Scrubby Flatwoods/Coastal Scrub Workshop Summary

7/16/2012

INTRODUCTION

On November 2nd, 2011, 27 natural resource managers and biologists convened at Merritt Island National Wildlife Refuge for a workshop to address two challenges to managing scrubby flatwoods and coastal scrub for Florida scrub-jays (*Aphelocoma coerulescens*):

1. How can managers restore the historical amount of sandy openings in scrubby flatwoods and coastal scrub?
2. In the absence of sandy openings, how can managers avoid complete, extensive burns that can harm scrub-jay populations?

This document presents a summary of discussions from the workshop. *The document is not meant to be a "cookbook" or prescription for addressing management challenges, nor should it be viewed as an endorsement of any given method.* One of the key results of the workshop is that we still have much to learn about effective methods for restoring openings and avoiding complete, extensive burns. Additionally, variation in environmental conditions and management constraints both among and within properties necessitates the availability of a wide range of management options. The objective of this document is to outline some of the available options, to stimulate additional ideas, and to provide a starting point for future discussion. This document is meant to be revised through time as we learn more about different methods. Superscript numbers following text refer to revisions and additions in Appendix C.

BACKGROUND

Populations of the Florida scrub-jay, the only bird species endemic to Florida, have declined by as much as 90% since European settlement (Woolfenden and Fitzpatrick 1996a). Loss of habitat to development and agriculture and habitat degradation due to fire exclusion are the primary reasons for the decline of scrub-jay populations (Woolfenden and Fitzpatrick 1996a), and the species is listed as Threatened by both the federal and state government.

Scrub-jays are non-migratory, extremely territorial, and restricted primarily to scrub and scrubby flatwoods natural communities (Woolfenden and Fitzpatrick 1996b). Historically, periodic fires maintained suitable habitat conditions for scrub-jays. Within each territory, scrub-jays require low, shrubby oaks that provide nest sites, cover from predators, and acorns; few trees; and bare patches of sand or sparse herbaceous vegetation. Optimal habitat conditions include patches of oak shrubs 4-5.5 feet (1.2-1.7 meters) tall, < 1 canopy tree per acre, and 10-50% bare sand (Breininger 2004).

In scrubby flatwoods and coastal scrubs, sandy openings disappear in the absence of fire as clonal oaks fill in the gaps (Schmalzer and Adrian 2001). Once sandy openings disappear, they can be difficult to restore, even when the vegetation height is restored to optimal (Duncan et al. 1999). For example, openings disappear within 1-2 years following a fire in some areas on Merritt Island (Figure 1).

Recent analyses suggest that demographic success is lower for scrub-jays in otherwise optimal territories with few sandy openings compared to scrub-jays in territories with sandy openings (D. R. Breininger, personal communication). The reasons why sandy openings are important to scrub-jays are not entirely understood. Openings provide places for scrub-jays to cache acorns, and scrub-jays often

build nests in shrubs adjacent to openings. There appears to be a relationship between a lack of sandy openings and reduced nest survival on the Atlantic Coast (Carter et al. 2011).

Sandy openings also facilitate mosaic fires that leave patches of unburned habitat. In the absence of sandy openings, extensive, complete burns can harm scrub-jay populations. Scrub-jay demographic success is poor when shrub height throughout the entire territory is below 4 feet (1.2 meters), and extensive, all-black burns can displace scrub-jay families and result in population declines (Breininger and Carter 2003, Breininger et al. 2009).

Thus, it is desirable to find methods to restore sandy openings and to find ways to avoid extensive, complete burns in occupied scrub-jay habitat. The sections below summarize discussions at the Scrubby Flatwoods/Coastal Scrub workshop, where participants considered different methods for addressing these challenges.

RESTORING SANDY OPENINGS

Workshop participants did not reach consensus on the scale (e.g., large vs. small patches) and type (e.g., patchy vs. linear) of sandy openings necessary to benefit scrub-jays. In scrubby flatwoods that have retained openings due to periodic fires, sandy openings are interspersed throughout the habitat (Figure 2). In other words, openings exist as many small sandy patches rather than few large, widely separated patches. It is possible that linear openings could provide "highways" for predators, and one participant noted that scrub-jay demographic performance appears to be less in areas with long, linear openings at Avon Park Air Force Range. However, the optimal scale and type of openings for scrub-jays is difficult to determine and has not been studied explicitly. Prior to creating openings, managers should consider how the scale and type of created openings could affect fuel continuity and the ability to conduct prescribed fires.

Methods to restore sandy openings

Participants recognized three broad categories of methods for restoring openings: fire, mechanical, and herbicide treatments.

Fire -- Several participants suggested that frequent, growing season fires in the early stages of restoration could be effective[2]. Participants noted that 60-80% of the biomass in scrubby flatwoods and coastal scrub resides below ground. Frequent, hot fires could stress oaks and restore openings by reducing underground reserves of encroaching oaks. Although openings created by growing season fires persist longer than openings from dormant season fires, the greater persistence time is only for months rather than years. This underscores the importance of fire frequency when using this technique to restore openings. Repeated fires also reduce the organic matter that builds up in the soil after long periods of fire exclusion. Burning the scrubby flatwoods as soon as it will accept fire again can be effective at stressing the oaks.

Participants emphasized that frequent, growing season fires are best used in restoration of unoccupied habitat, where frequent fires will not displace scrub-jays. Participants cautioned that forcing frequent, growing season fires in scrubby flatwoods and coastal scrub may require extreme weather conditions, which could make control more difficult. Participants reported mixed success at restoring openings using this technique.

Stumps, logs, and branches can create "hot spots" during fires, resulting in sandy patches. For example, one participant discussed how sand pine slash from a hurricane resulted in sandy patches

when a unit was burned. Another manager noted that the slash left over in ramp areas from a timber operation resulted in sandy openings after a fire.

Several participants noted that piling and burning fuels can kill roots of oaks if the pile burns hot enough. However, they cautioned that piles need to be constructed appropriately to achieve the desired result, the piled vegetation must be dry enough, and the piled material must not be left unburned long enough that the decomposing wood becomes less flammable[1]. One participant suggested experimenting with hot-burning piles of fine fuels such as cabbage palm fronds, pine straw, hay bales, or cedar boughs.

Piling and burning is labor intensive. Thus, it may not be feasible to create the desired spatial pattern of openings at larger scales. Care should be taken to avoid soil disturbance when piling debris.

Mechanical -- Mechanical treatments can help restore openings. Participants emphasized the need to follow mechanical treatments with fire whenever possible.

Root raking is effective at creating long-lasting sandy openings. However, root raking can be expensive in some circumstances, causes soil disturbance and potential for invasion by exotic plants, and has the potential to harm fossorial species. One participant emphasized that root raking over large scales can have undesirable consequences. Multiple participants succeeded in creating persistent sandy openings by raking small patches, and some suggested that root raking may be more appropriate for creating small rather than large-scale openings. At Cape Canaveral Air Force Station, avoiding raking all the way to the edge of a road shoulder helped minimize invasion of exotic plants into the interior of units. When using contractors for root raking, managers must take care to ensure that contractors understand the desired outcome.

Participants reported mixed success with other mechanical treatments. Mowing and mulching treatments did not achieve persistent sandy openings. One person noted that roller chopping did not facilitate sandy openings, and another manager indicated that the success of roller chopping depended on follow-up spraying of encroaching woody vegetation. A participant noted that roller chopping can encourage bare ground by reducing the density of saw palmetto. However, others suggested reducing the height of palmetto but not necessarily palmetto density, because palmettos supply important fuels to carry fires in scrubby flatwoods and coastal scrub. One participant suggested that a “sloppy chop” (i.e., leaving patches unchopped in a unit) can result in variation in fire intensity, with higher intensity in the unchopped patches helping to create sandy openings.

Herbicides -- Participants reported variability in the success of herbicide treatments. Options for herbicides discussed at the workshop included imazapyr (e.g., Arsenal), hexazinone (e.g., Velpar), and triclopyr (e.g., Garlon 4). Participants had used herbicides to control oaks in sandhill natural communities more often than in scrubby flatwoods and coastal scrub. Participants had mixed success with liquid hexazinone depending on soil moisture following spraying. One manager reported creating oak-free openings by accident when treating Natal grass (*Melinis repens*) with imazapyr. However, another participant found that openings created with imazapyr did not persist. Land managers reported some success at killing oaks using triclopyr. Cutting oaks and treating the stumps can be effective at creating openings but may not be feasible over large acreages. A potential advantage of herbicide treatments is the ability to be selective about the size and

interspersion of openings. Multiple herbicide treatments may be necessary to create persistent openings. Following herbicide treatments with fire may assist in creating sandy openings.

Participants cautioned that herbicides have the potential to adversely affect non-target plant species. For example, managers observed that liquid hexazinone can affect vegetation downslope of the area of application. One participant noted that pellet forms of herbicides could be mistaken for peanuts and ingested by scrub-jays, though another land manager pointed out that the pellets can be buried. Herbicide treatments can be labor intensive, determining the appropriate dosage can be difficult, and efficacy of the treatments can depend on achieving the right environmental conditions.

AVOIDING COMPLETE EXTENSIVE BURNS

What is a mosaic for scrub-jays?

As noted above, extensive, complete burns can displace scrub-jay families and result in population declines. Scrub-jays need a mosaic of burned and unburned patches to persist following a fire. Workshop participants noted that the mosaic needs to occur at the scale of a scrub-jay territory. Scrub-jays are extremely sedentary and defend year-round territories. The average size of a scrub-jay territory is 25 acres (10 ha) in landscapes that are saturated with scrub-jay families such as Archbold Biological Station and parts of Merritt Island National Wildlife Refuge. Scrub-jays often occupy larger territories in areas well below carrying capacity. Within each territory, scrub-jays need unburned patches of oak shrubs tall enough (e.g., 4-6 feet) to provide nest sites, cover from predators, and acorns. On Merritt Island, it is thought that scrub-jays will persist in a territory provided at least a few acres of unburned habitat remain. At Archbold Biological Station, scrub-jays can persist even if 80% of the territory is burned.

Participants emphasized that achieving a mosaic is only necessary in occupied habitat. From a scrub-jay perspective, it is not necessary to achieve a mosaic in unoccupied areas[3]. In fact, it may be desirable in some circumstances to foster intense, complete burns in restoration of unoccupied units.

Mosaic among management units

Participants identified two options for achieving a mosaic at the scale of a scrub-jay territory: creating a mosaic *among* management units and creating a mosaic *within* management units. Managers can achieve the former on properties with relatively small management units. In this case, managers can burn a unit completely as long as adjacent units provide suitable habitat. Managers then refrain from burning a unit until adjacent units are tall enough to provide suitable habitat. The downside of this approach is that having smaller management units requires more fire line maintenance, a greater number of burns, and hence higher costs. This approach also places constraints on the ability of managers to burn into the black because adjacent units must have suitable habitat.

Mosaic within management units

If a property has relatively large burn units, it is desirable to maintain a mosaic within management units. *Participants emphasized some important caveats for this approach*. Unburned patches have the potential to ignite in days following a burn if conditions change. Therefore, it is important to avoid having unburned patches close to the fire line. Participants suggested establishing a good black line around the unit and attempting to create a mosaic in the interior of the unit. For example, one participant suggested mechanically treating the perimeter of the unit to create a “dozer donut,” with

the mosaic established in the center of the donut. If adjacent burn units contain natural communities with a more frequent fire return interval (e.g., flatwoods, sandhill), it may be desirable to burn the adjacent units before burning the scrubby flatwoods/coastal scrub unit. Managers need to be aware of the weather in days following the burn in case unburned patches reignite or in case conditions are conducive for fog.

Workshop participants discussed several broad categories of methods for achieving a mosaic within a unit. As mentioned above, restoring sandy openings can help facilitate mosaic burns. Other options discussed at the workshop included frequent burning in adjacent natural communities, adjusting firing techniques, considering fuel moisture, and using mechanical treatments followed by fire.

Frequent burning of adjacent communities -- If a management unit contains natural communities with a more frequent fire return interval (e.g., flatwoods, sandhill), burning from the adjacent natural community into the scrubby flatwoods or scrub can result in a mosaic burn. Participants noted that this method is more likely to be effective if the adjacent communities are burned frequently enough to encourage herbaceous cover and reduced palmetto height. One participant noted that that the increase in wiregrass cover from frequent burning in adjacent communities could result in less intense fires that are less likely to result in a complete burn when burning into the scrubby flatwoods. Another participant stated that this management strategy might be particularly effective in heterogeneous units with a patchy mix of different natural communities. However, participants cautioned that it is difficult to predict fire behavior, and hence it is difficult to predict whether the fire will result in a mosaic burn or a complete burn.

Firing techniques -- Using different firing techniques may facilitate a mosaic burn. For example, point source ignitions can help create a mosaic, and one participant suggested spacing point source ignitions 20-40 yards apart. Another suggested lighting spots along mowed strips in the interior of the unit. Other managers have achieved a mosaic burn using a hot flanking fire. One participant suggested constantly mixing up burning technique to achieve a heterogeneous landscape, including burning at different times of day (or night when possible), burning at different relative humidity (RH), varying the fire return interval, and alternating among head fires and backing fires.

Fuel moisture -- Several participants expressed that managers can facilitate a mosaic by carefully choosing fuel moisture conditions. Participants noted that burning under less than optimal conditions can achieve a mosaic. For example, suggestions included burning on a cloudy day, with low wind, late in the day, or with high RH (one participant mentioned RH > 50%). Other possibilities included burning a few days after significant rain; conducting humid, growing season burns; and choosing to burn under conditions that would be marginal for starting a backing fire. One participant suggested having skilled ignitors seek out “burnable jackpots.” For aerial burns, burning under mild conditions and carefully choosing spacing of point source ignitions could facilitate a mosaic burn. One manager proposed dropping buckets of water during an aerial burn to facilitate a mosaic. There are some downsides to burning under conditions with higher fuel moisture. For example, the process can be slower and more labor intensive and may require multiple attempts to burn a unit. Also, taller oak thickets that a manager wishes to burn may not ignite under milder conditions.

Mechanical treatments plus fire – Mechanically treating scrubby flatwoods and coastal scrub before burning can help achieve a mosaic. Participants emphasized avoiding uniform mechanical treatments and instead adopting “sloppy” treatments that facilitate heterogeneity by leaving

untreated patches in a unit. One participant had success achieving a mosaic by chopping vegetation greater than five feet in height and following the treatment with fire. Another achieved a mosaic by leaving four to six foot tall oaks unchopped in 20% of a unit. Mowing strips within a unit is another option. One land manager proposed using mechanical treatments to reduce palmetto height and increase herbaceous cover directly adjacent to the scrubby flatwoods. This could potentially encourage a mosaic when the fire runs from adjacent natural communities into the scrubby flatwoods. Participants seemed in agreement that mechanical treatment should be followed with fire whenever possible.

Difficulty in predicting fire behavior makes it difficult to know whether a mosaic will be achieved from "sloppy" treatments. To ensure a mosaic, some workshop attendees used soft lines to either protect patches of habitat or to burn only a portion of a unit.

More intensive options include different types of cleared, grubbed lines within a unit. Merritt Island National Wildlife Refuge has tried creating "squiggly lines" on ridge tops to promote a mosaic (Figure 3). This technique involves creating a narrow, disked fire line with the berms pushed back in. When fire encounters the curved lines, the fire crosses the squiggly lines at some points and does not cross at others, thereby facilitating a mosaic. One participant wondered if non-permanent "soft squiggles" might achieve the same effect with less disturbance, and others wondered if disconnected half circles might be preferable to lines. Cape Canaveral Air Force Station uses intersecting cleared and grubbed lines within management units to achieve a mosaic.

Participants cautioned that mechanical treatments can have some disadvantages. Mechanical treatments increase the cost and time needed to prepare a management unit. Also, mechanical treatments can lead to increased soil disturbance and invasion by exotic species.

Some participants suggested using a combination of techniques to promote a mosaic. For example, one participant recommended: "[Burn] under wide range of conditions and often as possible to build patchy fuel into a non-uniform system. [Use] incomplete mechanical, non-uniform vegetation alteration in addition to fire."

Attempts to achieve a mosaic within a unit may not always be successful, so managers may need to be flexible in how they manage adjacent units. If burning a unit does not result in a mosaic, participants noted that managers can refrain from burning adjacent units. On the other hand, if a mosaic is achieved, managers have more flexibility to try to achieve a mosaic in adjacent units.

Once a mosaic is achieved, some participants thought that future management tends to continue to get mosaics. The most difficult part, according to these participants, is initially achieving the mosaic. Multiple participants suggested explicitly including mosaics in the burn plan to foster widespread support for the result.

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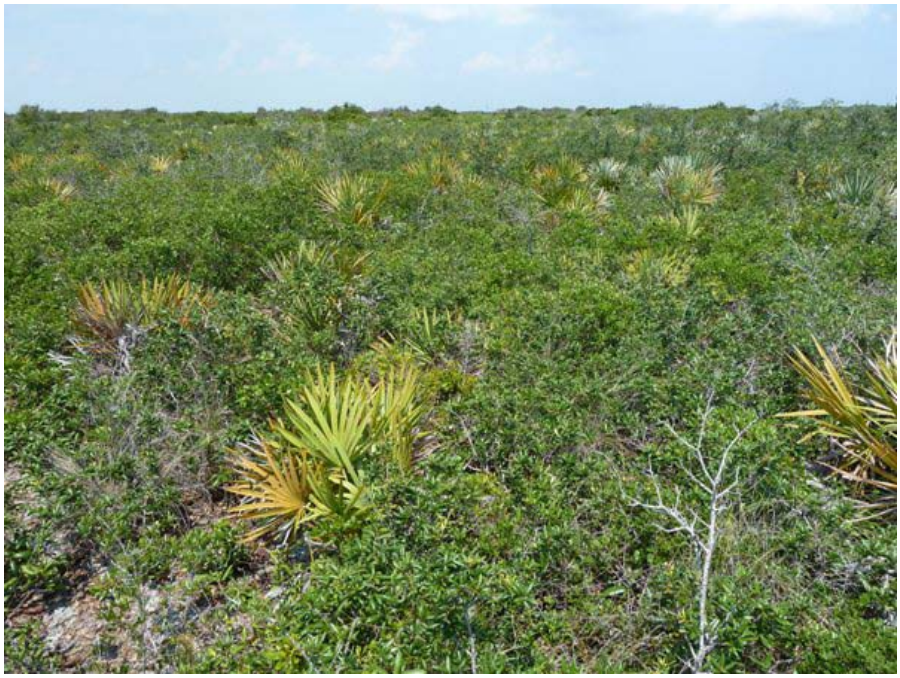

Figure 1. Sandy openings have already closed two years following a fire at this site on Merritt Island National Wildlife Refuge.

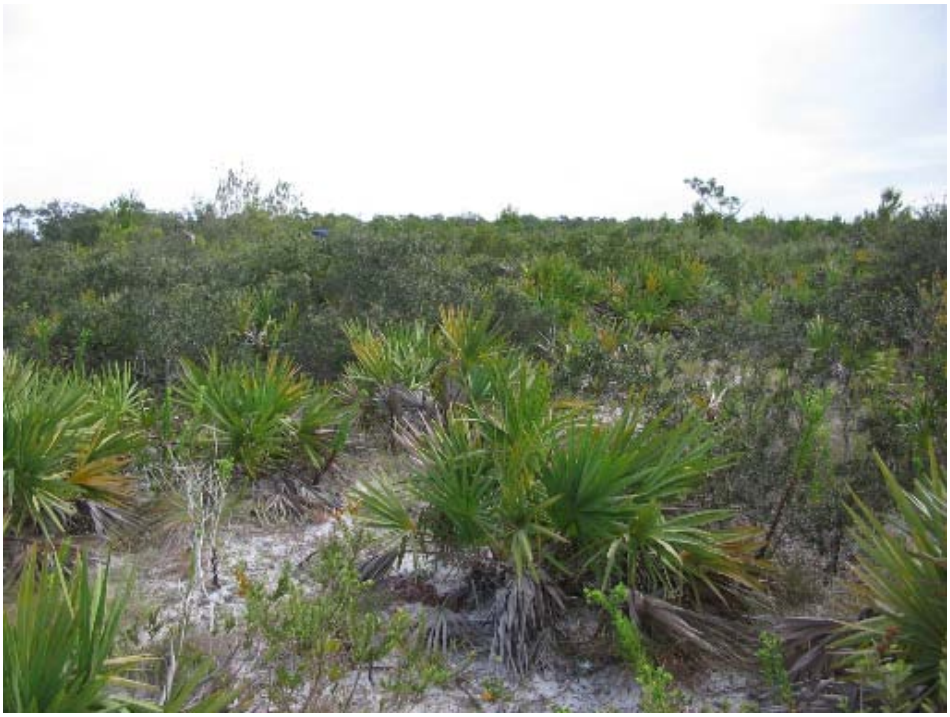

Figure 2. Sandy openings are interspersed throughout scrub-jay habitat with a history of fire, including this area of Valkaria Scrub Sanctuary in Brevard County.

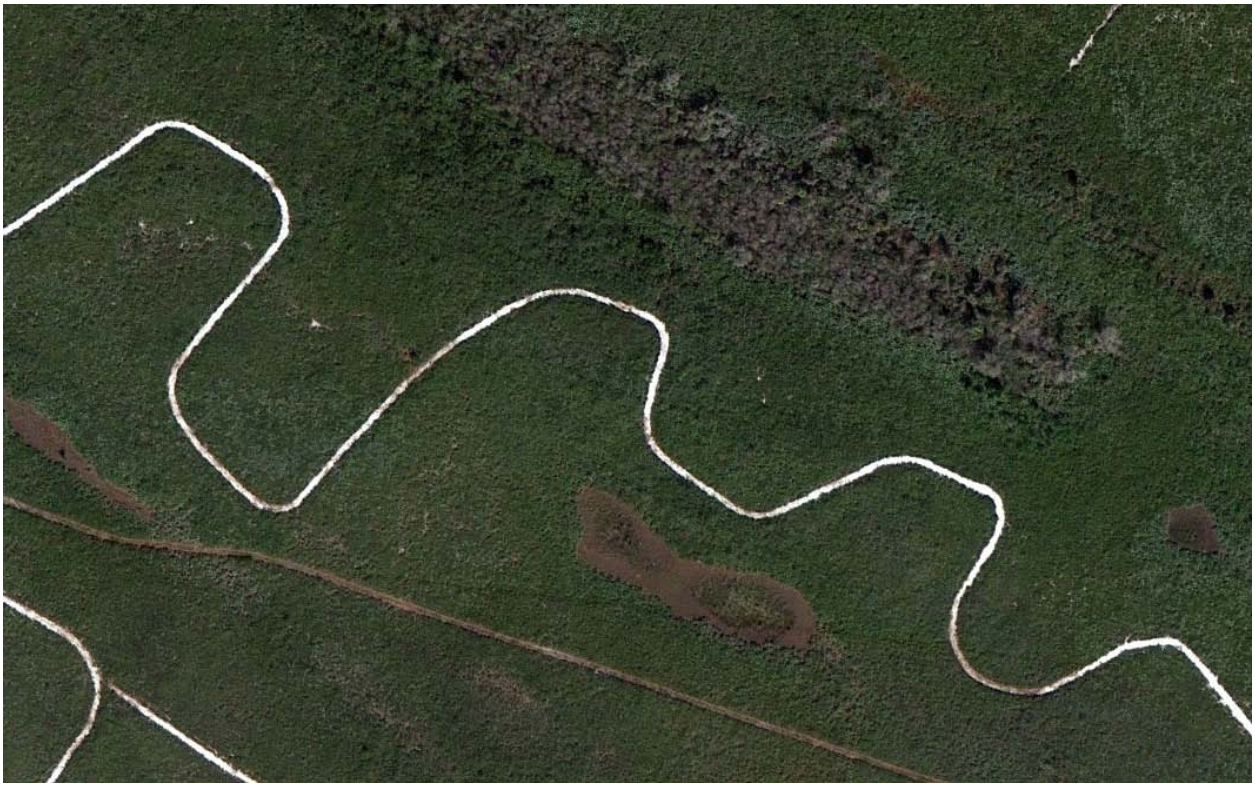

Figure 3. Merritt Island National Wildlife Refuge has experimented with creating “squiggly lines” on ridge tops to facilitate mosaic burns.

Appendix A. List of participants for the Scrubby Flatwoods/Coastal Scrub Workshop at Merritt Island National Wildlife Refuge, November 2, 2011.

Last Name	First Name	Organization
Becker	Chris	FL Park Service (District 4)
Bowman	Reed	Archbold Biological Station
Breininger	Dave	IHA/Kennedy Space Center
de Seguin des Hon	Xavier	Brevard Environmentally Endangered Lands
DePue	Jason	FL Park Service (District 3)
Duncan	Brean	IHA/Kennedy Space Center
Edmondson	Nancy	Sarasota County
Egensteiner	Erik	FL Park Service (Allen David Broussard Catfish Creek Preserve SP)
George	Don	Cape Canaveral Air Force Station
Henn	Pete	St Johns River Water Management District
Legare	Mike	US Fish and Wildlife Service
Lyon	James	US Fish and Wildlife Service
Main	Kevin	Archbold Biological Station
Martin	Matt	Cape Canaveral Air Force Station
McGee	Sam	FL Park Service (St. Sebastian River Preserve State Park)
McGuffey	Steve	Brevard Environmentally Endangered Lands
Mecklenborg	Todd	US Fish and Wildlife Service
Miller	Steve	St Johns River Water Management District
Morrison	Steve	The Nature Conservancy
Mulholland	Rosi	FL Park Service (Fire Coordinator, Central Office)
Pavlina	Brian	Sarasota County
Peterson	Adam	The Nature Conservancy
Phillips	Lynne	NASA
Rossmanith	Rob	FL Park Service (Jonathan Dickinson State Park)
Schmalzer	Paul	IHA/Kennedy Space Center
Titus	Parker	The Nature Conservancy
Turner	Dave	FL Fish and Wildlife Conservation Commission (Salt Lake WMA)

Recorder: Adam Kent (FL Fish and Wildlife Conservation Commission)

Facilitator: Craig Faulhaber (FL Fish and Wildlife Conservation Commission)

Appendix B. Responses from participants recorded on index cards: Creating sandy openings.

Method	Outcome achieved? 1 = Didn't meet objectives, 5 = almost always met objectives	Pros	Cons
Frequent burns	3-4	Natural	Doesn't always work
Short rotation burning	3	Less labor intensive than mechanical treatment; no soil disturbance	Height < preferred for jays
Burn often	2		hard to burn; time consuming
Force frequent fires		Reduce root reserves; patchier fire	Extreme weather needed
High-intensity growing season fire			Needs extreme burn conditions; control difficulty
Frequent growing season fire		Shortens growing season and maximizes dormant season	Can reduce useable scrub habitat if done in too many consecutive years
Keep on growing season burns		Deplete carbo storage underground	Weather windows
Focus on increasing the presence of herbaceous species and don't obsess over the sandy patches so much. Burn as often as possible and don't make time of year the deciding factor. Go for frequency and if can get growing season timing as much as possible but don't skip burning just because missed time of year.			

Experiment w/ hot-burning fine fuels in piles: cabbage palm fronds, pine straw, hay bales, cedar boughs	N/A - Haven't tried it	Shorter residual burn time than logs	labor intensive; small scale
Piled fuels burned	3	burning piled fuels killed roots/rhizomes of sprouting species. Openings close slowly from the sides.	Labor intensive; spatial pattern may not be best
Burn piles	3	if the pile burns "adequately"/hot enough, it will "sterilize" the soil	Pile must be "constructed" appropriately and burned when the vegetation is dry enough and not rotted/decomposed and non-flammable
Pile and burn		Create hot spots kills roots	Machine disturbance
Hurricanes taking down sand pines			
Pile of debris			
Velpar treatments	Have not tried	Kills oaks for openings	timing of treatment (leafing out rain needed)
Herbicide woody vegetation; Use chainsaws to cut woodys then herbicide	4	Cheaper than roller chopper	Having to maintain and spend time to spray and monitor; not really possible for large 10 acre plus zones
Use imazapyr spot treatments	4	No ground disturbance - we did it accidentally when treating Natal grass, made good oak-free openings	Introduction of chemicals w/ unknown collateral impacts
Using herbicides (Velpar and Garlon)	2	Select for specific species. Selective. Does not disturb the ground. Less likely to introduce exotics	Costly; may effect non-target species and areas; may not work based on environmental conditions
Herbicide-Imazapyr pellets		Can GPS pellet placement and monitor thru time	High soil activity - not target kill concerns
Herbicide pellets			? Would this work? Unrealistic? Not practical?
Herbicide - cut stump		Surgical - can implement at varying degrees	Labor intensive

Roller chopping (palmetto areas)	4	Selective, cheap, effective. Will eliminate or reduce saw palmetto density to encourage bare ground.	Possible chance to introduce exotics
Roller chopping	4	Vegetation reduction w/ hope that burning follows; can reduce veg over large acreage	Have to monitor and spray woody vegetation that invades sandy openings; more expensive than herbiciding
Root-raking	4	Long-lasting effects	Any mechanical can be nagative for soil disturbance of land-dwelling creatures
Root rake	4	Created bare sand areas	Couldn't do on large scale; very destructive; invasive exotics
Root raking with dozer and root rake	4	Creates immediate openings; can get to problem immediately	Very destructive; it is hard to tell the contractor what you want; must manage; small areas ata atime; possible exotic species introduction
Mulching with follow-up raking or prescribed burning	3	Lowers vegetation	Difficult to still achieve exposed sand -- needs follow-up; very temporary; burning areas may still not achieve objectives
"crop circles"/root rake openings	3	One "experimental" site on dune ridge was used by FSJs, gopher tortoises, and mouse burrows observed (SEBMs?)	not persistent
Squiggles or "drunken dozer"	3	Easy to replicate; easy to monitor; easy to order/request	Too much soil disturbance; opens in-roads for invasive exotics; only worthwhile in combination w/ burning
Light roller-chopping	1	Cost - manageable fire along urban interface	No added sandy openings
Mowing and burning	1	Equipment was available	Creates a duff fire - does not create sandy openings
Heavy roller-chopping - water in drum		Easier to control fire small or parial zone - urban interface; lower intensity fire	Recently burned, waiting on results
Dozer lines - plow to put out wildfire, then rehabbed - created some openings. Not intended, but occurred		Not costly	Creates disturbances, exotics, topography

Historical roles of alelopathic vegetation		Natural herbicide - cool!	Were these types of plants here?
Use TNC fire crews to help			

Appendix C. Responses from participants recorded on index cards: Avoiding complete, extensive burns.

Method	Outcome achieved? 1 = Didn't meet objectives, 5 = almost always met objectives	Pros	Cons
Not burn part of scrub		Protects/reserves some habitat for jays	Harder to burn around. Smaller burn units, more firelines.
Smaller "burn units"	4	Mosiac becomes unit sized and allows adjacent units to be utilized	Fire may not get "hot" enough to create opening(s). Less acreage burned.
Add more fire breaks	N/A	Smaller zones, severity of fire decreases, less smoke, scrub-jay populations won't decrease w/ less extensive burns.	More extensive burns lead to more scrub habitat burning.
Smaller unit	4	Easy	Tiem consuig and fireline maintenance
Go back in time			
Force frequent fires - may require mechanical assistance		Reduce root reserves, encourage herbs, grass	Need extreme conditions. Restoration phase only.
Short fire return intervals	3	Creates patchy mosaic, works best in heterogeneous mixed habitat types.	Difficult to predict fire behavior.
Shorten burn interval	?	Could be beneficial in keeping palmetto low	Could be detrimental to jay population.
Increase frequency to max flatwoods will burn and scrub will burn in a mosaic	3	Doestn't require mechanical, good for overall habitat matrix not just scrub.	Inability to control amount of scrub or pattern that burns each time. May not be optimal for FSJ management.
More frequent fire. Shorter burn interval	3	Ignites what will burn and there is more opportunity for other ares not to burn. This would be a restoration phase approach, NOT long-term.	Some areas will not burn because the fuel bed can not recover fast enough.
Dozer donut	N/A		

Burning multiple community types so flatwoods are used as the ignition source	4.5	Burning larger blocks at a time. Less overall burn days	No cons.
Regular burning of most frequent fire return interval community.		Will keep or tranisition more pyro communities to potential desired state while not being able to burn scrub at same interval.	Regular fire entry - need to keep burning!
Change burning technique (day vs. night, KBDI, RH, Zone size, lower fire interval, headfire vs backing)	3		
Space out ignition points 20-40 yards	3	Use less fuel	Increases edge effect.
How you light it			
How you ignite			
Backfire the entire unit	3	Easy and safe	Time consuming
Helicopter burn under more mild conditions		Can manipulate point source igntions closer together - further apart	Money
Look at burning under wide range of conditions and often as possible to build patchy fuel into a non-uniform system; Incomplete mechanical, non-uniform vegetation alteration in addition to fire		Can end up with more burn days because you are loosening the burn parameters.	Gound disturbance from mechanical. More time-consuming because returning to a block more often.
Alternate burning with higher fuel moisture and lower fuel moisture to try to "build" a mosaic		Limited disturbance?	Slow in results. Hard to have a successful fire program for many years.
Mild condition burning - use skilled ignitors to seek out burnable jackpots.		Not everything may burn	Can be tough work.
Burning in less than optimal conditions for scrubby flatwoods			

Burning with RHs above 50%	3	Usually does not create an extensive fire.	Often times do not accomplish burn objectives because 50-60% of zone is not burned.
Time of day, weather			
Burn under marginal Rx fire conditions when only head fires will burn and light spots	Have not tried this much in scrub	Is a fire-only method.	Difficult knowing you have right conditions.
Burn with higher humidity	5	Mosaics	May not get some of the taller oaks to ignite.
Burn a few days after significant rain	5	Nice mosaic	Oak thickets may not burn.
Humid growing season burns, small frequent fires, mosaic.		Mimics natural fire regime. Wiregrass benefits.	Labor intensive, need to set lots of small fires during hot humid conditions.
Propone weed killer		Use under conditions where fire will not spread to top-kill vegetation	Know of nowhere this has been done.
Leave some tall patch of scrub	3	Easy	At one point, you have to chop the tall scrub
Chopping vegetation height > 5' followed by burn (Maintenance chopping)	4	Helpts to maintain optimal height and mosaic burn	Cost and time needed to prep unit
Mow (soft lines) to exclude patches	4	Easily controlled	Mechanical disturbance - invasives.
Push over scrub with dozer		Less impact, relatively inexpensive, don't get as dense scrub as with mowing.	Can't do large oaks w/o heavy disturbance.
Sloppy chop w/ burn	5	it work pretty good	Some disturbance allows for pioneers.
Squiggly lines	4	Fast, works	Monitor exotics
Burn section of burn unit		Burn section of a jay family territory, do not displace family	Extensive prep (mowed line, roller-chopped section). Control issue, need additional equipment and crew.
"Checkerboarding" cleared/grubbed intersecting lines	4	not all black, fire managemnent, creates "openings," FSJS observed in lines	Can facilitate invasives, "openings" require periodic maintenance.
Stop uniform mowing techniques		Cheaper, covers more ground with same equipment	Soil disurbance. Bigger area impacted at same time, more for you to need to burn. Possibly more visitor comments.

Mechanical reduction over much of burn unit but leaving oaks of optimal structure/size (~20%). Adjust burn parameters, i.e. burn with some fuel moisture.	3	Ok - conditions during burn dictate success.	Expensive.
Fire suppression training - start small fires for crews to extinguish.		May be reasonable for for smaller units	Risky - escapes.

Appendix C. Revisions and new additions to the document.

Instructions for revising the document:

1. Go to the Shared Documents folder of the Scrub-Jay Sharepoint website.
2. Hover the mouse over the document title. You'll see an arrow appear on the right, next to the date. Click on the arrow and select "Check Out" from the drop-down menu.
3. At this point, you may be asked to enter a username and password. If you do not have a username or password or do not remember them, please contact craig.faulhaber@myfwc.com.
4. Click on the document title to open the document in Microsoft Word.
5. Add your ideas and experiences in Appendix C.
6. When you are finished editing the document, type Ctrl-S.
7. Finally, close the document, and select "yes" when asked if you wish to check in the document.

Alternatively, you can simply e-mail suggestions and revisions to craig.faulhaber@myfwc.com.

Revisions and Additions

[1] Piles should be examined prior to ignition to ensure that no eastern indigo snakes (or other species) have taken refuge in them. (Marilyn Knight, USFWS)

[2] "Although this is written to address primarily coastal scrub management, I can see it being referenced for central Florida scrub management as well. If so, my concern is that fires conducted too frequently to try and maintain openings will have a harmful effect on sand and blue-tailed mole skinks that seem to rely on the persistence of a duff layer to maintain genetically stable populations through time." (Marilyn Knight, USFWS)

[3] "I have concerns over the suggestion that mosaic burns are not necessary in unoccupied scrub-jay habitat for restoration burns. Although true for scrub-jays, it is a better overall management strategy (to benefit multiple species) to try to mimic natural fire and not burn completely. That being said, I understand that there are circumstances that may necessitate single species management to prevent further decline of the scrub-jay." (Marilyn Knight, USFWS)