Florida Fire Risk Assessment Update - FRA-II

Final Report

Submitted to: the Florida Division of Forestry, Forest Protection Bureau

Submitted by: MDA Federal

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Introduction

Project participants

The FRA-II project had many participants: staff from Florida Division of Forestry, MDA Federal (prime contractor), and three subcontractors. The primary personnel included:

Florida Division of Forestry
- Jim Brenner, Fire Management Administrator (Project Manager)
- Sam LeNeave, Forestry Operations Administrator, Suwannee Forestry Center
- Duane Weiss, District Manager, Myakka River District
- John Kern, Deputy Chief Field Operations, Region 3
- Sue McLellan, Systems Project Administrator (GIS)
- Karen Cummins, Computer Programmer Analyst II

MDA Federal
- Andrew Ralowicz, Ph.D. Geospatial Scientist (Project Manager)
- Kenneth Kay, Geospatial Analyst
- Lynn Denis, Geospatial Developer
- Michael Blank, GIS Services Manager
- Jung Lee, Geospatial Analyst
- David Cunningham, Vice President, Environmental and GIS Services.

Subcontractors
- Fire Program Solutions, LLC
  - Don Carlton, Fire Behavior Specialist

- Lanworth, Inc. (formerly Forest One, Inc)
  - Nick Kouchoukos, Ph.D., Director of Information Services
  - Greta Guzman, GIS Analyst

- Integrated Resource Management
  - Marc Barnes, Senior Project Manager
  - Kathy Von Arx, Electronic Data Entry Technical Support

Project Background

In 2002, the Florida Fire Risk Assessment (FRA) was completed by Space Imaging Solutions, now Sanborn Solutions. A significant development from the FRA was a wildland Fire Risk Assessment System (FRAS, Version 1.0) which is an Arc View 3.x extension. The FRAS was the first of its kind in the nation, and is used by the Division of Forestry and other land management agencies in Florida to measure the levels of risk or the Level of Concern (LOC) when considering a fire event and its impact on proximal values at risk.

A key input to the FRAS is a surface fuel model database. Surface fuels are directly related to the vegetation at any given location, and are classified into four fuel types—grasses, brush, timber, and slash. The differences in fire behavior among these fuel types are related to the fuel load by category and fuel bed depth and its distribution among the fuel particle size classes (Anderson, 1982). Fire behavior can be described in terms of rate of spread and flame length. The FRA surface fuel database, or layer, is a thematic raster or map depicting surface fuel models as described by Anderson (1982). The goal of quantifying surface fuels is to assess the potential for the surface fuels to burn and affect the surrounding values.

On March 8, 2005, an RFP titled 'Florida's Wildland Fire Risk Assessment Application Update' was released by the Florida Department of Agriculture And Consumer Services, Division of Forestry. The primary objective was to update the surface fuels data layer. There were two main reasons for the update. The first was the significant daily influx of permanent residents into Florida and the direct consequences of altering the vegetation landscape. The second and more important reason was the impact that hurricanes Charlie, Frances, Ivan and Jean had on changing the structure of the fuels layer in Florida. These hurricanes transitioned large quantities of vertical fuels, previously considered unavailable to the average surface fire, to horizontal fuels readily available to surface fires. It was predicted that this additional fuel loading would impact wildland fire activity by (1) making fires less accessible to traditional suppression methods because light and medium tractors would not be able to push through this debris, and (2) increasing fire intensity due to the additional fuel loading and this intensity would add to the lofting of fire brands down wind potentially affecting both the spot fire potential and distance.

Project Overview

- Update Surface Fuel Model Key. During the workshop that developed the 'Fuel Model Guide for the Southeastern Coastal Plain' held August 2-5, 2005 in Orlando, FL a decision was made to restrict the current Fire Risk Assessment (FRA-II) fuel model to the 1982 Fire Behavior Prediction System Fuel Model set (FBPS) described by Anderson (1982) that was used in FRA-I. It was decided to not use the 40 fire models developed by Scott and Burgan (2005).

- Project web portal created - http://fra2.mdafederal.com. This facilitated document transfer and initial review of proposed imagery.

- Landsat Imagery review & acquisition

- Secure client furnished materials – this included previous acquired imagery, FRA-I surface fuels raster, urban/wildland interface layer, and Tele Atlas roads data.

- Orthorectify and process Landsat and ASTER imagery. Imagery for FRA-II was orthorectified and processed to the same grid as the FRA-I imagery.

- Convert FRA-I data for percent canopy to digital format and create a geodatabase.

- Multispectral image change detection via Cross Correlation Analysis.

- Select Ground truth locations

- Ground Truth Data (GTD) collection set up – planning for ground data collection.

- GTD Training workshop - conducted the week of October 30, 2006 at the CMEL Facility in Palm Coast, FL. The workshop introduced FL DOF personnel to the FRA project, trained participants to use GPS units and electronic field data collection devices (RECON), use the dichotomous surface fuels keys to determine surface fuel model, collect data related to vegetation and canopy fire potential, and document the ground data collection site photographically. A faculty meeting was held May 23 – 26, 2006 in Palm Coast, FL to assign faculty respective responsibilities and tasks.

- Post FL DOF GTD processing and QC of ground truth fuel points. Reviewed and quality control for proper file name, complete data entry with respect to GPS coordinates and surface fire fuel that matched the corresponding photos. Separated ground truth data into training and validation points.

- GTD Collection Trip – collected supplemental ground data of surface fuels for inclusion in the Classification and Regression Tree (CART) process.

- Ancillary Data Layers. Secured additional GIS layers to enhance the final accuracy for the surface fuels map (slope, elevation, aspect, soils, GAP, NLCD, and Percent Canopy).
- CART to produce updated Surface Fuel Models.
- Manual production of Agricultural Land
- Automated identification of Water pixels based on 2005 Landsat images, and edits to produce Water mask.
- Ground accuracy assessment – traveled throughout the project area tabulating correct and incorrect predictions of surface fuel models in change areas.
- Make final edits based on ground data accuracy.
- Submitted Draft Final Fuels map and accuracy for FL DOF review
- Refined Southern Rough classes
- Delivered Final Fuels Map, Final Project Report and accuracy matrix.
- Generate Federal Geographic Data Committee (FGDC) metadata.

Project Methods

Data Acquisition and orthorectification

Landsat 5 Thematic Mapper (TM) imagery

Twenty-seven Landsat 5 images were obtained for the FRA-II project (Table 1). The images were orthorectified and processed to the same grid using FRA-I Landsat image tie points. Projection parameters for Landsat 5 TM images are shown in Figure 1.

Images were reviewed for proper registration to FRA-I Landsat images. Adjacent images (within and between paths) were reviewed for proper georegistration. Clouds were masked out of Landsat and ASTER multispectral images.

Table 1. FRA-II Landsat 5 TM images and acquisition dates.

Landsat Path Row	FRA-II Landsat Image date (YYYYMMDD)	
	Scene 1	Scene 2
P015 R041	20050125	20050330
P015 R042	20050125	20050415
P015 R043	20050125	
P016 R039	20050913	20041129
P016 R040	20050913	20041129
P016 R041	20050305	20041129
P016 R042	20050305	20041215
P016 R043	20050305	20041129
P017 R039	20050312	20050123
P017 R040	20050312	20050123
P017 R041	20050312	20041120
P018 R039	20050404	20051029
P019 R039	20050427	20041220
P020 R039	20050301	20041227

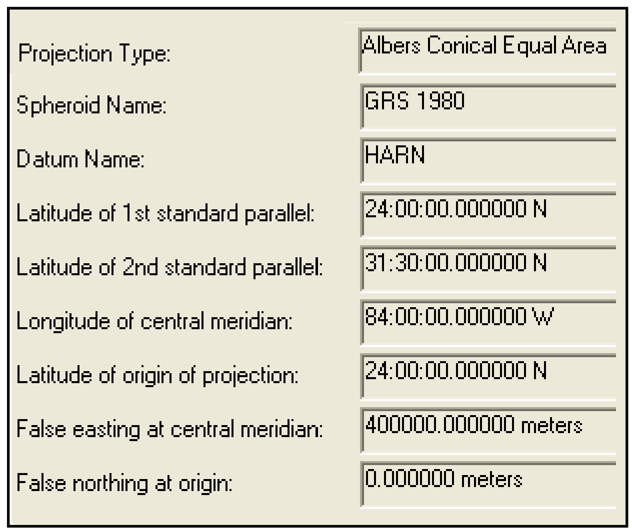

Figure 1. Projection parameters for FRA-II.

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

Forty ASTER images were obtained for the FRA-II project (Table 2). Images were orthorectified and processed to 30-meter pixels and the same grid for FRA-I Landsat image tie points. Projection parameters for ASTER images are shown in Figure 1. Images were reviewed for proper registration to FRA-I Landsat images.

Table 2. FRA-II ASTER images, Corresponding Landsat Footprints, and acquisition dates

ASTER Image File	Corresponding Landsat Footprint(s)	ASTER Acquisition Date (YYYYMMDD)
oast_l1b_00304212005161805_04262005114413	P016 R039 P107 R039	20050421
oast_l1b_00305072005161904_05122005120113	P016 R041 P017 R041	20050507
oast_l1b_00310022004162400_10132004124242	P018 R039	20041002
oast_l1b_00303112005162407_03182005134836	P018 R039	20050311
oast_l1b_00303112005162416_03182005135052	P018 R039	20050311
oast_l1b_00303132005161241_03202005122949	P015 R041 P016 R041	20050313
oast_l1b_00303132005161249_03202005122713	P015 R041 P015 R042 P016 R041 P016 R042	20050313
oast_l1b_00303132005161307_03202005123021	P015 R042 P015 R043 P016 R042	20050313
oast_l1b_00304212005161814_04262005114452	P016 R039	20050421
oast_l1b_00304212005161823_04262005114504	P016 R039 P016 R040 P017 R039	20050421
oast_l1b_00305072005161802_05122005115501	P016 R039 P017 R039	20050507
oast_l1b_00305072005161811_05122005115632	P016 R039 P017 R039	20050507
oast_l1b_00305072005161820_05122005115618	P016 R039 P016 R040 P017 R039	20050507
oast_l1b_00305072005161838_05122005115802	P016 R040 P017 R040	20050507
oast_l1b_00305072005161847_05122005115856	P016 R040 P016 R041 P017 R040 P017 R041	20050507
oast_l1b_00305072005161855_05122005120055	P016 R041 P017 R041	20050507
o2026222051	P020 R039	20041016
o2027180728	P019 R039 P020 R038 P020 R039	20041228
o2027180758	P019 R039 P020 R039	20041228
o2027537005	P020 R039	20050120
o2028617564	P020 R039	20050410

ASTER Image File	Corresponding Landsat Footprint(s)	ASTER Acquisition Date (YYYYMMDD)
o2027745726	P019 R039 P020 R039	20050205
o2027745725	P019 R039 P020 R039	20050205
o2027987821	P019 R039 P020 R039	20050302
o2027987835	P019 R039 P020 R039	20050302
oast_l1b_00305072005161829_05122005115845	P016 R040 P017 R039 P017 R040	20050507
oast_l1b_00303132005161258_03202005122803	P015 R042 P016 R042	20050313
oast_l1b_00303132005161316_03202005123843	P015 R042 P015 R043 P016 R042 P016 R043	20050313
oast_l1b_00304212005161832_04262005114524	P016 R040 P017 R039 P017 R040	20050421
oast_l1b_00310212005162352_10252005132533	P017 R039 P018 R039	20051021
oast_l1b_00309192005162345_0924200512555	P018 R039	20050919
oast_l1b_00310022004162409_10132004124334	P018 R039	20041002
oast_l1b_00310212005162401_10252005132441	P017 R039 P017 R040 P018 R039	20051021
o2027537008	P020 R039	20050120
o2032354004	P019 R039 P020 R039	20051212
oast_l1b_00311102004162945_12072004234218	P019 R039 P020 R039	20041110
oast_l1b_00303132005161232_03202005122756	P015 R041 P016 R041	20050313
oast_l1b_00303132005161325_03202005123903	P015 R043 P016 R043	20050330
oast_l1b_00308182005162403_08222005144554	P018 R039	20050818
oast_l1b_00304212005161841_04262005114535	P016 R040 P017 R040	20050421

Cross Correlation Analysis (CCA) multispectral change detection

CCA is a patented change detection procedure (U.S. patent No. 5,719,949) that is used to map land cover changes. CCA overcomes many limitations of conventional multispectral change detection methods because there is no reliance on direct pixel value comparison between the different scenes. Another strength and uniqueness is the ability to accurately detect change between disparate input data sets (source, sensor, and resolution independent) that have not been acquired under necessarily similar conditions. CCA performs well regardless of seasonal differences because former class boundaries are summarized with new class signatures to determine the relationship between pixel values and a feature class. The comparison is the difference between the observed value in one date of an image and the expected value at that location in the other image based on the mean of values stratified by statistical cluster. This approach isolates change, or reduces change detection artifacts better than conventional change detection procedures.

CCA was run between FRA-I and FRA-II Landsat images, and between FRA-I Landsat images and the corresponding ASTER images. Z score images or change images were reviewed individually to assess the “threshold values” for change. Pixels were categorized and recoded as “High likelihood of change”, “Moderate likelihood of change”, and Low to no likelihood of change’, in classes 3, 2, and 1, respectively. Change images then were mosaiced with a maximum function in ERDAS IMAGINE such that in areas of image overlap, the maximum pixel value would be expressed. Almost 10.7 million acres of change (Moderate and High likelihood) were detected through the entire state (Figure 2).

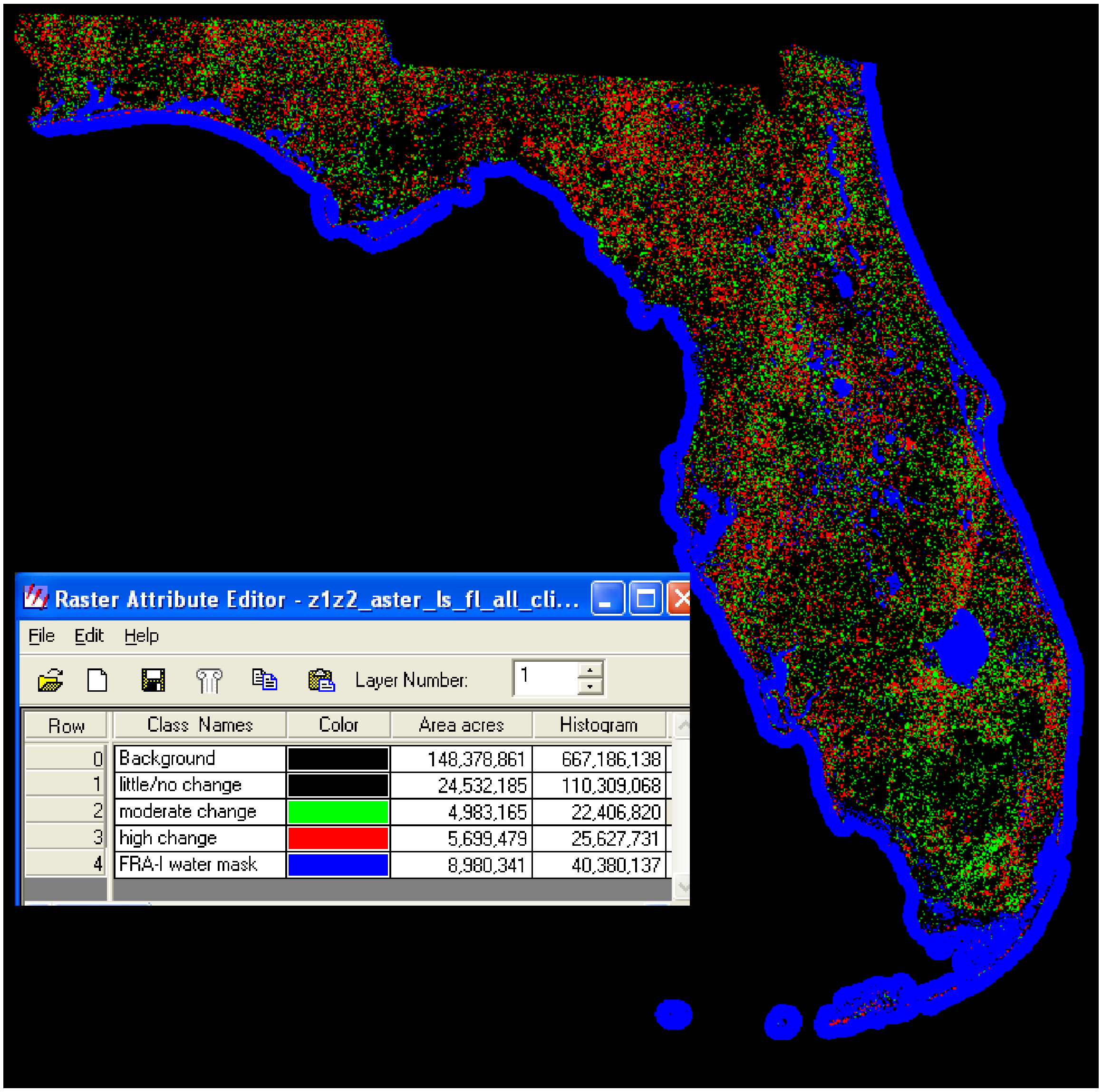

Figure 2. Change mosaic between FRA-I and FRA-II imagery generated using Cross Correlation Analysis.

Select ground data locations

Ground data points were to be selected based on 'Likelihood of change' and burnable fuel model. The project proposal proposed the collection of 85 samples total from each of the 12 burnable fuel models (FBPS 13 was excluded) such that 60 samples were taken from 'High likelihood", 15 samples from 'Moderate likelihood', and 10 samples from 'low likelihood' of change. In FRA-I, the state was divided into three sections or eco-regions (north, central, and south) to minimize regional vegetation differences (Space Imaging, 2002a). The sampling schema was proposed for each of the three eco-regions; such that 3,060 ground data sampling locations were to be identified (12 burnable fuel model X 85 samples per fuel model X 3 eco-regions. Ground data sampling locations had the restriction of being within 600 meters of a Tele Atlas database road.

Shortly after distribution of the ground data locations in late October 2006, it was evident that additional criteria were needed for stratification other than clusters of changed pixels within burnable fuel models. Data and photos were received for 354 locations in the initial ground data location set released by MDA Federal, and a decision was made to keep these data.

The strategy for enhanced stratification was to (1) expand the non-sampled area to include the Wildland Urban Interface (WUI) from FRA-I, (2) incorporate a level of spectral uniformity with a 9-pixel minimum cluster size, and (3), maintain the fuel model by change layer with a 9-pixel minimum cluster size.

To address the spectral uniformity, the multispectral images were converted to 240 cluster thematic files, and spectrally related clusters were grouped using the Dendrogram/Grouping Tool in ERDAS IMAGINE. The final number of spectral groups varied among all the images, but averaged approximately 13. There were 2704 "new" ground data locations generated and distributed after the enhanced stratification procedure.

Ground data collection training of Division of Forestry personnel

A faculty meeting was held May 24 – 25, 2006 in Palm Coast, FL. The FRA-II Fuels Workshop Training Faculty is listed in Table 3. The result of this faculty workshop was the development of a field manual 'Field Guide for Sampling Florida Fuels - October, 2006' presented in Appendix 1. In addition to the methods outlined for surface fuels and data collection, there are ten Appendices.

Table 3. FRA-II Fuels Workshop Training Faculty

Florida Division of Forestry
Jim Brenner, Fire Management Administrator
Tim Elder, Forest Area Supervisor, Okeechobee District
Keith Mousel, Resource Administrator, Withlacoochee State Forest
John Kern, Deputy Chief Field Operations, Region 3
MDA Federal
Andrew Ralowicz, Ph.D., Project Manager
Fire Program Solutions, LLC
Don Carlton, Fire Behavior Specialist

The FRA-II Ground Data Collection Training and Fuels Classification Workshop was held October 30 – Nov 3, 2006 in Palm Coast, FL. The workshop trained Florida. Division of Forestry personnel in the methods to use GPS units to locate specific geographic areas, use electronic data collection devices (RECONS), use a dichotomous surface fuels key, conduct data collection related to vegetation and surface fuels, and document the ground data collection site photographically. Prior to the meeting a decision was made to not train personnel to classify fuels based on the 2005 FBPS Fuel Model Set.

Approximately 60 individuals attended the training (Figure 3). The FRA-II Ground Data Collection Training and Fuels Classification Workshop Faculty are listed in Table 4.

Figure 3. Attendees at the FRA-II Ground Data Collection Training, Fuels Classification Workshop held October 30 – Nov 3, 2006 in Palm Coast, Florida.

Table 4. FRA-II Ground Data Collection Training Workshop Faculty

Florida Division of Forestry
Jim Brenner, Fire Management Administrator
Tim Elder, Forest Area Supervisor, Okeechobee District
Keith Mousel, Resource Administrator, Withlacoochee State Forest
John Kern, Deputy Chief Field Operations, Region 3
Duane Weiss District Manager, Myakka River District
MDA Federal
Andrew Ralowicz, Ph.D., Project Manager
Fire Program Solutions, LLC
Don Carlton, Fire Behavior Specialist
Integrated Resource Management
Marc Barnes, Senior Project Manager

Field Data Sample Forms (Field Guide for Sampling Florida Fuels - October, 2006, Appendix B) were created for the ground data collection. In addition, Digital Field Data Collection devices (RECONS) were used to acquire and preserve field data digitally. Ground data collection Team Leaders were established for each Field Unit (Table 5). Data administrators also were established for each Field Unit (Table 6).

Table 5. FRA-II Ground data collection Team Leaders.

Team Leader	Field Unit
Thomas Harrison	Blackwater Forestry Center
Claude Mosley	Chipola Forestry Center
Randy Gregory	Tallahassee Forestry Center
Butch Galbraith	Perry District Office
Jon Handrick	Suwannee Forestry Center
Jonathan Kirkus	Jacksonville District
Dave Conser	Waccasassa Forestry Center
Will Raulerson	Bunnell District
Bill Hodges	Bunnell District
Dave Fogler	Withlacoochee Forestry Center
Tom Donohoe	Orlando District
Victor Memmoli	Lakeland District
Brian Olsen	Myakka River District
Tim Hawks	Okeechobee District
Thomas Manning	Caloosahatchee Forestry Center
Roger Russell	Everglades District

Table 6. FRA-II Data Administrators.

Data Administrators	District
Dan Melvin	Blackwater Forestry Center
Claude Moseley	Chipola Forestry Center
Penny Horton	Tallahassee Forestry Center
Butch Galbraith	Perry District
Jon Handrick	Suwannee Forestry Center
Jon Kirkus	Jacksonville District
Dave Conser	Waccasassa Forestry Center
Bobby Cahal	Waccasassa Forestry Center
Will Raulerson	Bunnell District
David Fogler	Withlacoochee Forestry Center
Tom Donohoe	Orlando District
Victor Memmoli	Lakeland District
Brian Olsen	Myakka River District
Tim Rain SFR	Okeechobee District
Amanda Horney	Caloosahatchee Forestry Center
Rich Weyant	Everglades District

Post processing, QC, and review of DOF collected ground data

Incoming file transfer protocol (FTP) sites were created specifically for each Field Unit. Field Units with more than one data collection team had unique incoming ftp folders created for each team. Field Unit personnel uploaded data and photos to MDA Federal commencing November 28, 2006, and finishing March 30, 2007. Data and photos were received for 3013 locations, as some locations were not accessible (Table 7).

Table 7. Summary of ground data collection sites and sites with no data collection by Field Unit for FRA-II.

Field Unit	Total sites w/ collected data	Sites w/ No access or Not Observable	Total
Blackwater	116	1	117
Bunnell	204	0	204
Caloosahatchee	251	6	257
Chipola	409	0	409
Everglades	168	0	168
Jacksonville	99	0	99
Lakeland	105	2	107
Myakka	154	3	157
Okeechobee	348	0	348
Orlando	241	0	241
Perry	132	11	143
Suwannee	156	3	159
Tallahassee	203	9	212
Waccasassa	290	10	300
Withlacoochie	137	0	137
Total	**3013**	**45**	**3058**

As data were received at MDA Federal, records were kept by field unit. Messages were sent to field units that had sent data files with sites not assigned to them. There were instances of field units assisting others in ground data collection. Data Tracking Reports were submitted to the FL DOF Project Manager at regular intervals (Table 8).

Table 8. Submission dates of Data Tracking Reports

Data Tracking Report Submission Date (YYYYMMDD)	Data Tracking Report Submission Date (YYYYMMDD)	Data Tracking Report Submission Date (YYYYMMDD)	Data Tracking Report Submission Date (YYYYMMDD)
20061128	20070117	20070220	20070323
20061130	20070118	20070224	20070326
20061201	20070126	20070228	20070328
20061204	20070129	20070305	20070329
20061207	20070130	20070307	20070330
20061210	20070201	20070308	20070331
20061211	20070206	20070308	20070331
20061213	20070208	20070314	20070406
20061214	20070213	20070315	20070407
20070105	20070214	20070316	20070409
20070108	20070215	20070320	20070430
20070110	20070216	20070321	
20070112	20070219	20070322	

Quality control (QC) was performed on the data and photos received with regard to (1) confirming the site identifier corresponded to the actual location (2) confirming UTM coordinates with files, and (3) ensuring photo file names were in a uniform file naming format. Figure 4 shows the final distribution of ground data points within Field Units collected by FL DOF personnel.

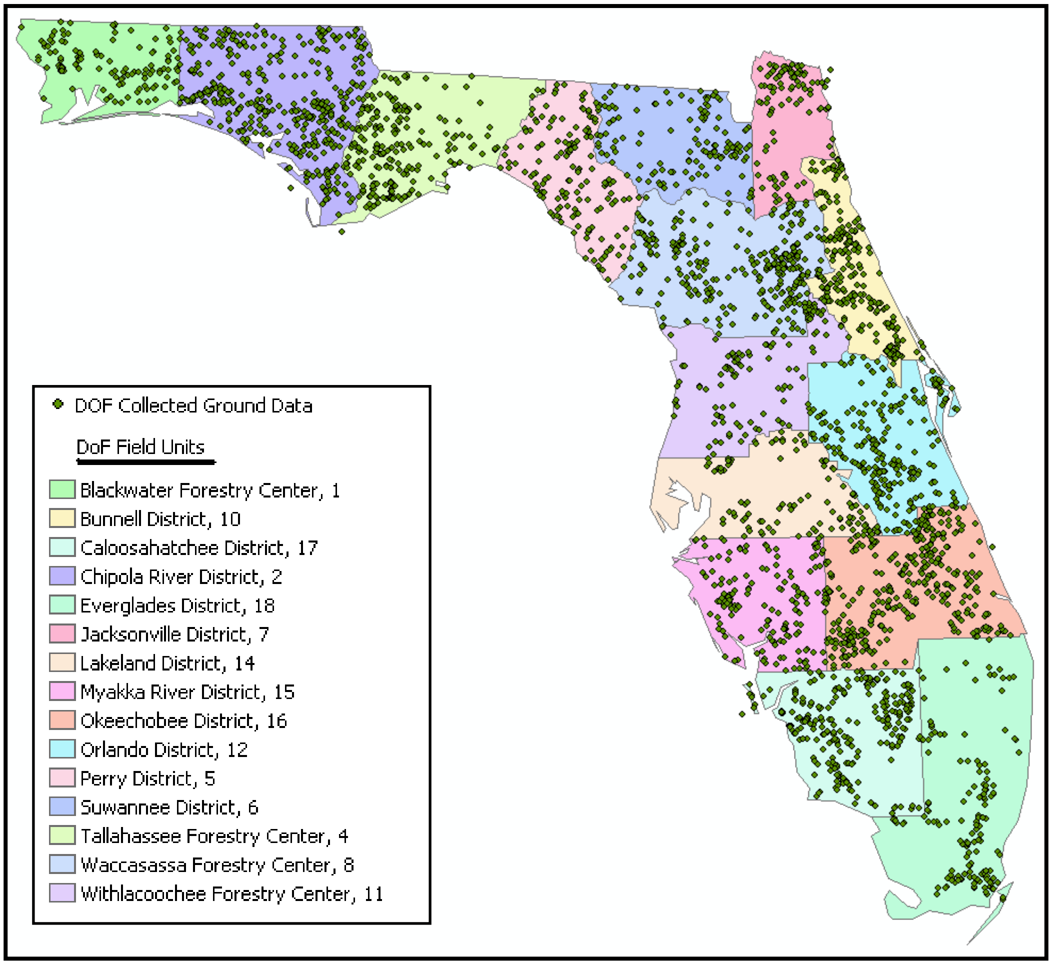

Figure 4. Ground data collection locations by Florida Division of Forestry Field Units.

The Field Units were separated into four regions and Fl DOF personnel performed quality control on a target 10 percent of the sites within a region. Table 9 shows the regions, DOF person responsible for QC plots, Field Units within regions, number of data collection sites assigned to the region, number of QC sites received, number of QC sites with FBPS fuel models 1-12, and the percent correct fuel model calls.

Table 9. Regions, DOF QC person, Field Units within regions, sites assigned to the region, QC sites received, number of QC sites with FBPS fuel models 1-12, and the percent correct fuel model calls.

Region	FL DoF QC	Field Units	No. Of Sites Assigned	QC sites received	Sites w/ Burnable fuel Model	% Correct
1	Brenner	Blackwater Chipola Tallahassee	738	71	64	47%
2	LeNeave	Jacksonville Perry Suwannee Waccasassa	701	24	24	42%
3	Kern	Bunnell Lakeland Orlando Withlacoochie	689	58	52	46%
4	Weiss	Caloosahatchee Everglades Myakka Okeechobee	930	31	29	52%
Total			3058	184	169	47%

A comprehensive QC review of all ground data location fuel model calls was conducted July, 24 – 26, 2007 in Lake City, Florida by Jim Brenner, Don Carlton, Andrew Ralowicz, Sam LeNeave, and Kenneth Kay. Ground data location photos were reviewed along with the 2005 FRA-II imagery, Google earth imagery, and the FRA-I surface fuels raster. The results, by DOF Field Unit are shown in Table 10.

Table 10. Number of correct and incorrect fuel model assessments and percent correct for FRA-II surface fuel model calls by DOF Field Unit.

Field Unit	No. Correct	No. Incorrect	% Correct
Blackwater Forestry Center	49	68	41.9%
Bunnell District	97	121	44.5%
Caloosahatchee Forestry Center	123	137	47.3%
Chipola Forestry Center	172	237	42.1%
Everglades District	70	83	45.8%
Jacksonville District	52	45	53.6%
Lakeland District	50	60	45.5%
Myakka River District	66	96	40.7%
Okeechobee District	169	188	47.3%
Orlando District	108	131	45.2%
Perry District	70	95	42.4%
Suwannee District	64	74	46.4%
Tallahassee Forestry Center	101	113	47.2%
Waccasassa Forestry Center	127	171	42.6%
Withlacoochee Forestry Center	51	70	42.1%
Total	1369	1689	44.8%

Table 10 demonstrates that it is essential to have qualified individuals in the field assessing surface fuels. In addition, it reveals that (1) the fuel model classification training might not have been adequate; (2) more time should have been spent in the field using the fuel model field guide with DOF personnel, or (3) the fuel model field guide might have been confusing or too complex.

Table 11 shows significant difficulties in identifying FBPS fuel model 2 (28%), FBPS fuel model 5 (19%), and FBPS fuel model 10 (9%). This is not surprising because in Florida, the 1982 FBPS fuel model 2 can consist of four ‘vegetation situations’ (Space Imaging, 2002b. p. 75). Similarly, FBPS fuel model 10 can consist of four ‘vegetation situations’ while FBPS fuel model 5 can consist of three ‘vegetation situations. These facts must be considered to strengthen any subsequent field training sessions.

Table 11. Percent correct calls within fuel model by DOF Unit for FRA-II.

	1982 FBPS										
Field Unit	**2**	**3**	**4**	**5**	**7**	**8**	**9**	**10**	**11**	**12**	**Average % Correct by Field Unit**
Blackwater Forestry Center	19%	46%	67%	25%	29%	39%	38%		0%		36%
Bunnell District	21%	89%	58%	11%	64%	51%	48%				45%
Caloosahatchee Forestry Center	28%	75%	60%	0%	74%	52%	72%	0%			49%
Chipola Forestry Center	30%	82%	63%	0%	56%	54%	20%	0%	100%	100%	43%
Everglades District	35%	100%	71%	50%	53%	56%	31%	0%	0%		48%
Jacksonville District	26%	100%	100%	100%	60%	64%	56%	0%		100%	57%
Lakeland District	23%	47%	33%	0%	38%	36%	39%	0%	50%	0%	48%
Myakka River District	21%	100%	67%	0%	46%	56%	50%				42%
Okeechobee District	38%	92%	67%	0%	60%	62%	51%	0%	100%		51%
Orlando District	30%	75%	67%	33%	59%	35%	57%	33%	83%		44%
Perry District	30%	100%	70%		60%	63%	41%				45%
Suwannee District	22%	100%	71%	0%	29%	52%	75%		100%	0%	46%
Tallahassee Forestry Center	26%	100%	83%	40%	63%	56%	43%		100%		50%
Waccasassa Forestry Center	23%	100%	54%	50%	52%	55%	52%	0%	100%		45%
Withlacoochee Forestry Center	23%	100%	55%		40%	50%	63%		50%		46%
Average % Correct by Fuel Model	28%	85%	65%	19%	56%	52%	50%	9%	78%	50%	

In the event of another FRA update, another strategy for surface fuels ground data collection would be to have ground crews document the location with a series of standard photos. For example, four photos could be taken a certain distance from a range pole that would document the vegetation present and vegetation height. All photos would be reviewed by a "surface fuels panel" to determine the appropriate surface fuel. Advantages to this method would be (1) to lower the amount of time a field crew spent at any one given site, (2) to efficiently increase the ground data quality by having consistent reviewers, and (3) free qualified surface fuel QC reviewers from having to perform field validations.

After QC review and removal of points where ground condition and hence surface fuel had changed since the imagery acquisition date, there were 2,456 ground data points with surface fuel models 2 through 12 from FL DOF. There were no FBPS 01 fuel models. Roughly, 80% of the ground data locations distributed to FL DOF was usable.

MDA Federal ground data collection

MDA Federal has developed a real time GPS mapping, land cover database application termed Fieldwork, Location and Attribution Program (FLAP). FLAP is based on RGMID, a GPS tracking software in ERDAS IMAGINE. This software, jointly developed by MDA Federal and Leica Geosystems, uses imagery in a standard ERDAS IMAGINE viewer, and incorporates real-time GPS tracking and land classification database access in the field. The database "classes", in this case surface fuel models, were constructed specifically for the FRA-II project. Digital photos were linked to the GPS surface fuels database by entering the picture identification number during field data collection.

MDA Federal ground data collection commenced on July 23, 2007 starting in Jacksonville, Florida with Jim Brenner, Don Carlton, Andrew Ralowicz, and Kenneth Kay. Ground data were collected in Jacksonville, Bunnell, and Suwannee districts. Half way through Day 1, a decision was made to perform the QC review of all ground data location fuel model calls collected by FL DOF personnel.

The second ground data collection trip commenced August 6, 2007 starting in Orlando, Florida. The goal was to have one team cover points south, and a second team cover points north. An ERDAS IMAGINE license key malfunction precluded the work of dual ground data collection teams. Duane Weis, Don Carlton, and Andrew Ralowicz traveled southwest collecting ground data points in Lakeland, Caloosahatchee Everglades, and Okeechobee districts. Don Carlton and Andrew Ralowicz continued from Orlando through Withlacoochee and Waccasassa districts. On Wednesday August 8, 2007, Don C. and Andrew R. met Jim Brenner in Tallahassee and data were collected in Tallahassee, Chipola, Blackwater, Perry and Suwannee districts. Data were collected in Suwannee, Jacksonville, and Bunnell districts on August 9, 2007, and Bunnell, Waccasassa, and

Withlacoochee August 10, 2007. Figure 5 shows the ground data collection locations within the Division of Forestry Field Units and associated dates.

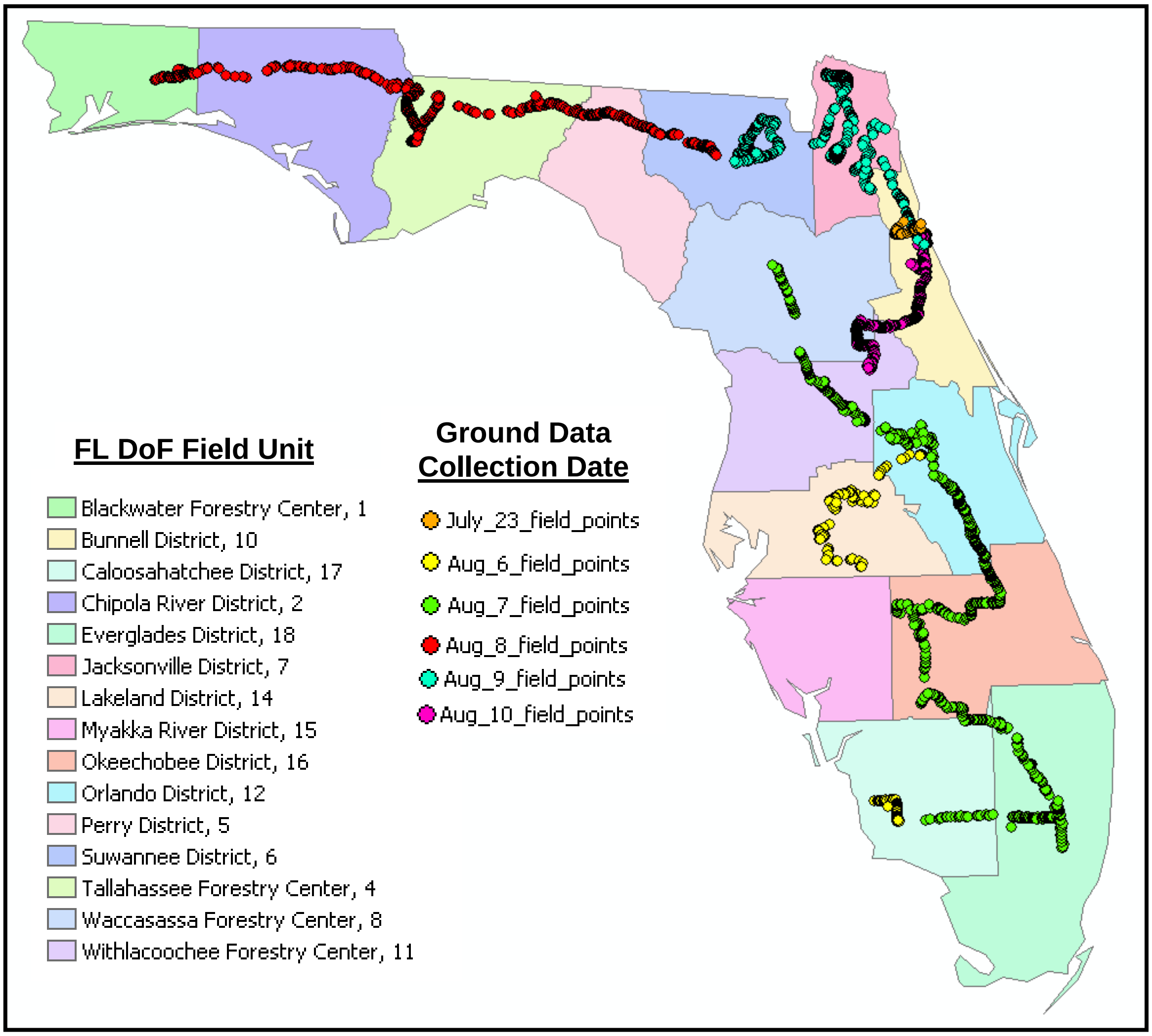

Figure 5. Ground data collection locations and dates within Division of Forestry Field Units.

There were 7,837 total ground data collected by MDA Federal. There were 4,686 ground data points collected in surface fuels 2 through 11.

Ground data points collected by FL DOF and MDA Federal were merged, and then randomly assigned a value of 1 through 5. Ground data points assigned the value of "5" were selected to be accuracy points. These accuracy points then were intersected with the change mask. Points designated as 'accuracy points' not intersecting the changed mask were returned to the training points. Ground data points assigned the value of 1, 2, 3, or 4, plus 5 not in change were training points.

Shapefiles for training and accuracy were converted to thematic rasters using ArcToolbox and ERDAS IMAGINE. All rasters had the same projection and pixel size as the base imagery and were put onto the same grid.

The southern and central ecoregion contained insufficient validation points for valid accuracy prediction among all fuel models. Therefore, all validation points were combined and CART was run with ecoregions as an independent variable. Table 12 shows the number of points by fuel model for Training and Accuracy, respectively.

Table 12. Numbers of Training and Accuracy points by 1982 FBPS Fuel Model.

Surface Fuel Model	Number of Training Points		Number of Accuracy Points
FBPS 01	0		0
FBPS 02	2,263		395
FBPS 03	366		33
FBPS 04	562		39
FBPS 05	231		51
FBPS 06	128		0
FBPS 07	791		54
FBPS 08	1,746		110
FBPS 09	756		76
FBPS 10	33		3
Total	6,876		761

Ancillary data layers

Ancillary data were secured as client furnished material, downloaded from public sources and generated in house. Canopy cover percent was generated based on DOF field collected data and Landsat 5 TM imagery. An impervious layer along with GAP and NLCD data were secured from public sources. The ecoregions from FRA-I were obtained as client furnished material. Finally, a tassled cap image of the entire state was generated from a color-balanced mosaic of Landsat 5 TM six-band multispectral images. Various combinations of these data sets were used in the CART process.

The tasseled cap transformation converts a six-band Landsat image (no thermal bands) to a three-band image depicting brightness, greenness and wetness (Crist and Cicone, 1984). Brightness is a weighted sum of all six bands, or a measure of overall reflectance. Greenness measures the presence and density of green vegetation and is determined by contrasting near-infrared and visible reflectance. Wetness is a contrast between shortwave-infrared (SWIR) and visible/ near-infrared (VNIR) reflectance, measuring soil moisture content, vegetation density, and other scene class characteristics. The tasseled cap transformation does not create information that was not present in the original data, but rather facilitates information extraction from the multispectral data.

Classification and Regression Tree

The program See5, developed by RuleQuest Research[1], was incorporated into ERDAS IMAGINE to facilitate CART analysis for thematic data. It was used to model the 1982 FBPS fuel models in the changed areas.

In CART, all the independent variables must have the same extent, projection and pixel size. The layers listed above then were layer-stacked and tested in a logical progression of combinations of trial and error to produce the greatest accuracy. The independent variables and combinations used are listed in Table 13. CART Run 4 produced the greatest initial accuracy (89.4%) using training and independent validation points as described.

Table 13. Independent variables used in the CART process, and combinations used in different CART Runs.

	Independent Variables Used			
	CART Run			
Independent Variables	**1**	**2**	**3**	**4**
1 = Landsat color balanced mosaic	1	1	1	1
2 = Landsat tassled cap image	2	2	2	2
3 = Ecoregions thematic raster	3	3	3	3
4 = USGS NED	4	4	4	4
5 = Canopy Cover Percent	5	5	5	5
6 = NLCD - 2001			6	6
7 = FRA-I fuels 2-10	7		7	
8 = GAP - 2001	8	8	8	8
9 = Impervious Percent	9	9	9	9
	Accuracy Statistics			
Overall Accuracy (no fuzzy rules)	87.5	87.1	88.4	89.4
Kappa	0.816	0.808	0.828	0.843

The Kappa statistic is an index that compares the agreement against that which might be expected by chance, or as the chance-corrected proportional agreement. Its possible values range from +1 (perfect agreement) via 0 (no agreement above that expected by chance) to -1 (complete disagreement). The Kappa statistic for CART Run 4 was also the greatest at 0.843.

Table 14 shows the accuracy by fuel model class. The Producer's accuracy refers to the probability that a certain surface fuel model on the ground is classified as such, User's accuracy refers to the probability that a pixel labeled as a surface fuel model in the map is really this surface fuel model. Yellow cells in Tables 14 show what number contributed to the overall accuracy, and the Producer's and User's accuracies.

[1] **© RuleQuest Research Pty Ltd. 30 Athena Avenue, St Ives NSW 2075 Australia**

Traditional or deterministic error matrix assume that an accuracy assessment sample site can have only one correct label, as classification scheme rules impose discrete boundaries on continuous natural conditions, surface fuel models in this project. Fuzzy error matrices implement rules permitting areas that are not absolutely correct, to be considered acceptable based on fuzzy rules. For example, areas mapped as fuel model 7 may be acceptable if they were mapped as a fuel model 4 as confusion can occur due to the difference in shrub height between these two fuel models. The fuzzy rules developed for FRA-I (Space Imaging, 2002a) are shown in Table 15, and were implemented in FRA-II.

Table 16 shows the overall accuracy improved slightly (1.4%) after applying FRA-I fuzzy rules (Space Imaging 2002a). Cells not on the diagonal that contribute to accuracies are highlighted in orange.

Table 14. Error matrix for The FRA-II Changed Area Update with no fuzzy rules applied.

		Field Collected data											User's Accuracy
		FM 1	FM 2	FM 3	FM 4	FM 5	FM 6	FM 7	FM 8	FM 9	FM 10	Totals	Commission
CART Predicted	FM 1	0	0	0	0	0	0	0	0	0	0	0	-
	FM 2	0	370	3	2	8	0	5	8	8	1	405	91.4%
	FM 3	0	3	27	0	0	0	1	3	0	0	34	79.4%
	FM 4	0	1	2	36	0	0	0	1	0	0	40	90.0%
	FM 5	0	0	0	1	40	0	0	0	0	0	41	97.6%
	FM 6	0	0	0	0	0	0	0	0	0	0	0	-
	FM 7	0	9	0	0	0	0	45	0	2	0	56	80.4%
	FM 8	0	8	1	0	3	0	3	97	2	0	114	85.1%
	FM 9	0	4	0	0	0	0	0	1	64	1	70	91.4%
	FM 10	0	0	0	0	0	0	0	0	0	1	1	100.0%
	Totals	0	395	33	39	51	0	54	110	76	3	761	
Producer's Accuracy	Omission	-	93.7%	81.8%	92.3%	78.4%	-	83.3%	88.2%	84.2%	33.3%		89.4%

Kappa = 0.843

Table 15. Fuzzy rules developed in FRA-I.

Fuel model 2
- Fuel model 3 is acceptable. This is based on the confusion in the field between fuel models 3 and 2 based on grass height.
- Fuel model 97 is acceptable. This is based on pasture being classified as Agriculture vs. Grass.
Fuel model 3
- Fuel model 2 is acceptable. This is based on the confusion in the field between fuel models 3 and 2 based on grass height.
Fuel model 4
- Fuel model 7 is acceptable. The difference between the two fuel models is based on shrub height (6 feet being the cut-off).
- Fuel model 9 is acceptable. The line between these two fuel models is % timber litter vs. Shrub.
Fuel model 7
- Fuel model 4 is acceptable. The difference between the two fuel models is based on shrub height (6 feet being the cut-off).
- Fuel model 9 is acceptable. There is confusion between these two classes as shrub coverage de-creases.
Fuel model 8
- Fuel model 9 is acceptable. For mixed forest areas there is confusion between these timber litter models depending on the forest/litter composition %.
Fuel model 9
- Fuel model 8 is acceptable. For mixed forest areas there is confusion between these timber litter models depending on the forest/litter composition %.
- Fuel model 7 is acceptable. There is confusion between these two classes as shrub coverage decreases.
Fuel model 97
- Fuel model 2 is acceptable. This is based on pasture being classified as agriculture vs. Grass.

Table 16. Error matrix for The FRA-II Changed Area Update with FRA-I fuzzy rules applied.

		Field Collected data											User's accuracy
		FM 1	FM 2	FM 3	FM 4	FM 5	FM 6	FM 7	FM 8	FM 9	FM 10	Totals	Commission
	FM 1	0	0	0	0	0	0	0	0	0	0	0	-
CART Predicted	FM 2	0	370	3	2	8	0	5	8	8	1	405	91.4%
	FM 3	0	3	27	0	0	0	1	3	0	0	34	88.2%
	FM 4	0	1	2	36	0	0	0	1	0	0	40	90.0%
	FM 5	0	0	0	1	40	0	0	0	0	0	41	97.6%
	FM 6	0	0	0	0	0	0	0	0	0	0	0	-
	FM 7	0	9	0	0	0	0	45	0	2	0	56	83.9%
	FM 8	0	8	1	0	3	0	3	97	2	0	114	86.8%
	FM 9	0	4	0	0	0	0	0	1	64	1	70	92.9%
	FM 10	0	0	0	0	0	0	0	0	0	1	1	100.0%
	Totals	0	395	33	39	51	0	54	110	76	3	761	
Producer's accuracy	Omission	-	94.4%	90.9%	92.3%	78.4%	-	83.3%	89.1%	89.5%	33.3%		90.8%

Don Carlton of Fire Program Solutions, the project Fire Behavior Specialist, suggested changes to a number of the fuzzy rules, and offered the rules presented in Table 17. The modifications are based on a fire behavior perspective and not a remote sensing perspective. The error matrix based on the modified fuzzy rules is presented in Table 18.

Table 17. Modified fuzzy classification rules for FRA-II.

Fuel model 2
- Fuel model 97 is acceptable. This is based on pasture being classified as Agriculture vs. Grass.
Fuel model 4
- Fuel model 7 is acceptable. The difference between the two fuel models is based on shrub height (6 feet being the cut-off).
Fuel model 7
- Fuel model 4 is acceptable. The difference between the two fuel models is based on shrub height (6 feet being the cut-off).
- Fuel model 9 is acceptable. There is confusion between these two classes as shrub coverage decreases.
Fuel model 8
- Fuel model 9 is acceptable. For mixed forest areas there is confusion between these timber litter models depending on the forest/litter composition %.
Fuel model 9
- Fuel model 8 is acceptable. For mixed forest areas there is confusion between these timber litter models depending on the forest/litter composition %.
- Fuel model 7 is acceptable. There is confusion between these two classes as shrub coverage decreases.
Fuel model 97
- Fuel model 2 is acceptable. This is based on pasture being classified as Agriculture vs. Grass.

Table 18. Error matrix for The FRA-II Changed Area Update with modified fuzzy rules applied.

		Field Collected data											User's accuracy
		FM 1	FM 2	FM 3	FM 4	FM 5	FM 6	FM 7	FM 8	FM 9	FM 10	Totals	Commission
CART Predicted	FM 1	0	0	0	0	0	0	0	0	0	0	0	-
	FM 2	0	370	3	2	8	0	5	8	8	1	405	91.4%
	FM 3	0	3	27	0	0	0	1	3	0	0	34	79.4%
	FM 4	0	1	2	36	0	0	0	1	0	0	40	90.0%
	FM 5	0	0	0	1	40	0	0	0	0	0	41	97.6%
	FM 6	0	0	0	0	0	0	0	0	0	0	0	-
	FM 7	0	9	0	0	0	0	45	0	2	0	56	83.9%
	FM 8	0	8	1	0	3	0	3	97	2	0	114	86.8%
	FM 9	0	4	0	0	0	0	0	1	64	1	70	92.9%
	FM 10	0	0	0	0	0	0	0	0	0	1	1	100%
	Totals	0	395	33	39	51	0	54	110	76	3	761	
Producer's accuracy	Omission	-	94.4%	90.9%	92.3%	78.4%	-	83.3%	89.1%	89.5%	33.3%		90.0%

Final edits and quality control review between the color balanced mosaic and the predicted surface fuels layer were performed manually.

It is important to note that the error matrix tables do not include Agriculture, Urban, Rock, or Water. The objective of FRA-II was to generate burnable surface fuel models based on the changed areas. An agricultural mask and water mask were produced separately from the CART process. Had these classes been included in the accuracy assessment, especially with application of fuzzy rules, overall accuracies would have been greater.

Final Fuels Map Construction

Newly predicted surface fuels pixels in changed areas were mosaiced with the previous FRA-I raster with an overlay function in ERDAS IMAGINE. An independently produced water layer based on 2005 Landsat imagery was added. Agriculture was based on data from Florida water management districts, except the NW WMD. For this area agricultural pixels from FRA-I were used. FL DOF staff reviewed WMD agricultural areas in Region 2 (Lee Barnwell, Senior Forester – GIS, Suwannee Forestry Center). For areas not actually agriculture yet described as such in WMD databases, notes were taken on vegetation type and then surface fuel models assigned accordingly. Water Management District personnel (Steven R. Miller, Director, Division of Land Management, St. Johns River Water Management District) also reviewed surface fuels and made recommendations for surface fuel edits/changes.

The non-changed urban layer and rock layers from FRA-1 then were incorporated. Surface fuels within the Bugaboo fire complex were generated using GIS modeling rules (Table 24) based on Burned Area Reflectance Classification (BARC) data and the updated surface fuels map (FRA-I non change and FRA-II predicted) and then incorporated. Tele Atlas roads layer then was added. Finally, ground data were added to complete the updated Florida Surface Fuels layer. The process is shown in Figure 6. The Final Surface Fuels layer is shown in Figure 7.

Table 24. GIS Rules for modeling fuel models in the Bugaboo Complex based on Burn Severity Index values.

	Burn Severity Index Value			
	1	2	3	4
1982 FBPS	**Modeled 1982 FBPS**			
2	2	2	2	2
3	3	3	3	3
4	4	7	7	5
5	5	5	2	2
6	6	6	6	6
7	7	7	5	9
8	8	8	2	2
9	9	9	2	2
10	7	7	7	5
Ag	Ag	Ag	Ag	Ag
Urban	Urban	Urban	Urban	Urban
Barren	Barren	Barren	Barren	Barren
Water	Water	Water	Water	Water

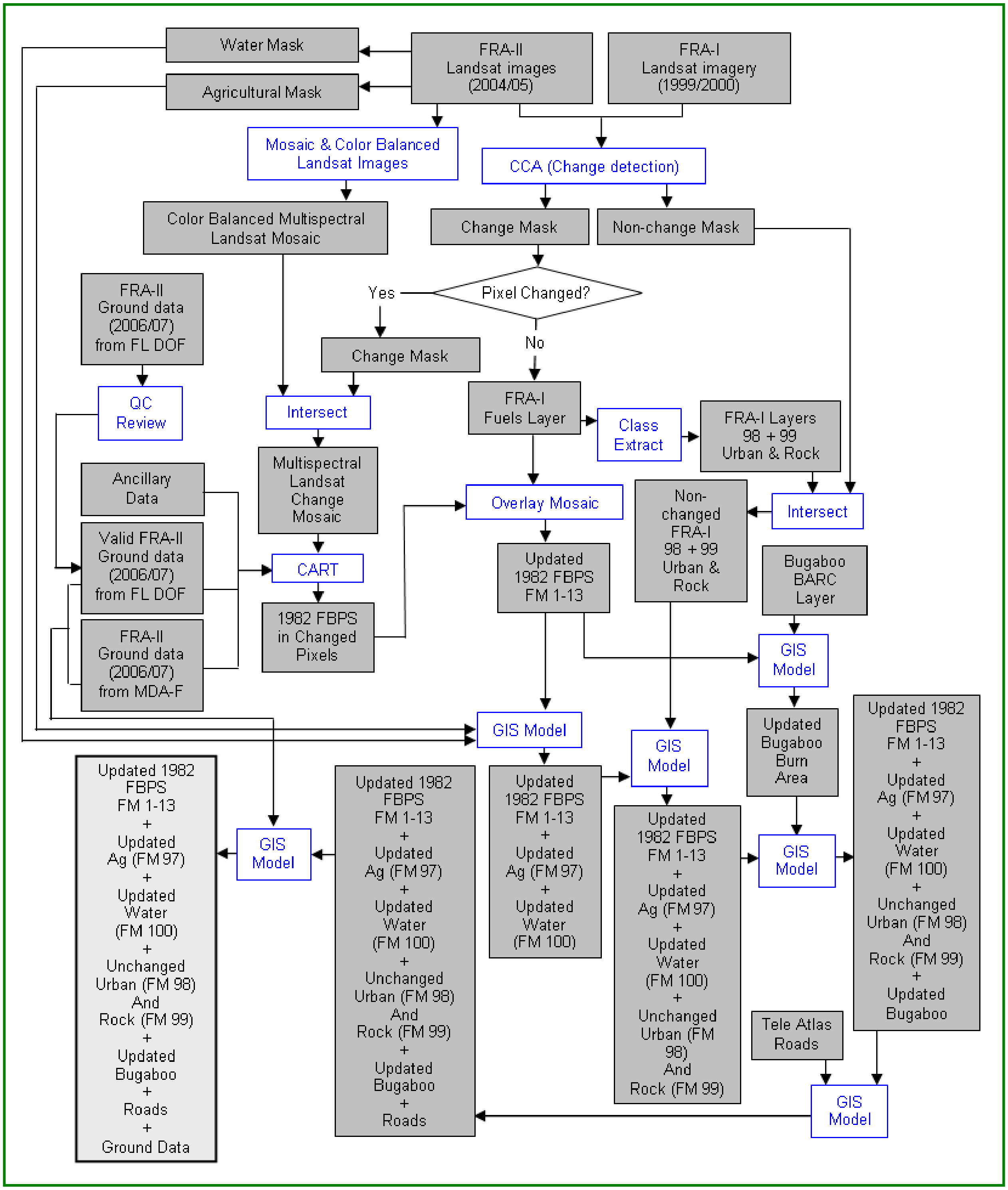

Figure 6. Construction of the FRA-II Fuels Layer.

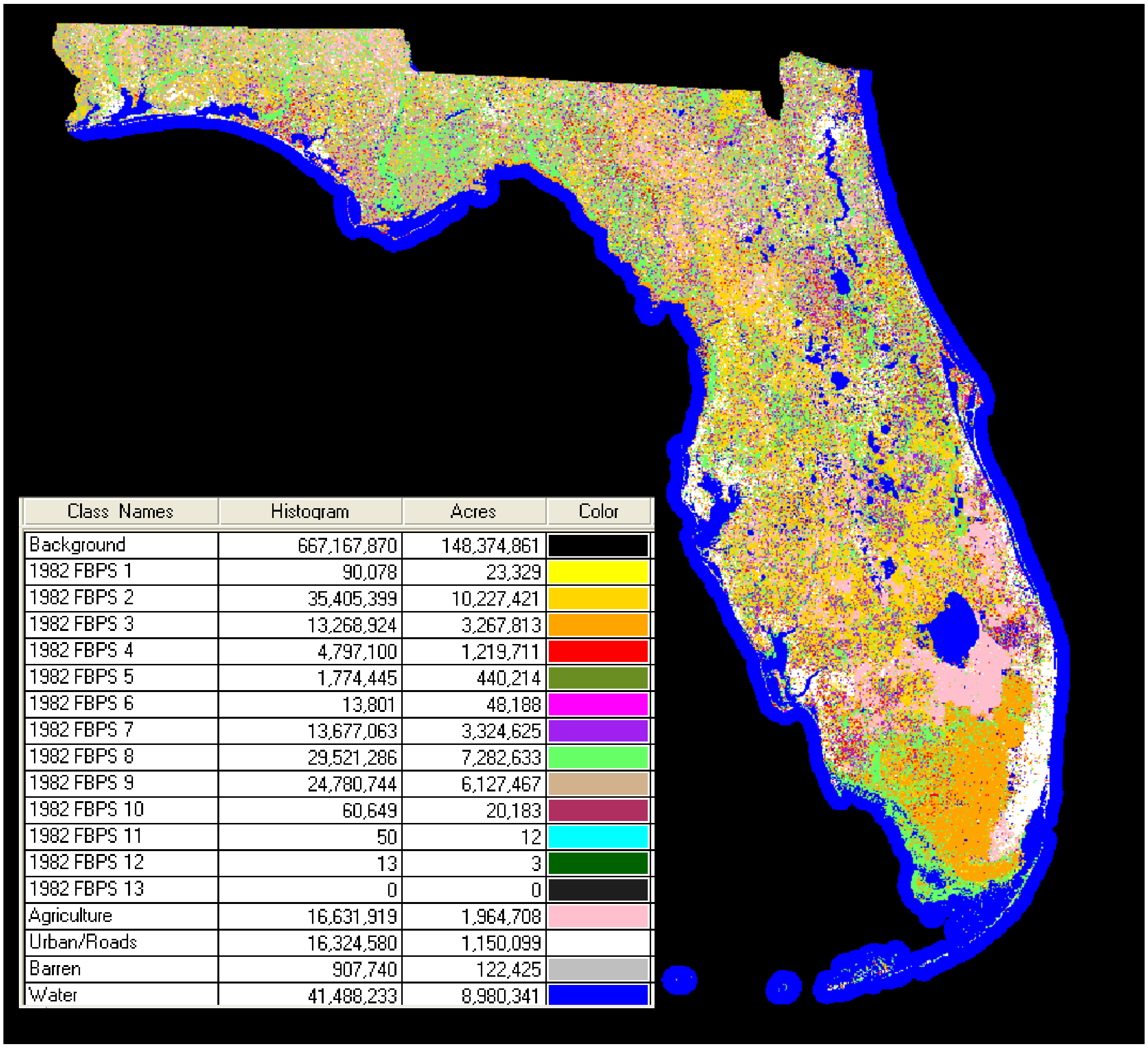

Figure 7. The Final Surface Fuels layer for the FRA-II based on 2005 imagery.

Metadata

Metadata is an important component to all digital products, describing the data of each file. With proper metadata it is possible to tell what the digital file represents, in what units of measure the values are, how to obtain the data, the accuracy of the data, and to list all disclaimers.

Federal Geographic Data Committee (FGDC) compliant metadata was generated for all delivered GIS data layers (Rasters and shapefiles) created during the FRAS-II update. This was accomplished using a custom generated metadata parser incorporated into Arc Catalog. The metadata and validation (parser) engines are based on the National Park Service (NPS) Metadata Tools Extension.

Pages 34 - 44 are the metadata for the final 2005 Surface Fuels data layer shown in the light gray box in Figure 6, and displayed in Figure 7.

Identification_Information:
  Citation:
    Citation_Information:
      Originator: MDA Federal Inc
      Publication_Date: 20080801
      Title: 2005_final_fuel_data_20080730.img
      Geospatial_Data_Presentation_Form: remote-sensing image
      Online_Linkage: NA
  Description:
    Abstract: This is a surface fuels thematic raster based on the 1982 FBPS described by Anderson, with 13 surface fuel model classes plus Agriculture, Urban, Barren, and Water. The raster contains surface fuel data at 30m resolution or pixel size from FRA-I (2002) and updated Surface Fuels data (based on 2005 imagery) that are not distinctly identified temporally. Cross Correlation Analysis (CCA) was performed on imagery from FRA-I (2000) and the Florida Sruface Fuels Update project (2005) to identify areas of spectral change. Using Classification and Regression Tree (CART) techniques, surface fuels were predicted in areas of spectral change between FRA-I Landsat imagery and 2005 imagery. Predicted surface fuels pixels in changed areas were mosaiced with the previous FRA-I raster. An independently produced water layer based on 2005 Landsat imagery was added. Agriculture is based on data from Florida water management districts, except the NW WMD. For this area agricultural pixels from FRA-I were used. FL DOF staff reviewed agricultual areas, making recomendation on areas not actually agriculture, but rather forested. These pixels then were reassigned the appropriate surface fuel model. Water Management District personel also reviewed surface fuels and made reccomendations for surface fuel changes. The urban layer from FRA-I had roads data from Tele Atlas incorporated and then was added. Surface fuels within the Bugaboo fire complex were generated using GIS modeling techniques based on FRA-I fuels and Burned Area Reflectance Classification (BARC) data. The Urban/Roads layer was overlaid again to compensate for changes due to fuel modeling in Bugaboo.
    Purpose: This raster contains FRA-I data (2000) and updated Surface Fuels data (based on 2005 Landsat and ASTER imagery) that are not distinctly identified. This is a surface fuels raster based on the 1982 FBPS described by Anderson. There are 13 surface fuel model classes. 30m resolution. Using CART techniques, surface fuels were predicted in areas of spectral change between FRA-I Landsat imagery (2000) and   the 2005 imagery. Spectral change was identified using Cross Correlation Analysis (U.S. patent No. 5,719,949). Newly predicted surface fuels pixels in changed areas were mosaiced with the previous FRA-I raster. This database is used in the Fire Risk Assessment System (FRAS) to determine Level of Concern with respect to fire behavior situations.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 2005
    Currentness_Reference: Date of the Landsat and ASTER imagery - 2005
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Unknown
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -88.381805
      East_Bounding_Coordinate: -78.727137
      North_Bounding_Coordinate: 31.316571
      South_Bounding_Coordinate: 23.586479
  Keywords:
    Theme:

Theme_Keyword_Thesaurus: Fire Behavior Prediction System, Fire Fuel Models, Florida, 1982 FBPS, Surface Fuels, Change Detection, Cross Correlation Analysis, CCA, Classification and Regression Tree, CART
Theme_Keyword: Fire Behavior Prediction System, Fire Fuel Models, Florida, 1982 FBPS, Surface Fuels, Change Detection, Cross Correlation Analysis, CCA, Classification and Regression Tree, CART
Access_Constraints: None
Use_Constraints: none
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Andrew Ralowicz, Ph.D.
Contact_Organization: MDA Federal Inc
Contact_Position: Project Manager
Contact_Address:
Address_Type: Mailing and Physical Address
Address: 6011 Executive Blvd #400
City: Rockville
State_or_Province: MD
Postal_Code: 20852
Country: USA
Contact_Voice_Telephone: 240 833 8200
Contact_TDD/TTY_Telephone: 240 833 8200
Contact_Facsimile_Telephone: 240 833 8201
Contact_Electronic_Mail_Address: andrew.ralowicz@mdafederal.com
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Quality control was conducted for FL DOF ground data visually by Jim Brenner, Don Carlton, Sam LeNeave, and Andrew Ralowicz by reviewing each fuel call with photos and imagery resources. In addition, ground data locations (10%) were verified in field by FL DOF personnel (Jim Brenner, Sam LeNeave, John Kern, and Duane Weiss). MDA Federal ground data were verified in the field by consensus among senior project participants - Jim Brenner, Don Carlton, Duane Weis, Sam LeNeave, and Andrew Ralowicz. Agricultural areas in Region 2 were reviewed by Lee Barnwell (Senior Forester – GIS, Suwannee Forestry Center), and areas identified as forested were incorporated into the final map product.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Overall Accuracy (no fuzzy rules) = 89.4%. Kappa = 0.843. User's Accuracy by 1982 FBPS Surface Fuel Model (no fuzzy rules): FM 2: 91.40%; FM 3: 79.40%; FM 4: 90.00%; FM 5: 97.60%; FM 7: 80.40%; FM 8: 85.10%; FM 9: 91.40%; FM 10: 100.00%. Producer's Accuracy by 1982 FBPS Surface Fuel Model (no fuzzy rules): FM 2: 93.7%; FM 3: 81.8%; FM 4: 92.3%; FM 5: 78.4%; FM 7: 83.3%; FM 8: 88.2%; FM 9: 84.2%; FM 10: 33.3%.
Attribute_Accuracy_Explanation: Ground data: visual verification with group consensus. Surface Fuel raster: classification accuracy was determined via an error matrix (confusion matrix or contingency table) based on methods reviewed by Congalton (1991). Congalton, R.G. 1991. A review of assessing the accuracy of classifications of remotely sensed data. Remote Sensing of Environment 37(1): pp. 35-46.
Logical_Consistency_Report: manual check for projection information
Completeness_Report: NA
Positional_Accuracy:
Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: Landsat and ASTER scenes were geo-referenced by MDA Federal. Spatial accuracy: pixels register to +/- 1 pixel (30 m) with reference imagery from FRA-I
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: Landsat and ASTER scenes were geo-referenced by MDA Federal using NED.
Lineage:
Process_Step:
Process_Description: Logical consistency check by sorting fuel model values to verify values were within range (FBPS 1-10). Geographic verification by confirmation points were within the state of Florida and verified against the originally distributed points assigned to FL DoF Field Units using GIS models.
Source_Used_Citation_Abbreviation: NA
Process_Date: 20080420
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Andrew Ralowicz, Ph.D.
Contact_Organization: MDA Federal Inc
Contact_Position: Project Manager
Contact_Address:
Address_Type: Mailing and Physical Address
Address: 6011 Executive Blvd #400
City: Rockville
State_or_Province: MD
Postal_Code: 20852
Country: USA
Contact_Voice_Telephone: 240 833 8200
Contact_TDD/TTY_Telephone: 240 833 8200
Contact_Facsimile_Telephone: 240 833 8201
Contact_Electronic_Mail_Address: andrew.ralowicz@mdafederal.com
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Pixel
Row_Count: 28258
Column_Count: 30643
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 24.000000
Standard_Parallel: 31.500000
Longitude_of_Central_Meridian: -84.000000
Latitude_of_Projection_Origin: 24.000000
False_Easting: 400000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 30.000000
Ordinate_Resolution: 30.000000

Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Florida
Entity_Type_Definition: Florida
Entity_Type_Definition_Source: Unknown
Attribute:
Attribute_Label: Attributes: Class Name; Histogram; Acres; Color, Red, Green, Blue, Opacity
Attribute_Definition: Class Name - Surface fuel model based on the 1982 FBPS described by Hal Anderson [There are 13 surface fuel classes plus Agriculture (97), Urban (98), Soil/Rock/Barren (99) and Water (100); Histogram - number of pixels contained within that class (surface fuel model); Acres - area in acres of a class (surface fuel model); Color - color; Red - value of red in RGB space; Green - value of green in RGB space; Blue - value of blue in RGB space, Opacity - degree of opaqueness (0 = completely opaque to 1 = visible color as expressed in color attribute)
Attribute_Definition_Source: Anderson. H E. 1982. Aids to Determining Fuel Models For Estimating Fire Behavior. USDA, Forest Service, Intermountain Forest and Range Experiment Station. General Technical Report INT-122
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 0 No data or Background
Enumerated_Domain_Value_Definition: Classes where HISTOGRAM = 0 contain no data, Classes 14 - 96 are not valid surface fuel models and contain no data.
Enumerated_Domain_Value_Definition_Source: N/A
Attribute:
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Contact_Organization: MDA Federal Inc
Contact_Position: Project Manager
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State_or_Province: MD
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Country: USA
Contact_Voice_Telephone: 240 833 8200
Contact_TDD/TTY_Telephone: 240 833 8200
Contact_Facsimile_Telephone: 240 833 8201
Contact_Electronic_Mail_Address: andrew.ralowicz@mdafederal.com
Resource_Description: Downloadable Data
Distribution_Liability: This product is available for distribution.

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Literature Cited

Anderson. H. E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA, Forest Service, Intermountain Forest and Range Experiment Station. General Technical Report INT-122

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Space Imaging. 2002a. Florida Fire Risk Assessment, Final Project Report. . December 20, 2002.

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Appendix 1 – Field Guide for Sampling Florida Fuels. October, 2006.

Field Guide for Sampling Florida Fuels

October, 2006

Prepared For:

Florida Division of Forestry
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Tallahassee, FL 32399-1650

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Appendices

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Field Guide for Sampling Florida Fuels

Background Information

The purpose of this training is to explain the procedures for collecting vegetation information that will be used to generate an updated fuels map of the state of Florida. The data collected will include information on surface fuels, aerial fuels and canopy closure.

Project Objectives

The objective of the project is to update the fuels layers in the Fire Risk Assessment System that identifies and defines the individual elements that compose wildland fire risk and hazard in the State of Florida. The Florida Risk Assessment:

- Provides maps of fuels statewide
- Models and maps “Level of Concern” where cooperative efforts between the State, and public and private landowners are needed to focus fuel reduction work
- Allows for analysis of the sensitivity of “Level of Concern” to changes in model input variables
- Facilitates updating of the fire risk model to account for changes in fuels and land use

The result of the project will be the update the fuels layers in the Fire Risk Assessment System (FRAS). The system will combine several landscape characteristics to create a map of Level of Concern. Landscape characteristics will include:

- Wildland Fire Susceptibility
- Fire Effects
- Population Density
- Measures of ability to respond to fire occurrences

There are two components of the project 1) Fuels Mapping and 2) GIS Model Specification, Development and Implementation. The first component is to develop two maps; surface fuel model and canopy closure. The second component is to use the surface fuel model and the canopy closure maps along with other ancillary data layers (slope, aspect, elevation and percentile weather) as inputs into a fire behavior prediction program. Outputs from the fire behavior prediction program model will be used in conjunction with other information to develop a GIS coverage of wildland fire susceptibility of the State of Florida. The GIS layers of Wildland Fire Susceptibility and Fire Effects will be combined and ranked to develop estimates of “Level of Concern”.

Overview of Sampling Process and Procedures

Purpose

The ground visit and data collection within the training sites provides the basis for classification of the imagery. The data collected and the classification key provide a label for each individual training site and this label is applied to each pixel in the image that is included in that training site. The training sites and their labels drive the classification, hence it is critical that the training sites cover the variation (both on the ground and in the image) found throughout the mapping area. It is equally important that the data collected be accurate and precise.

Visiting Sites

A quad map or any good road map, the imagery or GPS unit can be used to navigate to the site shown on the image map. A directory of site # and UTM coordinates will be provided. Selective availability can be turned on at any time by the Department of Defense and could introduce error into the GPS readings. Also, the training site coordinates can be off by up to 30 meters.

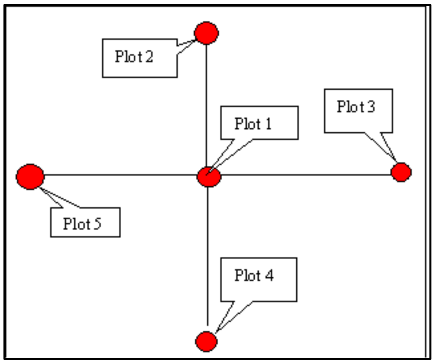
Equipment/Instrumentation for Field Work

1. GPS Unit – to navigate to site and verify location of site
2. Data Recorder
3. Compass – navigation
4. Navigation maps as needed; ie. Quad. name, roads, and hydrology
5. Field sheets – site/plot forms (1 set per site to be sampled)
6. Field Manual – details field procedures
7. Densiometer – to quantify crown closure
8. 2 foot by 2 foot quadrat – to quantify grass cover
9. 100ft. tape – for collecting tree plot data
10. D Tape to measure tree diameters (Note: A Loggers Tape can do both 9 and 10)
11. Range (Forestry) pole – used to mark the center of the plot
12. Clinometer – used to measure tree height
13. Digital camera – to document the site
14. USGS 1:24,000 quad maps – navigation – same scale as field maps - optional
15. Clipboard – optional
16. Wire pins to mark site and/or plot centers
17. Plastic tape
18. Site ID on 8.5 x 11 in paper and 2 alligator clips

Step 1 – Locate the Site

Using the coordinates of the site, locate the center of the sampling area. Pushing the plot rod into the ground at the plot center.

The sampling design requires the establishment of five plots at each site. The diagram at the right show the plot layout with the site center located at the spot identified as Plot 1. Measurements will be taken at each plot with the values recorded on a Field Sample Data Form or entered directly into the Data Recorder. The distance from plot 1 to plots 2-5 should be one to one and a half chains (66-99 feet).



The following instructions follow the format of the Field Sample Data Form. A description of each field follows.

1.1 Observer

Record the 3 initials of the name of lead observer completing the field form.

1.2 Date

Record the date the field data collection was taken.

1.3 Site ID

Record the site identifier as provided by MDA federal. This will be a number between 1 and 3060.

1.4 GPS Location

Enter the Easting (X-coordinate) and Northing (Y-coordinate) in UTM coordinates. Select the UTM zone (either 16 or 17).

1.5 Level of Observation

Record how the site was observed. The options are: Site Measured, Viewed from a Distance or Site Not Observable.

1.6 Land Cover Class

Select the Land Cover Class that best describes the site from the provided list of community types. This information is used in the fuel model keys. The options include the following:

- Non-vegetated
- Transitional
- Planted/Cultivated
- Pasture/Hay
- **Crop**
- Non-woody Wetland
- Woody Wetland
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Natural/Semi Grassland
- Natural/Semi Shrub or Young Forest

1.7 Predominant Stand Type

The options are: Pine, Melaleuca, Hardwood, Cabbage Palm, Cypress, TiTi or No Trees.

No Trees - No tree measurements are taken. Steps 1 through 5.1 are performed.

TiTi Stand – No tree measurements are taken. Steps 1 through 5.1 are performed.

Pine Stand – Tree measurements will be taken on all pine species in the stand. Steps 1 through 5.1 as well as Step 5.3 and Step 5.4 will be performed

Melaleuca Stand - Steps 1 through 5.1 and Step 5.4 are performed.

Hardwood/Cabbage Palm/Cypress Stand – Steps 1 through 5.1 and Step 5.5 are performed.

1.8 Is the area actively managed?

Are management activities such as timber management and prescribed burning actively being conducted on the area? If so select the Y, otherwise select the N.

1.9 Site Disturbance in Last 5 Years

Select from the following options:

- Thin 1 (First commercial thinning)
- Thin 2 (Second commercial thinning)
- Broadcast Rx Fire (Broadcast prescribed fire)
- Non Rx Fire Fuels Treatment (Fuels treatment that was not broadcast prescribed fire)
- None

1.10 Has the Site Changed Since October 2004?

If the site has changed since October 2004, then the observation measurements may not represent what is on the satellite image. Select from the following change agents:

- Thinned
- Wildfire
- Broadcast Rx Fire
- Non Rx Fire Fuels Treatment (Fuels treatment that was not broadcast prescribed fire)
- Herbicide
- Hurricane
- None
- Other (Please explain on form only)

If the answer to this question is yes, then complete items 1.1 – 1.11 in Steps 1 as well as Step 7, surface fuel model determination.

1.11 Unusual Conditions

Select None or See Site Form. If See Site Form is selected, then explain conditions on the form.

Step 2 - Record Observer, Date and Site ID

Step 2 involves recording basic site information on page 2 of the Field Sample Data Form.

2.1 Observer

Record the name of lead observer completing the field form.

2.2 Date

Record the date the field data collection was taken.

2.3 Site ID

Record the site identifier as provided by MDA federal. The site identifier should be the same as field 1.3.

Plot Measurements

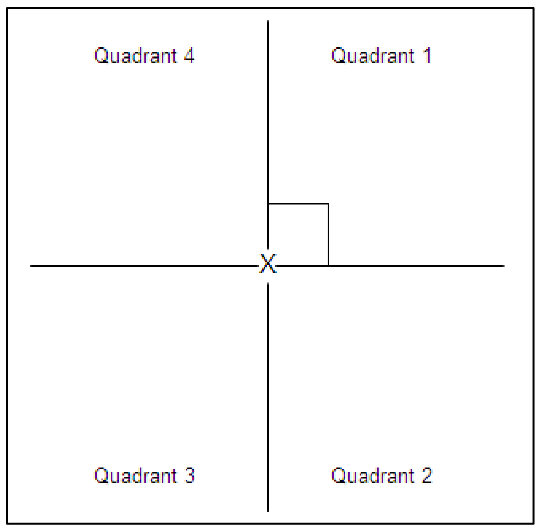
Steps 3, 4 and 5 involve the measurement of values that quantify information on grasses, shrubs and trees (optional) at each plot on the site. Steps 3 through 5 are repeated at each of the five plots at the site.

Locate the Plot Center

Locate the center of plot 1 and pushing the plot rod into the ground at the plot center.

Establish Quadrants

Divide the plot area into four quadrants as follows. The first quadrant clockwise is called quadrant 1, the next quadrant 2, the next quadrant 3 and the last quadrant 4.



Step 3 – Grass Measurements

In Step 3, grass percent cover and height are recorded.

3.0 Grass/Herbaceous

Determine the percent grass cover and height in inches.

Place the PCV quadrat in Quadrant 1 with one corner at the plot center and one of the sides aligned with the line of travel to the next plot.

Estimate the percent grass cover and measure the grass height in the quadrat and record on the data form.

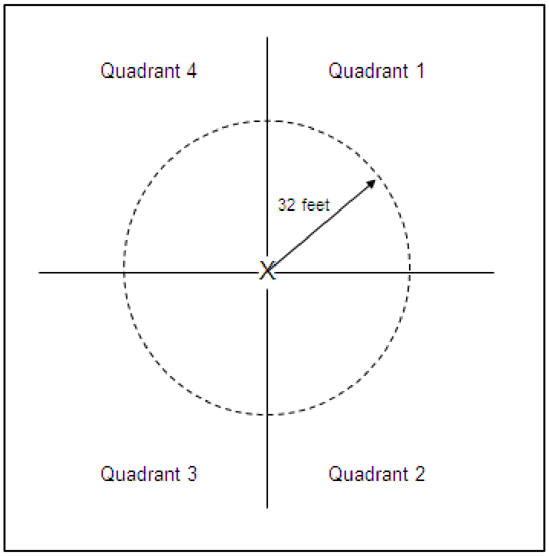
In the next plot place the quadrat in Quadrant 2. Continue to rotate the quadrant's location clockwise as you advance to future plots.

Step 4 – Shrub Measurements

In Step 4, shrub percent cover and height are recorded.

4.0 Shrubs

This step allows for the determination of the percent shrub cover and average shrub height.



Shrub Height

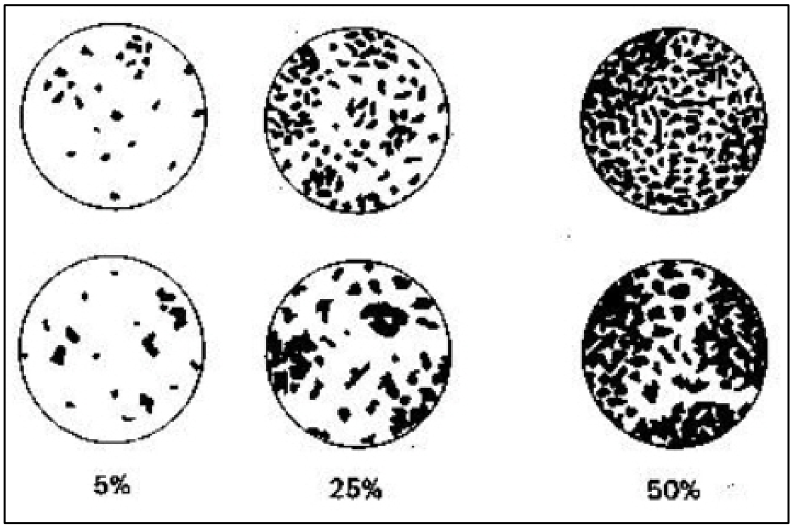
Start in Quadrant 1. Survey the area in each quadrant (see figure to the right) for a distance of 32 feet from the plot center and record the average height of the shrubs in inches.

Use a tape of a measuring rod to measure the shrub plant's height in inches. Determine this height as the average of the top of the stems that establish the shrub's crown tops.

Repeat this estimate for Quadrants 2, 3 and 4.

Percent Cover

Use the diagram below to record the percent cover of the shrubs collectively within 32 feet of the plot center in all four quadrants. The options are: 0-10%, 11-20%, 21-30%, 31-50% and >50%.



Step 5 – Tree Measurements

In Step 5.1, the tree percent cover is recorded. In addition, measurements are made for trees in Pine stands, Melaleuca stands (Step 5.4) and Hardwood, Cabbage Palm or Cypress (Step 5.5) stands so that canopy attributes can be calculated. For pine stands, there will be two nested circular subplots at each plot. For Melaleuca and Hardwood, Cabbage Palm or Cypress (Step 5.5) stands, only one subplot will be used.

Step 5.11 – Tree Canopy Cover

Determine the percent tree canopy cover. Stand facing the line of travel to the next plot. Hold the spherical densometer about belt high. Count the number of dots that are covered by shade and multiply his number by ten. This is the percent canopy cover. Record the value on the Plot Form.

Step 5.12 – Specify Circular Plot Radius for Pine Stands with Trees with DBH > 5.49 inches

A fixed radius circular plot will used to record information on trees with a diameter at breast height > 5.49 inches.

Determine Plot Radius

From the selections provided in the data recorder, determine the plot radius. The options are 12, 16, 20, 24, 28 or 32 feet. Select a plot radius that is most likely to contain at least five trees per plot that have a DBH > 5.49 inches. *Once selected for the site, this plot radius remains the same for all plots on the site.*

Step 5.13 – Specify Stand and/or Tree Sizes to be Sampled

The options are:

Pine Stand Selected in Step 1.7

- Pine_Tree – Sample trees greater than 5.49” DBH
- Pine_Sap – Sample trees less than or equal to 5.49” DBH

Go to Steps 5.2 and 5.3

Melaleuca Stand Selected in Step 1.7

- Melaleuca

Go to Step 5.4

Hardwood, Cypress or Cabbage Palm Stand Selected in Step 1.7

- HDW_CP_CY

Go to Step 5.5

Step 5.2 – Pine Stands with Trees with DBH 5.49 inches or less (8 ft circular plot)

An 8-foot radius circular plot will used to record information on trees with a diameter at breast height (DBH) ≤ 5.49 inches.

Tree Measurements

Determine the plot radius using a measuring tape. Starting from due North and going in a clockwise direction, locate the first tree with a DBH that ≤ 5.49 inches. This is the first tally tree. This tree will have the following items recorded:

Tree # 1 - Required Data

- Plot Number
- Tree Number
- Tree Species Code
- Count - record a "1" in this field
- DBH – estimate the DBH to the nearest 1" class
- Tree Class – Enter the tree class for the tree (see the diagram below classes)
- Total Tree Height – Measure the height of the tree
- Height to the First Live Limb (BLC) – Measure the height from the base of the tree to the first live limb attachment to the tree's bole.

Subsequent Trees -- Required Data

The subsequent trees on the plot are group tallied based upon diameter class (1" diameter class) and species.

- Plot Number
- Tree Number
- Tree Species Code
- Count - Record the number of individuals in the species and diameter group within the plot radius (8 feet).
- DBH – Estimate the DBH to the nearest 1" class
- Tree Class (TC) – Enter the tree class for the trees (see the diagram below for classes)

Step 5.3 - Pine Stands with Trees with DBH > 5.49 inches

A fixed radius circular plot will used to record information on trees with a diameter at breast height > 5.49 inches.

Tree Measurements

Using a measuring tape, go out the plot radius determined earlier. Starting from due North and going in a clockwise direction, locate the first tree that is with a DBH that is greater than 5.49 inches. Measure the distance from the plot center to the center of the tree (pith) to determine if the tree is within the plot. This is the first tally tree. This tree will have the following items recorded:

Tree # 1 Required Data

- Plot Number
- Tree Number
- Tree Species Code
- DBH – Estimate the DBH to the nearest 1” class
- Tree Class – Enter the tree class for the tree (see the diagram below classes)
- Total Tree Height – Measure the height of the tree
- Height to the First Live Limb (BLC) – Measure the height from the base of the tree to the first live limb attachment to the tree’s bole.

Subsequent Trees -- Required Data

The subsequent trees on the plot, the following data is recorded for each tree with a DBH > 5.49 inches.

- **Plot Number**
- **Tree Number**
- Tree Species Code
- DBH – Estimate the DBH to the nearest 1” class
- Tree Class – Enter the tree class for the tree (see the diagram below classes)
- Height to the First Live Limb (BLC) – Estimate the height from the base of the tree to the first live limb attachment to the tree’s bole.

Step 5-4 – Melaleuca Stands (all trees)

Using an ocular estimate only, record the following information for the Melaleuca trees within an 8-foot radius of the plot center:

- Estimated Number of Trees (whole number)
- Average DBH (whole number in inches)
- Average Stand Height (whole number in feet)
- Average Base to Live Crown (whole number in feet)

Step 5-5 – Hardwood, Cabbage Palm or Cypress Stands (all trees)

Note if the stand is predominately hardwood or cypress. Using an ocular estimate only, record the following information for the trees within a 28-foot radius of the plot center:

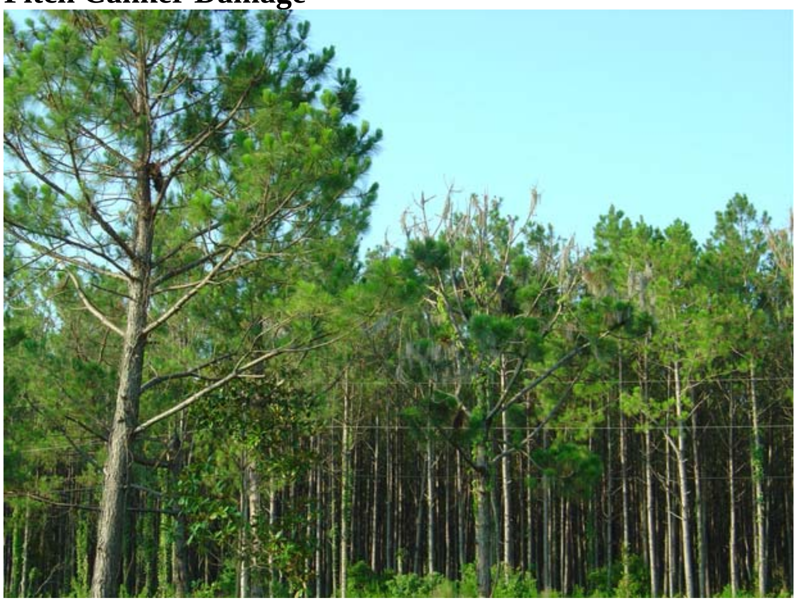
- Average Stand Height (whole number in feet)
- Average Base to Live Crown (whole number in feet)

Tree Class Descriptions

Classes 1 – 6 are for live trees:

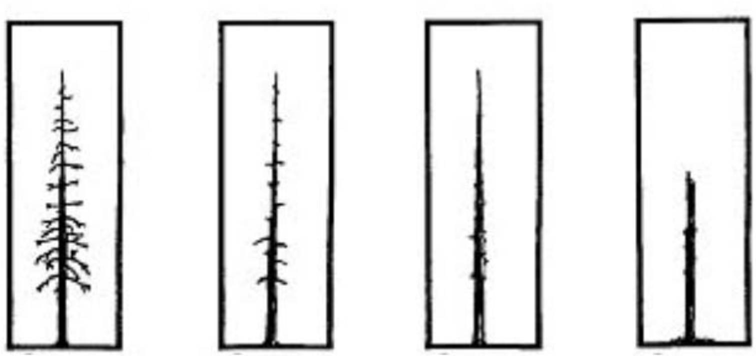
Class	Description
1	Dominant
2	Co-Dominant with ≥ 1/3 Canopy
3	Co-Dominant with < 1/3 Canopy
4	Co-Dominant with < 1/3 Canopy-Disease/Insect (This should include trees with beetle damage, pitch canker, etc)
5	Intermediate
6	Suppressed

Pitch Canker Damage



Southern Pine Beetle Damage

Classes 7-10 are for Dead Tress:



Class 7 Class 8 Class 9 Class 10

Class	Bark	Heartwood Decay	Sapwood Decay	Limbs	Top Breakage	Time Since Death
7	Tight, intact	Minor	None to incipient	Mostly present	May be present	1-5 years
8	50% loose or missing	None to advanced	None to incipient	Small limbs missing	May be present	> 5 years
9	75% missing	Incipient to advanced	None to 25%	Few remain	Approx. 1/3	> 5 years
10	75% + missing	Advanced to crumbly	50% + advanced	Absent	Approx. ½ +	> 5 years

Step 6 – Repeat Steps at Additional Plots

Go to the next plot center. The distance between the center of Plot 1 and Plots 2-5 will be 1.5 chains. Repeat Steps 2 – 5 at each plot.

Step 7 – Determine Surface Fuel Model for the Site

In Step 7, the 1982 FBPS fuel model(s) will be determined for the site. Using the surface fuel observations at each plot and the 1982 FBPS surface fuel model key, complete Steps 7.1 – 7.3.

7.1 What is the primary carrier of the fire?

Circle: Grass, Brush, Timber Litter or Slash. Assume the weather conditions as defined below:

1-hour Dead Fuel Moisture	Relative Humidity	20 foot Wind Speed*	Woody (shrub) Fuel Moisture
7-9 %	45-50%	7-8 mph	140%
* - Wind speed is a 10-minute, 20-foot average.			

7.2 First Choice 1982 FBPS Fuel Model

Use the fuel model key to list the fire behavior fuel model for the area. The primary fuel model selected should be from the fuel category that was circled as the Primary Carrier of the Fire (Field 7.1). Be sure to survey the surface fuels in all five plots before making this decision.

7.3 Second Choice 1982 FBPS Fuel Model

If the selection of the fire behavior fuel model is a difficult choice, list the alternative choice here. It is acceptable for this field to be blank.

Note that the second choice fuel model does not have to have the same primary carrier of the fore as the first choice fuel model.

Step 8 - Take Digital Photos

Take a picture of a representative area showing each of the fuel models selected in Steps 7.2 – 7.5 as appropriate. On 12” x 12” board that is on top of the range pole, use alligator clips to attach a piece of paper with the site identifier and photo identifier defined as follows. Make sure the numbers on the board are readable in the photo. For the First Choice 1982 FBPS fuel model, use the following: XXXX-1 where XXXX is the site identifier. For the Second Choice 1982 FBPS fuel model, use the following: XXXX-2 where XXXX is the site identifier. Title the electronic file using the same scheme; ie. XXXX-1.jpg.

Appendix A

RECON Care and Maintenance

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RECON Care and Maintenance

Hot Tip

If you encounter a problem, consult the appropriate documentation provided first. If a resolution of the problem does not occur, then contact the District Data Administrator for this project.

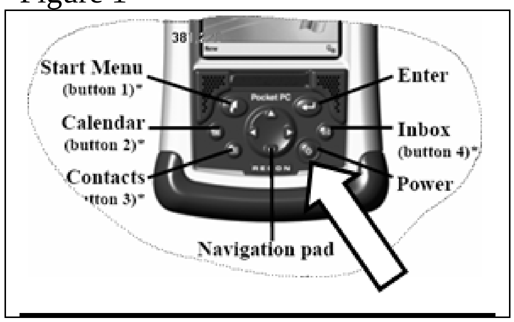
Data Capacity of RECON

The RECON can only contain field data 26 sites. The data sets start with a letter, A through Z Once a data set is named starting with a Z, data sets will need to transferred to the Data Administrator's computer. It is suggested that the user plan accordingly so that adequate memory space will be available on the RECON to complete work in an efficient manner.

Rebooting the RECON

If the user encounters a problem where the only solution is to restart the RECON (cold reboot), then do so by pressing and holding down the Power Button for five seconds (Figure 1). To restart the data collection application, proceed to Step 1 – Detailed Sampling Process and Procedures, Appendix C.

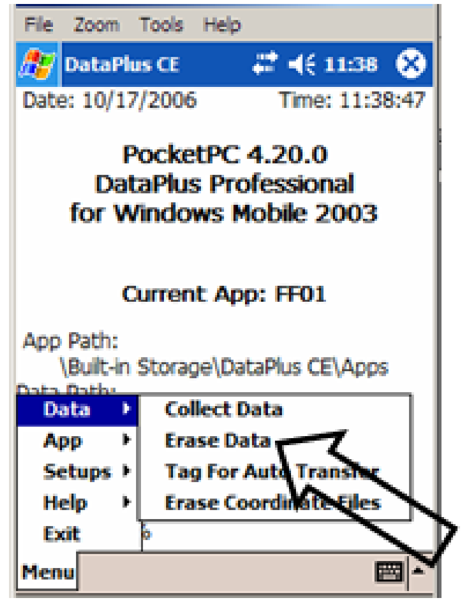
Figure 1



Deleting a Site from RECON

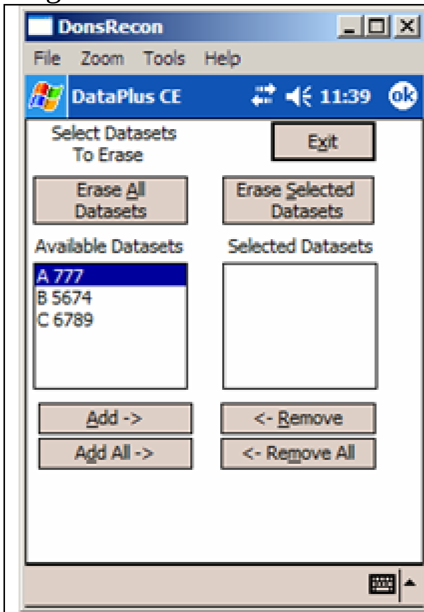
If a site needs to be deleted, go to **Menu => Data => Erase Data.**

Figure 2



The screen in Figure 3 appears. Below is an explanation of each of the buttons on the screen in Figure 3.

Figure 3



<u>Add -></u>

Clicking this button will move a Dataset from the Available Datasets window and to the Dataset to the Selected Datasets window.

<u>Add All -></u>

Clicking this button will move all Datasets from the Available Datasets window and to the Dataset to the Selected Datasets window.

<u><- Remove</u>

Clicking this button will move a Dataset from the Selected Datasets window and to the Dataset to the Available Datasets window.

<u><- Remove All</u>

Clicking this button will move all Dataset from the Selected Datasets window and to the Dataset to the Available Datasets window.

Hot Tip

Use caution when using the Erase All Datasets and Erase Selected Datasets Buttons

Erase All Datasets
Clicking this button will cause all of the Datasets in the Available Datasets window to be deleted from the RECON.

Erase Selected Datasets
Clicking this button will cause the Datasets that have been added to the Available Datasets window to be deleted from the RECON.

Exit
Clicking this button will exit the user from this dialog.

Data Recorder Maintenance

Setting Up Software Defaults

Got to **Menu => Setups => Preferences** (Figure 4). Make selections per the window in Figure 5. The selections shown in Figure 5 are the defaults and are recommended.

Figure 4

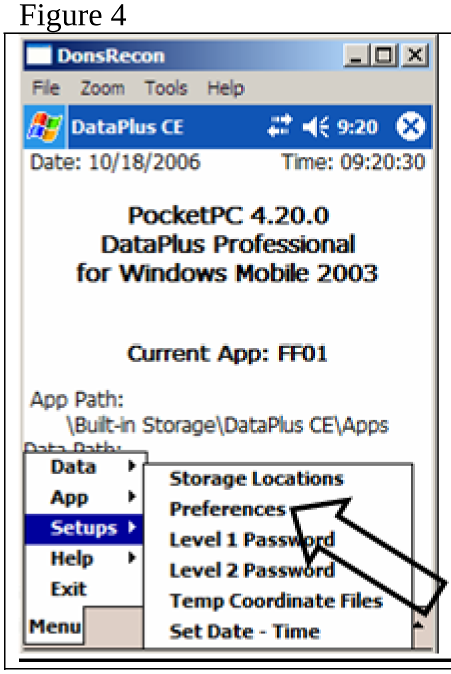
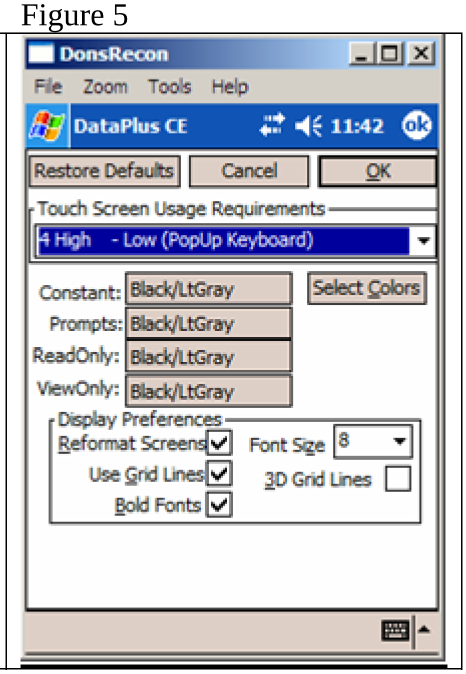


Figure 5



Setting Hardware Defaults and Setting

Setting the Brightness and Backlighting on Screen

Go to **Start => Settings** (Figure 6). Click on System Tab (Figure 7) and select the Backlight icon. Set per screen as shown in Figure 8.

Figure 6

Figure 7

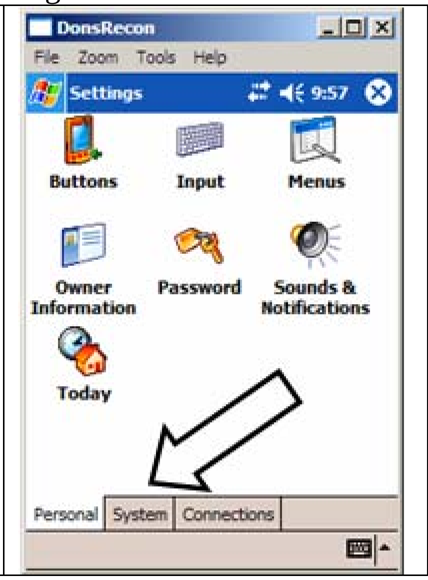
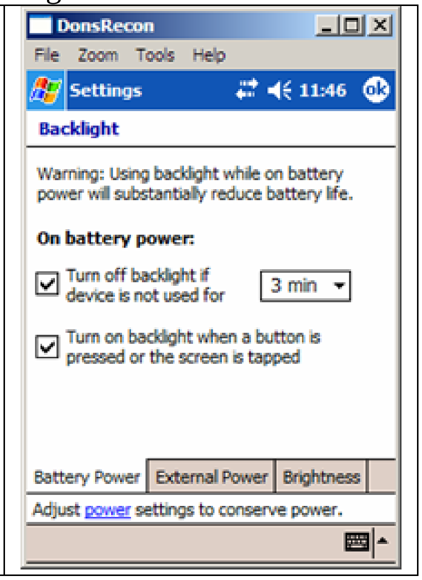
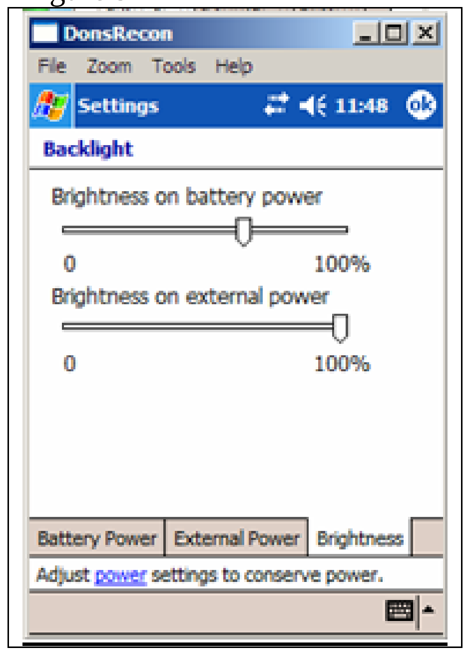


Figure 8



Select the Brightness of the backlighting. Set per screen shown in Figure 9 which are the system defaults. The user can adjust the setting for "Brightness in battery power" is desired.

Figure 9



Care

First, the data recorders are supplied with a screen protector. Please keep on the recorder and replace with extras provided as necessary. The RECON is watertight so the user can clean it with a damp cloth.

Hot Tip

ONLY use the stylus to touch the screen.
Do not use other items like a stick, pencil, pen, pocket knife, etc.

Charging

The RECON should be fully charged before taken to the field. To facilitate this, it is recommended the RECON be connected to an external power supply when stored in the office at all times.

The RECON is never off power use. Hence leaving the RECON unconnected from an external power supply will eventually cause the battery to go dead. If this happens, the Data Administrator will need to reinstall the DataPlus Professional Handheld software as well as the Data Collection Software.

Appendix B

Field Sample Form

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Page 1

Florida Fire Risk Assessment - Field Sample Data Form

1.0 – Site Information

1.1 Observer __________ (Enter 3 initials) **1.2 Date** ________/__________/_____
Day Month Year

1.3 Location __________ (Enter 1 – 3060)

1.4 GPS Location UTM Zone ______ (16 or 17) Easting_________ Northing___________

1.5 Level of Observation Plot measured Viewed from distance Not observable

1.6 Land Cover Class

Non-vegetated Transitional Planted/Cultivated Crop Pasture/Hay

Non-woody Wetland Woody Wetland Natural/Semi Grassland

Deciduous Forest Evergreen Forest Mixed Forest Natural/Semi Shrub or Young Forest

1.7 Predominant Stand Type

Pine **Melaleuca** **Hardwood** Cypress TiTi Cabbage Palm No trees

1.8 Is the area actively managed? **Y** N

1.9 Site Disturbance in Last 5 Years
Thin 1 Thin 2 Broadcast Rx Fire Non-Rx Fire Fuel Treatment None

1.10 Change since October 2004?

Thinned Wildfire Broadcast Rx Fire Non-Rx Fire Fuel Treatment None Other

Herbicide Hurricane

Explain Other: ____

____

1.11 Unusual Conditions

None See Site Form

____
____
____

Page 2

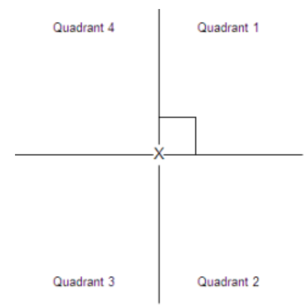
2.1 Observer ____________________ **2.2 Date** ______ / ______ / ______
Day Month Year

2.3 Location ____________________

3.0 - Grass/Herbaceous

Plot	Percent Cover	Height (inches)
1		
2		
3		
4		
5		

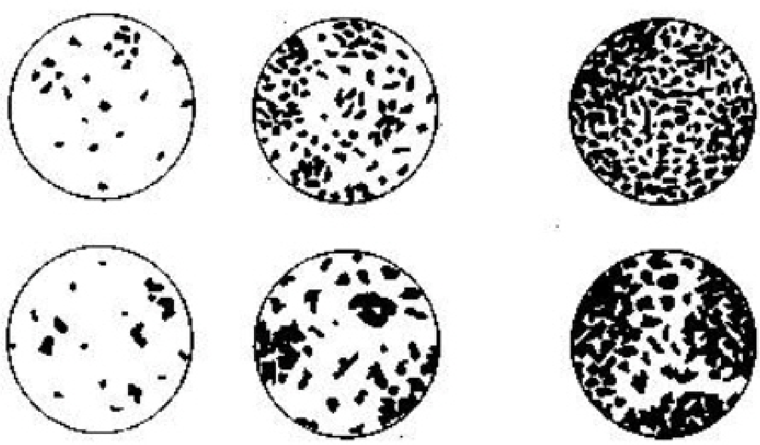
Percent Cover Options	Percent Cover Options
0%	55%
5%	65%
15%	75%
25%	85%
35%	95%
45%	100%



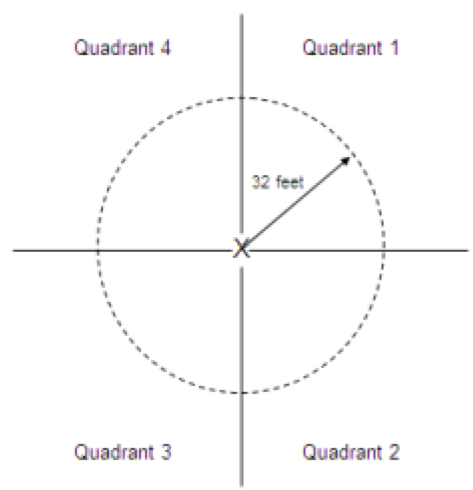
4.0 - Shrubs

Plot	Percent Cover	Average Shrub's Height (inches)			
		Quadrant			
		1	2	3	4
1					
2					
3					
4					
5					

Percent Cover Options
5%
15%
25%
37%
> 51%



5% 25% 50%



5.0 - Trees

5.11 Tree Canopy Cover Percent

Plot	Percent Cover
1	
2	
3	
4	
5	

Percent Cover Options	Percent Cover Options
0%	55%
5%	65%
15%	75%
25%	85%
35%	95%
45%	-----

5.12 Specify Circular Plot Radius for Pine Stands with Trees with DBH > 5.49 inches

Value in Feet is	Options Are
	12 feet
	16 feet
	20 feet
	24 feet
	28 feet
	32 feet

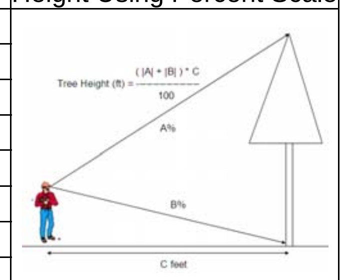
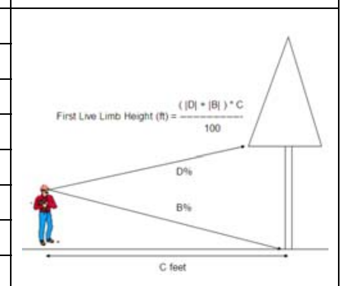
Note: Plot should contain on the average 5 trees.

Page 3

2.1 Observer ____________________ **2.2 Date** ________ / ________ / ________
Day Month Year

2.3 Location ____________________

5.2 (Pine) Trees with DBH 5.49 inches or less (8-feet circular plot)

Plot #	Tree #	Species Code	DBH (inches)	Count (# of trees)	Tree Class	Tree Height (feet)	Base to First Live Limb (feet)	Species Code	Pines
								PIPA2	Longleaf
								PITA	Loblolly
								PISE	Pond
								PICL	Sand
								PIELS	Slash (So. FL.)
								PIELN	Slash (No. FL.)
								PIEC2	Shortleaf
								PINE	Generic
									Other Species
								MELAL	Melaleuca
								HDWD	Hardwood
								CYPR	Cypress sp.
								SAPA	Cabbage Palm
								Height Using Percent Scale	
									
									
								Height Using Topog Scale	
								$\text{Height (ft)} = \frac{(\lvert A\rvert + \lvert B\rvert) * C}{66}$	
								or	
								$\text{Height (ft)} = \frac{(\lvert D\rvert + \lvert B\rvert) * C}{66}$	

Page 4

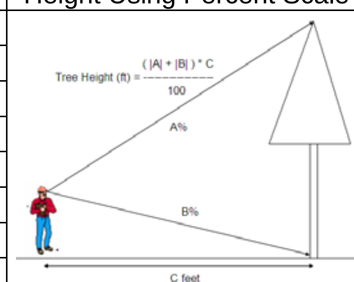
2.1 Observer ________________ **2.2 Date** ______/______/______

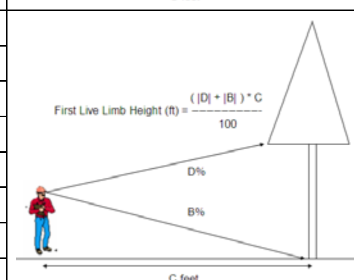
Day Month Year

2.3 Location ________________

5.3 (Pine) Trees with DBH 5.5 inches or GREATER (variable radius circular plot)

Plot #	Tree Number	Species Code	DBH (inches)	Tree Class	Tree Height (feet)	Base to First Live Limb (feet)	Species Code	Pines
							PIPA2	Longleaf
							PITA	Loblolly
							PISE	Pond
							PICL	Sand
							PIELS	Slash (So. FL.)
							PIELN	Slash (No. FL.)
							PIEC2	Shortleaf
							PINE	Generic
								Other Species
							MELAL	Melaleuca
							HDWD	Hardwood
							CYPR	Cypress sp.
							SAPA	Cabbage Palm
							Height Using Percent Scale	
							Height Using Topog Scale	





Height Using Topog Scale

$$\text{Height (ft)} = \frac{(|A| + |B|) * C}{66}$$

or

$$\text{Height (ft)} = \frac{(|D| + |B|) * C}{66}$$

Page 5

2.1 Observer ____________________ **2.2 Date** ________/________/____________
Day Month Year

2.3 Location ____________________

5.4 Melaleuca (For trees within an 8-feet circular plot)

Plot Number	Estimated No. Of Trees	Avg. DBH (inches)	Avg. Stand Height (feet)	Avg. Base To Live Crown (feet)
1				
2				
3				
4				
5				

5.5 Hardwood, Cabbage Palm or Cypress (For trees within an 28-ft circular plot)

Plot Number	Avg. Stand Height (feet)	Avg. Base To Live Crown (feet)
1		
2		
3		
4		
5		

6.0 – Repeat Steps at Additional Plots

7.0 - Determine Surface Fuel Model for the Site

What is the Primary Carrier of the Fire?

Grass (GR) Shrub (SH) Timber Litter (TL) Slash (SL)

	Fuel Model	Photo Title
7.2 First choice 1982 FBPS fuel model	________	____________
7.3 Second choice 1982 FBPS fuel model	________	____________

Page 6

Data Overflow Page - use only if necessary

5.2 (Pine) Trees with DBH 5.49 inches or LESS (8 ft circular plot)

Plot #	Tree #	Species Code	DBH (inches)	Count (# of trees)	Tree Class	Height (feet)	Base to First Live Limb (ft)	Species Code	Pines
								PIPA2	Longleaf
								PITA	Loblolly
								PISE	Pond
								PICL	Sand
								PIELS	Slash (So. FL.)
								PIELN	Slash (No. FL.)
								PIEC2	Shortleaf
								PINE	Generic
									Other Species
								MELAL	Melaleuca
								HDWD	Hardwood
								CYPR	Cypress sp.
								SAPA	Cabbage Palm

5.3 (Pine) Trees with DBH 5.5 inches or GREATER (variable radius circular plot)

Plot #	Tree number	Species	DBH (in)	Tree Class	Height (ft)	Base to First Live Limb (ft)	Species Code	Pines
							PIPA2	Longleaf
							PITA	Loblolly
							PISE	Pond
							PICL	Sand
							PIELS	Slash (So. FL.)
							PIELN	Slash (No. FL.)
							PIEC2	Shortleaf
							PINE	Generic
								Other Species
							MELAL	Melaleuca
							HDWD	Hardwood
							CYPR	Cypress sp.
							SAPA	Cabbage Palm

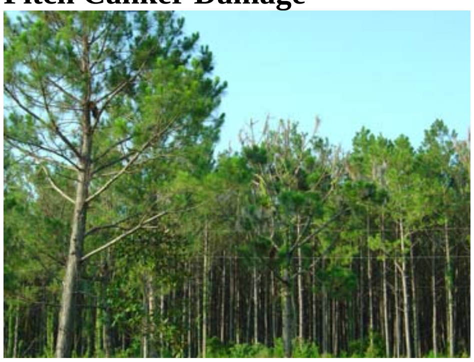
Other Comments/Notes (Use back side of page if necessary)

Page 7 - **Tree Class Descriptions**

Classes 1 – 6 are for live trees:

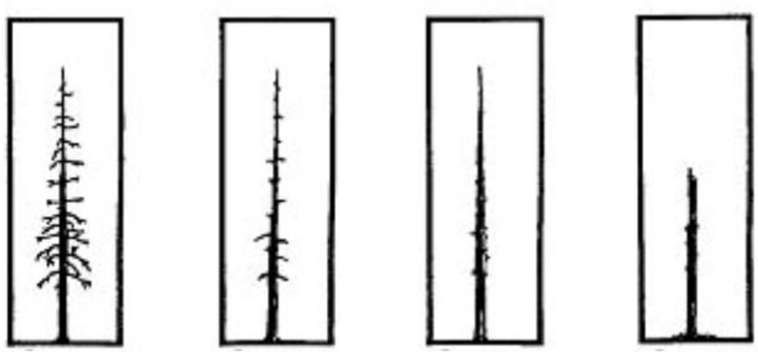
Class	Description
1	Dominant
2	Co-Dominant with ≥ 1/3 Canopy
3	Co-Dominant with < 1/3 Canopy
4	Co-Dominant with < 1/3 Canopy-Disease/Insect (This should include trees with beetle damage, pitch canker, etc)
5	Intermediate
6	Suppressed

Pitch Canker Damage



Southern Pine Beetle Damage

Classes 7-10 are for Dead Tress:



Class 7 Class 8 Class 9 Class 10

Class	**Bark**	**Heartwood Decay**	**Sapwood Decay**	**Limbs**	**Top Breakage**	**Time Since Death**
7	Tight, intact	Minor	None to incipient	Mostly present	May be present	1-5 years
8	50% loose or missing	None to advanced	None to incipient	Small limbs missing	May be present	> 5 years
9	75% missing	Incipient to advanced	None to 25%	Few remain	Approx. 1/3	> 5 years
10	75% + missing	Advanced to crumbly	50% + advanced	Absent	Approx. ½ +	> 5 years

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Appendix C

Detailed Sampling Process and Procedures

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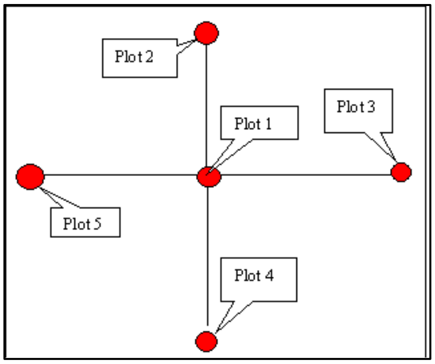
Detailed Sampling Process and Procedures

Step 1 – Locate the Site

Using the coordinates of the site, locate the center of the sampling area. Pushing the plot rod into the ground at the plot center.



The sampling design requires the establishment of five plots at each site. The diagram at the right show the plot layout with the site center located at the spot identified as Plot 1. Measurements will be taken at each plot with the values recorded on a Field Sample Data Form or entered directly into the Data Recorder. The distance from plot 1 to plots 2-5 should be one to one and a half chains (66-99 feet).

The following instructions follow the format of the Field Sample Data Form. A description of each field follows.

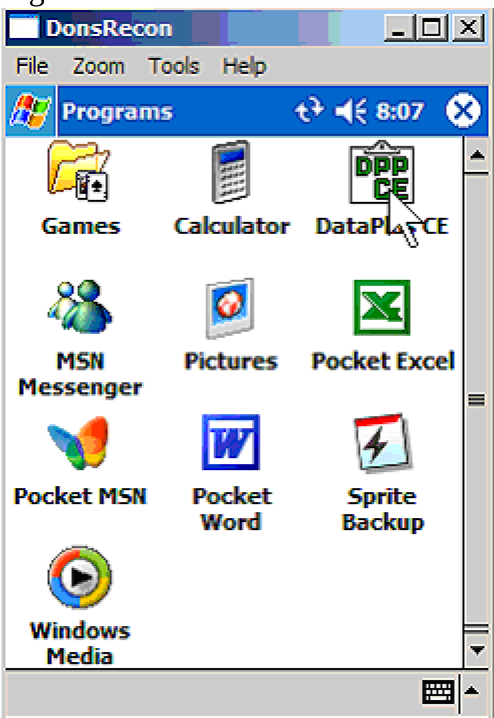
Start Data Recorder

To start the data recorder, press the Enter button (Figure 1).

To start the program, use the stylus to select the Start menu. Next select Programs and the screen shown in Figure 2 will appear. Use the stylus to select the DataPlus Professional (DPP-CE) program.

Figure 1

Figure 2



The screen in Figure 3 will appear. To select the data collection application, select the Menu item shown on the lower Task Bar (Figure 4). From that menu, select **Menu=>App=>Select Application.**

Figure 3

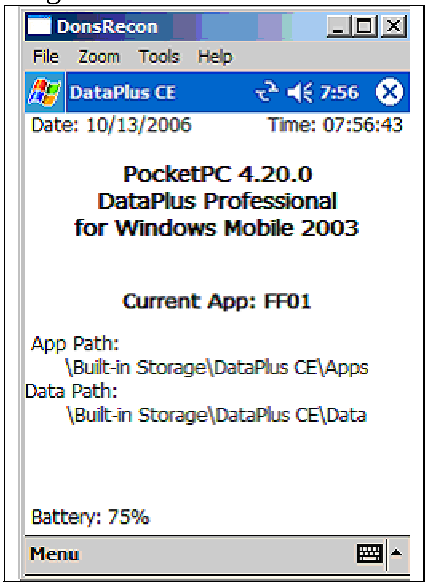
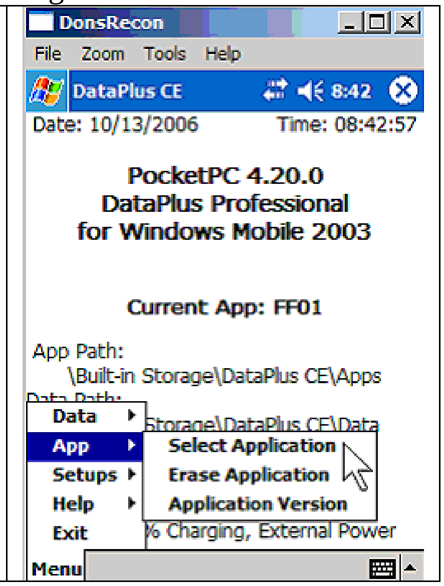


Figure 4



Select the FF01 application and then click OK (Figure 5). Select the **Menu=>Data=>Collect Data** menu (Figure 6).

Figure 5

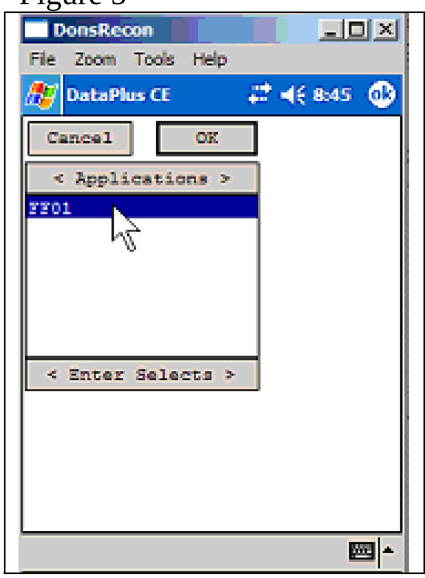
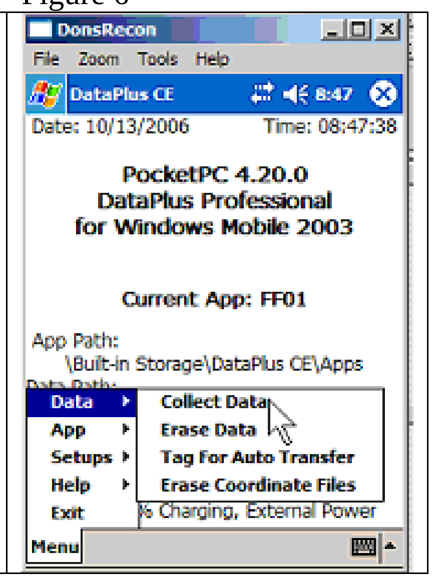


Figure 6



A screen similar to the one in Figure 7a will appear. If the user desires select a site where data has already been collected, the the user should click on that site in the select Old datset window and click on on the Open Selected button. If a new site is to sampled, the user should click on the Create New button. The dialog shown in Figure 7b will appear. Enter the Site ID in the New Dataset Name frame (Figure 7b). This is the most important piece of data that you will collect. Please double check this value prior to entry. Once this is done, click **Create**. The screen in Figure 8 will appear.

Figure 7a

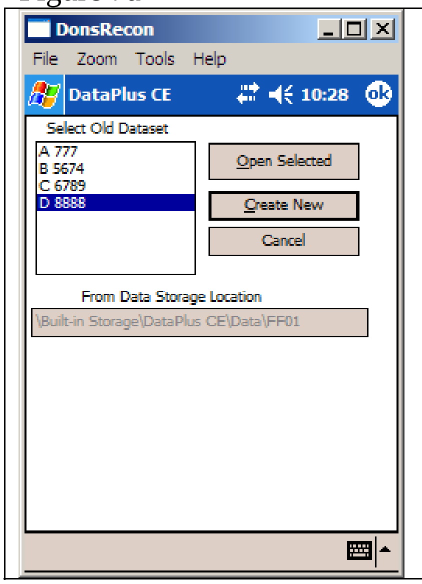
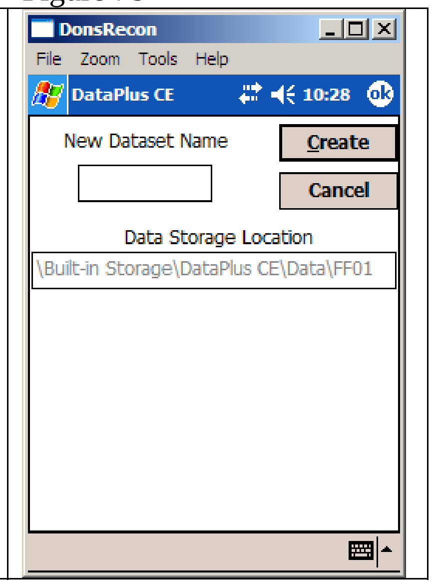


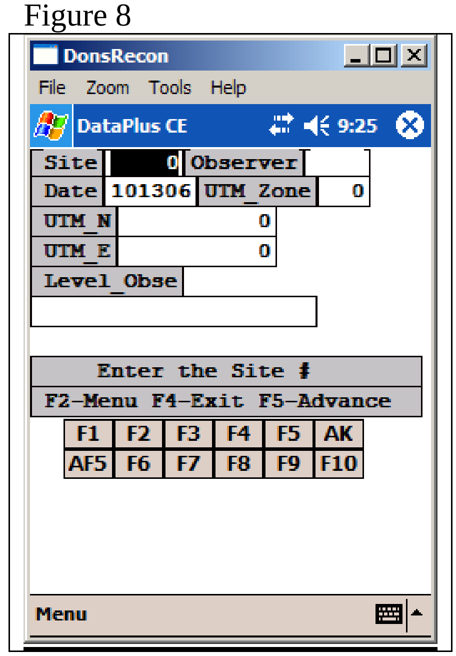
Figure 7b



Function Keys

The following function keys support the user as follows. The explanations that are bolded are the ones most frequently used.

Figure 8



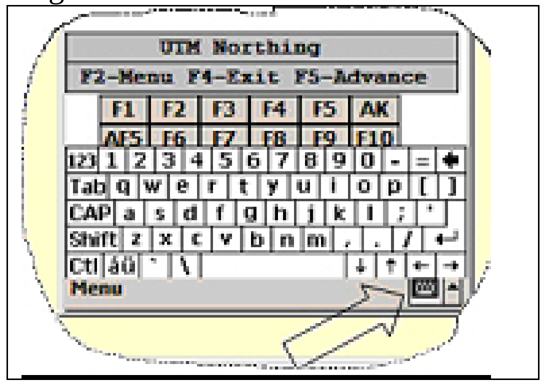
F1 – Access to Program Help
F2 – Access to Application Help, Pull-down Menus and Acceptable data Ranges
F3 – Search Column for a Defined Value
F4 – Checks File for Missing Data and also Backups Up one File Level
F5 – Checks File for Missing Data and also Advances Down One File Level
AK – Accesses Additional Functions of Which the Most Used One is Escape
AF5 – Checks File for Missing Data and also Advances Laterally to Another File
F6 – Moves Cursor to Selected Line Number
F7 – Access to Custom Programs (Will Not Be Used)
F8 – File Level Program List (Will Not Be Used)
F9 – Use to Insert a Line of Data
F10 – Delete a Line of Data

Data Entry

To display the Input Panel, click on the keyboard icon in the lower right corner of the RECON display window (Figure 9).

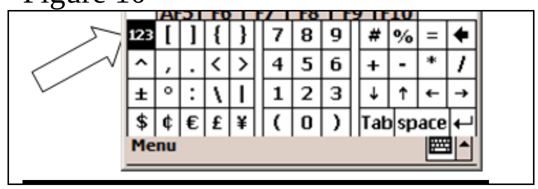
The user can select a number or letter to enter by tapping the number of letter with the stylus.

Figure 9



Selecting the 123 field displays the keyboard in Figure 10. The user can return to the keyboard display shown in Figure 9 by clicking on the 123 field.

Figure 10



1.1 Site ID Field

Enter the site identifier as provided by MDA federal. This will be a number between 1 and 3060. Enter the same site identifier entered previously as the New Dataset Name. Please double check that this is the correct ID and agrees with the New Dataset Name as there is no way to do an error check in the data recorder on these two fields.

1.2 Observer Field

Record the 3 initials of the name of lead observer completing the field form in the Observer field.

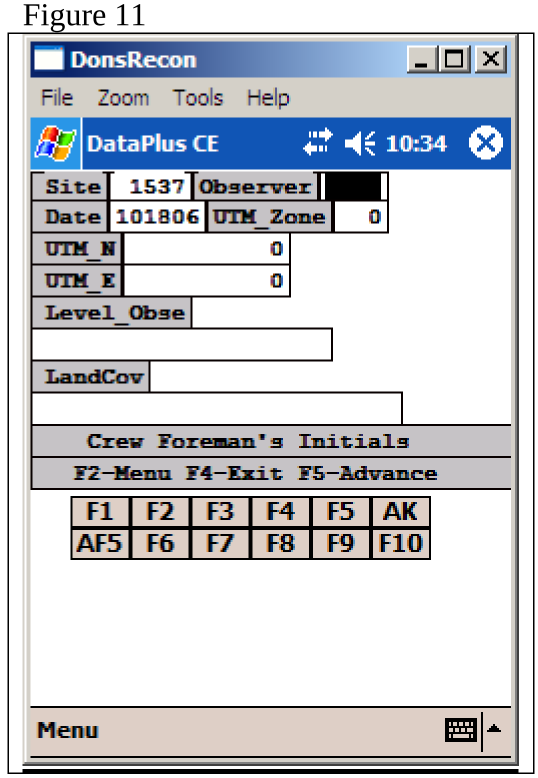
1.3 Date Field

This field should auto-fill with the date in the data recorder. Check to be sure it is correct and type in the correct data if necessary.

1.4 GPS Location Fields

Select the UTM zone (F2) (either 16 or 17) in the UTM_Zone field. Next, enter the Easting (X-coordinate) and Northing (Y-coordinate) in UTM coordinates.

Figure 11

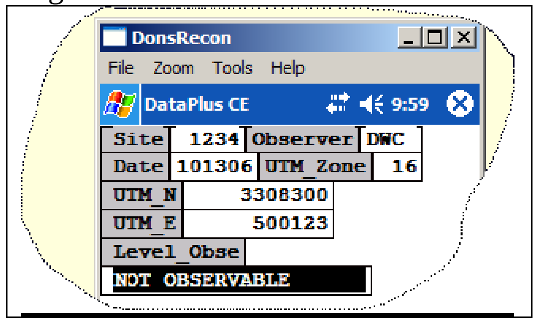


1.5 Level of Observation (F2)

Record how the site was observed. The options are: Site Measured, Viewed from Distance or Not Observable.

Figure 12 contains example data entries.

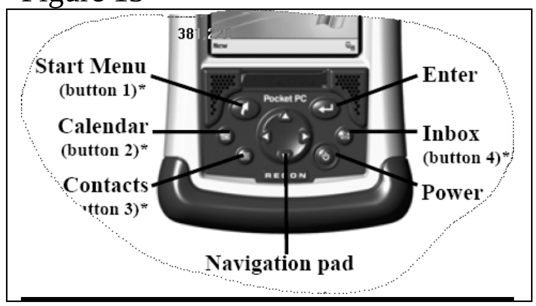
Figure 12



Once the last entry or a screen is entered, the application should display the next screen. If not, use the Navigation Pad on the RECON (Figure 13) to scroll to the next screen. To move to the next screen, use the down arrow on the Navigation Pad.

The user can also use the Navigation Pad arrows to scroll through a list shown on the RECON when the F2 function key is selected.

Figure 13

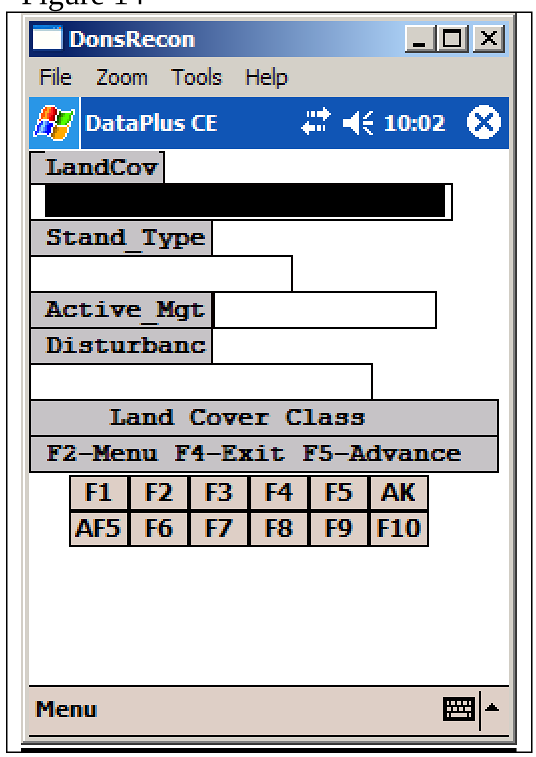


The second screen on the application is shown in Figure 14.

The data entries on this screen are:

- ***Land Cover Class***
- ***Predominant Stand Type***
- Is the area actively managed?
- Site Disturbance in Last 5 Years

Figure 14



1.6 Land Cover Class (F2)

Select the Land Cover Class that best describes the site from the provided list of community types. This information is used in the fuel model keys. The options include the following:

- Non-vegetated
- Transitional
- Planted/Cultivated
- Pasture/Hay
- **Crop**
- Non-woody Wetland
- Woody Wetland
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Natural/Semi Grassland
- Natural/Semi Shrub or Young Forest

1.7 Predominant Stand Type (F2)

The options are: Pine, Melaleuca, Hardwood, Cabbage Palm, Cypress, TiTi or No Trees.

- **No Trees -** No tree measurements are taken. Only Steps 1 through 5.1 are performed.
- **TiTi Stand –** No tree measurements are taken. Only Steps 1 through 5.1 are performed.
- **Pine Stand –** Tree measurements will be taken on all pine species in the stand. The sampling is done using the description in Steps 5.2 and 5.3.
- **Melaleuca Stand -** Tree measurements will be taken on all Melaleuca species in the stand. The sampling is done using the description in Step 5.4.
- **Hardwood/Cabbage Palm/Cypress Stand –** Only measurements of live height to live crown base and average stand height will be taken in these stands. Steps 1 through 5.1 and Step 5.5 will be done.

1.8 Is the area actively managed? (F2)

Are management activities such as timber management and prescribed burning actively being conducted on the area? If so select the Y, otherwise select the N.

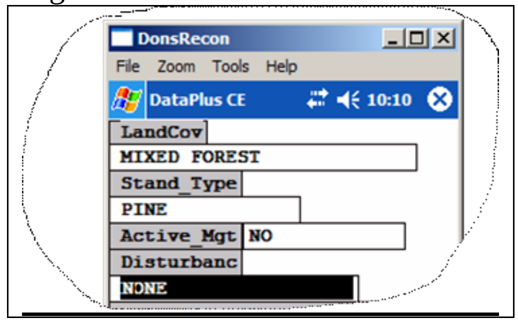
1.9 Site Disturbance in Last 5 Years (F2)

Select from the following options:

- Thin 1 (First commercial thinning)
- Thin 2 (Second commercial thinning)
- Broadcast Rx Fire (Broadcast prescribed fire)
- Non Rx Fire Fuels Treatment (Fuels treatment that was not broadcast prescribed fire)
- None

Figure 15 contains example data entries.

Figure 15

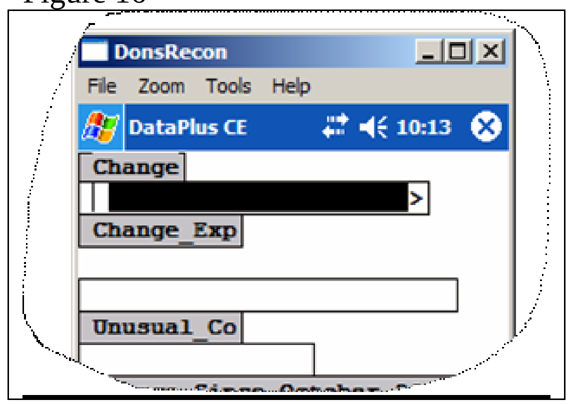


The third screen on the application is shown in Figure 16.

The data entries on this screen are:

- Has the Site Changed Since October 2004?
- Unusual Conditions

Figure 16



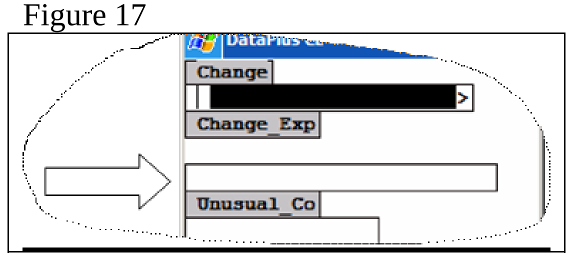
<u>1.10 Has the Site Changed Since October 2004? (F2)</u>

If the site has changed since October 2004, then the observation measurements may not represent what is on the satellite image. Select from the following change agents:

- Thinned
- Wildfire
- Broadcast Rx Fire
- Non Rx Fire Fuels Treatment (Fuels treatment that was not broadcast prescribed fire)
- Herbicide
- Hurricane
- None
- Other (Please explain on form only)

If "Other" is selected, use the stylus to enter a brief description in the box on the RECON screen (Figure 17).

Figure 17



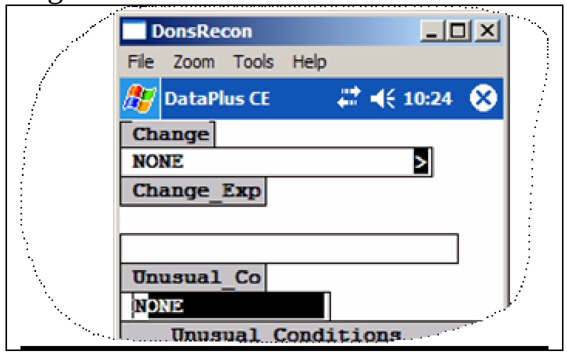
If the answer to this question is yes, then complete items 1.1 – 1.11 in Steps 1 as well as Step 7, surface fuel model determination.

1.11 Unusual Conditions (F2)

Select None or See Site Form. If See Site Form is selected, then explain conditions on the form.

Figure 18 contains example data entries.

Figure 18



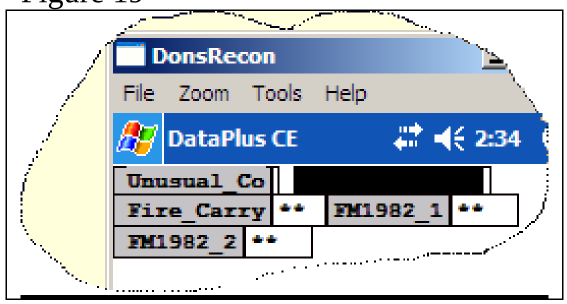
Placeholder Values for Surface Fuel Information

Due to the organization of the programming, the application enters placeholder values for the following values:

- What is the primary carrier of the fire?
- First Choice 1982 FBPS Fuel Model
- Second Choice 1982 FBPS Fuel Model

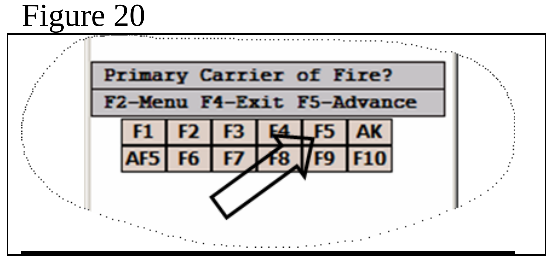
Note: The user will need to revisit this screen to complete Step 7 of the sampling process.

Figure 19



This completes the data collection of the Site Level. To advance to the plot collect level, click on the F5 icon (Figure 20).

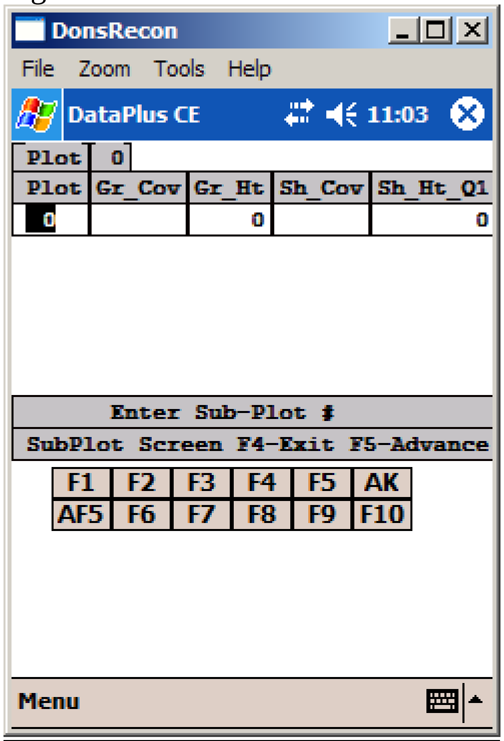
Figure 20



The screen shown in Figure 21 will be displayed.

Proceed to Step 2 of the data collection process.

Figure 21



Step 2 - Record Observer, Date and Site ID

Step 2 involves recording basic site information on page 2 of the Field Sample Data Form.

Note: On the paper form, enter the Observer, Date and Site ID. This information is entered on each page of the sample forms to allow for identification in case pages become separated.

Plot Measurements

Steps 3, 4 and 5 involve the measurement of values that quantify information on grasses, shrubs and trees (optional) at each plot on the site. Steps 3 through 5 are repeated at each of the five plots at the site.

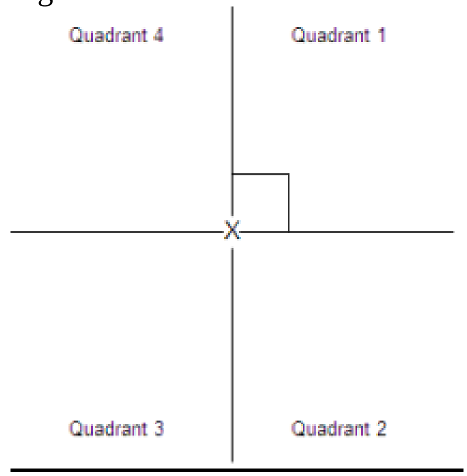
Locate the Plot Center

Locate the center of plot 1 and pushing the plot rod into the ground at the plot center. This is noted by the X in Figure 22.

Establish Quadrants

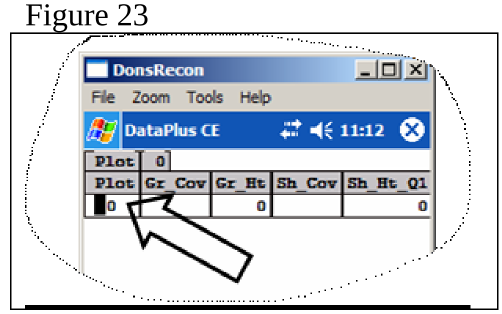
Divide the plot area into four quadrants as follows (Figure 22). The first quadrant clockwise is called quadrant 1, the next quadrant 2, the next quadrant 3 and the last quadrant 4.

Figure 22



Enter the plot number in the RECON and proceed to Step 3 of the data collection process (Figure 23).

Figure 23



Step 3 – Grass Measurements

In Step 3, grass percent cover and height are recorded.

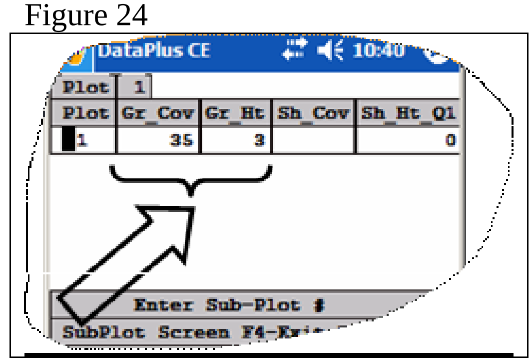
3.0 Grass/Herbaceous

Determine the percent grass cover and height in inches.

Place the PCV quadrat in Quadrant 1 with one corner at the plot center and one of the sides aligned with the line of travel to the next plot.

Estimate the percent grass cover (F2) and measure the grass height in the quadrat and record on the data form and the RECON (Figure 24).

Figure 24



Note: On the next plot, place the quadrat in Quadrant 2 (Figure 22). Continue to rotate the quadrant's location clockwise as you advance to future plots.

Proceed to Step 4 of the data collection process.

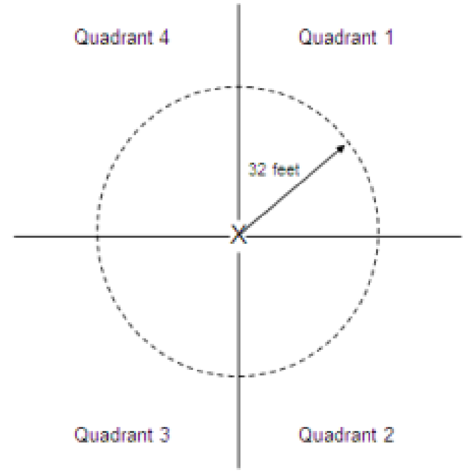
Step 4 – Shrub Measurements

In Step 4, shrub percent cover and height are recorded.

4.0 Shrubs

This step allows for the determination of the percent shrub cover and average shrub height.

Figure 25



Shrub Height

Start in Quadrant 1. Survey the area in each quadrant (see figure to the right) for a distance of 32 feet from the plot center and record the average height of the shrubs in inches.

Use a tape of a measuring rod to measure the shrub plant's height in inches. Determine this height as the average of the top of the stems that establish the shrub's crown tops.

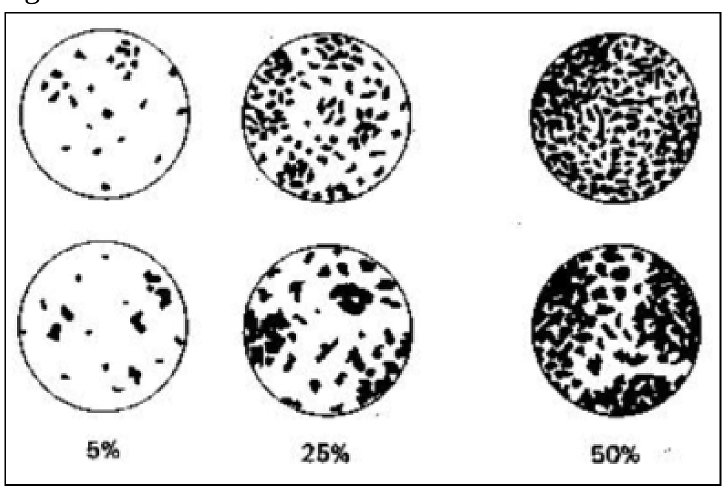
Repeat this estimate for Quadrants 2, 3 and 4.

Percent Cover (F2)

Use the diagram in Figure 26 to record the percent cover of the shrubs. The options are:

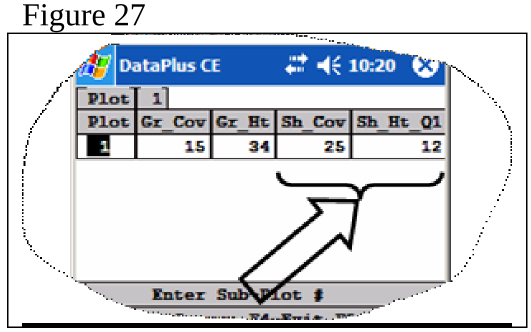
- 0-10%,
- 11-20%,
- 21-30%
- 31-50%
- >50%.

Figure 26



In the RECON, enter the values of the Shrub Cover and Shrub Height for Quadrant 1 (Figure 27).

Figure 27



Note that to get to the data entry for quadrants 2, 3 and 4 in the RECON, use the right arrow on the RECON Navigation Pad (Figure 28) to move to the next window on the RECON. The screen in Figure 29 will appear.

Figure 28

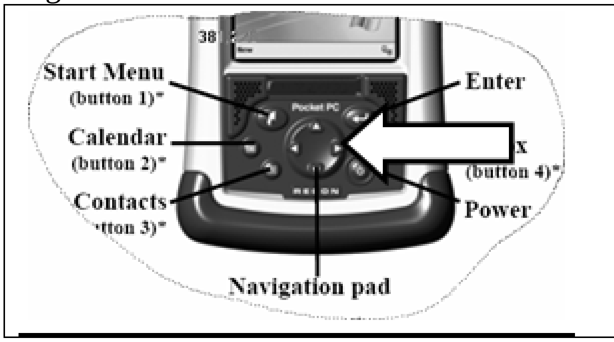
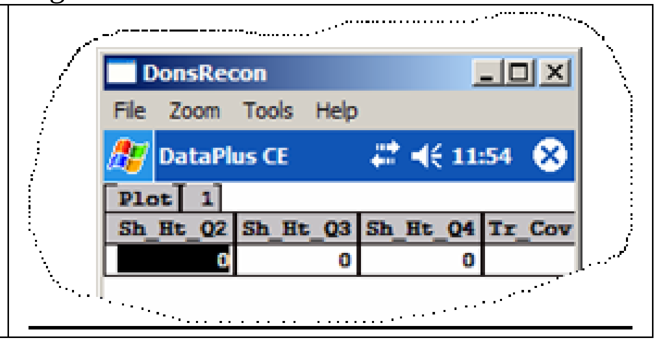


Figure 29



Step 5 – Tree Measurements

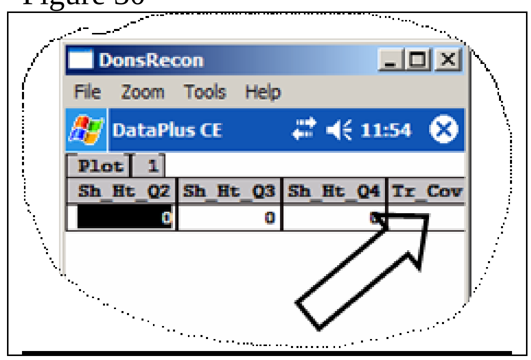
In Step 5.1, the tree percent cover is recorded. In addition, measurements are made for trees in Pine stands, Melaleuca stands (Step 5.4) and Hardwood, Cabbage Palm or Cypress (Step 5.5) stands so that canopy attributes can be calculated. For pine stands, there will be two nested circular subplots at each plot. For Melaleuca and Hardwood, Cabbage Palm or Cypress (Step 5.5) stands, only one subplot will be used.

Step 5.11 – Tree Canopy Cover (F2)

Determine the percent tree canopy cover. Stand facing the line of travel to the next plot. Hold the spherical densometer about belt high. Count the number of dots that are covered by shade and multiply his number by ten. This is the percent canopy cover. Record the value on the Plot Form and the RECON (Figure 30).

To move to the next screen on the RECON, press the right arrow key on the Navigation Pad (Figure 28).

Figure 30



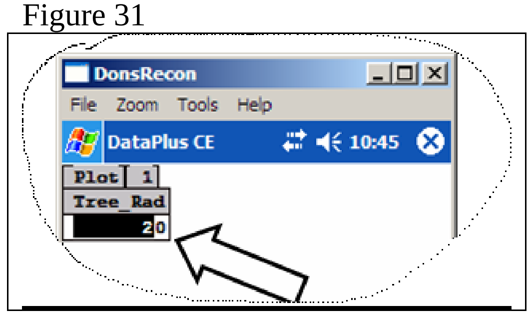
Step 5.12 – Specify Circular Plot Radius for Pine Stands with Trees with DBH > 5.49 inches

A fixed radius circular plot will used to record information on trees with a diameter at breast height > 5.49 inches.

Determine Plot Radius

From the selections provided in the data recorder, determine the plot radius. The options are will depend on the Vegetation Type selected in Step 1.7. For Pine stands, the options are 12, 16, 20, 24, 28 or 32 feet. For other stands, there is no option that needs to be selected as the default and used value is entered automatically by the application. Select a plot radius that is most

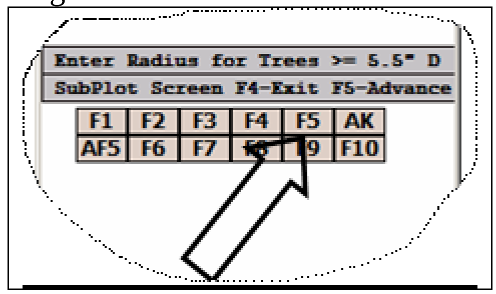
Figure 31



likely to contain at least five trees per plot that have a DBH > 5.49 inches. *Once selected for the site, this plot radius remains the same for all plots on the site.* Record the value on the Plot Form and the RECON (Figure 31).

To advance to the tree data collect level, click on the F5 icon (Figure 32).

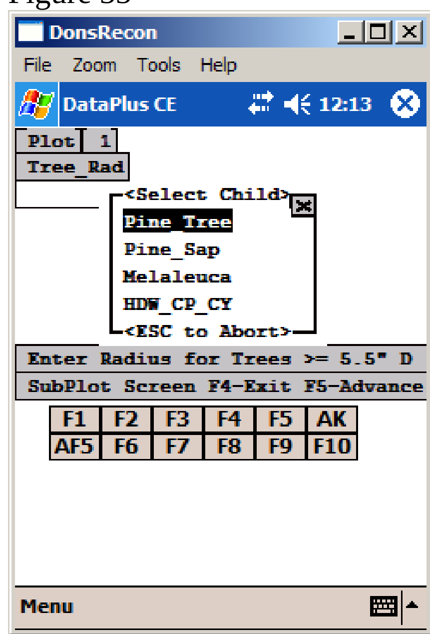
Figure 32



<u>Step 5.13 – Specify Stand and/or Tree Sizes to be Sampled</u>

After the F5 is selected, the screen in Figure 33 will appear. The options are:

Figure 33



<u>Pine Stand Selected in Step 1.7</u>

- Pine_Tree – Sample trees greater than 5.49" DBH
- Pine_Sap – Sample trees less than or equal to 5.49" DBH

<u>Melaleuca Stand Selected in Step 1.7 (Go to Step 5.4)</u>

- Melaleuca

<u>Hardwood, Cypress or Cabbage Palm Stand Selected in Step 1.7 (Go to Step 5.5)</u>

- HDW_CP_CY

Note: To proceed in a Pine stand as these instructions are written, select the Pine_Sap option first.

Step 5.2 – Pine Stands with Trees with DBH 5.49 inches or less (8-foot circular plot)

An 8-foot radius circular plot will used to record information on trees with a diameter at breast height (DBH) ≤ 5.49 inches.

Select the Pine_Sap option in the RECON (Figure 34). The screen in Figure 35 will appear.

Figure 34

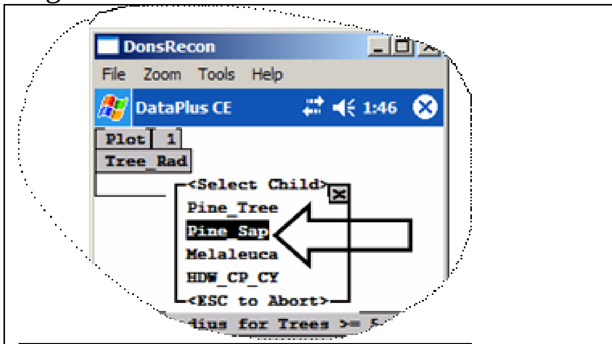
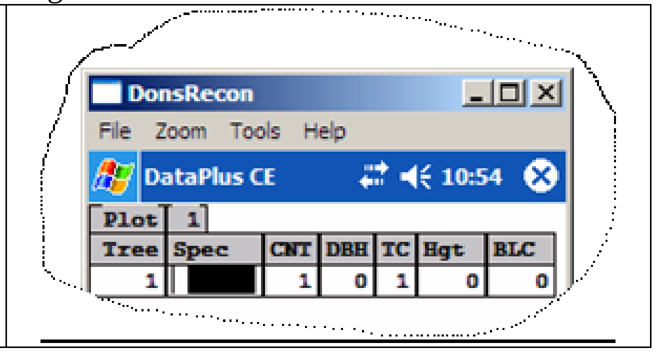


Figure 35



Tree Measurements

Determine the plot radius location using a measuring tape. Starting from due North and going in a clockwise direction, locate the first tree with a DBH that ≤ 5.49 inches. This is the first tally tree.

This tree will have the following items recorded:

Tree # 1 Required Data

- Plot Number
- Tree Number
- Tree Species Code
- Count
- DBH
- Tree Class
- Total Tree Height
- Height to the First Live Limb (BLC)

Plot Number

The plot number is already displayed and no entry is needed.

Tree Number

The first tree is titled “1” which is already displayed and no entry is needed.

<u>Tree Species Code (F2)</u>

The species codes are available clicking on the F3 icon. Below is a list of codes and species.

- PIPA2 – Longleaf pine
- PITA – Loblolly pine
- PISE – Pond pine
- PICL – Sand pine
- PIELS - Slash (So. FL.) pine
- PIELN - Slash (No. FL.) pine
- PIEC2 – Shortleaf pine
- PINE – Generic Florida pine (use if unable to determine pine species for tree)
- MELAL - Melaleuca
- HDWD - Hardwood
- CYPR - Cypress sp.
- SAPA - Cabbage Palm

<u>Count</u>

The value for this field is always “1” and no entry is needed.

<u>DBH</u>

Estimate the DBH to the nearest 1” class.

<u>Tree Class</u>

Enter the tree class for the tree (See Tree Class Diagram).

<u>Total Tree Height</u>

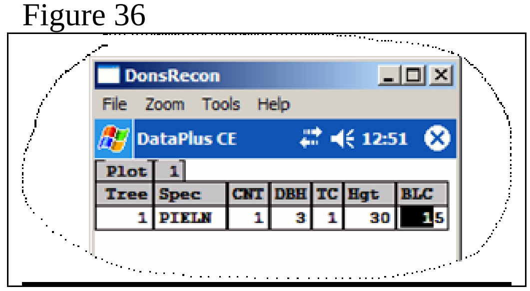
Measure the height of the tree

<u>Height to the First Live Limb (BLC)</u>

Measure the height from the base of the tree to the first live limb’s attachment to the tree’s bole.

Record the values for the first sample tree on the Plot Form and the data recorder (Example shown in Figure 36).

Figure 36



Subsequent Trees -- Required Data

Within the 8-foot plot radius, continue in a clockwise direction and locate the next tree with a DBH that < 5.49 inches. This is the first subsequent tally tree.

For all subsequent tally trees on the plot, they are tallied as a group based upon diameter class (one inch diameter class) and species.

- Plot Number
- Tree Number
- Tree Species Code
- Count
- DBH
- Tree Class

<u>Plot Number</u>
The plot number is already displayed and no entry is needed.

<u>Tree Number</u>
The tree number will be automatically entered to be one more than the previously entered tree number.

<u>Tree Species Code (F2)</u>
As a possible aid, the previous tree number's species is entered. The species codes are available clicking on the F3 icon if a change is needed.

<u>Count</u>
Record the number of individuals in the species and diameter group within the plot radius (8 feet).

Note: The application defaults to 1 tree and the user should change this default to record the number of trees on the plot that are the noted DBH, species and tree class.

<u>DBH</u>

Estimate the DBH to the nearest one inch DBH class.

<u>Tree Class</u>
Enter the tree class for the tree (See Tree Class Diagram).

Note: Tree height and height to crown base is not taken on subsequent trees (Figure 37).

To advance the RECON to show a line to enter data for a subsequent sample tree, press the down arrow on the RECON Navigation Pad (Figure 37). Record the values for the second sample tree on the Plot Form and the data recorder (Example shown in Figure 38).

Figure 37

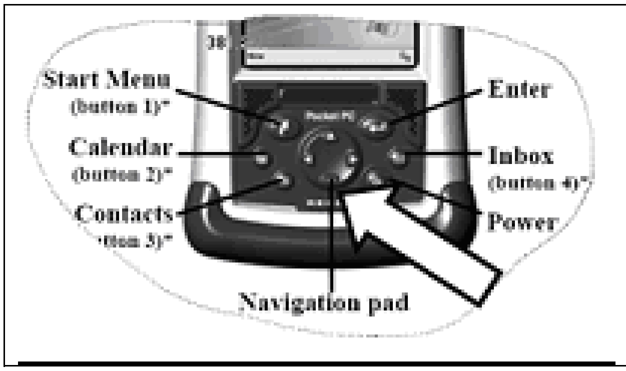
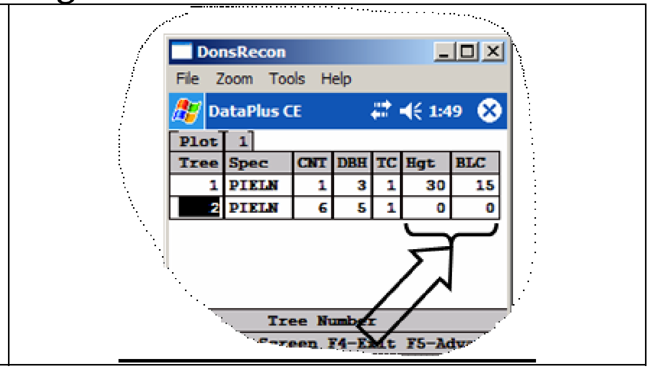


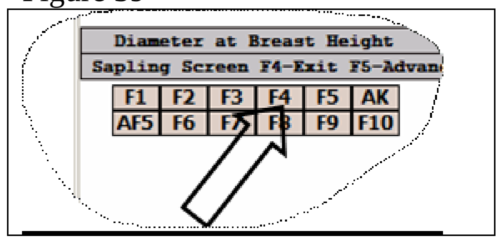
Figure 38



Continue entering data for subsequent sample trees until the first sample tree is encountered.

Once all subsequent tree data is gathered, select F4 (Exit) (Figure 39).

Figure 39



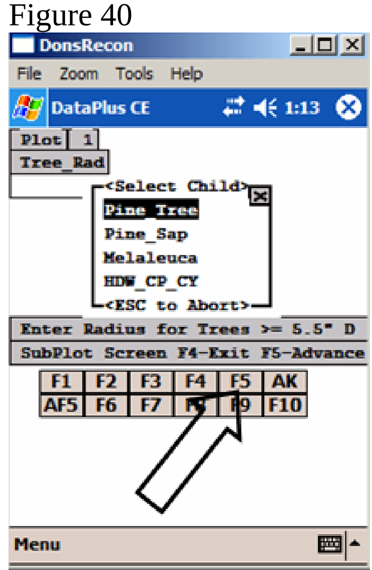
<u>Step 5.3 - Pine Stands with Trees with DBH > 5.49 inches</u>

A fixed radius circular plot will used to record information on trees with a diameter at breast height > 5.49 inches.

To select the screens in the RECON to enter this data, click on the F5 icon. The screen in Figure 40 will appear.

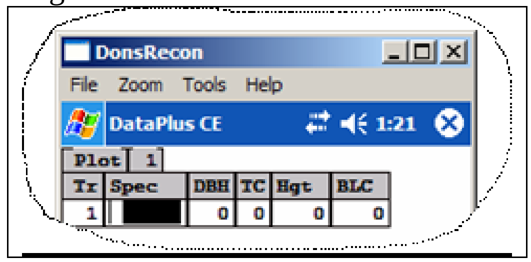
Select Pine_Tree from the menu.

Figure 40



After the Pine_Tree option is selected, the screen in Figure 41 will appear.

Figure 41



Tree Measurements

Using a measuring tape, go out the plot radius determined earlier in Step 5.12. Starting from due North and going in a clockwise direction, locate the first tree that is with a DBH that is greater than 5.49 inches. Measure the distance from the plot center to the center of the tree (pith) to determine if the tree is within the plot. This is the first tally tree.

This tree will have the following items recorded:

Tree # 1 Required Data

- Plot Number
- Tree Number
- Tree Species Code
- DBH
- Tree Class
- Total Tree Height
- Height to the First Live Limb (BLC)

Plot Number

The plot number is already displayed and no entry is needed.

Tree Number

The first tree is titled "1" which is already displayed and no entry is needed.

Tree Species Code (F2)

The species codes are available clicking on the F3 icon.

DBH

Estimate the DBH to the nearest 1" class.

Tree Class

Enter the tree class for the tree (See Tree Class Diagram).

Total Tree Height

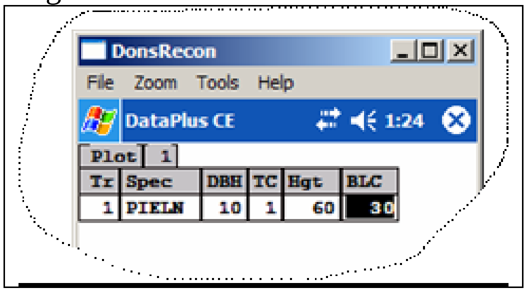
Measure the height of the tree

Height to the First Live Limb (BLC)

Measure the height from the base of the tree to the first live limb's attachment to the tree's bole.

Record the values for the first sample tree on the Plot Form and the data recorder (Example shown in Figure 42).

Figure 42



Subsequent Trees -- Required Data

Within the defined (Step 5.12) plot radius, continue in a clockwise direction and locate the next tree with a DBH that > 5.49 inches. This is the first subsequent tally tree. For the subsequent trees on the plot, the following data is recorded for each tree with a DBH > 5.49 inches.

- Plot Number
- Tree Number
- Tree Species Code
- DBH
- Tree Class
- Height to the First Live Limb (BLC)

<u>Plot Number</u>

The plot number is already displayed and no entry is needed.

<u>Tree Number</u>

The first tree is titled "1" which is already displayed and no entry is needed.

<u>Tree Species Code (F2)</u>

The species codes are available clicking on the F3 icon.

<u>DBH</u>

Estimate the DBH to the nearest one inch DBH class.

<u>Tree Class</u>

Enter the tree class for the tree (See Tree Class Diagram).

<u>Height to the First Live Limb (BLC)</u>

Estimate the height from the base of the tree to the first live limb's attachment to the tree's bole.

Note: Tree height is not taken on subsequent trees (Figure 44).

To advance the RECON to show a line to enter data for a subsequent sample tree, press the down arrow on the RECON Navigation Pad (Figure 43). Record the values for the second sample tree on the Plot Form and the data recorder (Example shown in Figure 44).

Figure 43

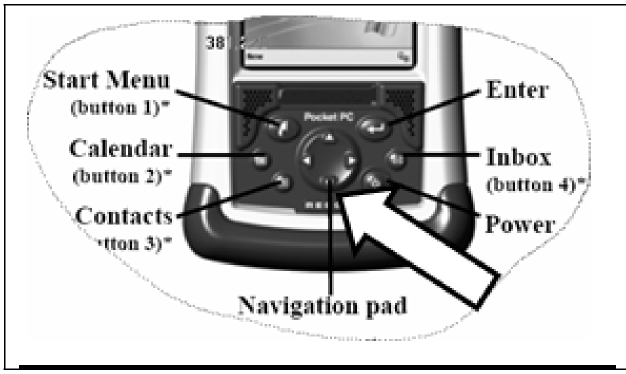
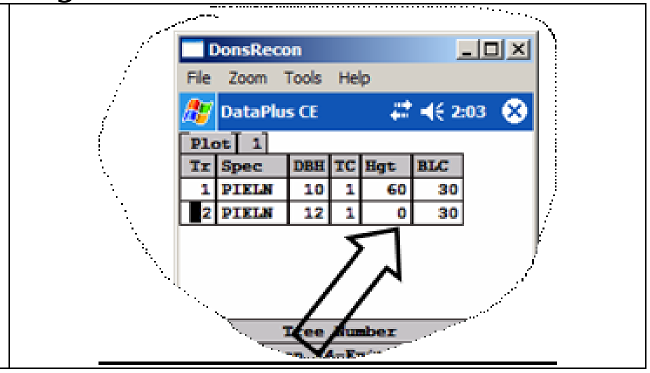


Figure 44



Continue entering data for subsequent sample trees until the first sample tree is encountered.

Once all subsequent tree data is gathered, select F4 (Exit) (Figure 45). The screen in Figure 46 will appear. This completes sampling on Plot 1.

Figure 45

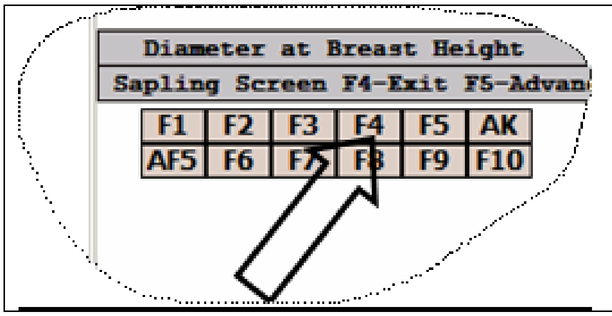
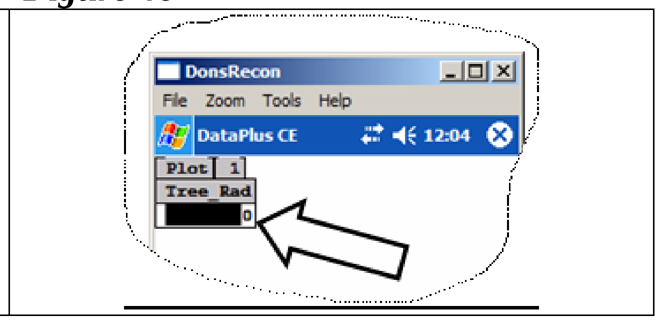


Figure 46



To proceed to gather data for Plot 2 in the RECON (Step 6 of the process), press on the down arrow on the Navigation Pad (Figure 47). The screen in Figure 48 will appear.

Figure 47

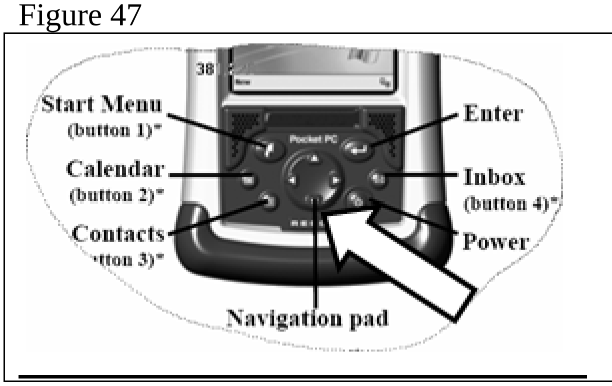
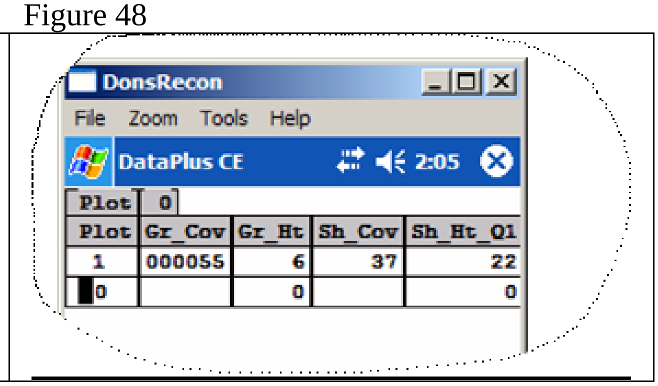


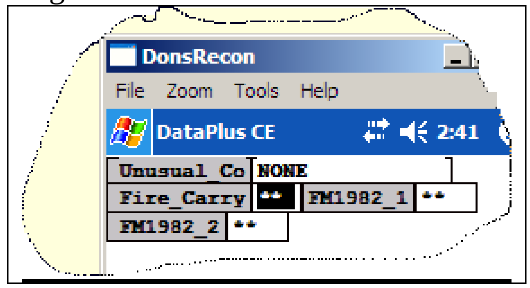
Figure 48



On the last row and in the first column, enter the Plot number. Proceed per the instructions documented earlier starting with Step 3.

After Plot 5 has been entered, click on the F4 icon twice to proceed to the site level. Scroll down, if necessary, to the bottom of file level. The screen in Figure 49 will appear. This screen has the "placeholder" ** values for the primary carrier of the fire and the fuel model selections.

Figure 49



Go to Step 7 to complete the primary carrier of the fire and the fuel model selections.

Step 5-4 – Melaleuca Stands

If the selection in Step 1.7, Predominant Stand Type, is Melaleuca, then follow these steps in the RECON to record data.

After the site level data has been entered and the first plot data from Grass and Shrubs is entered (Steps 3 and 4), the screen in Figure 50 will appear. Click on the F5 icon to select Melaleuca (Figure 51). The screen in Figure 52 will appear.

Figure 50

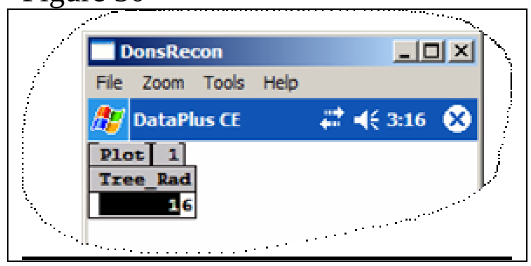


Figure 51

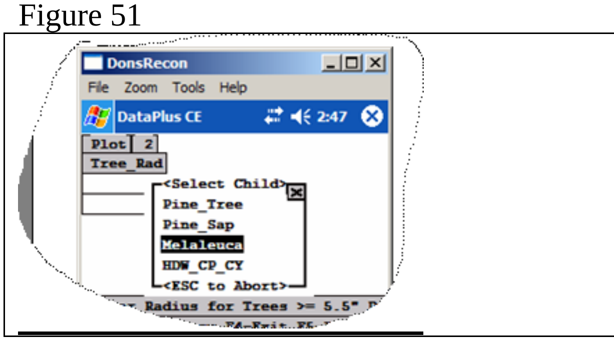
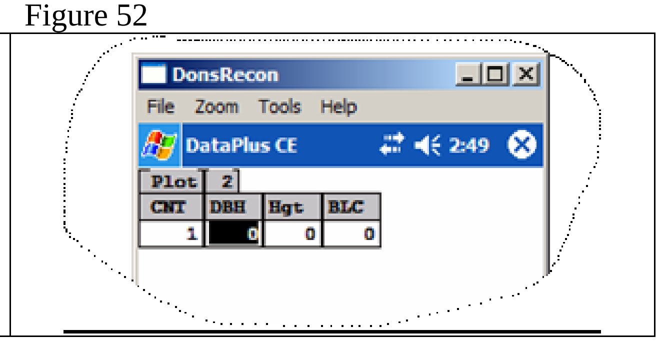


Figure 52

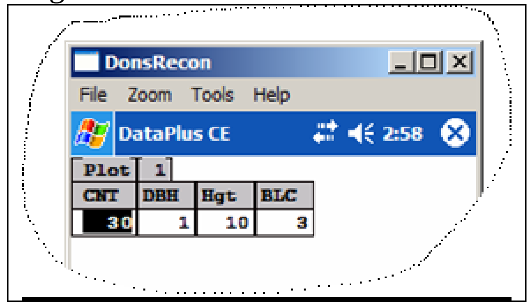


Using an ocular estimate only, record the following information for the Melaleuca trees within an 8-foot radius of the plot center:

- <u>Estimated</u> Number of Trees (whole number)
- Average DBH (whole number in inches)
- Average Stand Height (whole number in feet)
- Average Base to Live Crown (whole number in feet)

Record the values for the first plot on the Plot Form and the data recorder (Example shown in Figure 53).

Figure 53



To proceed to gather data for Plot 2 in the RECON (Step 6 of the process), press on the down arrow on the Navigation Pad (Figure 54). The screen in Figure 55 will appear.

Figure 54

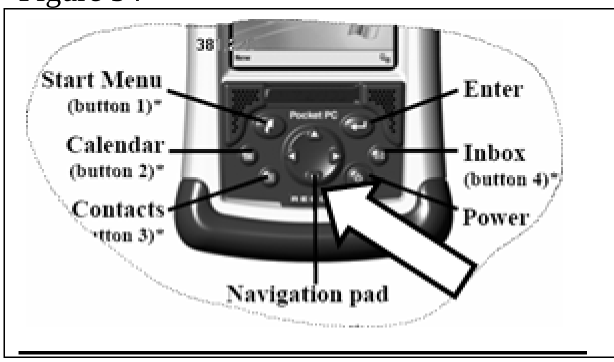
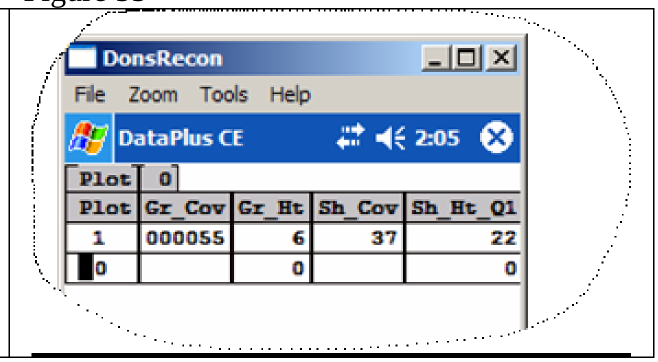


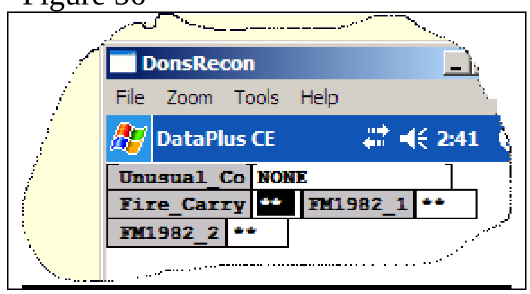
Figure 55



After Plot 5 has been entered, click on the F4 icon twice to proceed to the site level. Scroll down, if necessary, to the bottom of file level. The screen Figure 56 will appear. This screen has the “placeholder” ** values for the primary carrier of the fire and the fuel model selections.

Go to Step 7 to complete the primary carrier of the fire and the fuel model selections.

Figure 56



Step 5-5 – Hardwood, Cabbage Palm or Cypress Stands (all trees)

If the selection in Step 1.7, Predominant Stand Type, is Hardwood/Cabbage Palm/Cypress Stand, then follow these steps in the RECON to record data.

After the site level data has been entered and the first plot data from Grass and Shrubs is entered (Steps 3 and 4), the screen in Figure 57 will appear. Click on the F5 icon to select HWD_CP_CY (Figure 58). The screen in Figure 59 will appear.

Figure 57

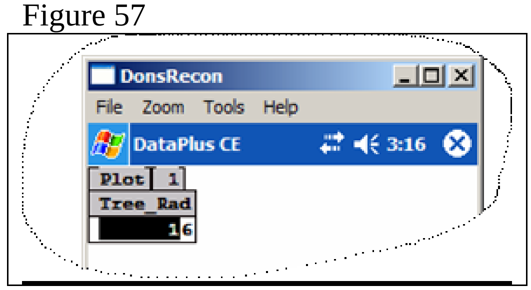


Figure 58

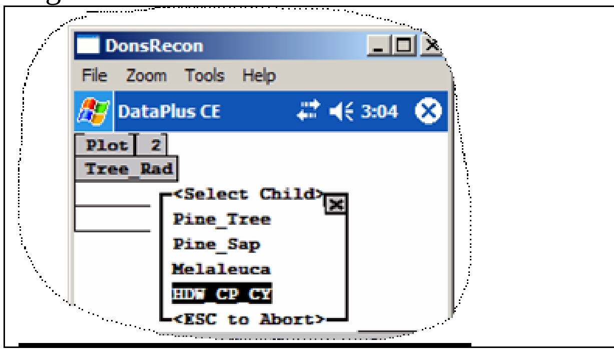
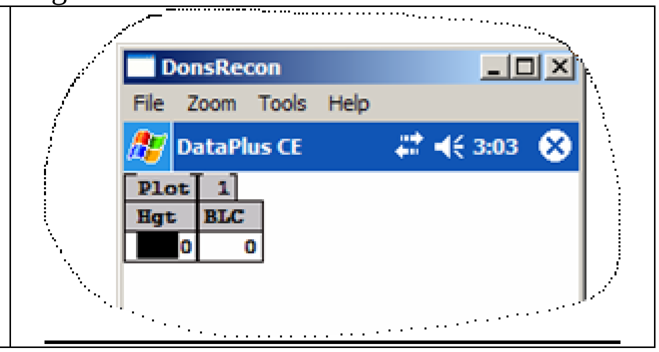


Figure 59

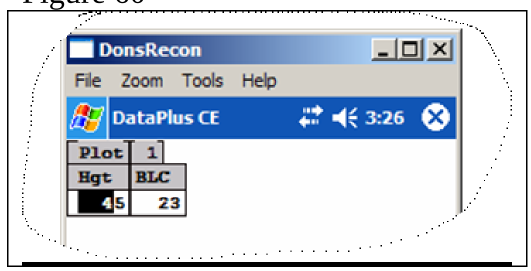


Using an ocular estimate only, record the following information for the trees within a <u>28-foot radius</u> of the plot center:

- Average Stand Height (whole number in feet)
- Average Base to Live Crown (whole number in feet)

Record the values for the first plot on the Plot Form and the data recorder (Example shown in Figure 60).

Figure 60



To proceed to gather data for Plot 2 in the RECON (Step 6 of the process), press on the down arrow on the Navigation Pad (Figure 61). The screen in Figure 62 will appear.

Figure 61

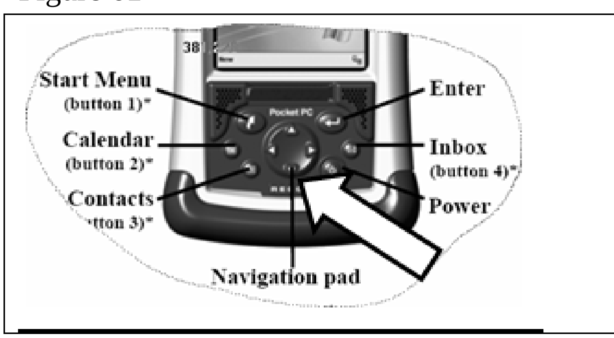
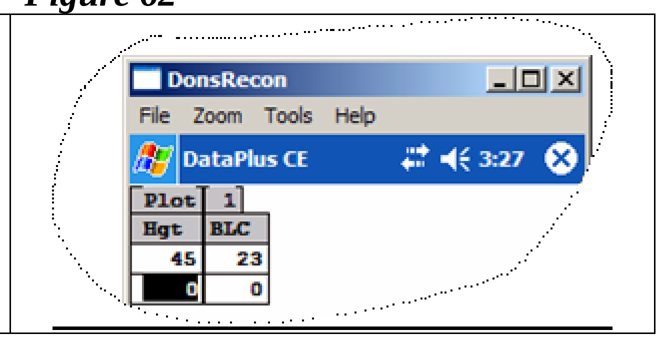
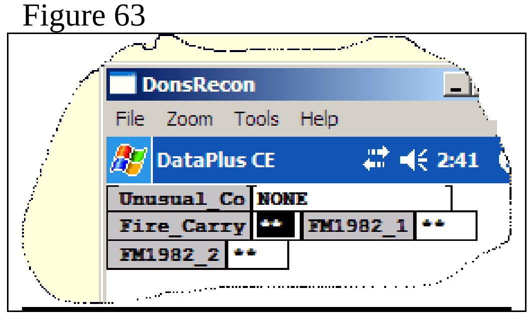


Figure 62



After Plot 5 has been entered, click on the F4 icon twice to proceed to the site level. Scroll down, if necessary, to the bottom of file level. The screen in Figure 63 will appear. This screen has the "placeholder" ** values for the primary carrier of the fire and the fuel model selections.

Figure 63



Go to Step 7 to complete the primary carrier of the fire and the fuel model selections.

Step 6 – Repeat Steps at Additional Plots

Go to the next plot center. It is suggested the distance between the center of Plot 1 and Plots 2-5 be 1 to 1.5 chains. Repeat Steps 2 – 5 at each plot.

Step 7 – Determine Surface Fuel Model for the Site

In Step 7, the 1982 FBPS fuel model(s) will be determined for the site. Using the surface fuel observations at each plot and the 1982 FBPS surface fuel model key, complete Steps 7.1 – 7.3.

7.1 What is the primary carrier of the fire?

Select: Grass, Brush, Timber Litter or Slash. Assume the weather conditions as defined in Figure 64:

Figure 64

1-hour Dead Fuel Moisture	Relative Humidity	20 foot Wind Speed*	Woody (shrub) Fuel Moisture
7-9 %	45-50%	7-8 mph	140%
* - Wind speed is a 10-minute, 20-foot average.			

7.2 First Choice 1982 FBPS Fuel Model

Use the fuel model key to list the fire behavior fuel model for the area. The primary fuel model selected should be from the fuel category that was circled as the Primary Carrier of the Fire (Field 7.1). Be sure to survey the surface fuels in all five plots before making this decision.

7.3 Second Choice 1982 FBPS Fuel Model

If the selection of the fire behavior fuel model is a difficult choice, list the alternative choice here. It is acceptable for this field to be blank.

After Plot 5 has been entered, the user can click on the F4 icon twice to proceed to the site level. Scroll down, if necessary, to the bottom of file level. The screen in Figure 65 will appear. This screen has the "placeholder" ** values for the primary carrier of the fire and the fuel model selections. Use the F2 icon to display the possible entries for the primary carrier of the fire and the first and second choice fuel model by fuel model set. An example of this screen when complete is shown in Figure 66. Note that the second choice fuel model does not have to have the same primary carrier of the fore as the first choice fuel model.

Figure 65

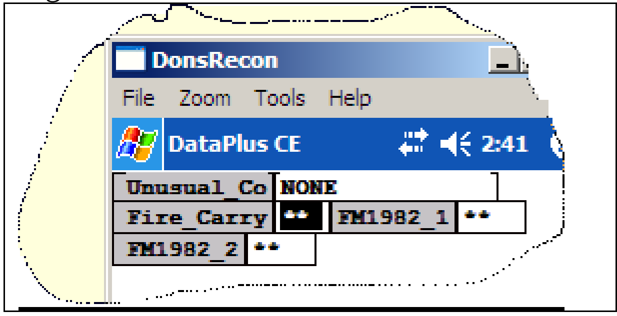
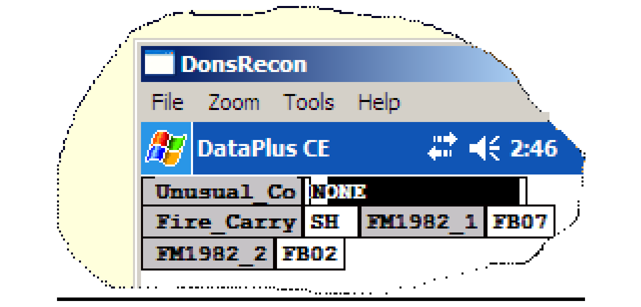


Figure 66



Step 8 – Take Digital Photos

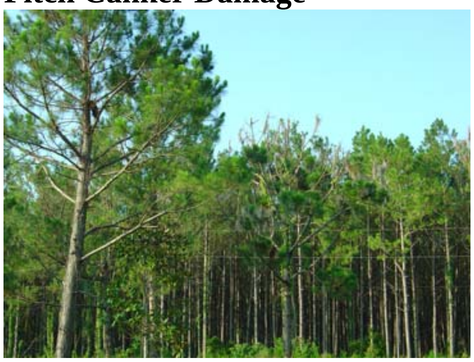
Take a picture of a representative area showing each of the fuel models selected in Steps 7.2 – 7.5 as appropriate. On 12” x 12” board that is on top of the range pole, use alligator clips to attach a piece of paper with the site identifier and photo identifier defined as follows. Make sure the numbers on the board are readable in the photo. For the First Choice 1982 FBPS fuel model, use the following: XXXX-1 where XXXX is the site identifier. For the Second Choice 1982 FBPS fuel model, use the following: XXXX-2 where XXXX is the site identifier. Title the electronic file using the same scheme; ie. XXXX-1.jpg.

Tree Class Descriptions

Classes 1 – 6 are for live trees:

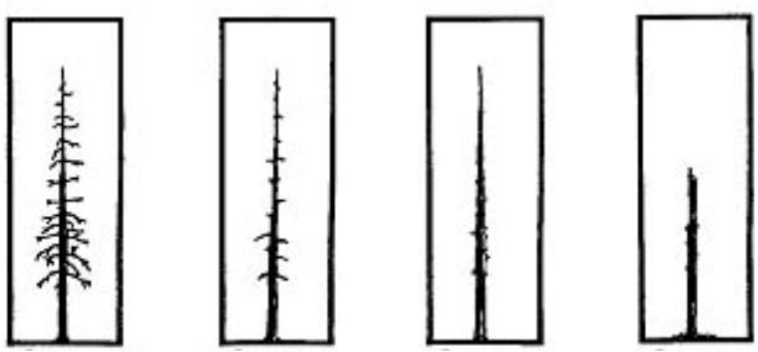
Class	Description
1	Dominant
2	Co-Dominant with ≥ 1/3 Canopy
3	Co-Dominant with < 1/3 Canopy
4	Co-Dominant with < 1/3 Canopy-Disease/Insect (This should include trees with beetle damage, pitch canker, etc)
5	Intermediate
6	Suppressed

Pitch Canker Damage



Southern Pine Beetle Damage

Classes 7-10 are for Dead Tress:



Class 7 Class 8 Class 9 Class 10

Class	Bark	Heartwood Decay	Sapwood Decay	Limbs	Top Breakage	Time Since Death
7	Tight, intact	Minor	None to incipient	Mostly present	May be present	1-5 years
8	50% loose or missing	None to advanced	None to incipient	Small limbs missing	May be present	> 5 years
9	75% missing	Incipient to advanced	None to 25%	Few remain	Approx. 1/3	> 5 years
10	75% + missing	Advanced to crumbly	50% + advanced	Absent	Approx. ½ +	> 5 years

Appendix D

State of Florida Fuels Classification Key
For the 1982 FBPS Fuel Model Set

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State of Florida Fuels Classification Key
For the 1982 FBPS Fuel Model Set

The 1982 FBPS Fuel Model Set

Fuel Type	Model ID	Model Description
Grass	1	Short grass (1 ft.)
	2	Timber (grass and understory)
	3	Tall grass (2.5 ft.)
Brush	4	Chaparral
	5	Brush
	6	Dormant brush - hardwood slash
	7	Southern rough
Timber Litter	8	Closed timber litter
	9	Hardwood (long-needle pine) litter
	10	Timber (litter and understory)
Slash	11	Light slash
	12	Medium slash
	13	Heavy slash
Non-Burnable	96	Urban
	97	Agriculture
	98	Water
	99	Rock

Use the following key to and the description of the fuel models to determine the predominate surface fuel model on the site.

I. Non-Flammable Areas

A. Water

Use **Fuel Model 98**

B. Rock

Use **Fuel Model 99**

C. Urban, Non-Wildland
This includes all areas classified as urban.

Use **Fuel Model 96**

D. Agriculture
Area has an agricultural product and being maintained in a non-burnable condition.

Use **Fuel Model 97**

II. Transitional Vegetation

Areas where vegetation cover is less than 25% and is presumed to be dynamically changing from one land cover type to another, often because of land use activities. Examples include transition phase between forest and agricultural land, and temporary clearing of woody or herbaceous vegetation. Includes areas changed due to natural causes (e.g. fire, flood, etc.)

A. Fresh Slash is present (0-3 years or so) with no live fuel present

Go to the **VIII. SLASH FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Dead/down material is present and aged and overgrown with live fuel.

1. Slash is from trees. Leaves have fallen and cured. Considerable vegetation (tall weeds) has grown in amid the slash and has cured or dried out (Canopy closure has little or no effect on the rate of spread, but may require sustained moderate winds to support the rate of spread; under certain conditions juvenile stands of Chinese tallow may also fit in this fuel model)

   Use **Fuel Model 6**

2. Slash is from trees. Needles and leaves have fallen and considerable vegetation (tall weeds and some shrubs) has overgrown the slash. Fire spreads in surface fuels consisting of litter and/or dead and down stem wood occasionally produced by weather (tornado or hurricane) or other biological impacts such as insect defoliation and mortality. Dry ladder fuels resulting from herbicide application to vine laden treed communities and light slash associated with incompletely harvested timber operations may also contribute to this fuel type.

   Use **Fuel Model 10**

III. Planted/Cultivated Vegetation

Areas dominated by typical green vegetation with cover ranging from 25-100% at peak times of growing season. Vegetation has been planted in its current location, and/or is treated with annual tillage, modified conservation tillage, or other intensive management or manipulation.

A. Planted/Cultivated Woody - Vegetation Occupies Greater than 25% Cover of Area
Of vegetation present, 25-100% of the cover is woody; includes orchards, vineyards, and tree plantations planted for the production of fruit, nuts, fiber (wood), or ornamental:

1. If > 60% of surface cover is grass,
   then ....Go to **IV., B., 1. Natural/Semi-natural Grassland**
2. If > 60% of surface cover is shrubs or trees,
   then ... Go to **IV., B., 2. Natural/Semi-natural Shrub or Forest**
3. If > 60% of surface cover is dead/down material...................... Go to **II. Transitional**

B. Pasture/Hay

Of vegetation present, 75-100% of the cover is herbaceous. The majority of the vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, or seed. The areas of herbaceous vegetation planted by humans in developed settings or for livestock grazing or the production of seed or hay crops or planted for wildlife use and areas of grasses, legumes, or grass-legume mixtures planted or intensely managed for livestock grazing or the production of seed or hay crops.

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

IV. Native/Natural and Exotic Vegetation

Areas dominated by typical green vegetation with cover ranging from 25-100% at peak times of growing season. Vegetation is native or naturalized that has not been cultivated or treated with any annual management regime.

A. Wetlands

Areas dominated by natural vegetation in which the soil or substrate is periodically saturated with or covered with water.

1. Non-woody Wetlands

Of the vegetation present, 75-100% of the vegetated surface cover is herbaceous. Examples include freshwater marshes and wet prairies. Disturbed sites may include torpedo grass, Japanese climbing fern, and sesbania.

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Woody Wetlands

Of the vegetation present, woody vegetation (either tree or shrub species) makes up 25-100% surface cover. Examples include Ti-ti stands, mangrove swamp, hpericum marshes, cypress swamp, bay swamp, gum swamp, pond pine forest. Disturbed sites may include Brazilian pepper stands, primrose willow stands, Japanese ligustrum stands.

a. Titi stands/thickets > 70 % of cover

Use Fuel Model 4

b. Tree Canopy is 25 to 60%

1. Greater than 60% of surface cover Herbaceous

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Greater Than 60% of surface cover Shrubs

   Go to the **VI. SHRUB FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

c. Tree Canopy is > 60%

1. Melaleuca

   Use Fuel Model 4

2. Not Melaleuca

   Go to the **VII. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Uplands – Flatwoods and Sandhills

Areas dominated by vegetation in which the soil or substrate is not periodically saturated with or covered with water.

1. Natural/Semi-Natural Grasslands

Of the vegetation present, natural upland herbaceous vegetative cover ranges from 75-100%. Most of these areas are dominated by graminoids, and are extensively utilized by grazing animals. Examples include areas dominated by wiregrass and broomsedge. Disturbed sites may be dominated by cogongrass, air-potato, kudzu and castorbean.

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Natural/Semi-Natural Shrub or Forest

A.) Primary carrier of fire is dead/down material resulting from management or a significant natural event.

1) No live fuel present

   Go to the **VIII. SLASH FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2) Live fuel is present

   Use **Fuel Model 10**

B.) Shrub cover > or = to 60%

1) Hardwood Overstory > or = 75%

Go to the **VII. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2) Hardwood < 75%, Pine overstory or no overstory

Go to the **VI. SHRUB FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

C.) Shrub cover < 60%

1) Surface cover is > 60% timber litter

Go to the **VII. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2) Surface cover is > 60% grass

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

V. Primary Carrier of the Fire is Grass - Key to Grass Fuel Models

A. Fire spreads in grassy fuels where the density of the overstory or canopy may contribute to a reduced rate of spread and reduce the intensity.

Use **Fuel Model 2**

Figure 1 - Example of Fuel Model 2

Central Florida

Central Florida

South Florida Cypress flats

South Florida Flatwoods

B. Fire spreads in grassy fuels without canopy or where a limited canopy has little effect on the rate of spread and the fuel bed is **< *1 foot tall***.

Use **Fuel Model 1**

Figure 2 - Example of Fuel Model 1

South Florida Miami rockland prairie

C. Fire spreads in grassy fuels without canopy or where a limited canopy has little effect on the rate or intensity, the fuel bed is **> *1 foot tall*** or is cogongrass.

Use **Fuel Model 3**

Figure 3 – Example of Fuel Model 3

Central Florida Marsh

Central Florida Cogon Grass

South Florida Cattail Marsh

South Florida Sawgrass Marsh in Everglades

VI. Primary Carrier of the Fire is Shrubs – Key to Shrub Fuel Models

A. Live fuels are not present

1. Fire spreads through patchy shrubs ***(3-6 feet in height)*** with little or no logging slash and where canopy closure has little or no effect on the rate of spread, but may require sustained moderate winds to support the rate of spread. An example would be areas dominated by Rosemary Scrub.

   Use **Fuel Model 6**

B. Live fuels are present

1. Fires spreads in ***shrubs < 4 feet in height***. Shrubs may be palmetto/gallberry association with pine canopy. Managed pine flatwoods may be represented.

   Use **Fuel Model 7**

Figure 4 – Example of Fuel Model 7

Central Florida Flatwoods

Central Florida Flatwoods

South Florida Flatwoods

North Florida Flatwoods

2. Fire spreads in ***shrubs > 4 feet in height*** and/or melaleuca or cogongrass is present and are likely to contribute to the overall intensity of the shrub ignition, which may and often does lead to canopy involvement. (Scrubby flatwoods, Pine Flatwoods, coastal palmetto, and tall palmetto, Titi, Pine Plantations and Oak scrub.

   Use **Fuel Model 4**

Figure 5 – Example of Fuel Model 4

Central Florida Scrub

South Florida Scrub

South Florida Melaleuca Stand

South Florida Japanese Climbing Fern

3. Fire spreads in light, green shrubby herbaceous vegetation often with substantial overstory. However, shrubby flame length rarely lead to or contribute to the ignition of the overstory; wild grape, kudzu, or other vines may be present, but do not provide sufficient age and biomass to contribute as ladder fuels which would lead to canopy involvement. (Young scrub, 1-2 year old plantations, scrubby flatwoods)

   Use **Fuel Model 5**

Figure 6 – Example of Fuel Model 5

Central Florida – Gallberry | South Florida Hammock

VII. Primary Carrier of the Fire is Timber Litter - Key to Timber Litter Fuel Models

A. Dead foliage is tightly compacted, short needle (2 inches or less) conifer litter or hardwood litter. (Include aged stands of Brazilian Pepper and Australian pine).

   Use **Fuel Model 8**

Figure 7 - Example of Fuel Model 8

B. Fire spreads in the surface litter of leafy or fine, blowy fuels. A canopy of long needle pine or deciduous hardwoods contribute to the seasonal accumulation of litter without logging slash. Some closed canopy pine plantations and Turkey Oak fit in this class.

Use **Fuel Model 9**

Figure 8 - Example of Fuel Model 9

C. Fire spreads in surface fuels consisting of litter and/or dead and down stem wood occasionally produced by weather (tornado or hurricane) or other biological impacts such as insect defoliation and mortality. Dry ladder fuels resulting from herbicide application to vine laden treed communities and light slash associated with incompletely harvested timber operations may also contribute to this fuel type.

Use **Fuel Model 10**

Figure 9 - Example of Fuel Model 10

VIII. Primary Carrier of the Fire is Slash - Key to Slash Fuel Models

A. Slash is not continuous. Needle litter or small amounts of grass or shrubs must be present to help carry the fire, but primary carrier is still slash. Live fuels are absent or do not play a significant role in fire behavior. The slash depth is about 1 foot.

Use Fuel Model 11

Figure 10 - Example of Fuel Model 11

South Florida Slash

B. Slash generally covers the ground (heavier loadings than Model 11), though there may be some bare spots or areas of light coverage. Average slash depth is about 2 feet. Slash is not excessively compacted. Approximately one-half of the needles may still be on the branches but are not red. Live fuels are absent or are not expected to affect fire behavior.

Use Fuel Model 12

C. Slash is continuous or nearly so (heavier loadings than Model 12). Slash is not excessively compacted and has an average depth of 3 feet. Approximately one-half of the needles are still on the branches and are red or all the needles are on the branches but they are green. Live fuels are not expected to influence fire behavior.

Use Fuel Model 13

D. Same as 3, EXCEPT all the needles are attached and are red.

Use Fuel Model 4

Appendix E

State of Florida Fuels Classification Key
For the 2005 FBPS Fuel Model Set

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State of Florida Fuels Classification Key
For the 2005 FBPS Fuel Model Set

The 2005 FBPS Fuel Model Set

Fuel Type	Model ID	Model Description
Grass	GR01	Short, sparse dry climate grass (Dynamic)
	GR03	Low load, very coarse, humid climate grass (Dynamic)
	GR04	Moderate load, dry climate grass (Dynamic)
	GR05	Low load, humid climate grass (Dynamic)
	GR08	High load, very coarse, humid climate grass (Dynamic)
	GR09	Very high load humid climate grass (Dynamic)
Grass/Shrub	GS03	Moderate load, humid climate grass-shrub (Dynamic)
Non-Burnable	NB01	Urban
	NB03	Agriculture
	NB08	Water
	NB09	Bare ground
Shrub	SH01	Low load, dry climate shrub (Dynamic)
	SH03	Moderate load, humid climate shrub
	SH04	Low load, humid climate, timber-shrub
	SH05	High load, dry climate shrub
	SH06	Low load, humid climate shrub
	SH07	Very high load, dry climate shrub
	SH08	High load, humid climate shrub
	SH09	Very high load, humid climate shrub (Dynamic)
Timber/ Understory	TU01	Light load, dry climate timber-grass-shrub (Dynamic)
	TU02	Moderate load, humid climate timber-shrub
	TU03	Moderate load, humid climate timber-grass-shrub (Dynamic)
	TU05	Very high load, dry climate timber-shrub
Timber Litter	TL01	Low load, compact conifer litter
	TL02	Low load, broadleaf litter
	TL04	Small downed logs
	TL05	High load, conifer litter
	TL06	Moderate load, broadleaf litter
	TL08	Long-needle litter
	TL09	Very high, load broadleaf litter
Slash/ Blowdown	SB01	Low load activity fuel
	SB02	Moderate load activity or low load blowdown
	SB03	High load activity fuel or moderate load blowdown
	SB04	High load blowdown

I. Non-Flammable Areas

A. Water

Use **Fuel Model NB08**

B. Rock/Bare Ground

Use **Fuel Model NB09**

C. Urban, Non-Wildland

This includes all areas classified as urban.

Use **Fuel Model NB01**

II. Transitional Vegetation

Areas where vegetation cover is less than 25% and is presumed to be dynamically changing from one land cover type to another, often because of land use activities. Examples include transition phase between forest and agricultural land, and temporary clearing of woody or herbaceous vegetation. Includes areas changed due to natural causes (e.g. fire, flood, etc.)

A. Fresh Slash is present (0-3 years or so) with no live fuel present

Go to the **X. SLASH FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Dead/down material is present and aged and overgrown with live fuel.

1. Slash is from trees. Leaves have fallen and cured. Considerable vegetation (tall weeds) has grown in amid the slash and has cured or dried out (Canopy closure has little or no effect on the rate of spread, but may require sustained moderate winds to support the rate of spread; under certain conditions juvenile stands of Chinese tallow may also fit in this fuel model)

   Use **Fuel Model GS03**

2. Slash is from trees. Needles and leaves have fallen and considerable vegetation (tall weeds and some shrubs) has overgrown the slash. Fire spreads in surface fuels consisting of litter and/or dead and down stemwood occasionally produced by weather (tornado or hurricane) or other biological impacts such as insect defoliation and mortality. Dry ladder fuels resulting from herbicide application to vine laden treed communities and light slash associated with incompletely harvested timber operations may also contribute to this fuel type.

   Go to the **X. SLASH FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

III. Planted/Cultivated Vegetation

Areas dominated by typical green vegetation with cover ranging from 25-100% at peak times of growing season. Vegetation has been planted in its current location, and/or is treated with annual tillage, modified conservation tillage, or other intensive management or manipulation.

A. Planted/Cultivated Woody - Vegetation Occupies Greater than 25% Cover of Area

Of vegetation present, 25-100% of the cover is woody; includes orchards, vineyards, and tree plantations planted for the production of fruit, nuts, fiber (wood), or ornamental:

1. If orchard…………………………….………………….............................. **NB03**

2. If > 60% of surface cover is grass,
   then .... Go to **IV., B., 1. Natural/Semi-natural Grassland**

3. If > 60% of surface cover is shrub or trees,
   then ... Go to **IV., B., 2. Natural/Semi-natural Shrub or Forest**

4. If > 60% of surface cover is dead/down material .... **II. Transitional**

B. Pasture/Hay

Of vegetation present, 75-100% of the cover is herbaceous. The majority of the vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, or seed. The areas of herbaceous vegetation planted by humans in developed settings or for livestock grazing or the production of seed or hay crops or planted for wildlife use and areas of grasses, legumes, or grass-legume mixtures planted or intensely managed for livestock grazing or the production of seed or hay crops.
Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

C. Cropland

Areas of herbaceous vegetation planted characterized by regular (e.g. annual, semi-annual, biennial) tillage.

Use **Fuel Model NB03**

IV. Native/Natural and Exotic Vegetation

Areas dominated by typical green vegetation with cover ranging from 25-100% at peak times of growing season. Vegetation is native or naturalized that has not been cultivated or treated with any annual management regime.

A. Wetlands

Areas dominated by natural vegetation in which the soil or substrate is periodically saturated with or covered with water.

1. Non-woody Wetlands

Of the vegetation present, 75-100% of the vegetated surface cover is herbaceous. Examples include freshwater marshes and wet prairies. Disturbed sites may include torpedo grass, Japanese climbing fern, and sesbania.

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Woody Wetlands

Of the vegetation present, woody vegetation (either tree or shrub species) makes up 25-100% surface cover. Examples include Ti-ti stands, mangrove swamp, hpericum marshes, cypress swamp, bay swamp, gum swamp, pond pine forest. Disturbed sites may include Brazilian pepper stands, primrose willow stands, Japanese ligustrum stands.

a. Titi stands/thickets > 70 % of cover

1. Greater than or equal to 3 inch DBH

   Use **Fuel Model TL04**

2. Less than 3 inch DBH

   Use **Fuel Model SH08**

b. Tree Canopy is 25 to 60%

1. Greater than 60% of surface cover Herbaceous

   Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Greater Than 60% of surface cover Shrubs

   Go to the **VII. SHRUB FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

c. Tree Canopy is > 60%

1. Melaleuca

   Use **Fuel Model TL04**

2. Not Melaleuca

   Go to the **IX. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Uplands – Flatwoods and Sandhills

Areas dominated by vegetation in which the soil or substrate is not periodically saturated with or covered with water.

1. Natural/Semi-Natural Grasslands

Of the vegetation present, natural upland herbaceous vegetative cover ranges from 75-100%. Most of these areas are dominated by graminoids, and are extensively utilized by grazing animals. Examples include areas dominated by wiregrass and broomsedge. Disturbed sites may be dominated by cogongrass, air-potato, kudzu and castorbean.

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2. Natural/Semi-Natural Shrub or Forest

A. Primary carrier of fire is dead/down material resulting from management or a significant natural event.

   Go to the **X. SLASH FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Primary Carrier of the fire is grass or shrub with litter from forest canopy. Shrub cover/grass cover greater than 20% but less than 60%.

   Go to the **VIII. TIMBER/UNDERSTORY LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

C.) Shrub cover > or = 60%

1) Hardwood Overstory > or = 75%

Go to the **IX. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2) Hardwood < 75%, Pine overstory or no overstory

Go to the **VII. SHRUB FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

D.) Shrub cover < 60%

1) Surface cover is > 60% timber litter

Go to the **IX. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

2) Surface cover is > 60% grass

Go to the **V. GRASS FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

V. Primary Carrier of the Fire is Grass - Key to Grass Fuel Models

A. No-overstory present or widely scattered pine or cypress

1. Grass fuelbed depth is ≤ 1 foot

Grass fuelbed depth < than 1 foot and patchy. Includes heavily grazed pasture.

Use **Fuel Model GR01**

Figure 1 - Example of Fuel Model GR01

No overstory or widely scattered pine with wiregrass understory. Fuelbed depth less than 6 inches. For taller wiregrass.

2. **Grass fuelbed depth is > 1 foot but ≤ 3 feet**

   a. The primary carrier of fire is continuous, coarse bahia grass, 1 to 3 feet in depth

      Use **Fuel Model GR04**

Figure 2 - Example of Fuel Model GR04

Coarse continuous bahia grass,
one to two feet in depth.

b. The primary carrier of fire is continuous, coarse, humid-climate grass. Grass and herbaceous fuel load is relatively light; fuel bed depth is about 2 feet. Shrubs are not present in significant quantity to affect fire behavior. Note: For shorter Muhleygrass, see GR1; for taller Muhleygrass, see GR5.

Use **Fuel Model GR03**

Figure 3 - Example of Fuel Model GR03

Muhleygrass prairie in south Florida (three to five years since burn).

Two to three foot coastal grasses, tidal marshes, or large water bodies

Dry prairie with no overstory or widely scattered overstory. For taller grass, see GR5.

c. The primary carrier of fire is continuous, coarse, humid-climate grass. Grass and herb fuel load is moderate; fuel bed depth is 2 to 3 feet. Shrubs are not present in significant quantity to affect fire behavior.

Use **Fuel Model GR05**

Figure 4 - Example of Fuel Model GR05

Muhley grass five years or greater since burn, shrub cover up to 30%

Sawgrass prairie less than five years since burn

3. **Grass fuelbed depth is > than 3 feet**

a. The primary carrier of fire is heavy, very coarse, humid climate grass.

Use **Fuel Model GR08**

Figure 5 - Example of Fuel Model GR08

Heavy load sawgrass with no overstory,

5 years or longer since burn.

b. The primary carrier of fire is continuous, dense, tall (> 3 feet), humid-climate grass.

Use **Fuel Model GR09**

Figure 6 - Example of Fuel Model GR09

Heavy load cord grass (Spartina) three years or greater since fire

Heavy load cogongrass, continuous and uniform two years or greater since fire

B. Overstory Present

1. Grass fuelbed depth is < 2 feet

The primary carrier of fire is continuous, coarse, humid-climate grass. Grass and herbaceous fuel load is relatively light; fuel bed depth is about 2 feet. Shrubs are not present in significant quantity to affect fire behavior. For older (closed canopy) plantations, see TL1 or TL4. For older rough, see GR5.

Use **Fuel Model GR03**

Figure 7 - Example of Fuel Model GR03

Pine plantation up to six years old.

Wiregrass needle litter with a long leaf overstory one to two year rough.

2. Grass fuelbed depth is > 2 feet

The primary carrier of fire is continuous, coarse, humid-climate grass. Grass and herb fuel load is moderate; fuel bed depth is 2 to 3 feet. Shrubs are not present in significant quantity to affect fire behavior.

Use **Fuel Model GR05**

Figure 8 - Example of Fuel Model GR05

Wiregrass, needle litter,
some shrubs (3-4 years since burn).

May include pine overstory

VI. Primary Carrier of the Fire is Litter and Shrubs under Shrubs - Key to Grass/Shrub Fuel Models

A. Live fuels are not present

The primary carrier of fire is a moderate fuel load of grass and shrubs combined.

Use **Fuel Model GS03**

Figure 9 - Example of Fuel Model GS03

Pine overstory with dense wiregrass and 30 to 50% shrub cover (palmetto). Fuel bed depth 3 to 5 feet.

Time since burn is 3 to 5 years.

Seasonal or Intermittent Ponds, grass center, transition to shrub edge.
Time since burn is 3 to 5 years.

No overstory or widely scattered pine with dense wiregrass understory and 30% to 50% shrub cover, primarily palmetto. Fuel bed depth 1 to 2 feet.

Time since burn is 5 to 7 years.

VII. Primary Carrier of the Fire is Shrubs - Key to Shrub Fuel Models

A. Live fuels are present

1. Shrub fuelbed depth is < or = to 1 foot

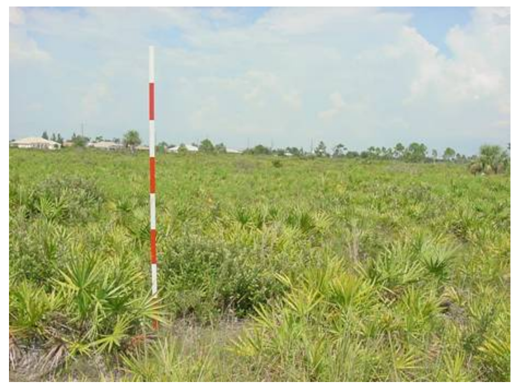
The primary carrier of fire is woody shrubs and shrub litter. Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present.

Use **Fuel Model SH01**

Figure 10 - Example of Fuel Model SH01

South Florida Slash Pine Rocklands with midstory of silver palm and thatch palm and grass understory.

Mesic or Scrubby Flatwoods with low palmetto/gallberry understory.



2. Shrub fuelbed depth is about 3 feet

The primary carrier of fire is woody shrubs and shrub litter. Low to moderate shrub and litter load, possibly with pine overstory, fuel bed depth < 3 feet. Time since last fire 5 to 10 years.

Use **Fuel Model SH04**

Figure 11 - Example of Fuel Model SH04

Upland Pine forest - open canopy pine stand with grasses and heavy shrub understory (yaupon, gallberry, scattered palmetto, waxmyrtle).

Pine Rocklands - South Florida Slash Pine with midstory of silver palm and thatch palm and grass understory (lower Keys).

3. Shrub fuelbed depth is > 2 foot and ≤ 3 feet

a. The primary carrier of fire is woody shrubs and shrub litter. Fuel load is moderate. Depth is 2 to 3 feet.

Use **Fuel Model SH03**

Figure 12 - Example of Fuel Model SH03

Sand Pine Scrub regeneration - low scrub open sandy patches, sand pine seedlings ranging in size

from 2 to 3 feet.

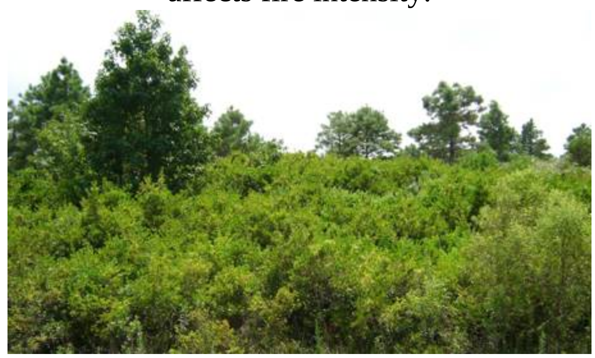
b. The primary carrier of fire is woody shrubs and shrub litter. Dense shrubs with little or no herbaceous fuel.

Use **Fuel Model SH08**

Figure 13 - Example of Fuel Model SH08

Coastal Palmetto - Pine overstory with dense palmetto shrub cover. Time since fire 3 to 5 years.

Low Pocosin - slash pine overstory (if present) mixed shrubs in a dense understory less than 4 feet. (titi, fetterbush, gallberry) organic soils (peat), water table (drought) affects fire intensity.



c. The primary carrier of fire is woody shrubs and shrub litter. Dense shrubs with little or no herbaceous fuel.

Use **Fuel Model SH06**

Figure 14 - Example of Fuel Model SH06

Scrubby/Mesic Flatwoods - Scattered longleaf, slash pine overstory, or sand pine mix with palmetto and scrub understory. Time since fire is 2 to 5 years.

Xeric scrub - sand pine overstory, scrub oaks not full grown. Stand age 15 to 25 years.

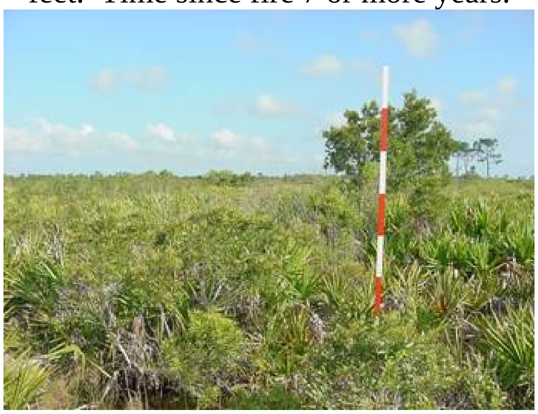
4. Shrub fuelbed depth is > 5 feet

a. The primary carrier of fire is woody shrubs and shrub litter. Dense shrubs with little or no herbaceous fuel.

Use **Fuel Model SH08**

Figure 15 - Example of Fuel Model SH08

Dry Prairie - no overstory or widely scattered pine with continuous palmetto understory. Fuel bed depth greater than 6 feet. Time since fire 7 or more years.

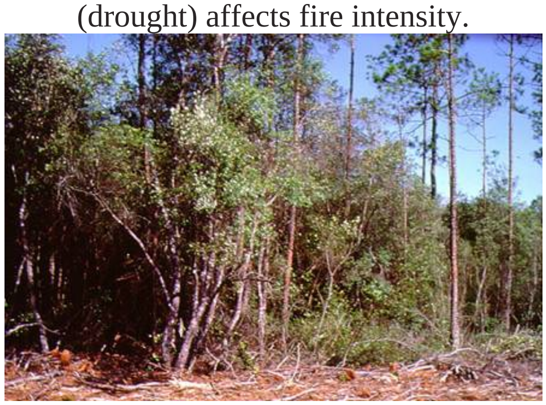


b. The primary carrier of fire is woody shrubs and shrub litter. Heavy shrub load.

Use **Fuel Model SH05**

Figure 16 - Example of Fuel Model SH05

High Pocosin - Slash pine overstory (if present) mixed shrubs in a dense understory greater than 6 ft (titi, fetterbush, gallberry) organic soils (peat), water table (drought) affects fire intensity.



c. The primary carrier of fire is woody shrubs and shrub litter. Very heavy shrub load, shrub depth 4 to 6 feet.

Use **Fuel Model SH07**

Figure 17 - Example of Fuel Model SH07

Scrubby flatwoods - slash/sand pine overstory, scrub height 5 feet plus with palmetto.

Time since fire is 6 to 11 years.

Scrub – pole class sand pine overstory, scrub 5 to 6 ft.

Stand age 25 to 40 years

Pine Rocklands (lower Keys) - South Florida Slash Pine with midstory of silver, thatch and cabbage palm and grass understory. Time since fire is 10+ years.

d. The primary carrier of fire is woody shrubs and shrub litter. Dense, finely branched shrubs with significant fine dead fuel, about 4 to 6 feet tall; some herbaceous fuel may be present.

Use **Fuel Model SH09**

Figure 18 - Example of Fuel Model SH09

Mesic Flatwoods - Pine overstory with dense continuous palmetto/gallberry understory and needle drape. Time since fire 5 or more years.

Xeric scrub – senescent sand pine overstory, scrub 6-8 feet.

VIII. Primary Carrier of the Fire is Timber Litter/Understory - Key to Timber Litter/Understory Fuel Models

The primary carrier of fire in this fuel model is forest litter in combination with herbaceous or shrub fuels.

A. Depth of timber litter/understory fuel ≤ 6 inches

Go to the **IX. TIMBER LITTER FUEL MODELS** Fuel Model Descriptions to Select Fuel Model

B. Depth of timber litter/understory fuel > 6 inches

Primary carrier is needle leaf litter and grasses. The primary carrier of fire is a low fuel load of grass and/or shrub with litter.

Use **Fuel Model TU01**

Figure 19 - Example of Fuel Model TU01

Upland Pine forest - open canopy pine stand, natural or plantation after thinning, mixture of light timber litter and light grasses and/or shrubs. Fuel bed depth 1 to 2 inches. Time since fire is 1 to 2 years.

C. Depth of timber litter/understory fuel 1 to 3 feet

Primary carrier is needle leaf litter and grasses.

1. Moderate litter fuel load of grass and/or shrub component with time since fire 2-5 years.

   Use **Fuel Model TU02**

   Figure 20 - Example of Fuel Model TU02

Upland Pine forest - open canopy pine stand, natural or plantation after thinning, mixture of moderate timber litter with grasses and/or shrubs. Fuel bed depth 1 to 2 feet. Time since fire 2 to 5 years. 	Wet Flatwoods – grasses and light shrub are the most significant fire carriers. Some palmetto, light to moderate forest litter. Time since fire 2 to 3 years. 

2. Mixture of loosely compacted needle litter with significant shrub component and time since fire 6-15 years.

   Use **Fuel Model TU03**

   Figure 21 - Example of Fuel Model TU03

Upland Pine forest - open canopy pine stand, natural or plantation after thinning, mixture of loosely compacted needle litter with significant shrub component. Fuel bed depth 1 to 2 feet. Time since fire 5 to 15 years.

D. Depth of timber litter/understory fuel is > 3 feet
Primary carrier is moderate leaf litter and shrubs.

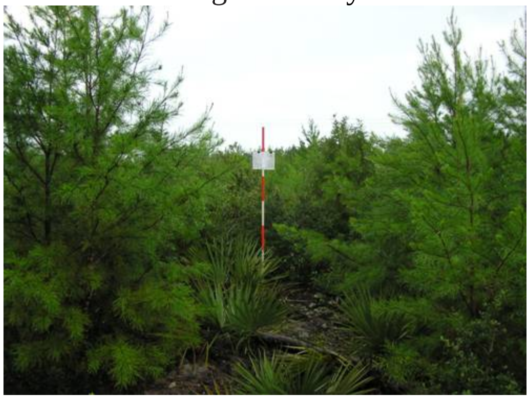
1. The primary carrier of fire is heavy forest litter with shrub or small tree understory component.

   Use **Fuel Model TU05**

Figure 22 - Example of Fuel Model TU05

Sandhill – three to four foot shrubs with sparse wiregrass, some needle drape.
Time since burn 5+ years.

Scrub - sand pine dominated scrub, scrub oaks forming a scattered understory, open sandy patches present.
Stand age 7 to 14 years



Scrubby flatwoods - over-mature scrub over head high, ground shaded, scattered slash/sandpine overstory. Sparse palmetto in understory.

Time since fire 12+ years

IX. Primary Carrier of the Fire is Timber Litter - Key to Timber Litter Fuel Models

A. Depth of timber litter fuel ≤ 6 inches

1. The primary carrier of fire compact forest litter. Light to moderate fuel load and dead fuels 1 to 2 inches deep.

   Use **Fuel Model TL01**

   Figure 23 - Example of Fuel Model TL01

Closed Upland Pine plantation - closed canopy plantation, primarily timber litter, slash, loblolly or longleaf overstory, light needle litter. Time since burn one to three years.	Tropical Hammock - compact leaf litter under tropical hardwoods. Time since burn greater than 25 years.
	

2. The primary carrier of fire is broadleaf (hardwood) litter. Light fuel load, compact broadleaf litter

   Use **Fuel Model TL02**

   Figure 24 - Example of Fuel Model TL02

Cypress Dome - dense overstory, cypress leaf litter, more compact than bay swamp.

Upland Hardwood hammock - closed oak canopy with compact timber litter.

Prairie Hammock - dense overstory, oak, cabbage palm overstory.

3. The primary carrier of fire moderate load of fine litter and coarse fuels, 3 to 4 inches deep.

   Use **Fuel Model TL04**

Figure 25 - Example of Fuel Model TL04

Upland Mixed Oak and Pine - oak and pine canopy with mixed litter. Fuel depth 3 to 4 inches. (Minimum 40%, maximum 60% Oak)

Bay Head/hardwood swamp – species include magnolia, bay, gum, hickory, etc. loose hardwood litter and possibly some pine litter.

Melaleuca - Dense canopy, leaf litter

B. Depth of timber litter fuel > 6 inches but less than 1 foot and is long needle leaf litter

1. The primary carrier of fire is moderate fuel load leaf litter.

   Use **Fuel Model TL06**

   Figure 26 - Example of Fuel Model TL06

   Sandhill - longleaf/oak, needle and leaf litter. Shrub component contributes to fire behavior in the growing season.

2. The primary carrier of fire is moderate fuel load of long-needle pine litter, which may include a small amount of herbaceous fuels.

   Use **Fuel Model TL08**

   Figure 27 - Example of Fuel Model TL08

   Upland Pine Plantation - closed canopy plantation, primarily timber litter, slash, loblolly or longleaf overstory, moderate loosely compacted needle litter. Fire return interval is 3+ years.

C. Depth of timber litter fuel > 1 foot and is long needle leaf litter

1. The primary carrier of the fire is high load conifer litter; light slash or mortality fuel.

   Use **Fuel Model TL05**

   Figure 28 - Example of Fuel Model TL05

   Australian Pine (Caussurina) - dense overstory, needle/leaf litter continuous, compact.

   Maritime/coastal hammock. Species composition Live oak, hardwoods, cabbage palms, leaf litter carries fire.

2. The primary carrier of fire is very high fuel load, with pine needle litter and loosely compacted broadleaf litter. Can also be used to represent heavy needle-drape.

   Use **Fuel Model TL09**

   Figure 29 - Example of Fuel Model TL09

   Sandhill - needle and leaf litter, scattered brush head high, some needle drape. Time since burn 5+ years.

X. Primary Carrier of the Fire is Slash - Key to Slash Fuel Models

A. The primary carrier of fire is light dead and down activity fuel. Fine fuel load is 10 to 20 t/ac, weighted toward fuels 1 to 3 inches diameter class, depth is less than 1 foot.

Use **Fuel Model SB01**

Figure 30 - Example of Fuel Model SB01

Scattered wind damage.
Existing fuel bed may support greater fire potential than blowdown.

B. The primary carrier of fire is moderate dead and down fuel or light blowdown. Fine fuel load is 7 to 12 t/ac, evenly distributed across 0 to 0.25, 0.25 to 1, and 1 to 3 inch diameter classes, depth is about 1 foot. Blowdown is scattered, with many trees still standing

Use **Fuel Model SB02**

Figure 31 - Example of Fuel Model SB02

Moderate wind damage.
Existing fuel bed may support greater fire potential than blowdown.

C. The primary carrier of fire is heavy dead and down activity fuel or moderate blowdown. Fine fuel load is 7 to 12 t/ac, weighted toward 0 to 0.25 inch diameter class, depth is more than 1 foot. Blowdown is moderate, trees compacted to near the ground.

Use **Fuel Model SB03**

Figure 32 - Example of Fuel Model SB03

Heavy hurricane damage.
Existing fuelbed may support greater fire potential than blowdown.

D. The primary carrier of fire is heavy blowdown fuel. Blowdown is total, fuelbed not compacted, most foliage and fine fuel still attached to blowdown.

Use **Fuel Model SB04**

Figure 33 - Example of Fuel Model SB04

Heavy overgrown hurricane damage.

Appendix F

Key to and Descriptions of Some Florida Trees

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Pine Tree Identification Guide

A. Needles are in bundles of 2.

The cones about 3” long, with slender, mostly persistent prickles. The cones, remaining closed at maturity, persistent on the branches for many years; Needles are dark green and not twisted.

Select Sand Pine

B. Needle bundles in clusters of 3.

1. Leaves are mostly 12” or more in length, are borne on stout branchlets; Buds are white; Cones are about 9” long, sessile and usually leave the basal portions on the branches when falling away.

Select Longleaf Pine

2. Leaves are usually less than 9” in length and borne on slender branchlets; The buds are brown to reddish brown; The cones are less than 6” long and if sessile, they do not leave the basal portion on the branches when falling away.

a. Cones are narrowly conical and about 5” in length; Needles are 6” to 9” in length; Bark is without resin pockets

Select Loblolly Pine

b. Cones are broadly ovoid to nearly globular with the scales armed with weak, deciduous prickles; Needles are 6” to 8” long.

Select Pond Pine

C. Needle bundles in clusters of 2 and 3.

1. Cones are stalked, and about 5” in length; Needles are 8” to 12” in length.

Select North Florida Slash Pine

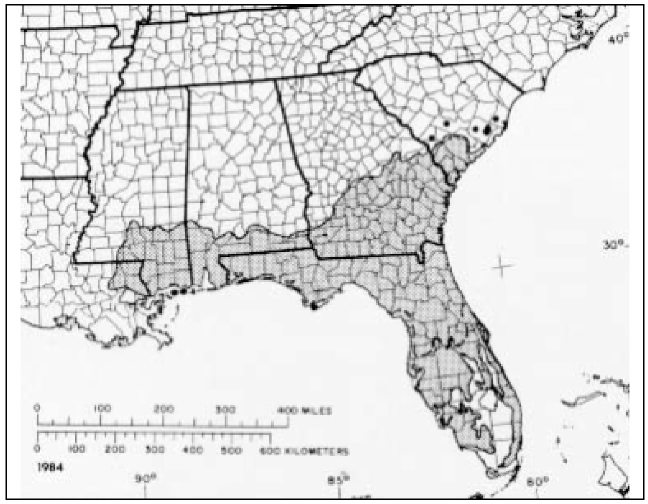
2. Cones are stalked and about 4” in length; Needles are 10” to 12” or more in length.

Select South Florida Slash Pine

3. Cones are sessile and about 2” in length; Needles are 3” to 5” in length; Bark has resin pockets.

Select Shortleaf Pine

North Florida Slash Pine (*Pinus elliottii*)



Slash pine *(Pinus elliottii) is* one of the hard yellow pines indigenous to southeastern United States. Other names occasionally used for this species include southern pine, yellow slash pine, swamp pine, pitch pine, and Cuban pine. It is one of the two southern pines used for naval stores and one of the most frequently planted timber species in North America. Two varieties are recognized: *P. elliottii* var. *elliottii,* the slash pine most frequently encountered, and *P. elliottii* var. *densa,* that grows naturally only in the southern half of peninsula Florida and in the Keys. Slash pine has the smallest native range of the four major southern pines. The range extends over 8° latitude and 10° longitude, and 45 percent of the present growing stock is in Georgia. Slash pine grows naturally from Georgetown County, SC, south to central Florida, and west to Tangipahoa Parish, LA. Its native range includes the lower Coastal Plain, part of the middle Coastal Plain, and the hills of south Georgia. Slash pine is a major component of three forest cover types including Longleaf Pine-Slash Pine (Society of American Foresters Type 83), Slash Pine (Type 84), and Slash Pine-Hardwood (Type 85). The species has been established by planting as far north as Tennessee, in north central Georgia, and Alabama. It has also been planted and direct-seeded in Louisiana and eastern Texas where it now reproduces naturally. Since it has been artificially propagated far outside its natural range, slash pine can now be found in association with many other species. Within its natural range, the distribution of slash pine was initially determined by its susceptibility to fire injury during the seedling stage. Slash pine grew throughout the flatwoods of north Florida and south Georgia. It was also common along streams and the edges of swamps and bays. Within these areas either ample soil moisture or standing water protected young seedlings from frequent wildfires in young forests. With improved fire protection and heavy cutting of longleaf pine *(Pinus palustris),* slash pine has spread to drier sites, replaced longleaf pine in mixed stands, and invaded abandoned fields. This increase in acreage was possible because of slash pine's frequent and abundant seed production, rapid early growth, and ability to withstand wildfires and rooting by hogs after the sapling stage. Although slash pine is adaptable to a variety of site and topographic conditions, it grows best on pond margins and in drainages where soil moisture is ample but not excessive and the soil is well aerated. Some seeds are produced each year, with good crops about every third year. Slash pine cones mature during September, approximately 20 months after pollination. There is a wide variation in time of cone maturation among trees, regions, and years. Slash pine develops an extensive lateral root system and a moderate taproot. Taproots may be deformed as a result of poor planting technique, a restricting soil horizon, or a high water table. The most serious disease of slash pine is fusiform rust caused by the fungus *Cronartium quercuum* f. sp. *fusiforme.* Most of the southern oaks serve as alternate hosts but the fungus damages only pines. Annosus root rot, caused by the fungus *Heterobasidion annosum, is* another serious disease of slash pine. Pitch canker, caused by the fungus *Fusarium moniliforme* var. *subglutinans,* causes heavy damage to slash pines in nurseries, seed orchards, and plantations.

Cankers high in the crown may kill only the leader and a few laterals; the tree survives with a stem deformity and reduced growth. Cankers below the crown may eventually girdle the trunk and kill the tree. Young slash pines are susceptible to injury by wildfires until they are 3.0 to 4.6 m (10 to 15 ft) tall and the bark has thickened. Up to 50 percent of the needles may be scorched, but not consumed, with little mortality or growth loss.

Figure 1 - North Florida Slash Pine

South Florida Slash Pine (*Pinus elliottii* var. *densa*)

South Florida slash pine *(Pinus elliottii* var. *densa* Little & Dorman) is a variety of slash pine found on about 121 410 ha (300,000 acres) in the southern half of the peninsula of Florida. It grows in pure stands on flatwood sites in the southern part of its range and on swampy or streamside sites in the northern part. Where its range overlaps with the typical slash pine, there is a transition zone where morphological traits show clinal variation between the two varieties. The range of South Florida slash pine also overlaps with that of longleaf pine*(P. palustris)* in transition zones between wet and dry sites, with longleaf more numerous on the drier sites. South Florida slash pine is characterized by long needles, although they are not as long as those of longleaf, in fascicles of two, rarely three; thick branches with needles appearing clumped at the end; hard wood; whitish bud scales; and cones 20 percent smaller than typical slash pine. The seedlings have a grass stage similar to longleaf pine and a thick taproot. Mature trees have an irregular crown. When wildfires occurred in young stands, one-third of the surviving grass stage seedlings were observed to sprout from the root collar, but sprouts on the leader died back. South Florida slash pine is more fire resistant than the typical variety in the seedling and sapling growth stages due to its thicker bark. Controlled burns are possible when the trees are 3.7 to 4.6 m (12 to 15 ft) tall. Once height growth commences, South Florida slash pine has fewer insect and disease problems than the typical variety. Pitch canker does affect this variety, and as a grass stage seedling it is susceptible to brown spot *(Scirrhia acicola).*

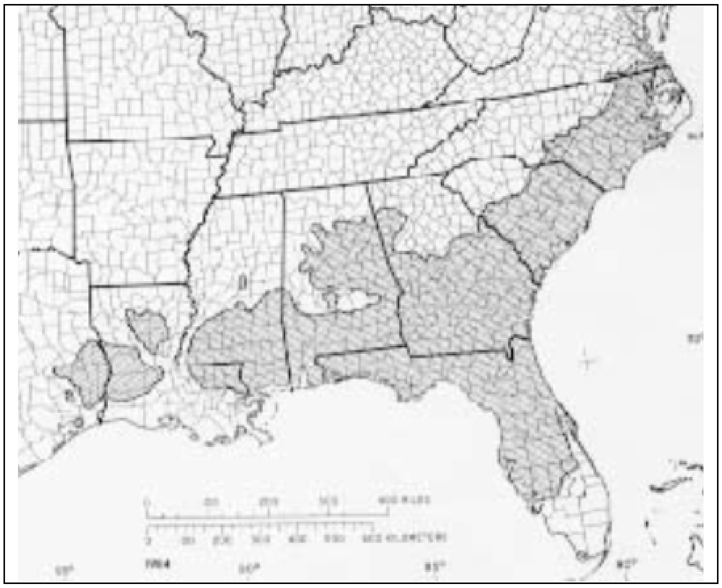
Figure 2 - South Florida Slash Pine

Loblolly Pine (Pinus taeda)

Loblolly pine (Pinus taeda), also called Arkansas pine, North Carolina pine, and oldfield pine, is the most commercially important forest species in the southern United States, where it is dominant on about 11.7 million ha (29 million acres) and makes up over one-half of the standing pine volume. It is a medium-lived, intolerant to moderately tolerant tree with rapid juvenile growth. The native range of loblolly pine extends through 14 States from southern New Jersey south to central Florida and west to eastern Texas. Loblolly pine is an adaptable species that has been successfully planted along the periphery of its natural range and has been introduced on other continents with varying degrees of success. Loblolly pine is found in pure stands and in mixtures with other pines or hardwoods, and in association with a great variety of lesser vegetation. When loblolly pine predominates, it forms the forest cover type Loblolly Pine (Society of American Foresters Type 81). In the southern part of its range, loblolly frequently is found with slash pine (Pinus elliottii) and laurel oak (Quercus laurifolia). On moist lower Atlantic Plain sites loblolly pine is found in Longleaf Pine (Type 70), Longleaf Pine-Slash Pine (Type 83), and Slash Pine-Hardwood (Type 85). In bays, ponds, swamps, and marshes of the Atlantic Plain it is a common associate in Pond Pine (Type 98), the cabbage palmetto-slash pine variant of Cabbage Palmetto (Type 74), and Sweetbay-Swamp Tupelo-Red Bay (Type 104). Seed production of loblolly pine varies according to physiographic region, climatic factors, and tree or stand condition. In the southern coastal portions of the Atlantic Plain, loblolly is generally a prolific and consistent seed producer, but in some of the inland portions of the Atlantic Plain, the Piedmont, and in the western extremities of its range, seed production is often lower and more erratic. Seedfall usually begins in October, and the bulk of the seeds are released in November and early December. Maximum recorded age of one tree in a small stand of 20 trees in North Carolina was 245 years, with the group averaging 240 years. The largest tree in this stand was 135 cm (53 in) in d.b.h. and 45.7 m (150 ft) tall. The most serious insect pests to loblolly pine are bark beetles, particularly the southern pine beetle (Dendroctonus frontalis), whose attack may result in extensive mortality, and pine engraver beetles (Ips spp.), that can cause death of isolated or small groups of trees. Loblolly pine is generally the preferred host of the southern pine beetle, which is the most destructive insect for this species. Most infestations originate in stands that are under stress because of poor site, adverse weather, overstocking, or overmaturity. Once a buildup of southern pine beetle occurs, adjacent well-managed stands may also be attacked. Other pests affecting loblolly pine include: pine tip moths (Rhyacionia spp.), that often infest young trees; seedling debarking weevils (Hylobius spp. and Pachylobius spp.), that sometimes result in girdling and death of young seedlings up to 13 mm (0.5 in) in d.b.h.; and cone and seed feeders (Dioryctria spp. and Leptoglossus spp.), that can seriously reduce seed crops.

Figure 3 - Loblolly Pine

Longleaf Pine (*Pinus palustris*)

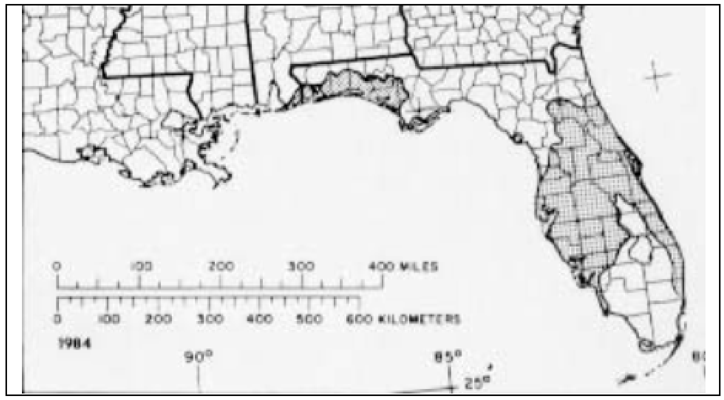


Longleaf pine *(Pinus palustris)*, whose species name means "of the marsh," has been locally referred to as longstraw, yellow, southern yellow, swamp, hard or heart, pitch, and Georgia pine. In presettlement times, this premier timber and naval stores tree grew in extensive pure stands throughout the Atlantic and Gulf Coastal Plains. At one time the longleaf pine forest may have occupied as much as 24 million ha (60 million acres), although by 1985 less than 1.6 million ha (4 million acres) remained. The natural range of longleaf pine includes most of the Atlantic and Gulf Coastal Plains from southeastern Virginia to eastern Texas and south through the northern two-thirds of peninsular Florida. The species also grows in the Piedmont, Ridge and Valley, and Mountain Provinces of Alabama and northwest Georgia. Longleaf pine is native to a wide variety of sites ranging from wet, poorly drained flatwoods to dry, rocky mountain ridges. Longleaf pine is long-lived compared with other southern pines, with some individuals reaching 300+ years old. The principal longleaf cover types are Longleaf Pine (Society of American Foresters Type 70), Longleaf Pine-Scrub Oak (Type 71), and Longleaf Pine-Slash Pine (Type 83) (12). Longleaf pine is also a minor component of other forest types within its range: Sand Pine (Type 69), Shortleaf Pine (Type 75), Loblolly Pine (Type 81), Loblolly Pine-Hardwoods (Type 82), Slash Pine (Type 84), and South Florida Slash Pine (Type 111). Longleaf naturally prunes itself well. Most stems are well formed, straight, and largely free of branches. Longleaf pine develops in close association with periodic surface fires. The vegetation associated with longleaf pine reflects the frequency and severity of burning. In the past, frequent fires resulted in open, parklike stands of longleaf with few other woody plants and a ground cover dominated by grasses. With a reduction in fire occurrence, hardwoods and other pines encroach on the longleaf forest. Seeds require contact with mineral soil for satisfactory germination and establishment. Longleaf seeds, with their large wings, cannot easily reach mineral soil through a heavy cover of grass and litter. The accumulated material must be removed before seedfall, either mechanically or by burning. Burning within a year of seedfall normally provides an adequate seedbed. Lack of seedbed preparation can result in a regeneration failure. While in the grass stage, seedlings develop extensive root systems. Growth can be followed by observing the increase in root-collar diameter. When it approaches 2.5 cm (1 in), active height growth is imminent. Grass-stage seedlings, once they reach 0.8 cm (0.3 in) in root-collar diameter, are highly resistant to fire, even during the growing season. Seedlings in early height growth, up to a height of about 0.6 to 0.9 m (2 to 3 ft), become susceptible to damage by fire. Once beyond this stage, longleaf pines are again fire resistant. Longleaf pine develop massive taproots that, in mature trees, may extend to a depth of 2.4 to 3.7 m (8 to 12 ft) or more. A hardpan can arrest downward growth of the taproot. If the hardpan is close to the surface, windfirmness of the tree is reduced. The southern pine beetle *(Dendroctonus frontalis)* does not seem to afflict the species severely.

The black turpentine beetle *(Dendroctonus terebrans)* can be a problem, especially on trees injured by turpentining, logging, or fire. Perhaps the greatest single cause of mortality in longleaf stands of pole and sawlog size is lightning, which is often followed by infestation by bark beetles (*Ips* spp.). Windthrow from hurricanes or tornados can cause heavy losses locally.

Figure 4 - Longleaf Pine

Sand Pine (Pinus clausa var.clausa and Pinus clausa var. immuginata)



Sand pine (Pinus clausa) is also known as scrub pine and spruce pine. The majority of trees in natural sand pine stands of western Florida, especially between Panama City and Pensacola, bear cones that open when mature. These stands tend to be uneven-aged, somewhat open, with abundant reproduction developing in the openings. Sand pine stands in eastern and central Florida are generally dense and even-aged with a majority of the trees bearing serotinous cones. Two geographic races have been distinguished on the basis of cone characteristics: Ocala (var. clausa) from northeastern to south Florida and Choctawhatchee (var. immuginata D. B. Ward) in northwest Florida and Baldwin County, AL. Sand pine grows on well-drained to excessively drained, infertile, acid to strongly acid sandy soils of the order Entisols. This sand is of marine origin, much of which was deposited in terraces developed during the Pleistocene epoch. The sand pine scrub of north-central Florida is one of the most distinctive plant communities of the State. Of particular interest is the sharpness of the boundaries with the adjacent sandhill vegetation which is dominated by longleaf pine (Pinus palustris), turkey oak (Quercus laevis), and pineland threeawn (Aristida stricta). Sand pine is the principal component of the forest cover type Sand Pine (Society of American Foresters Type 69). It may also be found in several additional cover types such as Longleaf Pine (Type 70), Longleaf Pine-Scrub Oak (Type 71), and Slash Pine (Type 84). Sand pine does not self prune well and most mature trees retain their branches. The majority of Ocala sand pine cones are serotinous: they remain closed when mature and require heat to open. Overly dense, unmanaged stands of the Ocala sand pines have developed following wildfire, which causes the cones to open and release large quantities of seeds. Seed dissemination of Choctawhatchee sand pine differs from that of Ocala sand pine. The majority of Choctawhatchee cones open when mature and most of the seeds are disseminated during September, October, and November. Trees ranging from 51 to 66 cm (20 to 26 in) in d.b.h. and 23 to 26 m (75 to 85 ft) in height are found on the best sites but smaller sizes are more common. The largest sand pine in Florida, for example, is 63 cm (24.8 in) in d.b.h. and 31.4 (103 ft) tall. Bark beetles, primarily Ips (Ips calligraphus and I. grandicollis), probably cause the greatest volume loss in sand pine, especially the Choctawhatchee variety. Generally, stress factors such as severe drought, lightning, fire, mechanical damage, or crowded stand conditions are associated with Ips beetle attacks. Fire is probably the principal enemy of sand pine, which is much less fire resistant than longleaf or slash pine. Hot ground fires which produce substantial needle scorch kill as readily as crown fires, yet sand pine can be burned under controlled conditions. This is especially true of Choctawhatchee variety, as its natural understory vegetation tends to be less flammable than that generally found in natural stands of the Ocala variety. A unique combination of fuel and weather conditions appears to be responsible for the occasional blowup fires that occur in Ocala sand pine forests. The moisture content of sand pine needles is often lowest in March, and their resin and energy contents reach a yearly high from February through May. This condition is known as the "varnish stage" by those familiar with fire in Ocala stands.

These fuel properties take on critical importance when they are combined with severe drought conditions and blustery spring weather characterized by unstable air masses, low relative humidity, and high winds. The relation between Ocala sand pine and fire is somewhat of a paradox. Many acres of Ocala sand pine forest owe their existence to fire which releases seed from the serotinous cones. As a considerable volume of timber may be lost to such fires, however, this method of regeneration cannot be considered an acceptable form of management.

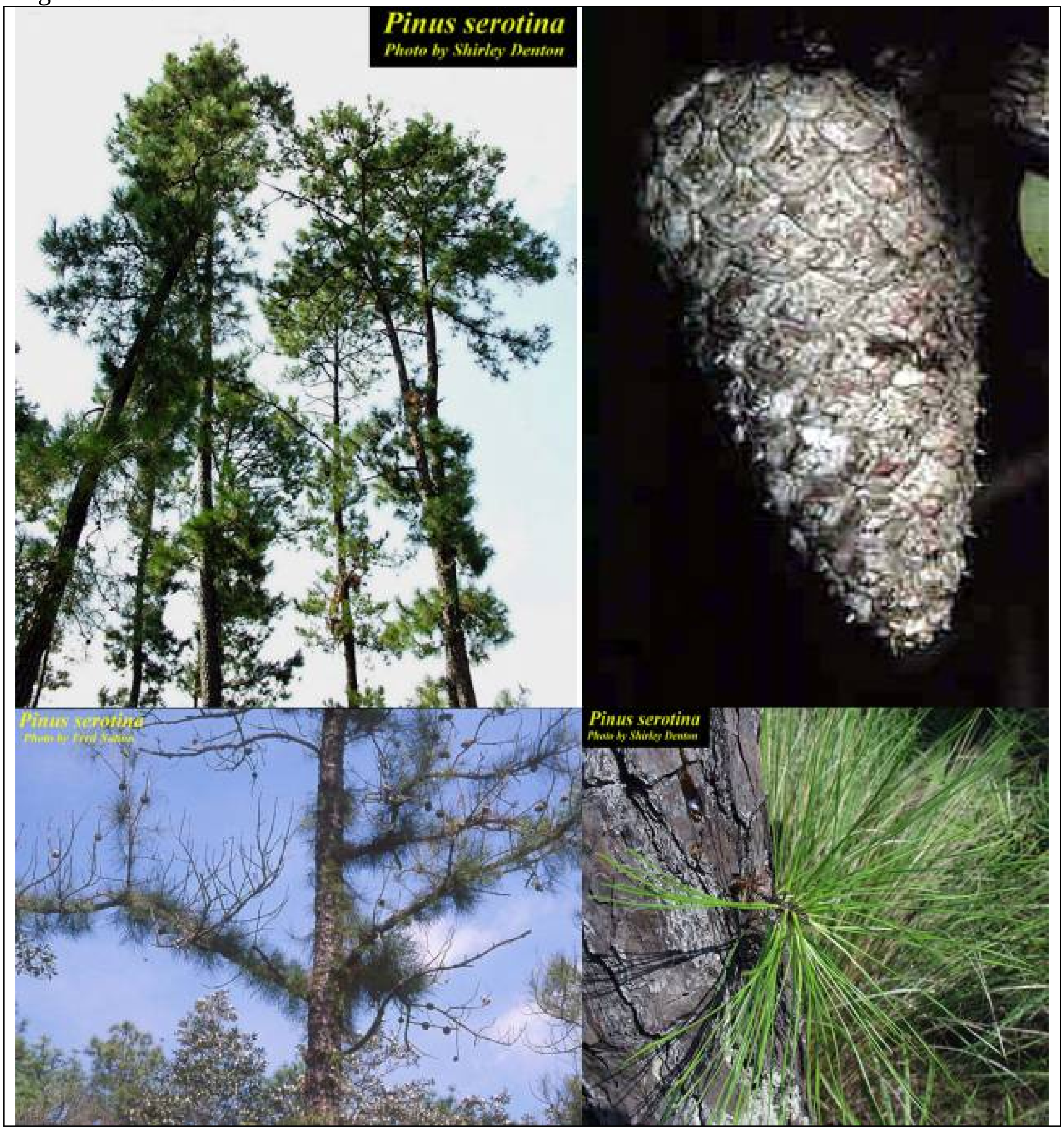
Figure 5 – Sand Pine

Pond Pine (Pinus serotina)

Pond pine (Pinus serotina), also called marsh pine, bay pine, and pocosin pine, is a medium-sized tree that grows on soils with a high water table. The species name, serotina, means "late" and refers to the delayed opening of the cones, up to 2 years before seeds are shed. Open cones persist for many years and often become embedded in the growing branches, giving the tree the appearance of being overloaded with cones and a prolific seed producer. Pond pine grows from Cape May, New Jersey, southward through the Coastal Plains of Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia to central Florida and southeastern Alabama. Within its native range, pond pine is most frequently found on wet or poorly drained sites. Pond pine is a major species in the forest cover type Pond Pine (Society of American Foresters Type 98) and is an associate in nine other cover types. Although pond pine is most frequently found on poorly drained lands, the species can make excellent growth on mineral soils or on land that is not continuously waterlogged. The slow growth of pond pine is primarily a function of prolonged water saturation and reduced soil aeration. Mature cones are normally 5 to 10 cm (2 to 4 in) long and remain on the tree for as long as 10 years. Because the cones are serotinous, only a few seeds are released at maturity each year, and the seed crop of several years may be present in an individual cone bearing tree. Viability does not decrease in cones that remain closed for as long as 3 years. Cones open gradually over several years, with two seasonal periods of seed dissemination: April through September and October through January. Like other pine species with serotinous cones, pond pine cones open and release seeds soon after exposure to heat from fire. The intensity of heat does not adversely reduce the viability of seeds; even badly charred cones, following wildfires, release seeds that are capable of germination. Without question, fire has been a major influence on the perpetuation of pond pine in coastal regions of the Southeastern United States. The majority of present-day stands date to a previous wildfire. For natural regeneration, prescribed fires reduce the dense understory of shrubs, prepare a seedbed, and open the serotinous cones. Fires must generally be of high intensity to consume understory shrubs, yet not so intense that serious damage or mortality occurs to the overstory pines. There is usually only a narrow range of weather and fuel conditions where silvicultural objectives and controlled fire can be attained in a given pocosin. Key elements in a prescribed fire plan include light to moderate winds with relative humilities between 35 and 50 percent. The water table also should be close to the surface to prevent spotting and burning of the organic soils. Among pine species, pond pine is unique in that it sprouts readily from stumps until quite old. Pond pine grows surprisingly well on the better sites with soils that have good internal drainage. In fact, pond pine may be difficult to distinguish from loblolly pine in the sapling stage when in natural or planted stands on comparable upland sites. More typically, however, pond pine is found in the pocosins where it grows very slowly. The most serious disease of pond pine is red heart (Phellinus pini), which is common in most of the older pocosin stands. Pond pine is subject to both fusiform rust (Cronartium quercuum f. sp. fusiforme) and eastern gall rust (C. quercuum), which cause stem and branch cankers on pines and have alternate stages on oaks.

During drought periods, the fire hazard of pond pine sites is extremely high because of the heavy fuel accumulation in the dense understory. Dry fuel weights of the understory and litter layer are frequently more than 22.4 t/ha (10 tons/acre). When fires occur in pocosin areas the excessive fuel and large areas of unbroken forest make fire control extremely difficult. Very intense fires consume the trees, shrubs, and litter, but the peat soils as well.

Figure 6 – Pond Pine



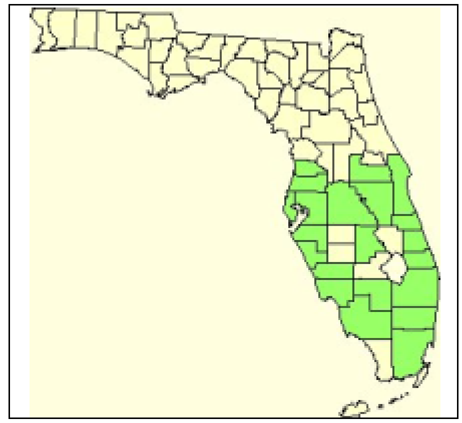
Shortleaf Pine (Pinus echinata)

Shortleaf pine (Pinus echinata) is one of the four most important commercial conifers in the southeastern United States. Depending upon locale, the species is also called shortleaf yellow, southern yellow, oldfield, shortstraw, or Arkansas soft pine. Shortleaf pine tolerates a wide range of soil and site conditions and maintains its growth rate for a relatively long period. However, the species tends to grow slower during the early years after establishment than other southern pines. Shortleaf pine is the most common species regenerated in the northern and western parts of its range. Shortleaf pine has the widest range of any pine in the southeastern United States. It grows in 22 States over more than 1 139 600 km² (440,000 mi²), from southeastern New York and New Jersey west to Pennsylvania, southern Ohio, Kentucky, southwestern Illinois, and southern Missouri; south to eastern Oklahoma and eastern Texas; and east to northern Florida and northeast through the Atlantic Coast States to Delaware. In 1915, shortleaf pine was reported to grow in 24 States. Fossil pollen found in Michigan suggests that it may have once grown there. Shortleaf pine grows best on deep, well-drained soils having fine sandy loam or silty loam textures. These soils are found primarily on flood plains. Shortleaf pine is now considered a major component of three forest cover types (Society of American Foresters, 16), Shortleaf Pine (Type 75), Shortleaf Pine-Oak (Type 76), and Loblolly Pine-Shortleaf Pine (Type 80). Although shortleaf pine grows very well on good sites, it is generally only temporary and gives way to more competitive species, particularly hardwoods. It is more competitive on drier sites with thin, rocky, and nutrient deficient soils. With the species' ability to grow on the medium and poor sites, it is not surprising that shortleaf pine is a minor component of at least 15 other forest cover types. Seedfall usually begins in late October or early November with good to excellent cone crops occurring every 3 to 10 years in the Northeast and 3 to 6 years in the South. Shortleaf pines on good sites attain a height of 30 m (100 ft) or more and diameters (d.b.h.) of 61 to 91 cm (24 to 36 in). Shortleaf pine seedlings can develop a taproot at an early age, which may become quite massive if allowed to grow uninhibited. If the taproot is damaged, the seedling can grow a new one. In much of the region where shortleaf pine grows, however, taproots do not develop because of shallow, rocky soils and in some cases hardpans. Littleleaf disease is the most serious pathological threat to shortleaf pine, occurring on poorly drained soils from Virginia to Mississippi and south to the Gulf Coast. No practical control measures for littleleaf disease in forest stands have been developed. It is suggested that proper site selection, species selection, and maintenance of stand vigor are the best defenses against this disease. The southern pine beetle (Dendroctonus frontalis), occasionally causes great losses. Other important insects are the pine engraver beetles (Ips spp.), especially during severe droughts, and the black turpentine beetle (Dendroctonus terebrans). Shortleaf pine is generally fire resistant, but wildfires in young plantations are very damaging.

The crowns are usually killed, but shortleaf pine will sprout from the base and form new stems. Larger trees may be killed by very hot fires, particularly if fuels near the tree bases are heavy. Fire damaged trees are also more susceptible to insect damage. Shortleaf pine is generally considered to be windfirm over most of its range, although trees may be uprooted by wind where root systems are shallow.

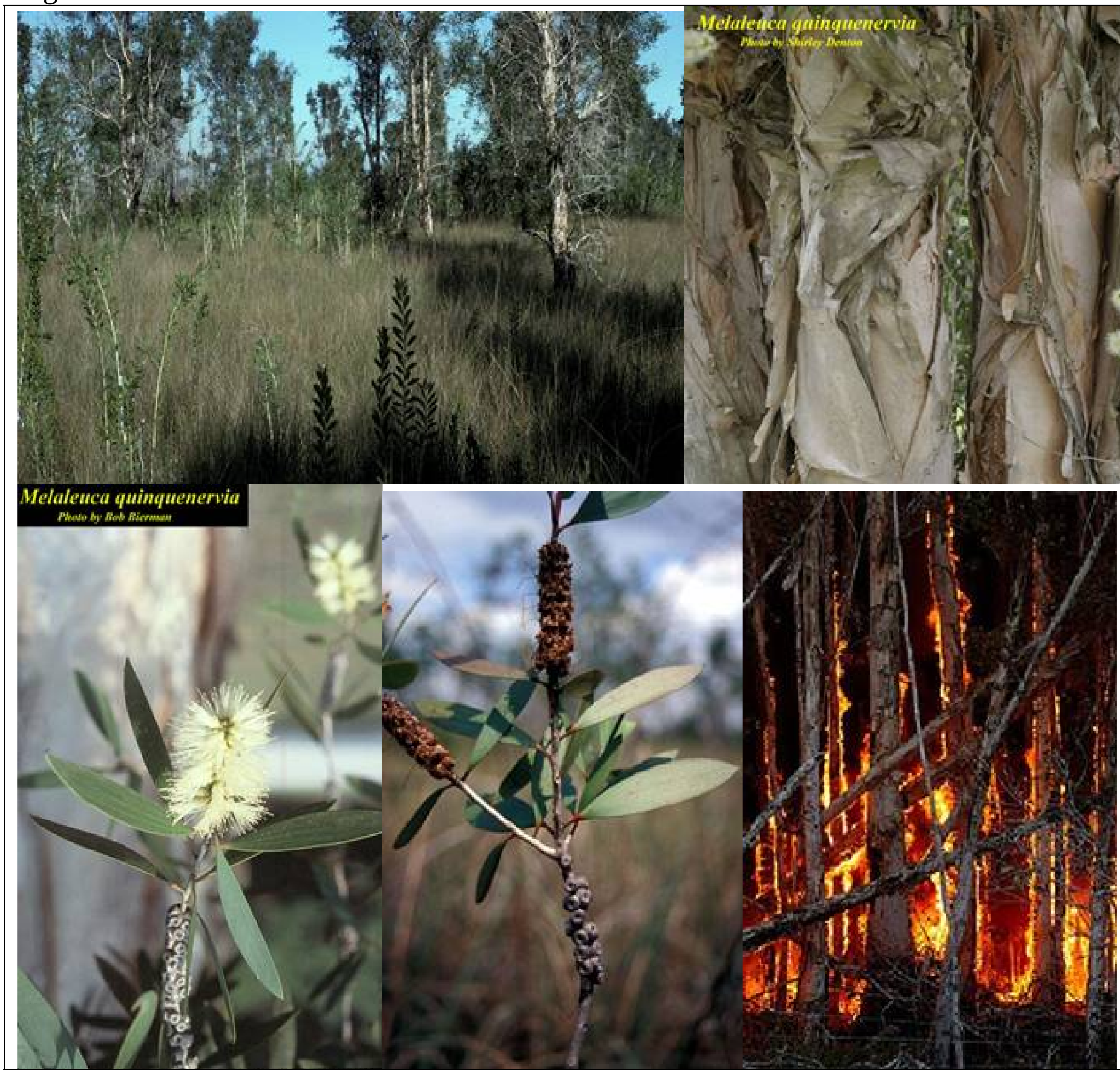
Figure 7 – Shortleaf Pine

Melaleuca (Melaleuca quinquenervia)

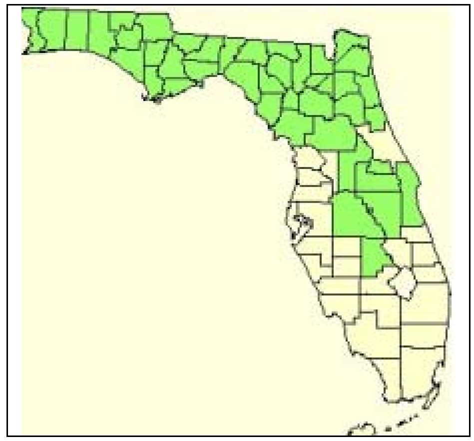


The name melaleuca is of Greek origin, meaning "black and white", presumably referring to the white bark that is often charred black by fire. Melaleuca is native to eastern Australia, New Caledonia, southern New Guinea, and adjacent Indonesia. In the continental United States, melaleuca is apparently only invasive in southern Florida. As of 2005, there are no published accounts of melaleuca escaping cultivation in the United States outside of Florida. Melaleuca was probably first introduced to southern Florida during the late 1800s to early 1900s, at several different locations. Melaleuca can now be found in both central and southern peninsular Florida. In southern Florida extensive stands generally occur along the coasts, inland from the large metropolitan areas of Palm Beach, Broward, and Dade counties in the east and Lee County in the west. The most extensive melaleuca stands are located near the sites of original introduction. These are also the areas that have been most severely altered by human activities and where melaleuca has been most widely planted for landscape purposes. In central Florida melaleuca apparently spreads little, if at all. It is found mainly in and around urban areas. Protected ornamentals have been noted in Alachua County. Stands of escaped melaleuca are generally uncommon in inland areas farther north than Lake Okeechobee, although established melaleuca stands have been observed along lakeshores as far north as Orange County. Northward migration of melaleuca in peninsular Florida is thought to be limited mainly by frost. Melaleuca is an evergreen tree of variable form and size. Crown form ranges from open to relatively slender with few branches, depending on stand density. Plants may be multistemmed or with a single, moderately straight trunk. Average height of trees in "mature" stands in Florida "swamps" ranges from 49 to 69 feet (15-21 m), with a maximum height of 98 feet (30 m). Branches are ascending on young trees, commonly somewhat drooping on older trees. Twigs are long and slender, often drooping. Leathery leaves are mostly 2 to 5 inches (4-12 cm) long and 0.4 to 2 inches (1-6 cm) wide, arranged in 5 spiral rows. Inflorescences are densely flowered spikes 1 to 4 inches (3-10 cm) long. After flowering, twigs continue to elongate from the ends of spikes, producing either foliage or more flowers. Borne terminally, growth flushes typically alternate between inflorescences and foliage. Fruits are woody capsules, 0.2 inch (0.4 cm) in length and width, persistent up to a year. Seeds are tiny (0.02-0.04 in. (0.5-1 mm) long or a little more; up to 850,000 or more/oz. (30,000/g)) and numerous. Bark is thick (sometimes >0.8 inch (2 cm)), corky or spongy, and composed of many thin layers. On the lower trunk the outer bark layers are looser and usually become torn, ragged, and partly unrolled. Melaleuca sprouts from branches and stems in response to frost, fire, mechanical, and herbicide damage. When branches or stems are cut or broken, multiple sprouts are produced from buds located beneath the bark and within inches of the injury. Entire crowns of saplings and large trees that are defoliated by frost or fire can recover in just a few months by epicormic sprouting. The most favorable sites for melaleuca establishment, with regard to moisture conditions, include depressions in pine flatwoods, the broad ecotonal region where pine and cypress mix, and drained organic soils. Other sites where melaleuca has been mentioned as occurring include disturbed wet prairie, wet pine flatwoods, cypress swamps, "low areas", and generally "disturbed sites". Melaleuca invades the littoral zone of Lake Okeechobee, where it was originally planted along the shoreline in the 1940s to stabilize the newly constructed levee. Melaleuca forests in southeastern Queensland, Australia, are associated with coastal floodplains, where it forms open, relatively monospecific stands that burn regularly. Melaleuca's invasiveness may be enabled by natural disturbance, especially fire. Massive seed rain typically follows disturbance such as fire, frost, and breakage from wind events. Once established, melaleuca is likely to attain and retain dominance on sites visited by frequent fire. March to June is typically considered wildfire season in southern Florida. Aside from invading natural communities in southern Florida, disturbance associated with human activities can also promote melaleuca invasion. Areas where the native plant community has been compromised, combined with favorable moisture conditions, present opportunities for melaleuca colonization. Examples include drained fields with ridges and furrows on abandoned farmlands, depressions in stump-harvested pinelands, and road and canal construction through wetlands that create road embankments, ditches, levees, and borrow pits. In addition to providing protection from fire, the dry, shaggy outer layers of bark are highly flammable and provide a ladder fuel that can quickly carry fire into the canopy, destroying leaves and branches. It is suggested that where melaleuca invades forested habitats in southern Florida, this structure is likely to increase probability of lethal crown fires that are uncommon in native southern Florida forest communities. Melaleuca invasion may alter fire regimes in southern Florida by changing fuel conditions. In doing so, site conditions may be influenced in ways that favor melaleuca at the expense of native species. One way melaleuca invasion can alter fuels is by increasing surface litter. These changes in surface fuels may increase ignition of organic soils, "a condition that is much less common in the cooler burning sawgrass fires" and often lethal to sawgrass. Changes in aerial fuels resulting from melaleuca invasion, coupled with flammable bark that serves as ladder fuel, may also alter fire severity in ways that favor melaleuca. The combination of loose flammable bark and volatile foliage result in a high propensity for torching of melaleuca trees during fire. In addition, melaleuca frequently establishes extremely dense stands (several thousand stems/acre), making them highly susceptible to running crown fires. Melaleuca-infested sites that experience wildfire should be given high priority for control, since the postfire environment is probably the most susceptible to melaleuca population increases. The quantity of seedlings established after fire is likely to be huge, and initial growth may be rapid relative to what would occur on an equivalent unburned site. In the event of a wildfire releasing vast quantities of seed, seed trees should be treated with herbicide within 1 postfire year to prevent replenishment of seed stores, then establishing seedlings should be controlled. Saplings that survive the fires may also be treated with herbicides.

Figure 8 – Melaleuca



Swamp Titi, Cyrilla (Cyrilla racemiflora)



Cyrilla occurs in swamps on the Atlantic and Gulf coastal plains from eastern Texas eastward to Florida, and north to Virginia and Maryland. In the southeastern Coastal Plain, cyrilla dominates or codominates in bay swamps, cypress swamps, and shrub bog communities. Cyrilla is an important browse for white-tailed deer. Cyrilla is a thicket-forming, tall, semievergreen shrub or small tree growing to a height of 30 feet (9 m). It typically has a short trunk with spreading, irregular branches and a wide, even crown.Its narrow, long, elliptical leaves are semipersistent, alternate, and clustered at the twig tips. The bark is thin and smooth. The perfect flowers are in narrow racemes near the tips of the twigs and open in the spring before new leaves appear. The fruit is a two-celled capsule with two seeds in each capsule. Cyrilla can reproduce sexually from seed, but most seeds do not germinate. Its primary mode of reproduction is by vegetative sprouting from adventitious buds on the roots following disturbance. Cyrilla is usually restricted to low elevation areas along streambanks, river swamps, and bottomlands. Cyrilla grows well where moisture is abundant and fairly permanent. Fire does not usually invade the wetlands and lower slopes of the floodplains because the soil duff layer is normally very damp. When fire does occur during dry periods, cyrilla will sprout from adventitious buds on the roots or, less commonly, establish seedlings from seed stored in the soil. Fire typically top-kills aboveground portions of cyrilla. Survival of shallow underground roots is most likely following light- to moderate-severity fires which do not burn the peat moss. Woody shrubs such as cyrilla are found in great abundance as understories on moist sites and compete with pine for available light, moisture, and seeding sites. Periodic fires have been effective in controlling cyrilla and other hardwoods.

Figure 9 – TiTi

Appendix G

Global Positioning System (GPS) Procedures for Garmin III Plus and Garmin V GPS Units

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Global Positioning System (GPS) Procedures for Garmin III Plus and Garmin V GPS Units

GPS is a satellite navigation system, which consists of 24 satellites that orbit the earth in 12 hours. The satellites transmit information to earth that can be processed by a GPS receiver, enabling the receiver to compute position, velocity and time. To get an accurate reading, when the GPS unit is in 3-D mode, the receiver needs to have an unobstructed, clear view of the sky.

A GPS point will be taken at the center of each field site. The coordinates will be noted on the field data form. Because field site locations are critical to our mapping efforts all attempts should be made to receive satellite signals in 3-D mode. For example, if under a dense canopy and no satellites are being received, move within the plot boundaries to more open areas in the canopy or try obtaining position at a later time.

General Operation

- To turn the unit on, press and hold the red power key.
- To turn the unit off, press and hold the red power key for one second.

Initializing the GPS

Initialization is only necessary under the following conditions:

- The first time you use your receiver (new from the factory).
- After the receiver has been moved over 500 miles (with the power off) from the last time you used it.
- If the receiver's memory has been cleared and all internally stored data has been lost.

The Welcome Page will be displayed while the unit conducts a self-test. Once testing is complete, the Welcome Page will be replaced by a Warning Page and then by the Satellite Status Page. A message will inform the user to "Select the Initialization Method". (If the initialization prompt has not automatically appeared, press MENU and highlight 'Initialize Position'.)

To initialize the unit, do the following:

- Press enter to acknowledge the message and see a list of initialization options.
- Use the rocker keypad (large button in center) to highlight 'Use Map', and press enter.
- Use rocker keypad to point the map cursor to your approximate location (within 250 mile). You may also wish to use the in and out keys to make it easier to identify your approximate position.
- Press ENTER to select the position and begin searching for satellites.

Setting up the Garmin GPS III & V Projection Information

The Garmin GPS III and V, by default, is set to a geographic degree, minute, second coordinate system. For the purposes of the fieldwork, this default setting needs to be changed to the following coordinate system:

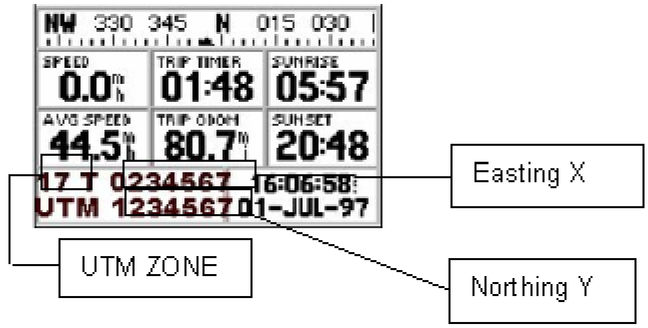
Position Format: UTM/UPS

Map Datum: WGS84

To set up the coordinate system, do the following:

1. Press the MENU button twice to access the main menu.
2. Scroll to and highlight the SETUP menu option using the ROCKER KEYPAD (large button) and press ENTER.
3. Navigate to the POSITION (LOCATION on the Garmin V) tab by pressing the right side of the ROCKER KEYPAD.
4. Press downward on the ROCKER KEYPAD to highlight the POSITION/FORMAT (LOCATION FORMAT on Garmin V) setting and press ENTER.
5. Scroll to the UTM/UPS option and press ENTER.
6. Highlight the MAP Datum setting by pressing downward on the ROCKER KEYPAD and press ENTER.
7. Scroll to the WGS84 option and press ENTER.
8. Press QUIT until the POSITION PAGE is displayed.
9. In the bottom left hand corner "UTM" should be displayed with the two-digit zone number directly above and the Easting and Northing coordinates to the right.

The Garmin GPS III and V Position Screen



Recording the Field Site Locations

To record a field site location, do the following:

1. Navigate to the POSITION PAGE

2. Press the MENU button once, highlight AVERAGE POSITION in the menu and press ENTER.

3. The AVERAGE POSITION screen should be displayed. Record the UTM Easting and Northing values for each field site after at least 100 measurements are taken.

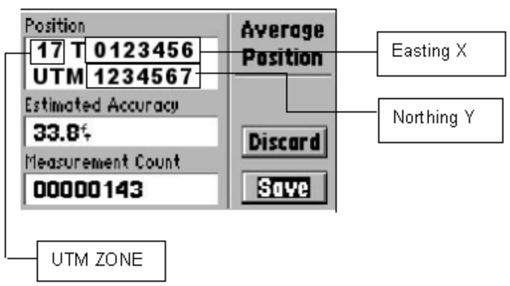
4. (Optional steps 4-8) To save the location as a waypoint highlight SAVE and press ENTER.

5. To rename the waypoint highlight the number at the top of the screen and press ENTER.

6. Label the waypoint using the Plot Number (1-3060) and press enter (highlight the OK and press ENTER on the Garmin V).

7. Highlight the DONE (highlight OK on the Garmin V) button and press ENTER.

The Garmin GPS III Average Position Screen



Saving an Unvisited Waypoint

The user may wish to enter the coordinates of a field site prior to visiting the site for navigation purposes. To do so, perform the following steps:

1. Press and hold the ENTER/MARK button until the MARK WAYPOINT screen appears.

2. Highlight the waypoint number at the top of the screen and press ENTER.

3. Label using the plot number (1-3060) and press ENTER on the Garmin III; or label as needed and select OK and press ENTER on Garmin V.

4. Highlight the coordinates and press ENTER.

5. Change coordinates to the field site location and press ENTER (or select OK on Garmin V and press ENTER).

6. Highlight DONE (or select OK on Garmin V press ENTER) and press ENTER.

Navigating to a Waypoint in the Garmin III

To navigate to a waypoint, do the following:

1. After a waypoint has been saved press the GOTO button.
2. Highlight the waypoint you are going to and press ENTER.
3. Navigate using the map screens and distance/bearing readings.

   Note: The North Region area for the DOF is divided into two UTM zones (16, 17). Navigate close to the site location using the provided maps and then use the appropriate UTM Zone site list based on the zone the GPS unit is reporting.

Navigating to a Waypoint in the Garmin V

To navigate to a waypoint, do the following:

1. After a waypoint has been saved press the FIND button.
2. Highlight WAYPOINTS, press ENTER and choose BY NAME, press ENTER.
3. Enter first few letters of the waypoint's name and then highlight OK and press ENTER.
4. Scroll through the list of waypoints and highlight the waypoint you are going to and press ENTER.
5. Highlight GOTO and press ENTER.
6. Navigate using the map screens and distance/bearing readings.

   Note: The North Region area for the DOF is divided into two UTM zones (16, 17). Navigate close to the site location using the provided maps and then use the appropriate UTM Zone site list based on the zone the GPS unit is reporting.

Deleting a Waypoint in the Garmin III

To delete a waypoint in the Garmin III, do the following:

1. Press MENU twice to access the main menu.
2. Highlight WAYPOINTS in the menu and press ENTER.
3. Highlight the waypoint to be deleted and press MENU.
4. Highlight DELETE WAYPOINT and press ENTER twice.

Deleting a Waypoint in the Garmin V

To delete a waypoint in the Garmin III, do the following:

1. Press MENU twice to access the main menu.

2. Highlight FIND and press ENTER.

3. Select WAYPOINTS and press ENTER.

4. Select “Nearest” or “By Name” in the menu and press ENTER.

5. Highlight the waypoint to be deleted and press ENTER.

6. Select DELETE from the choices at the bottom and confirm that you want to delete the waypoint by hitting enter.

Helpful Hints

To change the map scale:

- Press the IN zoom key to select a smaller scale and more detail for a smaller area.
- Press the OUT zoom key to select a larger scale and display a larger area.

To view the main menu:

- Press the MENU key twice

To select a submenu item from the Main Menu:

- Highlight the desired item using the rocker keypad, and press ENTER
- To return to the Main Menu press QUIT.

To choose more or less detail on the GPS maps displayed.

- From the map view, press menu.
- Select Setup Map (or Map Setup in Garmin III) and press ENTER
- Select Map Detail by pressing down on rocker button and press ENTER.
- Scroll to detail level desired (Most, More, Normal, Less, Least) and press ENTER to select.

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Appendix H

Glossary of ArcGIS and GIS Terms

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Glossary of ArcGIS and GIS Terms

A number of technical terms, acronyms and institutional terms are used throughout the Southern Fire Risk Assessment System (SFRAS) and associated documents. To aid the reader in interpreting these, and to minimize the use of footnotes, the following table provides definitions for the terms used in this document.

Accuracy - The degree to which the coordinates match the real world.

ArcView 3.x - The conventional standalone ArcView software is ESRI's desktop GIS commercial software. ArcView is proprietary and utilizes the Avenue language for programming applications. ArcView 3.x is the most robust and universally accepted GIS platform in the GIS industry.

ArcGIS 9.1- ESRI's latest GIS software product. ESRI's core GIS software package, the ArcGIS platform, is comprised of several modules (ArcMap, ArcCatalog, ArcToolbox) that are available in 3 different licensing schemes, based on the level of functionality required as either ArcView, ArcEditor or ArcInfo. ArcView provides the least functionality and ArcInfo the most. See ArcView, ArcEditor and ArcInfo. SFRAS is designed to operate in ArcView ensuring that it operates with the minimal licensing option for ArcGIS.

ArcMap- The standard menu interface for the ArcGIS software. ArcMap replaces the ArcView 3.3 interface.

Area of Interest (AOI) - An AOI is a small area, defined interactively by the user, for which processing will be restricted. In most scenarios, District users may only wish to review, modify or derive new data for a small subset of their District(s). By defining a small AOI, by digitizing on the map, or selecting other data features, they can restrict processing to the small area. Using an AOI greatly enhances modeling performance.

Cell - The smallest unit of information in a raster or grid map. Usually rectangular, cell is often used synonymously with pixel. 30 meter cells are used in SWRA datasets.

Coordinates - The x- and y-values that define a location in a 2-D coordinate system; the z-value would define the height in a 3-D coordinate system.

Data Frame - The Data Frame is the interactive view for the ArcMap software. It is analogous to views in ArcView 3.3. The SFRAS application utilizes different data frames to represent different views of the SWRA data.

District - The key operational administrative area within the South for which key SFRAS output data has been compiled and derived. Data has been compiled and derived on a per District basis to support operational use of the data.

ESRI - Environmental Systems Research Institute, Inc.

Geodatabase - The database format for ArcGIS datasets. An ArcGIS Geodatabase is in MS Access format and contains both spatial and attribute data. A GeoDatabase is a collection of datasets (spatial and attributed), stored in MS Access for a Personal GDB. The GDB is a new format only supported by ArcGIS and does not work with previous versions of ESRI software, such as ArcView 3.

Georeferenced - To assign coordinates from a known reference system, such as Albers or latitude/longitude, to the page coordinates of a map.

Graphical User Interface (GUI) - A program interface in which the user clicks on graphic icons and menus with a mouse instead of typing commands with the keyboard. GUIs are also referred to as 'dialogs' for specific options.

Grid - Equally sized square cells arranged in rows and columns. Attributes are associated with each cell. Same as a raster.

Layer - A vector or raster layer of related geographic features, such as streets, rivers, or land cover types represented in an ArcMap data frame. These are analogous to themes in ArcView 3.3.

Map Layout - A window within ArcMap where map elements, such as the title, legend, view, north arrow, and scale bar, are arranged for printing a map.

Pixel - The smallest unit of information in a raster or grid map. Usually rectangular, pixel is often used synonymously with cell. Pixel is typically used to describe remotely sensed data, while cell is used to describe GIS raster data.

Polygon - A polygon represents areas of homogeneity in the classification. For example, a land cover classification would have a field of grass, a stand of trees, a water body, etc. enclosed in polygons

Pulldown Menu - Refers to a textual list of menu items that 'pull-down' from the top main menu in an application. Selecting a menu item will result in a list of options. SFRAS is available within ArcMap as a series of pull-down menu options. Selecting an option with prompt the user with a dialog (form) to run the selected function.

Raster - Raster data contains pixels organized in a grid of columns and rows representing a geographical area. Attributes are associated with each cell. Rasters are also called 'grids'.

Spatial Analyst - Spatial Analyst is a module for ArcGIS that facilitates raster data modeling and analysis. Most of the modeling processes within SFRAS utilize the Spatial Analyst module to create output data.

Vector - A data structure used to represent linear geographic features represented by points, lines or polygons. Attributes are associated with each feature. In ArcGIS vectors can be stored as either shapefiles, or in Geodatabases as feature classes. A feature class is the same as a vector dataset.

Appendix I

Glossary of FRA, SWRA, FRAS and SFRAS Terms

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Glossary of FRA, SWRA, FRAS and SFRAS Terms

1-h - The one-hour (1-h) timelag dead fuel category includes fuels from 0 to 0.24 inches (0.64 cm) in diameter. This includes needles, leaves, cured herbaceous plants and fine dead stems of plants.

10-h - The ten-hour (10-h) timelag dead fuel category includes fuels from 0.25 to 0.99 inch (0.64 to 2.54 cm) in diameter.

100-h - The hundred-hour (100-h) timelag fuel category includes fuels from 1 to 2.99 inches (2.54 to 7.62 cm) in diameter.

20-foot Wind Speed - The wind speed is frequently taken at a National Fire Danger Rating System weather station. The National Fire Weathers Observers Handbook provides the standards for the gathering of weather at stations designated to provide data for the National Fire Danger Rating System (Deeming et. al, 1972). The wind speed measurement is taken at 20 feet above the vegetation and is measured based on a 10-minute average. Wind speed values used should be average expected values that can be expected to occur during the period of time the projection is for. Enter the 20-foot wind speed in the cell.

AOI – Abbreviation for Area of Influence

Area of Interest – Generally a subset area inside a District or Districts that one wishes to define. An entire District can be defined as an Area of Interest. Within an Area of Interest, Project Areas can be defined for analysis of mitigation measures.

Broadcast Rx Fire – The application of fire to the entire Project Area.

Broadcast Rx Fire Followed by Chopping – The application of fire to the entire Project Area followed by the mechanical application of equipment that chops vegetation into smaller pieces.

Broadcast Rx Fire Followed by Herbicide – The application of fire to the entire Project Area – followed by the application of herbicide to the entire Project Area.

Chopping and Harrowing – Chopping of fuels followed by harrowing.

Chopping Followed by Rx Fire – Chopping of wildland fuels followed b

Defensible Space – The area around a structure that when cleared of flammable vegetation increases the ability of firefighters to protect the structure from a wildland fire.

District – A defined organizational area within the Florida Division of Forestry.

Farsite – A computer program that predicts wildland fire behavior and growth using the models in the Fire Behavior Prediction System applied on 3-dimentional GIS data layers.

FBPS - Abbreviation for the Fire Behavior Prediction System

Fb3.dll – The fb3.dll is a dynamic link language program that generates fire behavior data across the landscape for a given set of weather, fuels and fuel moisture data inputs.

Final Fire Size – The size of a fire in acres upon containment.

Fire Behavior Prediction System – The Fire Behavior Prediction System includes all of the mathematical models and fuel model that are included in the Behave and BehavePlus computer systems.

Fire Effects Index - The Fire Effects Index was then calculated by adding 80% of the Environmental Effects Rating to 20% of the Suppression Rating. The Fire Effects Index can range from 0 – 100.

Fire Occurrence Area - A Fire Occurrence Area (FOA) is an area where the probability of each acre igniting is the same. The historical fire locations from the past 20 years were used with a few exceptions. Pictorially, if one were to locate the point location for historic ignitions on a map of an FOA, the points would appear to be equally spaced.

Fire Response Accessibility Index - The Fire Response Accessibility Index (FRAI) is a relative measure of how long it would take initial attack resources to drive from their resource location (resource location) to the cell.

FireFamily Plus – A computer program that utilizes historic daily weather observations and historic fire occurrence information to support analysis of fire danger and staffing requirements.

FlamMap - FlamMap is a computer program that generates fire behavior data across the landscape for a given set of weather, fuels and fuel moisture data inputs.

Flame Length - This is the length of the flame in a spreading surface fire within the flaming front. Flame length is measured from midway in the combustion zone to the average tip of the flames.

Florida Dichotomous Fuel Model Key – A dichotomous key based on vegetation and site characteristics that supports the classification of wildland vegetation in Florida to one of the 13 FBPS fuel models, rock, water or urban areas.

FOA - Abbreviation for Fire Occurrence Area

FRA - Abbreviation for Fire Risk Assessment

FRAI - Abbreviation for Fire Response Accessibility Index

Fuel Model – A surface fuel model is a set of attributes that define fuel bed characteristics. The attributes such as fuel loading, depth and surface area to volume ratio support the fuel inputs to the Rothermel Fire Spread Model.

Fuel Profile – A description of the fuels in a wildland area over time.

Fuel Situation - A fuel situation is a specific vegetative and physical condition in Florida that identifies a condition where a specific FBPS fuel model would occur. Within the Florida Fuel Model Dichotomous Key, fuel situations were defined. The same FBPS fuel model can result from different fuel situations. As fuels mitigation measures are defined, the appropriate fuel situation will need to de defined for the fuel models that exist within the Project Area.

Fuel Type – Fuel types are based on the primary carrier of fire, which are grass, brush, timber litter and slash.

Herbaceous - Live herbaceous fuels are grasses and forbs that are living. Herbaceous fuels can be either annual or perennial.

Herbicide Only – The application of herbicide as the sole fuel treatment method.

Initial Dispatch Locations – Locations where firefighting equipment is located or stationed. In many cases, these are fire station locations for urban/rural fire departments or Florida DOF offices.

Landscape File – A file used by the FlamMap program that integrates all of the data layers needed to run the Farsite or FlamMap programs.

Levels of Concern - The Levels of Concern are calculated as the Wildland Fire Susceptibility Index (WFSI) times the Fire Effects Index (FEI). The Level of Concern is equal to the WFSI * Fire Effects Index. The WFSI is a value between 0 and 1. The Fire Effects Index is a value between 0 and 100. Hence the LOC is a value between 0 and 100.

LOC - Abbreviation for Levels of Concern

Mastication – Use of machinery that used powered rotary mechanical action to change wildland fuels.

Mitigation Options – Methods and projects that are proposed to reduce the effects of the current situation. In FRAS analysis of the effectiveness of fuels treatment projects and fire prevention activities to reduce the effects of wildland fires is stressed.

National Fire Danger Rating System – Refers to the 1972, 1978 and 1988 versions of the fire danger rating systems developed for the United States.

Organic/Peat (Muck Soils) - Muck soils are organic soils that constitute areas of concern for firefighting efforts as fires within these areas tend to be expensive and difficult to extinguish. Muck soils were extracted from SSURGO data..

Percentile Weather – A set of weather conditions that represent the average conditions that would occur a defined percent of the fire season.

Piling and burning (or chipping) w/machine – A fuel treatment method where fuels are arranged by hand or mechanical means into pile which are then burned or chipped.

Plantations - The plantation data were obtained from each individual state and supplemented with a crosswalk from GAP data where available.

Project Area - A Project Area is defined as the area where fire prevention and/or fuels treatment measures are to be analyzed.

Published Results - The primary output from the Florida Fire Risk Assessment is the data developed by the project team of experts that describes fire risk across the state. These maps and data define the current situation and are referred to as the Published Results. These outputs provide a data platform for use by operational DOF staff, as well as other fire management collaborators, in mitigation planning and communication activities. These results can be used for identifying areas where more localized analysis (Project Areas) may be appropriate.

Rate of Spread - Rate of spread is the "speed" the fire travels through the surface fuels. The rate of spread is the spread rate of the head fire spreading uphill with the wind blowing straight uphill. The rate of spread prediction uses the Rothermel (1972) surface fire spread model, which assumes the weather, topography and fuels remain uniform for the elapsed time of the projection.

Relative Packing Ratio - This is the fuel model's packing ratio divided by the optimum packing ratio for the fuel model. Vertically oriented fuel beds like grass and brush generally have a relative packing ratio less than one while horizontally oriented fuel beds such as timber litter and slash have a relative packing ratio greater than one.

Risk - The possibility of suffering harm or loss.

ROS - Abbreviation for rate of spread.

SC – Abbreviation for Spread Component.

SFRAS - Abbreviation for Southern Fire Risk Assessment System

Southern Wildfire Risk Assessment System – A computer application which is an extension to the ArcView 9.1 software that allows for the viewing and printing of information in the Published Results as well as a ability to analyze the effectiveness of some mitigation measures.

Southern Wildfire Risk Assessment – The Southern Wildfire Risk Assessment includes all of the data layers, indices, outputs, maps and report of the Published Results from the Southern Wildfire Risk Assessment Project.

Spread Component – The Spread Component is a index in the National Fire Danger Rating System. It is calculated using the Rothermel Spread Model with a few minor modification to the model used in the Fire Behavior Prediction System. It is the rate of spread measured in feet per minutes assuming a defined fuel model, slope class, climate class and herbaceous vegetation type with weather conditions from a NFDRS weather station.

Suppression Difficulty Rating – The suppression costs are evaluated by fuel type. Each cell in the state has been assigned a base, grass, shrub, timber litter or muck suppression score. Base is the expected average of all non-muck fires. Agency fire managers used the matrix to assign the fire suppression difficulty scores based on fuel type, soils and topography.

Surface Area to Volume - The 1-h surface-area-to-volume ratio (1-h SA/V) is the amount of area on the outside of the fuel (surface area) divided by the volume of the fuel. A way to visualize the surface-area-to-volume ratio is the square feet of wrapping paper in would take to wrap a box divided by the volume of the box in cubic feet. The 10-h and 100-h SA/V are set at 109 ft2/ft (358 m2/m3) and 30 (98 m2/m3) for all fire behavior fuel models.

Thinning – The cutting of trees generally in diameters classes that are smaller than the average stand diameter for a timber stand. Thinning reduces the number of trees per acre.

Transportation and Infrastructure – These areas includes a buffered distance from specified roads together with schools, hospitals and designated airports.

Urban Interface – The area between wildland fuels and defined urban communities and areas. The Wildland Urban Interface was downloaded from the SILVIS Lab at the University of Wisconsin - Madison. WUI is composed of both interface and intermix communities. In both interface and intermix communities, housing must meet or exceed a minimum density of one structure per 40 acres (16 ha). Intermix communities are places where housing and vegetation intermingle. In intermix, wildland vegetation is continuous, more than 50 percent vegetation, in areas with more than 1 house per 16 ha. Interface communities are areas with housing in the vicinity of contiguous vegetation.

Interface areas have more than 1 house per 40 acres, have less than 50 percent vegetation, and are within 1.5 mi of an area (made up of one or more contiguous Census blocks) over 1,325 acres (500 ha) that is more than 75 percent vegetated. The minimum size limit ensures that areas surrounding small urban parks are not classified as interface WUI.

Values Impacted Rating – This rating is the sum of the individual effects scores for transportation and infrastructure, urban interface and plantations adjusted based on the total maximum value.

Weather Influence Zone – A Weather Influence Zone (WIZ) is an area when the weather conditions are uniform. Within each WIZ, daily weather data was gathered from 1981 - 2000 from land management agency maintained weather stations and from National Oceanographic and Atmospheric Administration (NOAA) maintained weather stations. A computer program was developed by the Division of Forestry's State Meteorologist to geo-reference the weather observations from the weather stations within a WIZ to the geographical center of the WIZ. Hence, one weather data set was developed with a weather observation for each day from January 1, 1981 through December 31, 2000 for each WIZ. From this weather data set, percentile weather was developed for each WIZ.

WFSI - Abbreviation for Wildland Fire Susceptibility Index

Wildland Fire Susceptibility Index - The Wildland Fire Susceptibility Index (WFSI) is a value between 0 and 1. It was developed consistent with the mathematical calculation process for determining the probability of an acre burning. The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. But since all areas of the State have this value determined consistently, it allows for comparison and ordination of areas of the state as to the likelihood of an acre burning.

WIZ - Abbreviation for Weather Influence Zone

Woody - Live woody fuels are shrubs that are living.

Year of Interest – The year since fuels treatment that the fuel models in a Project Area will be displayed for.