Grassland and Livestock Regions of Mexico

RODERIC E. BULLER, E. HERNANDEZ X., AND MARTIN H. GONZALEZ

Associate Agronomist (Forage Crops) with the Mexican Agricultural Program of The Rockefeller Foundation; Professor Titular de Agrostologia, Escuela Nacional de Agricultura, Chapingo, Mexico; and Ingeniero Agronomo with the Oficina de Estudios Especiales, Secretaria de Agricultura y Ganaderia, Mexico, D. F.

Mexico is truly a grassland country. Over one third of its area—about 165 million acres—is in native pastures and ranges which support around 22 million grazing animals. Only about 10 percent of the country's land area is tillable, and of this 80 percent is semi-arid. The lack or uncertainty of natural rainfall limits the production of food crops and necessitates a grazing type economy in much of the country. Cultivated forage production occupies an important place in the agriculture of the more humid regions and irrigation districts.

Despite the obvious importance of grasslands and adequate forage production to the well-being of the nation, only recently has a serious coordinated effort been made to analyze the basic problems and to initiate an improvement program based on sound research techniques. Improvement of basic food crops such as maize, beans, and wheat has been rapid during the past 15 years, but improvement of the animal industry through the efficient and rational use of grazing lands and greater cultivated forage production has lagged behind.

The shortage of technicians in the field of range management and general forage crop production is acute. At the present time there are no more than about 15 investigators in the entire country spending part or full time in this field. The agricultural colleges have not emphasized forage and range courses in their curriculums and only a few offer specialized courses relating to these subjects.

This article is based primarily on experience and information obtained by the Oficina de Estudios Especiales, which is a cooperative research program of the Mexican government and The Rockefeller Foundation, and the National School of Agriculture. Among the published contributions that are pertinent to the subject, the following deserve mention here: Starker Leopold's treatment of the vegetative zones of Mexico (1950); a detailed study of the grasslands of Durango and neighboring states by H. S. Gentry (1957); F. Shreve's work on the vegetation of northern Mexico (1951); A. S. Hitchcock's taxonomic review of the grasses of Mexico and the U. S. (1913); and the Atlas Climatologico of the Mexican Department of Agriculture (1939).

For the purposes of this initial presentation, the country has been divided into 4 large grassland and livestock regions, (Figure 1) according to climate, natural vegetation and type of cultivated forage production, characteristics of animal population, and main objectives of the livestock industry. Although these divisions are large and can be subdivided, such a regional approach has proved valuable to the research program by bringing to light the most critical problems. Pertinent data concerning livestock populations are also presented in Table 1.

Major Regions
Northern Temperate

This region is the largest of the 4 and includes approximately 116 million acres of native grassland (Figure 2). A considerable portion borders on the southwestern United States, to which it naturally is similar in many ways. Rainfall is low, ranging from 8 inches on the plains to 28 inches in the high Sierra Madre Occidental mountain range, in the western portion. Except in several highly mechanized irrigation districts where cotton and wheat are the principal crops, farming is of minor importance because of limited moisture. While some alfalfa is grown un-
der irrigation, production could become much more important, as could the use of cotton by products for livestock feed.

Three general vegetation types are utilized by livestock: (1) grasslands due primarily to the influence of climate; (2) grasslands due primarily to the influence of saline soils; and (3) shrub and scrub vegetation with grasses as subordinate elements.

The first type may be subdivided in accordance with species dominance and the associated trees and shrubs. In all cases, however, the principal species are members of the genera *Bouteloua*, *Hilaria*, *Muhlenbergia*, *Heteropogon*, *Andropogon*, *Aristida*, *Eragrostis*, *Buchloe*, and *Lycurus*.

The best development of the halophyte grasslands exists in the abundant swales formed in the lower parts of the enclosed watersheds in Chihuahua, Coahuila, Durango, San Luis Potosi, and Zacatecas. Solid stands of *Distichlis* *spicata*, *Eragrostis obtusiflora*, *Sporobolus airoides*, and *Hilaria mutica* characterize this type.

Of special value are the grasses associated with the spiny shrubs and low woody species, mostly legumes, browsed by cattle and to a larger extent by goats. These grasses are *Muhlenbergia por- teri*, *Setaria macrostachya*, *Bouteloua curtipendula*, *B. breviseta*, *Trichachne californica*, and *Stipa eminens*.

The more than 10 million animals that graze the region are preponderantly beef cattle, sheep, and goats. However, the raising of feeders and stockers for export to the United States occupies first place in the economy of the region. This is particularly true in the northwestern portion where United States buyers and Mexican sellers create a vigorous trading atmosphere. The importance of beef cattle in this region is illustrated in Figure 3. Hereford is by far the dominant breed, although Aberdeen Angus is gaining in popularity. Goats are most numerous in the drier eastern part of the region, where they subsist on the desert browse plants, Figure 4.

These northern grasslands require the most judicious use of range management practices, but although such practices are already employed by the progressive ranchers, unfortunately the major part of the area has been and still is being overgrazed. This situation is seriously aggravated by the recent prolonged period of abnormally low rainfall. Qualified ranchers estimate that in the State of Chihuahua, for example, the grasslands are able to support at present only half as many animals as 10 years ago. In addition, less scientific information has been accumulated here than in other areas. Proper stocking rates, supplemental feeding, livestock water development, range pitting, re-

### Table 1. Acres of grassland, livestock populations and production of selected roughages by regions in Mexico.*

<table>
<thead>
<tr>
<th>Regions</th>
<th>North</th>
<th>Central</th>
<th>Gulf Plains</th>
<th>Pacific Coast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasslands** (acres)</td>
<td>115,993,411</td>
<td>16,145,492</td>
<td>12,144,216</td>
<td>21,408,310</td>
</tr>
<tr>
<td>Total animal population (not including hogs)</td>
<td>10,671,628</td>
<td>5,807,023</td>
<td>2,357,477</td>
<td>2,786,219</td>
</tr>
<tr>
<td>Cattle</td>
<td>4,653,341</td>
<td>2,200,354</td>
<td>2,073,980</td>
<td>1,616,541</td>
</tr>
<tr>
<td>Horses</td>
<td>845,903</td>
<td>356,949</td>
<td>244,600</td>
<td>271,168</td>
</tr>
<tr>
<td>Mules</td>
<td>293,455</td>
<td>157,226</td>
<td>26,097</td>
<td>109,264</td>
</tr>
<tr>
<td>Donkeys</td>
<td>410,579</td>
<td>594,631</td>
<td>7,800</td>
<td>190,327</td>
</tr>
<tr>
<td>Sheep</td>
<td>1,458,170</td>
<td>1,186,140</td>
<td>2,000</td>
<td>106,039</td>
</tr>
<tr>
<td>Goats</td>
<td>3,030,180</td>
<td>1,302,729</td>
<td>3,000</td>
<td>432,080</td>
</tr>
<tr>
<td>Hogs</td>
<td>645,145</td>
<td>942,059</td>
<td>590,747</td>
<td>702,062</td>
</tr>
<tr>
<td>Alfalfa production (metric T)</td>
<td>533,840</td>
<td>1,139,311</td>
<td>non reported</td>
<td>100,777</td>
</tr>
<tr>
<td>Corn stover (metric T)</td>
<td>982,356</td>
<td>1,968,445</td>
<td>424,900</td>
<td>860,181</td>
</tr>
</tbody>
</table>

* Statistical data based on the 1950 census, Secretaria de Economia, Mexico, D.F., Mex.

** These figures include only the areas recognized as grasslands. From the point of view of livestock utilization, these should be augmented by the areas with browse plants.
seedling, and brush and poisonous plant control are some of the problems needing research. During the past year steps have been taken to acquire some of this information. The Chihuahua Regional Livestock Association has made available approximately 2,500 acres of grassland which are now being developed as an experimental range and will serve as a focal point for range improvement investigation and extension. This effort is being coordinated through the newly founded School of Animal Husbandry of the University of Chihuahua.

A taxonomic review of some 2,500 grass specimens collected in northwestern Mexico has provided the basic orientation for the practical range improvement program. Seed samples have also been collected for the establishment of native grass nurseries, in keeping with the philosophy of emphasizing indigenous species rather than exotic introductions.

Animal losses due to poisonous plants have been alarming in certain areas, particularly in north-central Chihuahua where it has been estimated that from 3 to 4 thousand animals died during the past 3 years because of one species alone, Drymaria arenarioides. Information for the effective and economic control of this species is now being obtained. Much of the basic information on poisonous plant control acquired by investigators in the United States appears to be directly applicable under local conditions.

Central Temperate

This region, which includes 16 million acres of natural grassland, is unique in containing also approximately 90,000 acres of irrigated alfalfa, about 60 percent of the total acreage of this crop in the Republic. The average annual rainfall varies from 12 to 32 inches with the occurrence of definite wet and dry seasons. The terrain has a bleak, parched appearance during the dry winter months, but turns to greenness with the first rains in June.

The production of irrigated alfalfa as soilage or pasture, (Figure 5) supplemented with corn for silage, supports a large dairy industry which meets the demands of Mexico City’s 4 million inhabitants, and other large population segments of the area. Considerable pressure has been imposed on the land, and the production of maize, wheat, and beans for human consumption is heavily practiced. The greatest number of dairy cows is concentrated in this region, most of them being Holsteins. Sheep are important, but are entirely restricted to the open grazing lands. Donkeys, oxen, and mules for work purposes are numerous and their distribution correlates well with the necessities of the rural human population. The hog industry has grown rapidly in the past 5 years, but it is chiefly maintained on concentrates and alfalfa soilage. Since food crops are grown almost exclusively for human consumption, no possible source of forage is left unexploited. In some sections, plant residues such as the stems and leaves of maize, beans, chickpea, and peanuts are heavily relied upon as roughage.

Because of the definite scarcity of forage to support the growing dairy industry, research efforts in this region have been directed toward increasing cultivated forage production. During the past 4 years more than 100 plant introductions, including different species and varieties, have been screened and tested. Among those studied have been legumes such as alfalfa (Medicago), red and Ladino clover (Trifolium spp.), and birdsfoot trefoil (Lotus sp.), and perennial grasses such as orchard (Dactylis), rescue (Bromus catharticus), Harding (Phalaris tuberosa var. stenoptera), smooth brome (Bromus inermis), tall fescue (Festuca arundinacea), and annual and perennial rye (Secale cereale and S. monatum). In general, throughout this area the adaptability and productivity of alfalfa has been outstanding. Experimentally, alfalfa yields have averaged 10

Figure 2. The Northern Temperate region with its 116,000,000 acres of grassland is the largest of the four regions.

Figure 5. Irrigated alfalfa is the principal forage crop grown for the dairy industry in the temperate regions of Mexico.
tons of hay per acre annually. It is possible to cut alfalfa from 6 to 11 times a year, depending on the region and mildness of winter temperature. The results of alfalfa variety testing have led to specific recommendations for farmers and the initiation of a certified seed production program. Selections from locally grown common varieties have been most promising. Cultural and management practices for alfalfa are also being studied. At the higher elevations of around 8,500 feet above sea level, medium red clover has averaged 12 tons of hay per acre annually in yield trials, consistently more than alfalfa in this cooler environment. Here, medium red clover has behaved like a perennial and it is in its fourth year of cutting. It is still relatively unknown to local dairymen. Research is also being conducted on numerous summer and winter annuals in order to fulfill the requirements of a well-balanced forage program.

In contrast to the large dairy industry, which is based on private enterprise and is dependent on irrigated alfalfa, the open grazing lands are communal properties and the movement of mixed herds from the villages to the neighboring pastures in the morning and their return at night is a common sight. The important indigenous grass species are Bouteloua gracilis, B. filiformis, B. radicosa, Hilaria cenchroides, Bromus spp., Festuca spp., Agrostis spp., Poa spp., Muhlenbergia spp., Trisetum spp., and Lycurus phleoides.

Over-grazing and its deleterious effects are in evidence, particularly in close proximity to the towns. These grazing lands are in a continual state of disturbance because of sporadic plantings of maize and beans which are grown in the rainy summer season. The present socio-economic situation with regard to land tenure will require special attention in any program designed to improve the productivity of these communal grasslands.

Gulf Plains

The natural vegetation of this region, which includes about 12 million acres and borders the Gulf of Mexico, consists of numerous types of tropical forests as well as various types of grassland. The grasslands may be classified as follows:

1. Sand dune and sandy plains of the coastal area; Bouteloua filiformis, B. curtipendula, Opizia stolonifera, Paspalum notatum, P. conjugatum, Mesosetum spp., Panicum repens.
2. Tropical deciduous forest with open grassland areas; Bouteloua hirsuta, B. curtipendula, Pennisetum spp., Opizia stolonifera.
4. Disturbed tropical humid forest; Paspalum notatum, P. conjugatum, Axonopus affinis.

Rainfall is extremely variable, ranging from 32 inches to as much as 120 inches annually.

The most economically important livestock enterprise is the production of beef, for local consumption and for Mexico City and other population centers of the central region. Meat is also produced here for shipment to the isolated Yucatan Peninsula farther to the east. A large number of small dairy herds produce milk for local needs. The majority of native cattle have a dominance of Zebu characteristics, but some herds of purebred Santa Gertrudis are to be found as well as Brown Swiss crosses.

Throughout the whole region the improved pastures consist of Guineagrass or paragrass, two very well naturalized species, (Figure 6). Although experimental data are lacking it is said that two and one half acres of this type of pasture will support
one animal unit throughout the year.

Despite the abundance of rainfall, much of the region experiences a dry season of from 4 to 6 months during the winter which seriously reduces pasture production. As would be expected in a warm, humid climate, the incidence of animal disease and insect and parasite problems is high; these factors often limit beef gains in spite of abundant forage. The majority of adapted tropical grasses are low in protein and digestible nutrients, and this coupled with the absence of herbaceous legumes results in a rather low quality forage. The situation is somewhat counterbalanced by vines and leaves of woody leguminous shrubs which are browsed or harvested manually.

In this high rainfall area shrubs and weeds are rapid invaders and constitute a constant threat to the maintenance of well managed pastures. This threat is commonly met by annual burnings at the end of the dry season, usually in April or May. Claims are also made that this burning reduces the populations of ticks, snakes, and rodents.

Clearing land for the establishment of pastures or for agriculture presents many problems and is costly. Local farmers accomplish it by cutting over the vegetation with a machete and then burning the entire mass after it has thoroughly dried. Seed of Guineagrass is then broadcast over the ash residue just at the beginning of the rainy season, usually in June. Additional cuttings are generally required to eliminate the regrowth of shrubs in these newly seeded pastures. On the experiment stations, land clearing with heavy equipment such as bulldozers has given excellent results. The use of chemicals for controlling brush is also being investigated.

The animal and forage production potential of this Gulf Coast region is tremendous, as is being verified by the results of forage investigations which were begun only 3 years ago and are therefore still in the initial phase. At the 2 tropical research stations, emphasis has been placed so far on determining the adaptability and productivity of numerous grass and legume introductions. Very few of the known tropical forage species are utilized by ranchers of this region even though they are successfully employed in other tropical countries. One elephantgrass hybrid, called Merkeron, has been outstanding in much of the area, yielding as much as 200 tons per acre of green feed annually. Figure 7. In contrast to the situation in the dry northern region, greater production of nutritious forage in the Gulf Coast area can best come through the use of properly managed introduced species rather than native vegetation. As the screening and testing process indicates promising material, studies on establishment and management are begun. Information on acceptability by animals and rancher opinions are acquired by maintaining close contact with progressive cattlemen.

Strangely enough, very little silage is made in the Gulf region, although it has tremendous application because of the excess of forage produced in the summer and the scarcity in winter. Excellent silage has been made in pilot silos during the rainy season using different introduced grasses and legumes. The good results achieved on a larger commercial scale by several ranchers point the way to an expansion of the use of silage for this region.

Pacífic Tropical

This region is actually a counterpart of the Gulf Coast region but is characterized by more heterogeneity in regard to topography, climate, and vegetation. It includes about 21 million acres of grassland and can be sub-

Figure 6. A typical improved pasture containing Guineagrass in the tropical Gulf Coast region.

Figure 7. Merkeron, an elephantgrass hybrid recently introduced into the tropics, has proven outstanding for chopped green feed.
divided into three major areas: the coast, the central valleys, and the river basins. Rainfall is less than in the Gulf Coast region, averaging from 20 to 60 inches annually.

The important indigenous grasses are *Hilaria semplei*, *H. cenchroides*, *Bouteloua filiformis*, *B. curtipendula*, *Cathestecum erectum*, *C. multifidum*, *Opizia stolonifera*, *Heteropogon contortus*, *Panicum* spp., *Paspalum* spp., *Elyonurus tripsacoides*, and *Tripsacum* spp.

Livestock populations are similar to those of the Gulf Coast, with beef and milk animals being the most numerous. However, goats are more important here because of the abundance of more arid vegetation.

For the present, research is not being undertaken in this area, and it has been included in this discussion chiefly to round out the regional grassland picture of Mexico.

**LITERATURE CITED**


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**Bitterlich’s Plotless Method for Sampling Basal Ground Cover of Bunchgrasses**

D. N. HYDER AND F. A. SNEVA

Range Conservationists, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture

Bitterlich’s plotless method was introduced to American foresters by Grosenbaugh (1952). Grosenbaugh provided a comprehensive description of the method, and a number of authors have subsequently discussed new instrumentation and field applications. Cooper (1957) has recently shown how the method may be used to sample shrub cover directly in percentage of ground surface covered.

The principle is that in a theoretical circular plot drawn around each plant, the area ratio of plant:plot is constant. For instance, with a plant:plot area ratio of 1:100 the plants are always 1 percent of the plot areas. Then the number of plots overlapping a given point may be counted and expressed directly as plant-cover percentage.

With a plant:plot area ratio of 1:100, the corresponding radius ratio of 2 circles is 1:10. The radius ratio of 1:10 describes an angle of 11°39'. That is, the angle will just include a small circle having a radius 1/10 as long as the distance of its center from the vertex of the angle. Thus, ground cover may be estimated by counting those plants that fill the angle when the vertex is fixed at a selected sample point. It is well to emphasize that the sample is a point, and that the objective is to count the theoretical plots which overlap at the point. The angle serves that objective because each plant that fills the angle has a plot that overlaps (includes) the sample point.

This paper presents an instrumentation of Bitterlich’s plotless method for sampling basal ground cover of bunchgrasses, and compares results obtained by this method with results obtained by line interception (Canfield, 1941).

**Procedure**

Application of Bitterlich’s plotless method requires an angle which is rotated in a complete circle about a selected sampling point as an observer views the vegetation. Consequently, an acute angle (described by the plant:plot radius ratio of 1:10) was prepared by welding 1½-inch angle iron (Figure 1). The arms extended about 4 feet, and further extension of the angle was accomplished with a straightedge when viewing large grass clumps beyond reach of the frame. A ¾-inch hole drilled at the vertex of the angle permitted pinning to selected sampling points.

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