

Florida Scrub-Jay (*Aphelocoma coerulescens*)

**5-Year Review:
Summary and Evaluation**

**U.S. Fish and Wildlife Service
Southeast Region
Jacksonville Ecological Services Field Office
Jacksonville, Florida**

5-YEAR REVIEW
Species reviewed: Florida Scrub-Jay (*Aphelocoma coerulescens*)

TABLE OF CONTENTS

I.	GENERAL INFORMATION	1
A.	Methodology Used To Complete The Review.....	1
B.	Reviewers	1
C.	Background	1
II.	REVIEW ANALYSIS	2
A.	Application of the 1996 Distinct Population Segment (DPS) policy.....	2
B.	Recovery Criteria	3
C.	Updated Information and Current Species Status	6
1.	Biology and Habitat	6
2.	Five-Factor Analysis	17
D.	Synthesis.....	30
III.	RESULTS.....	32
IV.	RECOMMENDATIONS FOR FUTURE ACTIONS	33
V.	REFERENCES	34
VI.	FIGURES	44
VII.	TABLES	46

5-YEAR REVIEW

Florida Scrub-Jay (*Aphelocoma coerulescens*)

I. GENERAL INFORMATION

- A. Methodology used to complete the review:** Public notice of this review was given in the Federal Register, and a 60-day comment period was opened. This review was completed by the U.S. Fish and Wildlife Service's scrub-jay recovery lead fish and wildlife biologist located in the Jacksonville Field Office, Florida. None of the review was contracted to outside parties. All literature and documents used in this review are on file at the Jacksonville Field Office and are cited in the Literature Cited section. We used peer-reviewed publications; interim and annual reports provided as part of local and Federal government contracts; data and information available on the internet; unpublished data; and personal communication with land managers, biologists, and researchers.

B. Reviewers

Lead Region - Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office - Jacksonville, FL, Ecological Service: Michael Jennings, 904-232-2580

Cooperating Field Office - Vero Beach, FL, Ecological Services: Marilyn Knight, 772-562-3909

C. Background

- 1. FR Notice citation announcing initiation of this review:** 71 FR 7993, February 15, 2006
- 2. Species status:** Decreasing (2006 Recovery Data Call): "Although a complete survey for this species has not been conducted since 1993, there have been numerous local surveys done. In addition, numerous section 7 consultations and section 10 permit applications confirm that habitat loss is continuing. These indicate a continuing decline is likely."
- 3. Recovery achieved:** .2 (26-50% recovery objectives achieved) (2006 Recovery Data Call)

4. **Listing history**
Original Listing
FR notice: 52 FR 20715
Date listed: June 3, 1987
Entity listed: Subspecies
Classification: Threatened
5. **Associated rulemakings:** N/A
6. **Review history:** FWS conducted a 5-year review for the scrub-jay in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species recovery. The notices stated that FWS was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notices indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in the scrub-jay's listing classification was recommended from this review.
7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 2c (this represents a species with a high degree of threat and a high recovery potential, as well as being in conflict with construction or other development projects or other forms of economic activity).
8. **Recovery Plan or Outline**

Name of plan: Florida Scrub Jay Recovery Plan
Date issued: May 9, 1990
Name of plan: South Florida multi-species recovery plan (identifies recovery contributions for the South Florida Ecological Service's office work area)
Date issued: May 18, 1999

II. REVIEW ANALYSIS

- A. **Application of the 1996 Distinct Population Segment (DPS) policy:**
 1. **Is the species under review listed as a DPS?** No.
 2. **Is there relevant new information regarding application of the DPS policy that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective measurable criteria? Yes.
2. Adequacy of recovery criteria:
 - a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. All of the recovery criteria are out-of-date. A revision of the recovery plan is currently underway to develop recovery criteria that reflect the best available and most up-to-date information on the biology of the species and its habitat.
 - b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? No. A revision of the recovery plan is currently under development, and new recovery criteria will address all five listing factors and all current known threats to the species.
3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The 1990 recovery plan lists four recovery criteria:

- The population must be stable or increasing from the current population level at the three existing, large population sites (Ocala National Forest, Merritt Island/Cape Canaveral, and Archbold Biological Station). Each site must have an approved management plan.
- There must be documented evidence of scrub-jays recolonizing restored or uninhabited areas throughout their historic range.
- Establishment of several scrub preserves with sufficient acreage to sustain viable scrub-jay populations.
- Use of scrub-jay habitat management guidelines by developers when proposing development in scrub habitat.

Much has been learned about scrub-jay biology and habitat requirements in the 17 years since the recovery plan was completed. The 1990 recovery plan included the best guidance available at the time, but, as our knowledge has increased, so too has our understanding of the needs of this species. As a result, by today's standards, the recovery criteria listed above are vague

and provide little definitive guidance. Nonetheless, progress has been made in achieving some of the stated recovery criteria. Achievements in meeting these criteria and remaining needs are summarized below.

Criterion 1: The population must be stable or increasing from the current population level at the three existing, large population sites (Ocala National Forest, Merritt Island/Cape Canaveral, and Archbold Biological Station). Each site must have an approved management plan.

Criterion 1 Achievements: Each of the three populations defined in this criterion either have a current management plan or have a management plan that is in the process of being revised. The Ocala National Forest revised its Forest Plan in 1999 that established scrub-jay habitat goals and corresponding scrub-jay target numbers. Merritt Island National Wildlife Refuge (including Cape Canaveral) is currently developing a Comprehensive Conservation Plan that includes scrub-jay habitat management and population targets (Service 2007a). Archbold Biological Station completed a management plan in 1997 to balance the ecological needs of xeric vegetative communities and research objectives (Main and Menges 1997). Long-term population monitoring at Archbold indicates that the scrub-jay population is stable (R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 26, 2007).

Criterion 1 Needs: Population monitoring data for Cape Canaveral indicates that the scrub-jay population is in decline (Steven and Knight 2005). Data are not available for Merritt Island National Wildlife Refuge (F. Johnson, personal communication, Fish and Wildlife Service, January 16, 2007) or Ocala National Forest (Service biologist, personal observation) to determine the status of scrub-jay populations.

Criterion 2: There must be documented evidence of scrub-jays recolonizing restored or uninhabited areas throughout their historic range.

Criterion 2 Achievements: Scrub-jays occupy restored habitat when it is in close proximity to existing occupied habitat and when recruitment of young birds exceeds adult mortality within habitat that is adjacent to restored habitat. There have been numerous observations of scrub-jays moving into recently managed habitat (e.g., Lyonia Preserve and Blue Springs State Park in Volusia County, Environmentally Endangered Lands program property in south Brevard, conservation lands in northern Indian River County, Oscar Scherer State Park in Sarasota County).

Criterion 2 Needs: Scrub-jay occupation and/or recolonization of restored habitat may not be possible in many locations within the historic range because scrub-jay numbers have declined and habitat has been fragmented. Even if habitat is restored and managed, it is unlikely scrub-jays will occupy

or recolonize some areas within the historic range because there are no scrub-jays available to colonize restored habitat or restored habitat may be located too far from existing scrub-jay populations. For example, Camp Blanding, Clay County, which is within the historic range of scrub-jays, recently reported the successful restoration of about 200 acres of scrub habitat, but scrub-jays have not yet recolonized this site (U. Kirkpatrick, personal communication, biologist, Camp Blanding, March 20, 2007). Camp Blanding is located about 40 to 50 miles north of nearest known large population of scrub-jays on the Ocala National Forest.

Criterion 3: Establishment of several scrub preserves with sufficient acreage to sustain viable scrub-jay populations.

Criterion 3 Achievements: Florida Natural Areas Inventory (2006) indicated that as of 2006, about 9,700 acres of scrub had been protected (acquired by local, state, Federal, or non-governmental conservation organizations) since implementation of the State of Florida's land acquisition programs [Preservation 2000 (1990-2000) and Florida Forever (2000-2010)]. Many of the acquisitions of large parcels that had the potential to support viable scrub-jay populations occurred on the Lake Wales Ridge (Turner *et al.* 2006), where prior to 1988, only three conservation parcels were known to support scrub-jays. Currently, 24 conservation parcels support scrub-jays on the Lake Wales Ridge (Turner *et al.* 2006).

Criterion 3 Needs: Long-term scrub-jay monitoring data are not available on most public lands that have been acquired. As a result, the viability of scrub-jay populations that occupy these sites cannot be determined.

Criterion 4: Use of scrub-jay habitat management guidelines by developers when proposing development in scrub habitat.

Criterion 4 Achievements: The Service has developed scrub-jay mitigation guidance that provides recommendations for compensating impacts to scrub-jay habitat due to land use conversions (Service 2003). Through technical assistance and formal consultation, the Service works with developers to minimize impacts to scrub-jays and scrub habitat.

Criterion 4 Needs: Federal habitat-based management guidelines have not been developed. However, scrub-jay behavioral and demographic data collected since the recovery plan was completed indicates that maintaining small, fragmented habitat within urban areas is not beneficial to scrub-jays (Bowman 1998). Thus, given our current understanding of scrub-jay demography and response to habitat fragmentation, this criterion is not relevant at this time.

Criterion 4 is a threats-related recovery criterion and partially addresses the listing criterion related to the present or threatened destruction, modification or curtailment of the scrub-jay's habitat or range. However, as discussed above, this criterion was never met and as a result, threats due to destruction, modification or curtailment of the scrub-jay's habitat or range were not abated due to this recovery criterion.

C. Updated Information and Current Species Status

1. Biology and Habitat

- a. **Abundance, population trends, demographic features, or demographic trends:** A statewide scrub-jay survey was conducted in 1992-1993, at which time there were an estimated 4,000 pairs of scrub-jays in Florida (Fitzpatrick *et al.* 1994). Of 39 counties within the historic range of scrub-jays, 32 remained occupied (82 percent). However, 19 of those 32 counties had fewer than 30 pairs of scrub-jays remaining, and nine of these had 10 or fewer pairs. Thirteen counties within the historic range (33 percent) had 30 or more pairs of scrub-jays. Since the early 1980s, Fitzpatrick *et al.* (1994) estimated that in the northern third of the species' range, scrub-jays declined between 25 to 50 percent. Rangewide, the species may have declined by as much as 25 to 50 percent during the mid 1980s to mid 1990s (Stith *et al.* 1996).

Following the 1992-1993 census, there has been no periodic, systematic surveys or censuses for scrub-jays throughout their range. Data exists for several areas where research or monitoring efforts have occurred or are ongoing, but these data are limited. Where data exists, it typically includes information about scrub-jay populations or metapopulations (groups of populations that are close enough for individual birds to periodically breed with birds from an adjacent population). Consequently, a rangewide assessment of abundance, population trends, and demographic features and trends since 1992-1993 cannot be provided for the species or metapopulations within the range of the species.

Area-specific information is summarized below and in Table 1. These summaries include information for scrub-jay populations or portions of metapopulations that comprise a relatively large proportion of a population or metapopulation. We have excluded information for small parcels because these data are not informative about larger-scale trends in scrub-jay populations or metapopulations.

From 2000 to 2002, Brevard County surveyed all areas previously surveyed and additional areas suspected of supporting scrub-jays, and found 183 scrub-jay families (Brevard County Natural Resources Management Office 2002). This represented a 50 percent decline of scrub-jay families since the 1992-1993 survey for this county, and an additional seven percent decline from that observed by Toland (1999).

On Cape Canaveral Air Force Station located on the barrier island of Brevard County, the number of scrub-jay groups and individual birds trended downward from 1995 to 2005. As many as 418 individual birds were identified in the mid 1990s and more recent surveys found about 280 birds. Similarly, the number of scrub-jay groups declined from about 160 to 100 (37.5 percent) during this same time period (Stevens and Knight 2005). These declines are attributed to low quality habitat and the resulting poor demographic performance of scrub-jays. Cape Canaveral Air Force Station has developed a scrub restoration plan, but successfully restoring the nearly 8,000 acres will take at least 11 more years (Steven and Knight 2005). In the mean time, poor scrub-jay demographics may continue to result in decreasing scrub-jay numbers.

On the Lake Wales Ridge 15 monitored populations declined by an average of about 33 percent between the 1992-1993 survey and 2006 (R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 30, 2007; TNC 2006a). Cumulative declines were greatest on public lands that were not managed and averaged 63 percent (from 146 to 54 groups) while the average cumulative decline on managed lands was seven percent (91 to 85 groups) (R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 30, 2007). Five of the 15 populations were small in 1992-1993 and increased in size as of 2006, but the greatest increase was only seven families. In total, 24 additional scrub-jay groups were found in these five populations compared to 1992-1993 levels. The total net decline in scrub-jay groups between 1992-1993 and 2006 was 229 (from 699 to 470 groups) in the 15 monitored populations (R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 30, 2007).

An updated survey conducted in Charlotte County in 2001 and 2002 showed about a 42 percent decline in the number of scrub-jay groups compared with the number of scrub-jay groups documented from the same areas during the 1992-1993 survey (Miller and Stith 2002). In calculating the change in group

numbers, we purposefully omitted data from one metapopulation (M6E in Miller and Stith 2002) because survey effort was different between the historic and recent surveys. Furthermore, we did not include 15 scrub-jay groups found in the M7 metapopulation during the 2001-2002 survey because these observations were made in areas not surveyed in 1992-1993 (see footnotes in Miller and Stith 2002, page 20).

In 2003, Lake County surveyed potential scrub-jay habitat, including, but not limited to, most areas surveyed during the 1992-1993 statewide census (LPG Environmental & Permitting Services and Environmental Management and Design 2003). More ($n = 310$) scrub-jays were found in 2003 compared with historic records ($n = 192$), but differences in survey effort, areas surveyed, and survey methodology preclude meaningful comparison. Of interest, however, was that most observations of scrub-jays during the 2003 effort were made in residential areas, improved/unimproved pasture, and abandoned citrus groves. About six percent of sightings occurred in scrub habitats. Furthermore, except for 52 individual birds observed on Seminole State Forest, most areas contained less than 10 birds, indicating the remaining scrub-jay populations are widely scattered in poor quality habitat. Birds appear to be dispersing from one patch of atypical habitat to another (LPG Environmental & Permitting Services and Environmental Management and Design 2003).

From 2004 to 2005, all scrub habitat was mapped and surveyed in the Hillsborough/Manatee scrub-jay metapopulation and a 65 percent decline in scrub-jay groups was found as compared to the same areas surveyed in 1992-1993 (Gordon 2005). The 1992-1993 survey documented about 65 scrub-jay territories, excluding suburban jays, in the Hillsborough/Manatee metapopulation (Fitzpatrick *et al.* 1994). The 2004-2005 survey located 23 groups from areas surveyed in 1992-1993. An additional 30 scrub-jay groups were found during the 2004-2005 survey, but these were found in areas not surveyed in 1992-1993.

The demography of scrub-jays is affected by habitat quality (e.g., vegetative structure, fragmentation, proximity to human development, etc.). Demographic parameters differ by habitat type and quality and are reported by several researchers (Woolfenden and Fitzpatrick 1984, 1991; Fitzpatrick *et al.* 1991; Bowman and Averill 1993; Breininger *et al.* 1995; Breininger *et al.* 1996; Bowman 1998; Breininger *et al.* 1999; Stith 1999;

Breininger and Carter 2003; Breininger and Oddy 2004; Breininger *et al.* 2006).

Bowman and others have been conducting long-term studies of scrub-jay demography along a suburban-to-rural gradient since 1991 in Highlands County (Bowman and Averill 1993; Bowman *et al.* 1996; Bowman 1998; Bowman and Woolfenden 2001). Suburban populations experience average to above average reproductive success through fledging, but survival of both juveniles and adults is much lower than in unfragmented habitat (Bowman and Woolfenden 2001). As a result, scrub-jay populations occupying fragmented habitat interspersed in suburban development remain stable only through net immigration from surrounding areas. Furthermore, Bowman's data, together with those of Woolfenden and Fitzpatrick (1996a), indicate that unfragmented habitat does not serve as the "source" for "suburban sinks." Instead, suburban populations draw their immigrants from nearby suboptimal and vanishing habitats.

Breininger *et al.* (2006) and Breininger and Carter (2003) concluded that demographic performance (number of yearlings recruited less the number of breeders that died) of scrub-jays was highest in good quality habitat and declined with increasingly unsuitable habitat. In Brevard County study sites, demographic performance was high only in habitats that were considered optimal. For habitats where vegetation was too short or too tall, adult mortality exceeded recruitment (Breininger and Carter 2003). Habitat fragmentation typically had adverse demographic impacts that were similar to those observed in suboptimal and poor quality unfragmented habitat. In all but the highest quality habitat (optimal), scrub-jay demographics were poor and did not ensure long-term persistence, especially if immigration did not occur (Breininger *et al.* 1999). As a result, scrub-jay populations in suboptimal and poor quality habitat decline over time because adult mortality exceeds recruitment. For example, poor demographic performance in central and south Brevard scrub-jay populations and in Merritt Island/Cape Canaveral has resulted in a 34 percent decline per decade in monitored scrub-jay populations (Breininger 2006).

Furthermore, habitat fragmentation increases the probability of inbreeding and genetic isolation, which is likely to increase local extirpations (Fitzpatrick *et al.* 1991; Woolfenden and Fitzpatrick 1991; Stith *et al.* 1996; Thaxton and Hingtgen 1996). Thaxton and Hingtgen (1996) concluded that female scrub-jays dispersing from urban areas have a higher mortality rate than those

dispersing from natural scrub areas. They also suggested that habitat in suburban areas, if abandoned or unoccupied due to death of the mated pair, had a higher probability of remaining vacant, leading to the conclusion that populations of scrub-jays in suburban areas were likely to decrease and eventually be extirpated. In addition, they showed that scrub-jays dispersing in the good (restored) habitat outnumber those that emigrate into poor suburban patches (of 128 observed dispersals, no birds dispersed from preserve to suburban territories) and that dispersal distances of these immigrants were longer than those using intact scrub.

Assessing population trends (changes in numbers over time) requires, at a minimum, comparison of at least two sets of count data (e.g., survey and/or census results). As described above, multiple datasets are available for a limited number of scrub-jay populations and these data are insufficient to draw broader conclusions about metapopulation or rangewide population trends.

In the absence of statistically robust, long-term count data for most scrub-jay populations or metapopulations, we reviewed metapopulation trajectory graphs that were part of metapopulation viability model output (Stith 1999). These data were intended to be used to compare relative metapopulation trajectories (Stith 1999) – to evaluate which metapopulations were at risk of extinction compared to others. As a result, the utility of the metapopulation trajectories in assessing and projecting absolute metapopulation trends is limited and not advisable. Consequently, we reviewed metapopulation trajectories and compared them with the observations discussed above to determine if the modeled metapopulation trajectories were consistent with on-the-ground observations (Table 1). We did not include observations from Lake County because areas surveyed historically could not be isolated in the dataset provided for the more recent survey.

The observations reported above include areas that encompass all or portions of 10 scrub-jay metapopulations evaluated by Stith (1999). These include the metapopulations of North Brevard, Central Brevard, Merritt Island-Southeast Volusia, South Brevard-Indian River-North St. Lucie, Lake Wales Ridge, Manatee-South Hillsborough, Sarasota-West Charlotte, Northwest Charlotte, Central Charlotte, and Lee and North Collier (nomenclature from Stith 1999).

Each of the 10 metapopulations declined in the modeled simulations and in the on-the-ground observations summarized above (Table 1). Metapopulations had relatively lower simulated rates of decline when there were larger numbers of scrub-jays and habitat under public ownership (e.g., Merritt Island-Southeast Volusia and Lake Wales Ridge) compared with metapopulations that had fewer scrub-jays and less habitat under public ownership. We could not draw conclusions between observed rates of decline because datasets varied substantially for each of the observations. Even so, we did confirm that on-the-ground observations of population and/or metapopulation declines were consistent with model statistics, which also projected declines in these metapopulations.

The spatially explicit individual-based population model developed for the scrub-jay to complete the metapopulation viability analysis also provided an estimation of relative risks of extinction (and quasi-extinction – falling below 10 scrub-jay groups in a metapopulation) for each of the metapopulations over a 60-year simulation period considering several future scrub-jay habitat acquisition scenarios (Stith 1999). Although these output statistics do not represent observed trends, they may be useful in assessing relative risks to scrub-jay metapopulations in the future (Table 2).

Thirty 60-year simulations were run for each of 21 metapopulations based on different scenarios of reserve design ranging from no acquisition of scrub-jay habitat to complete acquisition of all remaining significant scrub-jay habitat (Stith 1999). Results from the simulations provided estimates of extinction and quasi-extinction. We combined metapopulations into one of three categories of relative quasi-extinction risk (low, moderate, and high) and then compared projected metapopulation quasi-extinction risks between two habitat acquisition scenarios (no acquisition and complete acquisition) (Table 2). Simulation results suggest quasi-extinction risks would be low for six metapopulations that had relatively high numbers of scrub-jays and public lands under management (Figure 1). Quasi-extinction risks were greater for metapopulations that had relatively few scrub-jays and/or habitat under public ownership, and small metapopulations where there was little opportunity to acquire additional habitat (Figure 1).

In conclusion, long-term data on abundance, population trends, and demographics are limited. Available information indicate that scrub-jay numbers have declined from 37.5 to 65.0 percent

in all or portions of 10 metapopulations. Declining scrub-jay numbers are consistent with modeling statistics that project future responses to habitat distribution and availability. Declines are likely the result of poor demographic performance due to habitat degradation and fragmentation.

- b. **Genetics, genetic variation, or trends in genetic variation:** Comprehensive rangewide sampling of scrub-jays has been conducted for the last three years by Cornell University. Preliminary results indicate that genetic variation between populations and/or metapopulations of this species may be greater than any other known species of bird in North America (Fitzpatrick 2006). Data are not currently available to assess whether this new information will be informative about genetic variation or trends in genetic variation.
- c. **Taxonomic classification or changes in nomenclature:** At the time of listing, the scrub-jay was considered a subspecies (*A. c. coerulescens*). In 1995, it regained recognition as a full species (Florida scrub-jay, *A. coerulescens*) from the American Ornithologists Union (AOU 1995) because of genetic, morphological, and behavioral differences from other members of this group: the western scrub-jay (*A. californica*) and the island scrub-jay (*A. insularis*) (AOU 1995). The group name is retained for species in this complex; however, it is now hyphenated to “scrub-jay” (AOU 1995).
- d. **Spatial distribution, trends in spatial distribution or historic range:** At the time of listing, scrub-jays had been extirpated from Broward, Dade, Duval, Gilchrist, Pinellas, St. Johns, and Taylor counties (Service 1990). Following the 1992-1993 rangewide survey, scrub-jays were also considered extirpated from Alachua and Clay counties. Although still occurring in Flagler, Hardee, Hendry, Hernando, Levy, Orange, and Putnam counties, 10 or fewer pairs remained in these counties and were considered functionally extirpated (Fitzpatrick *et al.* 1994). Subsequent information indicated that at least one breeding pair remained in Clay County as late as 2004 [K. Miller, Florida Fish and Wildlife Conservation Commission (FWC), in litt. 2004] and an individual bird was observed in St. Johns County in 2003 [J.B. Miller, Florida Department of Environmental Protection (FDEP), in litt. 2003]. Recent information also indicates that there are at least 12 breeding pairs of scrub-jays located within Levy County (K. Miller, FWC, in litt. 2004).

The distribution of scrub-jays has been most noticeably reduced along northeastern and southeastern extremes of their former range along the Atlantic coast (Figure 2). Elsewhere, scrub-jay distribution has declined locally, but they are still found throughout much of their historic range (Fitzpatrick *et al.* 1994). For example, surveys conducted in Charlotte County from 2001-2002 documented the extirpation of scrub-jays from three of 16 populations where scrub-jays had been recorded during the 1992-1993 survey. In this example, scrub-jays were still relatively well distributed within the metapopulation, even though they were absent in some areas.

In other areas, assessing the distribution of scrub-jays is complicated by the response of birds to changing habitat conditions. In some areas, scrub-jays may be more likely to move between habitat patches, especially if habitat conditions are not optimal (LPG Environmental & Permitting Services and Environmental Management and Design 2003). Additionally, data limitations often preclude meaningful comparisons of scrub-jay survey results which may confound assessments of scrub-jay distribution. In the Lake County dataset for 2003, areas surveyed were not reported as they were during the 1992-1993 survey. As a result, no conclusions could be made about changes in the distribution of scrub-jays in Lake County.

In some cases, scrub-jay distributions change as a result of habitat conditions. To illustrate this point, Volusia County surveyed scrub-jays in 2003-2004 and found numbers similar to those documented during the 1992-1993 statewide survey (NeSmith *et al.* 2004). However, the new survey indicated a very different distribution within each of the three main scrub-jay populations described by Pranty (1996) and Stith (1999). The new survey documented 92 percent of all remaining scrub-jay families occurred in southwest Volusia County, with 46 percent of those occurring on protected lands. This shift in scrub-jay distribution was principally due to the recent aggressive management of Volusia County's Lyonia Preserve which restored nearly 300 acres of scrub habitat between 1994 and 2004 (Volusia County School District 2004). Habitat restoration allowed for the expansion of existing scrub-jay families resulting in a substantial increase in scrub-jay numbers in Lyonia Preserve (Noss 2006). During this same period, however, the southeastern portion of Volusia County experienced a decline of scrub-jays from 31 to 6 families (NeSmith *et al.* 2004).

e. **Habitat ecosystem conditions:** The condition, or value, of scrub habitat to Florida scrub-jays is largely dependent on the successional stage of the xeric plant community and its relative size and juxtaposition in the landscape in relation to other xeric plant communities. In general, scrub-jays only persist long-term in early successional scrub communities that are relatively large or in close proximity to other scrub communities. Thus, high quality or optimal habitat will be in early succession and large or close to adjacent scrub habitat patches. Habitat condition (quality) declines with vegetative height (mid- to late-succession) and degree of fragmentation (distance between habitat patches).

Historically, scrub vegetative communities were affected by, and responded to, periodic lightning-generated wildfires (Myers 1985, Robbins and Myers 1989). Wildfires burned scrub communities when adequate fuel loads were present. Natural fire return intervals varied between scrub vegetative communities and probably ranged from 5 to 60 years (Fitzpatrick *et al.* 1991, Woolfenden and Fitzpatrick 1996). However, with an increasing human population, fear of property destruction and safety concerns resulted in suppression of most naturally occurring fires (Duncan and Schmalzer 2004). Historical suppression of fire resulted in the degradation of fire-dependant ecosystems, including scrub (Myers 1985, Brevard County 2007). As a result, scrub-jay habitat typically became degraded because fire suppression resulted in a succession of scrub vegetative communities from relatively open, shrub-dominated habitat to a more tree-dominated, mesic environment. Reduced habitat quality, caused by disrupted fire regimes, was a major fragmentation effect that greatly magnified impacts of habitat loss (Breininger *et al.* 2006).

By the 1980s, ecological concerns, coupled with an increasingly fire-sensitive urban matrix, prompted many land managers to expand use of prescribed fire. In 1990, the Florida Legislature passed the Prescribed Fire Act which supported the use of prescribed fire and set guidelines for training and certifying prescribed fire practitioners (Brevard County 2007). Fire is now a common management strategy to restore and manage fire-dependent ecosystems and protect humans and urban development from periodic wildfire (Florida Department of Agriculture and Consumer Services 2007). However, due to decades of fire suppression, it will take time to restore many of the fire-dependent ecosystems. More specifically, severely overgrown scrub typically requires labor intensive (and

expensive) mechanical canopy removal prior to use of prescribed fire.

Fitzpatrick *et al.* (1998), Breininger (1999), Breininger and Carter (2003), and Breininger and Oddy (2004) suggested that scrub-jay habitat must be managed at optimal conditions to ensure that recruitment of young scrub-jays exceeds the mortality of adults. Thus, simply assessing the number of acres of habitat that has been managed with prescribed fire may not accurately reflect habitat conditions of the scrub-jay. Breininger and Carter (2003) indicated that habitat management and restoration must address habitat suitability at the territory scale because territories are the functional demographic unit within landscapes. Consequently, based on concerns of Breininger and Carter (2003), assessing current habitat ecosystem conditions at the rangewide scale may not be informative because such an approach cannot capture territory-scale habitat conditions. However, tracking territory-scale habitat quality would require a substantial commitment to biological and vegetative monitoring and few land managers have the time, funding, or expertise to undertake these activities. While we acknowledge the benefit of having territory-scale data in assessing scrub-jay habitat quality, we do not restrict our analyses due to lack of these data.

As mentioned above, territory-scale habitat conditions are largely unknown throughout much of the range of the scrub-jay. The only exceptions are for extensively studied scrub-jay populations in central and south Brevard County. In the Merritt Island-Cape Canaveral scrub-jay metapopulation, Breininger (personal communications, cited in Johnson *et al.* 2006) estimated that only about 13 percent of potential scrub-jay habitat was in optimal condition, despite mechanical treatment and use of prescribed fire for nearly 15 years. In the southern Brevard-Indian River-St. Lucie metapopulation recent observations suggest that scrub-jay populations on several intensively managed parcels in Brevard County may be reversing historic declining trends (Breininger 2006), but the majority of scrub-jay habitat within this metapopulation has not been evaluated at the territory scale.

Where territory-scale data are lacking, we used information provided by public land managers in response to a questionnaire developed by the Service (Service 2006a). Two hundred eleven land managers were asked to summarize their land management efforts. Eighty respondents indicated they controlled about 65,400 acres of potential scrub-jay habitat. Of this total, about

32,700 acres were currently suitable for scrub-jays and of those 32,700 acres, 18,700 acres were occupied. These data suggest that about 71 percent of potential habitat reported by respondents is not currently suitable for scrub-jays, or if it is, it has not yet been recolonized by scrub-jays. Even though a relatively low percentage (29 percent) of potential habitat is currently occupied, 86 of the respondents indicated that 73 percent of the habitat under their control had been managed to some extent over the last five years (Service 2006a). Reported management actions varied considerably and the habitat responses to these recently applied management actions may not be observed for several more years. Furthermore, the 80 respondents do not represent all public land managers; therefore, the quality of scrub-jay habitat on all public lands could not be assessed.

Assessing habitat conditions on private lands is challenging because most private lands are inaccessible. However, about 30 percent of remaining scrub-jays are thought to persist on private lands in urban landscapes (Stith 1999). Most of these urban habitats are accessible by public roads and many areas have been visited by biologists or researchers (personal observations, Service staff; Breininger 1997; Bowman 1998; LPG Environmental & Permitting Services and Environmental Management and Design 2003; Miller and Stith 2002). Breininger (1998) reported that urban landscapes in southern Brevard County that once contained about 50 scrub-jay groups had little potential to support scrub-jays in the future because it was poor quality. A county-wide assessment of scrub habitat on non-Federal lands concluded that about 67 percent of the 24,885 acres that remained in Brevard County was in poor condition and fragmented (Brevard County Natural Resources Management Office 2002). In Lake County, much of the remaining scrub habitat is considered to be overgrown and fragmented (LPG Environmental & Permitting Services and Environmental Management and Design 2003). Insufficient natural scrub habitat remains in Lake County and as a result, about 67 percent of scrub-jays observed in 2002-2003 were found in residential areas, improved pasture, unimproved pasture, abandoned citrus groves and shrub and brushland (LPG Environmental & Permitting Services and Environmental Management and Design 2003). Miller and Stith (2002) concluded that the vast majority of habitat in Charlotte County, whether privately or publicly owned, was moderately to heavily overgrown.

Although much of the remaining scrub-jay habitat is not currently in optimal condition, efforts have been made and are

underway by many local governments, state and Federal agencies, and conservation organizations to restore and maintain xeric vegetative communities, including scrub (Hastie and Eckl 1999; Stith 1999; TNC 2001, 2004; Gordon 2005; Stevens and Knight 2005; Service 2006a). The Florida Scrub-jay Fire Strike Team was organized in 1999 to provide prescribed burning assistance to various land managers in the Lake Wales Ridge. As of 2005, the Fire Strike Team had conducted restoration- and management-prescribed burns on about 20,000 acres of scrub-jay habitat (TNC 2007). Brevard County's Environmentally Endangered Lands Program actively manages about 10,000 acres of scrub and surrounding matrix habitat (Brevard County 2007).

In summary, we estimate that the combined efforts of local, state, Federal, and non-governmental organizations has resulted in the ongoing management of about 48,000 acres of scrub habitat (Service 2006a). However, relatively little managed scrub is in optimal condition and not all potential scrub-jay habitat in public ownership is managed. Most scrub-jay habitat in private ownership is degraded due to lack of management and these conditions will likely continue and gradually worsen with vegetative succession.

2. Five-Factor Analysis

- a. **Present or threatened destruction, modification, or curtailment of its habitat or range:** This section addresses the destruction of habitat, degradation of habitat due to fire suppression, and habitat fragmentation which results from the combined effect of habitat destruction and degradation.

At the time of listing, it was estimated that 40 percent of occupied scrub habitat had already been destroyed due to land use changes, and the total population of scrub-jays had declined by at least half. Fernald (1989), Fitzpatrick *et al.* (1991), and Woolfenden and Fitzpatrick (1996a) noted that habitat losses due to agriculture, silviculture, and commercial and residential development continued to play a role in the decline in numbers of scrub-jays throughout their range. More recently, Burns (2006) compared 1989 and 2003 sand pine scrub, xeric oak scrub, and coastal strand land cover classifications, as defined by land cover data sets produced by the FWC. The sand pine scrub and xeric oak scrub land classifications, both potentially suitable scrub-jay habitats, decreased 19 percent from 1989 to 2003, suggesting contemporaneous habitat loss.

Future destruction of scrub-jay habitat is anticipated, but many of these impacts are difficult to quantify because they will occur later in time and are the result of expanding urban and agricultural development, both of which are tied to economic factors that are not predictable (e.g., the rate of land use change is based on prevailing economic conditions).

Future habitat destruction can reasonably be quantified for projects that anticipate incidental take of scrub-jays and are currently under review by the Service. The Service's Environmental Conservation Online System (Service 2007b) was used to summarize the acreage of scrub-jay habitat likely to be destroyed in the near future due to issuance of section 10(a)(1)(B) permits. In total, 36 permits are currently pending that, if issued, have the potential to result in the loss of about 15,013 acres of scrub-jay habitat. Of this total, one project accounts for 14,928 acres; a habitat conservation plan developed to address take of scrub-jays due to urban development on small parcels in urban landscapes (Service 2006b).

Additional future destruction of scrub-jay habitat can be expected in the foreseeable future if human population increases occur as projected. Zwick and Carr (2006) used geographic information systems to develop a series of graphics depicting what land use might look like in Florida in the years 2020, 2040, and 2060, assuming a continuation of current development patterns. Between 2005 and 2060, Florida's population is projected to double from approximately 18 to 36 million people. Zwick and Carr (2006) found that roughly seven million acres of additional land will be converted from rural to urban uses in Florida, including 2.7 million acres of native habitat and 630,000 acres currently under consideration for conservation purchase. In addition, more than two million acres within one mile of existing conservation lands will be converted to an urban use, complicating their management and isolating them from other natural lands.

Although we cannot predict specifically where all future land use changes will occur and to what extent these changes will further fragment or destroy existing scrub-jay habitat, we anticipate these effects will be most prominent along Florida's coastline and the center of the state where existing urbanization is greatest. All or substantial portions of 14 scrub-jay metapopulations occur in these areas (Figure 1, Stith 1999) and are at risk of indirect and direct future urban development impacts.

Habitat degradation is also expected to occur in the future, but the extent and magnitude of these impacts are difficult to assess because they result from lack of action rather than the result of specific actions. For example, nearly all scrub-jay habitat that is on private property is susceptible to further degradation in the future unless active management is undertaken by landowners. Other than conservation lands owned and managed by TNC and Archbold Biological Station, we are not aware of individual private landowners who own relatively large parcels and are actively managing scrub-jay habitat. Consequently, scrub-jay habitat on most private lands will continue to succeed to more mesic conditions, eventually becoming unsuitable for scrub-jays. Most scrub habitats become overgrown and unsuitable for scrub-jays if not managed (burned) at least every 20 years (Fitzpatrick *et al.* 1991).

Habitat degradation can also be expected on some public lands, even where active management programs are in place.

Successful restoration of all scrub-jay habitat on many large parcels will take several years to achieve (Stevens and Knight 2005). Elsewhere, some public land managers do not currently have the resources to implement effective habitat management programs (Howell *et al.* 2003, Service 2006a) even though 98 percent of evaluated public lands were determined to be appropriately managed (Florida Department of Environmental Protection 2007). However, less than 25 percent of public land managers have been ranked as having an excellent prescribed burn program (Howell *et al.* 2003). On most public lands, scrub habitat is likely to continue to degrade unless funding and staffing increase in the future. Furthermore, some scrub conservation lands in southern Brevard County and in several locations on the Lake Wales Ridge may not be managed in the near future because there are multiple private landowners with inholdings. These patchworks of private and public land make use of prescribed fire as a management tool impractical (R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 30, 2007).

Habitat fragmentation results from habitat loss and degradation. When habitat is destroyed or becomes unsuitable for scrub-jays, the distance between occupied patches of scrub-jay habitat increases. Thus, habitat fragmentation increases with corresponding increases of habitat loss and degradation (Breininger 2006).

Habitat destruction, degradation, and fragmentation have been minimized through historic acquisitions of scrub habitat. As of March 2007, an estimated 280,000 acres of scrub has been acquired and protected (Florida Natural Areas Inventory 2007). Future impacts to scrub-jay habitat may be abated through continued acquisition under the State of Florida's Florida Forever program. As of 2006, nearly 94,000 acres of scrub habitat has been targeted for acquisition, but not yet acquired (Florida Natural Areas Inventory 2006). Additionally, citizens in 20 counties within the current range of scrub-jays have passed bond referendums that generate funding for acquisition of environmentally sensitive lands, conservation areas, greenspace, and parks and open spaces (TNC 2006b). These acquisition programs have the potential to acquire additional scrub habitat.

In summary, even though scrub-jay habitat has been acquired and more is targeted for acquisition, much of the remaining habitat in private ownership is vulnerable to destruction, degradation, and fragmentation. Habitat degradation remains a concern for scrub-jay habitat in public ownership as well because intensive management necessary to maintain suitable scrub-jay habitat is difficult to implement with limited staff and funding. Despite recent advances in land management efforts on many public lands, management applications may not be aggressive enough to maintain optimal scrub-jay habitat at the territory scale (Breininger and Carter 2003). Scrub-jay populations will likely to continue to decline on public lands where intensive management efforts are not undertaken. Scrub-jay habitat on private lands is likely to continue to degrade and eventually become unsuitable for scrub-jays.

Based on the analysis above, we believe habitat destruction, degradation, and fragmentation pose threats to scrub-jays. Consequently, the present or threatened destruction, modification, or curtailment of scrub-jay habitat or range is a significant risk factor.

- b. **Overutilization for commercial, recreational, scientific, or educational purposes:** At the time of listing, shooting of scrub-jays and their collection as pets were identified as threats. Since the time of listing, known incidences of scrub-jay shootings have been rare and have not substantially impacted the species. Research on scrub-jays over the past 20 years has increased, and numerous scientific research permits have been issued. To date, we are aware of one scrub-jay mortality resulting from permitted research. This factor does not pose a risk to scrub-jays.

c. **Disease or predation:** At the time of listing, disease and predation were not believed to be major threats. However, most scrub-jay mortality probably is from predation (Woolfenden and Fitzpatrick 1996b). The second most frequent cause of mortality may be disease, or predation on disease-weakened scrub-jays (Woolfenden and Fitzpatrick 1996b). Known native predators of scrub-jays are numerous (see Woolfenden and Fitzpatrick 1990; Fitzpatrick *et al.* 1991; Schaub *et al.* 1992; Woolfenden and Fitzpatrick 1996a, 1996b; Breininger 1999; K. Miller FWC, in litt. 2004; Franzreb and Puschock 2004).

Scrub-jays are also vulnerable to predation by feral and free-ranging domestic cats (Fitzpatrick *et al.* 1991; Bowman and Averill 1993; Bergen 1994; Breininger *et al.* 1995, 2001; Woolfenden and Fitzpatrick 1996a, 1996b; Breininger 1999; Toland 1999; Christman 2000). Woolfenden and Fitzpatrick (1996b) state that in suburban habitats, house cats are “important” predators to young and adult scrub-jays. Fitzpatrick *et al.* (1991) suspected that domestic cats supported by human food offerings could eliminate a small local population of scrub-jays. However, the impact of cat predation on scrub-jays has not been quantitatively assessed.

Woolfenden and Fitzpatrick (1996b) noted three episodes of elevated mortality (especially among juveniles) in 26 years at Archbold Biological Station. During the most severe of these presumed epidemics (August 1979 through March 1980), all but one of the juvenile cohort and almost half of the breeding adults died (Woolfenden and Fitzpatrick 1984, 1990). The 1979-1980 incident coincided with an outbreak of eastern equine encephalitis among domestic birds in central Florida (J. Day pers. comm., cited in Woolfenden and Fitzpatrick 1996b). From the fall of 1997 through the spring of 1998, the continuing population decline of scrub-jays along the Atlantic coast and in central Florida may have been augmented by an epidemic of unknown origin (Breininger 1999).

The scrub-jay hosts two protozoan blood parasites (M. Garvin pers. comm., cited in Woolfenden and Fitzpatrick 1996b) and 15 species of intestinal parasitic fauna have been documented (Kinsella 1974). Fly larvae (Woolfenden and Fitzpatrick 1996b), chewing lice (R. Price pers. comm., cited in Woolfenden and Fitzpatrick 1996b), wing-feather mites, chiggers, fleas (J. Kinsella pers. comm., cited in Woolfenden and Fitzpatrick 1996b), and tick nymphs and larvae (L. Durden and J. Keirans pers. comm., cited in Woolfenden and Fitzpatrick 1996b) are

known to occur on scrub-jays. These naturally-occurring parasites are not believed to have a negative impact on scrub-jay populations.

West Nile virus was first documented in Florida during 2001 (G. Wallace, FWC, in litt. 2001; Stark and Kazanis 2001). West Nile's appearance caused concern initially because of the scrub-jay's close familial relationship to other bird species that have been negatively impacted by this virus (CDC undated). It has not yet been confirmed that scrub-jays have been affected in Florida (Stark and Kazanis 2001; Collins *et al.* 2002, 2003; Rivers *et al.* 2004). There have been local die-offs of scrub-jays reported since the arrival of West Nile virus in Florida, but no confirmation that West Nile virus was responsible (Breininger *et al.* 2001, 2003).

Large scrub-jay populations are at lower risk of extinction due to disease outbreaks than small populations (Breininger *et al.* 1999). Long-term monitoring of large populations in Brevard County and the southern Lake Wales Ridge indicated that most large populations recovered from a suspected 1997 epizootic outbreak (Breininger *et al.* 2003). Furthermore, Breininger *et al.* (2003) suggests that some large populations in high quality habitat may not have shown reductions in breeding population size because surviving helpers represent a surplus of potential breeders in these situations. Thus, having many large scrub-jay populations may act to buffer scrub-jays from possible epidemics that may impact scrub-jays and appear to be patchy in distribution. Maintaining large, contiguous parcels of high quality scrub-jay habitat may reduce the impacts of disease in the future (Breininger *et al.* 2003).

In summary, disease has been periodic and patchy, affecting some scrub-jay populations. Research of scrub-jay diseases has not been extensive, but at present disease does not appear to be a significant risk factor to scrub-jays. Predation has been reported in many scrub-jay populations and is reported to be higher in urban landscapes. In urban areas, predation, in combination with other effects related to habitat fragmentation and degradation, contribute to poor scrub-jay demographic performance. However, predation alone is not a significant risk factor to scrub-jays.

d. Inadequacy of existing regulatory mechanisms:

Scrub-jays (including their eggs and young)(collectively referred to as “individuals” below) and/or their habitat are protected by the following regulatory mechanisms:

Federal

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 *et seq.*)
– individuals throughout range, except on Department of Defense property during military readiness training.

National Wildlife Refuge System Administration Act of 1966 – individuals and habitat on national wildlife refuges.

State

Chapter 68A-27.004, Florida Administrative Code –
individuals throughout range.

Chapter 68A-15.004, Florida Administrative Code -
individuals and habitat on State wildlife management areas.

At the time of listing, the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 *et seq.*) protected individual scrub-jays from take throughout their range, but did not protect their habitat.

Regulations finalized in February 2007 authorize incidental take of migratory birds, including scrub-jays, for military readiness training.

The National Wildlife Refuge System Administration Act (NWRAA) represents organic legislation that set up the administration of a national network of lands and water for the conservation, management, and restoration of fish, wildlife, and plant resources and their habitats for the benefit of the American people. Amendment of the NWRAA in 1997 required the refuge system to ensure that the biological integrity, diversity, and environmental health of refuges be maintained. The ability to meet these statutory requirements on Merritt Island National Wildlife Refuge is complicated by competing operational constraints on Cape Canaveral Air Force Station, which owns most of the refuge property.

The scrub-jay is listed in the State of Florida as a threatened species. Florida State Law (Chapter 68A-27.004, Florida Administrative Code) prohibits taking of individuals of state

listed threatened species, or parts thereof, or their nests or eggs, except as authorized; however, the statute does not prohibit destruction or modification of habitat occupied by threatened species. To date, the FWC has not developed a regulatory program that ensures compliance with this State statute. Instead, the FWC relies on Service implementation of the ESA through sections 7 and 10 and enforcement of the prohibitions in section 9.

On State wildlife management areas, regulations protect individual scrub-jays because they are not listed as a game bird and therefore have no legal seasons established for taking. Wildlife management area regulations prohibit destruction or modification of habitat, except for management and restoration activities.

Although there are no local regulations protecting scrub-jays or their habitat, Florida's State Comprehensive Plan and Growth Management Act of 1985 requires each county to develop local comprehensive planning documents. Comprehensive plans contain policy statements and natural resource protection objectives, including protection of state and federally listed species, but they are only effective if counties develop, implement, and enforce ordinances. Many county governments have developed protective ordinances, but all such ordinances are based on compliance with the ESA rather than local laws and therefore provide no additional protection. Within the current range of the scrub-jay, five counties and one municipality have provisions for reviewing all development proposals for impacts to scrub and/or scrub-jays and for referring projects that may potentially impact scrub-jays to the Service for ESA compliance (Service staff, personal observation). Four counties occasionally invoke threatened and endangered species screening, depending on the level of controversy surrounding pending developments. The remaining counties do not have environmental resource staff dedicated to habitat protection and/or have not developed protective ordinances

In summary, Federal laws currently protect individual birds on both private and most public lands and ensure protection and management of individuals and their habitat on national wildlife refuges. State statute exists to ensure protection of individuals on public and private property, but regulatory processes are not currently in place to implement this law. State regulations protect individuals and habitat on wildlife management areas. In

combination, these regulatory mechanisms adequately protect individual scrub-jays but not their habitat.

e. **Other natural or manmade factors affecting its continued existence:**

Fire Suppression - Fire suppression, and resulting habitat degradation, reduces habitat quality and scrub-jay demographic success (Woolfenden and Fitzpatrick 1984, 1991; Schaub *et al.* 1992; Duncan *et al.* 1995; Breininger 1999; Breininger *et al.* 1995, 1996, 1998, 2006) and is likely responsible for declines and local extirpations of scrub-jays throughout Florida (Miller and Stith 2002). Fire suppression and its adverse affects on scrub-jays have been discussed by many authors: Breininger 1998, 1999; Breininger and Carter 2003; Breininger and Oddy 2004; Breininger *et al.* 1996, 2006 (Central Brevard, South Brevard-Indian River County-St. Lucie and Merritt Island-Cape Canaveral metapopulations); Bowman and Fleischer 1998; Bowman and Woolfenden 2001; Schoech and Bowman 2001; Woolfenden and Fitzpatrick 1984, 1991 (Lake Wales Ridge metapopulation) and Thaxton and Hingten 1994, 1996 (Sarasota-West Charlotte metapopulation).

Stith *et al.* (1996) estimated that at least 2,100 breeding pairs of scrub-jays were living in overgrown habitat statewide. Toland (1999) and Brevard County Natural Resources Management Office (2002) reported that most of Brevard County's remaining scrub is overgrown due to fire suppression. Population declines of scrub-jays within Brevard County between 1991 and 1999 were attributed mainly to habitat degradation resulting from fire exclusion and resulting vegetative overgrowth of remaining habitat patches (Breininger *et al.* 2001). Overgrowth of scrub results not only in the decline of species diversity and abundance but also a reduction in the percentage of open sandy patches (Fernald 1989; Woolfenden and Fitzpatrick 1996b). In the northern third of the scrub-jay's range, fire suppression was likely responsible for the decline of the scrub-jay (Fitzpatrick *et al.* 1994).

Habitat degradation due to fire suppression may exceed habitat destruction as the single most important limiting factor (Woolfenden and Fitzpatrick 1991, 1996a; Fitzpatrick *et al.* 1994). Fire is important in the cyclical maintenance of scrub habitat (Nash 1895; Harper 1927; Webber 1935; Davis 1943; Laessle 1968; Abrahamson *et al.* 1984). Under natural fire regimes, late successional scrub habitats would have burned

periodically to create early succession habitats (those with no or few canopy trees). Prevention and/or control of natural fires essentially lock scrub habitats into late successional stage vegetative communities that are not occupied by scrub-jays. Fire suppression is likely to continue on private lands and result in further declines of scrub-jays in these areas (Fernald 1989; Fitzpatrick *et al.* 1994, unpublished data; Percival *et al.* 1995; Stith *et al.* 1996; Thaxton and Hingtgen 1996; Woolfenden and Fitzpatrick 1990, 1996a; Toland 1999).

Natural fire regimes are mimicked through the application of prescribed fires on many public lands that contain scrub-jay habitat. Generally, use of prescribed fire is viewed as an effective tool in the management of scrub-jay habitat. Research in various portions of the scrub-jay's range identifies the need for fire management in scrub habitats. Experimental data at Archbold Biological Station (Fitzpatrick *et al.* unpublished data) show that fire-return intervals varying between 5 and 15 years are optimal for long-term maintenance of productive scrub-jay populations in central Florida. These intervals also correspond with those yielding healthy populations of rare and federally listed scrub plants (Menges and Kohfeldt 1995; Menges and Hawkes 1998). Optimal fire-return intervals may, however, be shorter in coastal scrub habitats (Schmalzer and Hinkle 1992a, 1992b).

Breininger and colleagues have combined GIS techniques with field studies to document the ecology and habitat use of color-banded scrub-jays since 1980 at Merritt Island National Wildlife Refuge and Kennedy Space Center, in Brevard County (Breininger *et al.* 1991; Breininger 1992; Breininger *et al.* 1995, 1996, 1998, 2001, 2003; 2006). Breininger's model for habitat characteristics in coastal scrub and scrubby flatwoods demonstrates the importance of an open habitat structure containing no more than 15 percent pine canopy cover and a mixture of low (less than four feet) and medium-height (four to five and one half feet) scrub oaks interspersed with bare sandy soil (Breininger 2006). These habitat conditions can only be maintained with use of periodic prescribed fire at intervals which may vary from 3 to 10 years depending on matrix vegetation and adjacent habitats (D. Breininger, personal communication, avian ecologist, Dynamac Corporation, February 21, 2007).

Woolfenden and Fitzpatrick (1996a) cautioned that prescribed fire applied too often to scrub habitat can result in local extirpations of scrub-jays. Similarly, Breininger (2006) found

that aggressive prescribed burning creates oak scrub habitats that are structurally too short for scrub-jays. Demographic performance in extensively burned scrub are poorer than in optimal scrub (Breininger 2006).

Many public lands are not burned during the growing season or are ignited on a much smaller scale than would have occurred under natural fire regimes. Questions remain about the ecological effects of prescribed burning (during the non-growing season) on scrub-jays and their habitat. However, Foster and Schmalzer (2003) suggested that winter burning may not have significant biological impacts on the reestablishment of scrub vegetative communities.

More recently, some researchers have focused on development of adaptive fire management models (Breininger 2004, Johnson *et al.* 2004), recognizing that fire return intervals should be established based on ecological responses rather than a fixed burn schedule. This approach may be particularly useful where scrub vegetative communities occur within a matrix of other vegetative communities that naturally burned more frequently.

Many land managers are currently confronted with urban interface issues that preclude or limit use of prescribed fire (Service 2006a). Smoke management and fire containment are often cited as concerns that affect decisions on when and where to use prescribed fire on public lands. With an anticipated increase in the human population in Florida, these constraints are likely to increase in the future.

The beneficial effects of habitat restoration and subsequent maintenance burning are obvious. Scrub-jays were absent from Blue Springs State Park in Volusia County in 1989, when a 30-acre tract of overgrown scrub was clearcut and burned. Another 100 acres were mechanically cleared in 1997. In the last five years, a total of 266 acres have been treated within park boundaries. Demographic monitoring and color-banding of scrub-jays in the region documented a rebound to 22 scrub-jays in 6 families as of 2006 (M. Keserauskis, in litt. 2006). Similar increases in scrub-jays have been noted following restoration and management actions at Oscar Scherer State Park in Sarasota County (Thaxton and Hingtgen 1994), Lyonia Preserve in Volusia County (Noss 2006), and Halpata Tastanaki Preserve in Marion County (Gordon 2005).

Fitzpatrick *et al.* (1991, 1994) and Woolfenden and Fitzpatrick (1996a) expressed concern for the management practices taking place on Federal lands at Ocala National Forest, Merritt Island National Wildlife Refuge/Kennedy Space Center, and Cape Canaveral Air Force Station, all supporting large contiguous populations of scrub-jays. They predicted that fire suppression and/or too frequent fires (on the latter two) and silvicultural activities involving the cultivation of sand pine on Ocala National Forest would be responsible for declines of scrub-jays in these large contiguous areas of scrub. Monitoring of scrub-jay populations (Kennedy Space Center), demography (Kennedy Space Center, Ocala National Forest), and nesting success (Kennedy Space Center, Ocala National Forest) is ongoing to assess the effectiveness of management practices.

Road Mortality - Scrub-jays forage along roadsides and are susceptible to being killed by passing cars. Mumme *et al.* (2000) indicated that scrub-jay territories found next to a two-lane road experienced adult mortality that was higher than recruitment. Such demographics would typically result in the extirpation of affected family groups unless other scrub-jays immigrated into the roadside family groups. Scrub-jay road mortality has been reported within the Federal land complex on Merritt Island (Dreschel *et al.* 1990), Ocala National Forest (U.S. Forest Service 2006), and adjacent to Archbold Biological Station (Mumme *et al.* 2000). Road mortality is a known mortality source but current data are insufficient to assess its impact on overall population viability. Nonetheless, it presents a growing management problem throughout the remaining range of the scrub-jay (Dreschel *et al.* 1990; Mumme *et al.* 2000), and proximity to high-speed paved roads needs to be considered when designing scrub preserves (Woolfenden and Fitzpatrick 1996a).

Supplemental Food - Scrub-jays may persist locally in otherwise marginal or unsuitable areas in or adjacent to urban areas because they can obtain supplemental food from bird feeders (R. Bowman unpublished data, cited in Woolfenden and Fitzpatrick 1996a; Bowman 1998). However, recruitment in these scrub-jay populations appears to be lower than in populations occupying native habitat. Local densities of scrub-jays during nonbreeding seasons are sometimes elevated by supplemental food, even though breeding densities may not be elevated. Therefore, artificial feeding may cause certain areas to act as population sinks. Such a result could have long-term implications for managing wild populations close to residential development (R.

Bowman unpublished data, cited in Woolfenden and Fitzpatrick 1996a; Bowman 1998). In suburban areas where supplemental food was present, territory size was half that recorded in natural areas (Bowman 1998). In addition, suburban scrub-jays bred earlier, laid larger clutches, and attempted more nest starts per pair and more true second broods after successful first attempts than did scrub-jays in natural scrub. Despite these apparent benefits associated with supplemental food, annual recruitment of juveniles was 50 percent lower in suburban populations (Bowman 1998). Additionally, even though scrub-jays will preferentially supply natural food to their young, natural food availability is lower in suburban areas than in natural scrub. As a result, scrub-jays in suburban areas may be forced to switch to human-provided foods when feeding nestlings. Human-provided foods potentially result in reduced growth and survival of young (Sauter *et al.* 2006).

Changes in Habitat - Scrub-jays in suburban settings often nest high in tall shrubbery. During March, these nests tend to be susceptible to destruction by seasonal wind storms (R. Bowman and G.E. Woolfenden unpublished data, cited in Woolfenden and Fitzpatrick 1996b; Bowman 1998). In addition, daily ambient temperatures differ between suburban and wildland sites in south central Florida (Aldredge *et al.* 2005). The higher ambient temperatures in suburban sites decrease the viability of first-laid scrub-jay eggs.

Stochastic Events - Hurricanes pose a potential risk for scrub-jays, although the impact of such catastrophic events is largely unknown. Breininger *et al.* (1999) modeled the effects of hurricanes on coastal and inland scrub-jay populations and found that small (< 20 pair) coastal populations were at risk of extirpation due to storm surge. Hurricane Charley (a category 4 storm) passed directly over the Deep Creek study area in Charlotte County on August 13, 2004. Miller (2006) reported extensive scrub-jay habitat modification. Short-term impacts may include reduced acorn production and less nesting and sheltering habitat due to vegetative windfall. However, one year after the hurricane, the number of family groups in the population remained near pre-hurricane levels (Miller 2006).

Several hurricanes impacted east-central Florida in 2004 and 2005. Subsequent site visits by Service biologists found scrub-jays in areas that were previously heavily canopied and unsuitable for scrub-jays. Sandpine scrub in western Volusia County was substantially altered by these storms. In many areas,

pine canopy cover was greatly reduced, resulting in a more oak dominated scrub. Scrub-jays appear to have colonized areas where pine canopy damage was greatest (Service biologists, personal observations).

Exotic Plants and Animals - The invasion of some scrub habitat within Indian River, St. Lucie, and Martin counties by exotic plants and animals, including Brazilian pepper (*Schinus terebinthifolius*), cypress pine (*Callitris* sp.), and Australian pine (*Casuarina equisetifolia*), has degraded scrub-jay habitat locally. Exotic vegetation typically outcompetes native vegetation and results in a reduction or elimination of native food resources and sheltering and nesting habitat. Other human-induced impacts identified by Fernald (1989) include the introduction of domestic dogs (*Canis familiaris*) and cats, black rats (*Rattus rattus*), greenhouse frogs (*Eleutherodactylus planirostris*), giant toads (*Bufo marinus*), Cuban tree frogs (*Osteopilus septentrionalis*), brown anoles (*Anolis sagrei*), and other exotic animal species. These exotic species may compete with scrub-jays for both space and food, although scrub-jays opportunistically feed on small exotic vertebrates.

Although road mortality, supplemental food, changes in habitat, stochastic events, and exotic plants and animals all pose risks to some scrub-jay populations, fire suppression, and the resulting degradation in habitat, represents the most significant and widespread manmade threat affecting the scrub-jay's continued existence. As discussed in C.1.e. and in this section, current data indicate that declining scrub-jay numbers are likely due to habitat degradation resulting from lack of management or lack of territory-scale management.

D. Synthesis

The current recovery criteria for the Florida scrub-jay are generally not objective and measurable and do not address all threats. Consequently, the recovery criteria should be revised to address these needs and updated to reflect current scientific information.

Habitat degradation due to fire suppression continues to pose a significant threat to scrub-jays. The amount of habitat being managed on public lands is increasing, but management may not be aggressive enough in some areas to maintain optimal scrub-jay habitat. Inadequate funding may slow or preclude habitat restoration efforts on some public lands. Scrub-jays occupying habitat on private lands continue to be threatened with habitat degradation because most private landowners do not actively manage for scrub-jays.

Destruction of scrub-jay habitat due to land use changes threatens scrub-jays on private property. Habitat destruction is difficult to quantify but is anticipated based on past and projected human population growth in Florida. Ten scrub-jay metapopulations are most vulnerable to habitat destruction on private lands.

Viability modeling suggests that additional habitat must be acquired in many of the scrub-jay metapopulations to reduce quasi-extinction and extinction risks. The State of Florida's continued commitment to land preservation and local governments bond referendums, may contribute to scrub-jay habitat acquisitions.

Disease or predation will likely have a greater effect on this species in the future. We expect scrub-jay populations will become increasingly vulnerable to extirpation due to disease because many populations are already small and further declines in population sizes can be expected with habitat destruction and fragmentation. The ability of scrub-jays to recover from episodic disease outbreaks appears to be significantly improved when population sizes are large and habitat is managed in optimal condition; however, current trends in population size suggest vulnerability to disease will increase in the future.

The remaining factors (overutilization for commercial, recreational, scientific or education purposes and the inadequacy of existing regulatory mechanisms) are not considered limiting factors, but cumulatively with the other factors could make the species more prone to local extirpations.

In summary, although scrub-jays in 75 percent of populations recently surveyed have declined in numbers since 1992-1993, the species is still relatively widely distributed throughout its historic range. Furthermore, three metapopulations (Ocala National Forest, Merritt Island/Cape Canaveral, and Lake Wales Ridge) are believed to contain sufficient numbers of scrub-jay groups to persist long-term. Federal agencies responsible for land management within each of these metapopulations either have a current management plan or have a management plan that is in the process of being revised to address habitat management and scrub-jay population targets.

Other scrub-jay populations and/or metapopulations will benefit from recent land management activities on public lands, but the results have not yet been realized in most areas because scrub-jays do not respond immediately to habitat restoration. We believe that recent and planned management actions will slow the rate of decline in some populations and ultimately result in positive population growth in others. These results will be realized with the continued commitment of land managers to prioritize and adequately fund habitat management programs for scrub restoration and management. We will evaluate the progress of land managers in meeting their stated objectives related to scrub management and will consider these results during our next 5-year review (refer to Recommendations for Future Actions section for further detail on our recommendations regarding management efforts on public / private lands).

Previous land acquisitions by public and conservation non-profits have eliminated habitat degradation, destruction, and fragmentation threats to portions of some scrub-jay populations. As of March 2007, an estimated 280,000 acres of scrub has been acquired and protected (Florida Natural Areas Inventory 2007). Future impacts to scrub-jay habitat will be abated if acquisition by state and local governments and conservation organizations continues.

In addition, Federal laws currently protect individual birds on both private and most public lands and ensure protection and management of individuals and their habitat on national wildlife refuges. The Service has developed scrub-jay mitigation guidance that provides recommendations for compensating impacts to scrub-jay habitat due to land use conversions (Service 2003). Through technical assistance and formal consultation, the Service works with other Federal agencies and individuals to minimize impacts to scrub-jays and their habitat.

Because scrub-jays are still well represented within their historic range, are relatively secure in three large metapopulations, likely to respond positively to ongoing management actions elsewhere, and have benefited from previous public land acquisitions, we believe that the scrub-jay is not likely to be in danger of extinction throughout all or a significant portion of its range and should therefore remain a threatened species.

III. RESULTS

- A. Recommended Classification:** Threatened
- B. New Recovery Priority Number:** 8c

This recommendation represents a correction in the recovery priority number from 2c (high degree of threat, high recovery potential) to 8c (moderate degree of threat, high recovery potential). At the time of listing, we gave the species an RPN of 2c because the extent, magnitude, and temporal effects of habitat loss and degradation on the species' distribution and abundance were not well known and it was widely believed that scrub-jays were in imminent danger of becoming endangered.

However, this RPN was in error and is not consistent with our assessment of other species' threat levels. Scrub-jays are still relatively widely distributed throughout their historic range and although scrub-jay numbers and their distribution are in decline, we now know that intensive habitat management can reverse declines in scrub-jay populations. We do not currently believe the scrub-jay is in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Encourage the State of Florida to revise regulations to establish protection of scrub-jay habitat.

Encourage the State of Florida to develop a scrub-jay management plan.

Evaluate whether public land management actions in areas where jays exist are achieving stated land management plan objectives and goals beneficial to scrub-jays.

Revise metapopulation viability analysis for the Florida scrub-jay. The most recent metapopulation viability analysis was completed in 1999 and used scrub-jay distribution and abundance data collected during the 1992-1993 statewide survey. While useful in assessing expected trends and evaluating relative risks at the time of its completion, the 1999 analysis included several assumptions that ultimately resulted in model output that likely overestimated scrub-jay survival probabilities. We believe information is currently available to minimize the risks of overly optimistic model results. Also, the 1999 analysis did not account for all unoccupied, but potentially restorable, scrub-jay habitat, which likely resulted in underestimating scrub-jay survival probabilities in some locations. The effects that habitat edges have on scrub-jay viability should also be addressed in any revised viability model. Our understanding of edge effects is limited by spatial replication and a lack of data regarding interactions among variables. We need to better understand whether edges are good or bad for scrub-jays. Any model revision should also incorporate new or revised recovery criteria and assist in identifying metapopulation levels necessary to meet these criteria.

Current scrub-jay distribution and abundance data are needed for the development of a revised metapopulation viability analysis. Therefore, we also recommend that a statewide survey effort be completed prior to initiation of a revised metapopulation viability analysis.

Update the Florida scrub-jay recovery plan to include measurable recovery criteria that are related to reducing and/or eliminating threats.

Monitoring and research are needed to distinguish among conservation alternatives, and science and management need to be better integrated. Many monitoring methods that do not measure survival, recruitment, and dispersal of color-banded scrub-jays will have bias and poor precision in contrast to what is needed to distinguish among management alternatives (Johnson *et al.* 2006). Except for the detrimental consequences of fire exclusion, there is little detailed empirical data on how scrub-jay populations respond to alternative management actions, particularly regarding fire pattern, intensity, and season.

Provide technical and financial assistance to land managers to ensure scrub-jay habitat is effectively managed on public lands. To minimize risks of local extirpations and maintain or enhance long-term persistence of most scrub-jay

metapopulations, the continued protection and enhancement of habitat in public ownership must occur.

Use Safe Harbor Agreements, Partners for Fish and Wildlife grants, and U.S. Department of Agriculture's Farm Bill programs such as the Wildlife Habitat Incentives, Environmental Quality Incentives, and Farm and Ranchland Protection Programs to encourage private landowners to protect and/or manage scrub-jay habitat.

Encourage the development of scrub-jay conservation banks on large, privately owned and managed tracts of land with high quality scrub habitat. Conservation banks can provide additional preserved and managed habitat to augment scrub-jay conservation.

V. REFERENCES

- Abrahamson, W.G. 1984. Post-fire recovery of Florida Lake Wales Ridge vegetation. *American Journal of Botany* 71(1):9-21.
- Abrahamson, W.G., A.F. Johnson, J.N. Layne, and P.A. Peroni. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. *Florida Scientist* 47(4):209-250.
- Aldredge, R.A., R. Bowman, R.K. Boughton, S.J. Schoech, and E. Bridge. 2005. Increased ambient temperatures in an urban landscape affect hatching success of the threatened Florida scrub-jay (*Aphelocoma coerulescens*). *Integrative and Comparative Biology* 45(6):956.
- American Ornithologists' Union [AOU]. 1995. Fortieth supplement to the North American Ornithologists' Union Checklist of North American Birds. *Auk* 112(3):819-830.
- Bergen, S. 1994. Characterization of fragmentation in Florida scrub communities. Unpublished M.S. Thesis, Department of Biological Sciences, Florida Institute of Technology; Melbourne, Florida.
- Bowman, R. 1998. Population dynamics, demography, and contributions to metapopulation dynamics by suburban populations of the Florida scrub-jay, *Aphelocoma coerulescens*. Final report on Project No. NG94-032 to Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.
- Bowman, R. and L. Averill. 1993. Demography of a suburban population of Florida scrub jays. Annual progress report for Agreement No. 14-16-0004-91-950 with U.S. Fish and Wildlife Service. December 1993.

- Bowman, R. and G.E. Woolfenden. 2001. Nest success and the timing of nest failure of Florida scrub-jays in suburban and wildland habitats. Pages 383-402 in: J.M. Marzluff, R. Bowman, and R. Donnelly (eds.). *Avian Ecology and Conservation in an Urbanizing World*. Kluwer Academic Publishers, Norwell, Massachusetts.
- Bowman, R., G.E. Woolfenden, A.L. Fleischer, Jr., and L.M. Walton. 1996. Nest site selection by Florida scrub-jays in natural and modified habitats. Abstract, Archbold Biological Station 1996 Symposium. 12 September 1996. Lake Placid, Florida.
- Breininger, D.R. 1992. Habitat model for the Florida scrub jay on John F. Kennedy Space Center. NASA Technical Memorandum No. 107543. John F. Kennedy Space Center, Florida.
- Breininger, D.R. 1997. Florida scrub-jay demography in an urban metapopulation. 1997 final report. U.S. Fish and Wildlife Service, Jacksonville, Florida.
- Breininger, D.R. 1998. Florida scrub-jay demography in the Palm Bay urban metapopulation. Final report. U.S. Fish and Wildlife Service, Jacksonville, Florida.
-
- Breininger, D.R. 1999. Florida scrub-jay demography and dispersal in a fragmented landscape. *The Auk* 116(2):520-527.
- Breininger, D.R., M.J. Provancha, and R.B. Smith. 1991. Mapping Florida scrub jay habitat for purposes of land-use management. *Photogrammetric Engineering & Remote Sensing* 57(11):1467-1474.
- Breininger, D.R. 2004. An adaptive approach to managing Florida scrub-jay habitat. NASA Technical Memorandum NASA/TM-2004-211532.
- Breininger, D.R. 2006. 2006 annual report of research activities conducted under Federal Fish and Wildlife threatened species permit #TE106005-0 and Florida Fish and Wildlife Conservation Commission special use permit #WX05535. On file, Fish and Wildlife Service, Jacksonville, Florida.
- Breininger, D.R., V.L. Larson, B.W. Duncan, R.B. Smith, D.M. Oddy, and M.F. Goodchild. 1995. Landscape patterns of Florida scrub jay habitat use and demographic success. *Conservation Biology* 9(6):1442-1453.
- Breininger, D.R., V.L. Larson, D.M. Oddy, R.B. Smith, and M.J. Barkaszi. 1996. Florida scrub-jay demography in different landscapes. *The Auk* 113(3):617-625.
- Breininger, D.R., V.L. Larson, B.W. Duncan, and R.B. Smith. 1998. Linking habitat suitability to demographic success in Florida scrub-jays. *Wildlife Society Bulletin* 26(1):118-128.

Breininger, D.R. M.A. Burgman, and B.M. Stith. 1999. Influence of habitat quality, catastrophes, and population size on extinction risk of the Florida scrub-jay. *Wildlife Society Bulletin* 27(3):810-822.

Breininger, D.R., B. Toland, D. Oddy, M. Legare, J. Elseroad, and G. Carter. 2001. Biological criteria for the recovery of Florida scrub-jay populations on public lands in Brevard and Indian River county. Annual Progress Report to Endangered Species Office, U.S. Fish and Wildlife Service, Jacksonville, Florida.

Breininger, D.R. and G.M. Carter. 2003. Territory quality transitions and source-sink dynamics in a Florida scrub-jay population. *Ecological Applications* 13(2):516-529.

Breininger, D.R., B. Toland, D. Oddy, M. Legare, J. Elseroad, and G. Carter. 2003. Biological criteria for the recovery of Florida scrub-jay populations on public lands in Brevard County and Indian River County. Final Report to Endangered Species Office, U.S. Fish and Wildlife Service, Jacksonville, Florida. Dynamac Corporation, DYN-2, Kennedy Space Center, Florida.

Breininger, D.R. and D.M. Oddy. 2004. Do habitat potential, population density, and fires influence scrub-jay source-sink dynamics? *Ecological Applications* 14(4):1079-1089.

Breininger, D.R., B. Toland, D.M. Oddy, and M.L. Legare. 2006. Landcover characterizations and Florida scrub-jay (*Aphelocoma coerulescens*) population dynamics. *Biological Conservation* 128:169-181.

Brevard County. 2007. http://www.brevardparks.com/eel/education/fire/fire_2.htm. Accessed April 23, 2007.

Brevard County Natural Resources Management Office. 2002. 2000-2002 resurvey of Florida scrub-jays occupying 1993 scrub polygons within Brevard County, Florida. Prepared for the U.S. Fish and Wildlife Service, Endangered Species Office, Jacksonville. Cooperative Agreement No. 1448-0004-95-915.

Burns, G. 2006. A comparison of the areas of the sand pine scrub, xeric oak scrub, and coastal strand land cover classifications within the 1989 and 2003 land cover data sets produced by the Florida Fish and Wildlife Conservation Commission. Burns Consulting, Montverde, Florida.

Centers for Disease Control and Prevention [CDC]. Undated. List of bird species reported to CDC's West Nile Virus avian mortality database from 1999-present (accessed December 11, 2006). Available on the web at <http://www.cdc.gov/ncidod/dvbid/westnile/birdspecies.htm>.

Christman, S.P. 2000. Florida scrub-jay distribution and habitat analysis, Sarasota County. Unpublished report prepared for Sarasota County Natural Resources. November 2000.

- Collins, C., L. Conti, C. Blackmore, and D. Harris. 2002. Florida arboviral activity summary, 2002. Florida Department of Health. Available on the internet at <http://www.myfloridaeh.com/community/arboviral/data/2002/Annual-Arboviral-Activity-Summary-for-2002.pdf>. 5 pages.
- Collins, C., K. Payne, C. DeSouza, and C. Blackmore. 2003. Florida mosquito-borne disease summary for 2003. Florida Department of Health. Available on the internet at http://www.myfloridaeh.com/community/arboviral/pdfs/2003/Summary_2003.pdf. 8 pages.
- Davis, J.G., Jr. 1943. The natural features of southern Florida: especially the vegetation and the Everglades. Florida Department of Conservation, Florida Geological Survey Bulletin 25. 311pp.
- Dreschel, T.W., R.B. Smith, and D.R. Breininger. 1990. Florida scrub jay mortality on roadsides. *Florida Field Naturalist* 18(4):82-83.
- Duncan, B.W. and P.A. Schmalzer. 2004. Anthropogenic influences on potential fire spread in a pyrogenic ecosystem of Florida. *Landscape Ecology* 19:153-165.
- Duncan, B.W., D.R. Breininger, P.A. Schmalzer, and V.L. Larson. 1995. Validating a Florida scrub-jay habitat suitability model, using demography data on Kennedy Space Center. *Photogrammetric Engineering and Remote Sensing* 56:1361-1370.
- Fernald, R.T. 1989. Coastal xeric scrub communities of the Treasure Coast Region, Florida: A summary of their distribution and ecology, with guidelines for their preservation and management. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report Number 6. Tallahassee, Florida.
- Fitzpatrick, J.W. 2006. Email to Dawn Zattau, dated September 26, 2006.
- Fitzpatrick, J.W., G.E. Woolfenden, and M.T. Kopeny. 1991. Ecology and development-related habitat requirements of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*). Florida Game and Fresh Water Fish Commission Nongame Wildlife Program Technical Report No. 8. Tallahassee, Florida.
- Fitzpatrick, J.W., B. Pranty, and B. Stith. 1994. Florida scrub jay statewide map, 1992-1993. Archbold Biological Station. Lake Placid, Florida.
- Fitzpatrick, J.W., R. Bowman, D.R. Breininger, M.A. O'Connell, B. Stith, J. Thaxton, B. Toland, and G.E. Woolfenden. 1998. Unpublished manuscript. Habitat conservation plans for the Florida scrub-jay: a biological framework. On file, Fish and Wildlife Service, Jacksonville, Florida.
- Florida Department of Agriculture and Consumer Services. 2007. http://www.fl-dof.com/wildfire/rx_index.html. Accessed April 24, 2007.

- Florida Department of Environmental Protection. 2007. <http://www.dep.state.fl.us/lands/landmgmt/default.htm>. Accessed April 27, 2007.
- Florida Natural Areas Inventory. 2006. Florida Forever natural resource acquisition progress report. Tallahassee, Florida.
- Florida Natural Areas Inventory. 2007. Florida Forever natural resource acquisition report, May 2007. http://www.fnai.org/PDF/FF_progress_report_2007-06.pdf, accessed July 16, 2007.
- Foster, T.E. and P.A. Schmalzer. 2003. The effect of season of fire on the recovery of Florida scrub. In: Proceedings of the Second International Wildland Fire Ecology and Fire Management Congress, American Meteorological Society, Published on CDROM and at <http://www.ametsoc.org>.
- Franzreb, K.E. and J. Puschock. 2004. Year 3 (FY 2003): Status, population dynamics, and habitat use of the Florida scrub-jay on the Ocala National Forest, Florida. Draft annual report 2003. Southern Region, U.S. Forest Service. 19 pp.
-
- Gordon, W. David. 2005. Distribution of the Florida scrub-jay (*Aphelocoma coerulescens*) within the Hillsborough/Manatee metapopulation. Prepared for U.S. Fish and Wildlife Service under Grant Agreement 401813G024. Quest Ecology, Wimauma, Florida.
- Harper, R.M. 1927. Natural resources of southern Florida. Florida State Geological Survey Annual Report 18:27-206.
- Hastie, K. and E. Eckl. 1999. North Florida team rallies around scrub jay. Page 28 in: Durhan, M. (ed.) Fish and Wildlife News. July/August 1999. U.S. Fish and Wildlife Service, Washington, D.C.
- Howell W., B. Malloy, G. Brock. 2003. Land management review team findings: 1997-2003. Office of Environmental Service, Division of State Lands, Department of Environmental Protection. Tallahassee, Florida.
- Johnson, F.A., D.R. Breininger, B.D. Duncan, and M. Epstein. 2004. Adaptive habitat management for Florida scrub-jays at Merritt Island National Wildlife Refuge. Project Prospectus, U.S. Fish and Wildlife Service, University of Florida, Gainesville.
- Johnson, F.A., T. Beech, R.M. Dorazio, M. Epstein, J. Lyon. 2006. Abundance and detection probabilities of Florida scrub-jays at Merritt Island National Wildlife Refuge using spatially replicated counts. U.S. Fish and Wildlife Service, University of Florida, Gainesville.
- Keserauskis, M. 2006. Completed land manager questionnaire submitted to Service (see Service 2006a).

- Kinsella, J.M. 1974. Helminth fauna of the Florida scrub jay: host and ecological relationships. *Proceedings of the Helminthological Society of Washington* 41(2):127-130.
- LPG Environmental & Permitting Services and Environmental Management and Design. 2003. Distribution of the Florida scrub jay in Lake County, Florida. Prepared for Lake County Board of County Commissioners. On file, U.S. Fish and Wildlife Service, Jacksonville, Florida.
- Laessle, A.M. 1968. Relationships of sand pine scrub to former shore lines. *Quarterly Journal of the Florida Academy of Science* 30(4):269-286.
- Main, K.N. and E.S. Menges. 1997. Archbold Biological Station, Station Fire Management Plan. Land management publication 97-1. Archbold Biological Station, Lake Placid, Florida.
- Menges, E.S. and N. Kohfeldt. 1995. Life history strategies of Florida scrub plants in relation to fire. *Bulletin of the Torrey Botanical Club* 122(4):282-297.
- Menges, E.S. and C.V. Hawkes. 1998. Interactive effects of fire and microhabitat on plants of Florida scrub. *Ecological Applications* 8(4):935-946.
- Miller, J.B. 2003. Email to Bill Brooks (Service) *et al.*, dated May 13, 2003.
- Miller, K.E. 2004. Email to Dawn Zattau (Service), dated July 16, 2004.
- Miller, K.E. 2006. Assessing impacts of Hurricane Charley on Florida scrub-jays in Charlotte County. Interim report for agreement number 401815G176. Florida Fish and Wildlife Conservation Commission, Gainesville, Florida.
- Miller, K.E. and B.M. Stith. 2002. Florida scrub-jay distribution and habitat in Charlotte County. Final report, contract no. 2001000116: scrub-jay survey. December 2002. 204 pp.
- Mumme, R.L., S.J. Schoech, G.E. Woolfenden, and J.W. Fitzpatrick. 2000. Life and death in the fast lane: demographic consequences of road mortality in the Florida scrub-jay. *Conservation Biology* 14(2):501-512.
- Myers, R.L. 1985. Fire and the dynamic relationship between Florida sandhill and sandpine vegetation. *Bulletin of the Torrey Botanical Club*. 112:241-252.
- Nash, G.V. 1895. Notes on some Florida plants. *Bulletin of the Torrey Botanical Club* 22(4):141-161.

- NeSmith, K., S. Jue, and Gary E. Schultz. 2004. Survey for Florida scrub-jays and inventory of scrub habitat in Volusia County, Florida. Florida Natural Areas Inventory, Tallahassee, Florida.
- Noss, R. 2006. Lyonia Preserve scrub-jays – 2006 annual report. Submitted for Federal Fish and Wildlife Permit TE080628-2. University of Central Florida, December 6, 2006.
- Percival, H.F., D.B. McDonald, and M.J. Mazurek. 1995. Status and distribution of the Florida scrub jay (*Aphelocoma c. coerulescens*) on Cape Canaveral, Florida. Final report, research work order 136. Technical Report No. 51. Florida Fish and Wildlife Research Unit, Gainesville, Florida.
- Pranty, B. 1996. Distribution of the Florida scrub-jay, 1992-1993. Report to U.S. Fish and Wildlife Service under Cooperative Agreement No. 14-16-0004-91-950, Modification No. 5. Archbold Biological Station, Venus, Florida.
- Rivers, S., C. Collins, K. Payne, C. DeSouza, and C. Blackmore. 2004. Florida cumulative arbovirus activity by county. Available on the internet at http://www.myfloridaeh.com/community/arboviral/data/2004/2004_data_summary.pdf.
- Robbins, L.E. and R.L. Myers. 1989. Seasonal effects of prescribed burning in Florida: a review. The Nature Conservancy, Tallahassee, Florida.
- Sauter, A., R. Bowman, S.J. Schoech, and G. Pasinelli. 2006. Does optimal foraging theory explain why suburban Florida scrub-jays (*Aphelocoma coerulescens*) feed their young human-provided food? Behavioral Ecology and Sociobiology 60(4):465-474.
- Schaub, R., R.L. Mumme, and G.E. Woolfenden. 1992. Predation on the eggs and nestlings of Florida scrub jays. The Auk 109(3):585-593.
- Schmalzer, P.A. and C.R. Hinkle. 1992a. Recovery of oak-saw palmetto scrub after fire. Castanea 57(3):158-173.
- Schmalzer, P.A. and C.R. Hinkle. 1992b. Species composition and structure of oak-saw palmetto scrub vegetation. Castanea 57(4):220-251.
- Schoech, S.J. and R. Bowman. 2001. Variation in the timing of breeding between suburban and wildland Florida scrub-jays: do physiologic measures reflect different environments? Pages 289-306 in: J.M. Marzluff, R. Bowman, and R. Donnelly (eds.). Avian Ecology and Conservation in an Urbanizing World. Kluwer Academic Publishers, Norwell, Massachusetts.

- Stark, L.M. and D. Kazanis. 2001. Arbovirus surveillance: annual summary report, 2001. Florida Department of Health, Tampa, FL. Available on the internet at http://www.myfloridaeh.com/community/arboviral/pdfs/2001/2001_arboannual.pdf.
- Stevens, T. and G. Knight. 2005. Status and distribution of the Florida scrub-jay (*Aphelocoma coerulescens*) at Cape Canaveral Air Force Station, Florida, Annual Report: 2004-2005. Prepared for 45th CES/CEV, Patrick Air Force Base, Florida.
- Stith, B.M. 1999. Metapopulation viability analysis of the Florida scrub-jay (*Aphelocoma coerulescens*): a statewide assessment. Final Report to the Endangered Species Office, U.S. Fish and Wildlife Service, Jacksonville, FL. Contract No. 1448-40181-98-M324. August 1999.
- Stith, B.M., J.W. Fitzpatrick, G.E. Woolfenden, and B. Pranty. 1996. Classification and conservation of metapopulations: a case study of the Florida scrub jay. Pages 187-215 in D.R. McCullough, ed., Metapopulations and wildlife conservation. Island Press; Washington, D.C.
-
- Swain, H.M., P.A. Schmalzer, D.R. Breininger, K.V. Root, S. Bergen, S.R. Boyle, S. MacCaffree, S. Heflick, and T. Gregory. 1995. Appendix B: Biological consultant's report. In: Scrub conservation and development plan, Brevard County. Submitted to Natural Resources Management Division, Brevard County, Florida. Florida Institute of Technology, Melbourne, Florida.
- Thaxton, J.E. and T.M. Hingtgen. 1994. Responses of Florida scrub jays to management of previously abandoned habitat. District 4 Annual Research Report, Florida Park Service, Tallahassee, Florida.
- Thaxton, J.E. and T.M. Hingtgen. 1996. Effects of suburbanization and habitat fragmentation on Florida scrub-jay dispersal. *Florida Field Naturalist* 24(2):25-60.
- The Nature Conservancy [TNC]. 2001. Saving the Florida scrub-jay: recommendations for preserving Florida's scrub habitat. The Nature Conservancy and Audubon of Florida.
- The Nature Conservancy [TNC]. 2004. Florida scrub-jay fire strike team, fifth annual report, October 1, 2003- September 30, 2004. Provided to U.S. Fish and Wildlife Service as required by Grant Agreement No. 1448-40181-99-G-033. The Nature Conservancy, Babson Park, Florida.
- The Nature Conservancy [TNC]. 2006a. Jay watch annual report 2006. The Nature Conservancy, Babson Park, Florida.
- The Nature Conservancy [TNC]. 2006b. Summary table of Florida local land acquisition programs. Updated December 12, 2006. Tallahassee, Florida.

- The Nature Conservancy [TNC]. 2007.
<http://www.nature.org/initiatives/fire/work/art15394.html>. Accessed April 26, 2007.
- Toland, B.R. 1999. Current status and conservation recommendations for the Florida scrub-jay in Brevard County. Report to the Brevard County Board of County Commissioners. Brevard County Natural Resources Management Office, Viera, Florida.
- Turner, W.R., D.S. Wilcover, and H.M. Swain. 2006. State of the scrub: conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge. Archbold Biological Station, Lake Placid, Florida.
- U.S. Fish and Wildlife Service [Service]. 1990. Recovery plan for the Florida scrub jay, U.S. Fish and Wildlife Service, Atlanta, Georgia.
- U.S. Fish and Wildlife Service [Service]. 2003. Amended guidance for assessing mitigation needs for Florida Scrub-jays. On file, Fish and Wildlife Service, Jacksonville, Florida.
- U.S. Fish and Wildlife Service [Service]. 2006a. Excel spreadsheet containing questionnaire responses received from conservation land managers. On file, Jacksonville Field Office, Florida.
- U.S. Fish and Wildlife Service [Service]. 2006b. Florida scrub-jay umbrella habitat conservation plan and environmental assessment. On file, U.S. Fish and Wildlife Service, Atlanta, Georgia.
- U.S. Fish and Wildlife Service [Service]. 2007a.
<http://www.fws.gov/southeast/planning/PDFdocuments/Merritt%20Island%20Draft/E dited%20Draft%20CCP.pdf>. Accessed April 26, 2007.
- U.S. Fish and Wildlife Service [Service]. 2007b. Unpublished data. <https://ecos.fws.com>. Accessed April 24, 2007.
- U.S. Forest Service. 2006. Final Environmental Assessment, Florida scrub-jay project FY-2004. Lake George Ranger District, Ocala National Forest, Silver Springs, Florida.
- Volusia County School District. 2004. Florida scrub-jay habitat management plan for the Lyonia Preserve phase II and phase III project site, Volusia County, Florida. On file, Fish and Wildlife Service, Jacksonville, Florida.
- Wallace, G. 2001. Email, dated August 3, 2001, documenting presence of West Nile virus in Florida.

- Webber, H.J. 1935. The Florida scrub, a fire-fighting association. American Journal of Botany 22(3):344-361.
- Woolfenden, G.E. and J.W. Fitzpatrick. 1984. The Florida scrub jay: demography of a cooperative-breeding bird. Princeton University Press, Princeton, New Jersey.
- Woolfenden, G.E. and J.W. Fitzpatrick. 1990. Florida scrub jays: A synopsis after 18 years of study. Pages 241-266 in P.B. Stacey and W.B. Koenig, eds. Cooperative breeding in birds: long term studies of ecology and behavior. Cambridge University Press, Cambridge.
- Woolfenden, G.E. and J.W. Fitzpatrick. 1991. Florida scrub jay ecology and conservation. Pages 542-565 in: Perrine, C.M., J.-D. Lebreton, and G.J.M. Hirons (eds.). Bird population studies: relevance to conservation and management. Oxford University Press; Oxford, United Kingdom.
- Woolfenden, G.E. and J.W. Fitzpatrick. 1996a. Florida scrub jay. Pages 267-280 in J.A. Rodgers, H.W. Kale, and H.T. Smith, eds. Rare and Endangered Biota of Florida, Volume V. Birds. University Press of Florida; Gainesville, Florida.
- Woolfenden, G.E. and J.W. Fitzpatrick. 1996b. Florida scrub-jay. Pages 1-27 in A. Poole and F. Gill, eds. The birds of North America, No.228. The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union; Washington, D.C.
- Zwick, P.D. and M.H. Carr. 2006. Florida 2060: a population distribution scenario for the state of Florida. A research project prepared for 1000 Friends of Florida by the GeoPlan Center at the University of Florida, Gainesville. Available on the internet at <http://www.1000friendsofflorida.org/planning/2060.asp>.

VI. FIGURES

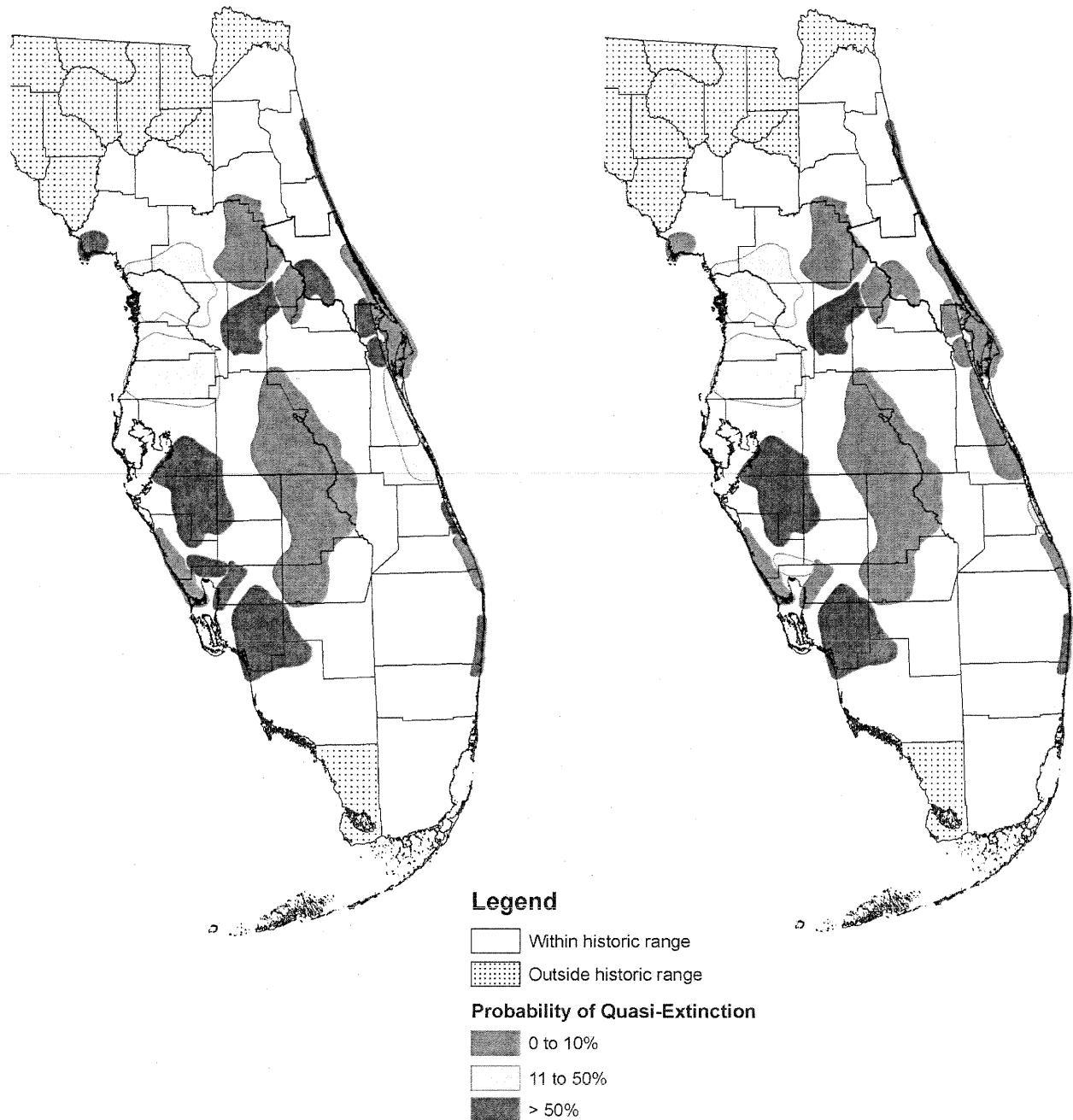


Figure 1. Quasi-extinction risks for scrub-jay metapopulations modeled by Stith (1999). The left map shows risk assuming no additional habitat protection over that which was protected in 1993. The right map shows quasi-extinction risks assuming all significant scrub-jay habitat is acquired and managed.

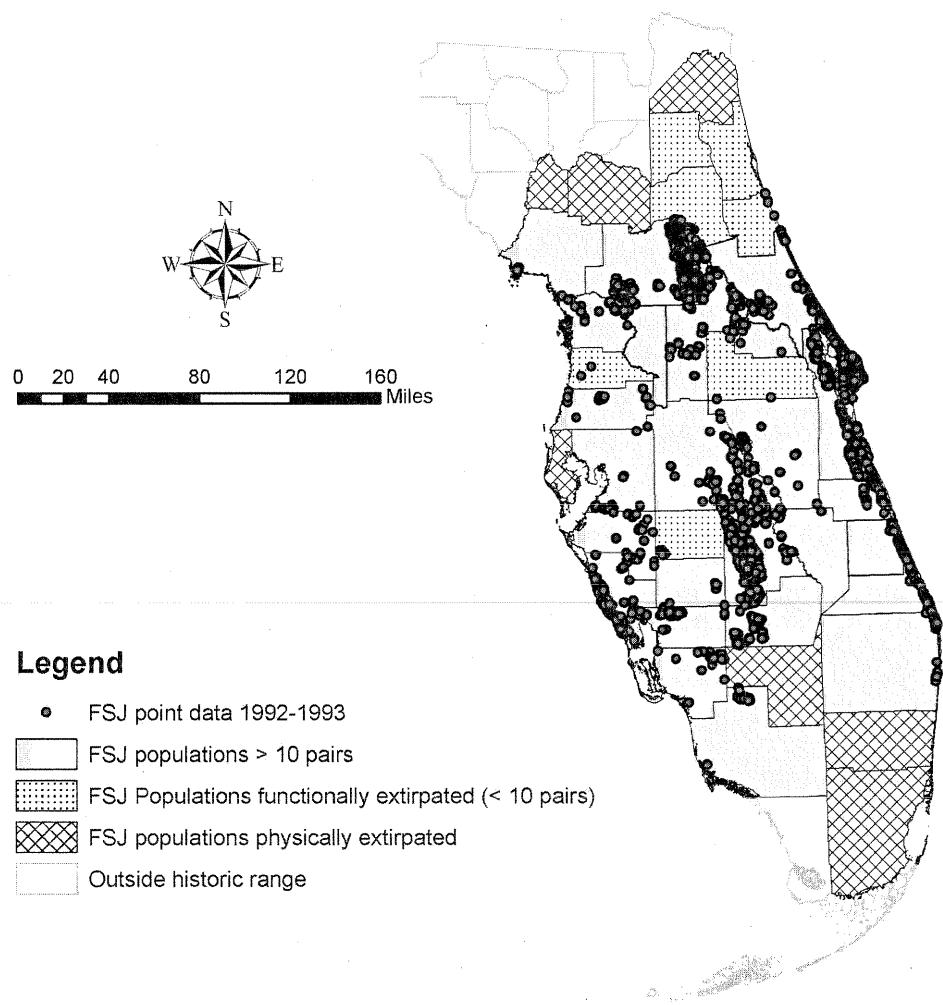


Figure 2. Historical vs. current scrub-jay distribution. Stippling and/or shading reflects known new sightings of scrub-jays since the 1992-1993 statewide survey.

VII. TABLES

Table 1. Comparison of the number of scrub-jay groups in areas surveyed in 1992-93 that was subsequently resurveyed (not all areas surveyed in 1992-93 were resurveyed).

Site	Initial Population Groups (year)	Most Recent Population Groups (year)	Percent Change
Archbold Biological Station ¹	215 (1992-93)	220 (2006)	+ 2.3
Avon Park Air Force Range ¹	90 (1992-93)	54 (2006)	-40.0
Placid Lake Estates ¹	120 (1992-93)	32 (2006)	-73.3
Lake Placid Scrub ¹	39 (1992-93)	23 (2006)	-41.0
Highlands Ridge ¹	68 (1992-93)	26 (2006)	-61.2
Holes Avenue ¹	18 (1992-93)	7 (2006)	-61.1
McJunkin Tract ¹	26 (1992-93)	33 (2006)	+26.9
Gould Road ¹	13 (1992-93)	9 (2006)	-30.8
Royce Ranch ¹	5 (1992-93)	7 (2006)	+40.0
Carter Creek ¹	35 (1992-93)	6 (2006)	-82.7
Silver Lake ¹	8 (1992-93)	13 (2006)	+62.5
Highland Park Estates ¹	25 (1992-93)	15 (2006)	-40.0
Allen D. Broussard Catfish Creek ¹	30 (1992-93)	8 (2006)	-73.3
Lake Kissimmee State Park ¹	2 (1992-93)	9 (2006)	+450.0
Flamingo Villas ¹	5 (1992-93)	8 (2006)	+60.0
North Peace River ²	1 (1992-93)	0 (2001-02)	-100.0
Washington Loop ²	11 (1992-93)	10 (2001-02)	-9.1
Prairie Creek ²	9 (1992-93)	9 (2001-02)	0.0
Shell Creek ²	4 (1992-93)	0 (2001-02)	-400.0
Tee & Green Estates ²	0 (1992-93)	0 (2001-02)	0.0
Jones Loop ²	4 (1992-93)	1 (2001-02)	-75.0
Burnt Store Road ²	0 (1992-93)	1 (2001-02)	+100.0
Water Plant ³	2 (1992-93)	0 (2001-02)	-200.0
Eleanor Avenue ³	11 (1992-93)	5 (2001-02)	-54.5
North Tippecanoe suburbs ³	5 (1992-93)	1 (2001-02)	-80.0
South Tippecanoe suburbs ³	17 (1992-93)	4 (2001-02)	-76.5
Gulf Cove ⁴	2 (1992-93)	14 (2001-02)	+700.0
Buffer Preserve ⁴	3 (1992-93)	2 (2001-02)	-33.3
Cape Haze ⁴	21 (1992-93)	5 (2001-02)	-76.2
Rotonda ⁴	7 (1992-93)	3 (2001-02)	-57.1

Table 1 (continued)

Site	Initial Population Groups (year)	Most Recent Population Groups (year)	Percent Change
East Englewood & Winchester Blvd. ⁴	13 (1992-93)	11 (2001-02)	-15.4
Lemon Bay ⁴	5 (1992-93)	0 (2001-02)	-500.0
North Buck Lake ⁵	12 (1992-93)	4 (2000-02)	-66.7
Seminole Ranch ⁵	11 (1992-93)	7 (2000-02)	-36.4
Tico/Grissom ⁵	72 (1992-93)	43 (2000-02)	-40.3
Cruickshank/Viera ⁶	26 (1992-93)	10 (2000-02)	-61.5
Wickham ⁶	16 (1992-93)	19 (2000-02)	+18.8
Melbourne Airport ⁷	7 (1992-93)	2 (2000-02)	-71.4
Palm Bay Road ⁷	5 (1992-93)	2 (2000-02)	-60.0
Palm Bay (city) ⁷	53 (1992-93)	18 (2000-02)	-66.0
Valkaria ⁷	59 (1992-93)	34 (2000-02)	-42.4
East Babcock ⁷	25 (1992-93)	8 (2000-02)	-68.0
Micco ⁷	7 (1992-93)	0 (2000-02)	-700.0
Corrigan ⁷	3 (1992-93)	3 (2000-02)	0.0
North Fork ⁷	3 (1992-93)	0 (2000-02)	-300.0
North Fork/Coraci ⁷	3 (1992-93)	7 (2000-02)	+133.3
Unnamed locations ⁸	47 (1992-93)	5 (2000-02)	-89.4
Cape Canaveral Air Force Station ⁹	123 (1995)	110 (2005)	-10.6
Hillsborough/ Manatee metapopulation ¹⁰	65 (1992-93)	23 (2004-05)	-64.6

¹ Scrub-jay populations within the Lake Wales Ridge metapopulation. Data from R. Bowman, personal communication, avian ecologist, Archbold Biological Station, April 30, 2007.

² Scrub-jay populations within the Central Charlotte metapopulation. Data from Miller and Stith (2002).

³ Scrub-jay populations within the northwest Charlotte metapopulation. Data from Miller and Stith (2002).

⁴ Scrub-jay populations within the Sarasota-West Charlotte metapopulation. Data from Miller and Stith (2002).

⁵ Scrub-jay populations within the north Brevard metapopulation. Data from Brevard County Natural Resources Management Office (2002).

⁶ Scrub-jay populations within the central Brevard metapopulation. Data from Brevard County Natural Resources Management Office (2002).

⁷ Scrub-jay populations within the south Brevard metapopulation. Data from Brevard County Natural Resources Management Office (2002).

⁸ Scrub-jay populations in Brevard County not identified by metapopulation. Data from Brevard County Natural Resources Management Office (2002).

Table 1 (continued)

⁹ Scrub-jay population within Cape Canaveral (portion of Merritt Island/Cape Canaveral metapopulation). Data from Stevens and Knight (2005).

¹⁰ Data from Gordon (2005).

Table 2. Comparision of on-the-ground observed trends in scrub-jay populations within 10 metapopulations and projected population trajectories of the same metapopulations based on model simulations (Stith 1999). Simulated responses of scrub-jays include a maximum of six possible land acquisition scenarios, including two each for the 30 percent and 70 percent habitat acquisition scenarios (see ^a). Not all land acquisition scenarios were modeled for each scrub-jay metapopulation.

Metapopulation	Observed Trend (%)	Percent change in metapopulation size (year 0 to year 60 of simulation)			
		No Acquisition ^a	30% Acquisition ^a	70% Acquisition ^a	Complete Acquisition
North Brevard	-50	No data	-48.8/-83.3	-20.8/-38.7	-16.7
Central Brevard	-50	-100.0	No data	-50.0	-36.3
Merritt Island-Cape Canaveral	-37.5	-0.7	No data	No data	-6.5
South Brevard-Indian River-St. Lucie	-50	-54.0	-21.0/-51.3	-21.1/-51.3	-24.8
Lake Wales Ridge	-40 -60	-18.5	No data No data	No data No data	-17.4
Manatee-South Hillsbourough	-65	-95.6	No data	No data	-96.6
Sarasota-West Charlotte	-42	-47.4	-44.9/-48.7	-40.7/-43.0	-47.3
Northwest Charlotte	-42	-91.8	No data	-69.1/-72.8	-60.7
Central Charlotte	-42	-100	No data	-19.3/-51.6	-65.4
Lee-North Collier	-42	-92.7	No data	-90.1/-92.0	-91.0

^a Where two numbers are provided, the first number represents risk based on acquisitions that favor protection of habitat near existing conservation lands and the second number represents risk based on acquisitions that favor protection of small areas that might be important for dispersal.

5-YEAR REVIEW of Florida Scrub-Jay

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: No change is needed

Review Conducted By: Michael Jennings

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Dil Plike Date 6/19/07

for **Lead Regional Director, Fish and Wildlife Service**

Approve Nora D. Wolf Date 7/28/07

APPENDIX A: Summary of peer review for the 5-year review of Florida scrub-jay (*Aphelocoma coerulescens*)

A. Peer Review Method: Prospective peer reviewers were identified if they met one or more of the following criteria: (1) they had recent scientific publications related to scrub-jay biology, ecology, or conservation; (2) they had recently conducted research or monitoring of scrub-jays related to biology, ecology, or conservation; or (3) they had knowledge of scrub-jay biology, ecology, or conservation because of their current professional position.

Prospective peer reviewers were notified electronically on March 5, 2007, and asked of their willingness to participate in the peer review and whether they would be able to complete their review by March 26, 2007, and follow peer review guidance (see B below).

Five prospective peer reviewers were notified: Dr. Reed Bowman, Archbold Biological Station; David Breininger, Dynamac Corporation; Dr. Brad Stith, U.S. Geological Survey; Robin Boughton, Florida Fish and Wildlife Conservation Commission; and David Gordon, Quest Ecology Inc.

B. Peer Review Charge: See Attachment 1.

C. Summary of Peer Review Comments/Report:

Ms. Boughton suggested we include information about the status of scrub-jays on Federal lands. She also questioned whether our statements about scrub-jay recovery from epidemics were supported by empirical data.

Mr. Breininger generally agreed with the information provided in the 5-year review, but provided several suggestions. First, he suggested the 5-year review emphasize the need to develop and implement adaptive fire management based on habitat and population states rather than on a fixed fire return interval. He also indicated that there are inherent limitations of metapopulation viability modeling with respect to management decision making and that viability modeling was best used for comparative purposes when considering alternative management actions and not for describing specific risks or trends. Mr. Breininger also stated that habitat edges are important to scrub-jay metapopulation viability analysis and that we need a better understanding of edge effects on vital statistics. He indicated that monitoring and research were needed to distinguish among conservation alternatives and that science and management need to be better integrated.

Mr. Gordon provided updated scrub-jay survey information for one metapopulation in westcentral Florida. He also suggested that we include mitigation (conservation) banks as a means to protect and manage scrub-jay habitat on private lands.

D. Response to Peer Review

Based on Ms. Boughton's suggestion, we have included scrub-jay status and trend information for Federally-owned lands, where data exists. We agree with Ms. Boughton that specific

empirical data do not exist to demonstrate scrub-jay population response to epidemics. This is because there were no experiments designed to evaluate the response of scrub-jays to disease outbreaks because such epidemics are not predictable and remain largely unknown until after the effects of the disease have occurred. With respect to scrub-jays, it is widely believed that an epidemic affected many scrub-jay populations during 1997, but no studies were initiated to specifically tract the response of scrub-jays. Consequently, we relied on long-term monitoring that was ongoing during the epidemic to tract demographic responses of scrub-jays in well-studied areas. The results of these studies indicated that many large scrub-jay populations rebounded rather quickly. Based on these results, researchers generally believe that small populations are vulnerable to disease outbreaks while larger populations can withstand short-term demographic perturbations. We have modified the 5-year review to better explain scrub-jay response to epidemics.

We agree with Mr. Breininger that adaptive management can further scrub restoration and scrub-jay conservation. We have included in our recommendations that additional work be pursued to develop and implement adaptive management strategies. We recognize potential problems exist in extrapolating beyond the intended uses of any modeling effort. We purposefully summarized metapopulation viability analysis results for the scrub-jay in very general terms within the text. However, we did rely on probability statistics to generate Figure 1, which lumps the output statistics of probabilities for each scrub-jay metapopulation into one of three categories. This figure was not intended to be used for management decisions, but rather for comparison of relative risks and possible future responses of scrub-jay metapopulations. There is increasing interest in the study of edge effects on scrub-jays. This emerging field of study may provide important information that can be used to better refine future analyses. As a result, we expanded our recommendation section to include consideration of habitat edge effects on population viability if future efforts are undertaken to refine and update the only existing metapopulation viability analysis done for scrub-jays. We agree with Mr. Breininger's suggestion that additional monitoring and research are needed and have incorporated this into our recommendations.

In response to Mr. Gordon's suggestions, we incorporated the updated survey information into section II.C.1.a. We concur with Mr. Gordon's observation that conservation banks are a tool that can be used to further scrub-jay conservation and we have included a short discussion in recommendations for future actions.

Attachment 1

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, North Florida Ecological Services Office

March 6, 2007

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

1. Review all materials provided by the Service.
2. Identify, review, and provide other relevant data that appears not to have been used by the Service.
3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.
4. Provide written comments on:
 - Validity of any models, data, or analyses used or relied on in the review.
 - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
 - Oversight, omissions, and inconsistencies.
 - Reasonableness of judgments made from the scientific evidence.
 - Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.
 - Strengths and limitation of the overall product.
5. Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Mike Jennings, U.S. Fish and Wildlife Service, at 904-232-2580, extension 113, email: michael_jennings@fws.gov.