Biological Criteria for the Recovery of Florida Scrub-Jay Populations on Public Lands in Brevard County and Indian River County

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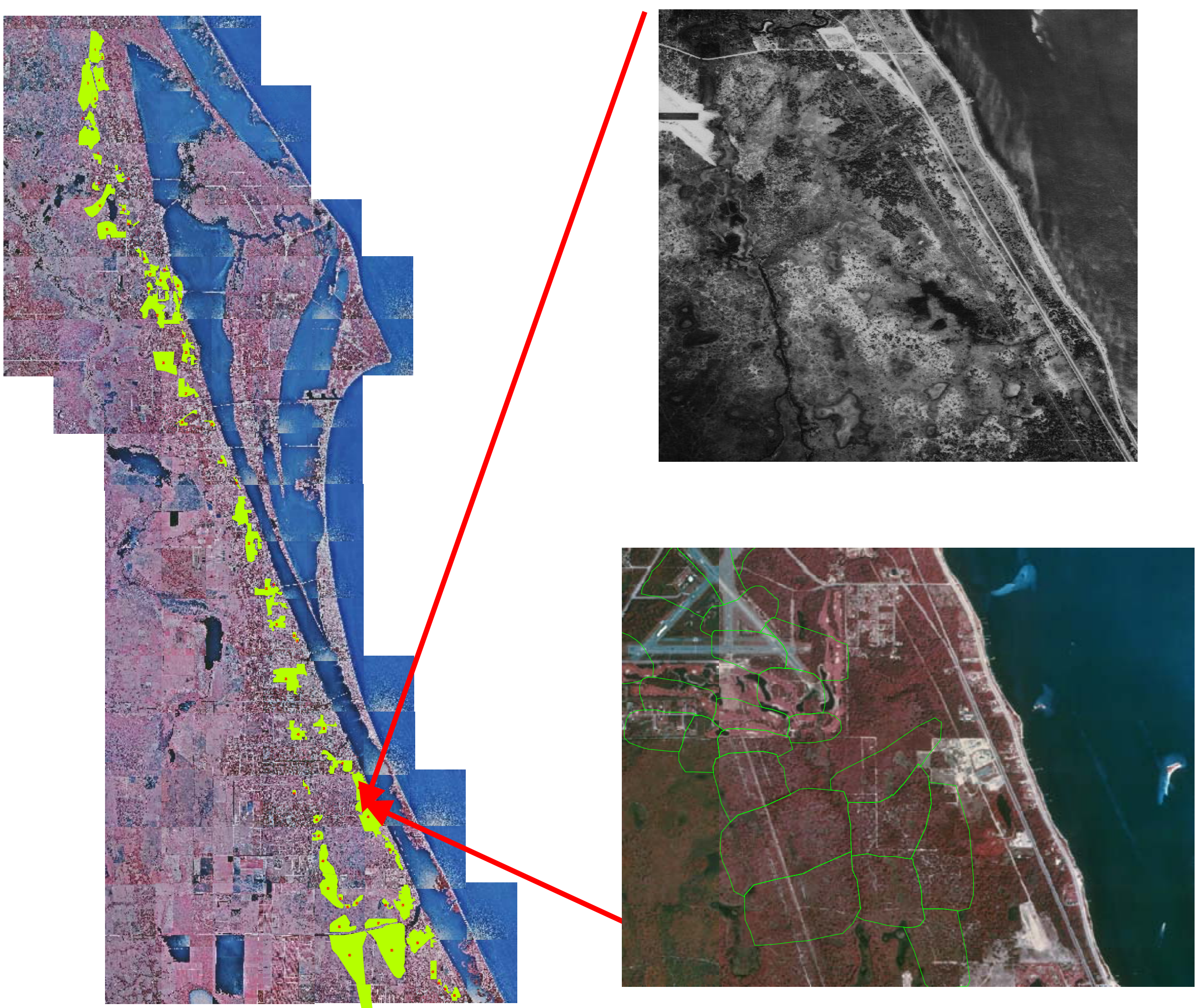

Abstract and Executive summary

Caption 1. The Florida Scrub-Jay is the only bird species unique to Florida.

Introduction The Florida Scrub-Jay (*Aphelocoma coerulescens*) is vulnerable to extinction because of habitat destruction, degradation, and fragmentation (Woolfenden and Fitzpatrick 1991, Root 1998, Breininger et al. 1999a, Stith 1999). This study of Florida Scrub-Jays, funded by the U.S. Fish and Wildlife Service, focuses on existing and proposed nonfederal conservation areas along Florida's central Atlantic coast. The central Atlantic Coast has 3 of the 7 largest Florida Scrub-Jay metapopulations (Stith 1999). This study investigates 4 of the 5 metapopulations that occur along the central Atlantic Coast. The 4 studied are North Brevard, Central Brevard, South Brevard-Indian River-St. Lucie, and South Beach. The 5th metapopulation along Florida's central Atlantic Coast is the federally-owned Merritt Island-Cape Canaveral population.

Objectives The objectives of this empirical study were to:

a) quantify habitat and describe population structure,
b) provide data to prioritize mitigation and land acquisition strategies,
c) quantify habitat-specific demography (e.g., juvenile production, yearling production, breeder survival, helper survival),

d) quantify dispersal (site tenacity, pair bond fidelity, delayed breeding characteristics, dispersal distances, population exchanges among habitat fragments),
e) evaluate habitat quality and identify habitat restoration and management needs,
f) quantify the colonization of restored and uninhabited habitat,
g) identify inventory criteria that identify habitat conditions where potential breeder production equals or exceeds breeder mortality.

The first major section of this report focuses on the geographic distribution of the habitat and the population. The second major section focuses on demography and dispersal of color-banded birds to develop a habitat-based recovery strategy. The final major section summarizes data relevant to habitat management, land acquisition, mitigation, and recovery. Minor sections include an executive summary, introduction, a technical approach, an update of the nearly extinct South Beach barrier island metapopulation, acknowledgements, and a literature cited section.

Geography of Habitat and Population Trends We remapped habitat from south Volusia County to Wabasso on the Atlantic Coastal Ridge and south to State Route 60 on the Ten Mile Ridge in Indian River County because existing landcover maps failed to identify much potential habitat. We aggregated patches of potential habitat that were large enough to support at least one territory into Potential Reserve Units (PRUs). We refined critical habitat polygons described by Stith (1999) because high-resolution digital imagery is now of greater quality and easier to use than was previously available. We overlaid existing and proposed conservation lands to determine how much of each PRU was in conservation ownership or proposed ownership. We used imagery to estimate how much habitat was lost between 1994 and 1999 in PRUs, but not among all scrub patches. We computed the number of territories that could occur in each PRU and evaluated their habitat quality.

Previous conservation analyses only considered xeric oak but more recent studies indicate that palmetto-oak can support Florida Scrub-Jay populations (Breininger et al. 1991a, 1995; Breininger and Oddy 2001). Mapping herein showed that there was enough xeric oak to support 354 territories. Including palmetto-oak provided an estimated population size of 870 territories. Within PRUs, enough habitat was conserved for approximately 267 breeding pairs, and proposed land acquisition programs could conserve another 207 pairs. There were approximately 3686 ha of xeric oak and palmetto-oak located in small habitat fragments outside PRUs. Existing and proposed reserves were poorly connected, and did not represent the geographic distribution of Florida Scrub-Jay habitat.

During this study, several new large populations were discovered and some populations were found to have more potential than previously thought. The locations of unoccupied habitat and occupied territories were not fixed so that we assumed the population was better described using existing locations of Florida Scrub-Jays supplemented by adjacent suitable habitat. Instead of the 1992 polygons that are usually used to describe Florida Scrub-Jay populations (Swain et al. 1995, Stith et al. 1996), we derived “potential territory clusters” to describe geographic structure. We began identifying potential territory clusters by overlaying the 1992 polygons, territory boundaries, and new sightings of Florida Scrub-Jays on habitat maps and aerial photographs. We then aggregated suitable habitat patches into potential territory clusters if they were <2 territory widths from each another or known occupied locations, providing the matrix between suitable patches was conducive to dispersal. This process enlarged and combined many 1992 polygons into larger areas in which we assumed jays would routinely evaluate habitat for dispersal opportunities.

Buffering operations based on dispersal propensities (Stith et al. 1996) were then used to evaluate 3 scenarios of subpopulation and metapopulation structure based on habitat potential, current conditions, and rapid urbanization that characterizes the region (Duncan et al. unpublished data). Based on potential habitat, results suggested that the mainland metapopulations could be viewed as one metapopulation that comprised 407 breeding pairs. Therefore, the population in 1992 was as large as the size used to define core populations (Stith et al. 1996).

Existing habitat and documented dispersals suggested that the three metapopulations might currently be best viewed as a North Brevard and South Brevard-Indian River-St Lucie metapopulation, which involved merging Central Brevard with South Brevard. The potential population size of the South Brevard-Indian River-St Lucie metapopulation could exceed 400 pairs and therefore also had recovery potential to be a core population under this scenario. The final metapopulation scenario assumed that the current rate of habitat loss in Central Brevard will continue so that the separation of the 3 metapopulations becomes more distinct.

The current population estimate for North Brevard, Central Brevard, and South Brevard-Indian River-St Lucie metapopulations combined is 288 breeding pairs. These metapopulations were well below carrying capacity because of poor habitat suitability, which was related to an anthropogenic reduction in natural fire regimes and habitat fragmentation. We estimated an average annual population growth rate of 0.96 suggesting a population decline of 4% per year. The population declines were comparable to predictions using population models and habitat-specific data collected elsewhere (Root 1998, Breininger et al. 1996b, 1999a).

Demography and Dispersal We used colorbanding, recruitment, survival, and dispersal studies to quantify population dynamics between Buck Lake and Sebastian Buffer Reserve. The number of territories studied ranged from 80-180 territories because of fluctuations in funding, increases in conservation land ownership, and a presumed epidemic in 1997. Demography studies were performed on 64% of the population by 2001, when 85% of the population had been surveyed to find dispersed individuals and estimate current population size and distribution.

Most colorbanding included existing and proposed conservation lands. However, we also conducted studies in Palm Bay and along Wickam Road, which both were highly fragmented landscapes. Florida Scrub-Jays residing within such areas have been hypothesized to be population sinks that might temporarily supply immigrants to reserves as reserves are restored (Breininger 1999).

Related studies on the nearby Merritt Island/Cape Canaveral metapopulation show that source-sink population dynamics apply within landscapes (Breininger and Oddy 2001, Breininger and Carter 2003). Landscapes can be partitioned into potential territories to determine the habitat arrangements needed for sources to offset demographic losses in sinks. Sources are territories where recruitment exceeds mortality so that emigration can exceed immigration. Sinks are territories where mortality exceeds recruitment and immigration usually exceeds emigration; sinks can persist only by immigration from sources.

Our approach to describe population dynamics began by characterizing habitat-specific demography. We subdivided territories into categories that addressed habitat potential and existing habitat suitability. Oak cover and soils were used to identify 3 categories of decreasing habitat potential (Breininger and Oddy 2001). Oak cover in territories was designated primary if the territory intersected ≥0.4 ha of well-drained oak scrub (Breininger and Oddy 2001). Territories were designated secondary if they did not intersect well-drained oak scrub but intersected polygons having ≥50% scrub oak cover that were ≥0.4 ha. Territories were designated tertiary if they lacked any oak scrub patches ≥0.4 ha that had ≥50% oak cover. We observed that primary and secondary territories were potential sources (recruitment exceeded mortality) when their height was optimal. We observed that tertiary territories were usually potential sinks (mortality exceeded recruitment) and that jays from sources did disperse into many types of sinks. This was consistent with related studies (Breininger and Oddy 2001, Breininger and Carter 2003).

We used three categories to describe habitat potential of territories based on their context to human-dominated landscapes. Core territories were not adjacent to human housing or hard surface roads. Territories within PRUs but not adjacent to hard surface roads were designated edge territories. Edges included buildings, airports, and golf courses. Territories within suburban areas or adjacent to hard surface roads were classified as suburban. We did not find a significant relation between demography and edge effects probably because height was suboptimal across most core, reserve edge, and suburb territories. We observed that core, edge, and suburb territories had recruitment ≥ mortality when their habitat conditions were optimal, but our sample sizes were low for edge and suburban territories that had optimal height. Greater replication of optimal edge territories is needed given that Mumme et al. (2000) found roadside territories to be sinks and Bowman (unpublished) found that territories among low housing densities to be sinks.

We used shrub height arrangements to classify habitat suitability related to recent fire history (Breininger and Carter 2003). Height categories included territories that were all short (<120 cm), optimal (matrix of short and patches 120-170 cm) mix, tall mix (<170 cm and >170 cm), and tall (>170 cm). Optimal territories tended to be sources and short and tall territories tended to be sinks, as expected (Breininger and Oddy 2001, Breininger and Carter 2003). Tall mix territories tended to have recruitment approximately equal to mortality in contrast to Breininger and Carter (2003), but similar to Stevens and Young (2002). Regardless of these small differences, population growth would only have been expected for optimal territories, which should be maximized because reserves are often far below carrying capacity and recovery requires population growth within reserves.

The success of Florida Scrub-Jay recovery efforts are influenced by Florida Scrub-Jay dispersal propensities (Fitzpatrick et al. 1999). We observed that Florida Scrub-Jays rarely divorced and usually remained together between years once they became breeders, although territory boundaries often fluctuated when there were changes in habitat suitability or where habitat was below carrying capacity. When one member of a breeding pair died, the surviving breeder usually stayed within the same territory and formed a pair bond with a new mate. Sometimes, the survivor did not breed. When the surviving breeder did not remain a breeder in the same territory, it often helped in that territory or in an adjacent territory, although a few females moved great distances to breed.

In Palm Bay suburbs, a disruption of normal population structure followed the 1997-1998 epidemic. Many surviving breeders did not find new mates but became floaters, which were rare in most study sites, as expected (Woolfenden and Fitzpatrick 1984, Stith 1999). Exchanges of jays between suburbs and reserves are believed to be one-way; form suburbs to reserves (Thaxton and Hingtgen 1996; R. Bowman personal communications). We found few exchanges between Palm Bay and conservation reserves and hypothesized that nonbreeders might be attracted to larger populations regardless of habitat potential because these clusters have more breeding opportunities than areas with few pairs (see Breininger 1999). In reserves, we often observed that unbanded immigrants were very tame, suggesting they came from suburbs where jays were accustomed to handouts.

We observed exchanges among many of the territory clusters within the South Brevard-Indian River-St. Lucie Metapopulation, where our studies began. We also observed several movements between this metapopulation and the Central Brevard metapopulation. Our study in North Brevard might have been too short to identify movements among clusters in North Brevard. We did not observe any exchanges between North Brevard and Central Brevard metapopulations but suspect they might occur and we suspect that the genetic connection might be important.

Although long distance dispersals were occasionally observed, approximately 91% of the jays that filled territory vacancies filled vacancies in the same territory cluster. Mean natal dispersal distances were 1.0 km for males and 2.8 km for females. Dispersal propensities were too short for jays to assess habitat quality throughout the metapopulation (and often throughout the territory cluster) so that jays did not uniformly distribute themselves in proportion to breeding opportunities throughout the metapopulation. Consequently, many optimal territories that resulted from restoration were unoccupied when they were not contiguous with territories that had helpers.

We made many sociobiological comparisons with studies by Woolfenden and Fitzpatrick (1984). Rates of breeding by one-year-olds were much greater than associated with stable populations because habitat restoration increased breeding opportunities and because mortality in many territories exceeded recruitment thereby providing increased breeding opportunities (Breininger 1999).

Experienced breeders and breeders with helpers had greater demographic success than novice breeders and breeders without helpers. These relationships, combined with low dispersal propensities, contributed to a slow recovery process within restored areas because experienced pairs with helpers accumulated slowly.

There were significant annual differences in demographic rates but the study was too short to quantify interactions with habitat quality. A presumed epidemic resulted in low survival and steep population reductions in 1997-1998. This was observed elsewhere (Breininger [1999]; Breininger [unpublished data]; Stevens and Young [2002]), Reed Bowman personal communication). We did not characterize the results of the 1997 epidemic as different from the other years (e.g., Woolfenden and Fitzpatrick 1984, 1991) because we assumed that we are entering a period of frequent disease outbreaks because of West Nile Virus. Many sentinel chickens in Brevard and Indian River County tested positive for West Nile Virus after field work in this study ended. Subsequent data indicated that Scrub-Jay mortality was excessively high in many locations between July 2002 and April 2003 (Breininger unpublished data).

Recovery Implications and Management Recommendations A large number of territories occurred in palmetto-oak even when territories in xeric oak (primary territories) were vacant because primary territories were often overgrown. Palmetto-oak had a greater propensity to be optimal in the infrequently burned landscapes because it had a greater propensity to burn (Breininger et al. 2002). Most territories restricted to palmetto-oak occurred on secondary ridges. Secondary and tertiary territories enhance population viability even though they are routinely overlooked in environmental assessments (Breininger and Oddy 2001). Although many potential primary territories were unoccupied because they were overgrown, they had potential to contribute most to recovery once restored because territory quality generally increases as oak cover increases providing other habitat conditions are not suboptimal (Breininger et al. 1995, Burgman et al. 2001). Applications that identify suitable and potential habitat should not only include xeric oak scrub but they should include all adjacent palmetto-dominated habitats that include scrub oaks (Breininger et al. 1995, 1998; Duncan et al. 1995). The ability to consider habitat additional to xeric oak scrub can enhance conservation, because there are restricted opportunities for establishing Florida Scrub-Jay population reserves due to rapid urbanization. Because Florida Scrub-Jays have poor long distance dispersal abilities and are potentially subject to edge effects, it is important to maximize the size of a few dozen reserves than to maximize the amount of xeric oak scrub among hundreds or thousands of habitat fragments. Such approaches rely on habitat-specific demography and dispersal data as provided herein. Land managers also agree with this approach because of the difficulty in burning small urban habitat patches.

It is not necessary to explicitly map scrub oak ridges to apply these results. One can grid landscapes into potential territories and categorize the habitat potential to determine the potential arrangements of sources and sinks. Habitat potential and height can be characterized as attributes of territories. Mean demographic rates can approximate the proportion of sink territories that can be supported by source territories, although approximations are best done using population models that consider additional complexities, such as stage-specific vital rates, stochasticity, and catastrophes (Burgman et al. 1993). If population models are not applied to account for stochasticity and epidemics, demographic gains from sources must greatly exceed demographic losses from sinks. More work is needed to identify these corrections.

Most scrub in east central Florida has been destroyed or is highly fragmented (Duncan et al. unpublished). Many Florida Scrub-Jays occur in suburban territories that will probably always be population sinks because of road mortality and poor habitat quality. If edge effects occur, individual PRUs must have enough core territories to offset declines in territories along roads and possibly suburbs. There is great uncertainty about the demographics associated with edge territories. If these edge effects are widespread, conservation reserves are being established in many of the wrong areas because they lack enough core territories to sustain losses along the edges. However, focusing only on the largest reserves results in a considerable contraction of the range and decreases in connectivity among reserves. Until the science improves, it is critical to design reserves that have low edge/area relationships. This can be achieved by purchasing mesic flatwoods and wetlands adjacent to potential territories and burning them frequently because forests also negatively impact habitat suitability (Breininger et al. 1995, Burgman et al. 2001). These matrix habitats can quickly become forests without frequent fire in east-central Florida (Duncan et al. 1999).

The Florida Scrub-Jay population is declining almost everywhere because of habitat destruction and because habitat does not burn enough. Considerable potential remains to maintain populations with low extinction risk but this depends on additional land acquisition and achieving optimal habitat conditions (Root 1998, Stith 1999). There has not been enough work to identify the level of further habitat reduction where populations can no longer be recovered but that point could soon be reached in Central Brevard many metapopulations throughout the range (Stith 1999). Restoration and habitat management must address habitat suitability at the territory scale (Breininger and Carter 2003). Most conservation reserves still had too much tall scrub even though they were recently burned. Territories that included tall scrub are either population sinks or have recruitment that barely matches mortality. Fires will rarely produce a landscape with only optimal territories but restoring landscapes to reverse population declines requires creating and maintaining enough optimal territories to meet population-based objectives. Because most populations are far below carrying capacity, recovery requires increases in population size. Most territories must be optimal for population growth to occur. Although managers sometimes leave buffers along edges, we recommend that the management for optimal territories begin at reserve edges because of the relatively low number of core territories in most large reserves and because edge territories will certainly be sinks if habitat is suboptimal.

Because tall patches are difficult to eliminate by mosaic fires without first cutting them, cutting must be applied to specific patches of tall scrub throughout the landscape or extensive fires must be used to burn all scrub. Florida Scrub-Jay population declines can occur after extensive fires but these can be followed by population growth (Breininger and Oddy 2001). Extensive fires occurring once every 20 years might be useful because they burn nearly all areas, including those resistant to fire (Breininger et al. 2002). These extensive fires will be most useful where tall mix territories have mortality that exceeds recruitment, where populations are below carrying capacity, or where managers lack the resources to perform patch-specific burns. Optimal habitat management will need to be more specific if West Nile Virus outbreaks are frequent.

Short dispersal propensities and infrequent exchanges among reserves must be considered. Population sizes and exchanges in potential reserves north of Wabasso are sufficient so that translocation is unnecessary. Reserves associated with the Buck Lake territory cluster might need translocation. Although many suburban jays are probably eventually doomed to extirpation, they will remain a potential source of birds as reserves become established and restored. Restoration should be prioritized in areas where jays already occur or adjacent to areas that have jays because the recolonization of restored habitat not adjacent to a source of new potential breeders is slow. It is very important to achieve optimal habitat conditions rapidly in small populations given the high rates of population decline and slow recolonization rates.