Florida Scrub-Jay Reintroduction Feasibility and Habitat Assessment

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Delivered to

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INTRODUCTION

Guana River Wildlife Management Area (GRWMA) is a 3,972 ha preserve in St. Johns County, Florida. Since 1984, it has been managed by various administrative entities of the State of Florida. Habitats within the GRWMA are diverse, but uplands comprise only about 35.4% of the total area. Uplands include pine flatwoods, coastal maritime hammock and sand pine or xeric oak scrub. The latter comprises only about 270 ha, about 19.2% of the total area of GRWMA. Currently, these habitats are managed by the Florida Fish and Wildlife Conservation Commission. In addition, approximately 192 ha of coastal strand and scrub habitats occur in a linear strip paralleling the beach; these habitats currently are managed by the Florida Department of Environmental Protection. Scrub has been a high management priority at GRWMA. The Executive Summary of the GRWMA Conceptual Management Plan cited a need for proper "management of scrub wildlife and plants species; especially scrub jays." Although the emphasis here is on management of the faunal components of this system, it is through creation of the desired vegetative structure and species composition that these goals are achieved.

To meet the needs of Florida Scrub-Jays (*Aphelocoma coerulescens*), probably the best known species endemic to peninsular oak scrubs, very specific scrub structural characteristics must be attained. Historically, most xeric oak scrubs in peninsular Florida were low and open, with oak shrub heights rarely exceeding 2 m (Peroni and Abrahamson 1986) . This structure was maintained through frequent lightning-ignited fires. In the absence of fires, low and open oak scrubs succeed into more structurally complex habitats, such as xeric oak hammocks or sand-pine scrubs that are not suitable for Florida Scrub-Jays. For over 30-years, from the 1960s through the 1990s, fire was suppressed in the scrubs at GRWMA. Although St. John's County and GRWMA is near the historical northern extent of the range of the Florida Scrub-Jays, they did once occur there, but had been extirpated by the late 1980s. Over that same time period, the total number of scrub-jays was declining throughout their range. Best estimates are that over the last 100 years, populations have declined by more than 90% from historic levels (Woolfenden and

Fitzpatrick 1984). Accompanying the decline has been loss of peripheral populations and a general shrinkage in the species range. The scrub-jay is known to have been extirpated from at least seven counties, most of them at the northern periphery of their range (including St. John's County). Whereas the scrub-jay population at GRWMA was once part of a network of other jay populations, all of them within frequent dispersal distance of one another, the nearest extant jays to GRWMA now occur over 50 km distant, at Camp Blanding, and this population is nearly extirpated. It may be possible, indeed likely, that the historic structure and composition of scrub be restored at GRWMA; however, establishment of a viable scrub-jay population at GRWMA cannot be guaranteed just through successful habitat restoration. To establish scrub-jays at GRWMA, intensive species-specific management in the form of translocation of birds from elsewhere in their range would have to occur. Even this could not guarantee a viable population because only two experimental translocations of Florida Scrub-Jays have previously occurred and neither resulted in the establishment of a viable population. Nevertheless, the presence of scrub-jays at GRWMA should not be viewed as the only criterion for successful scrub restoration. The Florida Scrub-Jay is an indicator species; having evolved in this system and being well-adapted to the ecological processes and disturbance regimes that maintain healthy scrubs, management that would result in conditions suitable for scrub-jays, tends to produce conditions that are suitable for an entire suite of plant and animal species characteristic or endemic to scrub. To this end, herein I describe current conditions in scrub habitats at GRWMA, especially as they relate to the various management regimes employed and to whether those habitats are trending towards the direction of a structure and composition that could sustain scrub-jay populations. I will evaluate the propriety of attempting to re-establish a population of Florida Scrub-Jays at GRWMA, with a complete justification of the conclusion. Regardless of that conclusion, I will also provide my best insights into the methodology that can be used to maximize the probability of translocation resulting in establishment of a viable population. Finally, I will provide some analysis of the scrub habitat management plan for GRWMA with recommendations on how implementation of that management might be improved.

CURRENT CONDITION OF SCRUB HABITATS AT GRWMA

A scrub ecosystem management plan was developed and implemented for GRWMA. Prior to implementation of this management, most of the scrub at GRWMA was severely overgrown, oak canopy heights often exceeded 4 m, and few fine fuels existed in the groundcover or shrub layer (Fig. 1). None of the scrub in that condition would have been suitable for Florida Scrub-Jays. This structure makes scrub exceedingly resistant to fire, thus the scrub management plan for GRWMA emphasized mechanical pre-treatment of standing biomass, followed by prescribed fire. This is an increasingly accepted management paradigm with increasing evidence supporting favorable ecological outcomes while also allowing safe and controllable burn conditions. Much of this management was begun in 1999. To assess variation in post-management vegetative responses, various combinations of mowing and roller chopping, followed by fire or no fire, were implemented in an incomplete randomized block study design. Treatments included mowing followed by fire, mowing with no fire, chopping followed by fire, and chopping with no fire.

Williges et al. (2006) reported that the mowing followed by fire appeared to be the most effective management regime. Invasion by weedy off-site species was minimized and the re-growth rate of the sand live oak was minimized, thus potentially maintaining the habitat in a condition optimal for Florida Scrub-jays that would occur under a different management regime. Management of the 200+ ha of scrub was to be implemented over a four-year time period, with approximately 25% of the scrub mechanically treated each year. Prescribed fires would be conducted within one-year following mechanical treatment and post-restoration, individual burn units, averaging approximately 10 ha each, would be burned in a rotation such that mean fire return intervals would vary between 8 and 15 years.

My comments about current scrub conditions at GRWMA are based on discussions with Justin Ellenberger and a site visit conducted 27-28 May 2008. I made no quantitative assessments of the scrub. Much of the scrub seemed to be in excellent condition. Probably close to 50% of the scrub had been

mechanically treated and burned with 1-2 years. Virtually all of this scrub was less than 1 m in overall height. Although fire is essential to the long-term persistent of scrub-jays, in does pose some potential short-term costs. Immediately post-fire, scrub is often unsuitable for Florida Scrub-Jays. Although the prey base and ability to forage in these habitats is excellent, the uniformly low shrubs do not provide adequate escape cover for roosting and nesting. Jays may incorporate such short areas into their territories, but only if they also have areas of taller shrubs, in the 1-2 m category or taller. Many of the scrub patches at GRWMA were uniformly short (Fig 1b).

Figure 1. Typical pre-restoration scrub habitat structure at GRWMA (left). After a series of management actions, including mowing followed by fire, much of the current scrub is low and open (right), with average shrubs heights 1-2 m, with adequate amounts of bare sand patches, and dominance by oak shrubs.

The goal of managing scrub for Florida Scrub-Jays should be to maintain the scrub in a structure that maximizes demographic performance for as long a time as possible. Scrub-jays may be extirpated from an area immediately after a fire, especially if the fire is complete and homogeneous, leaving relatively little above-ground biomass. As mentioned above, jays may immediately begin using these areas for foraging, but only if it is adjacent to optimal, unburned and occupied scrub. If isolated, these patches will tend to remain devoid of jays until suitable cover has regenerated. This can occur as rapidly as 1-2 years in coastal scrubs and 4-5 years in interior scrubs. Once adequate cover has grown back, jays will typically recolonize those sites and do relatively well for as long as the scrub remains relatively open. Once the habitat becomes overgrown, jays will begin to die out of a site (Fig. 2). This occurs not because jays abandon the site, but because demographic performance degrades and the birds eventually cannot replace themselves. Figure 1 provides a cartoon of the dynamic process between fire, habitat structure and jay occupancy.

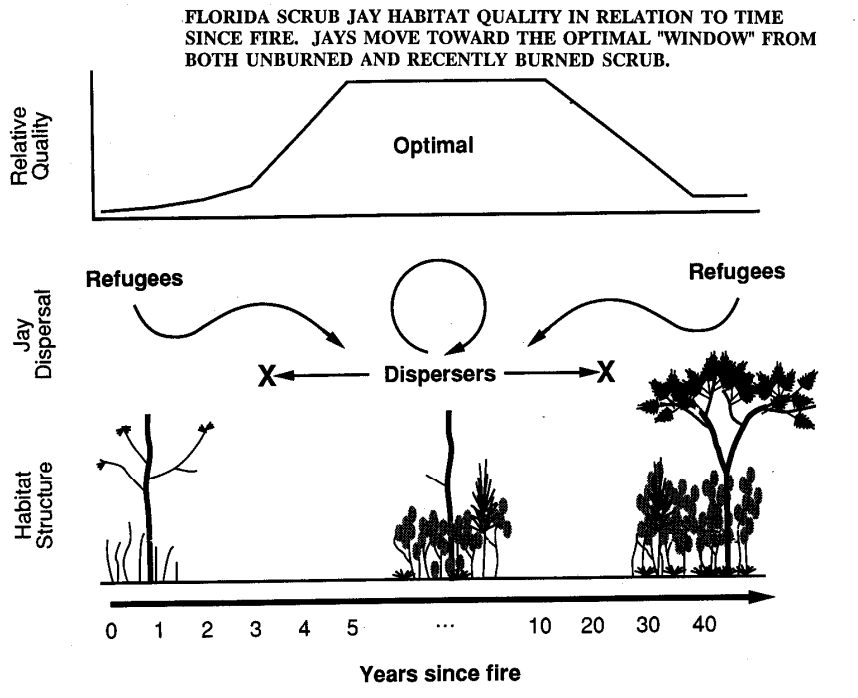

Figure 2. Schematic of the relationships between Florida Scrub-Jay occupancy, habitat structure and fire.

Burning scrub too frequently has the potential to truncate the period of optimal structure and good demographic performance, resulted in an increased proportion of time when jays are excluded from a habitat because it was recently burned, or because they have poor demographic performance because of the lack of appropriate escape and nesting cover. Breininger et al. (2006) have studied the relative demographic performance of scrub-jays in habitats of varying structure along the Atlantic Coast. Although jays are able to replace themselves only when the all of the occupied habitat is in optimal condition (1-2 m), the deviation from replacement is greater immediately after a fire than as the habitat begins to become overgrown (Fig. 3).

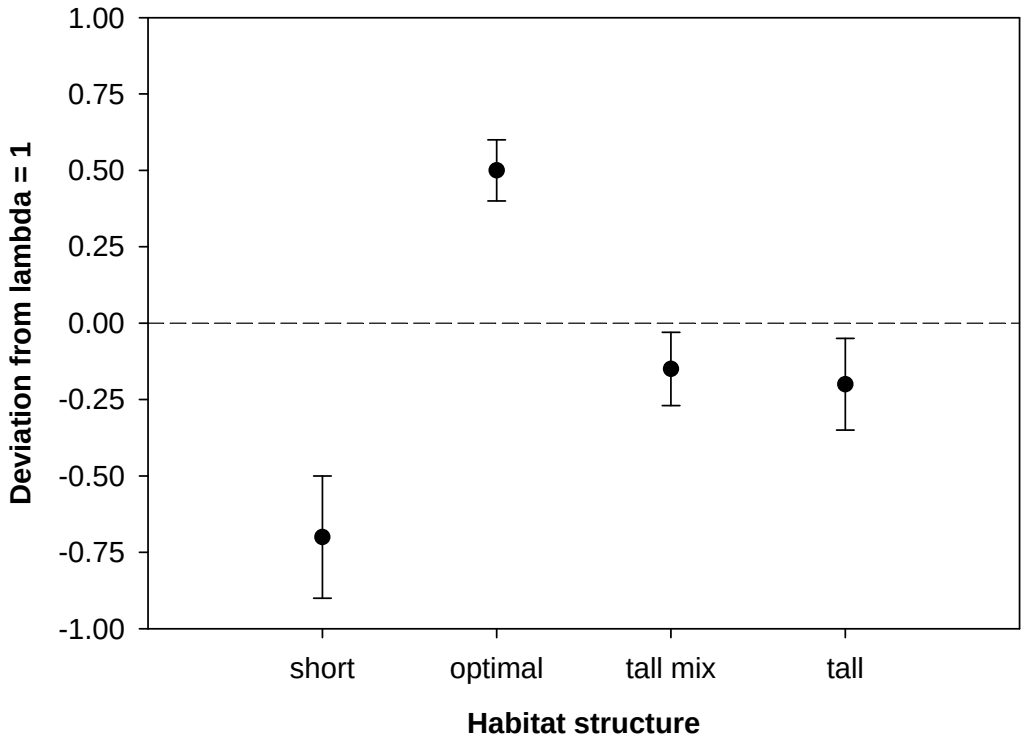

Figure 3. Deviation from lambda (lambda = 1 means adults are producing enough recruits to replace themselves) relative to habitat structure in Florida Scrub-Jay populations in Brevard County (From Breininger et al. 2006).

An example of this would be two different management scenarios in two habitats where the structural changes with time since fire were the same. In both, the habitat is optimal 4 years post-fire, but by 12 years post-fire is a tall mix and thus of declining quality for Florida Scrub-Jays. In one site, fire is applied every 10 years, thus the jay populations spend 4 years in short habitat with poor demographic performance and only six years in optimal habitat. At the second site, where fire is re-applied every 14 years, the jays spend 4 years in short habitat, 8 years in optimal, and another 2 years in habitat with a very minor reduction in their demographic performance. In this comparison, the jays will experience better demographic performance in the longer fire return interval. Thus, it is better to manage with fire return intervals that are slightly longer than with intervals that are too frequent.

However, a rigid adherence to a specific timing of fire is likely to lead to a loss in biodiversity. Fire return intervals should be based on the structural changes that occur post-fire and not on a specific number of years. This is likely to lead to a variety of post-fire return intervals within a site because scrub regenerates at different site-specific rates depending on the quality of soils, moisture gradients etc. Menges and Hawkes (1998) have shown that pyrodiversity often leads to increases in biodiversity because pyrodiversity favors the largest number of scrub-associated organisms which may respond differently to different fire return intervals.

I did observe a large number of off-site weedy species such as dog fennel and winged sumac in scrub habitats. Given the relatively high quality of the scrubs and their continued management with fire, I do not think the presence of these species is of great concern and I suspect that their prevalence will decline with time, as observed by Williges et al. (2005). However, I also observed that in some patches, old tall oaks were retained. This is specifically mentioned in the management plan as a means to increase diversity. However, this will not likely lead to additional diversity within scrub habitats. Maximum diversity for the entire site is achieved by maintaining a mosaic of different habitats, but not by maintaining structural diversity within scrub.

Guana River Wildlife Management Area has enough scrub habitat to support approximately 31-32 breeding groups of Florida Scrub-Jays. In a landscape with other jay populations, in which immigration and emigration was not deterred and occurring on optimal, fire-maintained habitat, such a population would likely have a relatively low risk of extinction. However, extinction risk increases with isolation, even on optimal habitats. As the probability of immigration decreases, the risk of stochastic extinction increases. Even a large population might suffer through a series of relatively poor years or might suffer some type of environmental catastrophe, such as an extremely intense wildfire, a hurricane, etc. Under these conditions, the population might be reduced enough in size that it has difficulty attaining its former size simply through intrinsic population growth. The risks might be only marginally higher, but over evolutionary time the probability of extinction is sharply increased. Fitzpatrick et al. (1991) modeled the extinction risk of scrub-jay populations and found that isolated populations of between 20-40 breeding groups were only adequately protected and had a >50% probability of extinction over as little as 200 years. Thus, the maximum population size possible at GRWMA could not guarantee long-term population viability. It is possible that some of the coastal strand scrubs could support scrub-jays and that might increase the maximum potential population size by another 10-12 pairs. However, this is the maximum population size and discounts the effects of habitat edges and of on-going management on jay population size. Scrub patches at GRWMA range in size from 112.5 ha to as little as 2.4 ha. Typically, it takes 9 ha of scrub to support a family of Florida Scrub-Jays. The ability of these patches to support jays is context-dependent. If these patches occur within a forested landscape, jays will avoid the forested edge. This avoided area may be large enough to deter jays from using the entire patch. Similarly, as much as 20-25% of the scrub within any reserve that is being maintaining with a natural fire regime is likely to have burned within the last 1-2 years. This habitat is likely to be too short to support jays. Historically, jay populations probably were best represented as a shifting mosaic. As some habitat burned, other habitat was just becoming suitable and as one jay population declined, a new one might be colonized that could

support jays into the future. Within the finite boundaries of a reserve, some habitat will always have to have been recently burned, thus the maximum carrying capacity of the habitat will be reduced. Given these constraints, it is likely that the maximum population of scrub-jays at GRWMA would not exceed 30 groups, even under the most favorable conditions.

Guana River WMA is extremely isolated from other scrub-jay populations. At present, no large population occurs within 60 km of this site. The nearest large populations of scrub-jays that are within the same metapopulation or genetic unit are the jay populations that occur at Merritt Island national Wildlife Refuge. In fact, current maps of the known distribution of scrub-jays have not extended as far north to include Guana River WMA (Fig. 4).

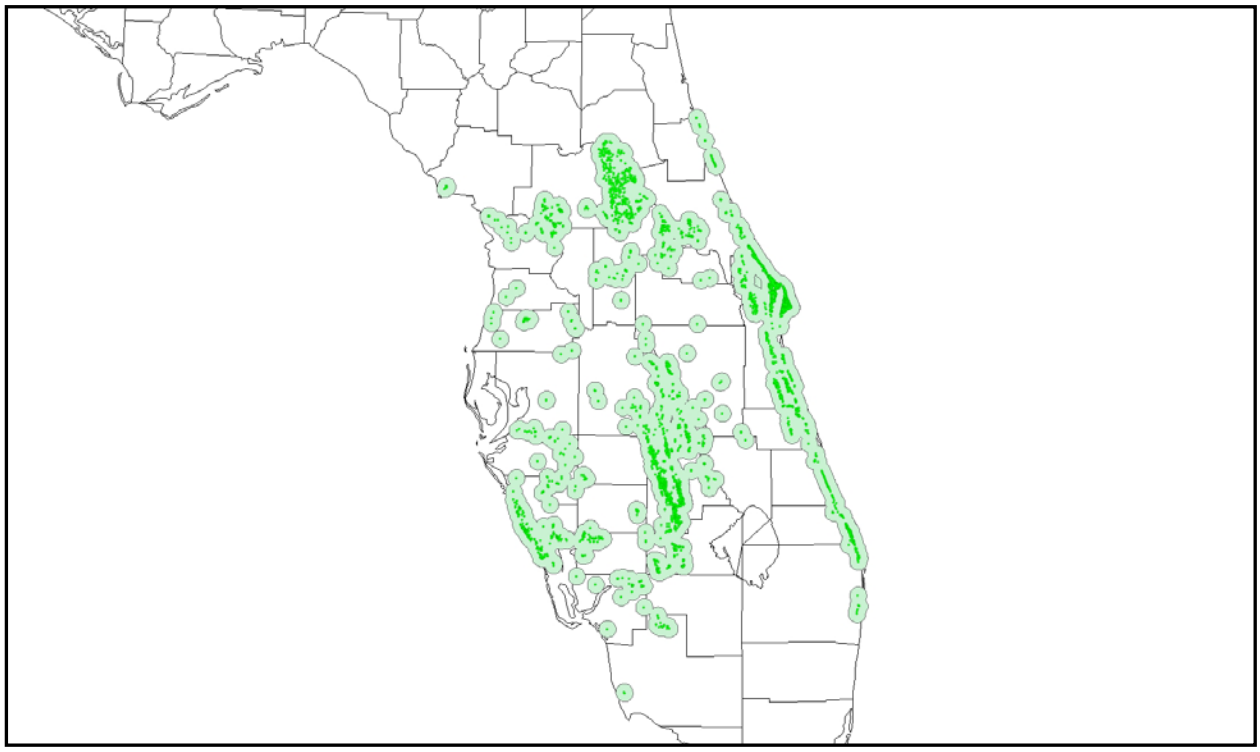

Figure 4. Distribution of Florida Scrub-Jays throughout their extant range in Florida determined from a state-wide survey conducted between 1992-1993. Green dots denote actually groups detected during the surveys and the light-green polygons surrounding them delineate metapopulation boundaries as defined by a 12 km buffer.

In recent years, blood samples were collected from all the major scrub-jay metapopulations in Florida to examine genetic structuring across the range of the entire species. Coulon et al. (2008) reported that 11 distinct genetic units of Florida Scrub-Jays exist. Based on the genetic analyses, the 21 extant and potentially viable metapopulations of the Florida Scrub-Jay are represented by 11 different genetic units (Fig 5.). The inter-population F*st* values range from 0.02, suggesting close genetic similarity, to as much as 0.176, suggesting large genetic divergence. Indeed, this later figure is greater than F*st* values between some closely related species, such as the Island Scrub-Jay (*Aphelocoma insularis*) and the Western Scrub-Jay (*Aphelocoma californicus*). These data suggest that Florida Scrub-Jays may be diverging into distinct populations, hopefully adapted to the local conditions. However, the existing levels of genetic diversity within the 11 genetic units is low, suggesting that many Florida Scrub-Jay populations are at risk of both demographic and genetic inviablity.

Neither Guana River WMA nor any jay within 60 km of GRWMA was sampled as part of these genetic analyses. We might assume that historically the scrub-jays that occurred at GRWMA were part of the northern-most genetic unit of extant scrub-jays, that occurs from Merritt Island, north through Flagler County. We can assume that the linear, north-south distribution of coastal strand and scrub linked historic jay populations; however, other landscape features have created vicariant distributions of jays along the Atlantic Coast. It is possible that jays that once occurred at GRWMA were part of another genetic unit that has since been extirpated. Although translocation of Florida Scrub-Jays has occurred between populations at great distances and of different genetic units, the consequences of moving birds into areas where local birds may be adapted to local conditions is unknown. Until the conservation need outweighs the uncertainty, the USFWS Florida Scrub-Jay Recovery Team has recommended that translocations occur within genetic units. This does not preclude such translocations, but for now they are discouraged.

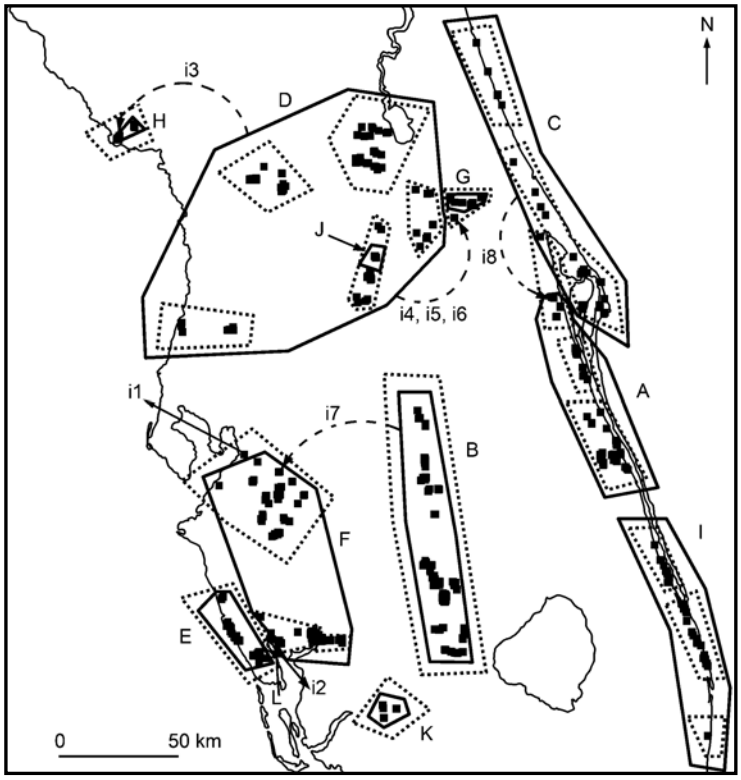

Figure 5. Results of the genetic clustering analysis Geneland obtained with Consana, and the metapopulations of Stith *et al*. (1996). Solid lines surround the individuals assigned to the same genetic group. Letters are identifiers of the genetic groups. Dashed lines surround the individuals belonging to the same metapopulation as defined by Stith *et al*. (1996). i1 and i2 are the only two individuals assigned as singletons to their own genetic groups. i3 to i8 are potential migrants; the arrows point toward the location in which they were sampled and originate in the genetic group to which they were assigned. The migrants are here defined based on the metapopulation design. (From Coulon et al. 2007).

One conclusion of the vast majority of translocation studies, including those on the Florida Scrub-Jay is the need to move a large number of candidates over a relatively long period of time, preferably with little or no impact on the donor population. Even though the genetic association of GRWMA is unknown, it is likely to include Merritt Island, Kennedy Space Center, and Cape Canaveral Air Station, all of which have relatively large populations of scrub-jays that occur on federal lands that are currently under long-term conservation management, thus a source of candidates exist. However, it is not currently known if the demographic rates of these populations are adequate to sustain a harvest for translocation purposes. However, Brevard County has been successful in establishing a network of protected lands under their

Endangered Lands Program. Many of these sites occur within the core of the Atlantic Coastal metapopulations; but because of long-histories of fire suppression, currently have few to no jays. Thus if translocation candidates were available within Brevard County, much more feasible sites exist within Brevard County.

In sum, translocation into GRWMA is feasible, but from a range-wide perspective should be considered a relatively low priority. It will be difficult, even given the most optimistic outcomes of translocation, that a population can be established at GRWMA that can become extinction resistant. Given the potential costs, both to the source population and the opportunity cost of not being able to translocate those birds to anther population that might have a better probability of achieving long-term stability, the risk greatly appears to outweigh the benefits of translocation to GRWMA. At some point in the future, should the Brevard County population expand into neighboring counties northward (Volusia, Flagler, etc) and a potential population at GRWMA become better connected to other jay populations, such translocation efforts would increase in priority.

REINTRODUCTION RECOMMENDATIONS, SCHEDULE, AND MANAGEMENT PLAN

These recommendations are based wholly on a previous translocation experiment conducted by Mumme and Below (1999) and one that is currently being conducted as part of a Habitat Conservation Plan for an Incidental Take Permit issued to Mosaic Phosphate Inc, and being conducted cooperatively between Mosaic, Quest Ecology, and myself. These recommendations refer only to specific methodologies and should be tempered by the previous recommendation that translocation of Florida Scrub-Jays into GRWMA is not recommended at the present time.

A successful translocation depends on a variety of factors. First and foremost is that enough suitable but unoccupied habitat exists for translocated birds to establish breeding territories without undue

interference from resident birds. A second consideration is that a source population exist that can withstand the harvest of translocated birds without any risk to its own viability and that it can provide those resources for many years. It is typical for translocation to have to continue for 6 or more seasons (and that depends on the number of individuals translocated per year) before a self-sustaining and growing population is established (typically >10 groups). Assuming that these essential prerequisites are met, we recommend the following:

Individuals to be translocated

Mumme and Below (1999) recommended moving 2-year old non-breeders based on the relatively high rate of residency of these birds relative to 1-year old nonbreeders. However, jays have relatively strict dominance hierarchies and it is likely that 2-year-old birds are dominant to 1-year-old birds. In the previous translocation, birds were moved to a very small release site and we suspect the dominant birds caused the subordinate birds to disperse. Because 1-year-old birds tend to be the most numerically abundant year class within a population, they are ideal candidates for translocation because they allow the greatest number of birds to be moved with the least potential impact to the population. If they are translocated without dominant older-birds, we hypothesized that their settlement rates would equal exceed that of two-year olds. In our work for Mosaic Phosphates, we have found this to be true (Concoby 2005). Based on this we make the following specific recommendations on the candidates for translocation:

1) Birds of the previous breeding season constitute potential candidates for translocation

2) Birds should come from within the same genetic unit as the translocation site

3) As many individuals should be moved per year as the source population can withstand, as the recipient population can sustain, and as time and economic constraints allow.

4) Birds should be moved in approximately equal sex ratios of males and females.

5) Efforts should be made at the source population to minimize the relatedness of translocation candidates. Ideally no more than two birds should come from a single breeding group and, if those birds are of opposite sex, they should be housed in different hacking cages on the release site. We also recommend that the sexes of translocation candidates be known. In most populations, this is not true for the young of the year because the behavioral cues that often distinguish males from females, such as the hiccup call or incubation behavior have not yet been manifested or observed. When trapped, we recommend that a blood sample be obtained so that the sex of translocation individuals is known.

6) All translocated birds should be uniquely color banded with at minimum, one USFWS aluminum band and 2 plastic color leg bands.

Timing of translocations

Mumme and Below (1999) recommended that translocations be conducted in the spring, immediately preceding the breeding season. They reasoned that birds would quickly settle down, form territories and begin breeding. They also reasoned the birds moved earlier in the winter would not have access to cached acorns and thus be vulnerable to episodic food shortages during the winter. During our translocations, we observed that this seems a reasonable strategy if the translocation is occurring where no there are no resident birds. However, if resident birds are near the hacking cages, even if those cages are placed where they are outside of the defended territory boundaries of resident birds, those residents will be attracted to the hacking cages and they will chase the translocated birds after release. This prevents the translocated birds from establishing their own territories, reduces the chance of breeding during the release year, and increases the chance of post-breeding season dispersal from the release site. Based on the above, we recommend the following:

1) Translocations occur late in the fall, ideally in mid to late November. This is a time of least territoriality in jays, giving the newly translocated birds time to explore their release site and form site attachments prior to the seasonal increase in territoriality that proceeds the breeding season.

2) Supplemental food should be provided to all translocated birds. This should be in the form of raw, red-skinned peanuts and/or waxworms. These should be placed on a platform feeder near the hacking cages and should be supplemented at least 2-3 times weekly. This will provide translocated birds with a reliable food source in lieu of local knowledge of cached acorns.

3) Translocated birds should be housed in hack cages for 5-6 days prior to release. Release should occur in the morning. Bird soften have to be tempted out of the hack cages with waxworms. Hack cage dimensions should follow that described in Mumme and Below (1999).

Post-release monitoring and long-term management

Translocation is still an experimental tool and anyone conducting such work should carefully document methods and results. We recommend the following:

1) Translocated birds should be surveyed at least once weekly. Sometimes it is better to minimize observations immediately after release and our observations suggest that most translocated birds remain on the release site for at least 12-weeks post-release. Complete surveys should be conducted weekly for the first month and then more frequently after the up through 12-weeks. After 12-weeks, monthly censuses of the entire population should be conducted.

2) When individuals are missing from the release site, surveys should be conducted in any potential scrub site within a 20 km radius of the release site (although we have seen birds travel even farther).

3) Each year during April, the breeding territories of any resident birds on the release site should be mapped. This is essential so that the following years release site can be selected so that translocated individuals have access to high quality, undefended scrub.

4) A complete census of the population should be conducted each July and basic metrics of the population recorded. These include mean group size, the AHY/HY ratio as an estimate of annual productivity, and the identities of any banded birds.

5) Translocations should continue until a local population of at least 10 breeding groups within frequent dispersal distance of each other (< 2 km) is established. Translocations can be discontinued in that happy event, but might need to be reinitiated if the population declines, if a serious sex ratio imbalance should occur, or some other unforeseen event that might require the introduction of new individuals to the population.

MANAGEMENT PLAN ANALYSIS

Much of the analysis of the management plan has been stated above. Here I summarize the main salient points:

1) The mow and burn treatments seem to be producing the best combination of habitat structure and composition and changes in structure over time. I suggest that this treatment regime continue. However, mechanical treatment might not be necessary over the long-term. As restoration of scrub proceeds and the historical structural and compositional elements are restored, fire alone might be an effective management tool. Since GRWMA occurs at the urban interface, mechanical treatment might still be necessary to ensure that fires can be frequently and successfully conducted with risk to surrounding human infrastructure.

2) I recommend that the fire return interval be lengthened from what I observed. Scrubs should be considered for management when a tall mix of shrub occurs, with most of the shrubs being in the

2-3 m height category. It is better to err on the side of burning too infrequently than too frequently.

3) Seasonality appears to be important, but restricting burning to a specific season usually has a negative and stronger effect on fire return intervals. I suggest that seasonality not be ignored, but that frequency take precedence over seasonality.

4) Trees, especially tall oaks, should not be retained in scrubs. They are not likely to be effective in increasing scrub biodiversity and might be effective at decreasing it. Pine overstory might be natural, but should not exceed 10-15 total canopy cover.

5) Finally, although managing scrub for scrub jays is an excellent management paradigm, the criteria used to evaluate the success of that management should not unduly weight whether or not the site is actually occupied by scrub-jays. As is the case with GRWMA, even if the scrub is managed perfectly, scrub-jays are not likely to colonize the site because it is now so isolated from any existing scrub-jay populations. Regardless, the conditions that are suitable for jays are likely suitable for a large suite of species that are adapted to the frequent fires characteristic of Florida scrub habitats.

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