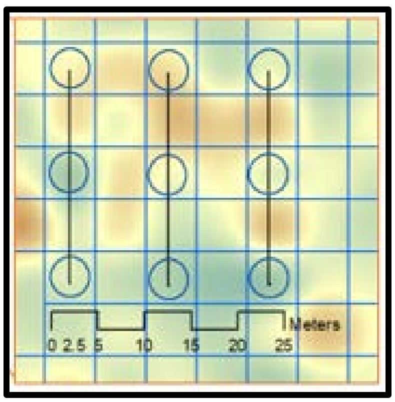
Baseline Survey to Evaluate the Future Effects of Restoration Techniques to Restore Longleaf Pine Forests at Flint Rock Wildlife Management Area



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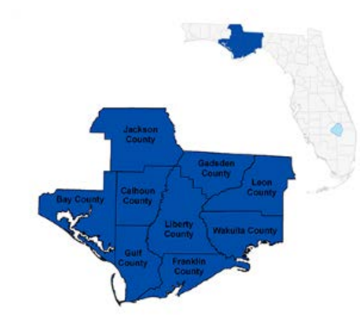

The Nature Conservancy

Apalachicola Regional Stewardship Alliance

Florida Natural Areas Inventory

Introduction

Understanding the effectiveness of various silviculture techniques is imperative for efficient and appropriate longleaf pine (*Pinus palustris*) forest restoration. In August 2019, Florida Natural Areas Inventory (FNAI) and the Nature Conservancy (TNC) staff conducted an assessment to quantify forest stand conditions and understory composition in Unit 12 at Flint Rock Wildlife Management Area. This assessment provides baseline survey information from long established pine plantation to evaluate the effects of future longleaf pine restoration efforts. This document is organized by a short summary of the most significant findings in the main body of the document, additional supporting tables and figures in Appendix I, a full list of species found by habitat in Appendix II, a description of the all the variables collected in Appendix III, and summary statistics for all variables collected in Appendix IV.

Methods

We randomly selected slash pine forest sites (>2 meters elevation) and permanently marked 2.5-meter radius subplots (approximately 20 m^2) that were nested along a set of three parallel transects forming macroplots. Macroplots consist of 3x3 grids of subplots (Figure 1). Collectively, the macroplots represent the forest stand conditions and the subplots can be used to analyze the fine scale changes between treatments or over time (e.g. row removal or pooled for plant community analysis). At each subplot, we collected the attributes found in Appendix III. Post-restoration monitoring will be conducted one-year post treatment in late summer to fall (August to November).

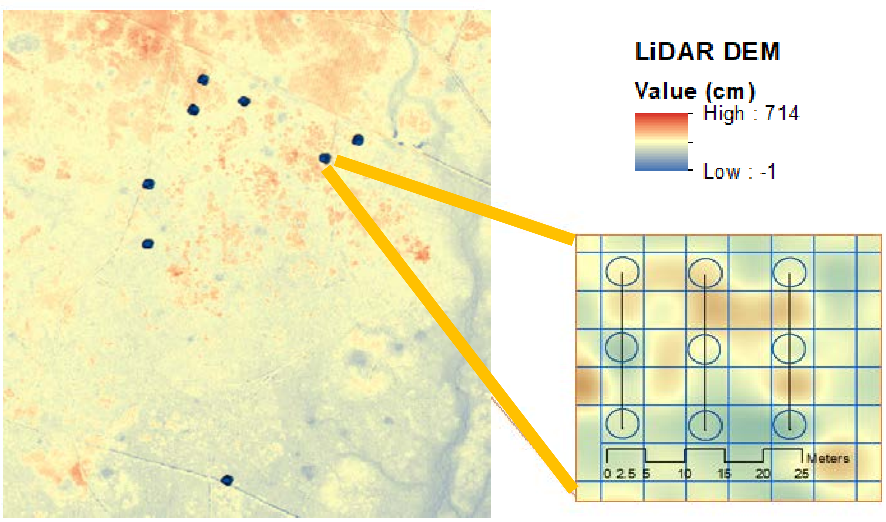

Figure 1. 2.5- Left- sample sites in unit 12 of Flint Rock WMA shown with LiDAR DEM baselayer. Right- 2.5 meter radius subplots were nested along a set of three transects that formed 3x3 grids. Transects were aligned to the angle of the plantation rows. Each set of 9 subplots made up one macroplot.

Within each treatment type, we determined the total number of plots based on the species data collected from pilot samples at each site using sample-based rarefaction (Mau Tau). Sample-based rarefaction computes the expected number of species $s*$ when $m*$ samples (1 ≤

$m* \leq M$) are drawn at random (without replacement) from a set of samples that are, collectively, representative of an assemblage (Gotelli & Colwell 2001; Colwell et al. 2004). Using data from a pilot sample collected at Flint Rock, we determined that we needed to sample 72 subplots based on the expected number of species per plot. To ensure plots were sampled in appropriate habitat, we omitted subplots if submerged aquatic plants (e.g. pickerelweed (*Pontederia cordata*), or combleaf mermaidweed (*Proserpinaca pectinata*)) dominated the plot (e.g. 50% or greater cover). We allowed the macroplot to be shifted within 100 meters if >33% of the subplots within a macroplot were omitted based on the aforementioned rule.

Statistical Analysis

We summarized and visualized the data in R (R core team 2017) with ggplot2 (Wickham 2009), bayesplot (https://cran.r-project.org/web/packages/bayesplot/), and PAST version 3.24 (Hammer 2019). If data was not normally distributed or could not be transformed towards normal, we used non-parametric tests (e.g. Kruskall-Wallis or Mann-Whitney U) to compare group means. Non-metric multidimensional scaling (NMDS) index was implemented in PAST to visualize and detect similarity or dissimilarity (distance) among plant community types. Differences among plant community groups were tested using analysis of variance (ANOVA), permutational multivariate ANOVA (PERMANOVA), and Bayesian estimation in R (BEST, https://cran.r-project.org/web/packages/BEST). We also used Markov Chain Monte Carlo (MCMC) Bayesian estimation algorithms to compare Flint Rock communities to similar community types found in northern Florida. To explore the effect of various forest conditions on structural metrics of interest (e.g. herb richness) we first transformed non-normal variables towards normal using Box-Cox power transformations, then removed non-informative and correlated variables to prepare the data for analysis. Next, we conducted stepwise generalized linear models (GLM) to identify which variables were most important in R using package MASS (https://cran.r-project.org/web/packages/MASS/MASS.pdf). We assessed residual normality and heteroscedasticity using standard diagnostic plots. We further verified results for final models using generalized additive models (GAM) using package mgcv, https://cran.rproject.org/web/packages/mgcv), and Bayesian GLM in Bayesplot.

Results:

Characterizing current communities

Based on NMDS ordination of plant community data, we identified two distinct community types at Flint Rock: mesic flatwoods and wet flatwoods (Figure 2). All mesic flatwoods within the unit were generally wet, as compared to most examples of mesic flatwoods found elsewhere in the region or state. Flint Rock is in the St. Marks Coastal Strip Physiographic Province which is defined by as a poorly drained erosional limestone plain with little soil, characterized by flatwoods and swamp (Brooks 1981). Given this, the flatwoods that form here are very poorly drained, heavily influenced by the underlying limestone with a more neutral substrate which increases cover of species such as cabbage palm (*Sabal palmetto*) and ferns.

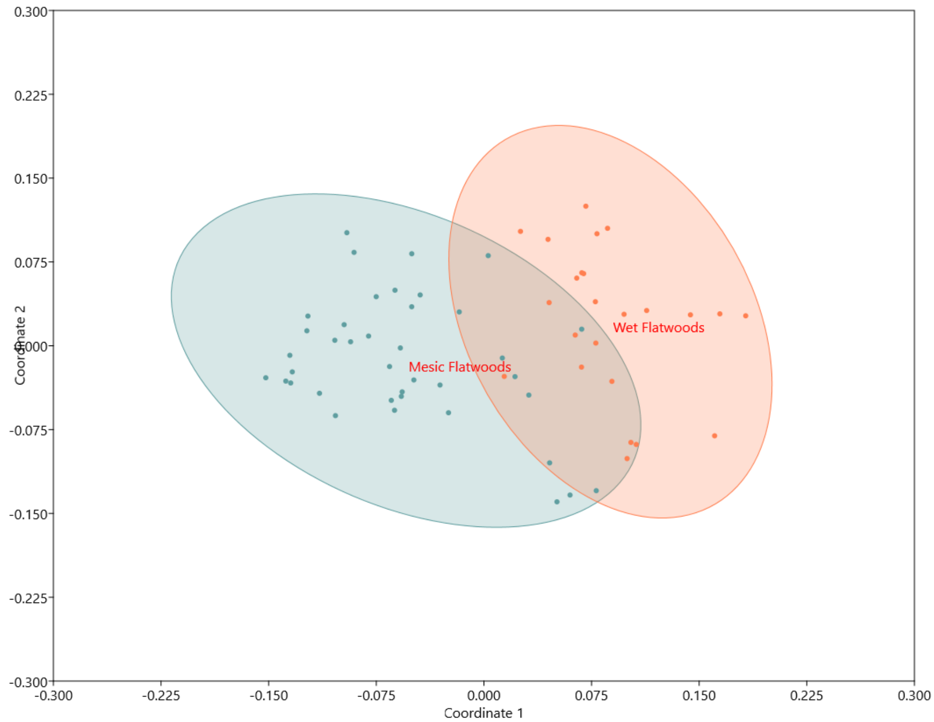

Figure 2. NMDS ordination plot based on plant community data collected. Flint Rock sites can be classified into two distinct community types: wet flatwoods and mesic flatwoods (F = 11.7, p < 0.001).

These communities differed significantly in their species composition (F = 11.7, p < 0.001). Mesic flatwoods were dominated by slash pine *(Pinus elliottii*), gallberry (*Ilex glabra*), bracken (*Pteridium aquilinum*), southern bayberry (*Morella cerifera*), and Virginia chain fern (*Woodwardia virginica*). Wet flatwoods were dominated by slash pine, southern bayberry, rosy camphorweed (*Pluchea baccaharis*), gallberry, and peelbark St. John's wort (*Hypericum fasciculatum*). The species that contributed the most to the distinction of wet flatwoods in terms of frequency per plot were rosy camphorweed, peelbark St. John's wort, large gallberry (*Ilex coriacea*), sawgrass (*Cladium jamaicense*) and cypress witchgrass (*Dichanthelium ensifolium*). In contrast, the following species were more dominant in mesic flatwoods than wet flatwoods: saw palmetto (*Serenoa repens*), bracken, Virginia chain fern, gallberry, and cat greenbriar (*Smilax glauca*).

There were 22 species which were absent in wet flatwoods that were present in mesic flatwoods and 38 species that were absent in mesic flatwoods that were present in wet flatwoods. In mesic flatwoods, we detected 66 species (SD= ±1.24, Appendix II) and in wet flatwoods we detected 107 species (SD= ±0.93, Appendix II). In total, 120 plant species were identified (SD= ±0.71, appendix II). Post-hoc comparison of species accumulation curves were similar to projections made using sample based rarefaction (Figure AI-1, Figure AI-2, Figure AI-3) which indicates high confidence in our estimates of species richness by community and supports our use of sample based rarefaction to predict necessary sample size. A full table of the differences in frequency of occurrence of each species between mesic and wet flatwoods can be found in Appendix II.

Plant Richness

Shrub richness was similar between flatwoods communities with a mean of 6 species per $20m^2$ plot (95% CI=5.6-6.8) in mesic flatwoods and 6 species per $20m^2$ plot (95% CI=6-7.4) in wet flatwoods. The maximum number of shrub species per $20m^2$ plot was much higher in mesic (13 species) than wet flatwoods (9 species), as a result the median differences were marginally significant (z=1.90, p=0.058). There was a significant difference in the herb richness between wet and mesic flatwoods (H=4.01, p=0.04). Mesic flatwoods in unit 12 have an average of 5.2 herb species per $20m^2$ plot (95%CI=3.8-6.58) and wet flatwoods have an average of 7.73 herb species per $20m^2$ plot (95% CI= 5-9.7). The maximum herb species per $20m^2$ plot in wet flatwoods was 19 and 15 in mesic flatwoods, respectively. In summary, the groups were similar with mesic flatwoods having marginally more shrub species and wet flatwoods having marginally more herb species per plot.

Overall Stand Structure

Because Flint Rock was heavily planted during the same time period across the site with slash pine (*Pinus elliottii*) the overall stand structure should be fairly homogenous across the unit. However, there are differences in stand structure based on the distribution of diameter at breast height (dbh, Figure 3) in the mean (F=5.05, p=0.02) and median (z=2.19, p=0.03) but not in the distributions (Z=0.7, p=0.18). These differences could be the result of a number of factors, but there are indications of different recruitment and survival of slash pine under the same management regime based on the type of flatwoods. Recruitment and survival of young pines (<4 in. dbh) is higher in wet flatwoods than mesic flatwoods. Additionally, the density of young mature pines (5-10 in. dbh) is higher, particularly on the lower end of the range. The average basal area of mesic flatwoods is 74 (95% CI=62-85 sq.ft/ac) which was significantly different than wet flatwoods which had an average of 93.5 sq.ft./ac (95% CI=79-108). These differences could be a result of many factors. In any case, noting the difference in these stands could be important to consider in future silvicultural or fire management operations.

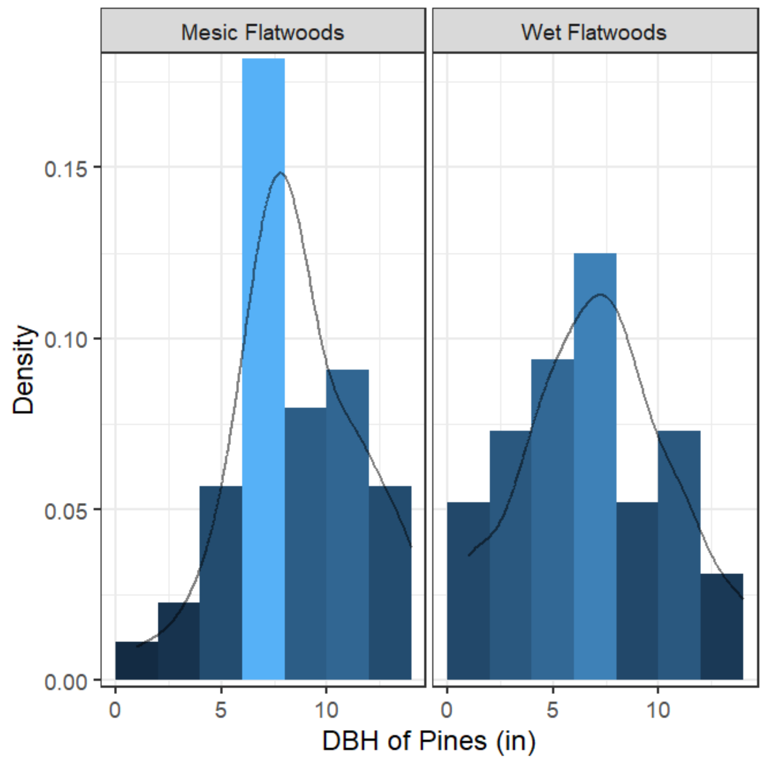

Figure 3. Density of slash pine size classes in wet and mesic flatwoods.

There were notable structural differences in the sub-canopy and herb layer between mesic and wet flatwoods. Graminoid cover was significantly lower (Figure 1) in mesic flatwoods plots than in wet flatwoods plots (Figure 4). Graminoid cover was on average of 4.9% cover per plot in mesic flatwoods (95% CI=1.9, 6.7), and 24.3% cover wet flatwoods plots (95%CI=17.2, 31.3). Similarly, herb cover was also significantly lower in mesic flatwoods than wet flatwoods (Figure 5). Mean herb cover was 7.5% (95% CI=4.7, 10.3) in mesic flatwoods and 42.1% (95% CI=31.8, 52.4) in wet flatwoods. Shrub cover was significantly higher in mesic flatwoods than wet flatwoods plots (Figure 6). Mean shrub cover was 67.2% (95% CI=61.0, 73.5) in mesic flatwoods and 38.0% (95% CI=28.3, 47.8) in wet flatwoods. None of the other structural metrics measured appeared to differ significantly between the two community types. A full list of summary stats for all variables collected can be found in Appendix III.

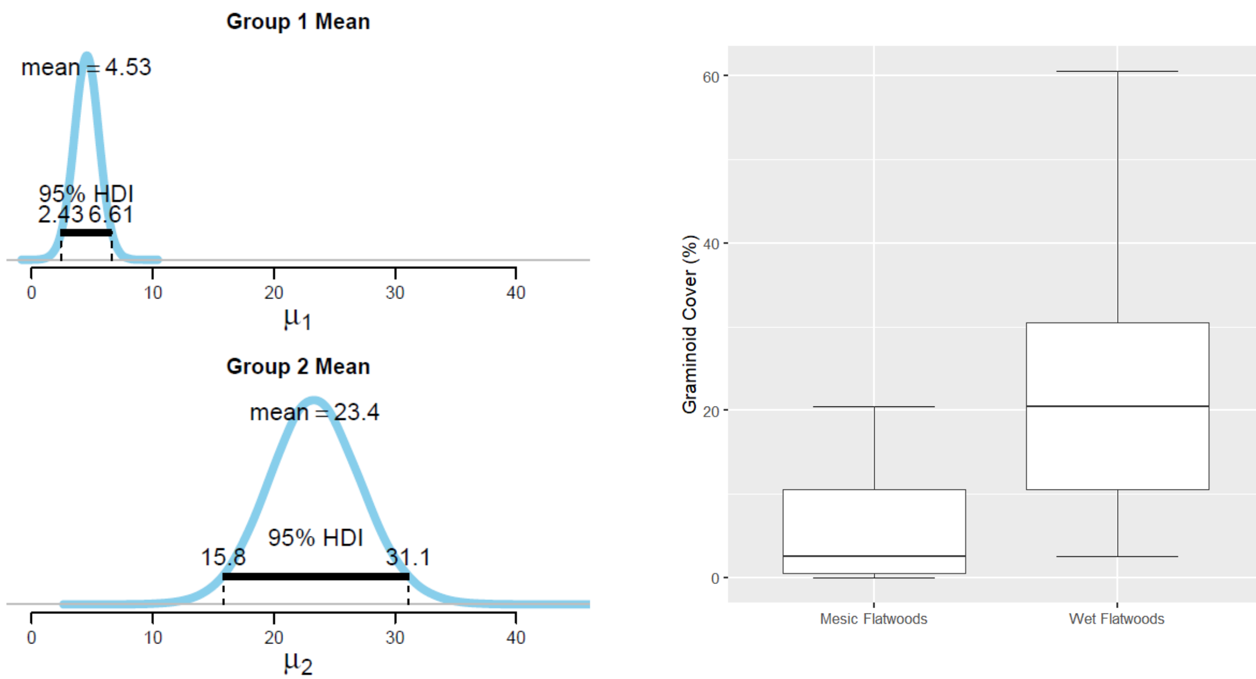

Figure 4. LEFT: Distributions of means of graminoid cover in both mesic and wet flatwoods shown with 95% high density interval (Bayesian inference confidence interval); see AI-4 for more details. Group 1 and group 2 are sampled from mesic and wet flatwoods sites at Flint Rock, respectively. RIGHT: Box plots of the same comparison. Differences were found to be significant (X^2=27.34, p<0.0005).

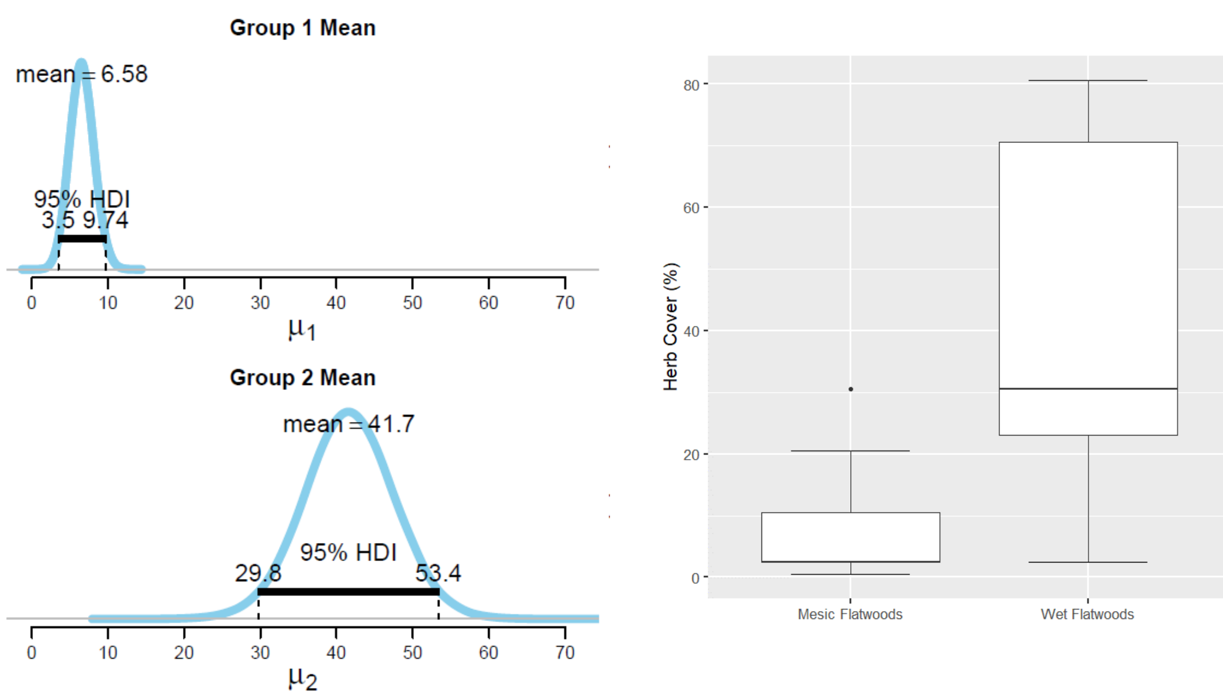

Figure 5. LEFT: distributions of means of herb cover in both mesic and wet flatwoods shown with 95% high density interval using Bayesian MCMC processes; see AI-5 for more details Group 1 and group 2 are sampled from mesic and wet flatwoods sites at Flint Rock, respectively. RIGHT: Box plots of the same comparison. Differences were found to be significant (X^2=31.19, p<0.0005).

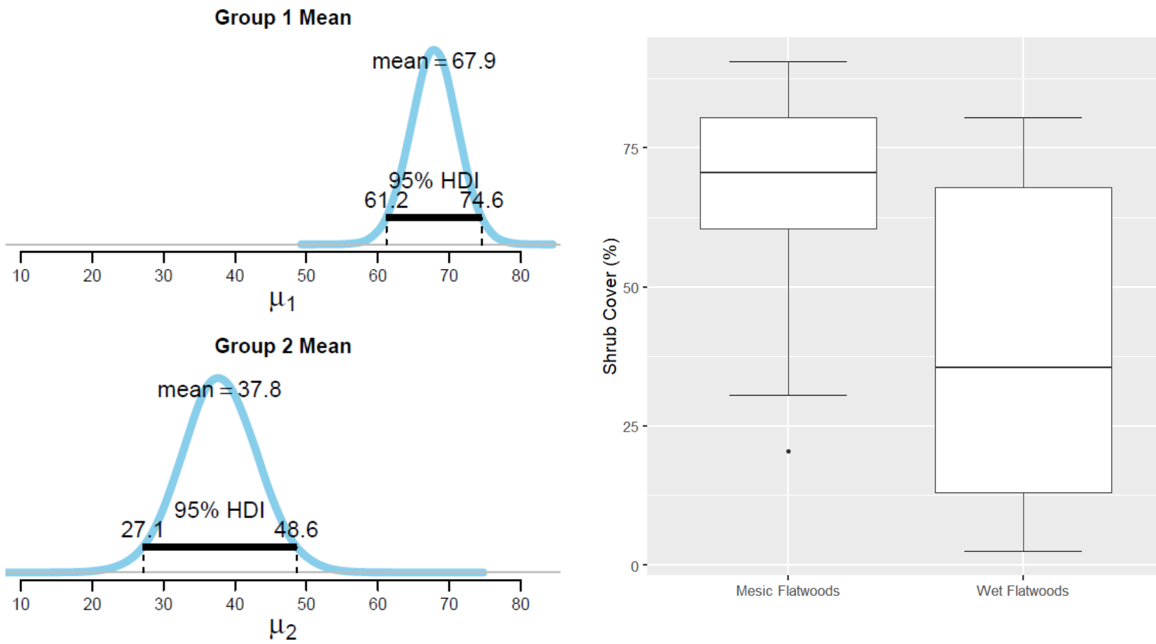

Figure 6. LEFT: Distributions of means of shrub cover in both mesic and wet flatwoods shown with 95% high density interval using Bayesian MCMC processes; see AI-6 for more details. Group 1 and group 2 are sampled from mesic and wet flatwoods sites at Flint Rock, respectively. RIGHT: Box plots of the same comparison. Differences were found to be significant (X^2=17.6, p<0.0005).

Comparison to natural community points across Florida

With the goal of providing a baseline assessment of the Flint Rock's forest condition in relation to conditions that exist across the state of Florida, we compared structural attributes of 37 mesic flatwoods and 26 wet flatwoods plots at Flint Rock to 279 mesic flatwoods and 111 wet flatwoods natural community sites from coastal flatwoods in northern Florida (e.g. Box R Wildlife Management Area, Apalachicola Regional Wildlife and Environmental Area, etc.). In order to avoid the assumptions and limitations of traditional frequentist statistical methods, we used Markov Chain Monte Carlo Bayesian inference to model the distributions and compare the differences between communities.

Across both mesic and wet flatwoods, basal area (Figure 7, Figure AI-4, Figure AI-5) and canopy cover (Figure 8, Figure AI-6, Figure AI-7) are higher in management Unit 12 of Flint Rock than when compared to other coastal flatwoods sites across northern Florida. However, sites in our sample at Flint Rock have similar shrub cover to other similar sites (Figure 9, Figure AI-8, and Figure AI-9). In mesic flatwoods, herb cover is much lower than the average across other coastal flatwoods sites (Figure 10, Figure AI-10, and Figure AI-11).

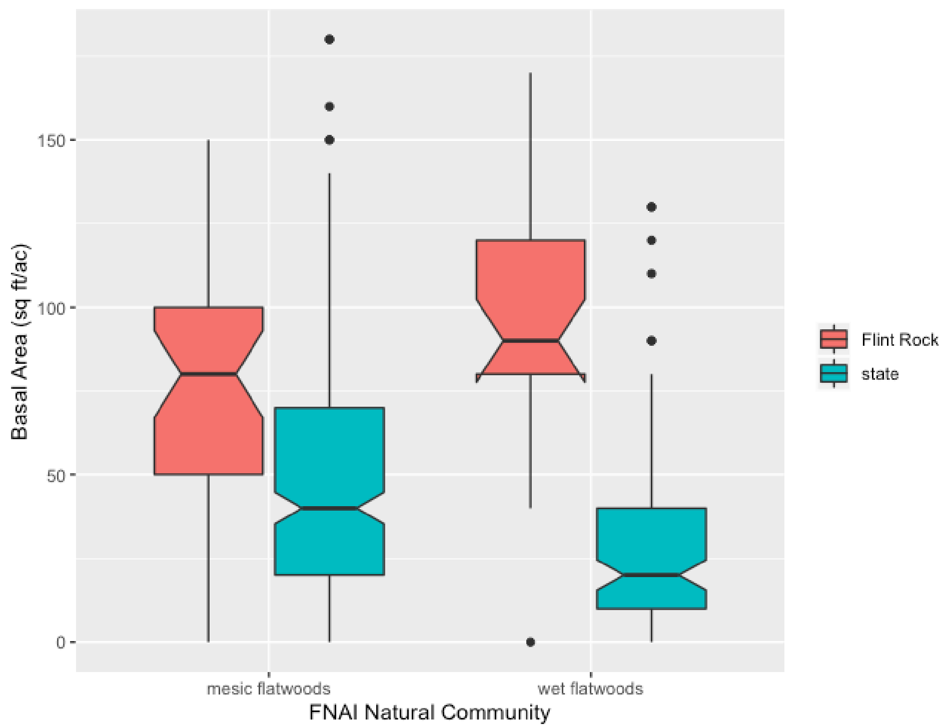

Figure 7. Flint Rock sites had higher basal area than other mesic and wet flatwoods sites from throughout the state.

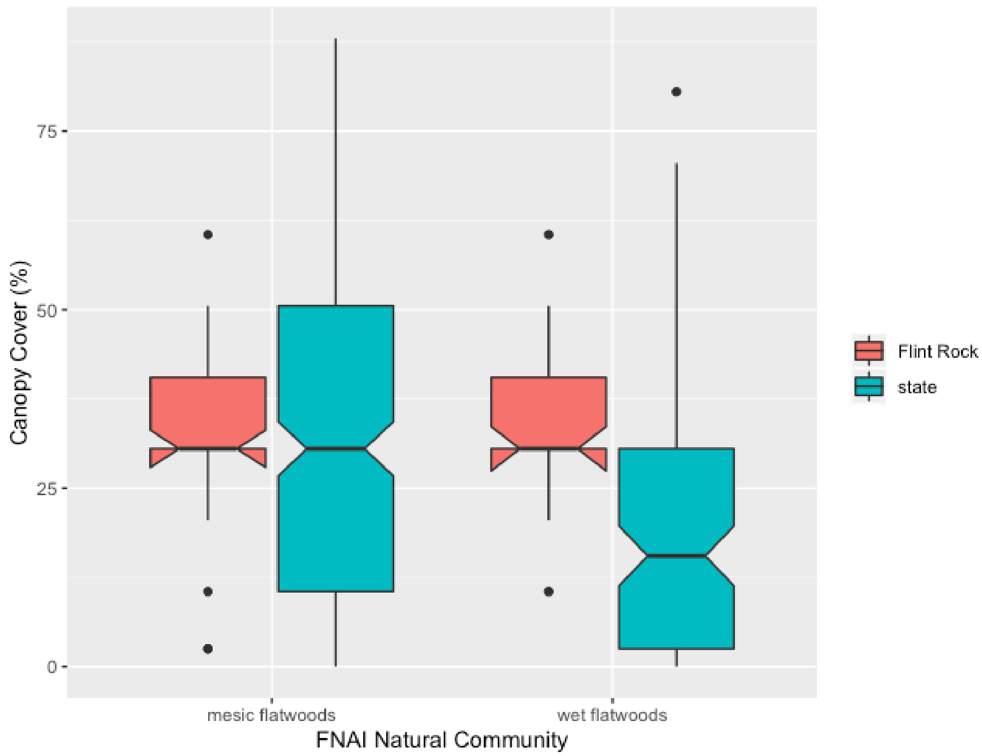

Figure 8. Flint Rock sites had higher canopy cover than other sites from north Florida.

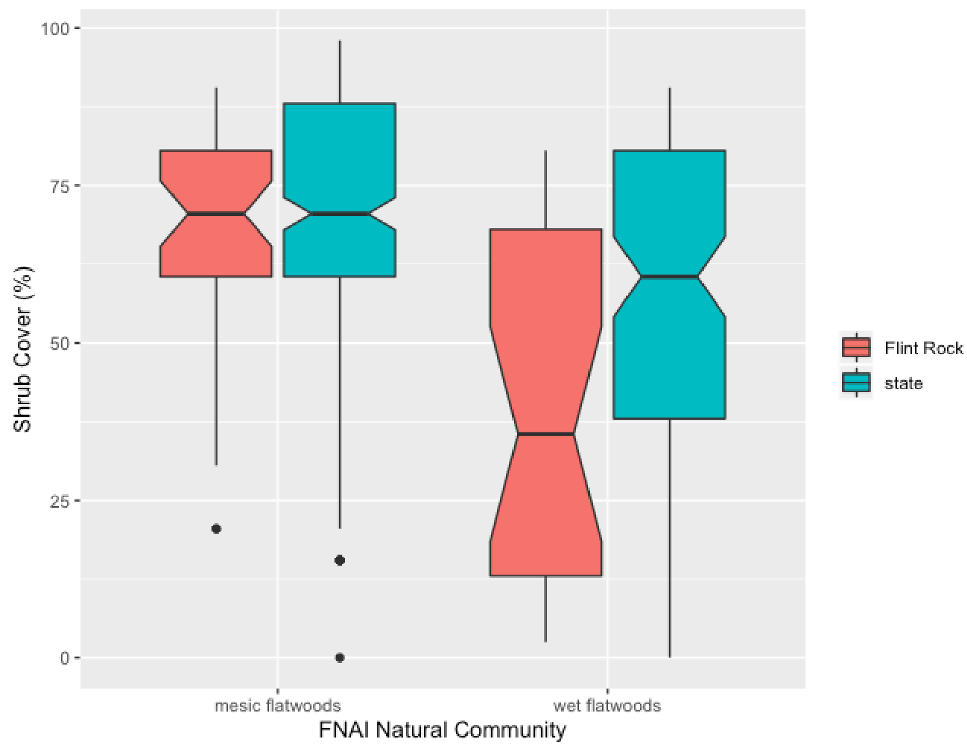

Figure 9. Flint rock sites had higher shrub cover than other sites from north Florida.

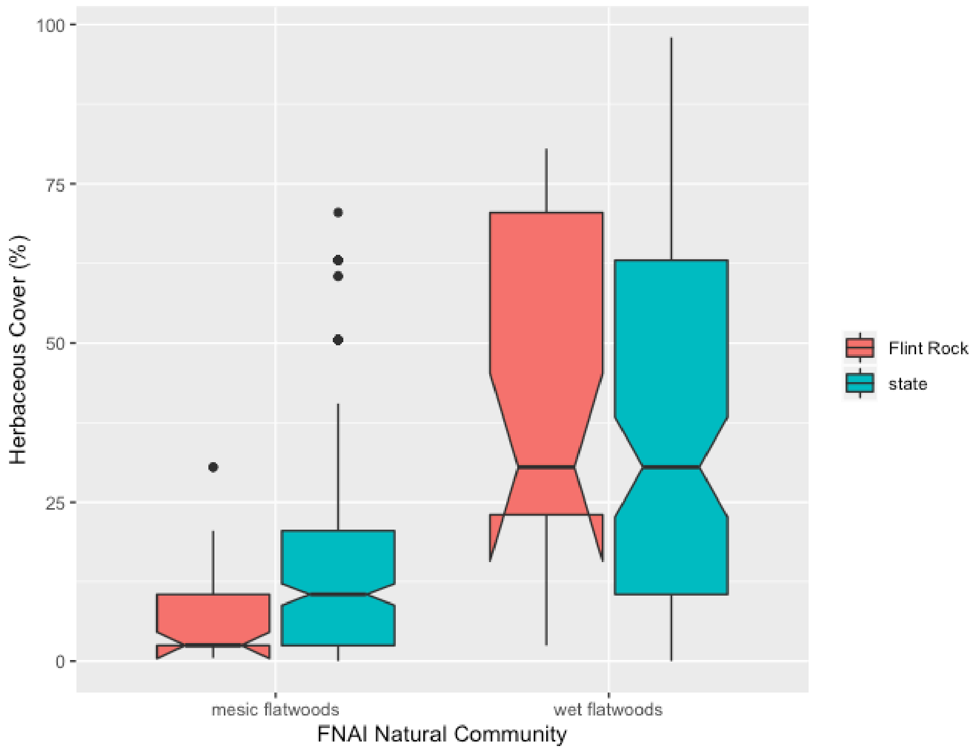

Figure 10. Herb cover was lower at Flint Rock sites than at state sties in mesic flatwoods, but this relationship was not true for wet flatwoods.

As an additional comparison, we compared the general structure of sites at Flint Rock to FNAI reference site standards (Table 1). Basal area, herb cover, and shrub cover did not fall within the range typical of other reference sites across the state. However, the percentage of bare ground fell within the reference range.

Table 1. FNAI reference site comparison. Values highlighted in red did not meet reference site standards. All values shown are means calculated using data from all plots within that community type. Values in parenthesis show the 95% confidence interval of the mean.

	Wet Flatwoods		**Mesic Flatwoods**	
	Recommended	*Current*	*Recommended*	*Current*
Basal Area of Pine (sq ft/acre)	10-50	93.5 (79.8, 107.1)	10-50	74.1 (63.0, 85.1)
Bare Ground (%)	<15	2.4 (1.2, 3.6)	<10	2.8 (1.1, -3.0)
Herb Cover (%)	>40	42.1 (31.9, 52.4)	>15	7.5 (4.7, 10.3)
Shrub Cover (%)	<10	38.0 (28.3, 47.8)	<25	67.3 (61.0, 73.5)
Exotic Cover (%)	0	0	0	0

Herb–Shrub Relationships and Modeling Results

Understanding herb-shrub dynamics is important for guiding management towards restoration goals. Restoration goals typically include reducing shrub cover and height in order to promote herbaceous and overall plant diversity. We generally found typical herb-shrub dynamics, with herb cover increasing as shrub cover decreased (Figure 11a). However, this effect was less dramatic in mesic flatwoods due to the fact that we did not encounter any mesic flatwoods with high herb cover in unit 12. Wiregrass (*Aristida stricta*) was proposed an important indicator variable, however it was only present at 3 plots, and so further analysis was not conducted.

The step-wise GLM that best predicted herb cover included shrub cover, litter cover, bare soil, and natural community (Table 2). Herb cover was near 53% when shrub litter was low and bare soil was high. Herb cover was reduced by about 5% with every 10% gain in shrub cover (Table 2, Figure 12). Similarly, herb cover was reduced by about 4% with every 10% gain in litter cover (Table 2, Figure 12). Bare ground increased 12% for every 10% increase in herb cover (Table 2, Figure 12), however the overall effect was weak due to the small range of bare ground observed, but statistically significant enough to include in the overall model. The most profound effect was shrub cover, followed by litter cover, natural community, and bare soil, respectively. This model explained 75% of the deviance and had an improved lower Akaike information criterion (AIC <5 from the next best model). Bayesian MCMC methods verified these results; credible intervals of the distribution overlapped zero for all covariates except shrub cover, litter cover, and bare soil (Figure AI-12).

Shrub cover was best explained by a GLM that included litter cover, herb cover, bare soil and basal area. As we know from the herb model, shrub cover, bare soil and litter cover are correlated. Shrub cover was near 94% when herb, litter were low are bare soil was relatively high (about 12%). Shrub cover was increased by about 7% with every 10% loss in herb cover. Similarly to the herb model, shrub cover was reduced by about 4% with every 10% gain in litter cover (Table 3, Figure 13). Bare ground increased 12% for every 10% increase in herb cover (Figure 13), but the maximum bare ground cover was only 12%. The most profound effect was herb cover, followed by litter cover, natural community, basal area, and bare soil, respectively.

Unique to the shrub model, was the influence of basal area. We generalized additive models to see if more variance could be explained with a non-linear model. GAM suggested that decreasing basal area alone explained 14% of the deviance. Including natural community types (e.g. wet flatwoods vs. mesic flatwoods) further improved the model (AICc reduced from 585.95 to AICc 569.68) and increased the deviance explained from 14 to 36% (Table 3). In other words, reducing basal area leads to an increase in shrub cover in mesic flatwoods. This finding was cross validated by a Bayesian MCMC models (Figure AI-13).

We explored models to predict both total herb richness and shrub richness. We found weak support for decreasing herb richness with palm height. We also found weak support for total shrub species being predicted by shrub height using both stepwise GLM and Bayesian MCMC algorithm approaches (Table 4-5, Figures 14-15).

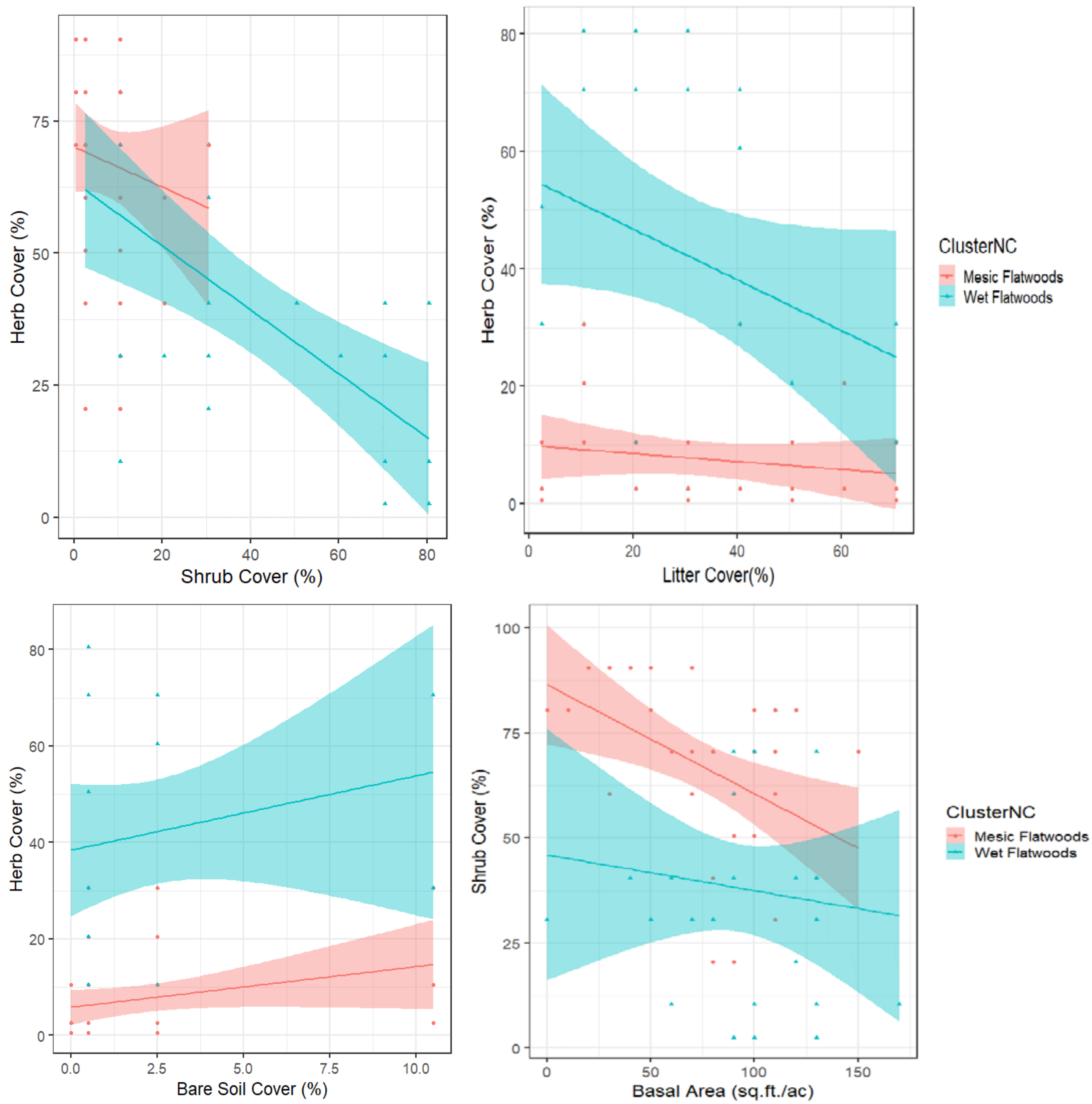

Figure 11. A) top left B) top right C) bottom left D) bottom right shown with linear regression smoothing

Table 2. Herb cover model- herb cover was best predicted by natural community, shrub, bare soil and litter cover. Bolded values denote comparisons that were significant.

	Estimate	Std. Error	t-value	p-value
Intercept	53.3	7.6	6.9	3.1E-09
Litter cover	**-0.4**	**0.1**	**-4.3**	**6.6E-05**
Shrub cover	**-0.5**	**0.1**	**-6.2**	**6.1E-09**
Community type	**17.5**	**4.4**	**4.0**	**1.5E-04**
Bare soil	**1.29**	**.62**	**2.1**	**0.03**

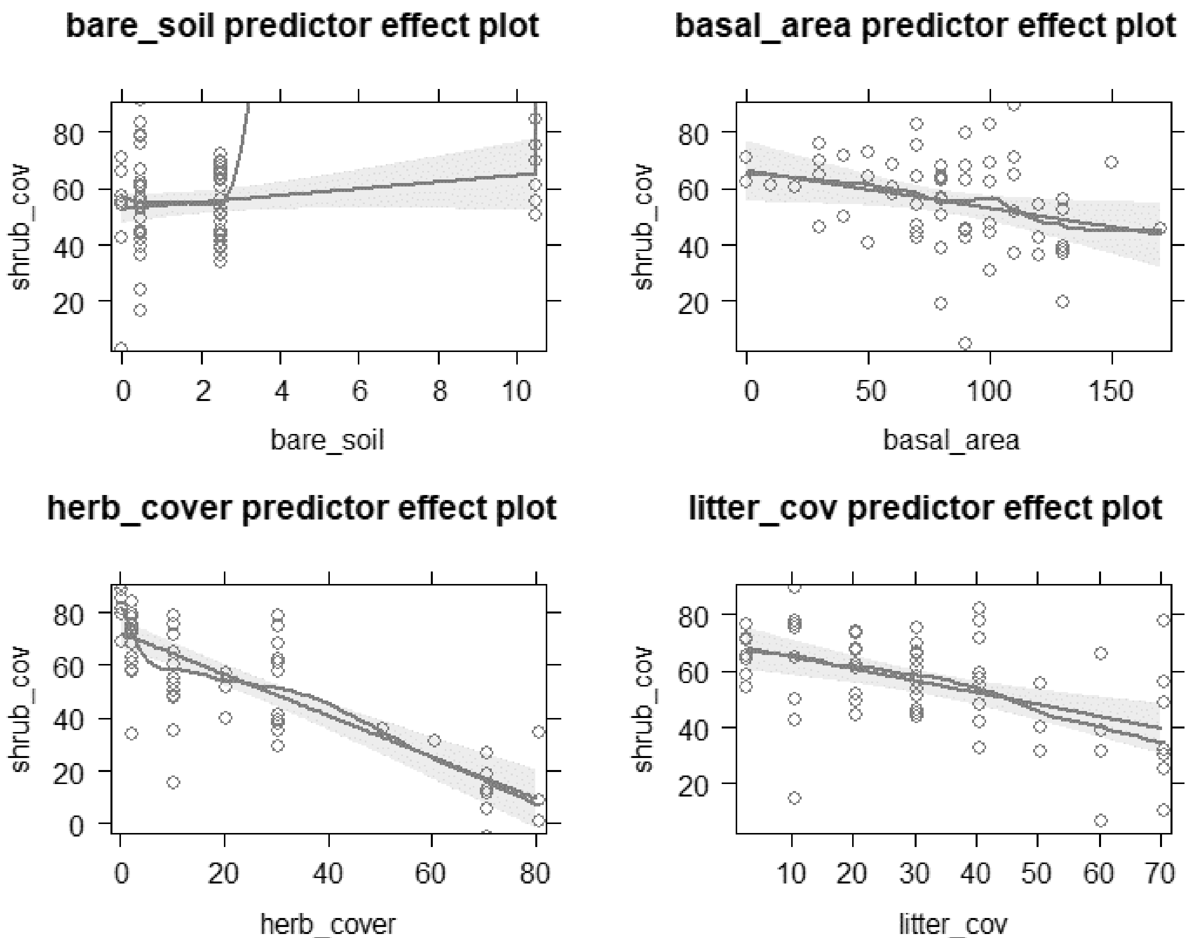

Figure 12: Top herb cover model predictor effect plots with residuals shown.

Table 3. Shrub cover was best explained by basal area but this effect differed in mesic and wet flatwoods. Basal area was included as a smooth term in the model. Bolded values denote comparisons that were significant.

	Estimate	Std. Error	t-value	p-value
Intercept	81.0	6.8	11.9	2.0E-16
Basal area	**-0.2**	**0.1**	**-2.4**	**0.02**
Community type	**-25.6**	**5.7**	**-4.5**	**2.8E-05**

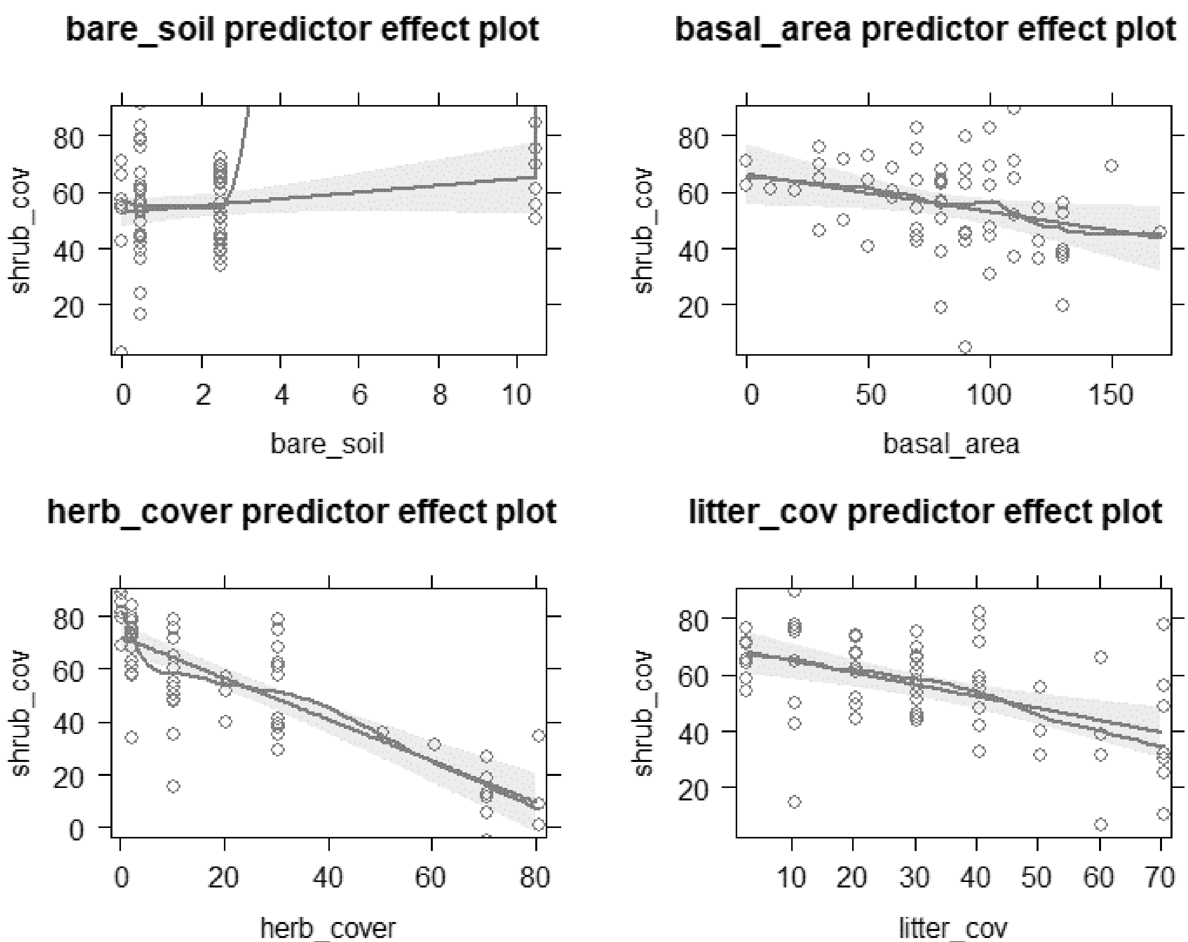

Figure 13: Top shrub cover full model predictor effect plots with residuals shown.

Table 4: Stepwise reduction GLM to achieve the best model for herb richness

Stepwise selection of top model for total herb species

Step: AIC=374.31

herb_tspp ~ palm_ht

	Df	Deviance	AIC
<none>	1	191.9	374.31
+ ClusterNC	1	1139.6	375.62
- palm_ht	1	1307.4	375.99
+ DEMcm	1	1157.2	376.59
+ bare_soil	1	1178.3	377.72
+ herb_cover	1	1185.3	378.09
+ basal_area	1	1185.4	378.10
+ inundated	1	1185.6	378.11
+ shrub_cov	1	1186.7	378.17
+ shrub_tspp	1	1187.7	378.22
+ LiveDBH_cnt	1	1187.8	378.23
+ palm_cov	1	1187.8	378.23
+ canopy_cov	1	1188.8	378.28
+ litter_cov	1	1191.3	378.41
+ Plot	8	1051.1	399.53

Call: glm(formula = herb_tspp ~ palm_ht, family = gaussian(identity), data = FRfinal2)

Coefficients:

(Intercept)	palm_ht
7.7637	-0.6365

Degrees of Freedom: 62 Total (i.e. Null); 61 Residual

Null Deviance: 1307

Residual Deviance: 1192 AIC: 370

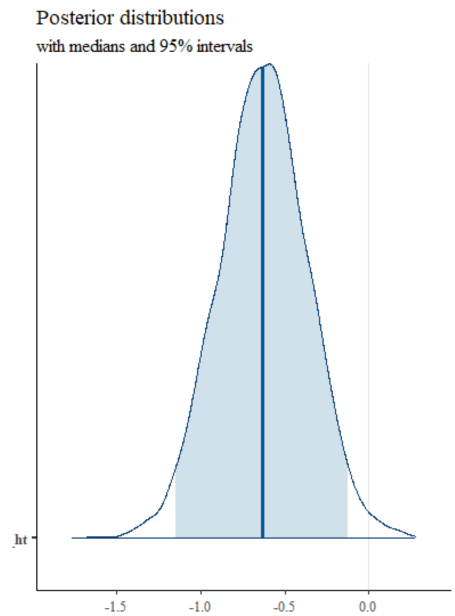

Figure 14 (ABOVE): Bayesian inference supporting palm height as a predictor of total herb species.

Table 5: Stepwise reduction GLM to achieve the best model for shrub richness

Stepwise Shrub Species Model

Step: AIC=269.96
shrub_tspp ~ shrub_ht

	Df	Deviance	AIC
<none>		227.47	269.96
+ herb_cover	1	220.76	272.21
+ shrub_cov	1	222.17	272.62
+ herb_tspp	1	223.98	273.13
+ palm_cov	1	224.07	273.15
- shrub_ht	1	255.65	273.17
+ canopy_cov	1	224.57	273.29
+ palm_ht	1	225.84	273.65
+ litter_cov	1	226.21	273.75
+ basal_area	1	226.24	273.76
+ LiveDBH_cnt	1	226.28	273.77
+ bare_soil	1	26.95	273.96
+ inundated	1	227.47	274.10
+ Plot	8	202.78	295.86

Call: glm(formula = shrub_tspp ~ shrub_ht, family = gaussian(identity), data = FRfinal2)

Coefficients:

(Intercept)	shrub_ht
4.7444	0.3637

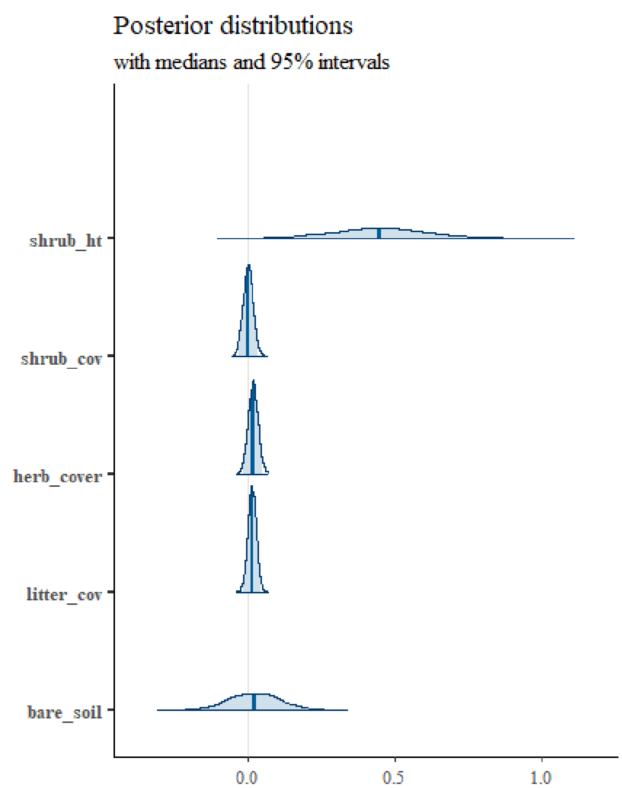

Figure 15 (RIGHT): Bayesian inference supporting shrub height as a predictor of total shrub species.

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Appendix I – Supplementary tables and figures

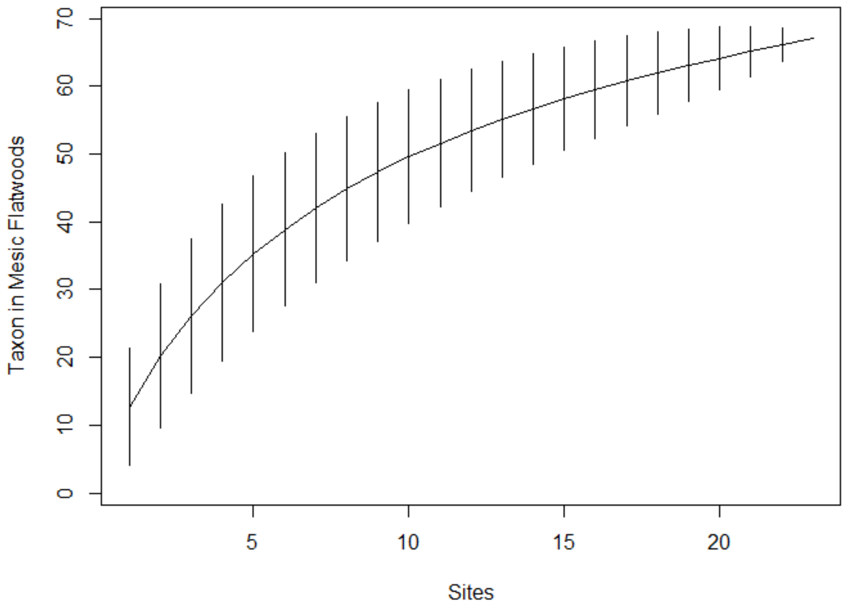

Figure AI-1. Species accumulation curve for taxon found in mesic flatwoods sampling plots.

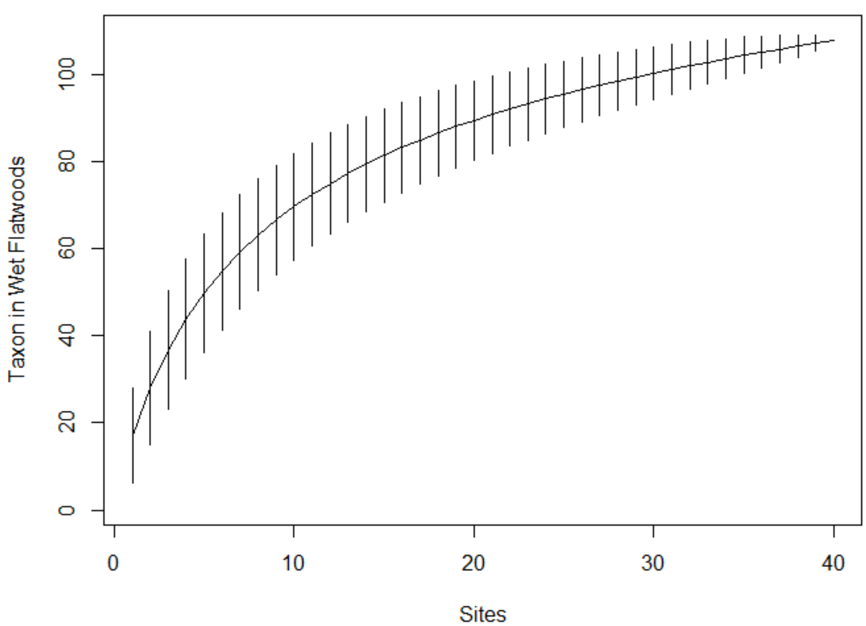

Figure AI-2. Species accumulation curve for taxon found in wet flatwoods plots.

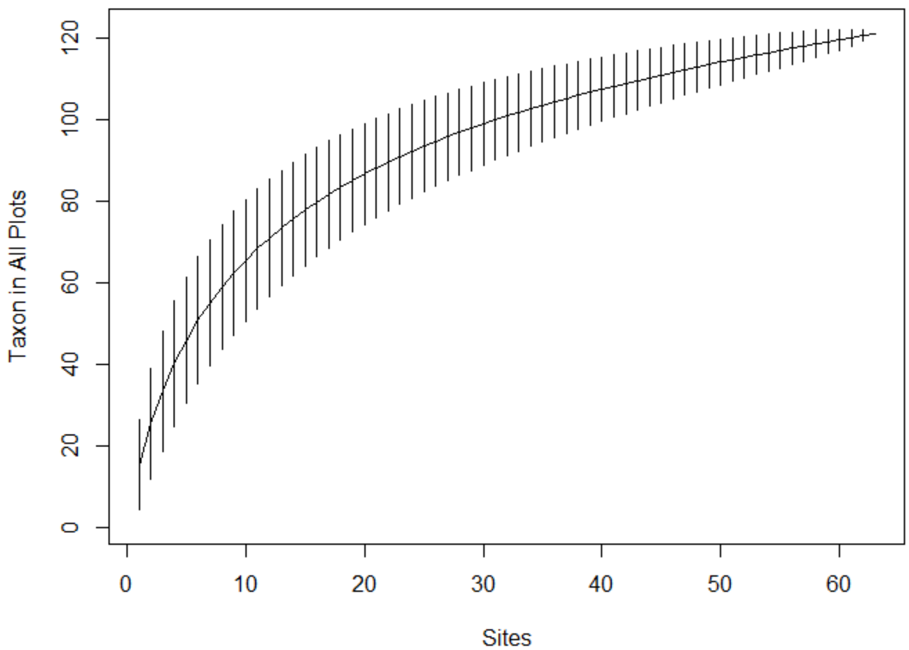

Figure AI-3. Species accumulation curve for all species detected at Flint Rock in both mesic flatwoods and wet flatwoods communities.

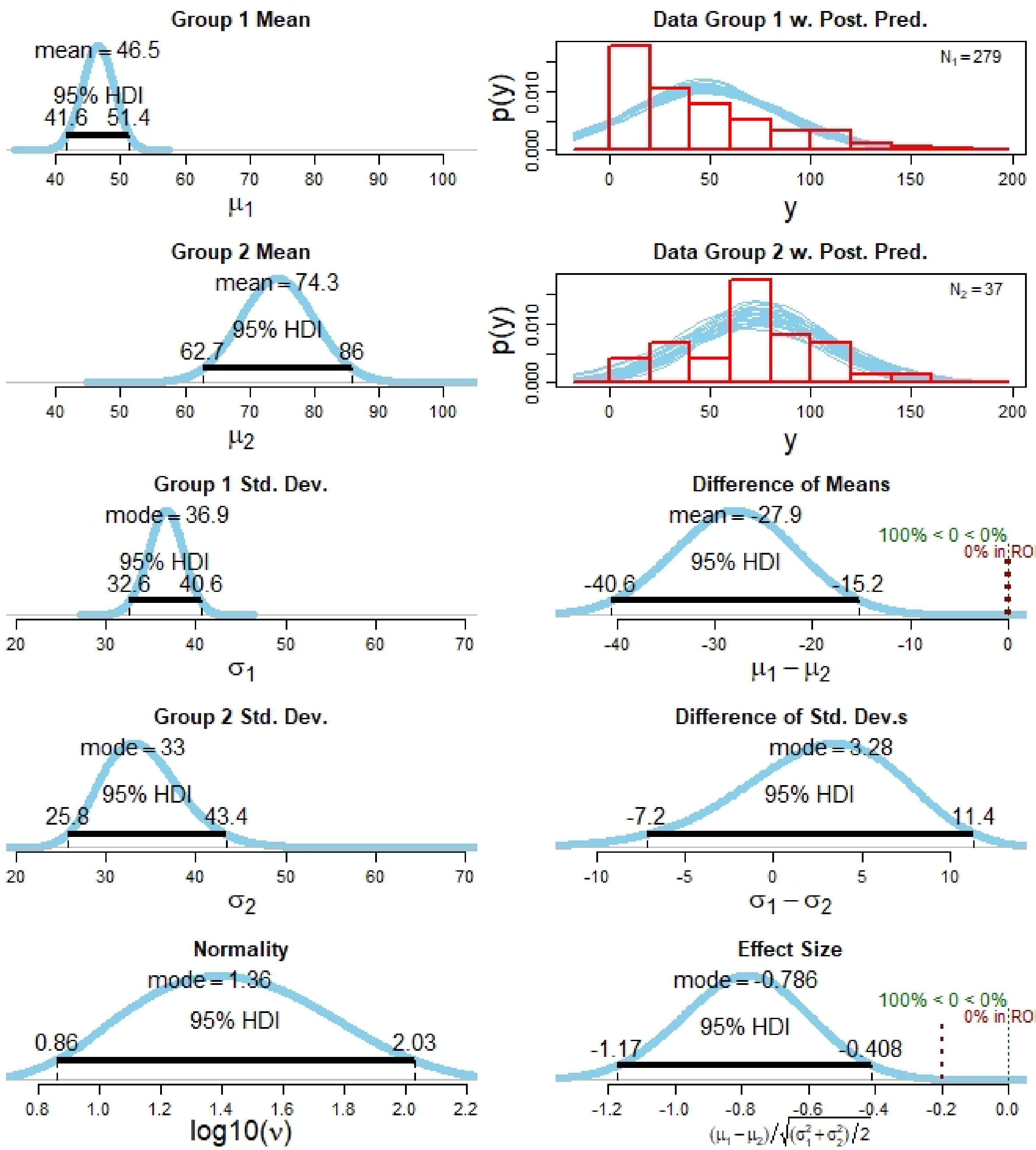

Figure AI-4. Bayesian estimation showed that mean basal area differed between mesic flatwoods sites from around the north Florida (Group 1) Flint Rock (Group 2) but that the standard deviations had similar values.

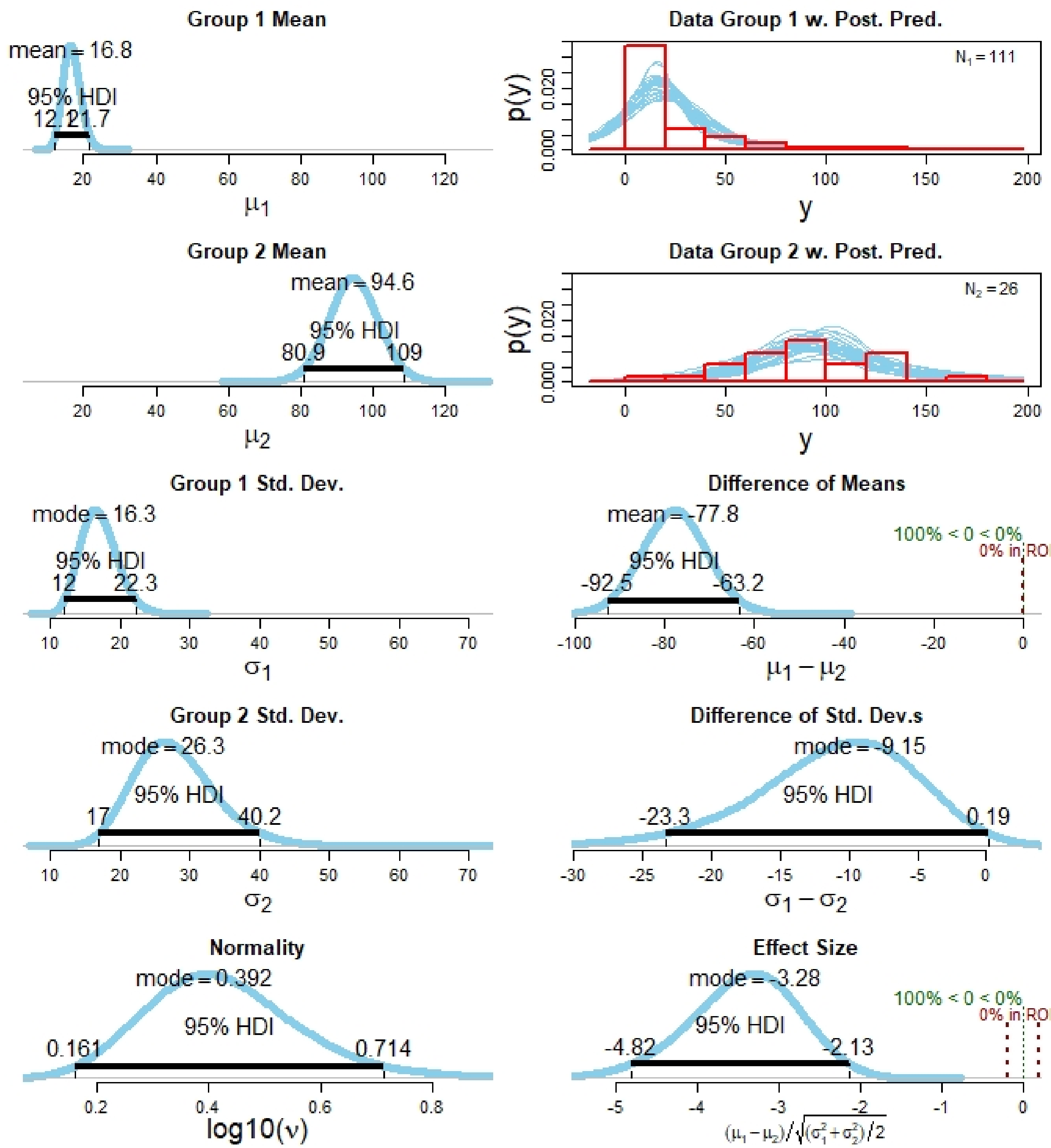

Figure AI-5. Bayesian estimation showed that the mean basal area differed between wet flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

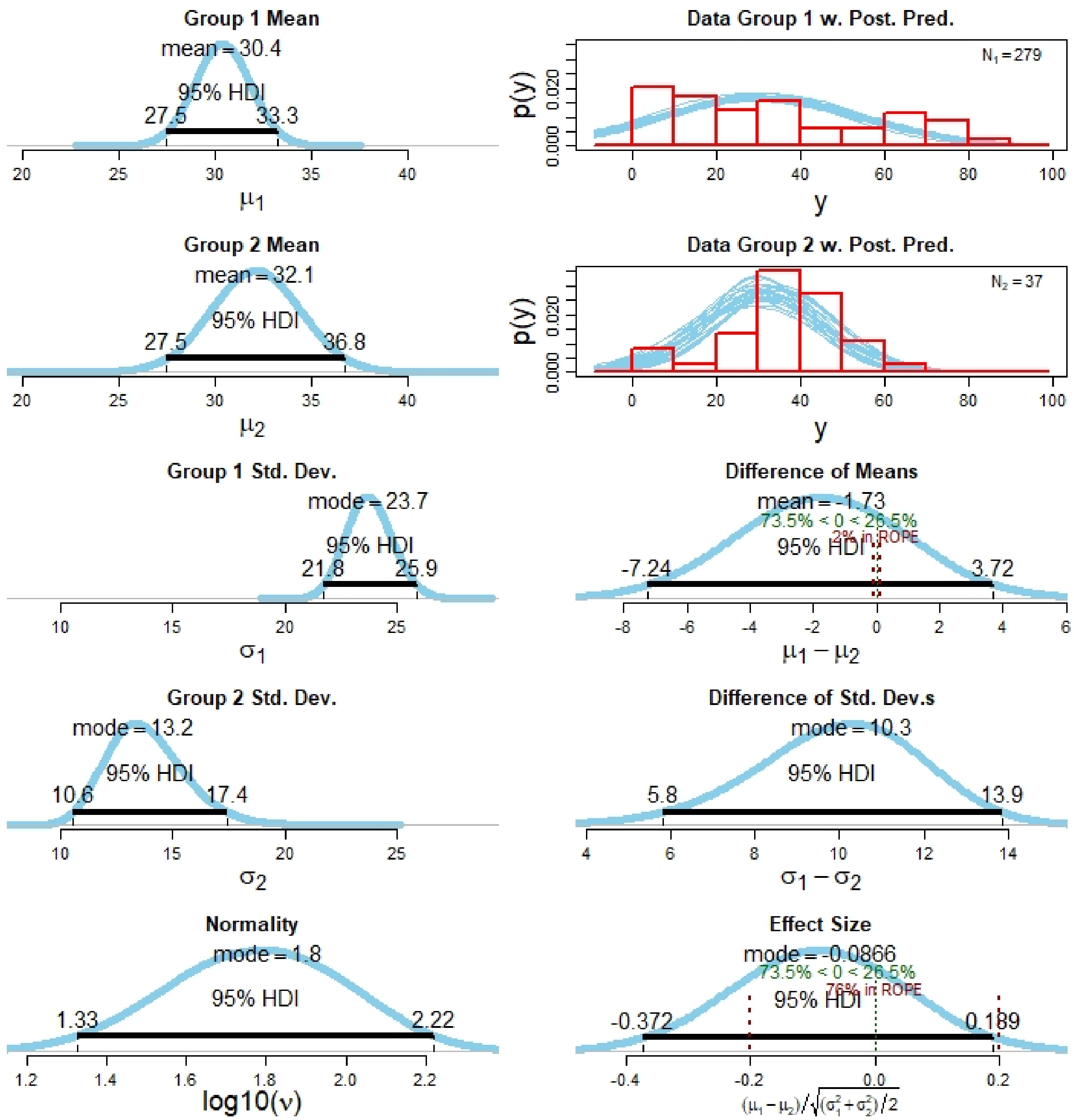

Figure AI-6. Bayesian estimation showed that the means not differ between mesic flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

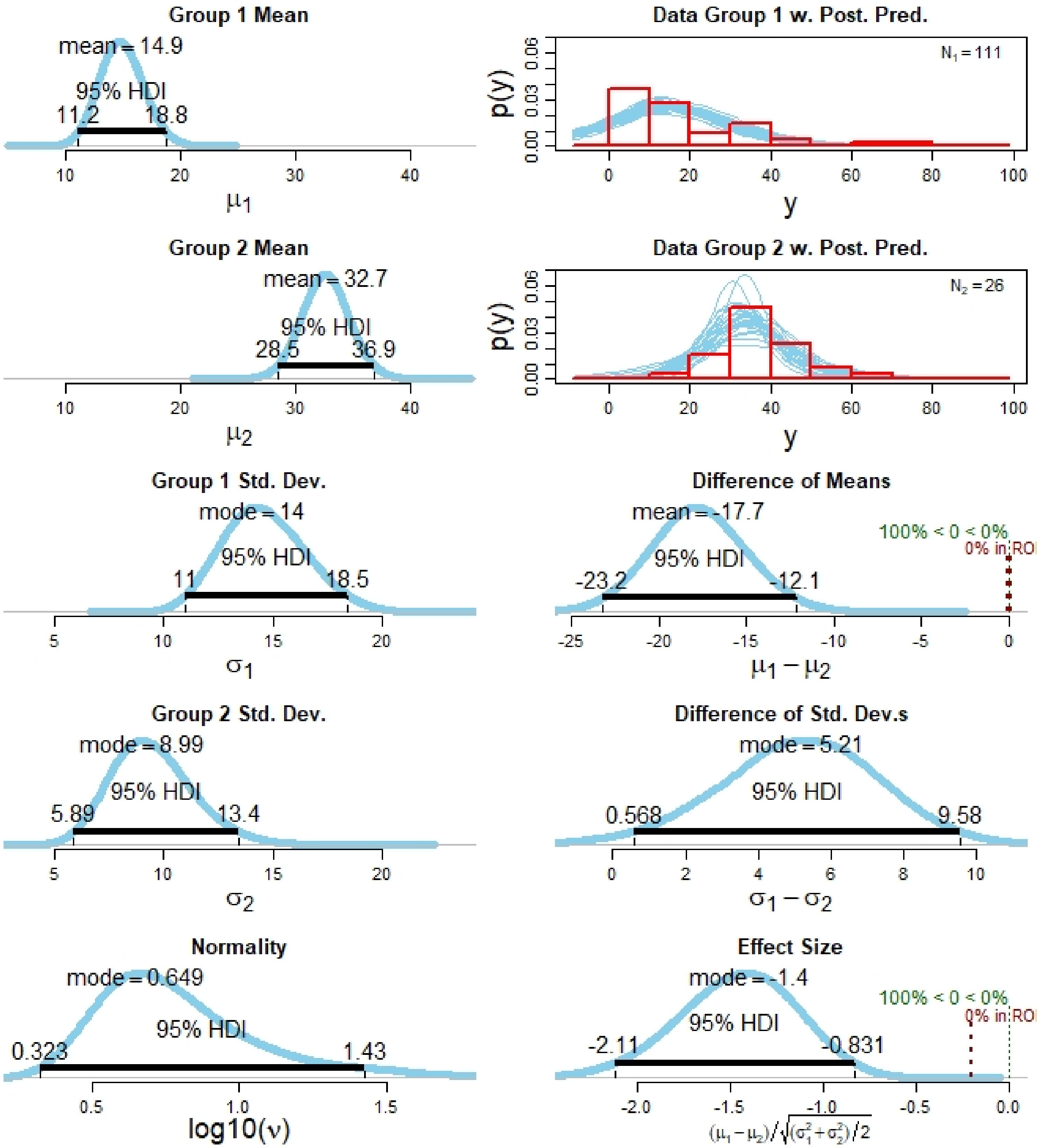

Figure AI-7. Bayesian estimation showed that canopy cover differed between wet flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

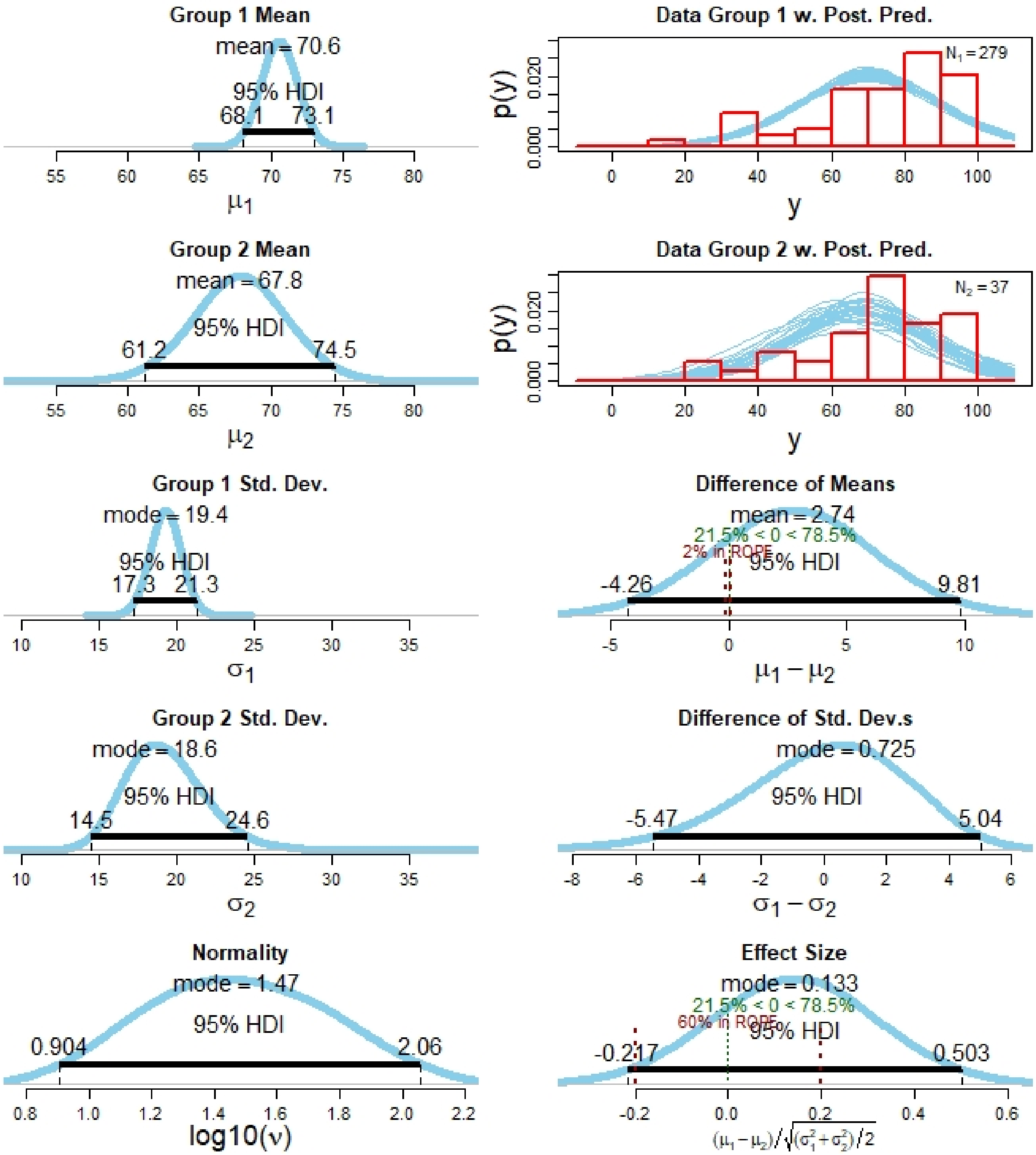

Figure AI-8. Bayesian estimation showed that mean shrub cover may not differ (78.5% confidence they do differ and 21.5% changes they don't differ) between mesic flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

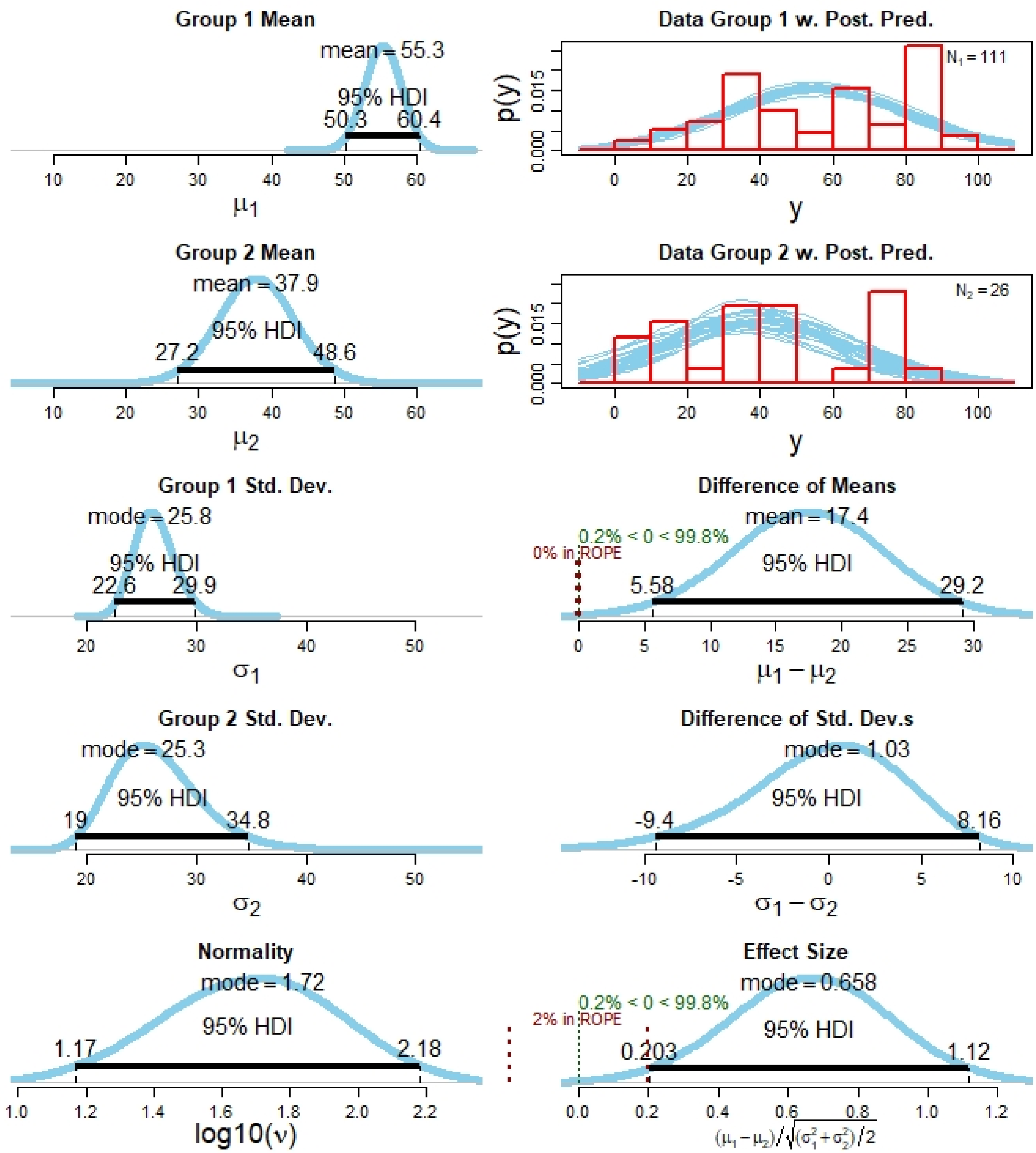

Figure AI-9. Bayesian estimation showed that mean shrub cover differed between wet flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

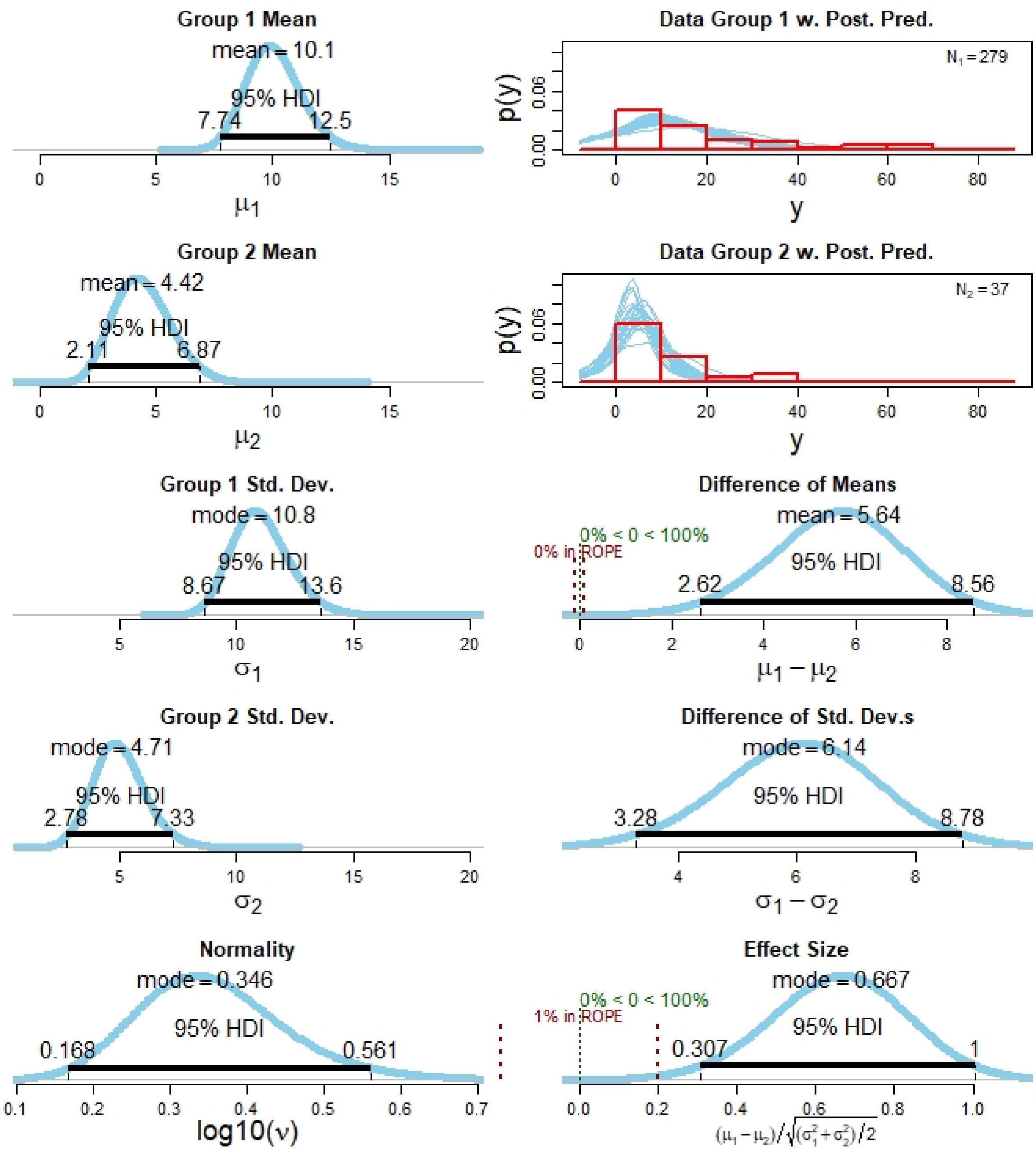

Figure AI-10. Bayesian estimation showed that mean herb cover differed between mesic flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

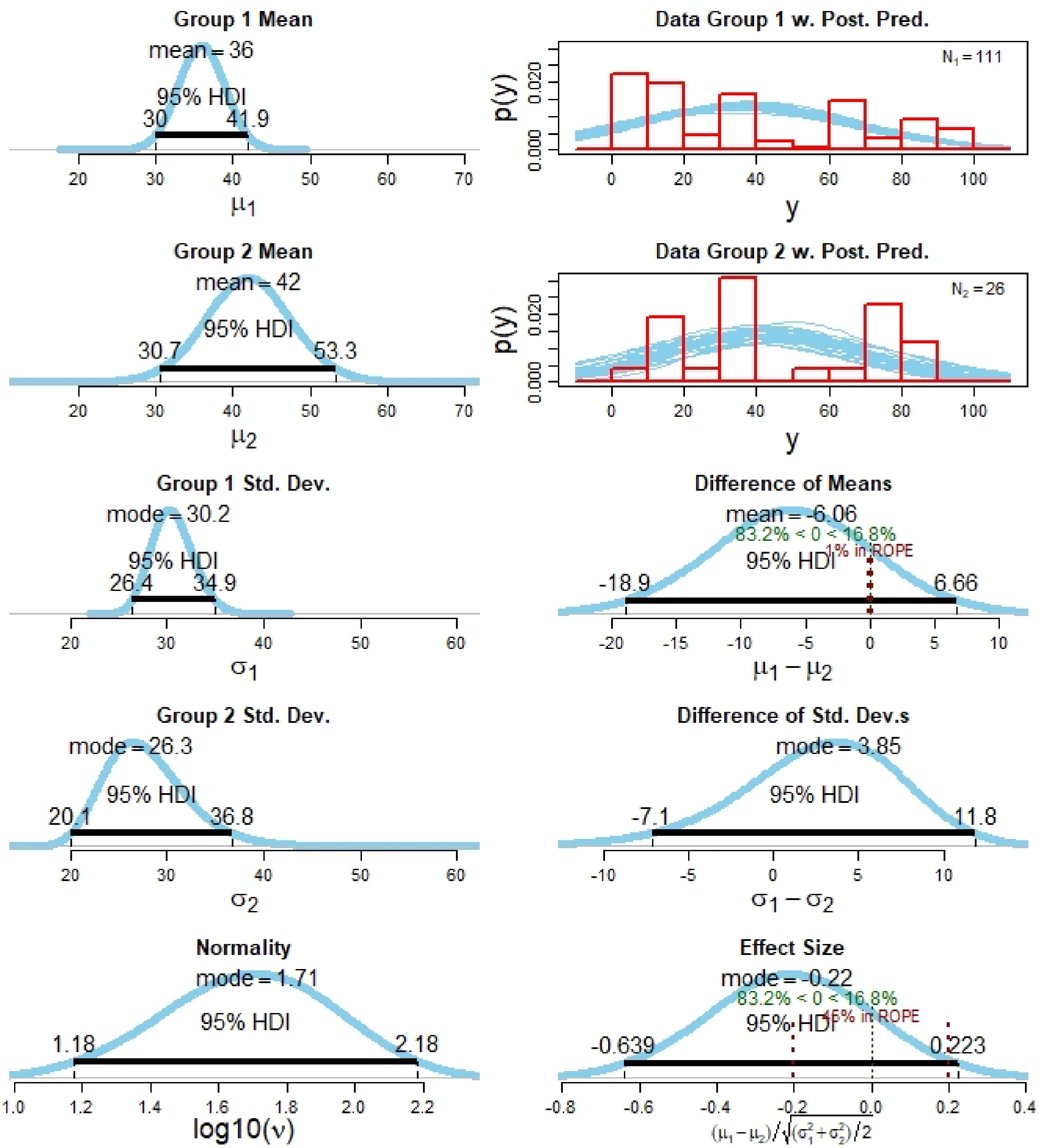

Figure AI-11. Bayesian estimation showed that herb cover may not differ to the 95% credible interval (83.2% likely the means do differ and 16.8% chance they don't differ) between wet flatwoods sites from around the state (Group 1) Flint Rock (Group 2).

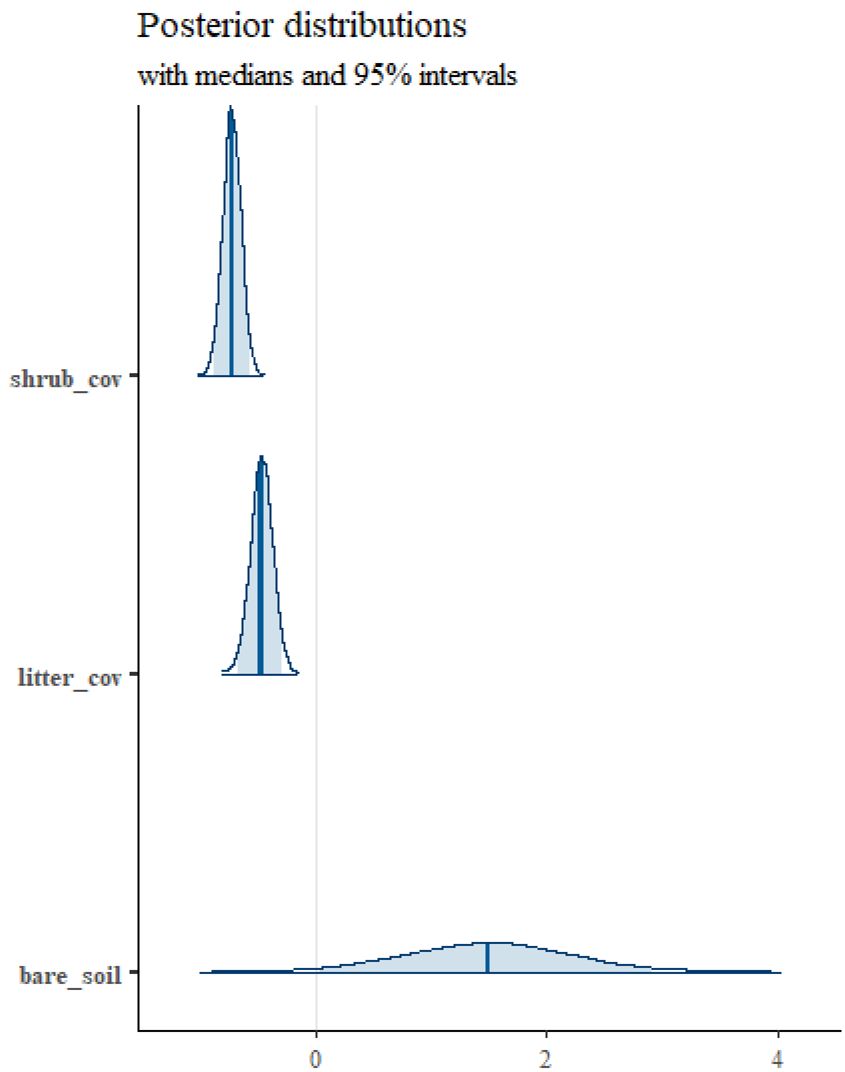

Figure AI-12. Distributions from a Bayesian GLM used to cross-validate the GLM result that shrub cover, litter cover, and bare soil cover best predicted herb cover.

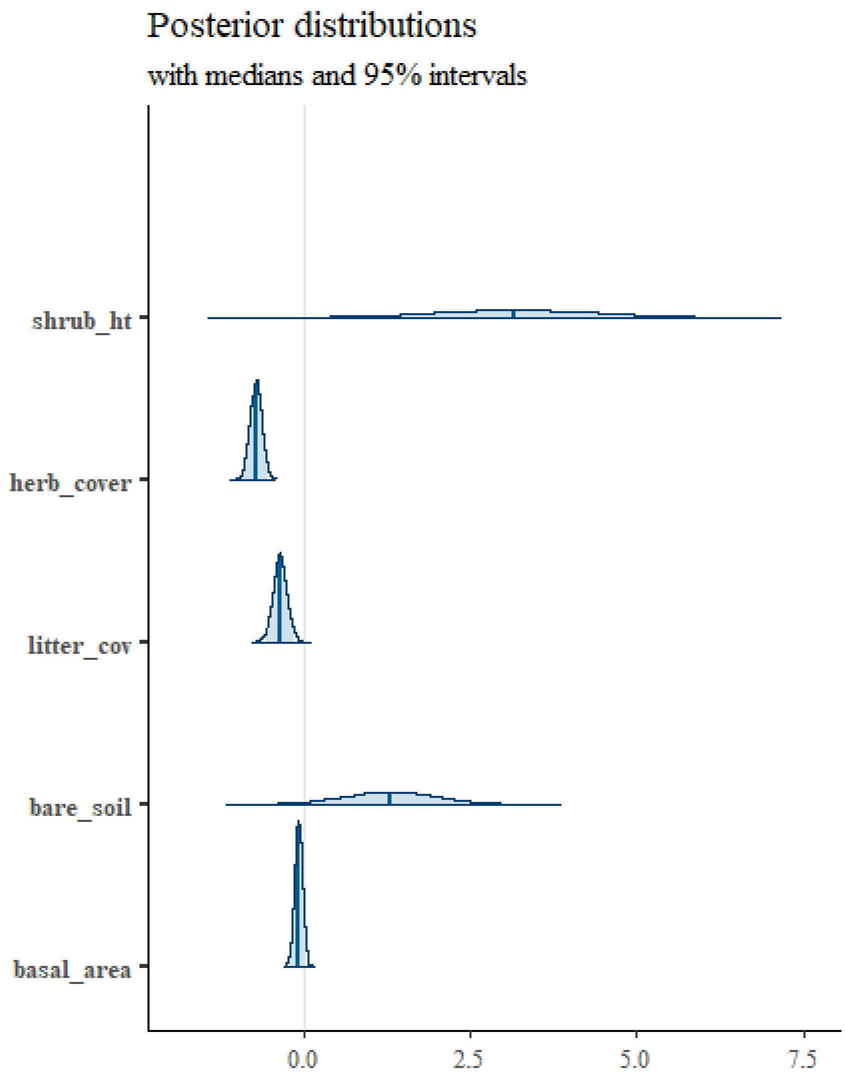

Figure AI-13. Distributions from a Bayesian GLM used to cross-validate the finding that shrub was the only metric measured that significantly predicted basal area. Unlike the GLM, Bayesian inference showed support for shrub height as helping to predict the distribution of shrub cover.

Appendix II – Species Frequency Table

Taxon	Av. dissim	Contrib. %	Cumulative %	Mean Mesic Flatwoods	Mean Wet Flatwoods
pluros	2.547	3.389	3.389	0.103	0.833
hypfas	2.176	2.897	6.286	0.154	0.708
clajam	1.968	2.619	8.905	0.231	0.667
serrep	1.875	2.495	11.4	0.59	0.125
pteaqu	1.777	2.365	13.77	0.538	0
rubpen	1.755	2.336	16.1	0.282	0.583
dicens	1.743	2.319	18.42	0.256	0.542

morcer	1.708	2.273	20.69	0.487	0.833
miksca	1.651	2.197	22.89	0.0513	0.5
hypala	1.615	2.15	25.04	0	0.5
diovir2	1.592	2.119	27.16	0.333	0.458
sabpal	1.59	2.117	29.28	0.205	0.458
woovir	1.515	2.017	31.29	0.462	0.167
perpal	1.374	1.828	33.12	0.256	0.333
acerub	1.339	1.783	34.9	0.128	0.375
liqsty	1.332	1.772	36.68	0.308	0.25
rhyfas	1.288	1.714	38.39	0.154	0.333
andglogla	1.27	1.691	40.08	0.205	0.333
hyphyp	1.235	1.644	41.72	0.179	0.292
cenasi	1.223	1.627	43.35	0.0256	0.375
ilegla	1.211	1.612	44.96	0.897	0.667
andropg	1.206	1.604	46.57	0.128	0.333
smilau	1.2	1.597	48.16	0.128	0.333
cyrrac	1.174	1.562	49.73	0.205	0.25
clealn	1.17	1.557	51.28	0.359	0.0417
eupcap	1.093	1.455	52.74	0.0256	0.333
sclret	1.081	1.439	54.18	0.0769	0.292
lycrub	1.056	1.405	55.58	0.0769	0.292
eleochg	1.033	1.375	56.96	0.0513	0.292
erigig	0.9467	1.26	58.22	0.0256	0.292
mitpet	0.9392	1.25	59.47	0	0.292
taxasc	0.9258	1.232	60.7	0.128	0.208
laccar	0.8791	1.17	61.87	0.154	0.167
rhymic2	0.836	1.113	62.98	0	0.25
smitam	0.8242	1.097	64.08	0.128	0.167
rhycad	0.8217	1.094	65.17	0.0256	0.25
scltri	0.8154	1.085	66.26	0.0769	0.208
smigla	0.7947	1.058	67.32	0.256	0
eridec	0.737	0.9809	68.3	0.0513	0.208
euspet	0.703	0.9357	69.23	0	0.208
hypcis	0.6874	0.9149	70.15	0.0769	0.167
dioter	0.6677	0.8887	71.04	0	0.208
rhymil	0.6625	0.8817	71.92	0	0.208
xyramb	0.6408	0.8529	72.77	0.103	0.125
ilevom	0.6383	0.8495	73.62	0.0256	0.167
eupmoh	0.6188	0.8235	74.44	0.0513	0.167
vacmyr	0.6144	0.8177	75.26	0.154	0.0417
lacanc	0.5812	0.7736	76.03	0.0513	0.125

ericom	0.5324	0.7086	76.74	0	0.167
vaccor1	0.5276	0.7022	77.45	0.128	0.0417
quevir	0.5224	0.6952	78.14	0.154	0
ilecor	0.5194	0.6912	78.83	0.154	0
olduni	0.5018	0.6678	79.5	0.103	0.0833
toxrad	0.4908	0.6532	80.15	0.0769	0.0833
lyoluc	0.4888	0.6506	80.8	0.128	0.0417
diovir1	0.4882	0.6498	81.45	0.0513	0.125
teucan	0.4782	0.6365	82.09	0.0256	0.125
bacang	0.4703	0.6259	82.72	0.0256	0.125
hyptet	0.4571	0.6083	83.32	0.0256	0.125
rhyinu	0.452	0.6015	83.93	0.0256	0.125
gelsem	0.45	0.5989	84.52	0.103	0.0417
stiaqu	0.442	0.5882	85.11	0.0256	0.125
houpro	0.4392	0.5845	85.7	0.0256	0.125
fuibre	0.4185	0.557	86.25	0	0.125
mitrep	0.4184	0.5569	86.81	0	0.125
violan	0.4101	0.5458	87.36	0	0.125
propec	0.4083	0.5435	87.9	0	0.125
rhucop	0.4077	0.5426	88.44	0.128	0
dichan1g	0.3948	0.5255	88.97	0.0513	0.0833
baccar	0.3778	0.5028	89.47	0	0.125
aristr	0.3672	0.4887	89.96	0	0.125
styaqu	0.3609	0.4804	90.44	0.0256	0.0833
xyrisg	0.2757	0.3669	90.81	0	0.0833
lyofru	0.2748	0.3657	91.17	0.0769	0
bersca	0.2624	0.3493	91.52	0	0.0833
erehie	0.2624	0.3493	91.87	0	0.0833
alelut	0.2541	0.3382	92.21	0	0.0833
quelau	0.2443	0.3251	92.53	0.0769	0
amparb	0.2442	0.325	92.86	0	0.0833
rhynch3g	0.2429	0.3233	93.18	0	0.0833
panhem	0.2354	0.3133	93.5	0.0256	0.0417
gayfro	0.2224	0.296	93.79	0.0769	0
parqui	0.2049	0.2727	94.06	0.0256	0.0417
pananc	0.184	0.2449	94.31	0.0256	0.0417
bachal	0.1814	0.2414	94.55	0.0256	0.0417
eriver	0.1804	0.24	94.79	0.0256	0.0417
vitrot2	0.1639	0.2182	95.01	0.0513	0
cirhor	0.156	0.2076	95.22	0	0.0417
junmar	0.1503	0.2	95.42	0	0.0417

ruecar	0.1503	0.2	95.62	0	0.0417
hydcor	0.1503	0.2	95.82	0	0.0417
rhylat	0.1503	0.2	96.02	0	0.0417
axofur	0.145	0.1929	96.21	0	0.0417
polygag	0.145	0.1929	96.4	0	0.0417
nysbif	0.145	0.1929	96.6	0	0.0417
calame	0.145	0.1929	96.79	0	0.0417
coerug	0.1354	0.1802	96.97	0	0.0417
quenig	0.1313	0.1748	97.14	0.0513	0
asclan	0.127	0.1691	97.31	0	0.0417
liaele2	0.127	0.1691	97.48	0	0.0417
saucer	0.127	0.1691	97.65	0	0.0417
eustacg	0.127	0.1691	97.82	0	0.0417
cepocc	0.1197	0.1593	97.98	0	0.0417
bidmit	0.1131	0.1505	98.13	0	0.0417
smiaur	0.1131	0.1505	98.28	0	0.0417
cyperaf	0.1131	0.1505	98.43	0	0.0417
grahis	0.1131	0.1505	98.58	0	0.0417
pinell	0.1131	0.1505	98.73	1	0.958
ilemyr	0.09724	0.1294	98.86	0.0256	0
sabmac	0.09365	0.1246	98.99	0.0256	0
asttor	0.09032	0.1202	99.11	0.0256	0
smibon	0.08722	0.1161	99.22	0.0256	0
rhycil	0.08433	0.1122	99.33	0.0256	0
eragrog	0.07908	0.1053	99.44	0.0256	0
fimbrig	0.0767	0.1021	99.54	0.0256	0
panicug	0.0767	0.1021	99.64	0.0256	0
quenig clealn	0.07446	0.0991	99.74	0.0256	0
rhepet	0.07234	0.09628	99.84	0.0256	0
rhocan	0.06182	0.08228	99.92	0.0256	0
asteraf	0.05897	0.07848	100	0.0256	0

Appendix III – Metrics Collected at Each 2.5 m Radius Plot

DATA ATTRIBUTES, DEFINITIONS, AND VALUES FOR NATURAL COMMUNITY POINTS

ATTRIBUTES	VALUES
SITE	Name of the managed area
DATE	Date of data collection
SURVEYOR	Name of the FNAI field surveyor

FIELD_ID — Number assigned to this point by the FNAI scientist during field work; not necessarily unique.

POINT_ID — Unique number assigned to each point.

FNAI_NC — Type of current natural community observed at the point, using the FNAI classification system plus

"pine plantation" – where planted pines are having an ongoing detrimental effect on native groundcover, where the history of planted pines has damaged ground cover to the point where further restoration beyond thinning and burning is required, or where the method of planting (e.g. bedding) has severely impacted groundcover.

"pasture - improved" pasture grass-dominated with little or no native species remaining and evidence of current or recent pasture activity (mowing, grazing, burning)

"pasture - semi-improved" contains a mix of pasture grasses and native groundcover (due to incomplete conversion to pasture, not regeneration). This category should apply regardless of pasture maintenance.

"Successional hardwood forest" – Closed-canopied forest dominated by fast growing hardwoods such as laurel oak (*Quercus hemisphaerica*), water oak (*Quercus nigra*), and/or sweetgum (*Liquidambar styraciflua*), often with remnant pines. These forests are either invaded natural habitat (i.e., mesic flatwoods, sandhill, upland pine, upland mixed woodland) due to lengthy fire-suppression or old fields that have succeeded to forest. The subcanopy and shrub layers of these forests are often dense and dominated by smaller individuals of the canopy species. Successional hardwood forests can contain remnant species of the former natural community such as turkey oak (*Quercus laevis*), saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), and infrequently wiregrass (*Aristida stricta* var. *beyrichiana*). Additionally, species such as beautyberry (*Callicarpa americana*), muscadine (*Vitis rotundifolia*), and sparkleberry (*Vaccinium arboreum*) are common. Restoration of these forests includes mechanical tree removal and reintroduction of fire. Where characteristic herbaceous species (e.g., wiregrass) have been lost, reintroduction via seed or plants may be necessary to restore natural species composition and community function.

“Successional hydric shrubland/forest” - Shrubland or closed-canopied forest occupying disturbed areas and dominated by fast growing hydrophilic hardwoods such as titi (*Cyrilla racemiflora*), black titi (*Cliftonia monophylla*), sweet gallberry (*Ilex coriacea*), sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), water oak *(Quercus nigra),* swamp laurel oak *(Quercus laurifolia),* wax myrtle (*Morella cerifera*), blackberry (*Rubus argutus*), and groundsel tree (*Baccharis halimifolia*). Weedy vines such as smilax (*Smilax* spp.) and muscadine (*Vitis rotundifolia*), and invasive exotic plants including *Japanese climbing fern (Lygodium japonicum) and privet (Ligustrum spp.)* may be common in the subcanopy and shrub layers. These shrubland/forests may invade herbaceous habitats (i.e., wet prairie, wet flatwoods, seepage slope, depression marsh, basin marsh, floodplain marsh) due to lengthy fire-suppression and/or hydrological alterations <u>OR</u> forested wetlands (dome swamp, basin swamp, strand swamp) that have been cleared and are not succeeding to swamp but to highly disturbed shrubland or forest dominated by hydrophilic hardwoods. Successional hydric shrubland/forests are often shrub thickets with few of the characteristic herbaceous or canopy (e.g. *Taxodium*) species from the former community remaining. They can resemble naturally occurring shrub bogs and can be distinguished from them by occurring in areas of historically herbaceous communities, where fire suppression and/or hydrological alterations have taken place or in former forested swamps that have been logged or undergone severe hydroperiod disruptions. Although some shifts in community type may be better described with a natural community designation, the use of “successional hydric shrubland/forest” is suitable to label areas that are known to be highly disturbed and altered, and where restoration efforts of hydrology restoration and/or re-introduction of fire would be particularly beneficial.

“Restoration natural community” – Former altered landcover type or successional natural community (pine plantation, xeric hammock, etc.) where active restoration is ongoing to return the community to its historic state. Examples of restoration activities include pine thinning, longleaf pine planting, groundcover restoration, hydrology restoration, and removal of exotics and other undesirable vegetation. In historically pyrogenic restoration natural communities, restoration activities are accompanied by the application of prescribed fire.

and the following ruderal types:

Abandoned field/abandoned pasture – Old fields, fallow pastures, early successional areas formerly grazed or in agriculture without recent activity to maintain the area as pasture or planted field. These areas are often dominated by weedy native (e.g., *Rubus* spp., *Morella cerifera*) and non-native species (e.g., *Indigofera hirsuta*). Generally designated for old pastures when weedy cover from woody species (*Rubus* spp., *Morella cerifera*, etc) is greater than 20 percent.

Agriculture – Row crops, citrus groves, and sod fields that are generally being maintained to grow products for human or domesticated animal use.

Artificial pond – water retention ponds, cattle ponds, etc.

Borrow area – dry or wet depression resulting from past or present mining operation. Phosphate pits and upland borrow pits (sand pits, clay pits, etc.).

Canal/ditch – Artificial drainage way.

Clearcut pine plantation – Areas of pine plantation that have undergone clearcutting of the pine canopy but have not yet been replanted with pine trees. These areas are often dominated by weedy native and non-native species. Natural pine dominated communities that have been clearcut but not further altered should be classified as the natural community.

Clearing –Recent or historic clearings that have significantly altered the groundcover and/or overstory of the original natural community (old homesites, etc.), clearings of unknown origin.

Developed – Check stations, ORV use areas, parking lots, buildings, maintained lawns (as part of recreational, business, or residential areas), botanical or ornamental gardens, campgrounds, recreational, industrial, and residential areas.

Invasive exotic monoculture – Stand of invasive exotic plant species that have eliminated the native vegetation, or nearly so.

Impoundment – Stream or watershed impoundment.

Road – Paved or unpaved

Spoil area – Area where dredge or spoil material is deposited, may be re-colonized by plants

Utility corridor – Electric, gas, telephone right-of-ways

Wildlife food plot - Planted or unplanted areas to benefit wildlife or game species; includes dove fields; if not maintained these areas are often dominated by weedy native and non-native species.

ROWTREAT Type of silvicultural treatment (e.g. take or leave row) in each subplot. If the plot overlaps two rows, then it will be deemed "overlapping."

Categorical Values: Take, Leave, Overlapping

CANOPY_COV Canopy cover is the percentage of ground covered by the canopy, when the edges of the canopy are mentally projected down to the ground. Canopy includes all woody stems >4"DBH.

Canopy cover values:

None
<1%
1-5%
6-15%
16-25%

26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

SUBCANOPY_COV Canopy cover is the percentage of ground covered by the canopy, when the edges of the canopy are mentally projected down to the ground. Canopy includes all woody stems 2-4”DBH.

Subcanopy cover values:

None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

CANOPY_HT Canopy height was determined by rangefinder estimate or using a clinometer where practical. Canopy height classes:

< 6 feet (applies only to dwarf cypress)
6 feet - 15 feet
>15 feet - 30 feet
>30 feet - 45 feet
>45 feet - 60 feet
>60 feet - 100 feet
>100 feet

CANOPY_SPP Dominant canopy species listed in order of abundance

SUBCANOPY_SPP Dominant canopy species listed in order of abundance.

BASALAREA Basal area of pine canopy trees was taken using a 10-factor prism in pine-dominated communities, such as mesic and wet flatwoods, and in pine plantations.

CANOPY_AGE Canopy age was determined by visual estimate. Canopy age classes:

Old growth: average dbh of canopy trees is very large and/or old growth tree morphology is prevalent in the canopy (e.g. "flat top" morphology in pines or cypress). If tree ages are known, they should average 100+ years old.

Older mature: average dbh of canopy trees is medium to large, and some old-age tree morphology (as described in "old growth" above) may be present in the canopy, but is not the norm for most canopy trees. If tree ages are known, they should average 50+ years old.
Mature: average dbh of canopy trees is medium size, and may have reached the typical height for a mature forest, but no trees exhibit old age morphology, and there are no trees of very large dbh present. If tree ages are known, they should be more than 30 years old.
Younger mature: average dbh for canopy trees is small, and trees may not have reached full height. The majority of canopy trees have reached reproductive status. If tree ages are known, average canopy tree age should be 5-30 years.
Pre-reproductive: average canopy tree is small in stature and little or no reproduction is evident, because the trees are too young.

SHRUBCOV Total shrub cover includes all multi-stemmed woody plants, regardless of height, plus all saplings, woody seedlings, and woody, non-aerial vines <2” DBH.

Total shrub cover values:
None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

SHRUB_HT Shrub height classes:
<1 ft
1 ft - 3 ft
>3 ft - 6 ft 6 ft - 9 ft
>9 ft - 15 ft
>15 ft - 30 ft
>30 ft - 45 ft
>45 ft - 60 ft
>60 ft

PALMCOV Includes all palms < 4” DBH. Palm cover values:
None
<1%
1-5%

6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

PALM_HT — Shrub height classes:
<1 ft
1 ft - 3 ft
>3 ft - 6 ft 6 ft - 9 ft
>9 ft - 15 ft
>15 ft - 30 ft
>30 ft - 45 ft
>45 ft - 60 ft
>60 ft

TITI_COV — Titi cover is a subset of SHRUBCOV and includes black titi (*Cliftonia monophylla*) and titi (*Cyrilla racemiflora*). Titi cover includes all titi <4” DBH.
Titi values:
None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

TITI_HT — Shrub height classes:
<1 ft
1 ft - 3 ft
>3 ft - 6 ft 6 ft - 9 ft
>9 ft - 15 ft
>15 ft - 30 ft
>30 ft - 45 ft
>45 ft - 60 ft
>60 ft

SHRUBDOM	Dominant shrub species listed in order of abundance.
HERB_COVER	Herb cover includes all non-woody, soft-tissued plants regardless of height, including non-woody vines, legumes, and graminoids (grasses, sedges, rushes). Herb cover values: None <1% 1-5% 6-15% 16-25% 26-35% 36-45% 46-55% 56-65% 66-75% 76-85% 86-95% 96-100%
HERBDOM	Dominant herbaceous species listed in order of abundance.
ALL_GRAMIN	All graminoid cover includes *all* grasses (Graminae/Poaceae), sedges (Cyperaceae), and rushes (Juncaceae). Graminoid cover values: None <1% 1-5% 6-15% 16-25% 26-35% 36-45% 46-55% 56-65% 66-75% 76-85% 86-95% 96-100%
WIREGRASS	Cover of wiregrass (*Aristida stricta*) values: None <1% 1-5% 6-15% 16-25% 26-35% 36-45% 46-55% 56-65%

66-75%
76-85%
86-95%
96-100%

PYROGRAM — Pyrogenic graminoids (Poaceae, Juncaceae, Cyperaceae) that potentially carry fire in a manner similar to wiregrass. This includes *Panicum abscissum, Sporobolus floridanus, Aristida rhizomophora, Cladium jamaicense*.
Pyrogram cover values:
None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

LITTER_COV — Litter cover includes litter exposed between plants as well as litter under shrubs, grass clumps, or other vegetation. Litter cover values:
None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

LICHEN_MOS — Lichen-moss cover includes all lichens and mosses, including those growing under other vegetation. Lichen-moss cover values:
None
<1%
1-5%
6-15%
16-25%
26-35%

36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

EPIPHYTE — Epiphyte abundance refers to ferns, bromeliads, and orchids that typically occur as epiphytes as well as other species that may inhabit tree trunks just above the water line in swamps. Epiphyte abundance values:
Infrequent: one or two trees or branches in the plot have a few epiphytes.
Occasional: several trees or branches support epiphytes.
Common: approximately half the trees or tree branches in the plot carry epiphytes, or a few trees or branches are dense with them.
Abundant: more than half of the trees or branches have epiphytes, or several trees or branches are especially dense with them.

EPIPHYTDOM — Dominant epiphytic plants listed in order of abundance.

VINE_ABUND — Vine abundance refers to climbing, sprawling, or twining woody vines. This field is independent of any other field that may include vines, e.g. WEEDY_COV or EXOTICS. For example, information on Old World climbing fern is entered here AND under EXOTICS. Vine abundance values:
none
Infrequent: one or two vines occur in the plot.
Occasional: several trees or branches support vines.
Common: approximately half the trees or tree branches in the plot support vines.
Abundant: more than half of the trees or branches support vines.

VINEDOM — Dominant vines listed in order of abundance.

BARE_SOIL — Bare soil coverage includes bare soil surface exposed between plants as well as the litter-free ground surface under vegetation (i.e. not “sky to ground” coverage). Bare soil cover values:
None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

INUNDATED	Is approximately 50% or more of the plot under water? Inundated values are: Yes No
ORGANIC	Organic layer depth includes the top surface of the soil that is still recognizable as being of plant origin and which has not fully decomposed. Does not include recognizable plant parts such as leaves and twigs, which are considered litter. Does not include sand grains stained black with organic material UNLESS there is a "greasy" feel when the sand is rubbed between your fingers and more than 75% of the grains are coated black with organic matter, as is the case in hydric soils. Organic soil depth values in inches: <1" 1 - 2" >2"
FINE_FUEL	Fine fuel load includes all terrestrial material less than 0.25 inch in diameter or in width, e.g. small twigs, narrow-leaved grasses, and pine needles. This field is NOT exclusive of litter, and some or all of the material recorded here may also be reflected in LITTER_COV. Fine fuel load cover values: none low moderate high
MED_FUEL	Medium fuel load includes material greater than 0.25 inch wide or in diameter but less than or equal to 3 inches, e.g. pine cones, larger twigs, small branches. This field is NOT exclusive of litter, and some or all of the material recorded here may also be reflected in LITTER_COV. Medium fuel load values: none low moderate high
HEAVY_FUEL	Heavy fuel load includes material greater than 3 inches wide or in diameter, such as large branches and logs. This field is NOT exclusive of litter, and some or all of the material recorded here may also be reflected in LITTER_COV. Heavy fuel load values: none low moderate high
WEEDYCOVER	Weedy cover includes **native** species present in the plot which, IN THAT PLOT, are functioning as invasive species, early successional pioneers, or disturbance-opportunists. Species that frequently become weedy such as blackberry (*Rubus* spp.), cattail (*Typha* spp.), broomsedge (*Andropogon virginicus*), catbrier (*Smilax auriculata*), muscadine (*Vitis rotundifolia*), and

dog fennel (*Eupatorium capillifolium*). Data in this field are independent of any other field, e.g. a weedy stand of broomsedge is recorded here as well as in ALL_GRAMIN, invasive blackberries are recorded here as well as in short shrubs, and a disturbance-related sprawl of muscadine vines is included here and in VINE_ABUND. Weedy cover values:

None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

EXOTICSCOV — Exotics cover includes any non-native species present in the plot. Exotics cover values are:

None
<1%
1-5%
6-15%
16-25%
26-35%
36-45%
46-55%
56-65%
66-75%
76-85%
86-95%
96-100%

PINEDBH — Count <1" DBH and measure all others

OTHERDBH — Count <1" DBH and measure all others

POLYDIST_1 — Polygon disturbance 1 describes the primary, or most prevalent, disturbance observed anywhere in the natural community polygon – not just in the plot surrounding the point. This is one of the few attributes that describe conditions observed throughout the polygon, not just within the plot. All types of disturbance, hydrologic or otherwise, are recorded in POLYDIST_1, 2, or 3. If there is more than one type of disturbance, the most prevalent form of disturbance is entered here and lesser disturbances are entered in POLYDIST_2 and POLYDIST_3. If there are more than three disturbance types, they are entered in DISTURBCOM. Polygon disturbance values are:

not evident
agriculture
cattle disturbance
clearing (includes dove fields, old fields, and food plots that are less than 0.5 acre, i.e. that are not delineated as ruderal polygons)
ditch/canal
exotics
firebreaks
fire suppression
forestry slash (e.g., landing area debris, slash piles.)
forestry groundcover disturbance (tire or equipment damage that removes top soil or results in rutting).
hog digging
hydrology alteration (ditching or drawdown)
impoundment (e.g. artificial ponds and lakes, borrow pits, dams, dikes)
ORV trail
road
trash dumping
woody encroachment
cause unknown
other (details provided in the DISTURBCOM field)

POLYDIST_2	Polygon disturbance 2 describes secondary disturbance in the polygon. If there are more than two types of disturbance, the third-most prevalent form of disturbance is entered in POLYDIST_3. POLYDIST_2 are the same as for POLYDIST_1.
POLYDIST_3	Polygon disturbance 3 describes the third-most prevalent form of disturbance in the polygon. POLYDIST_3 are the same as for POLYDIST_1.
DISTURBCOM	Disturbances not included in POLYDIST_1, _2, or _3, or other information about disturbance in the polygon.
POLY_SEVER	Polygon disturbance severity describes the overall impact of all combined disturbances noted in the natural community polygon. Values for polygon disturbance severity are: light moderate heavy severe
COMMENTS	Comments provides additional, optional information about the plot or polygon.
NC_RANK	Rank based on factors that reflect the present quality, condition, and landscape context of the natural community. Quality reflects species components; condition describes community structure; landscape context is the quality and condition of the surrounding communities irrespective of property ownership. Ranks reflect the degree to which people have directly

or indirectly adversely impacted community composition, structure, and/or function, including alteration of natural disturbance processes.

Excellent: Natural community is in excellent quality and condition. It is dominated by components and structure characteristic of that natural community type. This natural community has minimal restoration needs and management is at a maintenance condition. No or minimal exotic species are present. Landscape context allows for active management for rare elements and ecological processes.

Good: Natural community is in good quality and condition. Most dominant components of the community are present but some characteristic species are noticeably missing and/or there is a minor presence of weedy or early successional species. Community structure is such that aggressive fire management may be needed to achieve maintenance condition. May have light levels of invasive exotic species. Landscape context allows for active management of rare species and ecological processes.

Fair: Natural community is in fair quality and condition. Many dominant components of the community are missing or there is a heavy presence of weedy or early successional species. The community is in need of restoration to restore community structure (e.g., aggressive fire management or more intensive restoration or may have been converted in the past and is now in some stage of restoration). May have moderate levels of invasive exotic species OR heavy invasive exotic species infestations but is undergoing active treatment. Landscape context may hinder management of rare species and ecological processes.

Poor: Natural community is generally degraded but still retains some components and/or structure characteristic of the natural community. This natural community requires extensive restoration. Landscape context may prevent management of rare species and ecological processes.

Appendix IV- Summary Statistics for all Variables Collected

```
> summary(FRfinal2)
      FID          transect       Plot                FNAI_NC
 Min.   : 0.0    1       : 9   c       : 8   pine plantation:63
 1st Qu.:15.5    2       : 9   d       : 8
 Median :31.0    6       : 9   g       : 8
 Mean   :31.0    8       : 9   a       : 7
 3rd Qu.:46.5    4       : 7   b       : 7
 Max.   :62.0    5       : 7   f       : 7
                 (Other):13   (Other):18
           HistoricNC             ClusterNC      canopy_cov      subcanopy_
 mesic flatwoods:23   Mesic Flatwoods:37   Min.   : 2.5   Min.   :0.0000
 wet flatwoods  :40   Wet Flatwoods  :26   1st Qu.:30.5   1st Qu.:0.0000
                                           Median :30.5   Median :0.0000
                                           Mean   :32.5   Mean   :0.1508
                                           3rd Qu.:40.5   3rd Qu.:0.0000
                                           Max.   :60.5   Max.   :2.5000

   canopy_ht               canopy_spp   Canopy_tspp     subcanopy2 Subcanopy_tspp
 Min.   : 0.00   pinell         :50   Min.   :1.00   cyrrac: 1   Min.   :0.0000
 1st Qu.:52.50   pinell,sabpal: 5   1st Qu.:1.00   liqsty: 1   1st Qu.:0.0000
 Median :52.50   liqsty         : 1   Median :1.00   nysbif: 1   Median :0.0000
 Mean   :49.17   pinell,acerub: 1   Mean   :1.19   taxasc: 4   Mean   :0.1111
 3rd Qu.:52.50   pinell,liqsty: 1   3rd Qu.:1.00   NA's   :56   3rd Qu.:0.0000
 Max.   :52.50   pinell,nysbif: 1   Max.   :2.00               Max.   :1.0000
                 (Other)        : 4

  basal_area                  canopy_age    shrub_cov        shrub_ht
Min.   :   0.00   mature          :53   Min.   : 2.5   Min.   :0.500
1st Qu.: 65.00   younger mature: 9   1st Qu.:35.5   1st Qu.:2.000
Median : 80.00   NA's            : 1   Median :60.5   Median :4.500
Mean   : 82.06                         Mean   :55.2   Mean   :4.325
3rd Qu.:105.00                         3rd Qu.:70.5   3rd Qu.:4.500
Max.   :170.00                         Max.   :90.5   Max.   :7.500

   palm_cov         palm_ht          titi_cov           titi_ht
Min.   : 0.00   Min.   :0.000   Min.   : 0.000   Min.   :0.0000
1st Qu.: 0.00   1st Qu.:0.000   1st Qu.: 0.000   1st Qu.:0.0000
Median : 2.50   Median :2.000   Median : 0.000   Median :0.0000
Mean   :11.52   Mean   :2.397   Mean   : 1.254   Mean   :0.4444
3rd Qu.:15.50   3rd Qu.:4.500   3rd Qu.: 0.000   3rd Qu.:0.0000
Max.   :70.50   Max.   :7.500   Max.   :20.500   Max.   :4.5000

                                                          shrub_dom     shrub_tspp
clealn,cyrrac,hyphyp,morcer,ilegla,rhucop,rubpen,perpal : 1   Min.   : 2.000
clealn,ilegla,ilecor,rubpen,hypfas,cyrrac               : 1   1st Qu.: 5.000
clealn,ilegla,perpal,gayfro                             : 1   Median : 6.000
cyrrac,ilevom,morcer,rhyfas,styaqu,hyphyp               : 1   Mean   : 6.317
cyrrac,ilevom,morcer,rhyfas,styaqu,hyphyp,diovir2,sabpal: 1   3rd Qu.: 7.000
cyrrac,rubpen,ilegla,morcer,diovir2,hypfas,hyphyp,stiaqu: 1   Max.   :13.000
```

```
  herb_cover
 Min.   : 0.5
 1st Qu.: 2.5
 Median :10.5
 Mean   :21.8
 3rd Qu.:30.5
 Max.   :80.5

                                                                  herb_dom
 pteaqu                                                               : 4
 pteaqu,woovir                                                        : 2
 woovir                                                               : 2
 andglogla,rhyfas,laccar                                              : 1
 andglogla,rhyfas,laccar,rhepet,pteaqu,dicens,eriver,woovir           : 1
 andropg,eupcap,woovir,pluros,miksca,hypala,lycrub,rhymil,dicens,diovirl,pluros: 1
 (Other)                                                              :52

   herb_tspp        all_gramin       wiregrass          pyrogram
 Min.   : 0.000   Min.   : 0.00   Min.   :0.000000   Min.   :0.000000
 1st Qu.: 2.000   1st Qu.: 1.50   1st Qu.:0.000000   1st Qu.:0.000000
 Median : 5.000   Median :10.50   Median :0.000000   Median :0.000000
 Mean   : 6.238   Mean   :12.87   Mean   :0.007937   Mean   :0.007937
 3rd Qu.:10.000   3rd Qu.:20.50   3rd Qu.:0.000000   3rd Qu.:0.000000
 Max.   :19.000   Max.   :60.50   Max.   :0.500000   Max.   :0.500000

   litter_cov       lichen_mos        epiphyte epiphytdom          vine_abund
 Min.   : 2.50   Min.   : 0.000   Min.   :0   Mode:logical   0          :27
 1st Qu.:20.50   1st Qu.: 0.000   1st Qu.:0   NA's:63        infrequent:29
 Median :30.50   Median : 0.000   Median :0                  occasional: 7
 Mean   :32.79   Mean   : 0.619   Mean   :0
 3rd Qu.:45.50   3rd Qu.: 0.000   3rd Qu.:0
 Max.   :70.50   Max.   :10.500   Max.   :0

    vinedom       bare_soil      inundated    organic       fine_fuel         med_fuel
 smigla : 7   Min.   : 0.00   no :38     high   : 8   low     :50   high    : 2
 smitam : 6   1st Qu.: 0.50   yes:25     low    :16   moderate:13   low     :19
 smilau : 5   Median : 0.50              medium:23                  moderate:42
 gelsem : 4   Mean   : 2.19              none   :16
 0      : 1   3rd Qu.: 2.50
 (Other):13   Max.   :10.50
```

```
heavy_fuel   weedycover    exoticscov   ...44                        otherDBH
low:63      Min.   :0     Min.   :0     Mode:logical   0                 :49
            1st Qu.:0     1st Qu.:0     NA's:63        live 2; dead      : 2
            Median :0     Median :0                    live ; dead 2     : 1
            Mean   :0     Mean   :0                    live ; dead 3     : 1
            3rd Qu.:0     3rd Qu.:0                    live 17; dead     : 1
            Max.   :0     Max.   :0                    live 2 ; dead 2,2: 1
                                                       (Other)           : 8
              polydist_1                    polydist_2   polydist_3 disturbcom
fire exclusion      :16   fire exclusion      :47   Min.   :0    Mode:logical
forestry operations:47   forestry operations:16   1st Qu.:0    NA's:63
                                                    Median :0
                                                    Mean   :0
                                                    3rd Qu.:0
                                                    Max.   :0


   poly_sever NC_rank                    comments   comments2
 moderate:63   fair:63   very wet, not llp hab: 1   Mode:logical
                         NA's                 :62   NA's:63


   Dead_DBH    Avg_liveDBH      LiveDBH_cnt      Snag_count
Min.   :3    Min.   : 0.000   Min.   :1.000   Min.   :0.00000
1st Qu.:4    1st Qu.: 5.100   1st Qu.:1.000   1st Qu.:0.00000
Median :6    Median : 7.200   Median :1.000   Median :0.00000
Mean   :6    Mean   : 6.559   Mean   :1.746   Mean   :0.07937
3rd Qu.:8    3rd Qu.: 8.464   3rd Qu.:2.000   3rd Qu.:0.00000
Max.   :9    Max.   :11.500   Max.   :5.000   Max.   :1.00000
NA's   :58


     DEMcm
Min.   :229.0
1st Qu.:276.5
Median :297.0
Mean   :291.5
3rd Qu.:313.5
Max.   :343.0
```