COMPOSITION COMPARISONS IN SODIC MAP UNIT DELINEATIONS ON THE DICKINSON EXPERIMENT STATION RANCH HEADQUARTERS, NORTH DAKOTA

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INTRODUCTION

One of the most important functions of a soil survey is to provide users with valid estimates of soil variation within mapping units. Older soil surveys are limited in this respect since the definition of mapping units generally received less attention than did the definition of the soil series being mapped (Amos and Whiteside, 1968). The standards of the United States National Cooperative Soil Survey presently require a soil survey to identify the relative composition of inclusions in mapping units and to indicate where they are located on the soil landscape. Consequences of these standards are realized by soil survey users when evaluating inconsistent soil responses to uniform management procedures.

Variation in mapping unit composition is especially important in plots used for agricultural experimentation. Recent studies with short duration grazing (SDG) at the Dickinson Experiment Station Ranch Headquarters in western North Dakota have necessitated an investigation of soil variability on a mapping unit comprised of sodic soils. Previously published data on the SDG system indicated that 50 percent of the soils in the study area had been classified in the thin claypan range site (Pessin et al., 1986). Experiment station personnel indicated that the productivity of the study area is higher than the 50 percent figure allocated to the thin claypan range site (L. Manske, personal communication, 1986).

Uncertainty in regard to range site soil composition and the long-term nature of the SDG study (ten years) requires an investigation to determine the pedologic variation in the study area. The objectives of this study were to:

1. Determine pedologic variation within the thin claypan mapping units in order to update mapping unit composition to the standards of the National Soils Handbook (Soil Survey Staff, 1983).

2. Assess range site productivity and distribution within such mapping units.

MATERIALS AND METHODS

Study Area Location and Map Unit Description

The Dickinson Experiment Station Ranch Headquarters is located 40 km (25 miles) northwest of Dickinson, ND. The SDG study is located in Section 16, Township 143 north and Range 96 west. The east half of the section is an SDG treatment and the west half is a seasonlong grazing treatment. The dominant map unit for the thin claypan range site in the study area is Rhoades silt loam, 1 to 6 percent slopes of the fine, montmorillonitic Leptic Natriboroll family. Five map unit delineations of the Rhoades soil had been mapped in Section 16 (Wright et al., 1983).

The Rhoades mapping unit in the study area is described as a consociation mapping unit. The named soil and similar soils should encompass 75 percent or more of the soils in a consociation. The remaining areas in the mapping unit consist of dissimilar soils. No single similar soil is to exceed the proportion of the named member and the total amount of dissimilar inclusions should not exceed 25 percent of the total delineation. The total amount of limiting dissimilar inclusions should not exceed 15 percent of the total delineations (Soil Survey Staff, 1983). These percentages are intended to apply to entire map units within the survey area and not to a specific delineation.

The problem in field mapping then, lies with the soil scientists definition of similar and dissimilar soils in relation to the dominant land use. It is important for the soil scientist to recognize that decisions regarding similar and dissimilar soils should reflect the multiplicity of uses that management may apply to the soil. The field soil scientist must learn to utilize a conceptual framework (the mapping unit) in order to properly subdivide a heterogeneous natural landscape for use and management purposes.

The degree of landscape uniformity can aggravate the mapping process. The Rhoades soil is found on "natric" landscapes common to the Northern Great Plains. Such landscapes are characterized by a distinctive, highly visible, microrelief of elevated grassy areas broken by low, non- or sparsely vegetated "panspots". This type of landscape is easily recognized and exemplifies a mapping problem in which visible characteristics of soils on landscapes may be weighed more heavily than their actual effect on productivity.

Experimental Design and Sampling Methods

The pedologic variation within the Rhoades delineations was studied using a stratified random design (Freese, 1980). Five map delineations were identified as the strata. At least three transects were made within each strata. Transects were located by randomly choosing distances from an end point of the longest axis that could be measured across the polygon. At these points, transects were struck off perpendicular to the axis. Where a large polygon extended into an adjacent section, the entire map unit was used for observation. This step removed the possibility of biasing the transects within that portion of the polygon limited by the study area boundary.

Soils were observed at 18.3 m (60 foot) intervals along the transects, but if the map unit was too narrow to provide a reasonable number of observations the interval was reduced to 9.1 m (30 feet). Soils were described and identified to the series classification using procedures of the United States National Cooperative Soil Survey (Soil Survey Staff, 1975).

Soil properties measured at each site were: 1) depth to salts (principally gypsum), 2) depth to free calcium carbonate, and 3) depth to moderate or stronger grade of structure in the B horizon. Textural estimates of the A and B horizons were made and surficial microrelief and vegetative cover were noted.

RESULTS AND DISCUSSION

Soil variability within the Rhoades delineations extends across depth class, mineralogy, soil great group and soil order (Table 1). Fourteen distinct soil series were identified during the observation as well as two unnamed soils classified to the family level and a variant of the Rhoades series, which was moderately deep to shale rather than deep.

Table 1. Classification of Soils Using the United States Classification System (Soil Survey Staff, 1975)

Soil Series	Family Classification
Rhoades	fine, montmorillonitic, Leptic Natriborolls
Wayden	clayey, montmorillonitic (calc.) Typic Ustorthents
Daglum	fine, montmorillonitic, Glossic Natriborolls
Belfield	fine, montmorillonitic, Glossic Natriborolls
Amor	fine-loamy, mixed, Typic Haploborolls
Savage	fine, montmorillonitic, Typic Argiborolls
Moreau	fine, montmorillonitic, Typic Haploborolls
Reeder	fine-loamy, montmorillonitic, Typic Argiborolls
Regent	fine, montmorillonitic, Typic Argiborolls
Shambo	fine-loamy, mixed, Typic Haploborolls
Golva	fine-silty, mixed, Typic Haploborolls
Cabba	loamy, mixed (calc.) Typic Ustorthents
Farnuf	fine-loamy, montmorillonitic, Typic Argiborolls
Grail	fine, montmorillonitic, Pachic Argiborolls
Unnamed	fine-loamy, mixed, Entic Haploborolls
Unnamed	fine, montmorillonitic (calc.), Typic Ustorthents

The relative composition of each strata (Table 2) illustrates the wide and inconsistent range of the Rhoades delineations studied. There is a tenfold percentage difference between strata A and E. In three of the strata, (B, C, and E) the named member is less extensive than dissimilar soils not included in the mapping unit name (Table 2). It is evident that the Rhoades soil is only one component of a soil association. The significant percentage of "other soils", listed for strata C through D, confirm that these strata are extremely heterogeneous and well outside the concept of a consociation mapping unit.

The "leptic" great group classification for the Rhoades series requires the presence of salts as soluble or more soluble than gypsum (soluble salts) within 40 cm (16 in.) of the soil surface. Many of the pedons observed in all strata had soluble salts leached to depths greater than 40 cm. Table 3 clearly shows that a significant proportion of the pedons were leached of soluble salts to the depth of sampling.

Table 2. Percent of Named Soil and Major Inclusions in Strata A-E

Strata	Rhoades	Rhoades Var.	Wayden	Daglum	Belfield	Amor	Savage	Other
A	41.9	3.2	25.8	16.1	---	---	3.2	9.6
B	7.6	23.1	12.8	38.4	2.5	5.0	2.5	5.0
C	21.0	---	26.3	5.2	---	10.5	10.5	26.3
D	30.7	15.4	19.2	7.7	3.8	---	3.8	19.2
E	4.0	8.0	4.0	16.0	12.0	24.0	12.0	16.0
Total	20.7	11.4	17.1	19.2	3.6	7.1	5.7	13.6
(n=140)								

The presence or absence of soluble salts markedly influences the ability of the soil to support vegetation, and as such, constitutes the basis for delimiting these soils as dissimilar to the Rhoades series.

Table 3. Percent of Pedons Leached of Soluble Salts

Strata	# Pedons	# Leached	Percent Leached
A	31	3	9.6
B	39	8	20.5
C	19	8	42.1
D	26	7	26.9
E	25	16	64.0

The Rhoades delineations in the study area are not comprised of soils similar to the fine, montmorillonitic Leptic Natriborolls. The impact of these results on range productivity estimates is very significant for the SDG trial in the study area. Inspection of both study results and morphology of the associated soils illustrate how the potential forage productivity estimates were understated.

The Daglum and Wayden series are dominant components of the landscapes in the Rhoades mapping unit. These soils have far different soil morphology and are classed in Claypan and Shallow Clay range sites rather than Thin Claypan. Soil texture, permeability, available water capacity, and sodicity are properties controlling the edaphic suitability of these soils. Resultant rangeland vegetation varies in both amount and type on these soils.

The Rhoades soil supports only shortgrasses, and under high level management produces from 500 to 950 kg/ha (450 to 850 lbs./a) of air dry herbage. The Wayden soil supports both mid- and shortgrasses and is dominated by rhizomatous wheatgrasses which are capable of withstanding drought on clayey textures. The Wayden soil produces between 900 and 1350 kg/ha (800 to 1200 lbs./a) under high level management. The Daglum soil has a much thicker A horizon than the Rhoades soil and supports a mixture of cool-season midgrasses over an understory of shortgrasses. Production under high level management is 1300 to 1850 kg/ha (1150 to 1650 lbs./a) (Soil Conservation Service, 1984).

A significant number of the pedon observations fall into range site categories more productive than the Wayden or Daglum. The Belfield, Amor, Savage, and "other soils" account for 30 percent of the observations. The majority of these soils are fine-loamy or fine-silty Typic Haploborolls or Argiborolls, and as such, are classified as silty or clayey range sites. The contribution of these sites to total range productivity in the study area must be recognized. The silty range is perhaps the most productive in the study area; under high level management these sites produce 1850 to 2530 kg/ha (1650 to 2250 lbs./a) of air dry herbage. Clayey range sites under similar management produce 1740 to 2360 kg/ha (1550 to 2100 lbs./a).

In summary, it is evident that values for range productivity based upon the Rhoades mapping unit will be vastly underestimated. The Rhoades taxon was overused in mapping because of the impact of the panspots on the vegetation in the natric landscapes. The study results will improve the validity of the range improvement studies and facilitate the extrapolation of experimental results throughout the region.

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