# Vegetation and Soils

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Characterization of bottomland hardwood vegetation in relatively undisturbed forests can provide critical information for developing effective wetland creation and restoration techniques and for assessing the impacts of management and development. Classification is a useful technique in characterizing vegetation because it summarizes complex data sets, assists in hypothesis generation about factors influencing community variation, and helps refine models of community structure. Hierarchical classification of communities is particularly useful for showing relationships among samples (Gauche 1982).

This study had three objectives: (1) to classify the bottomland hardwood vegetation, (2) to produce a vegetation map, and (3) to quantify the physical and chemical characteristics of soils in each of the vegetative communities. During the summer of 1995, 68 sampling plots (fig. 2.1) were established and basal area and density of overstory trees, shrubs, and saplings were measured. In addition species composition, total stem density, and percent coverage of all woody seedlings and herbs were measured within subplots. Elevation and soil physical and chemical parameters (texture of A and B horizons, depth to b layer, chroma, value, organic matter content, pH, and the entire suite of inductively coupled plasma emission spectrometer elements) were measured for each plot.

Standard cluster analysis was performed on the relative basal areas of woody plants. The cluster analysis (fig. 2.2) showed there were four major community types—water tupelo (*Nyssa aquatica* L.), swamp tupelo (*N. sylvatica* var. *biflora* [Walt.] Sarg.), laurel oak (*Quercus laurifolia* Michx.), and mixed oak (*Q.* spp.)—arrayed along an elevational gradient, and one minor community type—overcup oak (*Q. lyrata* Walt.). An analysis of the species compositions determined that clusters could be keyed based on the following hierarchical decision process:

1. Water tupelo when > 30 percent of the basal area is *Nyssa aquatica.*
2. Swamp tupelo when:
   a. more than 25 percent of the basal area is in *N. aquatica, N. sylvatica* var. *biflora*, and *Taxodium distichum* (L.) Rich. and the proportion of basal area in *N. aquatica, N. sylvatica* var. *biflora*, and *T. distichum* is greater that the proportion of basal area in *Q. laurifolia*; or

   b. more than 50 percent of the basal area is in *N. aquatica, N. sylvatica* var. *biflora, T. distichum, L. styraciflua*, and *Acer rubrum* L. with at least 9 percent of the basal area composed of *N. aquatica, N. sylvatica* var. *biflora*, and *T. distichum* and < 15 percent of the basal area is *Q. laurifolia.*
3. Overcup oak (*Q. lyrata* Walt.) when > 25 percent of the basal area is in *Q. lyrata.*
4. Laurel oak when a greater proportion of basal area is in *Q. laurifolia* than in *N. aquatica, N. sylvatica* var. *biflora*, and *T. distichum* and
   a. more than 20 percent of basal area is in *Q. laurifolia*; or

   b. the sum of *Q. laurifolia, L. styraciflua*, and *A. rubrum* is > 40 percent of basal area and at least 15 percent of the basal area is in *Q. laurifolia.*
5. Mixed oak when > 30 percent of the basal area is in *Q. phellos* L., *Q. nigra* L., and *Q. falcata* var. *pagodifolia* Ell. and
   a. *Magnolia grandiflora* L., or

   b. *Liriodendron tulipifera* L.
6. Loblolly (*Pinus taeda* L.) when > 50 percent of the basal area is *P. taeda.*

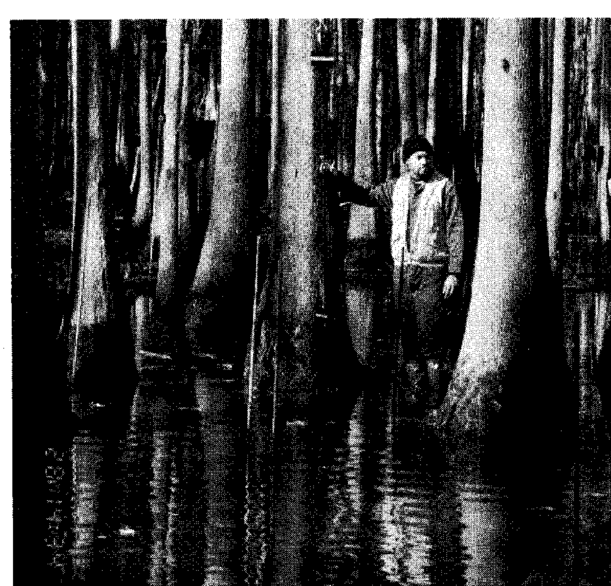

Photo by Marianne Burke

*Water tupelo community.*

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Using this information and vegetation surveys of numerous other points on the site, a vegetation map was produced (fig. 2.3) showing that flood-tolerant oaks with sweetgum and red maple were characteristic of the slightly higher elevations of the floodplain, and swamp tupelo, water tupelo, and sweetgum were characteristic of the shallow-to-deep swamps.

Soil analyses showed a difference among the soils of the main vegetation types. Soils in the water tupelo- and swamp tupelo-vegetated plots contained more clay in both soil horizons than the oak-dominated plots, which were sandier in both horizons (fig. 2.4). Extractable calcium, potassium, magnesium, cation exchange capacity, aluminum, organic matter, and pH were greatest in the water tupelo-vegetated sites and decreased up the flooding gradient. Bulk density, porosity, and depth to the B layer increased up the flooding gradient (table 2.1).

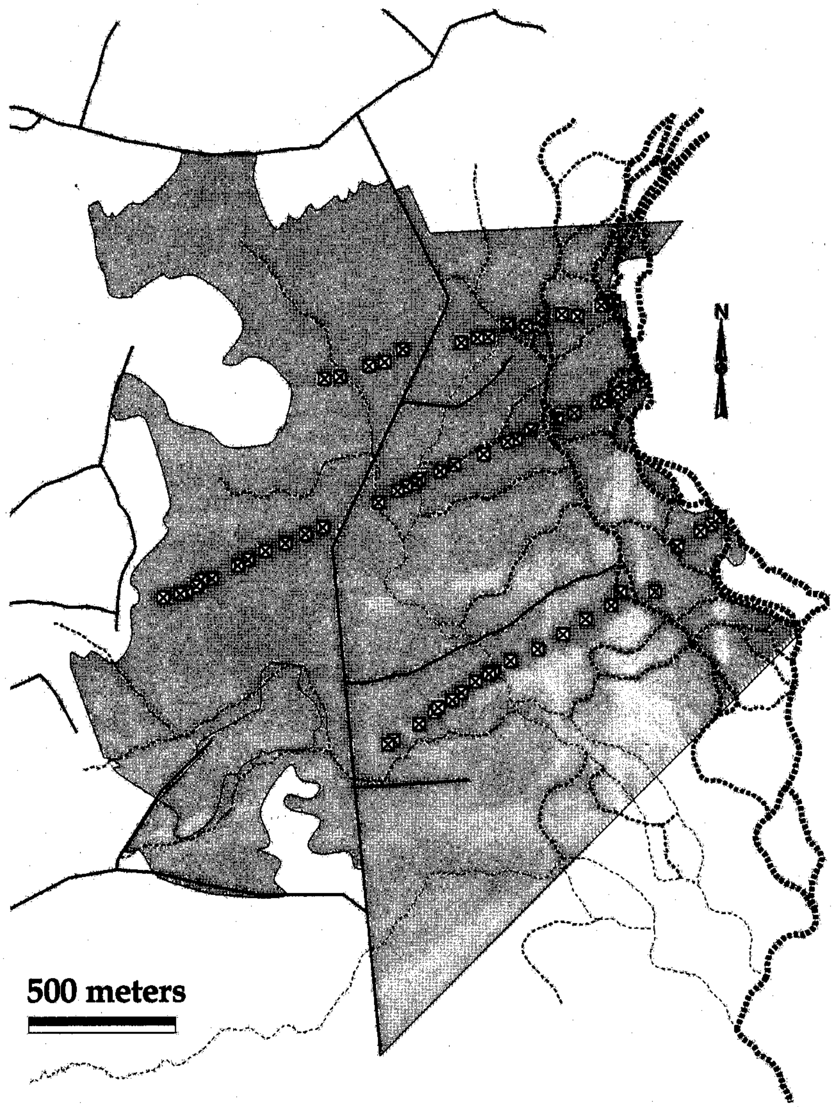


Figure 2.1—Ordination plot locations along transect 1 (southernmost), and 2 and 3 (northernmost).

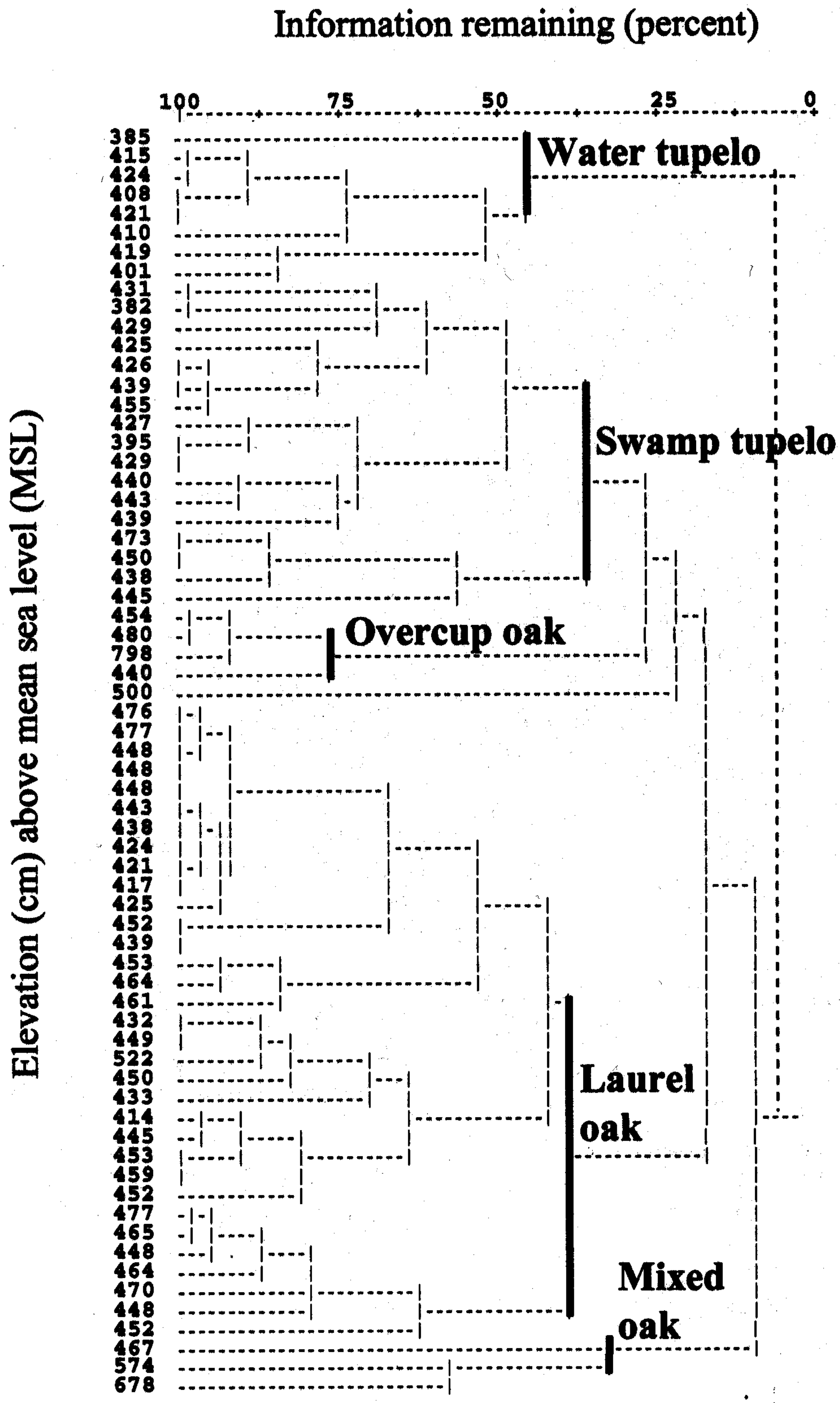


Figure 2.2—Results of standard cluster analysis performed on the relative basal areas of woody plants.

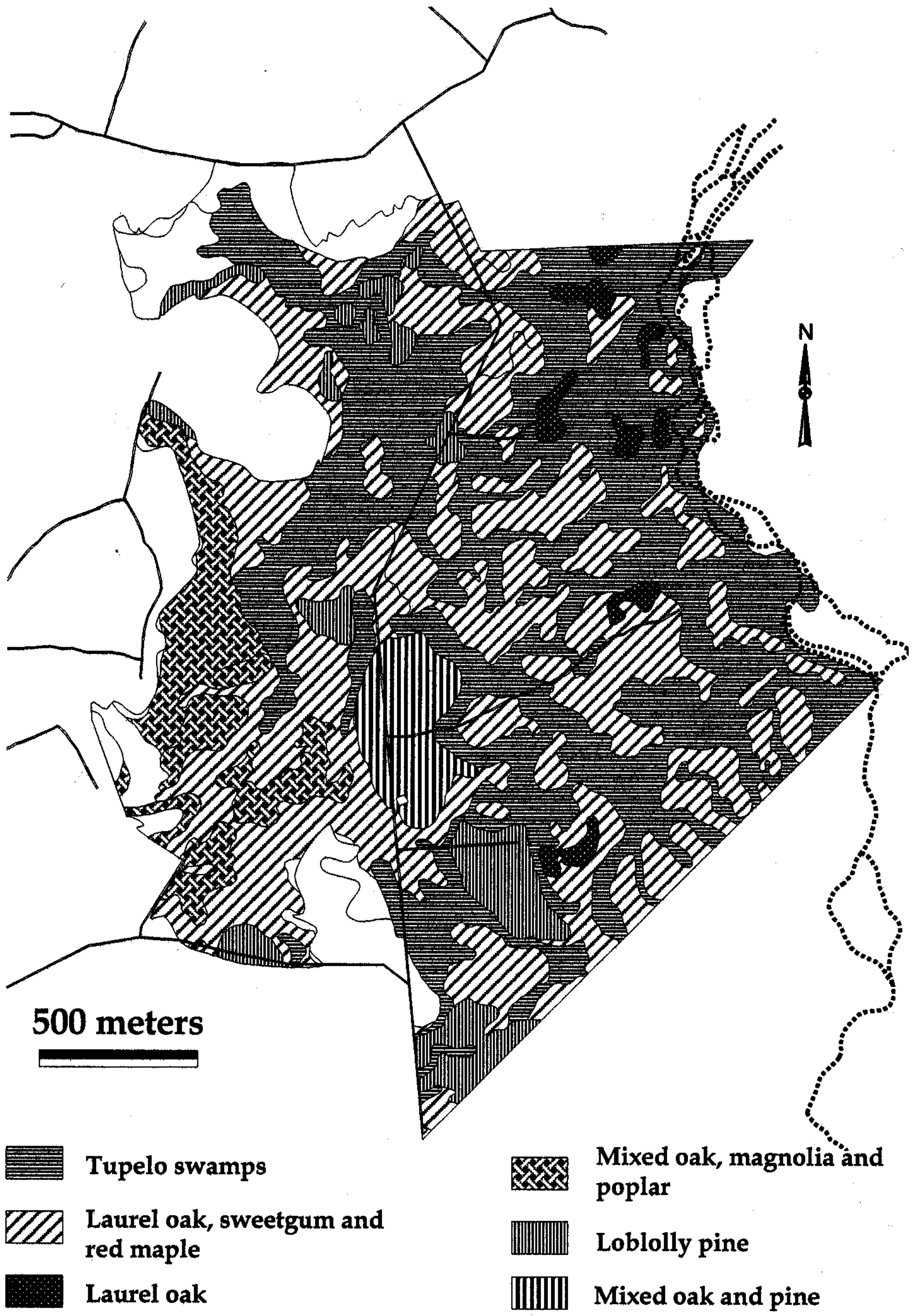


Figure 2.3—Vegetation types on the Coosawhatchie Bottomland Ecosystem Study site.

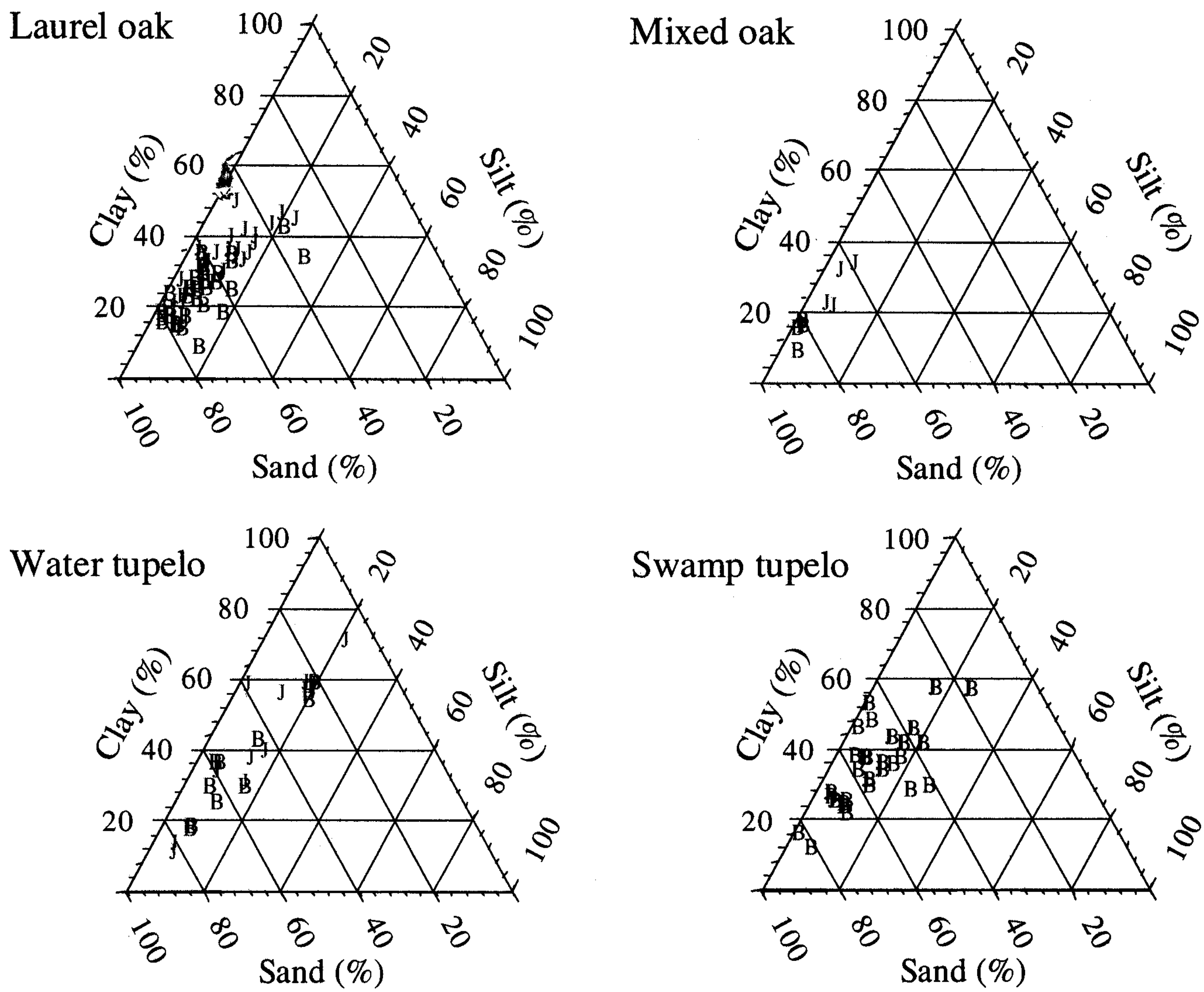


Figure 2.4—Texture triangles showing percent clay, silt, and sand in the A (uppercase B) and B (uppercase J) horizons for the four main plant communites.

**Table 2.1—Soil characteristics[a] for the four main community types[b]**

| Soil characteristics | Water tupelo | Swamp tupelo | Laurel oak | Mixed oak |
|---|---|---|---|---|
| $Ca_A$ (μg/g) | 829.39 (175.18)a | 460.17 (75.15)ab | 482.52 (53.13)ab | 195.37 (118.12)b |
| $Ca_B$ (μg/g) | 971.45 (168.81)a | 533.20 (87.25)ab | 725.55 (71.32)ab | 259.58 (152.[illegible]3)b |
| $K_A$ (μg/g) | 44.73 (6.44) | 38.17 (4.79) | 32.99 (2.43) | 25.77 (2.[illegible]2) |
| $K_B$ (μg/g) | 34.96 (6.55)a | 22.58 (1.30)b | 21.01 (.53)b | 20.50 (.50)b |
| $Mg_A$ (μg/g) | 165.52 (28.45)a | 105.61 (11.46)ab | 95.25 (8.54)b | 49.42 (23.64)b |
| $Mg_B$ (μg/g) | 162.13 (26.44)a | 102.59 (10.06)ab | 101.77 (8.80)b | 78.75 (27.41)b |
| $CEC_A$ (cmol/kg) | 1039.64 (208.19)a | 603.95 (89.44)ab | 610.75 (63.08)b | 270.56 (143.26)b |
| $CEC_B$ (cmol/kg) | 1168.54 (198.57)a | 658.37 (94.21)ab | 848.32 (77.36)ab | 358.82 (175.68)b |
| $P_A$ (μg/g) | 52.36 (9.93) | 48.03 (6.57) | 32.16 (3.17) | 41.92 (10.69) |
| $P_B$ (μg/g) | 39.44 (14.65)a | 25.65 (6.12)a | 9.57 (1.79)a | 100.72 (64.70)b |
| $Na_A$ (μg/g) | 28.88 (3.89) | 26.40 (1.39) | 22.80 (1.47) | 15.07 (7.23) |
| $Na_B$ (μg/g) | 35.45 (3.97) | 40.10 (9.47) | 47.28 (5.26) | 27.77 (16.20) |
| $Al_A$ (μg/g) | 1478.86 (273.10)a | 1230.59 (196.07)ab | 797.78 (75.40)b | 653.07 (74.74)ab |
| $Al_B$ (μg/g) | 1338.37 (327.64)a | 1011.09 (209.35)a | 411.93 (46.38)b | 765.73 (322.92)ab |
| Bulk $density_A$ ($g/cm^3$) | .79 (.07)A | .95 (.06)AB | 1.08 (.04)B | 1.17 (.09)B |
| Bulk $density_B$ ($g/cm^3$) | .97 (.11)A | 1.20 (.04)A | 1.42 (.03)B | 1.50 (.03)B |
| $Porosity_A$ ($cm^3/cm^3$) | .70 (.03)A | .64 (.02)AB | .59 (.01)B | .56 (.03)B |
| $Porosity_B$ ($cm^3/cm^3$) | .63 (.04)A | .55 (.02)A | .46 (.01)B | .43 (.01)B |
| $SOM_A$ (percent) | 8.12 (1.20) | 7.84 (.83) | 5.66 (.32) | 4.86 (.31) |
| $SOM_B$ (percent) | 6.04 (1.29)a | 4.14 (.70)ab | 2.03 (.22)b | 1.02 (.23)b |
| Elevation (MASL) | 4.19 (.05)b | 4.32 (.06)b | 4.51 (.04)b | 5.51 (1.25)a |
| Cm to B horizon | 25.6 (3.5)A | 29.2 (4.6)A | 30.6 (3.1)A | 55.7 (7.0)B |
| Chroma | .30 (.12)b | .67 (.23)b | .78 (.25)b | 1.56 (.68)a |
| Value | 2.18 (.10) | 2.33 (.12) | 2.19 (.07) | 3.53 (.90) |
| $pH_A$ | 4.70a | 4.50ab | 4.59ab | 4.35b |
| $pH_B$ | 4.76 | 4.61 | 4.68 | 4.78 |

Ca = Calcium, K = potassium, Mg = magnesium, CEC = cation exchange capacity, cmol = centimoles; P = phosphorus, Na = sodium, Al = aluminum, SOM = soil organic matter, MASL = meters above sea level.

[a] Results of multiple range tests (Sheffé's) on soil parameters. Nutrients are expressed in extractable (ammonium acetate) values. Variable subscripts indicate soil horizon. Different uppercase letters indicate significant differences ($p = 0.05$) within rows and different lowercase letters indicate significant differences ($p = 0.1$) within rows. All data were checked for homogeneity of variance before analysis, and variables with heteroscedastic variances were transformed before analysis.

[b] Standard error of the mean is in parentheses.