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PROJECT DIRECTORS:	James Cox, Kevin Robertson, and Ron Masters. Tall Timbers Research Station 13093 Henry Beadel Drive, Tallahassee, FL, 32312. Tel: (850) 893–4153
PROJECT ASSISTANT:	April Reckford
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ABSTRACT

Management of many natural areas in Florida requires the frequent use of prescribed fire. Assessing the use of fire on public lands is problematic because of different monitoring procedures currently used. We developed standard protocols for monitoring the use of prescribed fire on public lands based on a 5-step process: (1) we reviewed pertinent fire-monitoring literature and assessed existing programs; (2) we met with agency personnel (n = 17) who oversee management of public lands in Florida to determine agency goals and objectives; (3) we organized 3 regional workshops where land managers (n > 200) were invited to review proposed fire-monitoring procedures and to provide information on local needs; (4) we conducted field trials on 13 managed areas (23 burns) using draft procedures emerging from the literature review and workshops; and (5) we analyzed field trials and developed a final set of recommendations. Our recommended program has 3 tiers (Appendix 1) where the data collected range from the basic information provided in permit applications and prescription (most simple tier) to surveys of burned areas conducted several weeks after a burn using repeated sampling (most complex tier). Many land managers already collect most of the information required by the lower tiers we recommend. Providing a method for consolidating and processing these data and merging them into a statewide database may be the first step toward implementing a statewide monitoring system. Examples of database structures for our lower tiers are provided (Appendix 1). We also discuss positive incentives that must be included in the program to ensure broad participation by land managers.

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INTRODUCTION

Management of Florida's natural areas and the diverse wildlife such areas support requires the frequent use of prescribed fire (Myers and Ewel 1990). Some upland habitats in Florida may have burned every 1 to 2 years prior to European colonization, and many wetland habitats also experienced fire during periods of droughts and under other special conditions (Myers and Ewel 1990). The importance of fire to Florida's fauna and flora can be seen easily either when fire is removed from the landscape or when fire frequencies are substantially shifted from the natural cycles once thought to exist. Populations of many wildlife species decline rapidly when such changes take place (e.g., Engstrom et al. 1984, Landers 1987), flowering phenology, seed production, and herbivory are altered for several species of plants (Glitzenstein et al. 2003, Robbins and Myers 1992), and complex successional changes ensue that can lead to wholesale changes in community composition, species richness, and habitat structure (Myers and Ewel 1990, Breininger et al. 2002).

Given that fire carries such importance, conservation and management of Florida's fire-dependent natural communities requires methods for evaluating the efforts, accomplishments, and needs of those who use fire on public lands (James 1999). Do burn frequencies on public lands differ substantially from those believed to have occurred naturally? If so, how large are the discrepancies? Does a burn performed in winter have any advantages over a burn conducted in spring in terms of its effects on fuel loads, air quality, or brush and exotic species control? Are resources currently available for conducting prescribed burns on public lands sufficient to meet the long-term needs of natural areas?

Currently, it is difficult to evaluate important questions such as these because methods for recording prescribed burns and their effects vary tremendously both within and among land-management agencies. This variation precludes the compilation of basic summary statistics on

the use of prescribed fire in Florida or to compare fire-management practices among sites and agencies. Given the large acreage of fire-adapted communities under public stewardship and the large number of declining and rare species associated with fire-adapted communities (Millsap et al. 1990), methods for monitoring the use of fire on public lands may be one of the greatest unmet needs in comprehensive wildlife management.

The goals of this project were to review methods used to assess the effects of prescribed fire and to recommend procedures for monitoring the use of prescribed fire on public lands in Florida. Monitoring programs perforce are tailored to the specific objectives of individual parcels and land-management agencies, but, through discussions with public land managers (see below), we found that common ground exists in terms of monitoring the "first-order" effects that result from the use of fire. First-order effects (Reinhardt et al. 2001) relate to the immediate consequences of fire (both direct and indirect) and include response variables such as plant injury and death, fuel consumption, and smoke production. Second-order effects (Reinhardt et al. 2001), on the other hand, are indirect consequences that may manifest themselves only after many years (e.g., soil erosion, vegetation succession, and control of non-native species). First-order effects obviously have a bearing on second-order effects, and a focus on monitoring first-order effects better satisfies the diversity of objectives and goals we found among Florida's land-management agencies (Reinhardt et al. 2001).

Development and adoption of standard procedures for monitoring first-order fire effects has many potential benefits. The benefits include the ability to gauge accomplishments, assess management needs, and make decisions regarding the fire-dependent communities under public stewardship. Better monitoring of first-order fire effects also will help to close gaps in our knowledge regarding the effects of burn frequency, season, weather condition, ignition mode, patch size, and other related factors on Florida's fire-adapted communities (Robbins and Myers

1992). Other potential benefits derived from standard monitoring practices might be to provide critical documentation on staff and program needs (Mulholland et al. 2002), to provide more reliable information on air-quality and safety issues (Hardy 1995), to make the risk-assessments associated with the use of fire more precise (Andrews and Williams 1998), to increase knowledge about the effects of burn programs against the backdrop of an expanding urban landscape (National Wildfire Coordinating Group 2004), and, finally, to maintain institutional knowledge through changes in personnel (Hardin 2002, Mulholland et al. 2002).

The purposes of this project were (1) to review published methods for monitoring the use of prescribed fire; (2) to assess fire-monitoring procedures currently used by land managers in Florida and to gather other information regarding use of fire on public lands; (3) to evaluate monitoring methods for monitoring first-order fire effects critically through meetings with agency administrators and regional workshops involving scores of land managers; (4) to develop and test field procedures derived from steps 1-3; and (5) to prepare a draft manual describing methods for monitoring use of prescribed fire on public lands. We believe we have addressed most of field procedures associated with a comprehensive monitoring program, but, as we discuss, implementation will require coordination and determination on the part of land-management agencies. More specifically, land managers must see clear benefits resulting from their participation in such a program, and providing appropriate incentives will be a key to operations. Implementation of a statewide fire-monitoring program is overdue, and we believe implementation is an important focus for Florida's Comprehensive Wildlife Conservation Strategy (Florida Fish and Wildlife Conservation Commission 2005).

METHODS

We used a 5-step process to assess the fire-monitoring efforts in Florida, to consult with land-management personnel about their needs, and to develop a set of recommended procedures.

First, a review of the literature was conducted using generalized Internet search engines (e.g., Google Scholar) and on-line bibliographic databases (e.g., Biosis, Agricola, and the E.V. Komarek Fire Ecology Database). Searches were performed using keywords such as "fire monitoring," "prescribed fire evaluation," and "post-burn evaluation." References not included in the E.V. Komarek Fire Ecology database were added to this searchable, on-line database, and methods, data standards, and costs/benefits of the various methods were compared.

Second, we scheduled meetings with land managers and administrators to determine which monitoring procedures were currently used (if any). We also distributed a 45-question survey (Appendix 2) to land managers throughout Florida to collect better information on local monitoring programs, needs, and constraints. Prescribed burn data from a representative sample of managed areas (n = 17) also were collected to assess the information typically processed by land managers when they conduct prescribed burns.

Third, we developed an initial set of monitoring protocols based on Steps 1 and 2 and sought critical review of the procedures through a series of regional workshops. The primary sources used to develop our draft protocols were monitoring programs recommended by the U. S. National Park Service (2001), Lutes et al. (2006), U. S. Fish and Wildlife Service (2006), and Wade and Lunsford (1989). Draft protocols were distributed to land managers, and 3 regional workshops were held (Lake City [October 2005, 150 attending], Bartow [December 2005; 40 attending], and West Palm Beach [December 2005; 35 attending]) to provide land managers with a chance to critique proposed methods and offer alternative ideas and approaches. The workshops were advertised via agency e-mail distribution lists and the Internet. Lunch was provided to encourage broad participation.

Fourth, we refined the protocols based on the recommendations and information collected during workshops. The refined protocols were then used in field trials conducted on 13 managed

areas (Fig. 1) to develop estimates for the time requirements associated with the procedures. Site selection was determined by the availability of burn unit information, interest and cooperation from land managers, and the goal of assessing a cross section of Florida's geographical and ecological diversity. Field trials were conducted at Babcock-Webb Wildlife Management Area (WMA), Caravelle Ranch WMA, Chassahowitzka WMA, Chinsegut WMA, Guana River WMA, J.W. Corbett WMA, Lake Talquin State Forest, Lake Wales Ridge WMA, Moody Branch Mitigation Park, Tall Timbers Research Station, Tate's Hell State Forest, Triple N Ranch WMA, and Wekiva State Park. The sites (Fig. 1) included at least 4 sites each in south, central, and north Florida. Field trials covered 23 prescribed burns conducted between February and May 2006.

Fifth, information from field trials, workshops, and other sources were analyzed and used to develop a draft monitoring handbook and supporting materials. The proposed manual is provided as Appendix 1. Additional information regarding field sampling procedures, definitions, and habitat descriptions can be found in Appendix 1.

RESULTS AND DISCUSSION

Literature Review

A total of 80 references (Appendix 3) was reviewed and added to the E.V. Komarek Fire Ecology Database (www.talltimbers.org/info/fedbintro.htm). We found several monitoring programs that might serve as models for Florida. For example, the *National Park Service Fire Monitoring Program* (National Park Service 2001), which is used on all national parks (including parks in Florida) consists of 4 tiers. At the lowest tier, baseline data that include weather history, terrain, and socio-political features are collected prior to burns. At the second tier, data are collected during burn events, including ambient weather conditions, extent of the area to be burned, and fire and smoke behavior. At tier 3, fuel measures and vegetation

monitoring are conducted before, during, and up to 2 years after each burn. Finally, tier 4 addresses monitoring of long-term vegetation changes (i.e., second-order effects).

The U. S. Fish and Wildlife Service (2006) developed procedures for properties the agency manages in Florida and other southeastern states. The procedures include techniques for measuring fuels, fire-management objectives, and progress made towards meeting habitat objectives. Procedures proposed by the U.S. Fish and Wildlife Service (2006) are flexible in terms of the sampling procedures recommended. Rather than relying on fixed sampling procedures, managers are encouraged to use methods best suited to local conditions (including photo-point monitoring, fire weather and behavior observations, and smoke, fuel load, and burn severity estimations). The guide also estimates time and resource requirements, explains how data collection forms are created, and provides data analysis techniques.

Some common themes existed in the procedures we reviewed. First, a tiered system is generally recommended because it allows flexibility and is more likely to gain acceptance when broad and diverse needs exist. Resources dedicated to conducting prescribed burns vary considerably among agencies (Hardin 2002, Mulholland et al. 2002), and a tiered system allows participation at the level deemed most appropriate by individual agencies. In several monitoring programs (e.g., National Park Service 2001), the lowest tier of the monitoring consists of the basic information included in prescriptions and fire permit applications (e.g., acreage burned, relative humidity, drought index, wind speed, etc.). The second tier in most programs involves brief, follow-up visits where variables such as the extent of the area burned, crown scorch, and stem top-kill are collected. Higher tiers of monitoring typically involve more extensive monitoring procedures such as fixed-radius vegetation plots and vegetation transects. Still higher tiers continue to monitor vegetation and fire effects over many months.

Interviews and Survey Results

We interviewed representatives (n = 17) from the National Park Service, U. S. Fish and Wildlife Service, U. S. Forest Service, The Nature Conservancy, Florida Natural Areas Inventory, Dynamac Corporation, Florida Division of Forestry, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, 5 water management districts, local governments (Hillsborough and Palm Beach counties), and 2 higher education institutions (University of Florida [Ordway and Austin Cary Preserves] and University of Central Florida). Most of those interviewed (Appendix 4) expressed interest in standardizing the information collected when prescribed burns were conducted; however, some expressed concern about the additional demands that might be placed on staff by new reporting requirements. One administrator saw only limited value in a fire-monitoring program, while another warned that "…anything that takes time away from burning will be counterproductive."

Surveys completed by state, federal, municipal, and private-sector land managers (n = 87; Table 1) provided an informative look at the status of burning and burn monitoring on public lands. Perhaps the most significant finding was that 39% of the respondents already monitor first-order effects. The procedures often are specific to individual parcels and range from simple post-burn data sheets to more systematic surveys involving photo points, vegetation transects, and other procedures. Some agencies (e.g., Florida Division of Forestry) already have a standardized form for collecting post-burn information Meanwhile, another 43% of those responding use one of the systematic methods described above (e.g., National Park Service 2001) to monitor fire effects. When combined, the responses suggest a majority (83%) of the land managers in Florida already use some type of post-burn procedure to evaluate the first-order effects of the burns that they are conducting. Unfortunately, much of this information is never integrated with similar data collected elsewhere.

The survey also revealed that the building blocks for a statewide monitoring system are

largely in place today. Over 90% of those responding reported that burn blocks on their managed areas had been digitized and entered into a geographic information system (GIS). This suggests it would be feasible to compile a statewide database containing the vast majority of burn blocks on public lands. If such a database existed, it could be used much like the Florida Division of Forestry's on-line tool for evaluating smoke-sensitive areas (http://flame.fl-dof.com/wildfire/tools_sst.html) and open burn permits. Furthermore, if a common monitoring system was adopted and linked with this database, it would add another important GIS data layer to those now available for Florida (e.g., land-cover, human population centers, important wildlife habitats,). In addition, a majority (72.2%) of those responding said they used GIS frequently, while 21% said they used GIS occasionally. These percentages suggest that use of a standardized burn block database might not present a huge technological burden.

Most land managers also use common terminology when describing the habitats under their stewardship and the burn procedures being used. The burn certification process established in Florida has led to consistency in the use of terms such as flank, head, and backing fires, Keetch-Byrum index, minimum and maximum relative humidity, and various measures of wind speed. In addition, 85% of those responding said they regularly use the habitat descriptions developed by the Florida Natural Areas Inventory (1990) and have GIS-based habitat maps of their managed areas that are based on these or similar descriptions.

Our survey also provided a brief look at information that might be available if standard fire-monitoring methods were adopted. For example, we asked land managers to estimate the percent area burned in the different seasons of spring (Feb-Apr), summer (May-Aug), fall (Sep-Nov), and winter (Dec-Feb). Responses suggested that most of the burning now takes place in spring (40%) followed by winter (36%), summer (28%), and fall (18%). We believe this is the first estimate ever provided regarding the seasonality of burning performed on public lands in

Florida and the variation among agencies (Table 2). For example, respondents from the Florida Fish and Wildlife Commission conducted nearly twice as much burning in summer months (based on percentages) when compared to respondents from the Florida Division of Forestry. Meanwhile, the Florida Fish and Wildlife Conservation Commission also appears to conduct nearly twice as much winter burning when compared to the Florida Division of Forestry. These and other comparisons could become commonplace if standardize monitoring procedures were adopted. Comparative data such as these might prove extremely helpful when trying to address important questions regarding the effects of the seasonality of prescribed burning (Robbins and Myers 1992).

Draft Protocols

Our initial monitoring protocol consisted of 5 tiers. Major dividing lines for the 5 tiers were:

Tier 1: On the day of the burn, record the acreage of burn block(s) and actual acres (or percent) that burns.

Tier 2: On the day of the burn, also collect smoke behavior data and fire-intensity data.

Tier 3: In addition to tier 2 monitoring, perform a post-burn evaluation by returning to the burn site within 6 months and collecting data on fuel reduction, vegetation response (hardwood top-kill), crown scorch, pine seedling kill, and other variables.

Tier 4: In addition to tier 2 monitoring, return to burn block within 6 months and conduct repeated samples (0.04-ha plots [0.1-acre]) along a transect that traverses the major axis of the burn block. Collect data on fuel reduction, vegetation response (hardwood top-kill), crown scorch, pine seedling kill, and other information for each plot.

Tier 5: In addition to tier 2 and tier 4 monitoring, implement a more thorough fire-monitoring program similar to those described in Lutes et al. (2002). Collect data in a pre-established fire monitoring plots according instructions in Lutes e t al. (2002).

Peer Review and Workshops

Regional workshops provided a forum for more critical review of the proposed 5-tiered monitoring program by public land managers, the people most responsible for implementing the program. Workshop participants included managers from Department of Defense, Florida Division of Forestry, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, state water management districts, U.S. Fish and Wildlife Service, private conservation organizations, and local land managers. Project personnel made brief background presentations at the outset of each workshop. The draft field forms were then distributed, and the remaining time was spent carefully reviewing different aspects of the proposed procedures.

Detailed notes from the workshops are provided in Appendix 5, but 1 key decision regarded the number of tiers proposed. Most managers thought tiers 1 and 2 should be consolidated, tiers 3 and 4 should be simplified, and tier 5 should be eliminated. As discussed below, these recommendations were implemented. Other key questions and the actions we took (in italics) were:

Habitats not described in Florida Natural Areas Inventory (1990) classification need to be added; *ruderal classes were added.*

Crown scorch is not an important variable; *we believe it is an important variable when used to help gauge fire severity.*

Additional weather information is needed, especially days since the last rain; *this*

variable was added.

Land managers may not have sufficient familiarity with Rothermel (1972) fuel models; *a cross-walk between Rothermel (1972) fuel models and conditions found in Florida was added*.

Make the data sheet more compatible with burn prescription data; *tier 1 data sheets were modified to include typical prescription information.*

Develop measures of brush scorch (in addition to canopy scorch); *brush scorch was added*.

Refine measures of fuel consumption because current options lack the resolution needed for many Florida habitats; *this is probably more technical than needed*.

Need to include some measure of smoke behavior and whether or not it behave as predicted*; this variable was added*.

Provide flexibility for different management goals by allowing managers to state *their* goals and progress toward their completion; *this perspective was added.*

Include measures of exotic species control; *a variable relating to exotic species was added*.

Workshops also revealed that there was broad agreement among land managers on the importance of monitoring prescribed burning. As noted, most managers already collect information comparable to tiers 1 and 2, but this information is not being processed in any systematic manner. We also found that most managers believed that conducting repeated samples along transects or at randomly generated point samples (tier 4 monitoring) would likely be difficult to implement because of staffing constraints and the large burn blocks used on many public lands. In addition, many land-management agencies have invested considerable time in vegetation monitoring (Florida Fish and Wildlife Conservation Commission 2005), which

measures the effects of fire to some degree by monitoring second-order fire effects. On the other hand, one land manager who conducts post-burn evaluations using line transects said that it took only 2 days to complete the surveys on a parcel where approximately 500 ha were burned annually.

Incentives also were discussed to make a fire-monitoring program more palatable to local land managers. All managers were in agreement on the need for positive incentives, and most felt that development of incentives might be the most critical aspect of the program. One recommendation was to link burn-monitoring programs with the burn-certification process; those providing data to a centralized database might receive points towards their certification. Consistent reporting also might be used to grant greater leeway when permits are requested. For example, if adequate documentation exists to show an area has been burned consistently over the past few years and therefore has reduced fuels (compared to worst-case scenarios), burn permits may be given when conditions fall on the margins of prescriptions.

In terms of data entry, a simple, Internet-based reporting system was deemed suitable, but many thought it might be just as effective to provide a monitoring handbook and a standardized spreadsheet for recording observations. Moving data efficiently from local land mangers to larger regional and statewide databases may be the biggest hurdle to overcome (see Management Implications), but most land managers seemed willing to enter and provide the data if entry time was kept to a minimum and the managers could efficiently retrieve their data. The manner in which the data might be used at the regional or state level also was a concern. Developing concrete products and analyses that focus on the achievements of land managers and the constraints they face could provide the incentives needed for participation.

Refine Procedures and Field Trials

Field trials were performed using a refined, 3-tiered monitoring system (Appendix 1) that

emerged from workshop discussions and literature reviews. Major dividing lines for the 3 tiers were:

Tier 1: All data are collected on the day of the burn. For each habitat type (using habitat definitions found in Florida Natural Areas Inventory [1990]), record the total acreage within the burn unit(s), the acres targeted for burning, and the actual acres burned on the day of burn. Also describe pre-burn conditions for the burn unit(s); weather conditions, reasons for the burn, date of the burn (i.e., season), main firing technique(s), ignition method(s), maximum flame length, and fire and smoke behavior.

Tier 2: For each burn unit, complete a post-burn evaluation within 2-10 weeks of the burn. This evaluation is a snapshot of burn effects based on a drive-through appraisal and broad categories that estimate canopy scorch, midstory/brush scorch, hardwood top-kill, young pine top-kill, exotic top-kill, charring, and substrate burn severity. Describe observations based on management goals, whether burn objectives were met, and recommendations for the next burn.

Tier 3: Conduct a post-burn evaluation within 2-10 weeks using repeated samples collected along line transects or at random points within the burn block. Other sampling procedures can be developed based on terrain and accessibility. A maximum of 40 samples is recommended to limit the time spent in very large burn blocks, and samples should be collected at a rate of approximately 1 sample per 5 ha (10 acres) for small burn blocks (<200 ha [ca. 500 acres]) until the maximum of 40 is

reached. For large (>200 ha) burn blocks, the maximum of 40 samples should collected. Samples should taken in habitats most affected by burns (i.e., avoid wetlands), and additional methods associated with tier 3 sampling are provided in Appendix 1.

Tier 1 Data.—Tier 1 data contained the information required on prescriptions and permit applications that could be highly valuable if available in a statewide database. For example, basic knowledge regarding the season, extent, and frequency of the burning could be better determined and used to evaluate dozens of land-management issues. Tier 1 data (Appendix 1) also included information on burn history, habitat types, fuel models (Rothermel 1972), pre-burn treatments, desired weather prescription, primary objective(s), forecasted and actual (on-site) weather conditions, firing technique(s), ignition method(s), maximum flame length, fire and smoke behavior data, and an estimate of the area that actually burned. All tier 1 data could be collected on the day of the burn, and most managers participating in our field trials said it took 15-30 minutes to enter the information on our data sheets. We estimate another 15-30 minutes would be needed to process the data into a standardized database.

Field trials suggested tier 1 data would help to provide more precise estimates for the actual acreage burned each year in Florida. Currently, such estimates often are obtained from burn permits granted by the Florida Division of Forestry. Such permits usually overestimate the acreage burned, and in some instances, the acreage listed in burn permits is 10- to 20-times larger than the acreage actually burned. On 1 test site, the burn permit application listed 6000 acres (2420 ha) as the area treated, but the actual acreage burned (as recorded on the tier 1 form) was only 165 acres (67 ha). This manager regularly applies for a much larger acreage in case escapes occur and the manager decides to let the fire carry across additional areas. The manager said this was a common practice used to avoid the negative consequences associated with fire escapes.

Use of permit data to estimate acreage burned complicates attempts to determine whether burning objectives are being met, over-estimates the pollution associated with prescribed fires, and obscures the consequences of rule and policy changes regarding the use of prescribed fire.

On another property, the acreage listed for the burn was 710 acres (287 ha), but, apparently because of the relative humidity was above 65%, the actual area burned was only 320 acres (130 ha; estimate provided by land manager). The manager's notes said "poor burning because of high humidity," information that would be valuable to future land managers of this area. The agency responsible for this site also uses the size of the burn block treated when it reports the acres it burns annually, not the area within the burn block that actually burned, so the burn acreage reported for this burn could be double the acreage that actually burned. Another burn that we visited on this managed area was dominated by wetlands that were unlikely to burn. These areas also would be included in annual reports and thus inflate estimates.

Finally, if these 2 examples are omitted and the acreage targeted for burning (based on tier 1 reporting) is compared to the acreage actually burned, it appears that most managers were highly successful in meeting their objectives. On average, managers reported that >90% of the targeted acreage actually burned. Tier 1 information thus helps to demonstrate the significant and very important accomplishments being made by Florida's land managers, and this type of positive feedback could help to justify the collection of post-burn data .

Tier 2 Data.— The time required to collect tier 2 information (which involved a return visit to the burned area 2-10 weeks after the burn) averaged <1 hour per burn (excluding driving time to and from the burn block); however, with experience, we believe tier 2 information usually could be collected and processed within 0.5-1.0 hours, depending on driving time.

Tier 2 monitoring (Appendix 1) included estimates for crown scorch, midstory/brush scorch, hardwood top-kill, young pine top-kill, exotic top-kill, and substrate burn severity using

broad, pre-defined categories (Appendix 1). Measures of these variables allowed for more detailed analyses regarding the first-order effects when the data were converted to numbers using simple rank order procedures (e.g., a maximum flame length <3' = 1, flame length of 3-6' = 2, flame length of 6-9' = 3, and a maximum flame length >9' = 4).

A bivariate plot comparing maximum flame length (tier 1 information) with the extent of significant (>90%) crown scorching (tier 2 information) showed the positive associations expected (Fig. 2). A Pearson correlation (Wilkinson 1998) comparing these 2 variables was strong ($r^2 = 0.694$), and the relationship suggests the area of extensive scorching increases by roughly 25% with each increase in the flame length categories. Dozens of similar comparisons might be made using tier 2 data, and these comparisons could lead to improved predictive capabilities. Although such relationships are intuitively understood by experienced land managers, documentation and analysis of tier 2 data could help administrators and higher-level officials understand the limitations and opportunities for effective burning dictated by weather conditions.

Tier 3 Data.—The time needed to conduct a single sample for tier 3 monitoring averaged 8.0 min (SD = 5.7 min) when transects were used and 10.0 min (SD = 6.3 min) when random points were used. These estimates do not include the time needed to reach burn blocks, but they imply that tier 3 sampling may require 3-5 hours for large (>400 ha, or ca. 1000 acres) burn blocks. We should note that we used a Trimble global position system to locate sampling points and record field observations. This equipment saved time but may not be widely available.

An example of the potential analyses possible when tier 3 data are collected can be seen by comparing the hardwood top-kill on the burns conducted in different seasons. We looked at burns conducted in pine flatwoods (*n* = 10; all fuel models listed as "low southern rough") and compared hardwood top-kill in burns conducted in the growing season to the top-kill observed in

burns conducted in the dormant season. Our measure of hardwood top-kill was again simply the rank order of tier 3 categories (i.e,. 0% top-kill = 0; <5% top-kill = 1; 5-20% top-kill = 3, etc.). Hardwood top-kill rank scores averaged 4.7 (SD = 0.8) for burns conducted in the growing season, while rank scores averaged 3.9 (SD = 0.8) in dormant season burns. Although the difference in means was not statistically significant (t_{11} = -1.1, P = 0.3), more extensive data of this variety might help to address a number of outstanding questions (Robbins and Myers 1992).

Tier 3 data processed for one managed area also demonstrated the improved resolution provided by repeated sampling. Tier 2 data associated with a burn conducted on Corbett WMA (Fig. 3) suggested severe canopy scorch (>90%) covered 40% of the burn block. Tier 3 samples suggested extreme scorching covered nearly twice as much of the burn block (ca. 70%), and the locations of our samples (Fig. 3) suggest a reason for the discrepancy. The scorching recorded for samples taken near the edges of burn blocks (where tier 2 samples recorded) was less severe than scorching recorded at points at more interior locations along the transects (Fig. 3). The edges of burn blocks represent ignition points and black lines where fire intensity would be expected to be lower. Tier 3 data provide greater precision in comparison to lower tiers and therefore should be considered when time allows.

MANAGEMENT IMPLICATIONS

The time required for tier 1 or tier 2 monitoring is small compared to the benefits such monitoring efforts provide. Most land managers already collect such data when they burn, and getting managers to record this information in a digital format may simply require development of convenient data-entry forms. In the interim, managers could set up columns in a spreadsheet that corresponded to the variables used in tier 1 and tier 2 monitoring (Appendix 1) to encourage more standard record keeping.

Consolidating tier 1 and tier 2 data into a statewide database, on the other hand, presents a distinct challenge that requires coordination across all land-management agencies. If data stored in hundreds of individual spreadsheets were sent to a central processing point, it would likely take a small full-time staff to consolidate the data, perform quality checks, and take care of follow-up issues. There would also need to be dedicated computers (including GIS software and sufficient storage), technical support and training, and administrative over-sight. If, on the other hand, a web-based data entry portal were created, initial development and testing would likely take 1-2 years to complete, but personnel requirements afterwards would likely be <<1 full-time employee. In fact, we believe land-management administrators would find the database to be very useful and therefore likely to promote data entry and analysis using available staff.

The Florida Division of Forestry is one of the most important lead agencies in this effort because the agency grants burn permits and has developed convenient web-based procedures for analyzing potential smoke problems, weather data, and other fire-related information. The Florida Division of Forestry also is in a good position to provide incentives (e.g., links to certification and burn permits) that are needed to encourage broad participation. Another key institution is the Florida Natural Areas Inventory, which maintains statewide, GIS databases describing natural community and rare species distributions, public lands boundaries, and other features. The Inventory is in the process of developing a statewide database consisting of the burn blocks on public lands (C. Kindell, pers. comm.), and it has experience processing data collected by many different organizations.

These considerations lead us to recommend a stepped approach to implementing tier 1 and tier 2 monitoring over the next few years. First, select a small number of managed areas from each of the major agencies to use as test sites. These sites will collect and process tier 1 or tier 2 data (using a standardize spreadsheet) in the first year. This additional round of testing

could lead to further refinements to field and reporting techniques. Next, an Internet-based data entry portal should be developed for each test sites that includes digitized burn blocks and habitat information (created from existing GIS layers). Another year should be spent refining the web-based data entry portal. In year 3, a consolidated database of burn blocks should be available from the Florida Natural Areas Inventory (C. Kindall, pers. comm.), data entry and field techniques will have been thoroughly tested, and the final stages of implementation statewide can proceed.

More complex types of fire monitoring (i.e., tier 3 as proposed here and some of the higher tiers used elsewhere) probably will require more time than land managers can invest. We share the sentiments expressed by one administrator who feared an elaborate monitoring system might reduce the time spent burning, but other options for tier 3 monitoring exist. For example, tier 3 monitoring could be performed on a small, random sample of the burns conducted each year. Tier 3 monitoring also might be performed by outside contractors with special training that would improve consistency and reliability. Some agencies use outside contractors to assist with vegetation monitoring, and a similar program might be developed for tier 3 monitoring. In those cases, analyses relating tier 1 and 2 fire effects to tier 3 fire effects (such as done above) could aid in projecting longer-term effects of burning on other properties with similar habitat types.

CONCLUSIONS

When it comes to monitoring the use of prescribed fires on public lands in Florida, >90% of the professionals that we interviewed acknowledged the need for standardized methods and better record-keeping procedures. Fire is an essential management tool for most of the state's most endangered upland habitats (Millsap et al. 1990, Noss et al. 1995), and monitoring its use on public lands is overdue.

Establishment of an effective fire-monitoring program need not be an administrative headache. Indications are that most land managers already record the type of information needed to address many questions regarding the use of fire. Developing standard methods for processing and recording the information that many managers currently collect may be one of the easiest ways to improve the monitoring, and land managers who collect and enter such data will have information that can assist with the day-to-day decision making. If this capability is also linked with incentives that provide land managers with greater opportunities to burn on public lands, management of natural areas will have improved significantly and the future of hundreds of species of plants and animals should be more secure.

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Figure 1. Locations of the field trials conducted on 13 managed areas. See text for names of the managed areas.

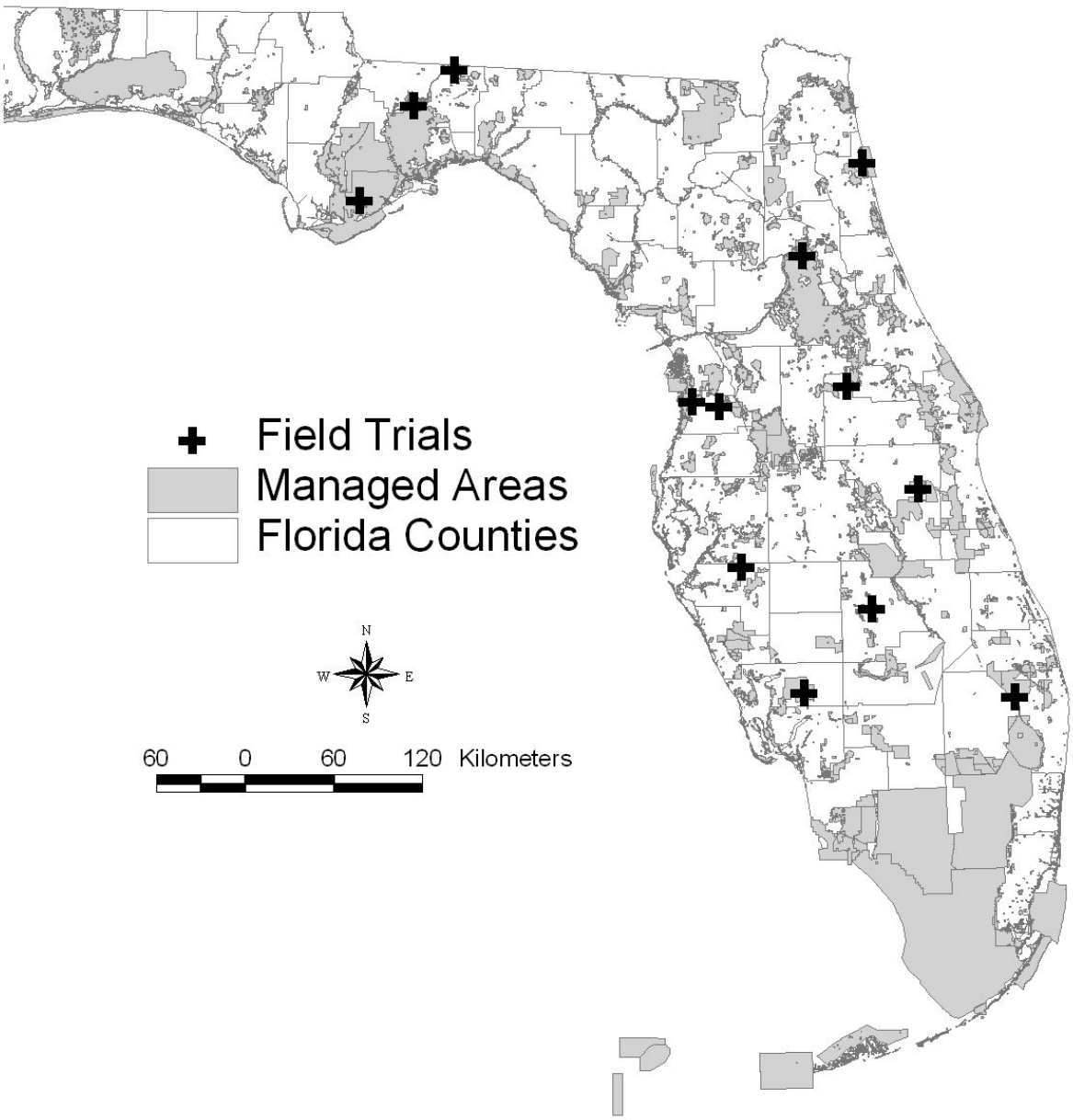


Figure 2. Relationship between maximum flame length (rank order; see text) and the estimated area of severe canopy scorching (>90% of canopy).

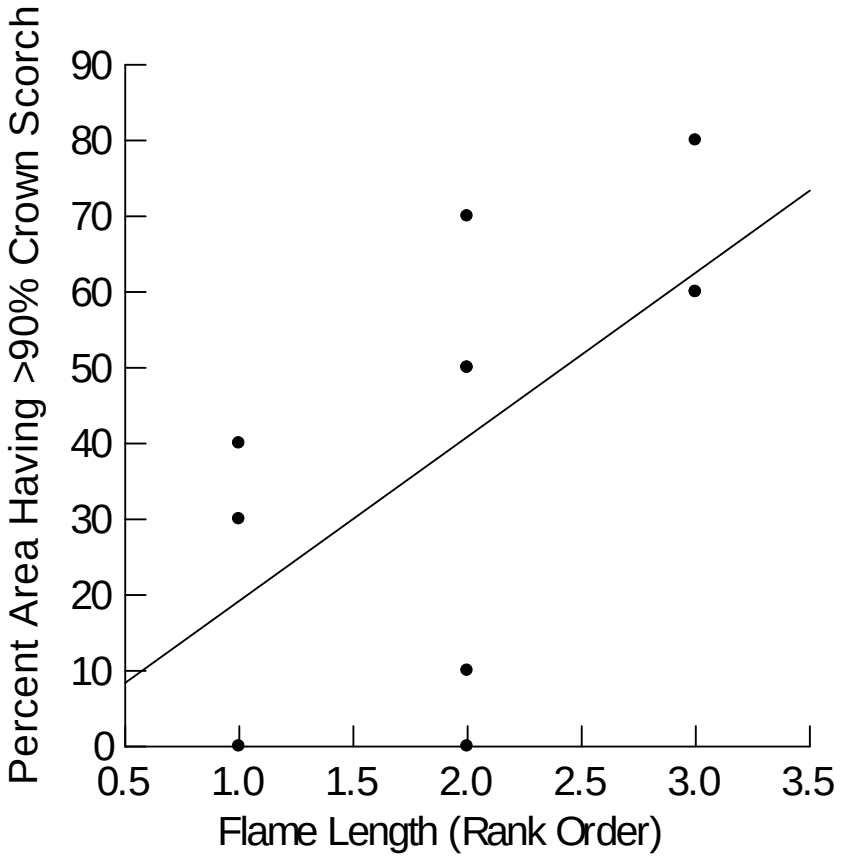


Figure 3. Transects for tier 3 monitoring conducted on Corbett Wildlife Management Area. Scorching was estimated using the procedures described in Appendix 1.

Table 1. Affiliations of land managers who completed a 45-question survey concerning the use of prescribed fire on public lands in Florida.

Affiliations of Survey Respondents	*N*
County Parks	12
Florida Department of Environmental Protection	19
Florida Division of Forestry	5
Florida Fish and Wildlife Conservation Commission	20
Private Conservation Organizations	6
South Florida Water Management District	7
St. Johns Water Management District	3
Suwannee River Water Management District	1
Southwest Florida Water Management District	7
U. S. Air Force	3
U. S. Fish and Wildlife Service	3
U. S. Navy	1
Total Responses	*87*

Table 2. Estimated percentages for the area burned in different seasons in Florida. Seasons were spring (Feb-Apr), summer (May-Aug), fall (Sep-Nov), and winter (Dec-Feb). Acronyms are MUN = county/municipal sites; FDEP = Florida Department of Environmental Protection; FDOF = Florida Division of Forestry; FFWCC = Florida Fish and Wildlife Conservation Commission; PRIV = private; SFWMD = South Florida Water Management District; SJRWMD = St. Johns River Water Management District; SWFWMD = Southwest Florida Water Management District; USAF = U.S. Air Force; USFWS = U.S. Fish and Wildlife Service; and USNA = U.S. Navy.

Season	MUN	FDEP	FDOF	FFWCC	PRIV
Fall	41.67	9.50	10.20	14.00	0.00
Spring	49.17	50.58	59.60	31.21	42.50
Summer	52.57	19.10	12.20	22.22	12.00
Winter	43.67	33.94	18.00	43.35	45.50

	SFWMD	SJRWMD	SRWMD	SWFWMD	USAF
Fall	23.00	3.00	10.00	22.50	0.00
Spring	34.71	34.33	30.00	50.00	34.67
Summer	21.86	21.00	20.00	28.00	26.67
Winter	17.43	42.67	40.00	23.57	38.00

	USFWS	USNA
Fall	0.00	10.00
Spring	30.00	10.00
Summer	75.00	
Winter	20.00	80.00

APPENDIX 1 – Recommended procedures for monitoring the use of prescribed fires on public lands in Florida.

MANUAL TO MONITORING PRESCRIBED BURNING

ON PUBLIC LANDS IN FLORIDA

SPONSORED BY THE FFWCC STATE WILDLIFE GRANTS PROGRAM SWG04-020

TABLE OF CONTENTS

1. INTRODUCTION

Conserving many of Florida's natural habitats and the wildlife they support requires the frequent use of prescribed fire. However, until now, information on burning accomplishments has not been available to agency and state officials due to the incompatibility of information gathered by state agencies and absence of a process to centrally compile data. This information is critical for accurately recording accomplishments of managers in applying prescribed fire, assessing needs for additional resources to achieve burning objectives, accurately estimating emissions from prescribed burning, providing institutional records through personnel changes, and ultimately guiding strategic changes to manage lands more effectively with prescribed fire.

Prescribed-burn monitoring involves recording the characteristics and direct effects of fire within a burned area on the day of burn or shortly thereafter. One copy of the form should be filled out for each burn unit. Burn units are defined and named according to the protocol established on your property, such that subsequent observations can be referred to the same unit.

The forms for collecting data are divided into three "tiers", of which Tier 1 includes the minimal data required, and Tiers 2 and 3 include optional additional data that would be of great benefit to the agency, other officials, and future land managers of the property. The forms are self-explanatory, with the aid of additional information provided below. Terms and definitions generally adhere to *The Guide for Prescribed Fire in Southern Forests* published by the National Wildlife Coordinating Group, 1989.

TIER 1

Information is compiled on the day of the burn. Much of the information may be transferred from the burn prescription and fire weather records taken during the burn. The required information includes the total acreage within the burn unit(s), acres targeted for burning, and an estimate of actual acres burned the day of burn. Florida habitat type and number is chosen from the table provided, as well as it can be matched with the actual habitat. Multiple habitats can be listed for each block, with the corresponding approximate number of acres. Multiple choices for weather conditions, reason for burn, firing

technique(s), ignition method(s), maximum flame length, and fire and smoke behavior data are self-explanatory. Definitions of terms are provided

TIER 2

Information is compiled 2-10 weeks after the burn during a short visit to the burn site. Observations are made on canopy scorch, low midstory/brush scorch, hardwood top-kill, young pine top-kill, exotics top-kill, and substrate burn severity class. Document method(s) used to collect data and list additional monitoring protocols. Describe observations dependent upon management goals, whether burn objectives were met, and recommendations for the next burn.

TIER 3

Information is also compiled 2-10 weeks after the burn but is a more rigorous examination using multiple point observations. A GPS unit or data logger is helpful. For each burn unit, a data dictionary or other data gathering format must be developed to collect site specific burn information relevant to burn objectives. Locate multiple points within the burn unit that represent the overall behavior of the burn and site conditions.

TIER 1 - PRESCRIBED BURN MONITORING FORM

1. PROPERTY _____ 2. AGENCY _____

3. BURN UNIT NAME / # _____ _____

4. # ACRES IN BURN UNIT _____ 5. PERMIT # _____ 6. DOF CUSTOMER # _____

7. BURN DATE ____/____/____ 8. LAST BURN DATE ____/____/____ 9. START TIME _____ 10. END TIME _____

TABLE 1.1

Burn Unit(s) #	Florida Habitat Type #*	Fuel Model #*	Habitat Type Characteristics	# Acres within burn	# Acres targeted to burn	# Acres actually burned

**** SEE REVERSE FOR DESCRIPTION OF FLORIDA HABITAT TYPES AND FUEL MODELS.***

TABLE 1.2

Weather Conditions	Prescribed	Forecasted	Actual	Weather Conditions	Prescribed	Forecasted	Actual
Percent Chance of Rain				Minimum Mixing Height			
Days Since Last Rain				Dispersion Range (Day)			
Surface Wind Direction				Dispersion Range (Night)			
Midflame Surface Windspeed				Maximum Temperature			
Transport Wind Direction				Minimum Relative Humidity			
Transport Windspeed Range				KBDI Maximum			

12. REASON(S) FOR BURNING: ECOLOGY | EXOTICS | FORESTRY | FUEL REDUCTION | RANGE | SITE PREP | WILDLIFE

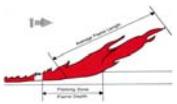
13. FIRING TECHNIQUE(S): BACK | FLANK | HEAD

14. IGNITION METHOD(S): AERIAL | FOOT | VEHICLE

15. SMOKE SENSITIVE AREAS EFFECTED: YES | NO

16. ANY ESCAPES: YES | NO

17. MAXIMUM FLAME LENGTH: < 3' | 3-6' | 6-9' | > 9'



18. PRE-BURN TREATMENT(S): CHEMICAL | CHOPPING | MOWING | MASTICATION | TILLING | NONE

GENERAL OBSERVATIONS: _____

Tier 1 - Prescribed Burn Monitoring Form

TABLE 1.3

#	Florida Habitat Types	Natural Communities*
0	Unburnable Habitat	Inundated Wetland; Hardwood Drain; Lakes
1	Upland Pine Forest	Open Sandhills and Clayhills with a herbaceous layer
2	Old-field Pine Forest	Open Pinelands on former agricultural lands with a woody and herbaceous layer
3	Pine Flatwoods	Mesic, Wet, and Scrubby Flatwoods
4	Scrub	Pine and Oak Scrub
5	Rocklands	Pine Rocklands
6	Upland Hardwood Forest	Xeric Oak Hammock; Upland Mixed Forest; Fire-suppressed Upland Pine Forest
7	Mesic Hardwood Forest	Slope and Bottomland Forest; Maritime, Mesic, and Prairie Hammock
8	Wetland Forest	Basin, Dome, Floodplain and Strand Swamp; Baygall
9	Dry Prairie	Nearly treeless plain with dense cover of grasses, herbs, saw palmetto, and/or low shrubs
10	Wet Prairie	Depression Marsh; Seepage Slope
11	Marsh / Slough	Basin, Floodplain, and Tidal Marsh; Marl Prairie; Slough; Swale
12	Upland Dense Timber Stand	Converted Sandhills and Clayhills; Plantation
13	Wet / Lowland Dense Timber Stand	Converted Flatwoods; Plantation
14	Pasture / Agriculture	Planted Pasture and Cropland
15	Ruderal Shrub and Brush	Former Fields and Agricultural Areas
16	Exotics	
17	Other	

**** FROM GUIDE TO THE NATURAL COMMUNITIES OF FLORIDA BY FLORIDA NATURAL AREAS INVENTORY AND DEPT OF NATURAL RESOURCES, 1997.***

TABLE 1.4

#	Standard Fuel Models	Fuel Descriptions with Associated Habitat Types*
1	Short Grass	Marsh / Slough with short grass < 2'; grassy Dry Prairie; Pasture
2	Timber (Grass and Understory)	Upland Pine Forest or Pine Flatwoods with grassy, herbaceous understory
3	Tall Grass	Marsh / Slough with tall grass > 2'; Cogongrass (exotic)
4	High Southern Rough	Pine Flatwoods or Wetland Forest with flammable evergreen shrub thicket > 4' tall; Dense scrub
5	Brush	Upland Pine Forest with low, shrubby understory; low shrubby Dry Prairie
6	Dormant Brush / Hardwood Slash	Sparse Scrub; Young Scrub , 4' tall; Hardwood resprouts after logging
7	Low Southern Rough	Pine flatwoods or Wetland Forest with flammable evergreen shrub thicket < 4' tall
8	Closed Timber Litter	Upland Hardwood Forest; Mesic Hardwood Forest; Plantation / Orchard with flat, compact litter
9	Hardwood (long needle pine) Litter	Upland Hardwood Forest; Mesic Hardwood Forest; Plantation / Orchard with fluffy litter
10	Timber (Litter and Understory)	Upland Hardwood Forest; Mesic Hardwood Forest; Plantation / Orchard with litter and slash
11	Light Logging Slash	Dispersed slash 1' deep with sparse grass
12	Medium Logging Slash	Irregular slash 2' deep with sparse grass
13	Heavy Logging Slash	Nearly continuous slash, 3'deep

**** ANDERSON H.E., 1982 AND SPACE IMAGING, 2002.***

ADDITIONAL NOTES: _____

_____

_____

TIER 1 - DESCRIPTIONS OF DATA ENTRIES

1. PROPERTY: Provide name of property.

2. AGENCY: Provide name of managing agency.

3. BURN UNIT NAME: Provide the name of the burn unit used by the managing agency.

4. BURN UNIT #(S): Provide the number/letter combination of the burn unit used by the managing agency.

**It is preferable to record only one burn unit per form, unless multiple units are burned as one large unit.*

5. # ACRES IN BURN UNIT(S): Provide the total number of acres within the burn unit(s).

6. PERMIT #: Provide the Department of Forestry permit number issued for the prescribed burn.

7. DOF CUSTOMER #: Provide the Department of Forestry customer identification number.

8. BURN DATE: Provide the date of the prescribed burn.

9. LAST BURN DATE: Provide the date the burn unit was last burned.

10. START TIME: Provide the hour of ignition for the prescribed burn.

11. END TIME: Provide the hour the prescribed burn finished including mop-up time.

TABLE 1.1

BURN UNIT #: Provide the number/letter combination of the burn unit used by the managing agency. It is important to distinguish between burn units.

FLORIDA HABITAT TYPE #: Enter a number from 0-17 designating the Florida Habitat Type from the table on the reverse side of the form. Use multiple lines for multiple habitat types as necessary.

FUEL MODEL #: Enter a number from 1-13 designating the Standard Fuel Model associated with each habitat type found within the burn unit from Table 1.4 on the reverse side of the form.

HABITAT TYPE CHARACTERISTICS: Record any burn unit information that could effect fire behavior. This includes information such as topography, stand age, thick duff, or hazardous fuels.

ACRES WITHIN BURN UNIT: Record the number of acres of each habitat type within the burn unit. The total number of acres recorded in this column should equal the number of acres in the burn unit.

OF ACRES TARGETED TO BURN: Record the number of acres prescribed to burn.

ACRES ACTUALLY BURNED: Record the number of acres that actually burned.

TABLE 1.2

Record all listed weather conditions for the prescribed burn. The burn prescription plan can be used to fill out the Prescribed column. The weather forecast for the day of burn is used to fill out the Forecasted column. Weather information taken during the burn is used to fill out the Actual column. Definitions of the required weather elements are:

SURFACE WIND DIRECTION – The compass direction from which the surface wind is blowing.

MIDFLAME SURFACE WINDSPEED – Windspeed within a stand at about eye level.

TRANSPORT WIND DIRECTION – The compass direction from which the transport wind is blowing.

TRANSPORT WINDSPEED – A measure of the average rate of the horizontal movement of air throughout the mixing layer.

MIXING HEIGHT – The height to which relatively vigorous mixing of the atmosphere occurs.

DISPERSION SPEED – The amount of time it takes for the decrease in concentration of airborne pollutants as they spread throughout an increasing volume of atmosphere.

RELATIVE HUMIDITY – The ratio, expressed as a percentage of the amount of moisture in the air, to the maximum amount of moisture the air is capable of holding under the same conditions.

KBDI (Keetch-Byram Drought Index) – A numerical rating of the net effect of evapotranspiration and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers.

12. REASON(S) FOR BURNING: Circle all that apply.

ECOLOGY - Maintain natural disturbance regimes; promote seed production.

EXOTICS - Control/eradicate exotic invasive plants such as *Melaleuca*. FORESTRY - Promote timber regeneration; thin overstocked timber stands.

FUEL REDUCTION - Reduce threat of wildfire, improve accessibility and aesthetics.

RANGE - Improve forage for cattle; promote specific warm or cool season grasses.

SITE PREPARATION - Prepare for planting and/or other improvements.

WILDLIFE - Promote habitat supporting wildlife species of concern.

13. FIRING TECHNIQUE(S): Circle all that apply.

BACK – A backing-fire is started along a baseline (anchor point), such as a road, plow line, stream, or other barrier, and is allowed to back into the wind.

FLANK – A flanking-fire is started with lines of fire set directly into the wind. The lines spread at right angles to the wind.

HEAD – A strip-headfire is started with a series of lines of fire set progressively upwind of the firebreak in such a manner that no individual line of fire can develop to a high energy level before it reaches either a firebreak or another line of fire.

14. IGNITION METHOD(S): Circle all that apply.

AERIAL - By airplane or helicopter

FOOT - Self explanatory.

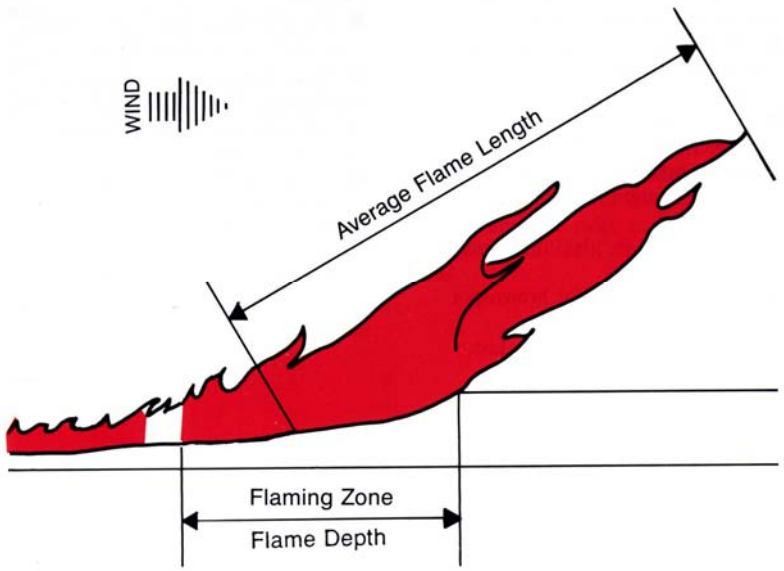
VEHICLE - Vehicle mounted drip-torch, flame-thrower, etc.

15. Smoke Sensitive Areas Affected: Circle yes or no, with reference to any smoke sensitive areas listed on the burn prescription.

16. Any Escapes: Circle yes or no.

17. Maximum Flame Length: Circle the maximum flame length category as estimated during the burn.

FLAME LENGTH - The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally at the ground surface).



18. PRE-BURN TREATMENT(S): Circle all that apply.

CHEMICAL - Herbicides

CHOPPING - Roller chopping

MOWING - Self-explanatory

MASTICATION - Using specialized machinery

TILLING - Widespread harrowing, plowing, or other intentional soil disturbance.

19. ***GENERAL OBSERVATIONS***: This space is provided to document any additional information about the fire's behavior and characteristics viewed during the burn. Some examples are unexpected smoke behavior, changes in firing techniques, and fire break breaches with their size and location.

TIER 2 - POST PRESCRIBED BURN MONITORING

1. PROPERTY _____ 2. AGENCY _____

3. BURN UNIT NAME _____ 4. BURN UNIT #(S) _____

5. BURN DATE ____/____/____ 6. RAIN AMT. SINCE BURN _____ 7. # ACRES IN BURN UNIT(S) _____

TABLE 2.1

Fire Effects on Burned Area						
Canopy Scorch*	N/A	None	1 – 30%	31 – 60%	61 – 90%	> 90%
Percent of Area						
Low Midstory/Brush Scorch	N/A	None	1 – 30%	31 – 60%	61 – 90%	> 90%
Percent of Area						
Hardwood Top-kill (d < 1", ht < 8')	N/A	None	1 – 30%	31 – 60%	61 – 90%	> 90%
Percent of Area						
Young Pine Top-kill (d < 1")	N/A	None	1 – 30%	31 – 60%	61 – 90%	> 90%
Percent of Area						
Exotics Top-kill	N/A	None	1 – 30%	31 – 60%	61 – 90%	> 90%
Percent of Area						
Substrate Burn Severity Class*	Unburned		Scorched	Lightly Burned	Moderately Burned	Heavily Burned
Percent of Area						

**** SEE REVERSE FOR DESCRIPTION OF CANOPY SCORCH AND SUBSTRATE BURN SEVERITY CLASS.***

TABLE 2.2

Method(s) Used to Measure Fire Effects							
Scorch	Roadside	Walk Through	Fixed Plots	Fixed Transects	GPS Points	GPS Transects	Remote Sensing
Method Used							
Top-kill	Roadside	Walk Through	Fixed Plots	Fixed Transects	GPS Points	GPS Transects	Remote Sensing
Method Used							
Substrate Burn	Roadside	Walk Through	Fixed Plots	Fixed Transects	GPS Points	GPS Transects	Remote Sensing
Method Used							

LIST ADDITIONAL MONITORING PROTOCOL(S) USED: _____

OBSERVATIONS DEPENDENT UPON MANAGEMENT GOALS: *(EXAMPLES: STEM CHAR, ROOT DAMAGE, RESIN SEEPAGE, INSECT DAMAGE, RARE/ENDANGERED SPECIES, TREE MORTALITY, SEEDLING SURVIVAL OR DEVIATIONS FROM PLAN)*

_____

_____

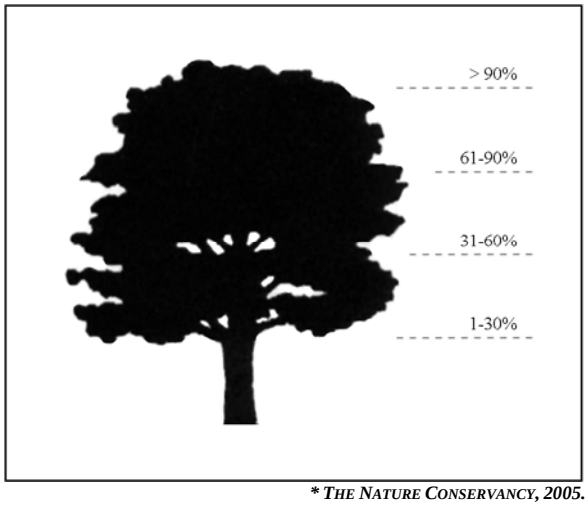
WERE BURN OBJECTIVES MET? YES | NO _____

RECOMMENDATIONS FOR NEXT BURN: _____

_____

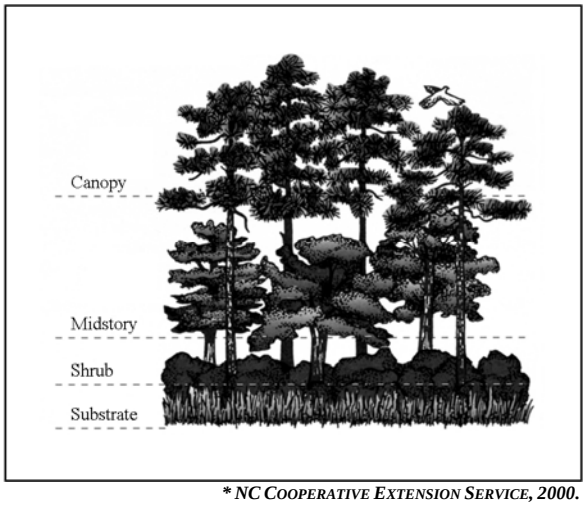
TIER 2 - POST PRESCRIBED BURN MONITORING

FIGURE 1 - PERCENT CANOPY SCORCH



**** THE NATURE CONSERVANCY, 2005.***

FIGURE 2 - VEGETATION LAYERS



**** NC COOPERATIVE EXTENSION SERVICE, 2000.***

TABLE 2.3

Substrate Burn Severity Class*					
	Unburned	Scorched	Lightly Burned	Moderately Burned	Heavily Burned
Substrate (Litter / Duff / Fine Fuels)	Not burned	Litter partially blackened, duff nearly unchanged, wood/leaf structures unchanged.	Litter charred to partially consumed, upper duff layer burned, wood/leaf structures charred, but recognizable.	Litter mostly to entirely consumed, leaving coarse, light colored ash, duff deeply burned, wood/leaf structures unrecognizable.	Litter and duff completely consumed, leaving white ash, mineral soil visibly altered, often, reddish in color, wood/leaf structures consumed.

**** NATIONAL PARKS SERVICE, 1991.***

ADDITIONAL NOTES: _____

TIER 2 - DESCRIPTIONS OF DATA ENTRIES

1. PROPERTY: Provide name of property.

2. AGENCY: Provide name of managing agency.

3. BURN UNIT NAME: Provide the name of the burn unit used by the managing agency.

4. BURN UNIT #: Provide the number/letter combination of the burn unit used by the managing agency.

**It is preferable to record only one burn unit per form, unless multiple units are burned as one large unit.*

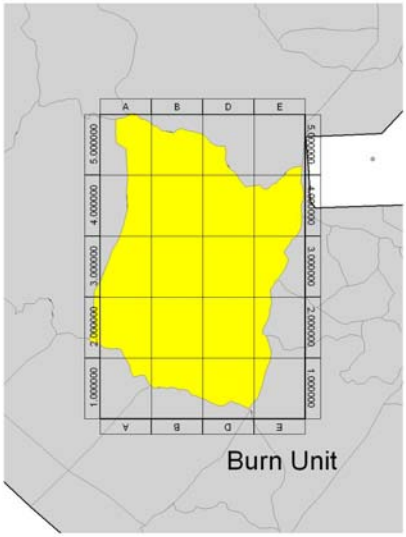
5. BURN DATE: Provide the date of the prescribed burn.

6. RAIN AMT. SINCE BURN: Give the rain amount to the nearest 1/10th of an inch.

7. # ACRES IN BURN UNIT(S): Provide the total number of acres within the burn unit(s).

TABLE 2.1

Record the first order fire effects for the burned area within the burn unit(s). If a fire effect category does not pertain to the burn unit(s), then mark the N/A column. Many of the ocular estimates requested below are aided by drawing a simple grid upon a map of the burned area (see figure to right). The number of cells in the grid should be 10 or 20 to help in making quick estimates of percentages based on the characteristics recorded for each grid.



CANOPY SCORCH**:** Make an ocular estimate of canopy scorch for the entire burn unit. Estimate how much of the burn unit falls within each percentage category (N/A, None, 1-30%, 31-60%, 61-90%, >90%). Canopy scorch percentages are taken on the volume browned or consumed.

LOW MIDSTORY/BRUSH SCORCH**:** Make an ocular estimate of midstory scorch for the entire burn unit. Midstory/brush is defined as brush, young trees, and other vegetation from 3 m (10') up to 7 m (20'). Estimate how much of the burn unit falls within each percentage category (N/A, None, 1-30%, 31-60%, 61-90%, >90%). Midstory scorch percentages are taken on the volume browned or consumed.

HARDWOOD TOP-KILL**:** Make an ocular estimate of hardwood top-kill for the entire burn unit. Estimate how much of the burn unit falls within each percentage category (None, 1-30%, 31-60%, 61-90%, and >90%). Hardwood top-kill is collected for woody stems < 1" in diameter and typically < 8' high. This measurement evaluates the patchiness of the burn.

YOUNG PINE TOP-KILL**:** Make an ocular estimate of young pine top-kill for the entire burn unit. Estimate how much of the burn unit falls within each percentage category (None, 1-30%, 31-60%, 61-90%, and >90%). Young pine top-kill is collected for pines < 1" in diameter.

EXOTICS TOP-KILL**:** Make an ocular estimate of exotics top-kill for the entire burn unit. Estimate how much of the burn unit falls within each percentage category (None, 1-30%, 31-60%, 61-90%, and >90%). Exotics top-kill is collected for exotic invasive species being controlled / eradicated by fire.

SUBSTRATE BURN SEVERITY CLASS**:** Make an ocular estimate of substrate burn severity for the entire burn unit. Estimate how much of the burn unit falls within each class (Unburned, Scorched, Lightly Burned, Moderately Burned, and Heavily Burned). Fine fuels, litter, and duff are evaluated together to determine the substrate burn severity. Descriptions of each class are listed in Table 2.3.

DUFF - The layer of decomposing organic materials lying below the litter layer and immediately above the mineral soil. It is comprised of the Fermentation and Humus layers of the forest floor.

FINE FUELS - Fast-drying, dead fuels which have a time-lag constant of 1 hour or less. These fuels ignite readily and are consumed rapidly when dry. Includes grass, leaves, pine needles, and twigs.

LITTER – The top layer of the forest floor directly above the fermentation layer, composed mainly of recently fallen leaves and pine needles, but also includes dead twigs, bark fragments, etc.

Substrate Burn Severity Class*					
	Unburned	Scorched	Lightly Burned	Moderately Burned	Heavily Burned
Substrate (Litter / Duff / Fine Fuels)	Not burned	Litter partially blackened, duff nearly unchanged, wood/leaf structures unchanged.	Litter charred to partially consumed, upper duff layer burned, wood/leaf structures charred, but recognizable.	Litter mostly to entirely consumed, leaving coarse, light colored ash, duff deeply burned, wood/leaf structures unrecognizable.	Litter and duff completely consumed, leaving white ash, mineral soil visibly altered, often, reddish in color, wood/leaf structures consumed.

TABLE 2.2

Record all prescribed burn monitoring method(s) used to measure fire effects. The categories are roadside, walk through, fixed plots, fixed transects, GPS points, GPS transects, and remote sensing.

METHOD USED (SCORCH): Check the method(s) used to measure canopy and midstory scorch.

METHOD USED (TOP-KILL): Check the method(s) used to measure hardwood, pine, and exotic top-kill.

METHOD USED (SUBSTRATE): Check the method(s) used to measure the substrate burn severity.

LIST ADDITIONAL MONITORING PROTOCOL(S) USED: List other monitoring methods used, such as FIREMON, State and Federal Agency Protocols, and The Nature Conservancy Protocols.

OBSERVATIONS DEPENDENT UPON MANAGEMENT GOALS: *(EXAMPLES: STEM CHAR, ROOT DAMAGE, RESIN SEEPAGE, INSECT DAMAGE, RARE/ENDANGERED SPECIES, TREE MORTALITY, SEEDLING SURVIVAL OR DEVIATIONS FROM PLAN)* List observations relevant to site specific management goals.

WERE BURN OBJECTIVES MET? Describe whether or not burn objectives were met, relating to objectives stated in the burn prescription.

RECOMMENDATIONS FOR NEXT BURN: List all recommendations for future prescribed burns as related to observations noted by the observer. Consider burn effectiveness in meeting management objectives.

TIER 3 - POST PRESCRIBED BURN MONITORING

A. DETERMINING SAMPLE LOCATIONS

Transects

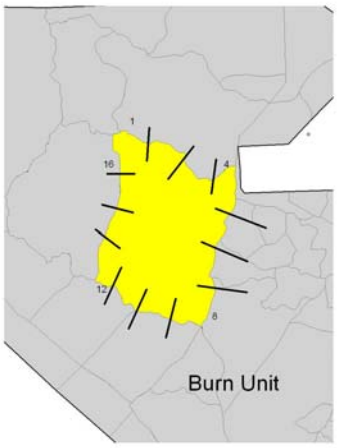
Field testing has shown that placement of Tier 3 sampling points along transects is the most efficient sampling procedure. To provide coverage throughout the block, a minimum of 4 transects per burn block is used. To limit the total time spent on very large blocks, a maximum of 40 samplings has been set. Based on the guidelines, each transect will contain of 2-5 sample points.

Sampling points should be set at the approximate densities listed below (Table 3.1) based on the distance between points (measured in terms on the number of steps). Based on the guidelines (Table 3.1), sampling for a 20-ha (50-acre) burn block would consists of 1-2 sample points along each of 4 transects (4-8 total points); sampling for a 40-ha (100-acre) burn block would consist of 3-4 sample points distributed along 4 transects; sampling for a 80-ha (200-acre) burn block would 4-5 sample points distributed among 4-5 transects; sampling for a 120 ha (300-acre) burn block would entail 5 sample points distributed among 6 transects, sampling for large blocks would entail 5 samples among >200 acres 1 sample per 5 ha (10 acres) for small burn blocks (<200 ha [ca. 500 acres]

TABLE 3.1

Burn Block Size	Points per Acre	Approximate Intervals between Points
<160 ha (400 Acres)	1 Point per 4 ha (10 Acres) up to maximum of 40	75 Meters (75-100 steps)
>160 ha (400 Acres)	40 samples (8 transects)	100 Meters (100-150 steps)

In addition, biases may enter into monitoring efforts unless starting locations and directions of transects are established in a random manner. We recommend fire lines or roads surrounding burn blocks be divided into 16 equal lengths similar to the figure shown to the right. The sections of these boundaries can then be numbered clockwise from 1-16 beginning at the segment found in the northwestern-most corner.



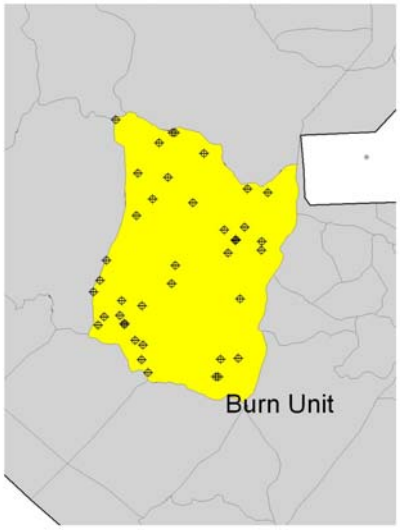
Using table 3.2, managers can conduct 4 coin flips to establish the starting point of a transect (e.g., flipping "heads, tails, tails, heads = segment 7). The approximate centers of each section could then be used as starting points, and the direction of transects is perpendicular to the fire lane or road. In addition, many spreadsheets also contain random number generators (e.g., the statement *=INT(16*(RAND()))* in Excel, which generates an integer between 1 and 16) that could be used instead of coin tosses.

Table 3.2

Flip 1	**Flip 2**	**Flip 3**	**Flip 4**	**Segment**
Heads	Heads	Heads	Heads	1
			Tails	2
		Tails	Heads	3
			Tails	4
	Tails	Heads	Heads	5
			Tails	6
		Tails	Heads	7
			Tails	8
Tails	Heads	Heads	Heads	9
			Tails	10
		Tails	Heads	11
			Tails	12
	Tails	Heads	Heads	13
			Tails	14
		Tails	Heads	15
			Tails	16

Random Points

A quick method for generating random sample locations is to use the *Animal Movement Extension* (available on-line at http://www.absc.usgs.gov/glba/gistools/animal_mvmt.htm) and ArcView GIS. The *Animal Movement Extension* generates random points within polygons (see figure to right), and points can then be downloaded to a GPS unit or printed out with land-cover maps and other GIS-layers as landmarks. Again samples should reflect a density of approximately 1 point per 4 ha (10 acres) until the maximum of 40 sampling points is reached at 160 ha (400 acres).



B. RECOMMENDED DATA DICTIONARY OR DATA LOGGER MENUS

1. OBSERVER: Individual performing data entry.

2. SEASON OF BURN: Log whether season was growing or dormant.

3. HABITAT TYPE: Set default entry to most typical habitat for burn unit.

4. FUEL MODEL 1: Enter primary fuel model type based on Florida habitat examples.

5. FUEL MODEL 2: Enter secondary fuel model type based on Florida habitat examples if necessary.

6. TOPOGRAPHY: Wetland; Flat (0-3%), Slope (3-8%), or Steep Slope (9-15%).

7. SUBSTRATE BURN SEVERITY CLASS*:

TABLE 3.3

Substrate Burn Severity Class*					
	Unburned	Scorched	Lightly Burned	Moderately Burned	Heavily Burned
Substrate (Litter / Duff / Fine Fuels)	Not burned	Litter partially blackened, duff nearly unchanged, wood/leaf structures unchanged.	Litter charred to partially consumed, upper duff layer burned, wood/leaf structures charred, but recognizable.	Litter mostly to entirely consumed, leaving coarse, light colored ash, duff deeply burned, wood/leaf structures unrecognizable.	Litter and duff completely consumed, leaving white ash, mineral soil visibly altered, often, reddish in color, wood/leaf structures consumed.

**** NATIONAL PARK SERVICE, 1991.***

C. FINE-SCALE MEASURES - INFORMATION COLLECTED FOR CONDITIONS WITHIN 4 M (13') RADIUS OF SAMPLE POINTS (CA. .001-ACRE SAMPLING)..

8. SMALL HARDWOOD STEM DENSITY*: Estimate the average number of small hardwoods and brushy stems per m^2 within a 4 m (13') radius. Categories are: 0, <1, 1-5, 5-10, 10-20, and >20.

   ** Small Hardwood Stem = stems < 1" diameter (typically <8' high).*

9. SMALL HARDWOOD TOP-KILL: Estimate % mortality for small hardwoods and brushy stems per m^2 within 4 m (13') radius. The categories are: N/A, None, 1-30%, 31-60%, 61-90%, and >90%.

10. SMALL PINE STEM DENSITY*: Estimate the average number of small pines per m^2 within 4 m (13'). Categories are: 0, <1, 1-5, 5-10, 10-20, and >20.

    ** Small Pine Stem = stems < 1" diameter (typically < 8' high).*

11. SMALL PINE TOP-KILL: Estimate % mortality for small pines per m^2 within a 4 m radius (13') radius. Categories are: N/A, None, 1-30%, 31-60%, 61-90%, and >90%.

12. SMALL EXOTICS STEM DENSITY*: Estimate the average number of small exotics per m^2 within a 4 m radius (13'). Categories are: 0, <1, 1-5, 5-10, 10-20, and >20.

    ** Small Exotics Stem = stems < 1" diameter (typically < 8' high).*

13. SMALL EXOTICS TOP-KILL: Estimate % mortality for small exotics per m^2 within a 4 m radius (13'). The categories are: N/A, None, 1-30%, 31-60%, 61-90%, and >90%.

D. LARGER-SCALE VARIABLES - INFORMATION COLLECTED FOR CONDITIONS WITHIN 12 M (CA. 40') RADIUS OF SAMPLE (CA. 0.01-ACRE SAMPLING).

14. CANOPY HEIGHT: Estimate height of tallest tree within 12 m (ca. 40') radius. Categories are: N/A, 10-20', 20-40', 40-60', or >60'.

15. CANOPY SCORCH: Estimate canopy scorch on trees within 12 m (ca. 40') radius. Canopy scorch percentages are taken on the volume browned or consumed. Categories are:

    N/A

    No scorch - All tree crowns unscorched.

    Spotty scorch - Partial scorch on at least 1 canopy tree, but some trees unscorched.

Moderate scorch - Partial scorch on all tree crowns, but few canopy trees completely scorched.

Heavy scorch - Nearly all tree crowns completely scorched, but few crowns consumed.

Extreme scorch - Nearly all tree crowns consumed.

16. MIDSTORY/BRUSH SCORCH: Estimate midstory scorch on trees/shrubs >3 m (10') and < 10 m (32') within 12 m (40') radius of sample. Midstory scorch percentages are taken on the volume browned or consumed. Categories are:

    N/A: vegetation layer absent

    No scorch - All visible vegetation within the 3-10 m (10-32') tier unscorched.

    Spotty scorch - Partial scorch on at least 1 tree/shrub within 3-10 m (10-32') tier, but some unscorched.

    Moderate scorch - Partial scorch on all trees/shrubs within 3-10 m (10-30') tier, but few scorched.

    Heavy scorch - Nearly all tree/shrub crowns completely scorched, but few crowns consumed.

    Extreme scorch - Nearly all tree/shrub crowns consumed.

17. CHARRING: Estimate charring on nearest large tree >4" DBH within 12 m (40') radius.

    Categories are: N/A, < 6', 6-12', > 12'

18. PRE-BURN TREATMENTS: Note all pre-burn treatments within 12 m (40') radius of sample.

    Categories are: None, Chemical, Chopping, and Mowing.

19. POST-BURN TREATMENTS: Note all post-burn treatments within 12 m (40') radius of sample.

    Categories are: None, Chemical, Chopping, and Mowing.

Figures. Examples of fine-scale and large-scale variables.

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Dense small hardwood stems (>20 per m^2), top-kill >95%.

5-10 hardwood stems per m^2, top-kill 60-90%.

Dense small hardwood stems (>20 per m^2), top-kill 60-90%.

Sparse small hardwood stems (<1 per m^2), top-kill >95%.

Midstory/brush scorch = heavy

Canopy scorch = no scorch; hardwood stems (foreground) 10-20 per m^2; small hardwood top-kill >90%; small pine stems (background) 5-10 per m^2; small pine stem topkill <10%

EXAMPLES OF MORE ELABORATE FIRE EFFECTS MONITORING PROGRAMS

1. NATIONAL PARK SERVICE FIRE MONITORING HANDBOOK

This program consists of a 4-tiered monitoring program mandated by the federal government and designed to collect fire data on all national parks. The initial 3 tiers are similar to the tiers proposed here, but long-term protocols are provided for tier 4 monitoring. Level 4 monitoring allows managers to identify significant trends to guide future fire management decisions. The National Park Service Fire Monitoring Handbook can be found on the National Park Services website at: www.nps.gov/fire/fire.fir_eco_science_monitoring_FMH.html.

2. USFWS: FUEL AND FIRE EFFECTS MONITORING GUIDE, SOUTHEASTERN REGION

This guide is used to outline the monitoring of prescribed burning on national wildlife refuges and other sites managed by the U.S. Fish and Wildlife Service (2006) in the southeastern United States. The guide includes techniques for measuring fuel treatment effectiveness, fire management objectives, and progress towards meeting refuge habitat objectives. The handbook provides a step-by-step fire monitoring program and includes flexible sampling procedures for collecting photo-monitoring, fire weather and behavior observations, smoke observations, fuel load estimates, burn severity, vegetation abundance estimates, vegetation species composition and structure, and emergency stabilization and rehabilitation methods. The guide details how data is collected, estimates time and resource requirements, explains how data collection forms are created, and provides data analysis techniques to facilitate adaptive management.

3. FIREMON: FIRE EFFECTS MONITORING AND INVENTORY SYSTEM, US FOREST SERVICE

This program provides protocols and software programming designed to support agency fire monitoring requirements. The FIREMON guide allows land managers to “design a monitoring project, conduct field sampling and, store and analyze their fire effects and other monitoring data” (Lutes et al. 2006).

APPENDIX 2. Forty-five-question survey distributed to land managers in Florida. A total of 87 surveys was returned (Table 1).

A Survey of Prescribed Burning
on Florida Conservation Lands

The conservation and management of many declining species hinge on the frequency of prescribed burning conducted on conservation lands in Florida. Fire has a dramatic influence on vegetation structure in almost all upland habitats in Florida, and prescribed fires are essential to sustaining many of the State=s most imperiled natural communities. Effective management of Florida=s fire-dependent communities requires better information on the efforts, accomplishments, and needs of land-management agencies trying to meet prescribed-burning goals. We also need better documentation of problems that land managers face as they attempt to use fire in an increasingly urban landscape.

To understand both the variation in protocols that exists as well as problems that land managers encounter when trying to burn, we developed an anonymous survey to help assess the state of prescribed burning on conservation lands throughout Florida. Funding for this study has been kindly provided by the *Florida Fish and Wildlife Conservation Commission=s State Wildlife Grants Program.*

We greatly appreciate your taking 30-45 minutes to complete the survey and returning it to us by the end of July 2005. We believe a better understanding of conditions in the field will be essential to expanding the resources and support needed for this critical management tool. We would like to have the survey completed by the person who oversees most of the burning performed on your managed area and also makes decisions regarding the timing and scope of burning.

The form was created using Adobe Acrobat Reader© and can be filled out on your computer if you have a copy of Adobe Acrobat Reader (www.adobe.com). You also may print the form and complete it by hand. For those using computers, you may save the survey as you work for convenience. Simply the file to your hard-drive by giving it a new new name (e.g., GreenSwampResponse.pdf). Once completed, you may return the survey electronically by simply attaching the form to an e-mail sent to jcox@ttrs.org, or by sending the survey to the address listed below.

We appreciate the time taken with the survey as well as the hard work public land managers perform on behalf of Florida=s great natural heritage. We trust results from this survey will provide you and your colleagues with a better understand of the state of prescribed burning in Florida and also help in the management of some of Florida=s rarest habitats and species.

Jim Cox and Kevin Robertson
Tall Timbers Research Station
13093 Henry Beadel Dr.
Tallahassee, FL 32312

Questions? Contact me via e-mail (jcox@ttrs.org) or phone (850) 893-4153 ext. 223

SITE INFORMATION

Managed Area: Approximate Acreage:
Lead Management Agency:

PERSONNEL INFORMATION

What is the highest education degree of the person overseeing prescribed burns on this area?

GED/High School __ 2-year AA __ Bachelor's Degree __ M.S. or Ph. D. __

2. What was the primary study area for the person overseeing prescribed burns on this area?

Wildlife Biology Fisheries Biology Forestry
Conservation Biology General Biology Geography
Archaeology History Ecology
General Education Other

3. How many years has the person overseeing prescribed burns on this area been serving in that role?
<2 2-5 5-10 10+ years

PRESCRIPTION/IGNITION ISSUES

4. Are the burn blocks in your managed area digitized and available for analysis using GIS?
Yes ____ No ____ Don't know ____

5. Do you have GIS software available and do you (or someone else in your office) regularly use GIS for fire management and evaluation?
___ Not available
___ Available but not used because of a lack of training
___ Available but not used because of a lack of time
___ Available but not used because appropriate GIS data layers not available
___ Available and used occasionally
___ Available and used frequently

6. What is average size of burn blocks on your managed area?
_____ acres _____ not sure

7. How would you describe the variability of season and prescriptions (e.g., humidity, wind direction, etc.) applied to the individual burn blocks each year?

___ Similar season and prescriptions used frequently
___ Season may vary but prescription fairly consistent
___ Both season and prescription vary considerably

8. How would you describe the ignition patterns you use on the average burn block?

___ Ignition patterns similar from burn to burn
___ Alterations to ignition pattern made as necessary
___ Effort made to vary patterns from burn to burn

9. Which ignition patterns do you typically use most (check 3 maximum)?

___Strip head fires ___Point ignition head fires
___Strip flanking fires ___Point ignition flanking fires
___Strip backing fires ___Point ignition backing fires
___Ring fires

10. Which ignition tools do you use most frequently (check 2 maximum)

___Hand-held drip torches ___Helicopter & ping-pong balls
___4-wheeler with drip torches ___Helicopter drip torches
___Truck with mounted torch ___Other

11. If it were possible to burn at night, how frequently do you think you might attempt to do so (circle one)?

Never Occasionally Seldom Frequently

HABITATS BURNED

12. If your managed area contains any of the habitat types listed, please check the return fire intervals (or fire rotation) that you use for each habitat type. The available choices were scaled for each habitat. For example, if you burn pine flatwoods at 5-year intervals, you should circle the ■5" next to ■Pine Flatwoods•. Please provide answers only for habitats you manage.

Sandpine Scrub	5 __	10	15	20	21-40	>40	
Oak Scrub	3	5	10	15	20	>20	
Sandhill/High Pine		1	2	3	4	5	>5
Scrubby Flatwoods		1	1	3	4	5	>5
Pine Flatwoods	1	2	3	4	5	>5	
Dry Prairie:	1	2	3	4	5	>5	
Pastures and Fields:		2	3	4	5	10	>15
Seasonal Marshes:		2	5	10	15	20	>20
Tidal Marshes:	2	5	10	15	20	>20	

13. If you believe you need to adjust your burning in the habitats you manage, how large an adjust would you like to make? If you want to increase burning in Pine Flatwoods, you might answer ■increase burning 10%• in the space provided; if you want to reduce burning in Dry Prairie, you might answer ■decrease burning 10%• in the space provided.

Sandpine Scrub: Dry Prairie:
Oak Scrub: Pastures and Fields:
Sandhilll/High Pine: Seasonal Marshes:
Pine Flatwoods: Tidal Marshes:

14. Provide an estimate of the percent of your managed area burned in the following seasons:

Winter (Nov-Jan) ____ Summer (May-Aug) _____
Spring (Feb-Apr) ____ Fall (Sep-Oct) _____

15. If you believe you currently need to adjust seasonal percentages to meet desired management goals for different habitats on your managed area, please describe briefly the adjustments you might like to make. No answer means no adjustments needed; another answer might be ▪increase winter burning 10%•.

Sandpine Scrub:
Oak Scrub:
Sandhilll/High Pine:
Pine Flatwoods:
Dry Prairie:
Pastures and Fields:
Freshwater Marshes
Tidal Saltmarsh

16. Some habitats may be fire suppressed to the point that prescribed burning might be dangerous or ineffective. If this has happened on your managed area for any of the habitats listed below, please estimate the percentage that can not be managed using prescribed burning exclusively.

Sandpine Scrub:	<5%	6-20%	21-45%	>45%
Oak Scrub:	<5%	6-20%	21-45%	>45%
Sandhilll/High Pine:	<5%	6-20%	21-45%	>45%
Pine Flatwoods:	<5%	6-20%	21-45%	>45%
Dry Prairie:	<5%	6-20%	21-45%	>45%

17. When looking at the boundaries of your typical burn blocks, estimate the percentage of boundaries that are established by the different features listed below.

Water bodies/Wetlands ____
Roads and trails ____
Plowed lanes ____
Mowed lanes ____
Other ____
These should total 100%

18. Which post-burn evaluation procedures do you use for this managed area (check one)?
None U.S.Fish and Wildlife Service The Nature Conservancy
U.S. Dept. of Interior Procedures list in mgt. plan U.S. Forest Service
None

Other:19. Are post-burn surveys, transects, and other evaluations geographically referenced using a global positioning system and/or GIS?

___ Yes ___ No

20. Please check any post-burn treatments that are typically applied. ▪Post-burn• means the treatment is within 3 months of burning. Leave blank if no treatments are applied.

Roller Chopping Mowing Disking Other Cutting Herbicide

21. What percentage of a typical burn area receives post-burn treatments?

___ < 5% 10-25%
___ 5-10% > 25%

22. Do you have any permanent vegetation plots or vegetation monitoring programs that can be used to follow changes in vegetation over time?

___ Yes ___ No

23. Which vegetation surveys do you use (circle all that apply)?

Vegetation transects Photo points
Vegetation quadrats Fixed or variable radius plots
None Objective Based Vegetation Management
GPS database Other

24. List any species for which you do any systematic surveys:

PLANNING ISSUES

25. Does your managed area have a written, long-range (>5 years) burn-management plan?
___ Yes ___ No

26. If no plan exists, do you envision developing a burn plan sometime during the next 2 years?
___ Yes ___ No

27. Does your managed area have a written, short-range (<5 years) burn-management plan?
___ Yes ___ No

28. If neither plan exists, could you briefly describe how you determine which areas to burn each year?

29. If a plan exists, when was it adopted? Date: _____ (year adequate)

30. Has the plan been implemented to your satisfaction?
Yes No (leave blank if no plan adopted)

31. If a plan has not been implemented to your satisfaction, which elements need the greatest attention before implementation can proceed *(leave blank if no plan adopted*)?

___ Administrative backing and support
___ Appropriate training in prescribed burning techniques
___ Budgetary support for staff time
___ Budgetary support for equipment needs
___ Information available from research and technical publications
___ Pressure provided by outside advocacy groups or local residents
___ Staff effort and dedication to managed area

___ Other (please describe):_____
___ Other (please describe):_____

32. What technical information do you need to achieve management objectives stated in the burn plan? (check all that apply)

____ Fire models developed specifically for Florida habitats and conditions
____ Better information on effects of burning on rare plants
____ Information on appropriate fire regimes for (check all that apply)

Sandpine Scrub	___
Oak Scrub	___
Sandhilll/High Pines	___
Pine Flatwoods	___
Dry Prairie	___
Pastures and Fields	___
Seasonal Freshwater Marshes	___
Tidal Saltmarshes	___

____ Better information on effects of prescribed burning on air quality
____ Better information on effects of fire regimes on timber growth and yield
____ Better information on effects of fire regimes on seedling establishment and forest regeneration
____ Better information on effects of fire regimes on state or federally listed wildlife

List top 2 species of concern:
____ More effective outreach materials
____ Better funding for land management
____ Other (please describe): _____

33. Does your managed area share a boundary with another managed area?
Yes ___ No ___

34. If ▪Yes,• describe the level of coordination that typically takes place when developing burn plans?
___No or very minimal coordination
___Burn plans are shared and referenced periodically
___Managers meet every few years to discuss and coordinate burning
___Managers meet annually to discuss and coordinate burning
___Managers meet twice a year or more to discuss and coordinate burning

35. Do you share equipment with another management area in your vicinity?
Never Seldom Occasionally Frequently

36. Does your agency or managed area make use of special strike teams?

Never Seldom Occasionally Frequently

37. What are the 3 most important reasons you give when describing why you burn (please check a maximum of 3)?
____ Control of exotic plants
____ Improve general habitat conditions
____ Improve wildlife populations
____ Improve wildflower areas
____ Improve endangered species habitats

____ Improve forage for cattle
____ Improve scenic quality or aesthetics
____ Maintain natural disturbance regimes
____ Promote specific warm- or cool-season grasses
____ Reduce threat of wildfire
____ Promote timber regeneration
Release timber from hardwood competition
____ Thin over-stocked timber stands
____ Other**:** _____
____ Other**:** _____

38. List the top 3 barriers to conducting burns, if any, on your management area (please check a maximum of 3
___ No barriers
___ Awaiting staff training
___ Conflicting resource management goals (e.g., coincides with nesting of rare species)
___ Conflicting site goals (e.g., emphasis on visitor numbers, historic resources)
___ External legal challenges or public opinion concerns
___ Improper fuel characteristics
___ Knowledge gaps that thwart decision-making
___ Not enough qualified staff resources
___ Not enough equipment resources
___ Restrictions on accumulation of over-time pay
___ Smoke management restrictions
___ Too few burn days permitted by authorities
___ Wildland/urban interface issues and fear of fire escape

SOCIAL AND CULTURAL ISSUES

39. List the smoke-sensitive areas surrounding your managed area that influence decisions whether or not to burn (circle all that apply)?

Urban Residential Major roads
Airports Health facilities Others

40. How many complaints from the public do you typically receive following a prescribed burn?
None 1-2 2-5 >5

41. Has your managed area been threatened with a lawsuit, court injunction, or some other legal prohibition related to burning?
Yes ___ No ___

42. Has there been a proposed change in municipal or county ordinance as a result of prescribed burning in your area?
Yes ___ No ___

43. How would you describe the opinions of neighbors of your managed area on the issue of prescribed burning?

___ Very favorable
___ Favorable

___ Mixed
___ Unfavorable
___ Very unfavorable

44. What is the approximate percentage of burn requests rejected annually?
<5% 5-10% 10-20% 20-35% >35%

45. Do you view the Florida Department of Forestry=s new certification revocation process as a potential impediment to burning?
___ No ___ Possibly ___ Definitely

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APPENDIX 4. Notes from phone conversations and meetings with agency personnel.

A. State agencies

1. Florida Division of Forestry (DOF)

7/29/05 – John Saddler, Florida Division of Forestry, Prescribed Fire Manager

- No monitoring procedures; everyone does different monitoring.
- State Lands Handbook – has a post burn evaluation form..

8/18/05 – DOF Burn Authorization Office 850-488-1871

- This office collects name, address, # of people on burn, location, equipment, what (acreage - pasture, hazardous removal, wildlife reasons, building; or pile - size)
- computer program to associate weather/smoke management concerns.

2. Florida Fish and Wildlife Conservation Commission (FFWCC)

8/22/05 - Mike Allen, FFWCC

- Uncertain of value of monitoring. Needs to see outcomes of existing programs, NPS, USFWS, etc.
- Most useful when done in conjunction with species of management concern.
- FFWCC uses Objective Based Vegetation Monitoring – 2-years post treatment.
- Perhaps use an outside group to perform fire monitoring.
- Remote sensing is a possible option.
- There is a growing need for smoke management due to growing urban-wild land interface across the state.
- When a burn jumps a break or in other extraneous circumstances, the event is then reviewed by the Internal Burn Review Committee.

3. Florida Department of Environmental Protection (DEP)

9/6/05 – Parks Small, DEP

- Monitoring at DEP is mostly based on individual interest; not much underway in general.
- DEP has 101 parks that need fire; 56 of them actually put fire on the ground. Some do photopoints. More detail monitoring is short lived.
- Post burn evaluation form is filled out per block but some blocks are very large. It was suggested that there be a minimum threshold for size of block when monitoring (i.e. for large burn unit, fill out form 3 or 4 times for different areas within the block)
- Just rewrote the minimum standards for burning; wants to put the more effort into burning.
- Post burn evaluation form is out dated, has not been revised for a long time.
- Parks would like to document why land managers are burning and frequency of burns with problems.
- Warned that elaborate monitoring requirements could very well be the last straw; difficult for some folks to find time to burn at all.

- Parks is trying to role accountability into the fire program. He has a yearly summary that includes:
  - Plan for year
  - Zones planning to be burned
  - Acres accomplished
  - Number of burns
  - Back log acres
  - Acres treated mechanically or another way
  - Wildfires
- Statewide database also used: tracks acres burned, training of staff, individual park management, etc. Eventually tied into GIS
- A problem he faces is no overtime; if crew works 40 hours in 3 days, they have to take the next couple of days off regardless of burn conditions.
- Parks doesn't foresee any new $ being put toward prescribed fire; $ goes toward equipment and prep to increase acres burned.
- He is open to allowing outside agencies to come onto DEP land to monitor.
- Fire teams also might travel to assist in burning, but this approach has not been very effective when used elsewhere.
- Folks in DEP have many different duties in their job descriptions; focusing on moves them away from other duties.
- Walt Thompson – TNC, held a meeting of representatives of successful fire programs; found out that a commonality was that all had some form of biology background.

8/18/05 - Terry Hintgen, DEP Dist 4 Land Manager
- Managers fill out forms and file these, sometimes take photos.
- Annual Report includes burn zones, acres burned; however, if burn was patchy, they still record the acreage of the burn block.
- Burn Rx created by park managers, rangers, burn bosses.
- Burn Interval based on FNAI "Guide to Nat Comm of Florida" Feb 1990, FNAI and DNR

4. Florida Counties

a. Hillsborough County

8/30/05 – Sheryl Bowman, Hillsborough Co., Parks, Recreation, and Conservation Department
- bowmans@hillsboroughcounty.org
- In the past, they sent "acres burned" data annually to the Central Florida Prescribed Fire Council. CFPFC has stopped asking for the information.
- Have a number of certified burners. Some are from DOF. Trying to hire contractor to introduce fire into urban areas, $250,000.
- Manage 40,000 acres through Environmental Lands Program (past 18 years), and manage regional parks, 70,000 ac.
- Have a lengthy approval process; DOF permit; Local fire department; county officials; neighbors. Takes up to 2 weeks.
- Post-burn evaluations are conducted; they go back out the next day.

- Some biological monitoring – listed species, rehabilitation grants by the FWC mostly for Scrub Jay areas.
- Data reported internally
- Afraid to set mandate for acres burned. Too many factors.

5. Florida Water Management Districts

a. Northwest Florida WMD

9/2/05 – Tyler MacMillan, NWFWMD, Director of Field Personnel, 850-539-5999 x60

- 3 Land Management offices, Western, Central and Eastern.
- Some burning carried out by offices, some through yearly purchase order, and some through on-going contracts.
- 200,000 total acres - ~~50,000 are dry and potentially burnable – thought not all can be burned because of habitat.
- Would like to be burning 5-6,000 acres in a year. Hard to accomplish. Only end up burning ~4,000 in a given year (some of those acres are "site prep burns")
- Get crews from the Prescribed Fire Training Center (PFTC)
- Post-burn evaluations also required for contractor to receive payment, includes map of area actually burned, prescription, etc. Is sending a copy via e-mail along with quote request for prescribed burning.
- No database, except acreage. Have management records for each stand.

b. Suwannee River WMD

9/2/05 – Ken McLaughlin, SRWMD, phone, 386-362-1001

- Have only 1 office, in Live Oak, FL.
- Manage 160,000 acres
- Develop District Management Plan; Conservation Area Management Plan (by sub divisions of river basins); Burn Prescriptions (written by contractors)
- Most burning done be state certified contractors. Some by DOF and very little by staff.
- Prescriptions and Management plans reviewed by SRWMD.
- Use FNAI natural communities to describe habitat. Recently reviewed/purchased areas have improved maps of natural communities.
- Goals – move habitat from current state to natural/historic conditions.
- Burn priority – use GIS coverage (historic comm., current stand descriptions, areas already burned) to assign priority, 1 2 or 3. Only have money enough to burn priority 1 and a few priority 2 sites. Priority 1 includes acreage burned more recently so they don't fall behind on recovery. Are defining which areas still have not received fire, primarily sandhill sites, and making them Priority 1.
- 2 years ago – burned 12,000 ac; 1 year ago – 3,000; this year – 7,500; next year – forecast 10,000 acres.
- Post-burn Evaluation Forms are used; they are similar to U. S. Forest Service forms. Contractors fill out on day of burn. Inc goals met, scorch, etc.
- SRWMD staff returns later to assess burn, and take more accurate estimates of scorch, etc data.
- No photo points established.

- No database or central report.
- GIS coverage is "stands" coverage, forestry terminology. Trying to move to a habitat description of every acre, and linking GIS to fire database.
- Currently have a contractor putting in Vegetation Monitoring Plots on new Conservation Areas.

c. St. John's River WMD

8/26/05 Steve Miller, SJRWMD, 386-329-4399

- Cover 18 counties; have a legal interest in 660,000 acres
  - 70,000 Less-than-fee easement
  - 160,000 owned but mgt. by another agency
  - 400,000 own and manage
  - 5,000 manage for someone else
- of the 405,000 – split into 5 regions, each with land manager, 2 management specialists, 1 GIS, 2 planners, 12 invasive plant managers (and every one is fire certified)
- 5-6 people burn and all work together.
- Own all equipment.
- Division of Public Works (levees and canals) occasionally helps out.
- Use FLUCS System (developed by DOT) to determine habitat type and burn intervals. Converted to FNAI system sometime.
- Will send me spread sheet of burn data and post burn report.
- Over the past decade or so, have gained ~3 times the land but almost no new employees.
- Do not burn pine dominated stands from Sept 15 through Nov 15 due
- All lands in district in FLUCS coding so he can crunch numbers.
- Coordination with other agencies – DOF, USFWS, FS, DEP, 3 or 4 counties, TNC, and sometimes FWC coordinate training, typically use barter system to avoid paperwork. MOU's established.
- If half the management unit is underwater; still say entire thing burned

d. Southwest Florida WMD

9/2/05 – Will Van Gelder, SWFWMD, Land Management Specialist, 352-796-7211 x4467

- Manage property in 15 counties. 310-320,000 acres owned In-Fee.
- Properties are assigned to individual specialists, from 1 to 6 per, depending on size of property.
- Most burning done in-house. 25-30,000 acres per year. Mail focus is water quality so it is hard to say how much should be burned. He guesses nearly 35,000 acres annually.
- Difficult to burn in WUI properties with increased fuels. They do hazard reduction burns before ecological burning. Estimates of fuel reduction not recorded, only understood.
- Are in process of converting system from maps to GIS data layers of burn units. This year all burn units will be entered into database.
- Post burn evaluations are conducted; weather recorded 2-3 times during burn, flame length; spot over, scorch, goals met, comments
- Are working on database of polygon per unit to link to database of information.
- Have areas of Restoration where they do some photo-monitoring.

- It is more important to get the burning done; can't spare the workers during burn season.
- Assist DOF with wildfire response.

e. South Florida WMD

8/18/05 – David Black, SFWMD, Staff Environmental Analyst, 561-686-8800 x2747

- Or 561-682-2747, direct to office.
- Shape files on web site → areas burned.
- Simple Burn Plan – filled out and attached to Rx, inc % scorch.

B. Florida Universities

1. University of Florida (UF)

9/8/05 – Steve Coates, University of Florida, Program coordinator for Ordway/Swisher preserves 352-846-0576

- coates@ifas.ufl.edu
- Ordway preserve is 6,300 ac; Carl/Swisher is 3,000 (owned by TNC, managed by university); Austin Cary is 2,000 ac.

2. Florida State University (FSU)

3. University of Southern Florida (USF)

C. Federal agencies managing land in Florida

1. National Park Service (NPS)

2. US Fish and Wildlife Service (USFWS)

3. US Forest Service (USFS)

8/26/05 – Bruce Davenport, U. S. DEPARTMENT OF AGRICULTURE, USFS

- In public arena there are 3 types of monitoring:
  - Implementation – goals accomplished; did fire burn, timber improve; internal questions answered; Plan document that set goals for project is put out to publication including any mitigation.
  - Effectiveness – for mostly private sector; did we achieve what we set out to achieve? ex. Fuel loads before and after.
  - Validation – Research based. Scientific design. Validate assumptions; address public concern about conflicting research.
- Good to be able to report Fuel decreased by how much?
- Smoke Management – in Mountains, learned that they were actually burning less fuel than they thought, might have to change models to reflect this.
- Use smoke monitoring instruments around fires – good to be able to say smoke is NOT at unhealthy levels.
- Predominately monitoring is an in-house standard.
- Can be used to argue cost effectiveness
- Every 5 years is reviewed by the next higher level of FS.

4. Department of Military Affairs (DMA)

9/6/05 – Jim Garrison, Camp Blanding, FWC 904-533-2768

- Jim.garrison@myfwc.com
- Prescribed burning is handled jointly between FWC and Department of Military Affairs
- Told me a little about the fire monitoring program used by Blanding, but will wait to record in case most is repeated or incorrect.
- FWC role is to provide corporation, equipment, staff, etc.

D. Non-profit agencies managing land in Florida

1. The Nature Conservancy (TNC)

8/3/05 – Steve Morrison, TNC, LWR region

- Conducted survey of land managers in LWR region as intro to fire monitoring meeting on Aug 11th from 8-12 at Avon Park Air Base, FL.
- Survey sent to WMDs, DEP, SPs, FWC, DOF, good response. Goal is to get fire managers to contribute data on one level or another to understand # of acres burned and results of burn.
- Ex – Scrub Jay Pres Fire Strike Team – acquire more SJ habitat, habitat declining due to fire suppression. Need way to document use of fire.
- Are conducting vegetation monitoring, but NO fire effects monitoring.
- LWR working group – committee to address issue of monitoring, fire, hard time agreeing, have agreed not to do anything!

8/3/05 – Zach Prusak, TNC, FL fire manager

- No one can agree on monitoring procedures.
- TNC has forms but not widely used.
- 6 months – standardized monitoring sheets on national level.
- Central Florida as fire college; use students to conduct monitoring.
- Some managers are open to adaptative management.
- Universities should do more Fire Research and should be included in conversation.

8/23/05 – David Printiss, TNC, Apalachicola Bluffs, phone

- Each TNC preserve has own form.
- He is currently updating, old too indepth, wants to assess control of hardwoods, wiregrass blooming, etc.
- TNC vs. State Facility – turnover is less…can see changes personally over time
- Consistency prob – biologists conducting surveys?
- Photopoints are very helpful – cheap and dirty.
- PBE – several days after, trees able to die or brown (see top-kill), and photopoints
- LWR takes weather data, how fire lit, last page is post burn effects, % burned, intensity…
- PBE has roots in research, maybe correct prescription is enough?

2. Tall Timbers Research Station (TTRS)

E. State wide and regional cooperative groups

1. Lake Wales Ridge Working Group (LWRWG)

2. Gulf Coast Plain Ecosystem Partnership (GCPAP)

3. Fire Learning Network (FLN)

8/25/05 – Keith Fisher, TNC, SE Region Fire Ecologist, FLN and LANDFIRE, phone

- There are a couple of Fire Learning Networks (FLN). Eglin AFB is established.
- Put network together on a landscape to work through fire management. Identify projects, secure funding, develop monitoring protocol.
- LANDFIRE – nationwide, looking at comprehensive set of tools that address fire, ecology, land management.
- 100 diff GIS layers – existing veg types, existing cover classes, existing biophysical settings (historic habitats through ecological modeling), fire regime condition class (FRCC, degree of separation of past and future conditions).
- Work through partnership to determine needs for monitoring.
- USFWS, USFS, NPS, DEP, DOF, and many more FL agencies.
- Just started one last January.
- FLN and LANDFIRE – tasked with app projects, compile data, used to compare to National Fire Product.
- Vegetation Dynamics Development Tool

8/26/05 – Paula Seamon, TNC, in her office

- NFP – funded a grant 3 1/2 years ago for: fire ed, fire training, and FLN.
- FLN is a process.
- 25 sites across the nation, attend a series of 4 meetings, all with homework assignments.
- Have discovered that nationwide approach is not as effective as regional.
- LANDFIRE – national, to identify current veg class, funded directly by congress for TNC to develop ecological models, answer question “if don’t treat then what?”
- Use priority fuel treatment both ecologically and economically.

APPENDIX 5. Notes from 2 workshops. No notes were taken for the north Florida workshop in Lake City.

Bartow, December 14, 2005

Proposed Tier 1 Monitoring

How many use FNAI: most appeared to use this classification system.

Are fuel models burdensome?

Subunits within burn units may be a helpful change because the units do not burn each year; this is useful in the GIS because not all the burn unit burns each year.

When people are setting this up on GIS, they should be aware of this. The target acreage listed on the form should get at the problem. If half the burn block is burned from another fire, it will not be in the target acreage for the year.

If you are using a baygall to break the fire, how do you estimate the acreage burned? Pull the baygall out or leave it in. Breakdowns by target acreage again should get at this.

FNAI descriptions: What other non-natural community types need to be included? Need more ruderal habitats, as well as exotics.

How many know Rothermel classifications (about 75% said "yes"); FNAI classification: 50%

Proposed Tier 2 Monitoring

Is it convenient to put the weather data in a standard file format?

May be best to change wording of "firing techniques" vs. "ignition techniques."

Landowner number needs to be included.

KBDI: why is it grayed out; the FDEP has a description they use, and days since the last rain may be the best way to get at this. All of this information is collected by most of the people present.

Customer number now used by DOF and a burn number; customer number collapses two items.

Proposed Tier 3 Monitoring

Canopy scorch: web sites that give examples of what is being requested would be helpful. It can be read either way at this point. It's really murky; say how much of canopy was scorched over

how much of the area. To average that out is difficult. What percentage of the area is lightly scorched vs. what the total percentage is scorched.

Percentage of each area in each category, differentiated by community types. Make this a matrix more than a row of options.

Refine some of the percentages because most pinelands will be a certain minimum and the resolution isn't adequate.

Are the wetlands inundated or dry? How soon does it rain after the burn is another variable of interest. At the point of a post-burn evaluation has it rained and how much?

It's really difficult to give an average for burn severity; it's almost meaningless; these data are too general. TNC has a write-up and they enter general description. Those guesses are better than no information. Would a guess be better than no information?

Danger with minimal approach; drive-by surveys often get inflated values for the acreage that is burned; broad estimates aren't helpful.

Specific recommendation that these data should be based on a walk-through of the property.

Need to characterize the nature of the estimate for the data; include some caveat for the most impressionistic data; perhaps specify how the data can be used.

Substrate burn severity is not used by TNC and DOF. Vegetation severity is used instead. Very hot burn had every category represented; vegetation qualifiers (all twigs burned) are better than substrate measures. Ridge bias is towards scrub/flatwoods, so the vegetation severity class is preferred. Huge amounts of duff in some areas and it's not very meaningful.

If you have canopy scorch, then we should kick people into conducting transects, perhaps may be a way to take the form here. Need to be thinking in terms of what the significance.

Pine scorch is not important.

Perhaps list the burn objectives and decide whether the burn objectives were met. This allows comparisons, but keeps the forms at the local level. This could allow distinctive questions to arise for each management area.

Include some measure of what the objectives were and whether the objectives were actually met on the ground.

Include a habitat column that determines whether the habitat objectives were met for the habitat types that are listed here.

Would you like a standard choice of objectives, or have an opportunity to list the objectives.

Table needs to be broken out; too simple; ask people to list how confident they are for the values they are reporting.

Are there objectives for each level? No, it's based on what we thought we could get. A better way to think about this is what do we want to get from each tier. Tier for were management objectives met.

Transects done using GPS. Specifics were not listed, but the information is the same as in Tier 3 but at multiple transects. May be best to distinguish by precision of data.

Higher Tier

Just point to federal standards; monitoring plots, and things like these. Photo points are a very simple procedure.

Should we even try to standardize the information being collected? This level would be very burdensome.

Once the technology jump has been made, it takes only a few days to collect.

When you are at higher tiers, it may be vegetation monitoring rather than fire monitoring. Probably just want to eliminate this tier, or that it doesn't belong in the recommendations.

That's not true; the fire helps to inform the vegetation data that we also are collecting.

Without the vegetation data, tier 5 doesn't really tell you anything, so it may not be necessary as another tier here.

You can do qualitative vegetation monitoring very easily, so why collect information on pine mortality and scorch?

We approached from the perspective of what can be collected within a narrow time window.

Perhaps needs to be cast as vegetation monitoring soon after a fire rather than burn monitoring per se.

Tiers 1 and 2: important to get very accurate data, but for higher tiers, there are other goals and objectives. So maybe we need to focus on lower tiers and then leave standardization for the higher tiers as vague at this point.

What if you have a very general form that is filled out a year plus later rather than more intensive information at the site level. Turn the table into a sequential measure rather than more intensive measurements taken at each site.

Lake Wales: shrub height, pine density; bare sand patches are very important; shrub density and height. In sandhills, herbaceous understory is very important.

One measures wiregrass vs. oaks; general dominance of different vegetation types. It's difficult to make one size fits all.

Different management objectives for different sites. Sometimes it's just get fire in there, once, and then refine it later.

Would want to accommodate the collection of very detailed data that is not routinely done.

Big issue is the degree to which agencies are using mechanical (and chemical) surrogates instead of fire.

What is the accuracy that you want for each tier? Organize the methodology rather than organize the information being collected.

Instead of dumping the data in a form, decide on what data you are dumping into a form and then contact information. Perhaps would link up people collecting similar information.

The overall purpose is to share information, so the goal of tier 5 is to find out who is collecting information and about getting the data, or the metadata standards. Just have a check box of what additional data you are collecting for your site? This would also help to determine whether there was a need for the data.

Some may want to collect information and may not know how.

Surrogate species monitoring? Might that be a better approach? Is anyone doing that? Dissertation project.

Data submission and analysis

Central database: need to have some means of updating the database by the person collecting the information. We send data somewhere and we get something different back. Have a password where you could upload the information and then retrieve it later.

FNAI invasive species database has been a problem for those in the field.

UCF has a GIS-based unit that they plug in information for their unit. The agencies plug in the information that they would like for each site.

Some institutions are setting up the database along the lines that UCF is for their areas. Questions about Tier 1 and 2.

Wouldn't it be easier just to include this information when the prescription is submitted? Tier 1 would be basics, and then include additional as time goes on. A lot of the Tier 1 data are available, or so we think.

What most managers will be able to give you most of the time is pretty minimal. Tier 1 and 2 are important for those managers are strapped for time. They also want to be able to find who is doing research and where.

Some of the information in Tier 2 should be placed in Tier 1. Tier 1 should be available and should be required by law. Tier 2 represents the first step beyond. Simplify the tier systems and then add a temporal component.

Tier 1: burn prescription
Tier 2: what happens on day of burn
Tier 3: what happens several days after the burn.

TNC has a lot of space on their forms that allows for comments on what happened; need to allow space for those types of comments on any form. A weather oddity, or the fact that a hurricane passed through early the previous year and left a lot of dry debris on the ground and the site burned extremely well. Need to have a way to look back at the history of the block, too.

Tier 1: all that stuff in there gets tabulated by DEP. This could be input for all their lands. Tier 2 is not in digital format and DEP likes to have it separated out.

Habitat type descriptions: if there were 10 different community types, each would be listed? How fine should this part of the form be broken out?

Is it easier to list in terms of acreage or in terms of percentage of blocks. Probably easier to use acreage now that GIS tools are available.

FNAI: stay tune to an update of their new natural community description. The new descriptions will probably be fine-tuning.

Should rename Tier 1 to be something different because you are simply reprocessing the information available from burn prescriptions.

Look at Widpekia as an example of an adaptable database, an encyclopedia that all can change and edit.

Use opaque paints that respond to different temperatures. Paints are $20 per vile.

Infrared tools can be used to measure fire temperatures, about $100, same thing used by air conditioning guys.

Fire councils should be used more for educational purposes. Devote more time to preparation of materials and presentations here. Largely the last thoughts on the heads of those that attend these, but it would be very helpful.

Hillsborough County has a database already developed that has been used for years now and may have some information that we use.

Lunch

Agree to changing yes/no about burnable habitat to acreage that is target for burn. Some habitats won't burn, but sometimes the goal is to have a patchy burn with a certain acreage burned. There is a bias in dealing with small blocks that don't translate to the 500-acre level. Tier 1 should be on prescription, vs. what is cut and paste from your own habitat type.

Express interest in broad kinds of changes in vegetation. Long-term monitoring would be advantageous so that broad changes in vegetation would be great. Changes in basal area of pines vs. oaks; herbaceous vs. woody. One person on a tract for 20 years has seen dramatic changes from palmetto to herbaceous. That type of information will not be included in these programs yet could be helpful.

Everglades
December 15, 2005

Proposed Tier I Monitoring

What should be in tier 1. What would agencies like to know about one another?

FNAI, Rothermel codes deemed useful.

Habitat types are included in reports. Mention predominant model and habitat, don't mention every habitat and relative habitats. It would be easy to estimate those other variables.

GIS maps of habitats were available for almost all present.

Would it be helpful to lump some FNAI?

Schuette: I like to lump. Hard to decide on Corbett where wet flatwoods and wet prairies start/stop.

Do not see altered habitat types. Predominant exotic or other cover types need to be included. It would change your behavior and fires move it from restoration to maintenance.

Standard Fuel Models:
Is this helpful? And is it difficult to assess?

No strong feelings; total silence. It's important to include in first tier, otherwise why are you burning in the first place? If you don't know what your fuels are, you should not be burning.

Tier II

Characteristics of weather and fire on day of burn.

Right now it applies to whole burn block. Should it be divided by different habitat types?

Lots of the fuel models are for 16 tons per acre from western habitats, not the 2000 tons for Florida habitats.

Sugar cane burning; what does their particulate release do? Smoke management may use E-vans to monitor smoke output more effectively. These monitoring areas would be helpful for measuring particulate matter in the air

This stuff is on the prescription, so it should be on Tier 1 form as well.

Smoke problem. Need to specify what the smoke problem was.

Having the information on when you burned and under what conditions and then what happened when the fire was set, that would be good information.

What are the different categories of smoke that might be meaningful?

Did plume go in right direction; did plume hit ceiling; did it lift and get out of here, or did it fall on a major road or area of concern?

Simple information on whether there were problems/complaints or not?

KBDI is not used at Loxahatchee; they use height of interior water rather than the index. Include an N/A box.

Dispersion forecasts have problems that track back to the original forecast. So you might want a question about whether plume was representative of what was predicted. A small difference in ground speed can throw off plume characteristics dramatically. How did smoke lift relative to projection.

Another problem might be failure of land managers to report escapes because of the point system now used by DOF that de-certifies burners. The DOF point system is being represented down hear. FFWCC asks a permit to burn 3x as much area as they actually burn each year.

Distinguish stop-overs from escapes. The accuracies could be difficult.
Most are collecting about 80% of the information asked for in Tier II already.

Tier III

Canopy scorch: is scorch correlated with flame length?

What is the best way to do it? Pole char and flame length are recorded by USFWS. Not part of the objectives, FFWCC classifies by percentage that falls in different scorch categories.

Lots of insect damage occurs post burn, so it helps to identify areas to keep an eye on.

Could also apply to exotic species, too. Did we kill them and did they come back? Including information on exotic and its interaction with fire would be helpful. Exotic control is what they use fire for in south Florida; Lygodium is on interest in south Florida.

Tree root damage is another problem, particular wagon wheel effect. Was there root damage, bole scorch, or anything else that is weird.

Substrate burn severity: used by several in the audience; most used a similar to this. Palm Beach only uses something liiike this for scrub habitat; trying to expose more mineral soil and an estimate of whether they did or did not.

Ranges of categories:

Are the ranges sufficiently refined? For melaleuca, they report it as percentage of the trees killed.

Lox wrote a prescription for 15,000 acres.

County burns 225 acres; 700 acre burn on the radar screen; 3.5 acres as well.

County collects polygons; photo monitoring plots are GPS'ed.

What other vegetation characteristics are monitored after burn.

Look to see whether Caesar weed or grape vine comes back in; presence absence of exotic species over time. Treatment then used for the exotics.

TNC has more of a research based evaluation. Percent cover bare ground, leaf litter, and vegetation are recorded; information on pine stem densities and growth rates and whether the fires have an effect on this.

Controlling plamettos is an important consideration. Under some regimes the palmettos come back slow and sometimes come back quickly. Some of the native range winter burning does a good job on palmetto; include this as one of the monitoring issues. Perhaps have coarse grass/palmetto/hardwood tabulations.
Objectives

Have a check box for these objectives and whether they were met.

To provide a check box that might be useful to other agencies.

Knowing whether or not photo points were being used. If no other data exist, photo plots are the most recommended because of the visual nature of things. Could be refined the protocols so the system also can be transported from one manager to the next. One meter pole, etc., and measuring pole, too. Looks more professional and rigorous.

There is an emphasis on photo monitoring. Plus a field marker at some distance.

Creating a central database will be most challenging part of this system. Need to be able to report the data on-line?

Feds have 4 databases they report fires into. If there is another on-line database, it's helpful to have all year to put the data in. Have a period when the data are checked. And then have a year-end reminder to ensure the people are reporting the information.

This is by far the biggest problem. One way possibly to go would be to tie reporting requirements to the permit process. DOF could send out a request to ask for some minimum information soon after the permit was issued. If you do 10 reports, you get 10 points toward your burn certification. Perhaps eliminate need for attending re-certification clinics, etc.

The information is out there for federal lands, but it is very difficult to cross-walk.

Data retrieval? It would be nice to be able to get the information from other agencies. The entire thing should be easy to retrieve and use.

Need also to include some wild fire information, not just prescribed burns. What would you do when a wild fire occurs. It should be reported to the same database as best the information allows.

Burn block doesn't even hold up very well on some properties. Natural barriers also influence the burn block. Not uncommon to stop a burn soon after it's ignition. Often doing 1000 acres and there are spots where you can decided to stop a fire.

Could also sell in terms of stopping wildfires and suppression; if a fire is coming up to a block that was burn last year and a block burned 5 years ago, set the break line only in the 5-year area.

Enforce reporting of Tier 1 data. Need some kind of strong carrot here.