



**National Park Service
Fire Ecology Annual Report
Calendar Year 2005**

Summary

The Everglades National Park fire monitoring program faced two major challenges in 2005, attrition of two valuable fire effects positions and the persistent effects of numerous tropical storms. With these challenges present, Everglades Fire effects were able to continue to read plots, refine methodology and begin archiving several thousand photo-monitoring slides. New variables were established to capture fire effects upon the host plants of critically rare butterflies within the frequently burned pinelands of Everglades National Park. Our fire effects monitors serve as advisors to the Pine Rockland Working Group, an international, multi-agency effort which has been effective at making recommendations and taking action to protect this imperiled ecosystem. Everglades National Park fire effects personnel have designed photo-monitoring protocols which were adopted by working group members in South Florida and the Bahamas.

Fire Ecology staff are key members of the Environmental Assessment process in support of our FMP. Because of their familiarity with fire effects and fire as an ecological process, fire ecology staff has guided fire managers through critical elements of the preparation of this document. In addition Fire Effects monitors have reviewed and made extensive comments on the fire management plan update. Beyond the FMP and EA, fire effects personnel are an important asset to fire operations. They serve, as qualified, on most prescribed fires, wildland fires and hurricane shut-down and clean-up. With the participation of fire ecology staff, operations have enhanced their ecological effectiveness while maintaining a safe fireline environment.

Table 1. Fire Effects Plot Workload 2005

In 2005 EVER fire effects conducted reads of 49 FMH plots in all 4 monitoring types within Everglades National Park. Nine plots were read for CANA

Table 2. Fire Ecology Staffing 2005

The fire ecologist position was fully staffed this year by Rick Anderson. Shanna Ramsey continued to fill her subject-to-furlough positions this year. Gina Hernandez and Germaine Ploos resigned from their positions this year. Hillary Cooley was hired in the assistant lead position and was selected to fill the lead position late in November.

Table 3. Management Objectives and Monitoring Results 2005

An underlined number of plots indicates that the minimum sample size has been attained for that variable.

Monitoring Unit	Management Objective (Restoration)	Monitoring Results (80% confidence interval)	Objective Achieved?
Slash Pine Savanna	0-40% reduction overstory pine density by one year post burn	Total reduction in density = 1 – 9% (<i>n</i> = <u>26</u> plots, 13 fires)	YES
	75 – 100% reduction of 1 and 10 hour dead fuel loading by immediate post	Total change in 1 hour fuel load = -26 – 35%, change in 10 hour fuel load = -1 – 44% (<i>n</i> = <u>25</u> plots-meets min for 10 hour only, 13 fires)	NO for both, decision made to omit this data collection, because these fuels data are not significant enough to pursue
Short Hydroperiod Prairie	0 – 50% reduction of organic substrate (periphyton) at immediate post burn	Total change in percent cover of periphyton = -2 – 27% (<i>n</i> = <u>21</u> plots, 9 fires)	YES
	50 – 100% reduction of exotics immediate post burn, 10 – 100% 1 year post burn	Percent cover of exotics in pre and post data = 0% (<i>n</i> =21 plots, 10 fires)	Refined objectives and sampling acceptance criteria
Coastal Prairie	≥ 50% reduction of exotic species immediately post burn	Total reduction of relative cover of exotics = 3 -- 50% (<i>n</i> =15 plots, 9 fires)	NO, Refined objectives and sampling acceptance criteria

Monitoring Unit	Management Objective (Restoration)	Monitoring Results (80% confidence interval)	Objective Achieved?
	5-yr postburn stand density: 50-250 trees/ha <80 cm DBH 10-75 trees/ha ≥ 80 cm DBH	stand density = 310-562 trees/ha <80 cm DBH 9-35 trees/ha ≥ 80 cm DBH (<i>n</i> =15 plots, 3 fires)	no

Ecologist Accomplishments

The fire ecologist provided key support in the writing and review of the program's Fire Management plan and the associated Environmental Assessment. He worked steadily through many difficulties to facilitate awarding a contract to Florida International University to conduct data analysis on the first five years of FMH data (see proposal Attachment 3). In February Rick taught a unit of RX-510 in Tucson, Arizona. He has established a working relationship with Big Cypress fire effects staff as well as the Resource Management Specialist at Canaveral National Seashore. A review of Big Cypress fire effects monitoring was conducted and collaboration continues between these two NPS units. At Canaveral Seashore refinements were made to prescribed fire objectives and monitoring protocols.

Sampling Design & Field Methods

Everglades National Park:

- After a review of the products of the photo monitoring associated with FMH plots, the following conclusions were drawn and changes initiated:
 - Refined Photo-monitoring and Archival Protocols were established (see attachment 2) The need for immediate access to photos in digital form was apparent. Shanna Ramsey has worked with the Park's data manager and archivist to establish a method to manage and store more than 3,000 fire effects photos.
 - The nine photos taken currently at each forest plot during each visit are excessive and will be reduced to four. These four will be taken back and forth along the length and width center lines of the plot using quantifiable methods.
 - Repeatable, professional photo series have been established with new techniques being explored. It includes some of the following changes:
 - A graduated range pole will be added to the photo.
 - A monopod with a level will be used to keep the camera at a consistent height (breast height, 1.37 meters)
 - The camera will be placed exactly at the plot rebar marking the bottom end of the subject instead of standing some distance behind the rebar and trying to include the rebar in the photo.
 - The photo board will be held consistently on one side of the photo and at a set distance from the camera.
- Dead and down fuel transects will no longer be sampled. It was determined that the data collected along the Brown's transects is just not relevant to this system.
- During the spring field season of 2005, the existing FMH plots will be maintained; however, new variable were added to capture *Zamia* and *Croton* populations (attachment 1).

Canaveral National Seashore:

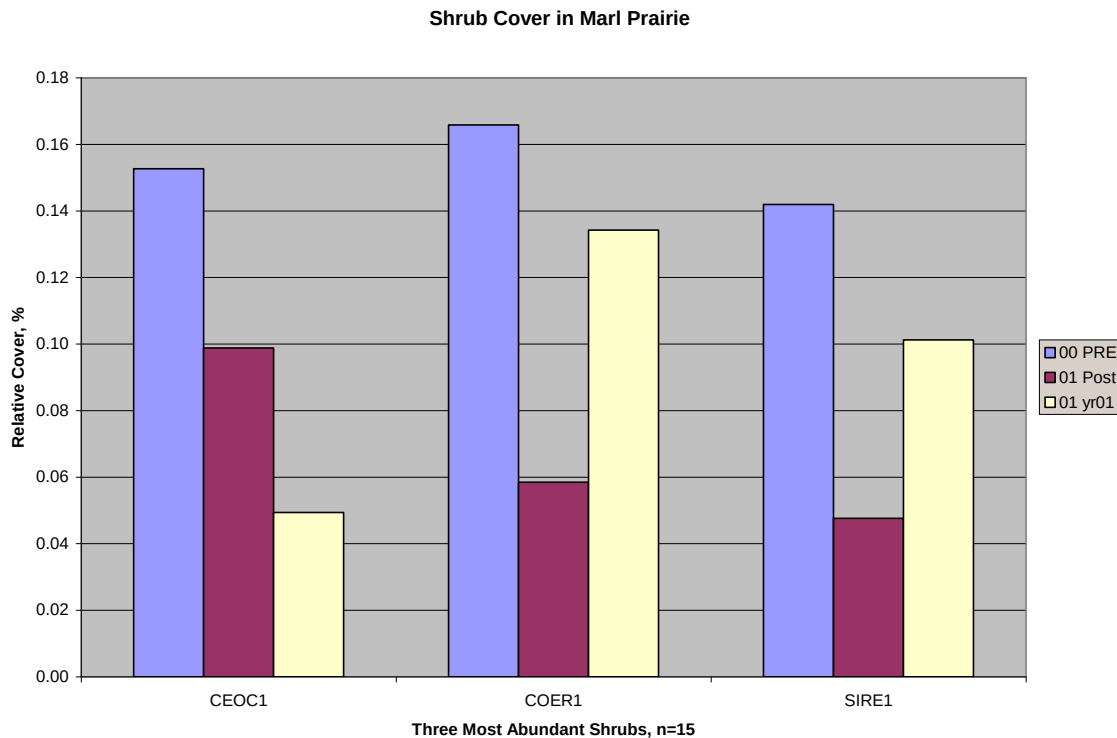
All 9 of the Canaveral FMH plots were burned and a summary was prepared for and sent to Resource management specialist, John Stiner (see attachment 4).

Status of Planning Documents

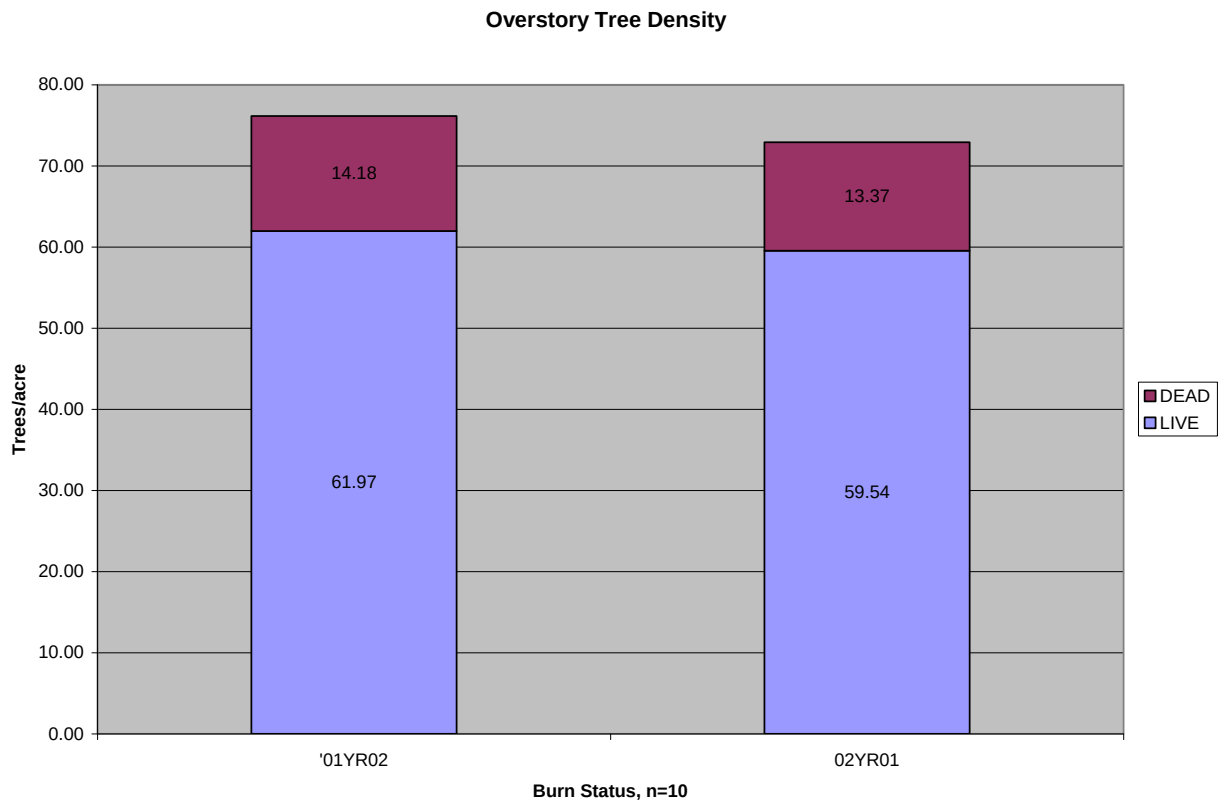
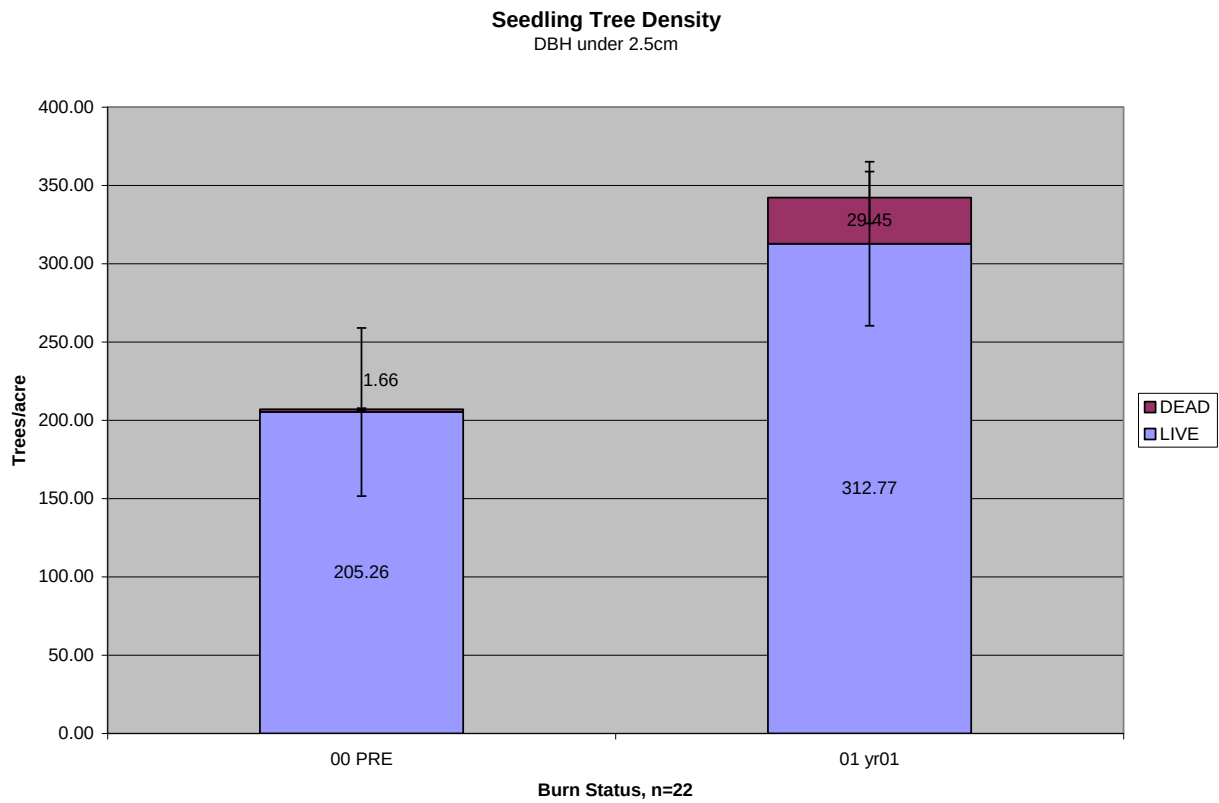
The fire effects monitoring plan is being rewritten to reflect RM-18 direction as well as ongoing refinements occurring at everglades national park. A draft has been circulated to the South Florida Natural Resource Center for review by their scientists. Editorial revision to this document is occurring at this time.

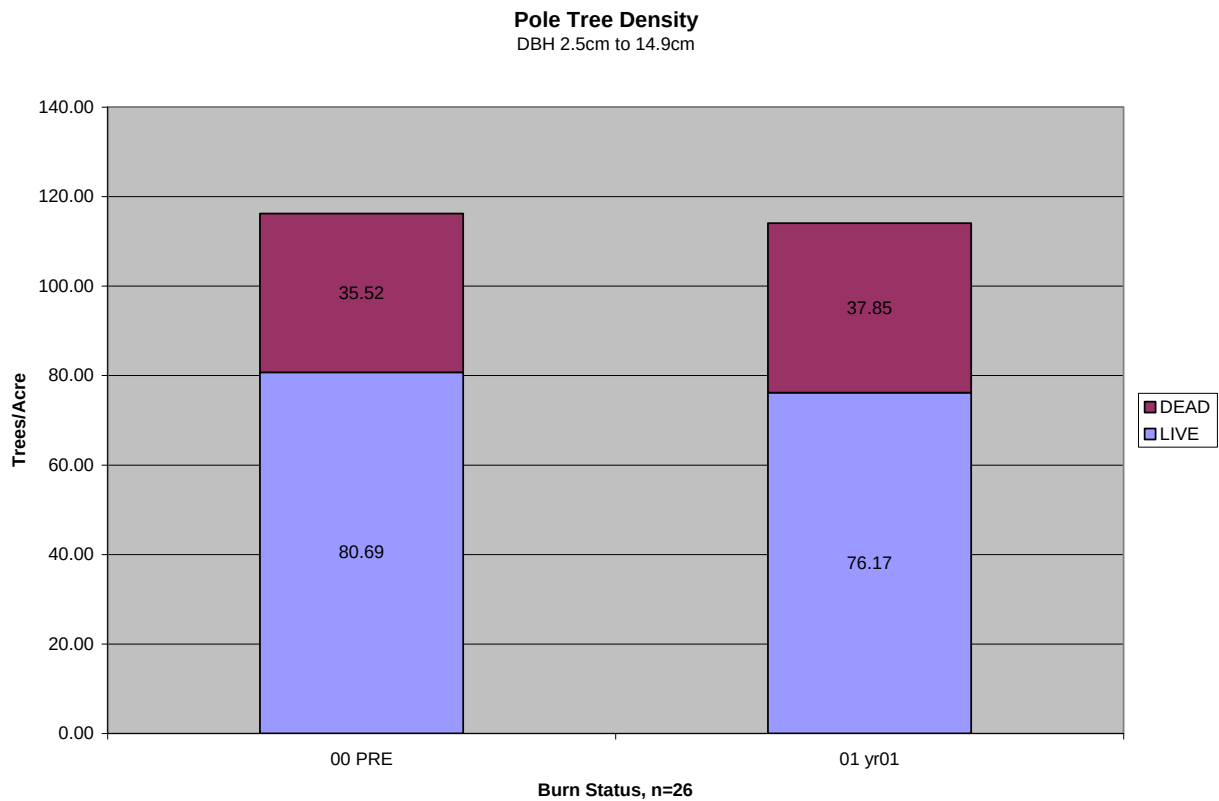
Monitoring Results

Everglades National Park: Analysis conducted using FMH software produced variable results, so much in fact the fire ecologist has contracted out the statistical analysis. FMH “black box” statistical runs were used to discover trends. Because of lack of confidence in FMH out puts many were rerun using paired T-test or ANOVA via Excel. Were both outputs agreed, in the table below for example, we often discovered some of our assumptions were incorrect. In this case hardwood encroachment was not a problem for coastal prairie.



- Conclusion: The combined relative cover of the most common hardwood shrub species in this monitoring type is less than 0.5%. Shrub cover was negligible and the objective was dropped from the prescription..





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Research Projects/Collaboration

With the arrival of the fire ecologist, collaboration has increased significantly.

- Pine Rockland Working Group
- Annual Cape Sable Seaside Sparrow Symposium
- Cavity nesting avian species Reintroduction by Gary Slater of the Eco Institute.
- Brian Beckage from University of Vermont on spatial extent of fire history within the Everglades landscape.
- Southern Everglades Restoration Project to develop fire-hydrology related performance measures for tree islands.
- Landscape Level Climate and Fire Interaction, Matt Slocum LSU

Adaptive Management

Programmatically, fire effects data is currently being used to rewrite the FMP as well as prescribed fire goals and objectives. This is the first time that this data will have been used to make changes in the objectives and strategies of Everglades fire management. Additionally, an assessment of FMH protocols are occurring with adaptations already accomplished.

Attachment 1: Fire Effects upon *Zamia* and *Croton*

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August 3, 2005

After a review of the National Park Service Fire Monitoring Handbook (FMH) vegetation monitoring protocols and concern for rare and endemic Lepidoptera, a more detailed evaluation of Lepidoptera host plants in Everglades National Park (ENP) began in summer 2005. *Zamia pumila* L. is the host plant for *Eumaeus Atala* (Atala) and *Croton linearis* Jacq. is the host plant

for *Strymon acia* (Bartram's Scrub-Hairstreak) and *Anaea trogladyta flouidalis* (Florida Leafwing). This study was initiated to evaluate the population, seasonal flowering and fruiting of these two host plants.

FMH plots following the FMH protocols are 20x50 meters. Vegetation monitoring of herbs from 1999-2004 consisted of a 30 meter transect line along the perimeter of the plot. Along the 30 meter transect line, every 30cm a point intercept was sampled, and the vegetation touching the intercept point recorded. This method did not provide population density or phenology information. A more intensive examination of both *Z. pumila* and *C. linearis* was determined necessary to better understand the population density, flowering/fruiting phenology (timing) and growth of both species.

The preliminary method to determine additional information about *Z. pumila* and *C. linearis* is to use existing FMH plots. Within FMH plots *Z. pumila* and *C. linearis* are located and hand mapped within the entire 20x50 meter plot using the FMH-11 Full Plot Tree map data sheet. The selected plots are near areas of past and possible future releases of Atalas, or known locations of Hairstreaks and Florida Leafwings. Past Atala release sites are Block J, the Long Pine Key campground picnic area, and across from the Coe Visitor's Center. Future Atala releases may be planned for Block A. On November 7, 2005 15 adult Atala's and 105 pupa were released in Block A at UTM coordinate of 17 R 0528914 and 2809771 and 17 R 052889 2809830 near the FMH plot of FPIEL1G0705.

FMH plots planned for initial *Zamia/Croton* sampling are FPIEL1G0701 and FPIEL1G0714 both in block J, FPIEL1G020 near the Coe Visitors Center, and FPIEL1G0703 in F2 and near the Long Pine Key campground picnic area. FMH plots in pine block A (FPIEL1G0716, FPIEL1G0705 and FPIEL1G719) maybe added if Atala release is approved in that area. After data is collected and analyzed from the above 4 to 7 plots, methods will be reviewed to determine if additional FMH plots in pineland habitat need to be sampled for *Z. pumila* and *C. linearis* or if a different method is needed. For example an increase in the area sampled or a non-random plots selection method to target areas with ample populations of host plants may need to be adopted.

Update August 22, 2005- After FMH plots FPIEL1G0701, FPIEL1G0714 in block J and FPIEL1G0703 in F2 were examined, *Croton linearis* was only found in plot FPIEL1G0701 and *Zamia pumila* was only found in plot FPIEL1G0714. Neither *Croton linearis* nor *Zamia pumila* was found in FPIEL1G0703. FMH plot FPIEL1G0703 in F2 was rejected as a possible long term monitoring plot for *Croton linearis* and *Zamia pumila*. In stead previously installed LSU plots in block G were examined because they were close to Atala release sites in the LPK Campground/Picnic area. LSU plot G4 was selected because it contained *Croton linearis*.

Update December, 2005- 4 plots are being monitored (FMH plots FPIEL1G071 and FPIEL1G0714 both in pine block J. FMH plots FPIEL1G20 and FPIEL1G03 were not selected as host plant monitoring sites because *C. linearis* and/or *Z. pumila* were not present in either site. Instead a plot with the same 20x50 meter dimensions was installed in block W near the small barrow pit close to the intersection of the Main Park Road and the road leading to Pine Island. LSU plot 4 in Block G continues to be monitored for *C. linearis*.

Zamia pumila

Methods for sampling *Zamia pumila* are similar to those used by Negrón-Ortiz and Gorchov (2000). After tagging and mapping, the number of leaves on each *Z. pumila* will be counted and the amount of herbivory on each leaf assessed (Table 1). If cones are present the sex and cone development stage will be recorded. Eggs and caterpillars present will also be identified (if possible) and recorded. See figures 1 and 2 for pictures of Echo Moth and Atala larva. If adult Atala (Figure 3) are observed in the area their presence will also be recorded.

Table 1: Herbivory codes- <i>Zamia</i> old leaves	
0	None - no herbivore damage (all leaflets complete)
1	Minor - less than half of the leaflets are partially eaten
2	Moderate - more than half of the leaflets partially eaten or less than half of the leaflets completely eaten
3	Severe - more than half of the leaflets completely eaten
4	Complete - all leaflets completely eaten (only rachis or portion of rachis remains)
Note: If more than one code applies use the higher code number.	

Example of how to record: For a plant with 5 total leaves, 2 leaves with less than half of the leaflets partially eaten, 2 leaves less than half the leaves completely eaten, and one leaf with leaflets completely eaten and only a rachis. 5 (2¹, 2², 1⁴)

If more than one branch on same plant use [] to separate branches and record the same as above. Example: 2 branches one with 2 leaves and one with 3 leaves [(2¹)], [3 (1⁰, 1², 1⁴)]

Stages for male cones (microspore cone)- 4-6.5 cm long, 12-18 mm in diameter (Correll and Correll 1982)

Developing (pre-pollen producing)

Dispersing pollen (sporophylls open, pollen visible)

Post pollen

Dead

Stages for female cones (megaspore cone)-6-10 cm long, 3-5.5 cm in diameter (Correll and Correll 1982)

Developing (pre-fertile condition)

Receptive to pollen (Sporophylls open)

Seeds developing (cone growing)

Seeds mature

Seed being released

Cone aborted or all seeds released



Female cone

Each month the plots will be visited, all *Zamia* will be relocated and the number and condition of the old leaves recorded. New leaves not recorded at the last visit will be recorded in the new leaf column. New leaves are given a development code listed in table 2.

Table 2: New leaf development code for <i>Zamia</i>	
a	-before individual leaflets visible (fiddle head shape, brown)
b	-leaflets partially expanded (Leaflets visible and green)
c	-leaflets expanded, immature leaf (light green color)
d	-leaflets expanded, mature leaf (dark green color)



Figure 1: *Seirarctia echo* larva-Red body with spines



Figure 2a: *Eumaeus Atala* larva



Figure 2b: *Eumaeus Atala* larva~1" in length. Body slug-shaped with short hairs, bright red with two rows of yellow spots on the back

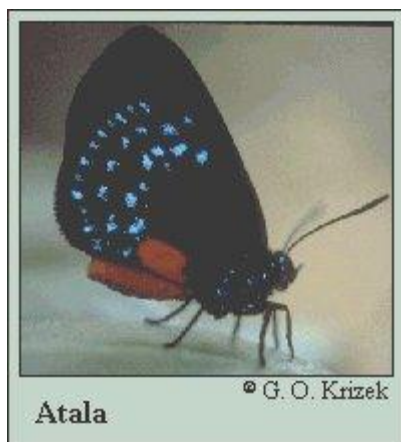


Figure 3: *Eumaeus Atala* adult

Croton linearis

In the FMH plots listed above all *Croton linearis* (Figure 4a) will be located, hand-mapped and tagged. The height, crown length and width, number of flower buds, flowers and fruits (figure 4b) and amount of herbivory (Table 3) recorded for each *C. linearis* found. The amount of biomass for *C. linearis* will be calculated from the regression equation $B=a+b(CA) + c (CA)$ where $a=0.077$ $b=-0.086$ and $c=0.175$ (Sah, Ross. Koptur, and Snyder 2003). The presence of eggs and caterpillar of either the *Strymon acia* (Bartram's Hairstreak) (Figure 5) and *Anaea troglodya floralis* (Florida Leafwings) (Figure 7) will also be noted. Adult Bartram's Hairstreaks (Figure 6) and Florida Leafwings (Figure 8a and b) will also be recorded if seen. Plots will be sampled one a month.

Table 3: <i>Croton linearis</i> Herbivory Codes	
0	None - No herbivory
1	Minor -Less than 5% of plant eaten
2	Moderate -6%-75% of plant eaten
3	Severe - 76%-99% of plant eaten
4	Complete - 100% eaten



Figure 4a: *Croton Linearis* plant



Figure 4b: *Croton linearis* Fruit



Figure 5: *Strymon acis* Bartram's Hairstreak larva--~0.7" in length. Head brown; body slug-shaped with short hairs.



Figure 6: *Strymon acia* Bartram's Hairstreak adult



Figure 7. Caterpillar of Florida Leafwing. *Anaea troglodyta floridalis* (Florida Leafwing) Larva-~1.4" in length. Head green with short, rounded orange spines, those on top of head orange and black; body slender, green with numerous tiny whitish spines, a yellow lateral stripe curved upward to a pair of dark spots on the top of the second abdominal segment, and some small dark patches on top of the posterior end.



Figure 8a: Florida Leafwing adult



Figure 8b: Florida Leafwing adult

Literature Cited

- Correll D.S. and H.B. Correll. 1982. Flora of Bahama Archipelago. A.R. Gantner Verlag KG., FL-9490 Vaduz, Germany
- Negrón-Ortiz, V. and Gorchov, D.L. 2000. Effects of Fire Season and Postfire Herbivory on the Cycad *Zamia pumila* (ZAMIACEAE) in Slash Pine Savanna, Everglades National Park, Florida. *International Journal of Plant Science* 161(4):659-669.
- Sah, J.P., M.S. Ross, S. Koptur, J.R. Snyder. 2004. Estimating aboveground biomass of broadleaved woody plants in the understory of Florida Keys pine forests. *Forest Ecology and Management* 203:319-329.

Attachment 2 Photo-monitoring

Photo Monitoring for Fire Effects Plots Everglades National Park May 2005

Everglades National Park established a photo monitoring protocol after 5 years of taking photos that closely followed the 2001 Fire Monitoring Handbook (FMH) protocols. These changes will reduce the large volume of slide photographs being collected while still providing adequate photo reference, and improving overall image quality. The primary change will be the inclusion of a 2 meter range pole, a move by the photographer to a marked location, the use of a monopod and level, the placement of the photo board in a defined location and the elimination of photographs at 5 points at forest plots.

Photo monitoring methods 1999-2004

During photo monitoring of plots from 1999-2004, fire effects monitors used 36-exposure Ektachrome 200 ASA slide film. Two 35mm semi-automatic cameras and one automatic 35mm point and shoot camera were used. Although a 28mm lens was used, the three cameras captured slightly different images because of unique lens types and viewfinders. In forest plots, nine photos were taken. In brush plots, two photos were taken. A photographic record sheet was maintained for each roll of film.

An 11"x14" white dry erase board with plot information was included in the photo as a reference (figure 1). The plot data (plot number, subject, burn status, date) was handwritten on the board with a black dry erase pen. An extra person held the board at the edge of the photo. Solo photographers propped or hung the board on the rebar. If monitoring occurred in parks other than Everglades, the four letter code of the park was included (i.e. CANA).

FPIEL1G07018 2m Q1→Q4 CANA 02 YR 01 05/22/03
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Figure 1: Data written on the photo board at a forest plot.

At brush and forest plots, the photographer stood 2-5 meters behind the rebar and photographed toward the opposite rebar. The camera was hand held at the photographers eye, therefore the variance in height of multiple photographers caused image perspectives to be inconsistent. Although the date and time of photos were recorded, no effort was made to duplicate taking photos at the same time of day. This allowed shadows and lighting to cause different effects. Usually, the top of the rebar was visible in the center foreground of the picture, but often the entire rebar was visible. The height of the camera and the thickness of vegetation affected the view of the rebar in photographs.

Photographs were taken during the pre-burn installation and print copies were included in the folder for future field references. During plot visits, efforts were made to replicate the pre-burn picture using the position of the photo board, trees and other landmarks. The photographer completed the photo log (FMH-23 Photographic Record Sheet) at each plot visit. Vegetation in front of the camera was (usually) not altered or moved to enhance the photographs. In some instances, one photo was taken “as is” and a second was taken with the branches or leaves pulled aside to allow a more clear view of the plot.

Photo monitoring occurred during each scheduled plot visit, with the exception of immediate post-burn visits from 1999-2001. During this time, photos were postponed until the 2 month post-burn visit, but in 2001 scheduling changed to include photographs at both 1 week and 2 month post-burn visits. Scheduled plot visits were pre-burn, 1 week post-burn, 2 month post-burn, 6months post-burn, 1 year post-burn, 2 year post-burn and 5 year post-burn.

All slides were labeled and filed with complete information on the mount edges (similar to FMH guidelines). Permanent markers have been used to write on slide mounts, but permanent archival ink pens have been used since 2004. When incorrect records exist (i.e. incorrect date or plot number), it was noted on the record sheet and the slide. All slides have been stored in plastic sleeves and since 2004 slide sleeves were of archival quality. For each plot, all original paper and photo data are stored together in paperboard hanging folders in a fireproof filing cabinet. All photo record sheets are filed together.

There are 86 FMH brush and forest plots in Everglades National Park and many slides have been collected. Some plots have missing photos due to camera malfunctions, slide processing errors, and poor quality photos. The hundreds of slides already collected will be scanned to digitally archive slides and provide easier access to images.

Photo monitoring methods 2005

Changes were implemented in photo monitoring protocols to reduce the volume of slides being collected and to improve the accuracy of photos. These techniques will quantify shrub reduction objectives. The primary difference in the new protocol will be the inclusion of a 2 meter range pole, a change in the position of the photographer to a marked location, the use of a monopod and level, the placement of the photo board in a defined location, and the elimination of 5 photo points in forest plots. The 35mm cameras and slide film will continue to be used.

Beginning in 2005, only 4 photo points will be taken in forest plots. Two photos each are taken across the width and length of the plot (see figure 2). A two-meter graduated range pole will be placed over plot rebar and will be 10 meters from the photographer. The photographer will stand at the rebar and aim toward the distant rebar. A monopod with a bubble level will be used to keep the image level and the height of the camera at 4’5” (1.37 m). The monopod will be adjacent to the rebar on the left side and the range pole will be the center of focus. At brush plots, two photographs will be taken, one from each end of the plot. The range pole will be placed over the opposite rebar, which is 30m from the photographer. By using these established rebars, a known place and distance is defined and will not require the addition of another marked

location. This method will greatly reduce the variability in photos and will provide adequate plot views.

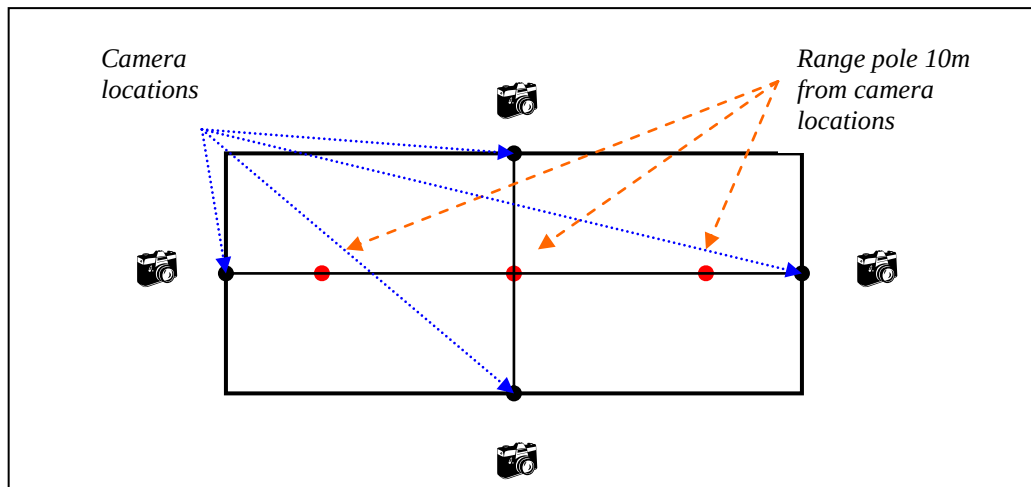


Figure 2. Location of photographer and range pole in 20m x 50m forest plot

A second person will hold the photo board 3m from the rebar on the left side of the photograph. If the board can not be seen at 3 meters due to heavy vegetation, move to 2 meters and write 2m on the board (figure 2). When possible, the board should be held level at 4'5" (1.37m) from the ground. The photographer should ensure that other persons and miscellaneous gear are not in the photograph, and limit the amount of visible body parts of the assistant to a minimal. Make a note of unusual conditions encountered when photographing transects. If there is a change of the protocol (i.e. photo board on right due to obstruction; 2m position), make a note in the plot maintenance log and on the photo record sheet. See figure 3 for an example of pre-burn and post-burn photographs using these new methods.



Figure 3. New photo monitoring protocols used at Canaveral National Seashore. These photo monitoring techniques were developed to address variable results from methods previously used for photo points. Initial field testing of this new protocol was successful and will continue to be used for all fire effects plots within Everglades National Park.

Reference

USDI National Park Service. 2001 Fire Monitoring Handbook. Boise (ID): National Interagency Fire Center. 288p.

EVERGLADES FIRE EFFECTS MONITORING

Everglades National Park initiated a Fire Monitoring Program in 1999 in Slash Pine Savannas with distinct management goals to assess the impact of prescribed burning upon the habitat of terrestrial species. In the following years, the program was extended to other habitats, such as Marl Prairie, Sawgrass Prairie, Coastal Prairie, and *Melaleuca* (Exotic) stands which contain numerous federally listed species. Among the species occurring in these habitats treated with prescribed fire and evaluated with NPS fire monitoring is the Cape Sable Seaside Sparrow. Since all five known populations of the CSSS inhabit highly flammable habitat the analysis of this data is crucial to determine fire management strategies for this imperiled species. A number of plots have been established in these habitats to collect data before and after fire (Table 1). Many of these plots received burning (single or multiple) treatments, and some of them were treated as control plots. In the plots, stratified sampling was used to collect data for herb, shrub, and tree (only pinelands) strata, and fuel loads. To collect data in different strata, various sampling units, plot-quarter and belt and line-transect were used. Along the line transect, species data were gathered using a point-intercept method. Table 2 illustrates a list of variables in each stratum recorded within the plots.

The analytical methods to be applied to the available data may vary among species, lifeforms, habitats, sampling procedures and the burning treatments. Table 3 summarizes parameters that will be calculated to examine the effects of treatments.

Data will be summarized by calculating mean and standard error for community structural parameters, including tree density, tree basal area and cover of hardwoods and saw palmettos in pinelands, and cover of herbaceous and woody species, shrub density and cover of native and exotic species in both pinelands and prairies. Changes in target variables over time, before and after burning, will be examined using analysis of variance (ANOVA). In addition to time, fire frequency and intensity, and habitat type will be considered as explanatory variables. Appropriate interactions among explanatory variables will also be examined. Logistic regression will be used to examine the mortality of tagged trees in subsequent samplings after burning.

One of the major objectives of prescribed burning is the reduction in fuel loads. Effects of fire on the reduction in fuel loads will be examined by comparing the fuel loads before and after fire. In addition, effects of fuel loads on fire behavior, such as burning severity, will also be examined. Fire behavior is also affected by fuel moisture. Available fuels and fuel moisture in turn depend on the site characteristics, such as time since last fire, plant density and basal area, maturity of plants. Regression models will be developed to explore relationships among site characteristics, fuel loads and fire behavior.

In addition, we will evaluate the efficiency of the sampling methods in assessing vegetation response to fire, and recommend improvements if any appear to be necessary. We will also explore alternative statistical measures of how well ENP fire objectives are being achieved.

Total budget requested (see attachment): \$16,726.

Time frame: Jan 1, 2005 – May 15, 2005.

Table 1: Habitat, Plot Index, number of plots, burning treatments and available data.

Habitat	Plot Index	No. of plots		Initial Year	Treatments (Summer 2004)	Data available	Notes
		Established	Effective				
Slash Pine Savannas	FPIEL1G07	28	27	1999	00 PR02; 00 PR01; 00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02; 02 POST; 02 mo06; 02 yr01; 02 yr02; 03 POST; 03 mo06; 03 yr01; 04 POST	Plot - Tree (pine) overstory Plot - Tree (pine) poles Plot - Tree (pine) seedlings Belt – shrub density Transect – herbaceous & woody Transect - Fuel inventory Fire intensity	Q. 1
Marl Prairie	BMUFI1G03	28	28 (7)	1999	00 PR01; 00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02; 02 POST; 02 mo06; 02 yr01; 02 yr02;	Belt – shrub density Transect – herbaceous & woody Herbaceous density (post) - ? Fire intensity	(7) Not yet burn – Control (?) Q. 1
	BMUFS1D03	28	28	?	00 PR01; 00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02; 02 POST; 02 mo06; 02 yr01; 02 yr02;	?	Q. 2
Sawgrass Prairie	BCLJA1G03	11	11 (9)	2000	00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02;	Belt – shrub density Transect – herbaceous & woody Herbaceous density (post) - ? Fire intensity	(9) Not yet burn – Control (?) Q. 1
	BCLJS1G03	11	11 (9)	2000	00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02;	?	Q. 2
Coastal Prairie	BCOPR1G03	18	18 (3)	2000	00 PRE; 00 POST; 01 yr01; 01 yr02;	Belt – shrub density Transect – herbaceous & woody Herbaceous density (post) - ? Fire intensity	(3) Not yet burn – Control (?) Q. 1
Litter	FLITT1D03	28	27	?	00 PR02; 00 PR01; 00 PRE; 00 POST; 01 mo06; 01 yr01; 01 yr02; 02 POST; 02 mo06; 02 yr01; 02 yr02; 03 POST; 03 mo06; 03 yr01; 04 POST	?	Q. 3
Exotic	FMEQU1G04	1	1 (1)	1999	00 PR01		(1) Not yet burn – Control (?)

Table 2: Sampling parameters

Data	Sampling unit	Plot Index	Variables	Unit	Notes
Tree overstory	Plot-Quarter	FPIEL1G07	PLOT ID QTR SPP CODE LIVE/DEAD DBH CROWN DAMAGE TAG	cm crown code damage type	
Tree poles	Plot-Quarter	FPIEL1G07	PLOT ID QTR SPP CODE LIVE/DEAD DBH HEIGHT TAG	cm height code	
Tree seedlings	Plot (Quarter?)	FPIEL1G07	PLOT ID SPP CODE LIVE/DEAD HEIGHT RESPROUT TALLY	height code	Q. 4
Herbs & Woody species	Points along Transect	FPIELIG07 FLITT1D03 (?) FCAJA1G03 FCAJS1G03 (?) FMUFI1G03 FMUFS1D03 (?) FCOPR1G03 FMEQU1G04	PLOT ID LINE POINT SPP CODE LIVE/DEAD HEIGHT DATACOLUMN	0 or 3 M ?	Q. 5; Q. 6
Shrub density	Belt	FPIELIG07 FLITT1D03 (?) FCAJA1G03 FCAJS1G03 (?) FMUFI1G03 FMUFS1D03 (?) FCOPR1G03 FMEQU1G04	PLOT ID LINE INTERCEPT SPP CODE LIVE/DEAD AGE TALLY	5 m interval Code (I, M, R) Abs	Q. 7
Herb density	Frame	FCAJA1G03 FCAJS1G03 (?) FMUFI1G03 FMUFS1D03 (?) FCOPR1G03	PLOT ID FRAME SPP CODE LIVE/DEAD TALLY	Abs	Only in Post-burn
Fuel inventory	Points along Transect	FPIELIG07 FLITT1D03 (?)	PLOT ID TRANSECT SLOPE AZIMUTH FMTL (1, 10, 100 HR) DIAMETER (1000 HR -R & S) DEPTH	O ? IN IN	Q. 8

Data	Sampling unit	Plot Index	Variables	Unit	Notes
			(DUFF & LTR)		
Forest plot Fire intensity	Points along Fuel transects	FPIELIG07 FLITT1D03 (?)	PLOT ID TRANSECT POINT TYPE RATING UPDATE		
Brush/Grassland Fire intensity	5-m points along Transect	FCAJA1G03 FCAJS1G03 (?) FMUFI1G03 FMUFS1D03 (?) FCOPR1G03	POINT TYPE RATING		
Overstory Tree Post-burn Assessment	Plot	FPIELIG07 FLITT1D03 (?)	PLOT ID LIVE CHAR SCHGT SCPER TAG	M M %	
Pole sized Tree Post-burn Assessment	Plot	FPIELIG07 FLITT1D03 (?)	PLOT ID LIVE CHAR SCHGT SCPER TAG	M M %	

Some questions:

- Q.1: (a) What do 'F', '1' and 'G07' in the Index Code 'FPIEL1G07' stand for?
(b) What do 'B', '1' and 'G03' in the Index Code 'BCAJA1G03' and 'BMUFI1G03' stand for?
(c) What do 'B', '1' and 'G03' or 'D03' in the Index Code 'BCAJS1G03' and 'BMUFS1G03' stand for?
- Q. 2: (a) What is the difference between 'BCAJA1G03' and 'BCAJS1G03'?
(b) What is the difference between 'BMUFI1G03' and 'BMUFS1D03'?
- Q. 3: (a) In which habitat were the plots 'FLITT1D03' located?
(b) What were sampled in the plots 'FLITT1D03'?
- Q. 4 (a) Were tree seedlings sampled in an entire plot or a particular quarter?
- Q. 5 (a) Transect data has one variable 'LINE'. For some plots, it is Line – 3, and for others it is Line – 0. What is the difference between Line-0 and Line-3?

(b) For plots FPIEL1G07 and FLITT1D03, transect data are shown under '50 m Herb Transect', but there are only 100 points, and Line '3' shows from Q4-30m. Is the length of transect 30m or 50m? If it is 50m, are the 100 points at every 0.5m?
- Q. 6 (a) What is the area of sampling unit for point intercept sampling along a transect? Is it just point or a circular sampling unit with some area?
- Q. 7 (a) What is the width of 'Belt' used to sample shrub individuals?
- Q. 8 What does 'FMTL' in Fuel Inventory Data stand for?
- Q. 9 Effects of prescribed burning depends on also time since last fire. Is there any record of fire history for the experimental plots?

Table 3: Fire management objectives, habitat types, variables measured in the field and proposed methods to be used for d

Fire Management Objective	Habitat	Variables measured	Dependent variables	
Reduce <i>Pinus elliotti</i> overstory by 0-40% one year post burn	Pineland	Overstory tree count DBH Crown position (?)	Tree mortality Tree density Basal area Crown (?)	
Reduce relative cover of hardwoods and saw palmetto by: 50-100% immediately post burn 0-50% one year post burn	Pineland	Species present (transect) Woody sp. (Stem?) count (Belt)	Relative cover of hardwood Relative cover of palms	
Reduce relative cover of woody species by: 50-100% immediately post burn 0-50% one year post burn	Marl prairie Sawgrass	Species present (transect) Woody sp. (Stem?) count (Belt)	Relative cover of woody sp.	
Reduce organic substrate by 0-50% immediately post burn	Pineland Marl prairie Sawgrass ¹	Litter	Percent of organic substrate	
Reduce 1 and 10 hour (live and dead) fuel loading by 75-100% immediately post burn	Pineland Marl prairie Sawgrass	Fuel depth by sizes	Fuel loads	
Reduce relative cover of exotic species 50-100% immediately post burn 10-100% one year post burn	Pineland Marl prairie Sawgrass	Species present (transect)	Relative cover of exotic sp.	
Increase relative cover of endemic species (Table 3) by greater than 0% one year post-burn	Pineland Marl prairie Sawgrass	Species present (transect)	Relative cover of native sp. Relative cover of endemic sp.	
Others: Related to pine seedlings & recruitment ²	Pineland	Pine seedlings count Pine seedling height Resprout	Seedling density Recruitment	
Others: Related to brush ²	Pineland Marl prairie Sawgrass	Woody sp. (Stem?) count (Belt)	Shrub density	

1. Only when growing on marl; 2. Specific objectives not clear. * Please see text for details.

Attachment 4

CANA Monitoring Type Description Sheet

Monitoring Type Name: Slash Pine Flatwoods

Monitoring Type Code: F P I E L

1 G 0 7

Prepared By: J. Stiner, D. Wallner, P. Reeberg, J. Hooke,
K. Walsh

FMH-4

MONITORING TYPE DESCRIPTION SHEET

Park: CANA

Date Described: 12/08/99. *Revised by Hooke & Wallner, 5/2000; Revised by Lansing, Stiner, Hernandez, 11/2001; Revised by Anderson, Stiner, Hernandez 11/2004; Revised by Anderson, 01/2006*

Burn Prescription: Season: December through March; Fire return interval: 5-15 years; Relative humidity: 30 to 70%; Temperature: 60 to 100°F; Firing method: head fire, spot ignition; KBDI < 650; Days since last wetting rain: 1 to 5; Soil moisture (hammock) > 82%; Mid-flame wind speed: 0 to 15 mph.

Habitat Management Goals: Restore, maintain, and preserve a fire-dependant ecosystem. Maintain or increase populations of eagles, scrub jays, gopher tortoises, and indigo snakes.

Fire Management Objectives:

- Limit mortality of *Pinus elliottii* overstory trees to less than 30% as measured two years post burn.
- Induce top-kill of pole size hardwoods by 50-100% immediately post burn.
- Promote 20% recruitment of seedling and pole sized PIEL >15cm in height five years post burn.
- Reduce height of hardwoods and shrubs <6 feet immediately post burn.
- Increase cover of bare ground/open space to 25% bare ground / 75% litter cover 5 years post burn.

Fire Monitoring Objectives: Monitor all objective variables to inform Canaveral Resource Management Staff of fire treatment impacts upon oak shrub heights and pine stand dynamics post burn.

Objective Variables: Overstory, pole and seedling survival of *Pinus elliottii* and oak shrub heights

Physical Description: Relatively flat upland sites ranging from 1.5 to 15 feet in elevation. Soil and/or organic layer depth is minimal. Soils characterized as:

- Daytona-Poola-Astatula association, which are moderately well-drained, grayish, sandy soils with organic stained subsoil and excessively drained grayish and brownish soils interspersed with areas of poorly drained soils
- Myakka-Smyrna-Immokalee soil association, which are nearly level, poorly drained, sandy throughout to a depth of 40 inches, and loamy below

Biological Description: Following Florida Natural Area Inventories description (FNAI). Overstory of *Pinus elliottii* with crown closure between 0% and 50%. Understory cover consists of saw palmetto (*Serenoa repens*), scrub oak species (*Quercus myrtifolia*, *Q. geminata*, *Q. chapmanii*), rusty Lyonia (*Lyonia ferruginosa*), gallberry (*Ilex glabra*); saw palmetto may dominate the understory on wetter sites. The herbaceous understory includes wire grass (*Aristida* spp.) and beard grass (*Andropogon* spp.) (0-20%).

Rejection Criteria: Exclude areas with bayheads (>10% of the plot), barren areas (>50% of the plot) and old control lines. Exclude areas with <3 overstory and >50 pole and overstory *Pinus elliottii*. Avoid areas within 50 meters of: developed areas, human created clearings, physical barriers such as roads or trails. Avoid areas within 50 meters of monitoring or other vegetation types, especially areas dominated by hardwoods, i.e., hammocks. Exclude plots farther than 200 meters from road or trail access.

Notes:

A modified FMH sampling design will be used as of November, 2004, in Bill's Hill monitoring unit. The 50 meter point intercept, shrub density belt, duff depth and dead woody fuel sampling will be eliminated. Overstory trees will continue to be sampled, tagged and mapped in the entire plot. The only species to be sampled as a tree will be PIEL. The sample area for pole trees will be expanded to the entire plot, also tagged and mapped. Seedling trees >15cm will be sampled and mapped in the whole area of quarter one. All oaks will be considered shrubs and density and height will be captured by using a graduated range pole in photo points (see new photo monitoring protocol, 2004). Only litter depth will continue to be sampled on the Browns transects.

PLOT PROTOCOLS

GENERAL PROTOCOLS		YE S	NO		YE S	NO
Preburn	Control Plots/Opt.		X	Herb Height/Rec.		X
	Herbaceous Density/Opt.		X	Abbreviated Tags	X	
	OP/Origin Buried		X	Crown Intercept/Opt.		X
	Voucher Specimens/Rec.		X	Herb. Fuel Load/Opt.		X
	Stereo Photography/Opt.		X	Brush Individuals/Rec.		X

	Photopoints	X		Stakes Installed: All		
	Belt Transect Width: none			Herbaceous Data Collected : Do not collect		
Burn	Duff Moisture/Rec.		X	Flame Zone Depth/Rec.		X
Postburn	Herbaceous Data/Opt.		X	Herb. Fuel Load/Opt.		X
	100 Pt. Burn Severity/Opt.		X	7 Pt. Burn Severity		X
	Brush Density		X	Photopoints	X	
Sampling Schedule: Pre burn (every 2 years before treatment); Post burn; 1, 2 and 5 year Post burn						

FOREST PLOT PROTOCOLS		YE S	NO		YE S	N O
Overstory	Area Sampled: 50 x 20m			Quarters Sampled: Q1-Q4		
	Tree Damage/Rec.	X		Crown Position/Rec.	X	
	Dead Tree Damage/Opt.		X	Dead Crown Positions/Opt.	X	
	Tagged	X		Mapped	X	
	Record DBH	X		Record DBH post and 1 year post		X
Pole-size	Area Sampled: 50 X 20m			Quarters Sampled: Q1-Q4		
	Height/Rec.	X		Poles Tagged/Rec.	X	
	Record DBH	X		Record DBH post and 1 year post		X
	Mapped	X				
Seedling	Area Sampled: 25 X 10m			Quarters Sampled: Q1		
	Height/Rec.	X		Seedlings Mapped/Opt.	X	
	Record Dead Seedlings	X		Notes: Record seedlings >15cm Map live seedlings only		
Fuel Load	Sampling Plane Lengths: 50feet, litter only					
Postburn	Char Height/Rec.	X		Mortality/Rec.	X	

Rec. = Recommended Opt. = Optional

