

An Inventory of Forest Fire Fuels
at Cumberland Island National Seashore,
Georgia

CPSU Technical Report - 6

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PURPOSE AND CONTENT OF THE REPORT SERIES

In order to make data and results from managerial studies more easily and quickly available to interested scientists, the U.S. National Park Service Cooperative Unit at the Institute of Ecology has initiated a numbered technical report series. This series produces limited printings of data matrices, bibliographies, review papers and scientific project reports concerning U.S. National Parks and park related problems. The reports are from various sources, not all federally funded, and are intended to supply scientific information rather than deal with park policy. The reports are subject to technical editing and review for scientific accuracy by Institute staff but are not necessarily reviewed by external experts and are not refereed in regard to overall quality or importance to the scientific community.

ABSTRACT

Woody fuel biomass was estimated for upland sites at Cumberland Island National Seashore (CUIS). One-hour and ten-hour fuel loads showed a significant variation between sites and averaged 51 g/m^2 and 122 g/m^2 respectively. The mean value of one-hundred hour fuels was 168 g/m^2 . Thousand-hour fuels were infrequently encountered at CUIS and averaged only 10 g/m^2 . For all size classes, the highest fuel loads were observed in the five year old regrowth at Table Point while the lowest fuel loads were found in the one year old regrowth at the old South Cut burn.

An equation for estimating the standing crop of saw palmetto (Serenoa repens) was developed ($r^2=.98$) and took the form:

$$\text{Mass (g/m}^2 \text{ excluding rhizome)} = 87.7 (\text{Volume of saw palmetto fronds in g/cm}^3) + 39.5 (\text{Diameter at base of rosette in cm}) + 20.7 (\text{Number of fronds}) - 241.2$$

Saw palmetto biomass estimates at CUIS averaged 100 to 300 g/m^2 .

These data are discussed in relation to the "typical" fuel parameters currently used in fire behavior models in southeastern coastal islands.

ACKNOWLEDGEMENTS

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INTRODUCTION

Information on forest fire fuels is necessary for an accurate understanding of fire behavior and for the development of a fire management plan. Fuel models have been developed for a number of community types as part of the National Fire-Danger Rating System (NFDRS) (Deeming et al. 1977) but these are stylized models, accurate only on a broad scale. A detailed analysis of local variations in fire susceptibility requires inputs of fuel parameters specific to the site. While extensive work has been done in other parts of the Southeast (McNab et al. 1978, Martin et al. 1978), relatively little is known about the fuel regimes in the live oak forests and related communities of the southeastern coastal islands. This study provides an estimate of the fuel biomass in various upland community types found at Cumberland Island National Seashore (CUIS), Georgia.

Cumberland Island is the southernmost and largest of Georgia's coastal islands, approximately 16 miles long and up to 3 miles wide. The vegetation of upland sites on CUIS is dominated by live oak-palmetto and live oak-pine forests. These two types comprise approximately 75% of the upland vegetation and 29% of the island's total area (Hillestad et al. 1975). A significant portion of the northern half of the island is dominated by pine-oak scrub or oak scrub forests (Hillestad et al. 1975), characterized by a typically high density and low stature, with a dense saw palmetto (Serenoa repens) understory. Information on species composition and site characteristics of the forest communities of CUIS has been presented by Hillestad et al. (1975).

The fire history of Cumberland Island is not well understood at present. Since the establishment of Cumberland Island National Seashore in

1972, there have been five reported wildfires, ranging from 40 to 1700 acres (16-680 ha) in size. Three of the five fires are believed to have been caused by lightning strikes and three of the five occurred predominantly in the pine-oak scrub community type (Table Point, 300 a., 1977; Table Point 50 a., 1980; and South Cut, 1700 a., 1981) (from fire records in CUIS files). Little is known of earlier fires, but records indicate that the last major fire before the establishment of the National Park occurred in 1956 in the same pine-oak scrub area that burned in the South Cut fire of 1981 (Carol Ruckdeshel, pers. comm.). Because of the lack of a detailed fire history, fuel loadings could not be correlated with the time since last burned, but were simply divided into burned and unburned classes for most analyses.

In addition to the effects of fire, many sites at CUIS had been disturbed by grazing pressure from cattle, deer, and feral hogs during pre-park conditions.

METHODS

Sampling of dead and down fuels was conducted using a modification of Brown's (1974) planar intersect technique. This method provides a relatively quick estimate of woody fuel volume, which, when combined with the average wood density, yields a biomass estimate in weight per unit area. Volume is calculated by the formula:

$$V = \frac{N_i * \pi^2 * d_i^2}{8 L}$$

Where V is the volume per unit area; N_i is the number of twigs of size class i; d_i is the geometric mean diameter of size class i; and L is the transect length.

Six transects were located for each of the size classes (0 - 0.7 cm., .7 - 2.5 cm, 2.5 - 7.6 cm, and 7.6 + cm) corresponding to the one-hour, ten-hour, hundred-hour, and thousand-hour size classes commonly used in fire behavior models (Deeming et al. 1977). Twigs in the three smallest size classes were tallied along a two meter transect; the transect was extended to five meters and individual diameters were recorded for wood in the largest size class. Thirty-three 30 m transects were added to increase the sample size of 1000-hr fuels. Leaf and twig litter depth was measured to the nearest centimeter at three points along each transect and the depth of decayed organic matter (fermentation and humus layers) was recorded twice along each transect.

In addition to the dead and down fuel transects, a 2 x 2 meter plot was used to quantify saw palmetto cover. All saw palmetto plants with at least four fronds were measured for height and width, diameter at the base

of the rosette, number of fronds, and the percent dead fronds. The distribution of other standing live and dead fuels at each site was recorded by visually estimating the percent cover in four horizontal strata: 0-1 meter, 1-2 meters, 2-5 meters, and 5+ meters.

The bulk density and percent moisture of leaf and twig litter was measured by collecting samples at 60 locations throughout a range of community types. Samples were oven dried for 12 to 24 hours at 110°C or until a constant weight was reached. The biomass of saw palmetto was determined by harvesting twelve plants representing the full range of sizes and oven drying them to a constant weight. This information was then related to the dimensional measurements collected for all saw palmetto plants to give regression equations that could be used to estimate the palmetto biomass at each site.

The twig volume equations were calibrated for CUIS by measuring all the twig diameters along a series of random transects, and computing the geometric means for each size class. Twig densities were determined by oven drying random samples and measuring the volume by water displacement. Densities for 100- and 1000-hr fuels follow Brown (1974).

All data analysis was performed using the Statistical Analysis System (SAS) available at the University of Georgia computing center. Summary statistics were calculated using the SAS procedure MEANS; Procedure STEPWISE and GLM were used for multiple regressions and unbalanced ANOVA.

hardwood forest (Table 1). The overall mean was 823 grams per square meter for undisturbed sites. Litter bulk densities averaged $.024 \text{ g/cm}^3$ and ranged from $.01$ to $.04 \text{ g/cm}^3$. Areas with a high proportion of saw palmetto in the understory (unburned pine-oak scrub, lowland mixed hardwood, and live oak-palmetto sites) tended to have the lowest bulk densities. Table 1 shows litter bulk densities for selected forest types.

An analysis of litter depth shows the same general pattern (Appendix 4). Sites could be divided into 4 distinct groups based on litter depth: 1) The heavily burned one year old pine-oak scrub and oak scrub forests had the lowest mean litter depth, averaging about one centimeter in height; 2) The unburned pine-oak scrub and lowland mixed hardwood types had a mean depth of 11.6 cm; 3) The five year old pine-oak scrub at Table Point averaged 20.5 cm.; and 4) All other types could not be distinguished statistically and had mean depths ranging from 1.4 to 10.4 cm. Sites where saw palmetto was present had significantly higher mean litter depths than sites without (8.1 vs. 3.5 cm., $t = 7.2$, $p = .0001$).

The mean depth of organic matter (the combined fermentation and humus layers) varied from 0 to 5.02 cm between forest types (Appendix 5). Again, the unburned pine-oak scrub and lowland mixed hardwood types had the highest mean depth (5 cm.). The high organic matter depth may be more related to the level site conditions at Old House Road than to characteristics of those forest types. Recently burned sites had a mean depth of .69 cm; the mean for all sites was 1.6 cm (Std = 1.7).

Data from the harvested saw palmetto plants yielded regression equations relating dimensional variables easily measured in the field to total biomass (Table 2). Not surprisingly, the volume of saw palmetto foliage predicted the weight of palmetto more accurately than any other single

Table 2. Saw Palmetto Biomass Equations used to estimate standing crop of palmetto at CUIS.

$W_T = 140.1 (V) + 45.5$	$\frac{R^2}{.94}$	(1)
$W_T = 103.6 (V) + 43.9 (D) - 150.3$	.98	(2)
$W_T = 87.7 (V) + 39.5 (D) + 20.7 (N) - 241.2$	.98	(3)
$W_T = 1.82 (Ht) + .71 (PCOV) - 25.48$	.55	(4)
$W_S = 85.6 (V) + 66.6$	.90	(5)
$W_L = 55.6 (V) + 36.1 (D) - 94.2$	.98	(6)
$W_S = 54.5 (V) - 21.1$	.96	(7)
$W_S = 40.9 (V) + 14.4 (N) - 97.9$	.97	(8)

where:

- W_T = total weight (g/m^2 excluding rhizome)
- W_S = weight of stems (g/m^2)
- W_L = weight of leaves (g/m^2)
- V_L = volume of foliage [$(\frac{1}{2} \text{ width})^2 * \pi * ht$] in g/cm^3
- D = diameter at base of rosette (cm)
- N = number of fronds
- Ht = mean height of palmettos (cm)
- $PCOV$ = percent cover

variable measured (eq. 1; $r^2 = .94$). Combinations of the volume and basal diameter (eq. 2) and volume + diameter + number of fronds (eq. 3) increased the predictiveness of the model, explaining 97% and 98% of the variance, respectively. Equation 3 is used throughout this study to estimate saw palmetto biomass, but the other equations give similar estimates.

Since those equations require measurements of each individual saw palmetto plant within a given area, a more time-efficient method was also derived, based on the predicted saw palmetto biomass and cover estimates (eq. 4). Although there is considerable sacrifice in predictiveness ($r^2 = .55$), it does provide a rough estimate of saw palmetto biomass with a minimum of effort.

The standing crop of saw palmetto showed a significant variation between sites and ranged from 0 to 1100 g/m². Because saw palmetto populations are often unevenly distributed, with islands of dense palmetto interspersed with areas of open understory, overall means for a forest type tend to be lower than expected. The lowland mixed hardwood type had the highest mean saw palmetto biomass with 353 g/m² (Appendix 6). Recently burned areas showed a reduction in saw palmetto biomass. One year old pine-oak scrub stands had a mean standing crop of 119 g/m² compared to 263 g/m² for unburned stands. Similarly, burned oak scrub sites averaged 86 g/m² compared to 121 g/m² for unburned sites.

Unlike other woody shrubs, saw palmetto does not drop dead palmetto fronds as soon as they senesce. Hence there can be an accumulation of dead fuels mixed in with the live palmetto, which increases the potential flammability. The proportion of cured material averaged 30% in unburned areas and 10% in the most recently burned sites.

Freshwater marshes were sampled for total herbaceous biomass in 13 sites, reflecting a mixture of burned and unburned conditions. Recently burned sites had much lower biomass than unburned sites ($\bar{x} = 360$ vs. 1200 g/m²). An equation relating the total biomass to height and percent dead material explained 90% of the variance in the model and took the form:

$$\log_{10} W = 1.62 (\log_{10} Ht) + 0.38 (\log_{10} PDead) - 0.74$$

where W is the total biomass (g/m²); Ht is the mean height of the saw palmetto (cm.), and PDead is the percentage of dead material. PDead is related to the time since last burned; some unburned sites had accumulations of thatch contributing over 75% of the total biomass.

The vertical distribution of fuels within a given site showed significant differences between forest types. Visual estimates of the percent cover in different strata show oak-pine sites as having the lowest continuity of fuels, consisting of a dense canopy but very little understory vegetation. In contrast unburned oak scrub sites have a nearly continuous fuel ladder. Scrub stands were only 7-15 m tall whereas oak-pine and live oak forests averaged 20-25 m.

DISCUSSION

Fuel models currently used for predicting fire behavior on the coastal islands are usually either the type O (pocosin) or type D (slash pine/palmetto-gallberry) models of NFDRS (Deeming et al. 1977). Data from this study reveal some differences between the observed fuel load and that of the 'typical' models. Although the dominance of saw palmetto in the understory suggests a type D model, most of the fuel data corresponds more closely to the pocosin type. Saw palmetto probably has the major influence on the fire carrying ability of a particular stand but the dominance of deciduous hardwoods in the canopy is a major determinant of other fuel parameters.

The estimated biomass of dead and down twigs is somewhat higher than data from other areas. McNab et al. (1978) reported a mean biomass of 73 g/m^2 for 10-hour fuels and 34 g/m^2 for 100-hour fuels in slash pine/palmetto-gallberry stands, compared to 120 and 172 g/m^2 at CUIS. The standing crop of litter at CUIS is more similar to the values reported for pocosin fuels (968 g/m^2 ; Martin et al. 1978) or low elevation oak-pine forests in Great Smoky Mountains National Park (800 g/m^2 ; Harmon 1980) than the slash pine/palmetto-gallberry type (332 g/m^2 ; McNab et al. 1978).

Estimates of saw palmetto standing crop at CUIS are consistently lower by a factor of ten than data reported for other areas (Table 3). Although McNab et al. (1978) included the entire understory layer in their biomass estimates (saw palmetto plus gallberry) many areas were dominated solely by saw palmetto. Estimates of saw palmetto biomass in Osceola National Forest (Bruce 1951) were very similar to the total understory estimates in slash pine/palmetto-gallberry stands. No data on total understory biomass was

Table 3. Biomass estimates of saw palmetto at CUIS compared to other areas of the Southeast. Only sites that had at least one palmetto plant are included. A conservative estimate of 20 years is used as the age of rough for unbound stands when computing predicted values based on the equations presented by McNab et al. (1978). Data from Bruce (1951) have been converted to metric units for comparison. Although no sites at CUIS are identical to the other areas the pine-oak scrub type is probably the most similar. Average understory biomass in the low pocosin fuel type range from 0.46 to .88 kg/m² (Martin et al. 1978).

<u>Forest type</u>	<u>Time since burn (years)</u>	<u>CUIS biomass kg/m²</u>	<u>Predicted biomass based on McNab's equation</u>	<u>Biomass rep. by McNab et al. (1978) for Slash Pine/Palmetto-Gallberry</u>	<u>Biomass rep. by Bruce (1951)</u>
Pine-Oak Scrub/Oak Scrub	1	0.105	0.730	0.3	1.38
Pine-Oak Scrub	5	0.135	1.28	0.6	1.98
Pine-Oak Scrub	--	0.141	2.31	1.7	4.58
Oak Scrub	--	0.130	1.92		
Live Oak Palmetto	--	0.127	1.20		

collected for CUIS. Gallberry is relatively unimportant and saw palmetto probably accounts for over 70% of the understory biomass in most areas. Wax myrtle (Myrica cerifera) is an important component of the understory at Table Point. Saw palmetto rhizomes were not included in the biomass estimates at CUIS; they were collected by McNab et al. (1978) and assuming they were included in their biomass estimates, this would be an obvious reason for the large differences between the CUIS data and McNab et al.'s (1978) data. It is not clear whether or not they were included in the other studies.

It is likely, however, that the difference in biomass is real. Although the height and volume of saw palmetto plants at CUIS is high, densities (both the number of plants/m² and the amount of foliage per unit volume) are probably lower under the closed canopy conditions common at CUIS than the more open slash pine stands studied elsewhere.

Although little information is available on the relationship between the time since burn and fuel accumulations at CUIS, the high fuel load at Table Point indicates a substantial increase following fire. McNab et al. (1978) found a rapid increase in total forest floor biomass for approximately five years following fire; thereafter the rate of fuels accumulation declines until an equilibrium level is reached. Assuming this pattern to be correct, the fuel biomass at Table Point should decrease its accumulation rate over the next several years to a level consistent with other sites at CUIS. Similarly, fuel biomass at the sites burned in the South Cut fire should increase during the next five years as the standing dead trees fall and as the understory continues to grow.

An analysis of previous fires shows that the pine-oak scrub and oak scrub community types are the most susceptible to fires and that fires do

not appear to carry in the live oak-palmetto forests under most conditions. The fuel data collected here do not show any obvious and consistent differences in fuel biomass between those types. Perhaps the most significant difference, however, is the lower degree of vertical continuity of fuels in the live oak-palmetto forests than in the scrub types. Also, live oak litter is probably not as combustible as other litter and the bulk density of live oak is also greater.

CONCLUSIONS FOR MANAGEMENT

- 1) Recovering scrub vegetation on Table Point (5 years since burn) had two to three times more biomass of one, ten and one hundred hour fuels than did the average forest stand.
- 2) Although the most accurate method of estimating saw palmetto biomass includes volumes of fronds, a quick estimate may be made with the equation
$$\text{Weight (g/m}^2\text{)} = 1.82 (\text{Height cm}) + .71 (\text{Percent cover}) - 25.5$$
- 3) In less than one year after the fire the pine-oak scrub had regenerated 119 g/m² palmetto biomass (about 45% of the expected), and the oak scrub had regenerated 86 g/m² (about 70% of the expected).
- 4) Marshes regenerated 360 g/m² in less than one year (about 30% of the expected unburned biomass).
- 5) The proportion of cured palmetto fronds averaged 30% in unburned areas. In some unburned sites, dead material accounted for 75% of the total biomass.
- 6) Twigs and litter at CUIS in slash pine/palmetto-gallberry type forest had higher estimated fuel weights than similar mainland stands. Estimates of palmetto, standing crop, however, were lower than for other similar areas.

- 7) If the site of the South Cut fire follows the trends at Table Point, one, ten and hundred hour fuels should be dense enough to support a fire after approximately three years of regeneration, and should be among the highest in the park within 5 years.
- 8) The fuel biomass in live oak/palmetto forest is comparable to that in some areas of scrub. The resistance of the live oak forest to fire is not due, therefore, to lack of fuels, but is probably due to a discontinuous fuel ladder, higher humidity and/or the lower combustibility of live oak litter.

Appendix 1. Mean biomass (g/m^2) of one-hour fuels in selected forest types (FT) at CUIS. PO = Pine-Oak Scrub type, SB = Scrub Border, OS = Oak Scrub, LM = Lowland Mixed Hardwoods, LP = Live Oak-Palmetto, MO = Mixed Oak-Hardwood, OP = Live Oak-Pine, OJ = Oak-Juniper-Palmetto, ST = Dune Scrub Thicket, PM = Pine-Mixed Hardwood. The numbers at right indicate the degree of burn (0 = no burn, 1 = moderate burn, 2 = intense burn) followed by the year (in parentheses), if applicable. N = number of samples.

Appendix 1. ONE-HOUR FUELS (g/m²)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE FWT1

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05

DF = 388

MS = 0.18283

<u>GROUPING</u>			<u>MEAN</u>	<u>N</u>	<u>FT</u>	<u>Burn</u>
	A		123.0	24	PO	2(77)
	B		72.8	13	SB	0
	B					
	B		70.2	30	OS	0
	B					
	B		68.8	24	LM	0
	B					
C	B		65.5	6	LP	1(81)
C	B					
C	B		64.5	6	LP	1(77)
C	B					
C	B		52.9	30	MO	0
C	B					
C	B		50.4	30	PO	0
C	B					
C	B	D	50.3	12	OP	1(81)
C	B	D				
C	B	D	50.1	24	OJ	0
C	B	D				
C	B	D	48.2	52	LP	0
C	B	D				
C	E	B	47.7	6	PO	1(81)
C	E	B				
C	E	B	47.1	12	OP	1(80)
C	E	B				
C	E	B	45.1	46	OP	0
C	E	B				
C	E	B	43.0	6	LP	2(81)
C	E	B				
C	E	B	35.1	6	ST	0
C	E	B				
C	E	B	34.0	6	MO	1(81)
C	E					
C	E		30.7	12	PM	0
C	E					
C	E		24.8	4	OS	1(81)
	E					
	E		19.4	48	PO	2(81)
	E					
	E		30.0	12	OS	2(81)

Appendix 2. Mean biomass (g/m^2) of ten-hour fuels in selected forest types (FT) at CUIS. PO = Pine-Oak Scrub type, SB = Scrub Border, OS = Oak Scrub, LM = Lowland Mixed Hardwoods, LP = Live Oak-Palmetto, MO = Mixed Oak-Hardwood, OP = Live Oak-Pine, OJ = Oak-Juniper-Palmetto, ST = Dune Scrub Thicket, PM = Pine-Mixed Hardwood. The numbers at right indicate the degree of burn (0 = no burn, 1 = moderate burn, 2 = intense burn) followed by the year (in parentheses), if applicable. N = number of samples.

Appendix 2. TEN-HOUR FUELS (g/m²)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE FWT2

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05

DF = 388

MS = 1.15592

<u>GROUPING</u>			<u>MEAN</u>	<u>N</u>	<u>FT</u>	<u>Burn</u>
	A		330.3	24	PO	2(77)
	B		221.1	13	SB	0
	B					
C	B		198.1	6	LP	1(77)
C	B					
C	B	D	178.8	6	LP	1(81)
C	B	D				
C	B	D	162.9	12	OP	1(81)
C	B	D				
C	B	D	154.2	24	LM	0
C	B	D				
C	E	B	141.2	12	OP	1(80)
C	E					
C	E	D	136.2	30	OS	0
C	E	D				
C	E	D	130.3	30	MO	0
C	E	D				
C	E	D	171.1	46	OP	0
C	E	D				
C	E	F	105.3	6	LP	2(81)
C	E	F				
C	E	F	104.3	30	PO	0
C	E	F				
C	E	F	101.4	12	PM	0
C	E	F				
C	E	F	89.9	6	PO	1(81)
	E	F				
	E	F	78.0	52	LP	0
	E	F				
	E	F	72.4	24	OJ	0
	E	F				
	E	F	68.3	48	PO	2(81)
	E	F				
	E	F	61.9	4	OS	1(81)
	E	F				
	E	F	22.7	6	MO	1(81)
	E	F				
	E	F	14.5	6	ST	0
	E	F				
	F		14.5	12	OS	2(81)

Appendix 3. Mean biomass (g/m^2) of one hundred-hour fuels in selected forest types (FT) at CUIS. PO = Pine-Oak Scrub type, SB = Scrub Border, OS = Oak Scrub, LM = Lowland Mixed Hardwoods, LP = Live Oak-Palmetto, MO = Mixed Oak-Hardwood, OP = Live Oak-Pine, OJ = Oak-Juniper-Palmetto, ST = Dune Scrub Thicket, PM = Pine-Mixed Hardwood. The numbers at right indicate the degree of burn (0 = no burn, 1 = moderate burn, 2 = intense burn) followed by the year (in parentheses), if applicable. N = number of samples.

Appendix 3. ONE HUNDRED-HOUR FUELS (g/m²)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE FWT3

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05

DF = 387

MS = 17.5894

<u>GROUPING</u>	<u>MEAN</u>	<u>N</u>	<u>FT</u>	<u>Burn</u>
A	797.9	24	PO	2(77)
B	353.5	13	SP	0
B	287.2	12	PM	0
B	255.3	6	LP	1(77)
B	255.3	6	LP	1(81)
B	255.3	12	OP	1(80)
B	207.4	24	LM	0
B	169.3	52	LP	0
B	141.5	46	OP	0
B	140.4	30	MO	0
B	127.7	12	OP	1(81)
B	111.7	24	OJ	0
B	105.7	29	PO	0
B	95.7	4	OS	1(81)
B	63.8	6	MO	1(81)
B	63.8	6	PO	1(81)
B	55.8	48	PO	2(81)
B	51.1	30	OS	0
B	0.0	6	LP	2(81)
B	0.0	12	OS	2(81)
B	0.0	6	ST	0

Appendix 4. Average litter depth (cm) in selected stands at CUIS.

Forest types follow those outlined in Appendix 1.

Appendix 4. LITTER DEPTH (cm)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LITTER

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05

DF = 388

MS = 39.3763

GROUPING		MEAN	N	FT	Burn
A		20.47	24	PO	2(77)
C	B	11.90	30	PO	0
	B				
	B	11.33	24	LM	0
	B				
	B	10.44	6	LP	1(77)
	B				
	B D	7.97	12	OP	1(81)
	B D				
	B D	6.08	4	OS	1(81)
	E D				
	E D	5.73	52	LP	0
	E D				
	E D	5.63	12	PM	0
	E D				
	E D	5.35	30	OS	0
	E D				
	E D	3.69	12	OP	1(80)
	E D				
	E D	3.34	46	OP	0
	E				
	E	2.97	30	MO	0
	E				
	E	2.83	6	LP	2(81)
	E				
	E	2.61	6	ST	0
	E				
	E	2.43	13	SB	0
	E				
	E	2.38	6	LP	1(81)
	E				
	E	2.04	48	PO	2(81)
	E				
	E	1.76	24	OJ	0
	E				
	E	1.50	6	PO	1(81)
	E				
	E	1.44	6	MO	1(81)
	E				
	E	0.11	12	OS	2(81)

Appendix 5. Average depth (cm) of decayed organic matter in selected stands at CUIS. Forest types follow those outlined in Appendix 1.

Appendix 5. DEPTH OF ORGANIC MATTER (cm)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DUFF

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05 DF = 388 MS = 1.7318

GROUPING				MEAN	N	FT	Burn
		A		5.02	24	LM	0
		A					
		A		4.90	30	PO	0
		B		2.70	12	PM	0
		B					
		B		2.50	52	LP	0
		B					
C		B		2.03	13	SB	0
C		B					
C		B	D	1.79	12	OP	1(80)
C		B	D				
C	E	B	D	1.66	6	LP	1(81)
C	E	B	D				
C	E	B	D	1.66	24	PO	2(77)
C	E	B	D				
C	E	B	D	1.58	6	ST	0
C	E		D				
C	E		D	1.51	30	MO	0
C	E		D				
C	E		D	1.43	30	OS	0
C	E		D				
C	E		D	1.16	6	LP	1(77)
C	E		D				
C	E		D	1.00	6	MO	1(81)
	E		D				
	E		D	0.91	46	OP	0
	E		D				
	E		D	0.77	24	OJ	0
	E		D				
	E		D	0.75	6	PO	1(81)
	E		D				
	E		D	0.66	6	LP	2(81)
	E						
	E			0.52	48	PO	2(81)
	E						
	E			0.50	12	OP	1(81)
	E						
	E			0.29	12	OS	2(81)
	E			0.12	4	OS	1(81)

Appendix 6. Standing crop of saw palmetto (grams/m²) in selected stands at CUIS. Forest types follow those outlined in Appendix 1.

Appendix 6. STANDING CROP OF SAW PALMETTO (g/m^2)

S T A T I S T I C A L A N A L Y S I S S Y S T E M

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MASS3

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05

DF = 374

MS = 18751.6

	<u>GROUPING</u>			<u>MEAN</u>	<u>N</u>	<u>FT</u>	<u>Burn</u>
	A			353.48	24	LM	0
	A						
B	A			312.57	6	LP	1(77)
B							
B				263.82	30	PO	0
B							
B	C			248.10	6	MO	1(81)
B	C						
B	C	D		194.28	4	OS	1(81)
B	C	D					
B	C	D		179.24	22	PO	2(77)
	C	D					
	C	D		154.26	51	LP	0
	C	D					
E	C	D		134.83	6	PO	1(81)
E	C	D					
E	C	D		121.34	30	OS	0
E	C	D					
E	C	D		119.18	47	PO	2(81)
E	C	D					
E	C	D		88.12	6	LP	1(81)
E	C	D					
E	C	D		87.73	6	LP	2(81)
E		D					
E		D		86.19	12	OS	2(81)
E		D					
E		D		24.68	13	SB	0
E							
E				0.00	30	MO	0
E							
E				0.00	36	OP	0
E							
E				0.00	12	OP	1(80)
E							
E				0.00	12	OP	1(81)
E							
E				0.00	12	PM	0
E							
E				0.00	6	ST	0
E							
E				-1.633125	24	OJ	0

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