1.

Table 1. Compensation ratios for proposed projects impacting designated Florida Scrub-Jay habitats (core, support or auxiliary) on KSC.

JAY HABITAT CLASSIFICATION	FOOTPRINT ADJACENT TO DEVELOPMENT (Ratios)	FOOTPRINT NOT ADJACENT TO DEVELOPMENT (Ratios)	KSC (Acres)	PROPOSED PROJECTS (Acres)
CORE	4: 1	8:1	7367	< 1
SUPPORT	2:1	4:1	3865	350
AUXILIARY	1:1	2:1	7891	402

2.3 Compensation Activities

Scrub, flatwoods, and adjacent marshes require controlled burns that ensure the reduction of fuels and lessen the possibility of catastrophic wildfires. MINWR began an active fire management program by 1982 which continues today. The funding emphasis of the controlled fire program has been to reduce hazardous fuel loadings rather than habitat restoration and management. Funding has not been adequate to perform habitat restoration necessary to meet all CCP and species' recovery goals. Some intermittent funding has been used for thinning pine trees to determine if that improved the ability to maintain scrub with controlled fire. Those timbering activities successfully returned some scrub to a state that could be better managed by fire and resulted in significant learning.

This new plan prioritizes similar compensation activities within landscapes by emphasizing the restoration of habitat quality to conditions where Florida Scrub-Jay recruitment exceeds mortality. Once compensation through restoration is achieved, maintenance of habitat quality will become part of the MINWR controlled fire management program.

Florida Scrub-Jay population recovery depends on increasing the proportion of medium height open scrub, which currently comprises a small proportion of the habitat. Openings that persist longer than 1 year post-fire have been difficult to obtain after the fire suppression period, and their establishment requires frequent mosaic fires. This scrub compensation plan focuses on converting sink habitats into source habitats at the territory scale. Proposed methods to compensate for environmental impacts focus on cutting trees and tall shrubs and then burning landscapes using controlled fires. Short-term success will be measured by the conversion of potential territories, represented by 10.1 ha (25 ac) grid cells, from sink habitat quality states to source habitat quality states, and preferably medium height open scrub. Measurement of Florida Scrub-Jay population density, recruitment, and survival will be also used to evaluate success. KSC will continue to emphasize policies that minimize scrub habitat destruction and avoid potential population cores to the extent possible when siting new construction. The techniques used to perform these activities are described in MINWR management documents associated with controlled fires and scrub habitat management (Adrian 2010).

Some compensation activities should be directed toward experimental approaches that use frequent mosaic fires to achieve stable medium height open habitat. Fuels reduction management approaches schedule fire intervals far enough apart to maximize the fuels consumption by individual fires, resulting in the loss of open sandy areas between fires. It is possible that increasing the time between controlled fires to maximize fuels consumption brings greater risk for wildfires compared to frequent, mosaic fire strategies that maintain biodiversity and fuels discontinuities, which slow fire spread. Testing such hypotheses might produce strategies that optimize wildfire and biodiversity management.

Areas that need to be mechanically treated (e.g., roller chopped) are inventoried by MINWR and provide the basis for most scrub compensation. Untreated, these areas degrade habitat suitability of adjacent scrub and restrict the spread of fires across landscapes. It is critical that mechanically treated areas are burned following treatment if an effective restoration process is to be established. Another mechanical treatment is pine thinning; this is most successful when the downed pines are left on the ground to serve as fuels for subsequent hot fires that create open sandy areas. Compensation acreages from small projects may need to be combined so that enough habitat is treated to make restoration efforts feasible.

Potential areas for treatment vary greatly in how they might benefit Florida Scrub-Jay recruitment and survival. Mechanical treatment of areas that are likely to produce wide expanses of medium height territories will have greater impact than treatment of areas adjacent to primary and secondary territories. Some landscapes need minor treatment to develop broad expanses of medium height and some need treatment of large areas to merit restoration. Areas needing extensive work will involve larger compensation projects. The understory beneath tree canopies also varies greatly, not just based on potential oak cover and soils, but also based on the amount of disturbance that influences exotic species and flammability. Compensation areas not only include scrub, but also include swale marshes that have become forested, resulting in degraded habitat quality and reduced fire spread. Overlaying grid cells that represent potential source territories within core areas will be used to prioritize the locations of compensation activities.

Maintaining suitable habitat to promote population connectivity among KSC cores and CCAFS populations is relevant, but of secondary importance. Florida Scrub-Jays generally live within one territory for life once they become breeders, are poor dispersers, and depend on having optimal habitat quality. Habitat quality degrades rapidly without regular burning and can take decades to restore to optimal conditions on MINWR. Therefore, it makes sense to first develop and maintain population source conditions in core populations before enhancing connections among potential cores. Maintaining populations of sufficient size in all cores is important for reducing the population risk from catastrophic events, such as epidemics (e.g., arboviruses) and major hurricanes.

2.4 Implementation

MINWR regularly revises a plan that identifies scrub management needs that are beyond activities associated with controlled fire management. The KSC Ecological Program routinely updates the population status and habitat states within core population areas. This process identifies habitat management improvements needed to meet recovery goals in core population areas that are discussed in Fire Action Team meetings. The KSC Fire Action Team is an interagency group of fire managers, administrators, and scientists that exchange ideas and concerns, and develop collaborative actions to enhance controlled fire management on federal properties, emphasizing KSC/MINWR.

Environmental management at KSC will identify expected compensation acreages needed for each proposed project and biologists with MINWR and the KSC Ecological Program will determine the best areas for compensation. The potential territory grid model will be used to select locations that will have the greatest population benefit, and to quantify the number of potential and actual Florida Scrub-Jay families expected to be positively impacted by restoration. These proposed areas for compensation will be provided to MINWR and NASA managers, who will then seek FWS Endangered Species Office concurrence. The space program offices responsible for project management will coordinate funding to MINWR based on the required acreage of compensation multiplied by the average restoration cost per acre. Refuge managers will accumulate enough acreage until restoration actions are feasible and then conduct restoration activities using MINWR staff or contractors managed by MINWR. Monitoring (described below) will provide guidance to revise and adapt future compensation plan activities based on habitat quality state changes and population parameters.

2.5 Monitoring

Project boundaries that determine compensation requirements are based on proposed facility footprints overlaid on habitat, and not by facility-specific territory mapping, as territory boundaries are dynamic. Territory boundaries are identified inside population cores during April/May by programmatic monitoring for purposes of understanding habitat-specific demography and responses to habitat management actions. Likewise, Scrub-Jay monitoring is not conducted before and after a construction event since factors that influence demography include habitat, sociobiology, and stochastic environmental variation. Separating cause and effect relationships requires advanced statistical modeling using large amounts of data and has been elaborated upon in many scientific journal articles. Monitoring that supports this compensation plan is incorporated into a long-term and center-wide approach to reduce uncertainty for space program customers and to prioritize activities to enhance recovery planning, implementation, and habitat management.

Annual monitoring of Scrub-Jay populations will continue within core areas to support adaptive management decision making that relies upon habitat-specific measures of recruitment and survival, territory occupancy, and habitat state of occupied territories. Delineating measures of habitat specific demography is important in a landscape with a checkerboard of sources and sinks in order to determine what habitat conditions and management actions lead to demographic success. Monitoring habitat states of all potential territories will continue for every year for which high resolution aerial imagery is available. Habitat state transition probabilities are likely influenced by fire histories across long time periods because so much vegetative biomass accumulates below ground and influences habitat structure above ground. Sample sizes have been insufficient to delineate fire history effects, but covariates describing those effects should become important for optimizing management regimes and reducing management uncertainty.

Monitoring activities are used to evaluate management efficacy and population recovery progress, but they also provide data to identify habitat restoration needs and optimize the use of available management resources. Monitoring data collection and analyses should also include covariates such as whether or not a territory has helpers. Important sociobiological and density dependent relationships such as this can lead to a better understanding of habitat requirements necessary to support population recovery.

Nesting studies are no longer routinely performed across study sites in order to focus resources on population dynamics across large areas. Locating nests requires much time in dense habitat, and nests fail frequently. Recruitment measures begin in July with surveys of independent young, which are conspicuous. Surviving young are uniquely color-banded, allowing the determination of habitat specific yearling recruitment and dispersal. Point counts or transect methods are not used because of numerous biases that occur.

3.0 Proposed Projects with Potential Scrub Impacts

Construction projects with the potential to impact Scrub-Jay habitat that are being planned for implementation within the next ten years are described below. Figure 2 depicts locations of proposed projects and potential areas of disturbance.

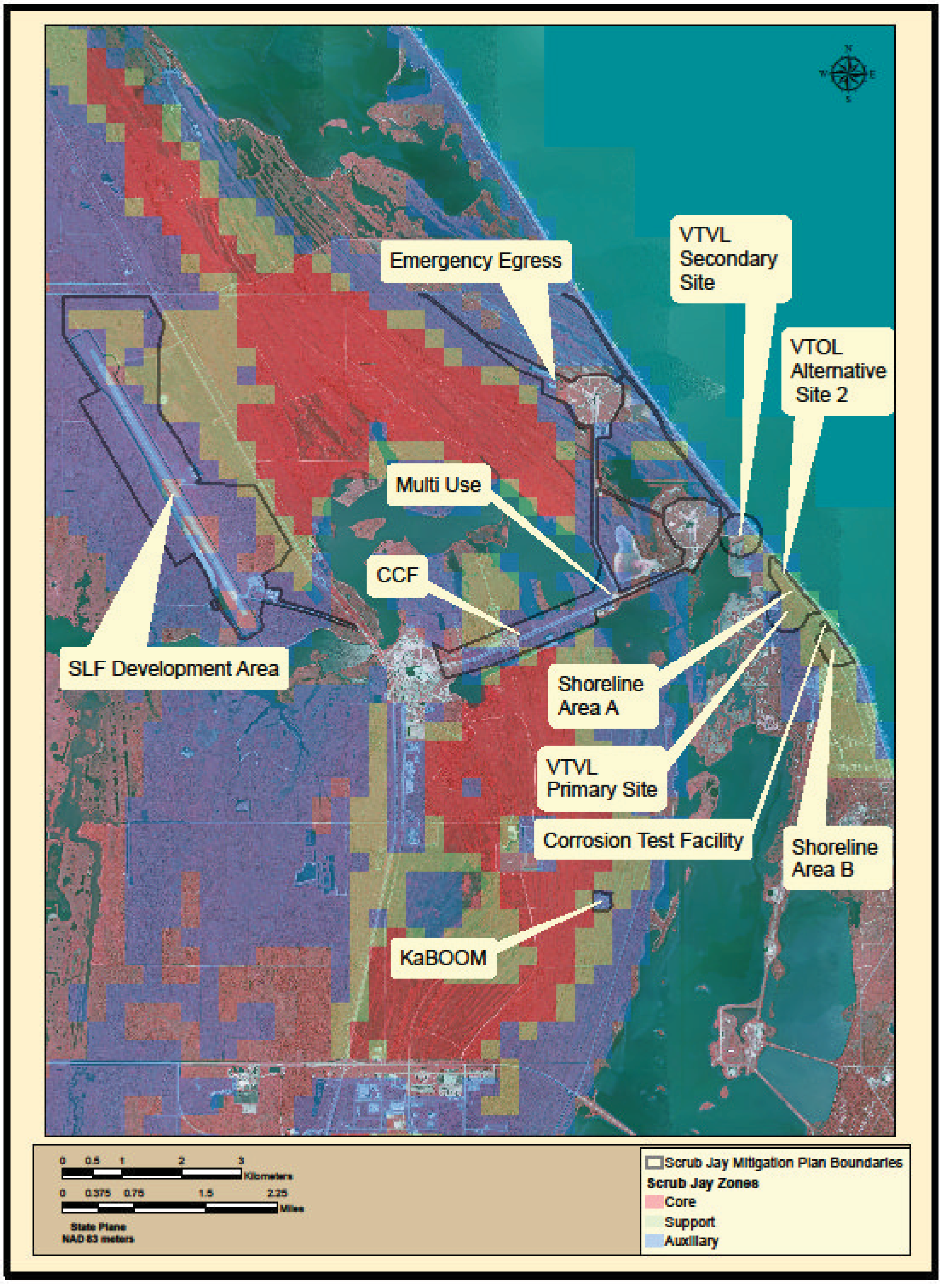

Figure 2. Proposed project areas and KSC Scrub-Jay habitat management zones.

3.1 Multi-use of LC39A and LC39B

In order to provide a continued capability of space exploration which includes the processing and launch of rocket powered vehicles, NASA proposes to allow multiple users to prepare and launch vehicles from LC 39A and LC 39B. To facilitate the multi-use of the LC39 area, future development would include construction of a Horizontal Integration Facility (HIF) at one or more of five potential locations.

Increased flight operations at LC 39A and LC 39B would also require construction of new Rocket Propellant 1 (RP-1) fuel storage and transfer facilities. Options for these facilities include either individual storage locations at each pad or a common storage facility centrally located. Delivery of RP-1 by railcar is being considered and railroad connections to chosen storage location(s) would be necessary to provide a mode of transport for incoming fuel supplies. These railroad connections would be constructed within existing roadways.

Ruderal land cover types make up most of the Multi-use Project area. Oak scrub is present on 2.4% of the site, while coastal strand and palmetto scrub each make up 0.1%. There are 9.4 ha (23.3 ac) of potential Scrub-Jay habitat within the Multi-use Project footprint (IHA 2013a).

3.2 SLF Development Area

The SLF area is being modified for future federal and commercial horizontal launch and landing activities to support KSC's mission and goals to be a commercial, multi-user spaceport. The Area Development Plan (ADP) completed in April 2012, along with the SLF Phase 1 Development Design (PCN 98923.1) and the SLF Commercial Development Study (PCN 98923.1), address siting and development criteria for two proposed commercial tenants that are considering constructing complexes at the SLF.

Tenant 1 is planning for a large operational complex consisting of over 13,935 square meters (m^2) (150,000 ft^2) of space for large air-assisted launch vehicle operations. Tenant 1 plans to use Jet A fuel for the carrier aircraft, solid rocket motors (SRM) delivered by rail for first and second launch vehicle stages, and liquid oxygen (LOX) and liquid hydrogen (LH_2) for the launch vehicle third stage. The payload would be fueled with hypergols off-site, thereby reducing toxicity concerns. The Tenant 1 aircraft is the largest proposed in the world with a 117 m (385 ft) wingspan, 72 m (235 ft) length, and a 15 m (50 ft) tail height. The fully loaded carrier aircraft, including the loaded launch vehicle and attached spacecraft, weighs approximately 635,029 kilograms (kg) (1.4 million pounds [lbs]). Flight testing of an inert launch vehicle and facility activation would occur in 2016. Flight operations may begin in 2017 with two flights per year. The frequency of fights is expected to increase to 32 flights per year by 2022 (NASA 2013b).

Tenant 2 is planning to operate a small suborbital spacecraft to carry a paying passenger or small payload. This craft has a 7 m (24 ft) wingspan, is 9.1 m (30 ft) long, and weighs 4,535 kg (10,000 lbs) fully loaded. The operations complex would consist of a 2,787 m^2 (30,000 ft^2) operations and maintenance hangar and a 2,787 m^2 (30,000 ft^2) hangar for spacecraft and payload manufacturing/assembly, integration, and processing. Tenant 2 plans to use LOX, special grade kerosene similar to RP-1 for propulsion, and small quantities of other energetic liquids for spacecraft attitude control and steering. This tenant may eventually require the use of LH_2. Tenant 2 expects to store and have the ability to load LOX and hydrocarbon fuels outside their hangar. They plan on loading the spacecraft in less than 30 minutes for airport-like throughput. Flight operations may begin in mid-to-late 2014 with vehicle testing, and later increase to four flights per day. A transient facility such as the Reusable Launch Vehicles (RLV) Hangar or an enclosed Convoy Vehicle Enclosure with hangar doors added might be used for temporary early-phase operations (NASA 2013b).

The SLF development area consists primarily of undeveloped natural area including 738 ha (1824 ac) of uplands, 134 ha (331 ac) of wetlands, and 168 ha (415 ac) of surface waters/ditches. Oak scrub 274 ha (678 ac) is the dominant upland land cover, with the exception of ruderal herbaceous. Other prominent land cover types identified include hardwood hammock [207 ha (510 ac)], palmetto scrub [23 ha (57 ac)], and scrub-shrub freshwater wetland [70 ha (172 ac)]. Portions of this scrub area are classified as primary and secondary Florida Scrub-Jay habitat and are considered crucial for long term maintenance of the Florida Scrub-Jay population at KSC.

3.3 Vertical Takeoff and Landing Sites

KSC plans to expand its spaceport capabilities to include the processing, launch, and recovery of horizontally and vertically launched suborbital rocket-powered vehicles. The Suborbital Processing, Launch, and Recovery Operations Environmental Assessment (EA) evaluated the expanded use of the SLF to accommodate horizontal take-off and landing of suborbital rocket powered vehicles, and the development of a site to process, launch, and land vertical take-off and landing (VTOL) vehicles conducting suborbital flights (IHA 2012). The EA addressed three alternative VTOL sites; alternative site 2 has scrub habitat and documented previous use by Scrub-Jay families.

VTOL Site 2 is located south of LC 39A and north of LC 41 along the KSC coastline. The dominant land cover is coastal strand (48%), ruderal herbaceous (28%), oak scrub (14%), with other land cover types making up the remaining 10%, including. While the oak scrub and coastal strand areas are of high quality, Brazilian pepper (*Schinus terebinthifolius*) has invaded hydric areas along the western portion of the site (IHA 2012). The VTOL site would support reusable vehicles in the small to medium classes with thrusts of up to 13,345 Newtons (N) (3,000 pound force [lb-f).]). Such vehicles could fly up to 105 kilometers (km) (65 miles [mi)]) in altitude, return to launch site, and land in a powered mode. Their rocket engines would be processed and the vehicle would either be prepared for another flight or removed from the launch area. The proposed facility would include a launch and landing concrete pad, two surface systems regolith test beds, lightning protection, parking areas for trucks, fuel tankers, trailers and cars, power hook-ups, LOX loading area, LOX Dewar/tanker truck parking, and a gaseous helium (GHe) loading/unloading area. The VTOL is anticipated to be a multi-user facility supporting the integration and launch of two or more vehicle systems using a single launch pad. It is anticipated that the combined average annual launch rate would exceed 100 launches per year.

NASA also conducted a study of Vertical Takeoff Vertical Landing (VTVL) vehicle operations sites under a Construction of Facilities (CofF) project (PCN 98924). This study identified a recommended site also located south of LC 39A and north of LC 41, south of the VTOL Site 2 discussed in the paragraphs above. A secondary VTVL site being considered is located just north of VTOL Site 2. The VTVL site will require a blockhouse, lightning protection, launch pad, and accommodation for a surface soil test bed for simulations of takeoffs and landings on various terrains (NASA 2012a).

The primary or recommended VTVL site is dominated by oak scrub (18 ha [45 ac]), and is also comprised of coastal strand (3 ha [7 ac]), mangrove (7 ha [17 ac]), interior saltwater (4 ha [10 ac], and hardwood forest (3 ha [7 ac]). The majority of the secondary VTVL site is interior saltwater, estuary, and saltwater marsh (16 ha [40 ac]), but also contains coastal strand (5 ha [13 ac]) and oak scrub (1 ha [4 ac]).

3.4 Pad 39B Emergency Egress for SLS

A study of Emergency Egress Systems (EES) to support the SLS launch vehicle at LC 39B is being conducted by NASA (PCN 98967). The study is to provide a selection of safe modes of egress from various launch vehicles, with different access height levels. Concepts B1 and B2 involve impacts to areas beyond the pad perimeter (northwest of the pad), providing egress to sites outside the Blast Danger Area 2,025 m (6,643 ft) (NASA 2013d).

Concept B1 incorporates a single-track rail car with multiple cars staged in series from the launch vehicle to the ground. There is an option in this concept for a powered assist at ground level to an area beyond the reach of gravity alone. Concept B2 uses a slide-wire on a new tower, egress is provided via a slide-wire basket to a site outside of the pad perimeter fence for transfer to pre-staged evacuation vehicles at the slide-wire terminal location.

The area to be impacted by the emergency egress route is primarily ruderal herbaceous (12 ha [31 ac]), coniferous/hardwood forest (6 ha [15 ac]), palmetto scrub (3 ha [7 ac]), oak scrub (2 ha [6 ac]), and saltwater marsh (8 ha [19 ac]). Primary infrastructure, surface water, and freshwater marsh account for the remainder of the site.

3.5 Converter/Compressor Facility

A study, driven by the need to update a 1966 facility to meet the needs for future space launch programs, was conducted for construction of a replacement of the existing Converter Compressor Facility (CCF), K7-0468 (NASA 2012). There are opportunities to increase the operational efficiency of the facility through reductions in helium process energy consumption, updated automation of the process equipment, and increased flexibility in sourcing nitrogen by establishing on-site processing, as well as elimination of dependence to the existing vendor pipeline. In addition to the new facility, construction will involve installation of an automated cryogenic liquid-to-gas helium conversion and compression system that utilizes a liquid helium pumping system to include cryogenic storage and associated process piping.

The primary site being considered is approximately 2 ha (5 ac) and includes constructing the CCF on and directly east of the existing CCF site. The existing building and processes must remain operational during construction, which will require shifting the new site to the east and clearing undisturbed land. Once the new facility is constructed and operational, the old building will be demolished and the new parking constructed over the existing building footprint. The area to be directly impacted by construction is mainly herbaceous and woody ruderal vegetation types, and primary infrastructure. It is contained within the footprint of the LC 39 Multi-use Project area. There is oak scrub present adjacent to the proposed site boundary.

3.6 Ka-Band Objects Observation and Monitoring at Fire Training Area

At the former Vertical Processing Facility (VPF) site, which was demolished in 2011, 12 m (40 ft) diameter dish antenna arrays are being constructed as part of the Antenna Test Bed Array for the Ka-Band Objects Observation and Monitoring (Ka-BOOM) system. The antennas will be part of the operations command center facility. The Ka-BOOM project is one of the final steps in developing the techniques to build a high power, high resolution radar system capable of becoming a Near Earth Object Early Warning System. While also capable of space communication and radio science experiments, developing radar applications is the primary focus of the arrays.

There are plans to expand the KaBOOM Ka-band antenna array to the Fire Training Area (located on the west side of Static Test Road, Facility L7-0888). Two antennas have been approved for the area, and an additional 48 are to be built over the next 3 years. Ka-band antennas are being set up to monitor space debris and study other near earth objects with the potential of impacting the planet. The KaBOOM uplink radar project is required to serve as the new National Radar Facility in service to the Executive Office of the

White House. Existing national radar capabilities are inadequate for imaging orbital debris, asteroids, and other classified targets.

The proposed KaBOOM antenna array will primarily impact herbaceous ruderal land cover and only a very small amount of oak scrub. However, the land adjacent to the existing Fire Training Area is dominated by oak scrub and scrub-shrub wetlands and would be impacted by proposed expansion of the array to 200 antennas.

3.7 Shoreline Protection

NASA is proposing an action to restore beach and coastal dune habitat that has been severely eroded over the past several years. Changes in the coastline have brought about increased frequency and severity of inundation events that threaten KSC infrastructure and assets, including natural habitats that support federally protected wildlife species. This trend is predicted to continue into the future. In order to maintain and preserve launch infrastructure and coastal habitats, KSC is proposing to implement measures to protect the shoreline from continuing damage. The four alternative actions being evaluated to accomplish shoreline protection include various amounts and locations of sand fill placement and subsequent dune planting. Each alternative seeks to establish an increased dune elevation and sand volume within the dune/beach barrier system for purposes of erosion control and flood prevention. This project will focus on the northern 8 km (5 mi) of the KSC 10 km (6 mi) ocean shoreline between the KSC north boundary/Eagle 4 and the False Cape (IHA 2013b).

Within the Shoreline Project area, there are 45 ha (112.4 ac) of coastal strand habitat that could potentially support Florida Scrub-Jays. Depending on the alternative chosen, between 5 ha (13 ac) and 11 ha (27 ac) of coastal strand would be impacted. Most of the coastal strand within the project area does not support jays, most likely because there is too little scrub oak of the appropriate height. There are two territories that have been documented on the southern end of the project area. One of the territories is 34 ha (83 ac) with two Scrub-Jays and the other is 23 ha (58 ac) with four Scrub-Jays (IHA 2013b).

3.8 Corrosion Test Facility Expansion

The KSC Beach Corrosion Test Site, K8-0237, is to be extended to the south by approximately 91 m (300 ft) of front row test rack space. Increased corrosion testing and evaluation from both internal and external customers has created the need for additional space. The current site is full and cannot accommodate the additional work. This expansion project will include land clearing and soil stabilization to allow placement of test racks and test articles. A fence will be installed around the perimeter of the new area. The approximately 1 ha (3 ac) area potentially impacted by construction is 95% coastal strand (1 ha [2.9 ac]).

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Appendix 1

Background to Florida Scrub-Jay Habitat Needs, Assessment, and Monitoring

Florida scrub-jays do not occupy areas with high tree densities and generally avoid using scrub near forests, which disrupt the spread of fires across landscapes (Breininger et al. 2005). The height of shrubs and extent of open sandy patches among scrub are the dynamic factors that most influence recruitment and survival in occupied areas and are important indicators of management needs and progress (Breininger et al. 2009, 2010). Management success greatly depends on habitat quality transition rates that will achieve a ratio of source-to-sink territories that will produce a positive population growth rate. Medium-height territories function as sources; short, tall-mixed, and tall territories function as sinks (Breininger and Carter 2003). Demographic performance rates (individuals/pair-year) are: -0.32 in short, 0.49 in open-medium, 0.15 in closed-medium, -0.24 in tall-mix, -0.31 in tall, and -0.31 in tertiary (no large scrub oak patches). Recruitment rates are further complicated by the presence of non-breeding adults called helpers, who are products of past demographic success and assist breeders in raising future generations, spot and mob predators, and defend territories (Table 1). Mean annual yearling production for pairs without helpers in closed-medium (0.36) is barely able to offset expected breeder mortality (0.30) and thus is unlikely to lead to population growth in populations that are far below carrying capacity.

Table 1. Mean Florida Scrub-Jay (*Aphelocoma coerulescens*) yearlings/pair (sample sizes) ±95% confidence intervals among source-sink and helper states (Breininger et al. in press)

Habitat state	Helpers present	Helpers absent
Strong source (open-medium)	1.01 (169) 0.80-1.22	0.70 (168) 0.53-0.86
Weak source (closed-medium)	0.67 (233) 0.54-0.81	0.36 (257) 0.26-0.46
Sink (short, tall mix, tall tertiary)	0.34 (736) 0.28-0.39	0.21 (1263) 0.18-0.24

Open-medium is a strong source but restoring habitat to this condition is difficult because openings disappear rapidly after fire. Frequent, mosaic fires that burn some scrub but leave some medium-height scrub unburned at the territory scale are needed to develop and maintain open-medium. Most KSC habitat is in a tall mix state, which seldom transitions to short or medium states without mechanical cutting; the tall mix state is a legacy of habitat fragmentation and the disruption of natural fire regime. Poor Florida Scrub-Jay survival in short territories, which result from extensive fires, greatly complicates fire management on KSC because opportunities for frequent fire are greatly limited by suitable meteorological conditions, and space and military operations.

Scrub compensation focuses on cutting tall scrub and forest in strategic locations that will maximize the transition probabilities of scrub into the open-medium state and maximize the net production of new adult Florida Scrub-Jays. Burning cut areas and successive mosaic fires are needed to complete restoration. Mechanical treatment of vegetation is not a substitute for fire because vegetation is uniquely adapted to fire. Mechanical treatment must be carefully applied to maintain conditions to promote long-term fire spread and avoid the spread of exotic plants.

<u>Florida Scrub-Jay population and habitat monitoring</u>

Florida Scrub-Jays, their habitat, and other scrub species of conservation concern have been studied by an interdisciplinary team of scientists on KSC and MINWR beginning in 1978. Objectives have been to support launch impact assessment, scrub compensation, climate change adaptation, and adaptive resource management. These studies resulted in >60 international scientific journal articles, which have informed many conservation plans, species recovery planning documents, and statewide scrub management guidelines (Kent and Kindell 2010). These studies began by quantifying relationships between Florida Scrub-Jay abundance and habitat variables, particularly why KSC had one of the largest Florida Scrub-Jay populations yet seemingly little optimal habitat. It was soon recognized that Florida Scrub-Jay mortality was exceeding recruitment in most landscapes because of poor habitat quality. These findings led to collaborations between MINWR and KSC to develop a conservation strategy for managing Florida Scrub-Jays that continues to evolve (Breininger et al. 1996). Studies of historical habitat change and fire regime changes quantified how habitat degradation began in the 1950s and that reversing degradation was difficult and complicated. Many ecological theories were tested including source-sink dynamics that provide an important basis for moving forward with management and restoration. Many remote sensing and photointerpretation approaches were developed, including the statistical modeling of habitat transition probabilities as functions of environmental features and management action histories. Studies in collaboration with many conservation partners were extended to the east central Florida mainland to facilitate scrub ecosystem conservation. The science, management capabilities, and need to make decisions under uncertainty became a case study about how endangered species management could be optimized by adaptive resource management (Breininger 2004, Johnson et al. 2011, and Williams et al. 2011).

<u>Uncertainty and the need for an adaptive approach</u>

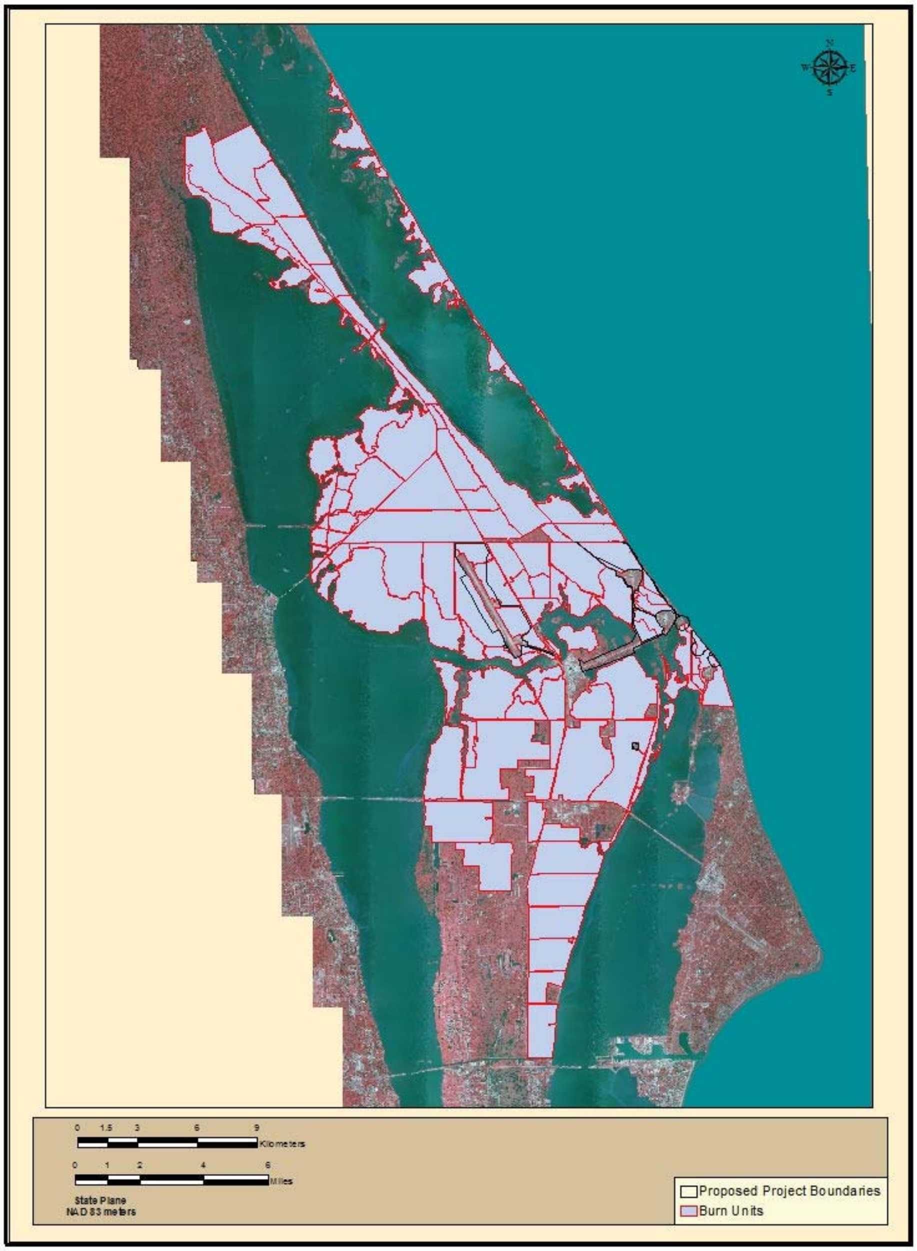
There is much spatial and temporal variation in habitat and population responses to management actions that partially can be explained by soils, edge effects, previous management history, habitat-specific demography, dispersal capabilities, rainfall, and environmental stochasticity. Fire return intervals are often based on vegetation type, yet fires and animal home ranges often extend far past vegetation types. Fire history is likely to have an effect because much scrub and flatwoods biomass accumulates underground so that long unburned sites have different responses than frequently burned sites. Therefore, management can be optimized by making site-specific management decisions based on system states determined by monitoring and predicted state-specific responses to alternative management actions. There usually are uncertainties in system responses and these uncertainties can be reduced by learning accomplished by comparing predicted and monitored system responses to management actions and comparing ecological models that describe uncertainty to determine which have the greatest support and thus can reduce uncertainty. Fire managers carefully consider fuels, meteorological conditions, firing techniques, and smoke sensitive areas when initiating a controlled burn, but there is much individual variation in individual fires particularly as local weather changes. Controlled fires reduce the risk of catastrophic wildfires, but KSC is within a part of the world with extremely high lightning and wildfires still occur. Therefore, the approach to compensation must consider a dynamic environment.

Previous scrub compensation efforts

Early efforts at scrub compensation focused on restoring tall scrub to offset impacts of habitat loss associated with the destruction of mostly degraded scrub (Schmalzer et al. 1994). Tall scrub rarely burns, at least under conditions safe for controlled fire (Schmalzer and Adrian 2001). A collaborative effort involving MINWR as management experts and KSC Ecology Program as monitoring experts explored many ways to cut and burn scrub using techniques that are now commonly used across the species range. Cutting scrub, followed by fire, is a successful approach to reintroduce fire back into the landscape and maintain vegetation composition. Restoring the proper arrangement of shrub heights and open sandy areas, relative to conditions needed so that Florida Scrub-Jay recruitment exceeds mortality, has proven surprisingly difficult in some landscapes. Rapid restoration of habitat structure and conducting mosaic fires is difficult across much of the species range.

Appendix 2

Fire Management Units Map
Kennedy Space Center, 2013


N
W
E
S
0 1.5 3 6 9
Kilometers
0 1 2 4 6
Miles
State Plane
NAD 83 meters
Proposed Project Boundaries
Burn Units

Appendix 3

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Appendix 4

Programmatic Biological Opinion for Kennedy Space Center

Florida Scrub-Jay Compensation Plan

United States Department of the Interior

U. S. FISH AND WILDLIFE SERVICE

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IN REPLY REFER TO:
FWS Log No. 04EF1000-2013-F-0194

November 6, 2013

Lynne Phillips
Physical Scientist, NASA
KSC Environmental Management Branch
Mail Code TA-A4C
John F. Kennedy Space Center, NASA
Kennedy Space Center, FL 32899

RE: Programmatic Biological Opinion for Kennedy Space Center Florida Scrub-Jay Compensation Plan

Dear Ms. Phillips:

This document transmits the U.S. Fish and Wildlife Service's (FWS) biological opinion based on the review of the proposed Florida Scrub-Jay Compensation Plan for Florida's Kennedy Space Center (KSC) and its effects on the Florida Scrub-Jay (*Aphelocoma coerulescens*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your request for formal consultation was received in this office on May 17, 2013.

This biological opinion is based on information provided in the Kennedy Space Center Florida Scrub-Jay Compensation Plan; meetings with Lynne Phillips (KSC), Dr. David Breininger (InoMedic Health Applications, KSC), Layne Hamilton (FWS), Ralph Lloyd (FWS), Mike Legare (FWS), Jim Lyon (FWS), Dr. Heath Rauschenberger (FWS), and Todd Mecklenborg (FWS); field investigations; and other sources of information. A complete administrative record of this consultation is on file in the Jacksonville Ecological Services Field Office.

Consultation History

On 16 January 2013, FWS's Ecological Services representatives attended a meeting with National Aeronautics and Space Administration's (NASA) KSC Environmental Management Branch staff and FWS's Merritt Island National Wildlife Refuge (MINWR) staff to discuss KSC's Master Plan for Future Development and Operations. In the upcoming years, KSC will transform from a government and program-focused, single-user launch complex to a more capability centered and multi-user spaceport to meet future government and commercial space industry needs. KSC's strategic priorities include environmental stewardship, sustainability, and evaluating the risks associated with future climate change. This involves focusing development and redevelopment into areas that can accommodate facilities and allow consolidation of compatible functional activities.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Many organizations have interest in using NASA property on KSC. The purpose of the Kennedy Space Center Florida Scrub-Jay Compensation Plan is to consolidate the goals of ecosystem management associated with Florida Scrub-Jays and compliance with the Act in order to streamline and reduce the costs of facility planning, impact assessment, and impact minimization. This will simplify the process and reduce regulatory uncertainty. Lands on KSC not directly used by NASA for space operations are managed by the FWS, who has primary responsibility for managing threatened and endangered species as well as wildlife at MINWR. However, the resulting process must be consistent with the MINWR Comprehensive Conservation Plan (CCP). In addition, the Kennedy Space Center Florida Scrub-Jay Compensation Plan considers anticipated construction impacts on KSC during the next 10 years and summarizes priorities in a spatially explicit manner. The compensation plan describes anticipated compensation requirements resulting from impacts to facilitate restoration of degraded habitat in areas most important to the KSC Florida Scrub-Jay population through resources provided to MINWR.

Construction projects with the potential to impact Florida Scrub-Jay habitat that are being planned for implementation on MINWR within the next 10 years are described below.

Multi-Use of LC39A and LC39B

In order to provide a continued capability of space exploration which includes the processing and launch of rocket powered vehicles, NASA proposes to allow multiple users to prepare and launch vehicles from LC 39A and LC 39B. To facilitate the multi-use of the LC39 area, future development would include construction of a Horizontal Integration Facility (HIF) at one or more of five potential locations.

Increased flight operations at LC 39A and LC 39B would also require construction of new Rocket Propellant 1 (RP-1) fuel storage and transfer facilities. Options for these facilities include either individual storage locations at each pad or a common storage facility centrally located. Delivery of RP-1 by railcar is being considered and railroad connections to chosen storage location(s) would be necessary to provide a mode of transport for incoming fuel supplies. These railroad connections would be constructed within existing roadways.

Ruderal land cover types make up most of the Multi-use Project area. Oak scrub is present on 2.4% of the site, while coastal strand and palmetto scrub each make up 0.1%. There are 9.4 ha (23.2 ac) of potential Florida Scrub-Jay habitat within the Multi-use Project footprint.

SLF Development Area

The SLF area is being modified for future federal and commercial horizontal launch and landing activities to support KSC's mission and goals to be a commercial, multi-user spaceport. The Area Development Plan (ADP) completed in April 2012, along with the SLF Phase 1 Development Design (PCN 98923.1) and the SLF Commercial Development Study (PCN 98923.1), address siting and development criteria for two proposed commercial tenants that are considering constructing complexes at the SLF.

Tenant 1 is planning for a large operational complex consisting of over 13,935 square meters (m^2) (150,000 ft^2) of space for large air-assisted launch vehicle operations. Tenant 1 plans to use Jet A fuel for the carrier aircraft, solid rocket motors (SRM) delivered by rail for first and second launch vehicle stages, and liquid oxygen (LOX) and liquid hydrogen (LH_2) for the launch vehicle third stage. The payload would be fueled with hypergols off-site, thereby reducing toxicity concerns. The Tenant 1 aircraft is the largest proposed in the world with a 117 m (384 ft) wingspan, 72 m (236 ft) length, and a 15 m (49 ft) tail height. The fully loaded carrier aircraft, including the loaded launch vehicle and attached spacecraft, weighs approximately 635,029 kilograms (kg) (1.4 million lb). Flight testing of an inert launch vehicle and facility activation would occur in 2016. Flight operations may begin in 2017 with two flights per year. The frequency of fights is expected to increase to 32 flights per year by 2022.

Tenant 2 is planning to operate a small suborbital spacecraft to carry a paying passenger or small payload. This craft has a 7 m (23 ft) wingspan, is 9.1 m (30 ft) long, and weighs 4,535 kg (10,000 lbs) fully loaded. The operations complex would consist of a 2,787 m^2 (30,000 ft^2) operations and maintenance hangar and a 2,787 m^2 (30,000 ft^2) hangar for spacecraft and payload manufacturing/assembly, integration, and processing. Tenant 2 plans to use LOX, special grade kerosene similar to RP-1 for propulsion, and small quantities of other energetic liquids for spacecraft attitude control and steering. This tenant may eventually require the use of LH_2. Tenant 2 expects to store and have the ability to load LOX and hydrocarbon fuels outside their hangar. They plan on loading the spacecraft in less than 30 minutes for airport-like throughput. Flight operations may begin in mid-to-late 2014 with vehicle testing, and later increase to four flights per day. A transient facility such as the Reusable Launch Vehicles (RLV) Hangar or an enclosed Convoy Vehicle Enclosure with hangar doors added might be used for temporary early-phase operations.

The SLF development area consists primarily of undeveloped natural area including 738 ha (1824 ac) of uplands, 134 ha (331 ac) of wetlands, and 168 ha (415 ac) of surface waters/ditches. Oak scrub is the dominant upland land cover with the exception of ruderal herbaceous. Other prominent land cover types identified include hardwood hammock [207 ha (511 ac)], palmetto scrub [23 ha (57 ac)], and scrub-shrub freshwater wetland [70 ha (173 ac)]. Portions of this scrub area are classified as primary and secondary Florida Scrub-Jay habitat and are considered crucial for long term maintenance of the Florida Scrub-Jay population at KSC.

Vertical Takeoff and Landing Sites

KSC plans to expand its spaceport capabilities to include the processing, launch, and recovery of horizontally and vertically launched suborbital rocket-powered vehicles. The Suborbital Processing, Launch, and Recovery Operations Environmental Assessment (EA) evaluated the expanded use of the SLF to accommodate horizontal take-off and landing of suborbital rocket powered vehicles, and the development of a site to process, launch, and land vertical take-off and landing (VTOL) vehicles conducting suborbital flights. The EA addressed three alternative VTOL sites; alternative site 2 has scrub habitat and documented previous use by Florida Scrub-Jay families.

VTOL Site 2 is located south of LC 39A and north of LC 41 along the KSC coastline. The dominant land cover is coastal strand (48%), ruderal herbaceous (28%), oak scrub (14%), with other land cover types making up the remaining 10%. While the oak scrub and coastal strand areas are of high quality, Brazilian pepper (*Schinus terebinthifolius*) has invaded hydric areas along the western portion of the site. The VTOL site would support reusable vehicles in the small to medium classes with thrusts of up to 13,345 Newtons (N) (3,000 pound force [lb-f).]). Such vehicles could fly up to 105 km (65 mi) in altitude, return to launch site, and land in a powered mode. Their rocket engines would be processed and the vehicle would either be prepared for another flight or removed from the launch area. The proposed facility would include a launch and landing concrete pad, two surface systems regolith test beds, lightning protection, parking areas for trucks, fuel tankers, trailers and cars, power hook-ups, LOX loading area, LOX Dewar/tanker truck parking, and a gaseous helium (GHe) loading/unloading area. The VTOL is anticipated to be a multi-user facility supporting the integration and launch of two or more vehicle systems using a single launch pad. It is anticipated that the combined average annual launch rate would exceed 100 launches per year.

NASA also conducted a study of Vertical Takeoff Vertical Landing (VTVL) vehicle operations sites under a Construction of Facilities (C of F) project (PCN 98924). This study identified a recommended site also located south of LC 39A and north of LC 41, south of the VTOL Site 2 discussed in the paragraphs above. A secondary VTVL site being considered is located just north of VTOL Site 2. The VTVL site will require a blockhouse, lightning protection, launch pad, and accommodation for a surface soil test bed for simulations of takeoffs and landings on various terrains.

The primary or recommended VTVL site is dominated by oak scrub (18 ha [44 ac]), and is also comprised of coastal strand (3 ha [7 ac]), mangrove (7 ha [17 ac]), interior saltwater (4 ha [10 ac], and hardwood forest (3 ha [7 ac]). The majority of the secondary VTVL site is interior saltwater, estuary, and saltwater marsh (16 ha [40 ac]), but also contains coastal strand (5 ha [13 ac]) and oak scrub (1.0 ha [2.5 ac]).

Pad 39B Emergency Egress for SLS

A study of Emergency Egress Systems (EES) to support the SLS launch vehicle at LC 39B is being conducted by NASA (PCN 98967). The study is to provide a selection of safe modes of egress from various launch vehicles, with different access height levels. Concepts B1 and B2 involve impacts to areas beyond the pad perimeter (northwest of the pad), providing egress to sites outside the Blast Danger Area 2,025 m (6,644 ft).

Concept B1 incorporates a single-track rail car with multiple cars staged in series from the launch vehicle to the ground. There is an option in this concept for a powered assist at ground level to an area beyond the reach of gravity alone. Concept B2 uses a slide-wire on a new tower, egress is provided via a slide-wire basket to a site outside of the pad perimeter fence for transfer to pre-staged evacuation vehicles at the slide-wire terminal location.

The area to be impacted by the emergency egress route is primarily ruderal herbaceous (12 ha [30 ac]), coniferous/hardwood forest (6 ha [15 ac]), palmetto scrub 93 ha [7 ac]), oak scrub (2 ha [5 ac]), and saltwater marsh (8 ha [20 ac]). Primary infrastructure, ditches, and freshwater marsh account for the remainder of the site.

Converter/Compressor Facility

A study, driven by the need to update a 1966 facility to meet the needs for future space launch programs, was conducted for construction of a replacement of the existing Converter Compressor Facility (CCF), K7-0468. There are opportunities to increase the operational efficiency of the facility through reductions in helium process energy consumption, updated automation of the process equipment, and increased flexibility in sourcing nitrogen by establishing on-site processing, as well as elimination of dependence to the existing vendor pipeline. In addition to the new facility, construction will involve installation of an automated cryogenic liquid-to-gas helium conversion and compression system that utilizes a liquid helium pumping system to include cryogenic storage and associated process piping.

The primary site being considered is approximately 2 ha (5 ac) and includes constructing the CCF on and directly east of the existing CCF site. The existing building and processes must remain operational during construction, which will require shifting the new site to the east and clearing undisturbed land. Once the new facility is constructed and operational, the old building will be demolished and the new parking constructed over the existing building footprint. The area to be directly impacted by construction is mainly herbaceous and woody ruderal vegetation types, and primary infrastructure. It is contained within the footprint of the LC 39 Multi-use Project area. There is oak scrub present adjacent to the proposed site boundary (0.4ha [1.0 ac]).

KA-Band Objects Observation and Monitoring at Fire Training Area

At the former Vertical Processing Facility (VPF) site, which was demolished in 2011, 12 m (40 ft) diameter dish antenna arrays are being constructed as part of the Antenna Test Bed Array for the Ka-Band Objects Observation and Monitoring (Ka-BOOM) system. The antennas will be part of the operations command center facility. The Ka-BOOM project is one of the final steps in developing the techniques to build a high power, high resolution radar system capable of becoming a Near Earth Object Early Warning System. While also capable of space communication and radio science experiments, developing radar applications is the primary focus of the arrays.

There are plans to expand the KaBOOM Ka-band antenna array to the Fire Training Area (located on the west side of Static Test Road, Facility L7-0888). Two antennas have been approved for the area, and an additional 48 are to be built over the next 3 years. Ka-band antennas are being set up to monitor space debris and study other near earth objects with the potential of impacting the planet. The KaBoom uplink radar project is required to serve as the new National Radar Facility in service to the Executive Office of the White House. Existing national radar capabilities are inadequate for imaging orbital debris, asteroids, and other classified targets.

The proposed KaBOOM antenna array will primarily impact herbaceous ruderal land cover and only a very small amount of oak scrub. However, the land adjacent to the existing Fire Training Area is dominated by oak scrub and scrub-shrub wetlands and would be impacted by proposed expansion of the array to 200 antennas (15.6 ha [38.5 ac]).

Shoreline Protection

NASA is proposing an action to restore beach and coastal dune habitat that has been severely eroded over the past several years. Changes in the coastline have brought about increased frequency and severity of inundation events that threaten KSC infrastructure and assets, including natural habitats that support federally protected wildlife species. This trend is predicted to continue into the future. In order to maintain and preserve launch infrastructure and coastal habitats, KSC is proposing to implement measures to protect the shoreline from continuing damage. The four alternative actions being evaluated to accomplish shoreline protection include various amounts and locations of sand fill placement and subsequent dune planting. Each alternative seeks to establish an increased dune elevation and sand volume within the dune/beach barrier system for purposes of erosion control and flood prevention. This project will focus on the northern 8 km (5 mi) of the KSC 10 km (6 mi) ocean shoreline between the KSC north boundary/Eagle 4 and the False Cape.

Within the Shoreline Project area, there are 45 ha (111 ac) of coastal strand habitat that could potentially support Florida scrub-jays. Depending on the alternative chosen, between 5 ha (12 ac) and 11 ha (27 ac) of coastal strand would be impacted. Most of the coastal strand within the project area does not support Florida Scrub-Jays, most likely because there is too little scrub oak of the appropriate height. There are two territories that have been documented on the southern end of the project area. One of the territories is 34 ha (84 ac) with two Florida Scrub-Jays and the other is 23 ha (57 ac) with four Florida Scrub-Jays.

Corrosion Test Facility Expansion

The KSC Beach Corrosion Test Site, K8-0237, is to be extended to the south by approximately 91 m (300 ft) of front row test rack space. Increased corrosion testing and evaluation from both internal and external customers has created the need for additional space. The current site is full and cannot accommodate the additional work. This expansion project will include land clearing and soil stabilization to allow placement of test racks and test articles. A fence will be installed around the perimeter of the new area. The approximately 1.0 ha (2.5 ac) area potentially impacted by construction is 95% coastal strand.

Figure 1 depicts the locations of the proposed projects and the potential areas of disturbance.

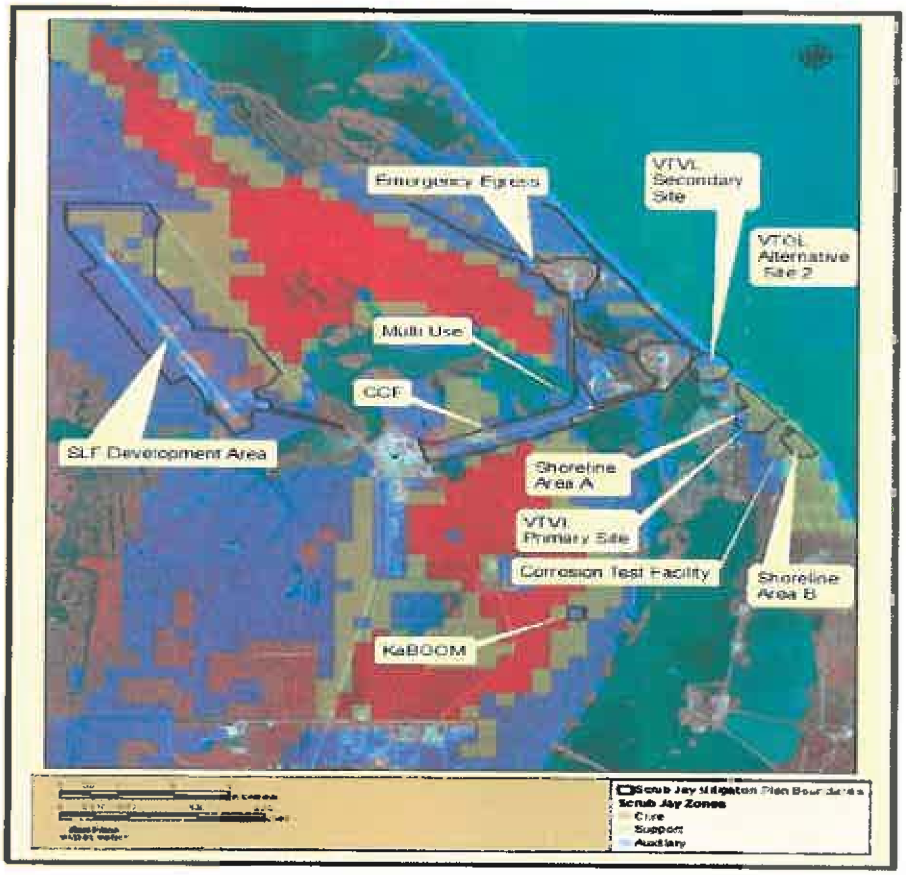

Figure 1. Proposed project areas and KSC Florida Scrub-Jay Habitat management zones

FWS has described the action area to include all of MINWR for reasons that will be explained and discussed in the "EFFECTS OF THE ACTION" section of this consultation.

STATUS OF THE SPECIES/CRITICAL HABITAT

This section summarizes Florida Scrub-Jay biology and ecology as well as information regarding the status and trends of the Florida Scrub-Jay throughout its entire range. We use this information to assess whether a federal action is likely to jeopardize the continued existence of the above mentioned species. The "ENVIRONMENTAL BASELINE" section summarizes information on status and trends of the Florida Scrub-Jay specifically within the action area. These summaries provide the foundation for our assessment of the effects of the proposed action, as presented in the "EFFECTS OF THE ACTION" section.

Species/critical habitat description

Florida Scrub-Jays are about 25 to 30 centimeters [cm] (10 to 12 inches [in]) long and weigh about 77 grams [g] (3 ounces [oz]). 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 Florida 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 Florida 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). Florida 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 vocalized only by females (Woolfenden and Fitzpatrick 1984, 1986). Florida Scrub-Jays that are less than about five months of age are easily distinguishable from adults; their plumage is smokey grey 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 Florida Scrub-Jays may be indistinguishable from adults in the field (Woolfenden and Fitzpatrick 1984). The wide variety of vocalizations of Florida Scrub-Jays is described in detail by Woolfenden and Fitzpatrick (1996b).

Habitat Characteristics

Florida Scrub-Jays are restricted to scrub and scrubby flatwoods occurring on relict dunes and sand ridges throughout Florida, primarily concentrated along the Atlantic Coast, Gulf Coast, and on the central ridges of the peninsula (Laessle 1958, Davis 1967, Myers 1990, Woolfenden and Fitzpatrick 1996b). At the landscape scale, Florida Scrub-Jays require suitable quantity and configuration of habitat to persist long-term. Given the size of Florida Scrub-Jay territories and the short dispersal distances exhibited by the species, it is critical to maintain large, contiguous blocks of Florida Scrub-Jay habitat to support local populations that are relatively resistant to local extinction (Fitzpatrick *et al.* 1991). The probability of persistence increases with increasing connectivity to other Florida Scrub-Jay populations (Coulon *et al.* 2010, 2012).

Within each territory, Florida Scrub-Jays require low, shrubby oaks, few trees, and bare patches of sand or sparse herbaceous vegetation (Breininger *et al.* 1998). Optimal habitat conditions include patches of oak shrubs 1.2-1.7 m (4-5.5 ft) tall, 10-50% bare sand, and less than one canopy tree per acre (Breininger 2004), though Florida Scrub-Jays can tolerate one to two pine trees per acre. The arrangement of shrub heights in a Florida Scrub-Jay territory is an important indicator of habitat quality (Breininger and Carter 2003, Breininger *et al.* 2013). Florida Scrub-Jays need scrub oaks of sufficient height to provide nest sites, acorns, and cover from predators; however, mortality exceeds recruitment when the average shrub height exceeds 1.7 m (5.5 ft), and Florida Scrub-Jays disappear from long-unburned, overgrown scrub (Woolfenden and Fitzpatrick 1996, Breininger and Carter 2003, Breininger *et al.* 2006).

No critical habitat has been designated for this species; therefore, none will be affected.

Life History

Diet

Florida 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 and lepidopteran larvae, comprise the majority of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Acorns are by far the most important plant food (Fitzpatrick *et al.* 1991). From August to November each year Florida Scrub-Jays harvest and cache thousands of scrub oak acorns throughout their territory. Each Florida Scrub-Jay may cache 6,500 to 8,000 acorns per year (DeGange *et al.* 1989). Acorns are mainly cached by hammering into the sand, but are also stuffed into pine needle tufts, Spanish or ball moss, and palmetto fronds (Woolfenden and Fitzpatrick 1996b). Acorns are typically buried 1 to 2 cm (0.4 to 0.8 in) beneath the surface of bare sand in openings in the scrub during fall, and retrieved and consumed in winter and early spring. Other small nuts, fruits, and seeds also are eaten.

Vertebrate prey items comprise the minority of the diet, but may include a wide array of species weighing up to 25 g (0.9 oz) (Toland 1996). Notable vertebrate prey species documented for Florida Scrub-Jays on both the Lake Wales Ridge and the Atlantic Coastal Ridge include, green treefrog (*Hyla cinerea*), squirrel treefrog (*H. squirella*), green anole (*Anolis carolinensis*), brown anole (*A. sagrei*), Florida scrub lizard (*Sceloporus woodi*), six-lined racerunner (*Cnemidophorus sexlineatus*), black racer (*Coluber constrictor*), peninsula crowned snake (*Tantilla relicta relicta*), rough greensnake (*Opheodrys aestivus*), house mouse (*Mus musculus*), cotton mouse (*Peromyscus gossypinus*), oldfield mouse (*P. polionotus*), and Florida mouse (*Podomys floridanus*) (Woolfenden and Fitzpatrick 1984).

In suburban areas, Florida Scrub-Jays will accept supplemental foods offered by humans, such as peanuts, corn, and sunflower seeds.

Social Structure

Florida Scrub-Jays have a social structure that involves cooperative breeding, a trait that the western North American populations of other scrub-jay species do not exhibit (Woolfenden and Fitzpatrick 1984). Florida Scrub-Jays live in groups ranging from two (a single mated pair) up to large, extended families of eight adults and one to four juveniles. Fledgling Florida Scrub-Jays remain with the breeding pair in their natal territory as "helpers," forming a closely-knit, cooperative family group. Pre-breeding 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).

Florida 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). Helpers participate in sentinel duties (McGowan and Woolfenden 1989), territorial defense, predator-mobbing, and the feeding of both nestlings (Stallcup and Woolfenden 1978) and fledglings (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 observed, the sentinel Florida Scrub-Jay gives a distinctive warning call, and all group members seek cover in dense shrub vegetation (Fitzpatrick *et al.* 1991).

Territoriality

Florida Scrub-Jay pairs occupy year-round, multi-purpose territories (Woolfenden and Fitzpatrick 1984; Fitzpatrick *et al.* 1991, 1994b). Territory size averages 9 to 10 hectares [ha] (22 to 25 acres [ac]), with a minimum size of about 5 ha (12 ac). The availability of territories is a limiting factor for Florida Scrub-Jay populations. Because of this limitation, non-breeding adult males may remain at the natal territory as helpers for up to five years, waiting for either a mate or territory to become available (Fitzpatrick *et al.* 1991). New territories are established several ways: by replacing a lost breeder on a territory (Woolfenden and Fitzpatrick 1984); through "territorial budding," where a helper male becomes a breeder in a segment of its natal territory (Woolfenden and Fitzpatrick 1978); by inheriting a natal territory following the death of a breeder; by establishing a new territory between existing territories (Woolfenden and Fitzpatrick 1984); or through "adoption" of an unrelated helper by a neighboring family followed by resident mate replacement (Toland 1996). Territories also can be obtained by creating suitable habitat in areas that were previously unsuitable through effective habitat management efforts (Thaxton and Hingtgen 1994).

Reproduction and Demography

To become a breeder, a Florida Scrub-Jay must acquire a territory and a mate. Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that Florida Scrub-Jays are permanently monogamous. The pair retains ownership and sole breeding-privileges in their 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 Florida Scrub-Jays (Woolfenden and Fitzpatrick 1984). These authors also reported never observing copulation between unpaired Florida Scrub-Jays, nor courtship behavior between a female other than her mate. Age at first breeding in the Florida 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 Florida Scrub-Jays exist only where there are scrub oaks in sufficient quantity to provide an ample winter acorn supply, cover from predators, and nest sites during the spring (Woolfenden and Fitzpatrick 1996).

Florida Scrub-Jay nests are typically placed in shrubby oaks, at a height of 1 to 2 m (3 to 6 ft). *Quercus inopina* and *Q. geminata* are the preferred shrubs on the Lake Wales Ridge (Woolfenden and Fitzpatrick 1984), and *Q. myrtifolia* is favored on the Atlantic Coastal Ridge (Toland 1991) and southern Gulf coast (Thaxton 1998). In suburban areas, Florida Scrub-Jays nest in the same evergreen oak species as well as in introduced or exotic trees; however they construct their nests in a significantly higher position in these oaks than when in natural scrub habitat (Bowman *et al.* 1996). Florida Scrub-Jay nests are an open cup, about 18 to 20 cm (7 to 8 in) outside diameter, and 8 to 9 cm (3 to 3.5 in) inside diameter. The outer basket is bulky and constructed of coarse twigs from oaks and other vegetation, and the inside is lined with tightly wound palmetto or cabbage palm 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 1 March through 30 June (Woolfenden and Fitzpatrick 1990; Fitzpatrick *et al.* 1994). On the Atlantic Coastal Ridge and southern Gulf coast, nesting may be protracted through the end of July (Toland 1996, Thaxton 1998). In suburban habitats, nesting is consistently initiated earlier (March) than in natural scrub habitat (Fleischer 1996), although the reason for this difference is unknown. Nesting failures are almost always caused by predation, most frequently by ground-based predators including eastern coachwhip (*Masticophis flagellum*), eastern indigo snake (*Drymarchon corais*), rat snake (*Elaphe obsoleta*), corn snake (*E. guttata*), raccoon *(Procyon lotor*), and domestic cat (*Felis catus*) (Fitzpatrick *et al.* 1991; Schaub *et al.* 1992).

Clutch size ranges from one to five eggs, but is typically three or four eggs. Clutch size is generally larger (up to six eggs) in suburban habitats, and the birds attempt to rear more broods (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 (Toland 1996, Thaxton 1998). Florida Scrub-Jay eggs measure 27.08 millimeters (mm) (1 in) x 20.18 mm (0.8 in) (length x breadth) (Woolfenden and Fitzpatrick 1996b), and coloration varies from a pea green to pale glaucous green, blotched and spotted with irregularly shaped markings of cinnamon rufous and vinaceous cinnamon, these being heaviest about the larger end (Bendire 1895, Bent 1946). Eggs are incubated for 17 to 18 days, and fledging occurs 16 to 21 days after hatching (Woolfenden 1974, 1978; Fitzpatrick *et al.* 1994b). 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.* 1994a), and the presence of helpers improves fledging success (Mumme 1992). Annual productivity must average at least two young fledged per pair for a population of Florida Scrub-Jays to maintain 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 Florida scrub-jay fledglings to yearling age class averages 33 percent in optimal scrub; while annual survival of breeding adults averages 78 percent (Woolfenden and Fitzpatrick 1996b). Florida Scrub-Jays that become breeders average 4.2 breeding seasons with 10-20% of the breeding-population age equal or greater than 10 years. The longest observed lifespan of a Florida Scrub-Jay is 15.5 years at Archbold Biological Station in Highlands County (Woolfenden and Fitzpatrick 1996b).

Dispersal

Florida Scrub-Jays are non-migratory, extremely sedentary, and permanently territorial. Juveniles remain in their natal territory for up to five years before dispersing to become breeders (Woolfenden and Fitzpatrick 1984). The length of time Florida Scrub-Jays remain helpers in their natal territories is influenced by many factors including sex, age, breeding opportunities, and mate availability (Breininger *et al.* 2010). Once they pair and become breeders, they remain on their breeding territory until death. Dispersal distances are skewed sharply toward short-distance dispersals, with most individuals dispersing within two territories from their natal territory (Breininger *et al.* 2006, Coulon *et al.* 2010). In suitable habitat, fewer than 5 percent of Florida Scrub-Jays disperse more than 8 kilometers [km] (5 miles [mi]) (Fitzpatrick *et al.* 1994b). Dispersal distances differ between sexes, with females dispersing significantly farther than males (Breininger *et al.* 2006, Coulon *et al.* 2010). Florida Scrub-Jay dispersal behavior is affected by the intervening landscape matrix. Protected scrub habitats will most effectively sustain Florida Scrub-Jay subpopulations if they are located within a matrix of surrounding habitats that can be utilized and traversed by Florida Scrub-Jays. Additionally, the distance between patches of potential habitat has a strong influence on Florida Scrub-Jay dispersal. Recent research has shown that gene flow decreases dramatically as the gap between scrub patches increases (Coulon *et al.* 2012). The authors concluded that gap widths beyond 2 to 3 km (1.2 to 1.9 mi) resulted in a reduction in gene flow. This is consistent with behavioral observations and analyses of dispersal data, which indicated that dispersal events and patch occupancy decreased beyond a gap size of 3.5 km (2.2 mi) (Stith *et al.* 1996).

Status and Distribution

The Florida Scrub-Jay was federally listed as threatened in 1987 primarily because of habitat fragmentation, degradation, and destruction (52 FR 20719). Florida Scrub-Jays once occupied 39 of the 40 counties south of, and including Levy, Gilchrist, Alachua, Clay, and Duval counties. Historically, many of these counties would have contained hundreds or even thousands of breeding pairs (Fitzpatrick *et al.* 1994). Only the southernmost county, Monroe, lacked Florida Scrub-Jays (Woolfenden and Fitzpatrick 1996a).

A decline in Florida Scrub-Jay population numbers was first noted in the literature by Byrd (1928), though Cox (1987) posited that Florida Scrub-Jay numbers probably had been declining since well before that time. Others continued to report population declines throughout the 20th century due to habitat loss from development and agriculture and habitat degradation from the exclusion of fire (Grimes 1940, 1943; Sprunt 1946; Early 1952; Longstreet 1954; Brigham 1973; Austin 1976; Woolfenden 1978; Cox 1987; Fitzpatrick *et al.* 1994; Toland 1999). By 1984, Florida Scrub-Jays had become extirpated from Broward, Dade, Duval, Gilchrest, Pinellas, and St. Johns counties, and Cox (1987) estimated that 15,600-22,800 Florida Scrub-Jays remained.

An extensive, state-wide survey of Florida Scrub-Jays in 1992-1993 estimated 3,961 Florida Scrub-Jay family groups with 10,972 individuals (Fitzpatrick *et al.* 1994). The survey most likely overestimated the abundance of Florida Scrub-Jays at MINWR and CCAFS (Boughton and Bowman 2011) but underestimated the abundance of Florida Scrub-Jays in Ocala National Forest (ONF), some areas in southwest Florida, and some areas in southern Brevard and northern Indian River counties (Miller and Stith 2002; Breininger *et al.* 2003; K. Miller, unpublished data). By the early 1990s, Florida Scrub-Jays had become extirpated from two more counties (Alachua and Clay), though at least one Florida Scrub-Jay group was later discovered in Clay County (Bowman and Boughton 2011). Ten or fewer Florida Scrub-Jay pairs remained in an additional seven counties (Flagler, Hardee, Hendry, Hernando, Levy, Orange, and Putnam) (Fitzpatrick *et al.* 1994). Population numbers in 27 of the original 39 counties had 30 or fewer breeding pairs (Fitzpatrick *et al.* 1994). Fitzpatrick *et al.* (1994) estimated that Florida Scrub-Jays had declined between 25 and 50 percent in the northern third of the species' range since the surveys by Cox (1987). Woolfenden and Fitzpatrick (1996b) estimated that Florida Scrub-Jay populations had declined by 90% or more since European settlement.

Based primarily on the 1992-93 statewide Florida Scrub-Jay survey, Stith (1999a) used a spatially-explicit individual-based population model to evaluate the vulnerability of remaining Florida Scrub-Jay populations. Stith identified 21 demographically-isolated metapopulations of Florida Scrub-Jays throughout the species' range. Assuming fully restored habitat with high occupancy rates, results of simulations indicated that 16 of the 21 metapopulations had a moderate or high risk of quasi-extinction (the probability of a Florida Scrub-Jay metapopulation falling below 10 pairs in 60 years), though the risk of quasi-extinction could be improved for 13 of the metapopulations through habitat acquisition (Stith 1999).

Florida Scrub-Jay populations have continued to decrease since the 1992-93 statewide survey and Stith's metapopulation model. For example, Toland (1999) estimated a decline of over 50% in areas in Brevard County that were re-surveyed in 1998-99. Part of this decline may be attributed to a possible rare epidemic in 1997-1998 (Breininger *et al.* 2003, cited in Toland 1999). Reductions have not been confined solely to unprotected lands. Florida Scrub-Jay populations have declined by 25% on managed conservation lands, excluding ONF, from 1992-93 to 2009-2010 due to inadequate habitat management (Boughton and Bowman 2011). Although population estimates were not available for ONF, the amount of suitable Florida Scrub-Jay habitat decreased by 22% from 1999-2012 (U.S. Forest Service, unpublished data). On average, Florida Scrub-Jay populations on managed conservation lands are estimated to be well below the potential carrying capacity.

The decline of Florida Scrub-Jay populations has been even more severe on unprotected lands, especially in suburban areas, where Florida Scrub-Jays have reduced demographic success compared to wildlands (Bowman 1998, Breininger 1999). For example, a suburban population in Highlands County (Lake Placid Estates) decreased from over 100 groups in the early 1990s to 7 groups by 2013 (R. Bowman, unpublished data). Similarly, Florida Scrub-Jays in the City of Palm Bay declined from 54 groups in 1993 to 16 groups by 2009 (Toland 1999, Larson 2012). Beginning in 2010, FWS and other interested parties began translocating family groups from the City of Palm Bay to managed conservation lands. Currently, there are 4 groups remaining (Larson 2013).

Florida Scrub-Jays are now extirpated from 8 of the 39 counties previously occupied (Alachua, Broward, Dade, Duval, Flagler, Gilchrist, Pinellas, and St. Johns), and only 9 counties had more than 30 Florida Scrub-Jay groups on managed conservation lands as of 2012 (Boughton and Bowman 2011, Faulhaber 2013). Coulon and colleagues (2008) identified 10 major genetic units of Florida Scrub-Jays, each encompassing one or more of Stith's (1999) metapopulations. Only 4 of the 10 genetic units had 100 or more Florida Scrub-Jay groups on managed conservation lands in 2010 (Boughton and Bowman 2011; K. Miller, unpublished data).

Boughton and Bowman (2011) estimated 2,400-2,600 Florida Scrub-Jay groups remaining, excluding ONF. Based on recent data from ONF (Miller 2012), a reasonable estimate of remaining Florida Scrub-Jay populations is 3,500-3,850 groups. Assuming a 50-70% decline on private lands since the 1992-93 survey, Faulhaber and Miller (in litt. 10/08/2012) estimated 3,100-3,750 Florida Scrub-Jay groups (7,758-9,383 individuals).

Climate Change

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change Report (IPCC 2007). The 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 (FWS 2007).

Temperatures are predicted to rise from 2° Celsius (C) to 5° C (3.6° Fahrenheit [F] - 9.0 ° F) for North America by the end of this century (IPCC 2007a, b). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise.

Climatic changes in Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management. 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 FWS 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 (FWS 2006). As the level of information increases concerning the effects of global climate change on the Florida Scrub-Jay the FWS will have a better basis to address the nature and magnitude of this potential threat and will more effectively evaluate these effects to the range-wide status of the Florida Scrub-Jay.

Analysis of the Species/Critical Habitat Likely to be Affected

The Florida Scrub-Jay's status since its listing in 1987 has not improved. The status and trends that we discussed above, clearly shows what two items are essential for recovery of this species: (1) additional acquisition of scrub lands for conservation in key areas; and (2) restoration and management of publicly-owned scrub conservation lands. Without these two important and necessary actions, it is unlikely that recovery can be achieved.

ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem, within the action area. The environmental baseline is a "snapshot" of a species health at a specific point in time. It does not include the effects of the action under review in the consultation.

Status of the Species in the Action Area

The KSC Florida Scrub-Jay population and habitat have declined for over 20 years, with this population currently estimated to be at about one-half carrying capacity (FWS 2007). Causes of past declines at KSC are similar to those observed across the species' range and include habitat destruction, fragmentation, and degradation, although there are examples of recovery by small local populations on KSC.

Habitat degradation on Merritt Island started before the 1950s when natural scrub habitat was converted to support agriculture and human infrastructure (e.g., roads). These changes concurrently reduced the ability of natural fires to spread across the landscape. Fire increases the opportunity for open sandy areas to persist and lowers tree and shrub densities, conditions which are most conducive to Florida Scrub-Jay survival (Breininger *et al.* 2009). A 20-year period of active fire suppression that ended in the early 1980s caused further habitat degradation.

Doubling the KSC Florida Scrub-Jay population size by improving habitat quality is a goal of both the MINWR CCP and FWS species recovery planning. Effective habitat management must result in

Florida Scrub-Jay recruitment exceeding mortality. Doubling the population requires intensive habitat management within four significant population areas identified on KSC (Breininger *et al.* 1996, 1999). These areas are the least fragmented and have the highest topography.

Currently there are between 250-300 Florida Scrub-Jay groups on MINWR. The MINWR CCP identifies a population target of 500-650 Florida Scrub-Jay groups with 350-500 Florida Scrub-Jay groups occupying optimal habitat. Meeting these objectives would result in a local population with low extinction risk. The Merritt Island/Cape Canaveral genetic unit (Northeast Coastal Genetic Unit C), which contains the second largest number of Florida Scrub-Jay groups among the 10 genetic units, is of primary importance in maintaining the species' viability.

Studies on habitat quality on MINWR suggest there are 125 potential territories in habitat that is of medium height (1.2-1.7 m [4-5.5 (ft)] tall) with few open sandy areas, and 28 potential territories in medium height scrub with many open sandy areas (Breininger *et al.* 2010). Both medium-height scrub categories are optimal for Florida Scrub-Jay survival, but open scrub typically has recruitment rates great enough to increase population size. Attaining the desired habitat and population goals will require more focused habitat management as well as a fuels management strategy.

Climate Change

Based on the present level of available information concerning the effects of global climate change on the status of the Florida Scrub-Jay, the FWS acknowledges the potential for changes to occur in the action area, but presently has no basis to evaluate if or how these changes are affecting the Florida Scrub-Jay. Nor does our present knowledge allow the FWS to project what the future effects from global climate change may be or the magnitude of these potential effects.

EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat and its interrelated and interdependent activities.

MINWR has a wide variety of habitats within the roughly 56,658 ha (140,000 ac) boundary that provides habitat for more than 1,500 species of plants and animals. The action area will include all habitats within the MINWR. This federal property provides habitat for the second largest remaining Florida Scrub-Jay populations. The KSC property along with the adjacent Cape Canaveral Air Force Station (CCAFS) property is one of ten unique Florida Scrub-Jay genetic units (Northeast Coastal, Genetic Unit C) throughout the species range. These populations comprising this genetic unit are of extreme importance to the recovery of the species.

Funding has not been adequate to perform Florida Scrub-Jay habitat restoration and management necessary to meet all CCP and species' recovery goals. The conservation measures described in the compensation plan proposed by KSC is intended to develop a partnership between FWS and NASA to perform habitat management in specifically selected areas to compensate for new construction impacts associated with proposed commercial, state, and federal projects and programs.

Appropriate facility planning begins by minimizing future development in scrub, and minimizing fragmentation of core areas. Curtailing impacts to the MINWR managed fire program is also important and accomplished through training that addresses the need for controlled fires. This information is to be included in the planning and development phase of new agency contracts. At

KSC, the formal National Environmental Policy Act (NEPA) process begins when projects are first anticipated to ensure that all environmental laws and agency goals are addressed. The new projects addressed by this biological opinion assume no disruption to prescribed fire planning and implementation. Thus, this biological opinion does not consider impacts additional to those associated with habitat destruction, which includes the inability to regularly burn an area. Only scrub habitat impacts are addressed by this biological opinion; other mitigation and compensation activities required for development and operations will be addressed during the formal NEPA process and reviewed by the Environmental Management Branch. This biological opinion assumes that all scrub impacted on KSC will be compensated on KSC.

Most core habitat is essential for achieving recovery and CCP objectives that represent habitat of greatest importance to the Florida Scrub-Jay population. Support habitat has lesser importance although some of it is necessary for connecting population cores and providing a population with high persistence probabilities. Auxiliary habitat is of lower habitat quality regardless of management history. These population areas are described by grid cells that depict potential Florida Scrub-Jay territories. These grid cells and Florida Scrub-Jay habitat types are explained in detail in the KSC Florida Scrub-Jay Compensation Plan. Facility footprints will be overlaid on maps of core, support, and auxiliary scrub to determine compensation ratios that benefit species recovery and ecosystem management, while at the same time allowing spaceport development. The respective ratios for grid cells that are adjacent to existing development are indicated in the second column of Table 1. The ratios for grid cells that are not adjacent to existing development are higher (effectively doubled). The acreage of habitat expected to be impacted within each category is multiplied by the compensation ratio and the areas of compensation acreages are summed across categories. An estimate of the current acreages of scrub habitat being considered for new projects within each habitat category is shown in column five of Table 1.

JAY HABITAT CLASSIFICATION	FOOTPRINT ADJACENT TO DEVELOPMENT (Ratios)	FOOTPRINT NOT ADJACENT TO DEVELOPMENT (Ratios)	KSC Hectares (Acres)	PROPOSED PROJECTS Hectares (Acres)
CORE	4:1	8:1	2981.4 (7367)	< 0.4 (<1)
SUPPORT	2:1	4:1	1564.1 (3865)	141.6 (350)
AUXILIARY	1:1	2:1	3193.4 (7891)	162.6 (402)

Table 1. Compensation ratios for projects impacting designated Florida Scrub-Jay habitats on KSC.

The KSC Florida Scrub-Jay Compensation Plan and this biological opinion prioritize similar compensation activities within landscapes by emphasizing the restoration of habitat quality to conditions where Florida Scrub-Jay recruitment exceeds mortality. Once compensation through restoration is achieved, maintenance of habitat quality will become part of the MINWR prescribed fire and habitat management program.

Potential areas for treatment vary greatly in how they might benefit Florida Scrub-Jay recruitment and survival based on spatial context, soils, and topography. The compensation goal for mechanical treatment of areas is to produce large expanses of medium height territories in landscapes with many contiguous Florida Scrub-Jay families where recruitment will exceed mortality rates (serve as population sources). Most KSC landscapes need minor treatment to develop broad expanses of medium height but some landscapes, greatly degraded by infrequent fire, need treatment of large areas to merit restoration. Areas needing extensive work will involve larger compensation projects because it is important to recover Florida Scrub-Jay populations converting large areas into optimal habitat quality. The understory beneath tree canopies varies greatly, not just based on potential oak cover and soils, but also based on the amount of disturbance that influences exotic species and flammability. Compensation areas not only include scrub, but also include swale marshes that have become forested, resulting in degraded habitat quality and reduced fire spread. Overlaying grid cells that represent potential source territories within core areas will be used to prioritize the locations of compensation activities.

Maintaining suitable habitat to promote population connectivity among KSC cores and CCAFS populations is relevant, but of secondary importance. Florida Scrub-Jays generally live within one territory for life once they become breeders, are poor dispersers, and depend on having optimal habitat quality. Habitat quality degrades rapidly without regular burning and can take decades to restore to optimal conditions on MINWR. Therefore, it is important to first develop and maintain population source conditions in core populations before enhancing connections among potential cores. Maintaining populations of sufficient size in all cores is important for reducing the population risk from catastrophic events, such as epidemics (e.g., arboviruses) and major hurricanes.

The Environmental Management Branch at KSC will identify expected compensation acreages needed for each proposed project. Biologists with MINWR and the KSC Ecological Program will determine the best areas for compensation using the potential territory grid model to select locations that will have the greatest population benefit. The potential territory grid model helps to quantify the number of potential and actual Florida Scrub-Jay families expected to be positively impacted by restoration. The proposed areas for compensation will be provided for review by NASA managers, who will then seek FWS's Ecological Services Office concurrence. NASA Project Managers and Contracting Officers will coordinate funding to MINWR based on the required acreage of compensation multiplied by the average restoration cost per acre. Refuge managers will accumulate enough acreage until restoration actions are feasible and then conduct restoration activities using MINWR staff or contractors managed by MINWR. Monitoring will provide guidance to revise and adapt future compensation plan activities based on habitat quality state changes and population parameters.

Factors to be Considered

<u>Direct Effects</u> – Several of the proposed projects will have overlapping project impacts. The development of the above noted proposed projects may result in the direct, permanent loss of approximately 304.3 ha (752 ac) of Florida Scrub-Jay habitat. The direct "take" of individual Florida Scrub-Jays, through harm and/or harassment, has not been exactly quantified because the exact footprints of the proposed facilities may vary, final design plans are not completed nor have the equipment and material staging areas or related supporting infrastructure necessary for the construction of the projects been finalized.

Assuming and average territory size of 10 ha (25 ac), incidental take of roughly 30 territories (family groups) or 75 individuals could occur (assuming 2.5 individuals per family group). However, existing territories could be partially impact to a degree that would preclude the family group from remaining in the territory, thus increasing the amount of take on the species through abandonment of the area.

<u>Indirect Effects</u> - Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultations, but will result from the action under consideration. The indirect effects may occur from the loss of

scrub habitat on the project site that may interrupt dispersal corridors between areas occupied by Florida Scrub-Jays and inhibiting management of adjacent scrub habitat.

The proposed projects will result in habitat destruction, which reduces the amount of area Florida Scrub-Jays can occupy, but also increases fragmentation of habitat. As more scrub habitat is altered, the habitat is cut into smaller and smaller pieces, separated from other patches by larger distances; such fragmentation increases the probability of genetic isolation, which is likely to increase extinction probability (Fitzpatrick *et al.* 1991, Woolfenden and Fitzpatrick 1991, Snodgrass *et al.* 1993, Stith *et al.* 1996, Thaxton and Hingtgen 1996). Dispersal distances of Florida Scrub-Jays in fragmented habitat are further than in optimal unfragmented habitat (Thaxton and Hingtgen 1996, Breininger 1999).

Another significant threat to Florida Scrub-Jay persistence is fire suppression and/or lack of fire management in scrub habitat (Woolfenden and Fitzpatrick 1984, 1991; Schaub *et al.* 1992; Stith *et al.* 1996; Breininger *et al.* 1999). The proposed facilities may restrict necessary management activities of the surrounding habitat, which would result in unsuitable habitat conditions resulting in Florida Scrub-Jay abandonment of the area. Additionally, the seasonally timing of prescribed burning, the fire intensities, and the amount of habitat that is subjected to fire management would be restricted because of smoke management and safety concerns. Impacts to fire management from development not addressed in this biological opinion and the resulting operations from those facilities will require additional consultation and are not covered in this proposed action.

CUMULATIVE EFFECTS

Cumulative effects include effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

All development projects that may affect occupied Florida Scrub-Jay habitat in the action area require federal review pursuant to either section 7 or section 10 of the Act. However, we have no jurisdiction over activities that unintentionally resulted in the loss of unoccupied, but potentially suitable, habitat. Without continual management, occupied habitat will continue to become overgrown to the point that it no longer supports Florida Scrub-Jays, and potentially suitable unoccupied habitat will be converted to other uses, precluding future management and occupation by Florida Scrub-Jays. The extent to which this has historically occurred in Brevard County and throughout the range of the Florida Scrub-Jay has been discussed previously. Habitat loss often results in habitat fragmentation which can have a greater impact then the amount destroyed by limiting or precluding the ability to effectively manage the remaining habitat. The extent to which it is likely to occur in the future is unknown.

The goal of this biological opinion is to minimize the outcomes of the proposed projects further contributing to the inability to burn and manage habitat because the proposed scrub compensation plan aims to counteract the forces contributing to habitat fragmentation effects additional to habitat losses. There are pre-existing operations on KSC, especially on the adjacent CCAFS, that interfere with fire management abilities and the involved agencies have formed a partnership to reduce these threats. As such, the cumulative effects associated with these projects should be insignificant and discountable.

CONCLUSION

This proposed project will result in the permanent loss of approximately 304.3 ha (752 ac) of scrub habitat occupied by Florida Scrub-Jays or approximately 30 Florida Scrub-Jay family groups consisting of roughly 75 individuals. From the information presented above, the following facts are apparent: 1) Florida Scrub-Jays are dependent on continuous human management of scrub habitat; 2) Florida Scrub-Jay recovery depends on additional purchase of scrub lands in key areas and effective restoration and management of protected lands; 3) succession of unmanaged scrub habitat is as important a factor in the decline of Florida Scrub-Jay populations as is loss of habitat to competing land uses.

The proposed KSC Florida Scrub-Jay Compensation Plan will result in the conservation, restoration, and perpetual management of existing scrub habitat that will be occupied by Florida Scrub-Jays, thus enhancing the long-term viability of this Florida Scrub-Jay metapopulation and genetic unit.

After reviewing the current status of the Florida Scrub-Jay, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's biological opinion that the proposed project is not likely to jeopardize the continued existence of the Florida Scrub-Jay. No critical habitat has been designated for this species; therefore, none will 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 or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be 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 nondiscretionary and must be undertaken by the NASA so that they become binding conditions of any grant or permit issued to future clients , as appropriate, for the exemption in section 7(o)(2) to apply. NASA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If NASA (1) fails to assume and implement the terms and conditions or (2) fails to require clients to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the grant, agreement, or permit document, the protection coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take NASA must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The FWS has reviewed the biological information for the Florida Scrub-Jay, information presented by NASA, and other available information relevant to this action. Based on our review, incidental take is anticipated not to exceed approximately 304.3 ha (752 ac) of Florida Scrub-Jay habitat or approximately 30 Florida Scrub-Jay family groups consisting of roughly 75 individuals.

EFFECT OF THE TAKE

In the accompanying biological opinion, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the FWS is required to give non-discretionary 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 FWS must also specify procedures to be used to handle or dispose of any individuals taken. The FWS considers the following reasonable and prudent measures are necessary and appropriate to minimize take:

1. Preconstruction surveys for active Florida Scrub-Jays nests when construction activities occur during the nesting season generally from March through June. The Environmental Management Branch must be contacted two weeks prior to any land disturbance to schedule a biological survey;

2. Disposition of dead or injured specimens (salvage);

3. Scrub compensation, population, and habitat monitoring and reporting requirements;

4. Facilitate annual meetings with FWS.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, NASA must comply with the following terms and conditions, which implement the reasonable and prudent measures for incidental take described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary:

1. If clearing of habitat occupied by Florida Scrub-Jays is to occur within the species' nesting season (typically March 1 through June 30), that area should be surveyed prior to clearing to determine if there are any active Florida Scrub-Jay nests located within the vegetation. If an active Florida Scrub-Jay nest is located, to the maximum extent practicable, clearing activities cannot take place within 150 feet of the nest site until nestlings have fledged or until it has been determined that the nest has failed;

2. Unauthorized take of Florida Scrub-Jays associated with the proposed activities should be immediately reported by notifying the Jacksonville Ecological Services Field Office at

904-731-3336. If a dead Florida Scrub-Jay is found in the project area, the specimen should be thoroughly soaked in water and frozen for later analysis of cause of death;

3. Long-term monitoring of Florida Scrub-Jay populations will continue within core areas to support adaptive management decision making that relies upon habitat-specific measures of recruitment and survival, territory occupancy, and habitat state of occupied territories as described in the KSC Florida Scrub-Jay Compensation Plan. Monitoring shall include annual territory mapping, regular color banding and monthly censuses to quantify survival, family size, recruitment, and habitat state across greater than 50% of the core habitat. Annual surveys shall quantify the number of families (breeding pairs) and juvenile production across greater than 70% of the core habitat. NASA is required to submit annual reports on the status of implementation and operation of the projects discussed in this consultation. The reports will include monitoring results, impacted acreages of occupied habitat, extent of take, and conservation measures implemented. These reports will be sent to FWS at the beginning of the calendar year;

4. The ability to impact habitat without jeopardizing the ability to meet species recovery goals relies on the success of the conservation measures described in this consultation to increase habitat quality in population cores. NASA shall meet with FWS annually to discuss the effectiveness of the conservation measures and potential additional measures to include for future projects. The agencies will review the previous year activities to ensure reporting requirements for calculating extent of take are adequate.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The FWS estimates that no more approximately 304.3 ha (752 ac) of Florida Scrub-Jay habitat or approximately 30 Florida Scrub-Jay family groups consisting of roughly 75 individuals will be incidentally taken or altered as a result of these actions.

If, during the course of these actions, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modifications of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the Act directs Federal agencies to use their authority 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 carry out recovery plans, or to develop information.

The FWS is not suggesting any conservation recommendations at this time.

REINITIATION OF SECTION 7 CONSULTATION

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

The FWS appreciates the cooperation of NASA, FWS Refuge Staff, and the applicant's environmental consultant during this consultation. The FWS would like to continue working with your agency regarding this project. If you have any questions regarding this biological opinion, please contact Todd Mecklenborg at (727) 892-4104.

Sincerely,

Michael Jennings
Acting Field Supervisor

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