Land management and soil composition effects on vegetation and nitrogen dynamics in Ft Benning, Georgia.

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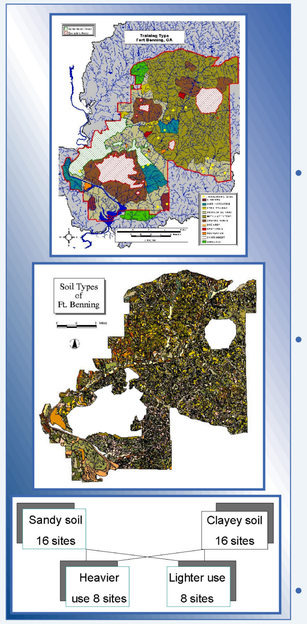
ABSTRACT

Military training and land management practices influence vegetation and nitrogen dynamics at Fort Benning. Our longterm goal is to identify thresholds beyond which upland forest communities cannot sustain the combined effects of forestry practices (burning and thinning to promote a longleaf pine ecosystem) and military traffic disturbances. We hypothesize that soil type influences disturbance thresholds. We compared vegetation and soil N of sandy (S) and clayey (C) sites subjected to heavier (H) or lighter (L) military use (8 400m x 400m sites of each combination). All sites were burned in spring, 2000. Prior land use, including the recent history of military and forestry practices, has influenced these sites. Remnant and active trails and roads, and gullies, are frequent disturbance features. Soils in heavily used sites tend to be higher in sand content, perhaps as a result of deposition from upslope. Canopy tree density is greater ($p = 0.06$) on LC sites; ground layer richness grades from a high in HC sites through LC and LS sites to a low in HS sites. Multidimensional scaling of canopy tree and ground layer composition revealed patterns related to land use intensity. Our results suggest clayey sites at Fort Benning are richer and more productive. Heavily used sites have a high proportion of pines in the canopy, lower tree density, and more "open site" ground layer. These results can be used to guide management practices to yield upland forests that sustain military training and forest management goals.



INTRODUCTION

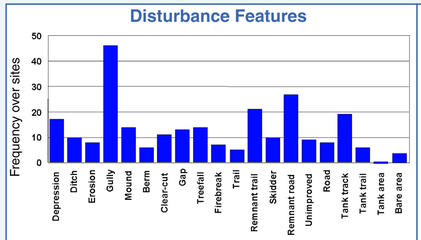
Ft. Benning, the U.S. Army Infantry Center, is located in southeastern Georgia within the Fall Line Sandhills District of the Coastal Plain and the Piedmont physiographic provinces. Our longterm objective is to evaluate the ecological effects of military training (Figure 1) and forest management for longleaf pine at Ft. Benning, to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of burning and military traffic disturbances. We hypothesize that soil type (sandy vs. clayey) (Figure 2) influences nutrient cycling, species diversity, and vegetation dynamics, as well as the threshold for sustainability of land use disturbances.

METHODS

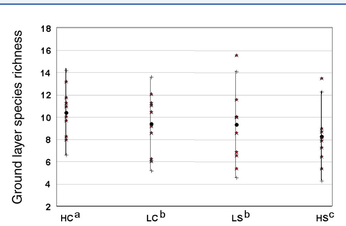
- We compared canopy and ground layer vegetation, soil texture, and soil N of sandy (S) and clayey (C) sites subjected to heavier (H) or lighter (L) military use (8 400m x 400m sites of each combination; Figure 3). All sites were burned in spring, 2000.
- Disturbance features were surveyed by line intercept along 2 300m transects in each site.
- A 100m x 100m plot was established in each site to survey vegetation. Five transects, with sampling points at every 20 m, were established at 20 m intervals within the plot (total 25 points). At each point, trees were surveyed by the point quarter method and ground cover was sampled by line intercept along a 6 m transect.
- Soil texture was determined at 9 locations per site using a Micro-pipette Method. Four samples were removed from each site for soil NO3-N and NH4-N analysis.

Data Analyses

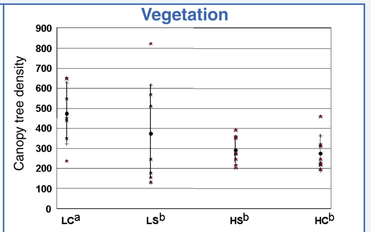
- Soil texture and chemistry, and vegetation measures, were compared among the four landuse/soil texture categories (HC, HS, LC, LS) using analysis of variance. In the ANOVA plots, we show category means (circles) and standard deviations (lines), and the mean of sites within each landuse/soil texture category. Category means with the same letter do not differ significantly.
- Multidimensional scaling was used to summarize trends in canopy and ground layer composition among sites.



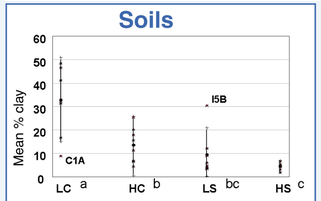
Remnant and active trails and roads, and gullies, were frequently encountered over the 32 sites.



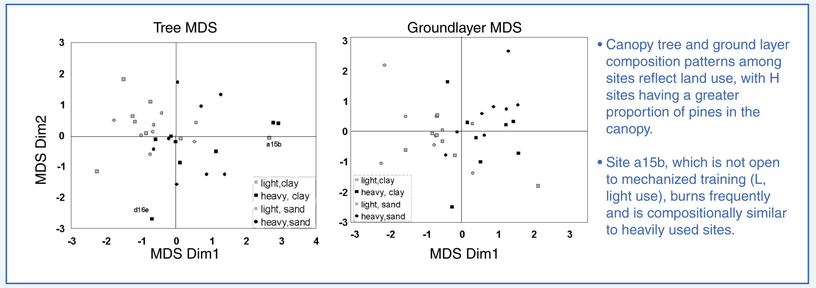
Ground layer species richness differs among landuse/soil texture categories (p=0.0001) and grades from heavily disturbed, clayey sites (HC) to heavily disturbed, sandy sites (HS).



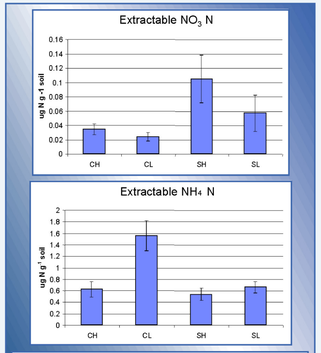
Canopy tree species richness and basal area do not differ among landuse/soil texture categories. Tree density (stems/ha) tends to be greatest on LC sites (p=0.06).



Greater clay content in L compared to H sites is possibly due to deposition from ridgetop roads.



- Canopy tree and ground layer composition patterns among sites reflect land use, with H sites having a greater proportion of pines in the canopy.
- Site a15b, which is not open to mechanized training (L, light use), burns frequently and is compositionally similar to heavily used sites.



Extractable soil N (May 2001) shows accumulation of N during the dormant season. Higher NO3 in H sites shows potential for N losses. Shown are the mean and standard error in each site use /soil category.

CONCLUSIONS

Land use at Fort Benning leaves small-scale features such as gullies, trails, and roads, and potentially affects soil texture and chemistry, and vegetation composition. Our preliminary results suggest soil texture in heavily used sites, those open to mechanized training, reflects sand deposition from upslope. These sites also may have a greater potential for nitrogen loss. Clayey sites appear to be more productive and richer. More heavily used sites have a high proportion of pines in the canopy, lower tree density, and an "open site" ground layer. Goals of upland forest management at Fort Benning are to sustain the military mission and promote the longleaf pine ecosystem, which supports the endangered red-cockaded woodpecker. Upland pine ecosystems may be favored by military training and forest management practices such as prescribed burning.

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