# The Influence of Grazing on the Roots and Rhizomes of Seacoast Bluestem[1]

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This paper describes some of the effects of grazing on the roots and rhizomes of seacoast bluestem *(Andropogon scoparius* var. *littoralis* (Nash) Hitchc.), a rhizomatus variety of little bluestem *(A. scoparius)*. Seacoast bluestem is one of the main forage grasses on extensive areas of the Gulf Coastal Prairie. The study was conducted during the summer of 1961 on the Rob and Bessie Welder Wildlife Foundation Refuge near Sinton, Texas.

The study area was typical of large range areas on the sandy soils of the Texas Coastal Bend. The soil was Nueces fine sand. Vegetation was of the bunchgrass-annual forb type (Box, 1961).

The major grasses found in the bunchgrass-annual forb community were seacoast bluestem, Pan American balsamscale *(Elyonurus tripsacoides)*, knotroot panicum *(Panicum firmulum)*, sand bur *(Cenchrus* spp.), fringeleaf paspalum *(Paspalum ciliatifolium)*, and hooded wildmill grass *(Chloris cucullata)*. The most common forbs were skunk daisy *(Verbesina encelioides)*, wooly croton *(Croton capitatus)*, rough nama *(Nama hispidum)*, heartsepal wild buckwheat *(Eriogonum multiflorum)*, and Texas bullnettle *(Cnidoscolus texanus)*. No woody species or prickly pear occurred on the sand (Figure 1).

It is generally accepted that repeated or frequent clipping, grazing or mowing of grass plants will decrease root production or root growth. Biswell and Weaver (1933) found that grazing little bluestem *(Andropogon scoparius)* reduced the diameter of the roots. Length of roots was also greatly decreased, and relative root production was reduced more than were the tops.

Aldous (1930) found that clipping little bluestem starting September 1 reduced production less than earlier clipping. Root weight was decreased more by removal of both leaves and stems than by removal of either leaves or stems alone (Jameson and Huss, 1959). Periodical removal of tops caused a greater reduction in growth of both roots and tops than did a similar pruning of roots (Nedrow, 1937). Weaver (1950) concluded that root deterioration was from the tips upward toward the crown. He also reported that as grazing increases, degree of root branching decreases.

Shantz (1911) reported little bluestem roots extending to a depth of about five feet and thoroughly occupying the sandy soil in the bunchgrass association of eastern Colorado. Roots were so abundant as to form a dense sod, completely filling the soil to a depth of from 12 inches in a gravelly soil and to as much as 30 inches in clay loam. The surface soil layer was especially well occupied with dense masses of finely branched rootlets. All the roots branched profusely to the third and fourth order, many of the branches being well over 30 inches long.

## Methods and Procedures

During the early summer of 1961 three groups of seacoast

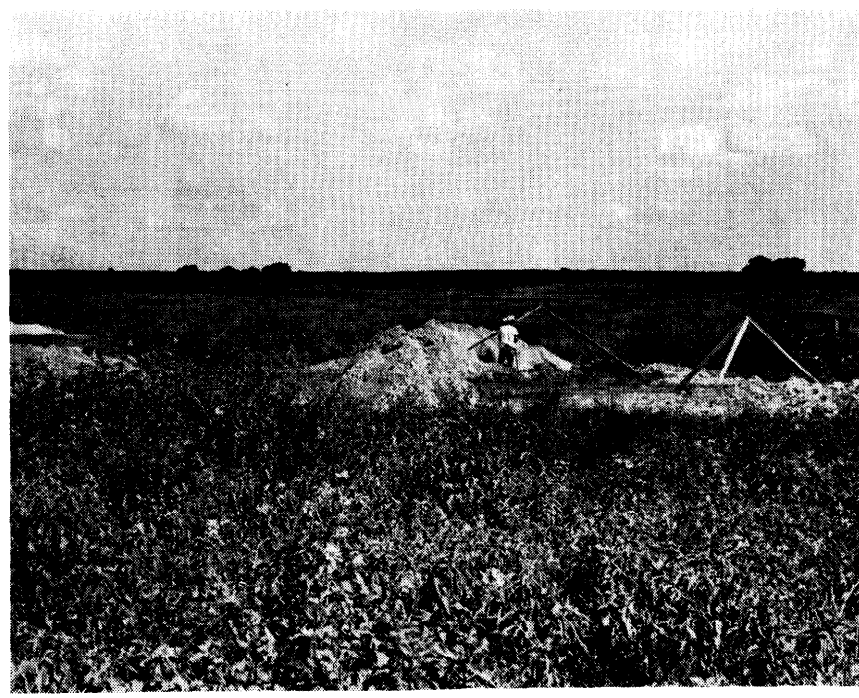

FIGURE 1. General view of area showing vegetation and level topography. Tripods used to suspend plants are shown at right of center.

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bluestem plants representing intensities of grazing were selected for the study. Exclosures were erected in 1957 and the plants within these exclosures were protected from grazing for four years before the study was conducted. The range around the exclosures was grazed continuously by steers. Plant samples taken from these exclosures will be referred to as "ungrazed" throughout this paper. "Wolf plants" or plants showing little evidence of grazing pressure were selected adjacent to the exclosures. These plants had large numbers of seed stalks, an abundance of dry foliage from the previous growing season, and little evidence of grazing during the year of study. These plants were designated as "lightly grazed." Heavily grazed plants, with basal areas approximately equal in size to the ungrazed and lightly grazed plants were selected near the exclosures for determining the effects of grazing on the root system. All plants used in the analysis were selected from the same general area in order to minimize the effects of topography and soil variations upon growth.

A six-inch core sampler was constructed from a section of oil well casing for use in the removal of the plants (Figure 2). As each plant was removed, the core was hauled to a water source and the sand slowly washed from the roots. Once the roots were removed from the core they were cut into four-inch segments, air dried and weighed.

Entire root systems of individual plants were excavated to show total depth and spread of roots.

Plant tops in all treatments were clipped, air dried, and weighed. Both total top weight and current year's top weight were obtained for the ungrazed and lightly grazed plants. Since the heavily grazed plants had only current year's growth, this was the only measurement taken.

## Results and Discussion

### Influence of Grazing

Differences between treatments were tested by simple group comparisons. A highly significant difference ($P>.01$) in root production existed between the heavily grazed and ungrazed plants. The difference in root production between lightly grazed and ungrazed plants (Table 1) was not significant.

Slight differences in basal areas existed between the three classes of plants. In order to reduce this variation an analysis of covariance of the data was used. The results were the same as those from the simple group comparisons. A highly significant difference in root production existed between the heavily grazed and lightly grazed plants; there were also highly significant differences between the heavily grazed and ungrazed plants. Again, there was no significant difference between the lightly grazed and ungrazed plants. The differences in the amount of root system produced were attributed to the influence of grazing and not to a difference in the size of plants. Light grazing had little effect on amount of roots produced, while heavy grazing significantly reduced root growth.

An analysis of covariance was again used to test differences between all three plant groups simultaneously. Basal area was again the variable which was adjusted. All three treatments were tested to determine if differences existed for root production, current top weights, and rhizome production. A highly significant difference in root production was found, providing further evidence that grazing does have a detrimental effect on the root system of this particular grass. It appears safe to assume that heavy and repeated grazing of seacoast bluestem will reduce

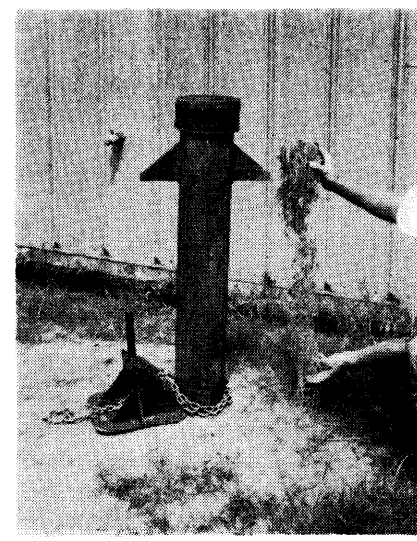

FIGURE 2. Core campler shown equipped with metal cap. Jack and chain shown at lower left, plant sample being held at right of sampler.

**Table 1. Production of roots, rhizomes, total top growth, current top growth, and basal areas of seacoast bluestem plants taken by a core sampler.**

| Treatment | Weight of Roots by Successive 4-inch Depths | | | | | | | | Number of Samples | Roots | Rhizomes | Current Top Growth | Total Top Growth | Average Basal Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 4-8 | 8-12 | 12-16 | 16-20 | 20-24 | 24-28 | 28-32 | | | | | | |
| | (Grams) | | | | | | | | | (Grams) | | | | (Sq. In.) |
| Heavily grazed | 2.64 | 1.28 | 0.76 | 0.63 | 0.56 | 0.53 | 0.40 | 0.24 | 22 | 7.04 | 1.70 | 14.2 | 14.2 | 7.53 |
| Lightly grazed | 5.24 | 2.00 | 1.16 | 1.01 | 0.91 | 0.82 | 0.68 | 0.42 | 20 | 12.24 | 2.58 | 36.1 | 87.98 | 10.32 |
| Ungrazed | 5.48 | 1.92 | 1.08 | 0.79 | 0.70 | 0.67 | 0.54 | 0.39 | 9 | 11.93 | 2.36 | 63.3 | 144.80 | 10.95 |

its ability to compete with the surrounding vegetation.

A highly significant difference was also found to exist between the current year's top growth of all three treatments pooled. Grazing reduced the amount of top growth which in turn resulted in a decrease in root systems.

Although a slight difference in the production of rhizomes between the three treatments existed, this difference was not significant (Table 1). Rhizome to root ratios were 1:4.14 for heavily grazed plants, 1:4.74 for lightly grazed plants, and 1:5.05 for plants receiving no grazing. Utilization and rhizome production are related by correlations to be presented later in the paper.

### Correlations of Roots to Other Attributes

Correlation coefficients were calculated to determine the relationships between root production and various components such as basal area and rhizome production (Table 2).

The relationship between root production and basal area was highly significant for the lightly grazed and ungrazed plants, but not significant for the heavily grazed plants. As basal area increased in the lightly grazed and ungrazed plants, root production increased accordingly. However, in the heavily grazed plants, root production did not increase as basal area increased.

The relationship between root production and rhizome production was highly significant for both the heavily grazed and lightly grazed plants, but was not significant in the ungrazed plants. Under grazing more rhizomes were produced in relation to the amount of roots produced than when plants were protected from grazing. It was also observed that plants in the field subjected to heavy grazing tended to show a definite sod forming type of growth habit. These plants were generally smaller, more numerous, and had characteristics of rhizomatous plants. In contrast, the ungrazed or lightly grazed plants had a typical bunch grass growth form.

Soil from sections of sod one meter long, one-half meter wide, and ten centimeters deep was removed by water pressure to expose the roots and rhizomes of protected and heavily grazed plants. The ratio of roots to rhizomes was 1:1.5 for the ungrazed plants and 1:2.4 for the grazed plants.

Similar measurements were made on the surface twelve inches of a four-square-foot sod of the excavated root systems of ungrazed and grazed plants. The ungrazed plants had a root rhizome ratio of 1:0.24 and for the grazed plants it was 1:0.82.

Grazing seacoast bluestem caused the plants to become sod formers and protection from grazing resulted in a bunch grass appearance.

**Table 2. Correlations of roots to basal areas and rhizomes from seacoast bluestem plants taken by core sampler.**

| Treatment | Basal Areas | Rhizomes |
|---|---|---|
| Heavily grazed[a] | 0.407 | 0.539** |
| Lightly grazed[b] | 0.721** | 0.634** |
| Ungrazed[c] | 0.914** | 0.565 |

** Significant at the .01 level.

[a] "r" values greater than 0.423 significant at 5 percent.
"r" values greater than 0.536 significant at 1 percent.

[b] "r" values greater than 0.444 significant at 5 percent.
"r" values greater than 0.561 significant at 1 percent.

[c] "r" values greater than 0.666 significant at 5 percent.
"r" values greater than 0.798 significant at 1 percent.

### Root Distribution

The greatest concentration of roots in all treatments was found in the surface few inches of soil. As depth increased root production decreased. The percentage of root weight in the surface foot of soil was 66.4 per cent for the heavily grazed plants, 68.6 per cent for the lightly grazed, and 71.1 per cent for the ungrazed plants. These results are similar to those reported by Weaver and Zink (1946). They found about grazed plants. No significant difbluestem in the surface foot of soil.

Weaver and Zink (1946) also reported that 36 per cent of the roots were found in the surface four inches of soil. This study revealed 37.5 per cent of roots from heavily grazed plants were found in the first four inches, 42 per cent for the lightly grazed plants, and 45.9 per cent for the ungrazed plants.

It is apparent from these data that the major reduction in root growth was in the surface foot of soil. Although total root weight was decreased significantly by grazing, the reduction in the surface foot was much more pronounced than at lower depths.

### Entire Root Systems of Seacoast Bluestem

Entire root systems of heavily grazed plants and ungrazed plants were removed by washing. There was a pronounced difference in the roots of the heavily grazed and ungrazed plants. The ungrazed plants followed the general pattern obtained with the core sampler. Only 26.3 per cent of the roots were found in the surface twelve inches which is less than the values reported for the core sampling technique. The time involved in removal of plants prevents adequate sampling. Therefore, the washing technique cannot be used as a practical method for describing population means.

Roots of the ungrazed plants

were found to a maximum depth of 103 inches compared to 90 inches for the heavily grazed plants. The majority of the roots from both treatments were found to be restricted by a compacted clay layer at about five feet. The few roots from each plant that penetrated the layer were used for maximum depth measurements.

## Summary

Root systems of seacoast bluestem plants were examined in the Nueces fine sand of the Texas Coastal Prairie during the summer of 1961 in order to examine the effects of grazing under actual conditions.

Three groups of plants were used to represent intensities of grazing. Ungrazed plants were sampled from exclosures that had received no grazing for four years. "Wolf plants" or plants showing little evidence of grazing were selected as lightly grazed plants. Heavily grazed plants were those having no seed stalks or old dry foliage and ample evidence of heavy grazing.

The root systems of these plants were excavated by means of a core sampler. Measurements were taken on root production, basal areas, total top growth, current year's top growth, and rhizome production.

Root production was decreased by heavy grazing. Plants which were heavily grazed had significantly lower root production than either lightly grazed or ungrazed plants. No significant difference was found between the lightly grazed and ungrazed plants. The rhizome to root ratio was increased by heavy grazing.

Highly significant correlation existed between root production and basal area for the ungrazed and lightly grazed plants, but there was no significant correlation for the heavily grazed plants.

There were highly significant correlations between basal area and rhizome production for the heavily grazed and lightly grazed plants, but no significant correlation was found for the ungrazed plants.

Roots of heavily grazed plants reached a depth of 90 inches while the ungrazed plants reached a depth of 103 inches.

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